

390. FLAX, H. J., MILLER, R. N., & HORVATH, S. M. (1949) Arch. of Physical Med. 30:630-637, "Alterations in peripheral circulation and tissue temperature following local application of short wave diathermy"
391. FLEMING, H. (1944) Electrical Engineering 63(1):18-21, "Effect of high frequency fields on micro-organisms (bacteria)"
392. FLEMING, J., JR., PINNEO, L., BAUS, R., JR., & McAFEE, R. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1 (Peyton, M. F., ed.), pp. 229-249, "Microwave radiation in relation to biological systems and neural activity"
393. FOFANOV, P. N. (1966) Klinicheskiye Meditsina 44(4):18-22, (JPRS 36301; TT-66-32733), "Features peculiar to hemodynamics in persons working in conditions of protracted electromagnetic high frequency radiation"
394. FOFANOV, P. N. (1966) Probl. Endokrinologii i Gormonoterapii, Moscow 12(5):16-17, (In Russian), (JPRS-39265), "On functional changes of the thyroid gland in persons exposed to the effect of microwave irradiation (preliminary report)"
395. FOFANOV, P. N. (1968) Sovetskaya Meditsina 31(9):107-110, (In Russian), "Clinical picture of continuous action of SHF-UHF electromagnetic radiation on man"
396. FOFANOV, P. N. (1969) Kardiologiya 9(4):124-126, (JPRS 48481, July 1969), "Hemodynamic changes in individuals working under microwave irradiation"
397. FOLLIS, R. H., JR. (1946) Amer. J. of Physiology 147:281-283, (Also, Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1 (Peyton, M. F., ed.) pp. 229-249, "Studies on the biological effects of high frequency radio waves (radar)" 1961),
398. FORTUNATOW, E. (1968) Report, ATD 68-105-108-9; N68-33037; AD 671436, "Soviet Radiobiology"
2783. FOSTER, K.R., & FINCH, E.D. (1974), Presented at the Biophysics Soc. Meeting, Minneapolis, Minn., 4 June 1974, "Microwave hearing: Thermoacoustic stimulation of the human auditory system by pulsed microwaves".
2784. FOSTER, K.R., & FINCH, E.D. (1974), Science, 185(4147):256-258, (19 July), "Microwave hearing: Evidence for thermoacoustic auditory stimulation by pulsed microwaves."
399. FRAENKEL, G. (1937) Archives Des Sciences Biologiques 47(3):115-132, (Arkh. Biol. Nauk), (In Russian) "A summary of our studies in the electric field of ultra-high frequency"
400. FRANKE, V. A. (1957) In: Proc. of Jubilee Scientific Session of Institute of Labor Hygiene and Occupational Diseases of Academy of Medical sciences of the USSR, Moscow, pp. 71-, "Measurement of electric and magnetic components of a high-frequency field in the immediate vicinity of radiation sources (in the induction zone) in the range 100 kHz - 300 MHz"
401. FRANKE, V. A. (1958) In: Protection from the Action of Electromagnetic Fields and Electric Current in Industry, Leningrad, p. 64-, "Measurement of electric and magnetic components of a high-frequency field in the frequency range 100 kHz to 3 MHz, and the design of equipment"
402. FRANKE, V. A. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, "Dependence on the frequency of the absorption of energy by a human in an electromagnetic field"
1989. FRANKE, V. A. (1960) In: Collection of Scientific Papers of the VCSPS Institutes of Industrial Safety, Leningrad, 3:36-45, (In Russian) "Calculation of the absorption of energy from an electromagnetic field by means of semiconductor models resembling the human body"
1990. FRANKE, V. A. (1961) In: High-Frequency Electrothermal Apparatus, Leningrad, pp. 138-144, (In Russian) "Problems of safety when working with RF and UHF installations in industry"
403. FRANKE, V. A., et al. (1962) Circulation Research 10:870-, "Study of high-frequency components in electrocardiograms by power spectrum analysis"
404. FRANKE, V. A., & USHINSKAYA, O. (1962) Arbeitsökonomik und Arbeitsschutz (Labor Economy and Occupational Safety) 6(1): 65-71, (In German) "Personnel safety problems confronting operators of (HF and VHF) radio frequency equipment"
405. FRANK-KAMENETSKIY, D. A. (1961) Nauka i Zhizn' (7):88-90, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17 (Apr. 1965)), "Observations by physics (electromagnetics)" [Use of electromagnetic fields in biological studies]
406. FRANK-KAMENETSKIY, D. A. (1961) Doklady Akad. Sci. USSR 136(2):476-478, (In Russian), (Also Transl. in Soviet Physics Doklady (in English) 6:91-92 (1961)), "Plasma effects in semiconductors, and the biological effect of radiowaves"
407. FRANKLIN, P. (ed.) (1969) Microwaves 8(9):13-14, "Microwave safe exposure level scrutinized"; p. 14, "Low level microwaves stop frogs' hearts"; (1969) p. 16, "Monkey deaths denied in RF bio-tests at Sanders"
408. FRASER, A., & FREY, A. H. (1968) Biophysical J. 8(6):731-734, "Electromagnetic emission at micron wavelengths from active nerves"
2381. FREDERICK, C.L. (19??), Rept., 66 pps., Ref ?, "Effects of electromagnetic energy on man".
409. FRENCKEL, G. L. (1941) Arkh. Biologii Nauk, Archives Des Sciences Biologiques 61(1):147-156, "Urgent problems of high frequency therapy and their experimental accomplishment"

410. FRENKEL', G. L. (1937) In: All Union Institute for Experimental Medicine, Moscow, pp. 115-137, also p. 410, "Some characteristics of the biological effect of VHF-HF"
411. FRENKEL', G. L. (1939) The Electrical (UHF-VHF-HF) Field (Ultrashort Waves) in Biology and Experimental Medicine, Vols. I and II; Vols. III and IV (1940) (Elektricheskaya pole ul'travysokoy chastoty (ul'trakorotkiye volny) v biologii i eksperimental'noy meditsine, Medgiz, Moscow, Leningrad)
412. FRENKEL', G. L., & KUPALOV, P. S. (1937), See Kupalov and Frenkel' (1937)
413. FREY, A. H. (1961) Aerospace Med. 32(12):1140-1142, "Auditory system response to radio frequency energy: technical note"
414. FREY, A. H. (1961) Presented at Aerospace Medical Assoc. Meeting, April, (Also at 4th Internat. Conf. on Medical Electronics, 20 July, Cornell Univ., Ithaca, N.Y.), "Auditory system response to modulated radio frequency energy"
415. FREY, A. H. (1961) In: Digest of the 1961 Internat. Conf. on Medical Electronics, 4th, (Frommer, P. L., ed.), p. 158 only, "Human auditory system response to modulated radio frequency energy"
416. FREY, A. H. (1962) J. of Applied Physiology 17(4):689-692, "Human auditory system response to modulated electromagnetic energy"
417. FREY, A. H. (1963) Amer. J. of Medical Electronics 2(1):28-31, "Some effects on human subjects of ultra-high frequency radiation"
418. FREY, A. H. (1963) Naval Research Reviews 16:1-, "Human response to very-low-frequency (VLF) electromagnetic energy"
419. FREY, A. H. (1965) Psychological Bulletin 63(5):322-337 (Also Rpt. #64-01, Institute for Research, State College, Pa., (47 pages), AD #606961), "Behavioral biophysics"
420. FREY, A. H. (1967) J. of Applied Physiology 23(6):984-988, (AD 678943), "Brain stem evoked responses associated with low-intensity pulsed UHF energy"
421. FREY, A. H. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 134-139, (AD 698195; N70-20352), "Effects of microwave and radio frequency energy on the central nervous system"
1991. FREY, A. H. (1971) IEEE Trans. on Microwave Theory and Techniques (Special Issue on Biological Effects of Microwaves) MTT-19(2):153-164, "Biological function as influenced by low-power modulated RF energy"
2383. FREY, A.H. (1971?), Rept., Ref ?, 6 pps., "Cardiac and neural effects of radar wavelengths".
2159. FREY, A. H., & EICHERT, E. E., III (1971) Pandoline, Inc., (Willow Grove, Pa.), Rept., 63 pages, "On the nature of electro-sensing in the fish"
3448. FREY, A.H., & FELD, S.R. (1975), J. of Comparative and Physiological Psychology, 89(2):183-188, "Avoidance by rats of illumination with low power nonionizing electromagnetic energy."
2785. FREY, A.H., FELD, S., & FREY, B. (1974), (In Press), "Modification of brain barriers' permeability by in vivo illumination with microwaves".
2786. FREY, A.H., & MESSENGER, R., Jr. (1973), Science, 181( ):356-358, "Human perception of illumination with pulsed ultra-high-frequency electromagnetic energy".
2382. FREY, A., MESSENGER, R., & EICHERT, E. (1972), Final Rept. to U.S. Army Mobility Equipment Res. & Dev. Ctr., Ft. Belvoir, Va.; from Randomline Inc., Willow Grove, Pa.. "A psychophysical study of the RF sound phenomenon." [A study of the RF parameters relevant to the preception of sounds when the head of man is irradiated.] [AD #747684]
422. FREY, A. H., & SEIFERT, E. (1968) Life Sciences 7 (part II):503-512, (AD 678942), "Pulse modulated UHF energy illumination of the heart associated with change in heart rate"
2384. FREY, J., & BOWERS, R. (1972), IEEE Spectrum, 9(3):41-47, "What's ahead for microwaves", [Contains section on microwaves as health hazard.]
2160. FREY, J., & BOWERS, R. (1972) Spectrum, Inst. of Electrical & Electronics Engineers, Inc., 9(3):41-47, "What's ahead for microwaves" [including research on health hazards]
2787. FREYSZ, T., SCHWARZ, H., & HOSSLI, G. (1967), as quoted in RESTALL, C.J., LEONARD, P.F., & TASWELL, H.F., et al., Anesth. & Analg., 46( ):625-628, "A microwave blood warmer: Preliminary report".
2788. FRICKE, H., SCHWAN, H., KAM, L., & BRYSON, V. (1950?), Rept., "A dielectric study of the low-conductance surface membrane in E. coli".
423. FRICKER, S. J. (1957) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.) 1:77-78, "Biologically meaningful units of RF measurement and dosimetry development"
424. FRICKER, S. J. (1957) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.) 1(Appendix C):104-108, "Summary of results of UHF radiation hazard experiments at Lincoln Laboratory, MIT"

425. FRICKER, S. J. (Moderator) (1957) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.) 1:79-88, "Microwave exposure discussion"
2385. FRIEDENBERG, Z.B., HARLOW, M.C., & BRIGHTON, C.T. (1971), J. of Trauma, 11(10):883-885, "Healing of non-union of the medial malleolus by means of direct current: A case report".
2789. FRIEDENBERG, Z.B., ROBERTS, P.G., DIDIZIAN, N.H., & BRIGHTON, C.T. (1971), J. of Bone & Joint Surg., 52-A( ):1400-1408, "Stimulation of fracture healing by direct current in the rabbit fibula".
3449. FRIEDMAN, H., BECKER, R.O., & BACHMAN, C.H. (1967), Nature, 213(5079):949-956, (Mar. 4), "Effect of magnetic fields on reaction time performance."
3450. FRIEDMAN, H., & CAREY, R.J. (1969), Physiology & Behavior, 4( ):539-541, "The effects of magnetic fields upon rabbit brains."
426. FRIEND, A. W., JR. (1970) Report, Moore School of Electrical Engineering, Univ. of Pennsylvania, "Some research results concerning the effects of AC electric fields and pulses on the Giant Amoeba, Chaos chaos"
427. FRIEND, A. W., JR. (1970) (A Report proposal for a course at Univ. of Pennsylvania, May), "An investigation of motion of living cells and related electrical, mechanical, and optical phenomena, using giant amoebae and the techniques of micro-circuitry"
2161. FRIEND, A.W., Jr. (1972), Naval Medical Res. Inst. (Bethesda, MD), Research Rept. No. 6 on Project MF12.524.015-00018), (AD #752451), "Low frequencies, motile cells, measurements, and models: Part I. The effects of low frequency electric fields on amoebae and their uses as tools for studying cellular structure."
3192. FRIEND, A.W., Jr., FINCH, E.D., & SCHWAN, H.P. (1975), Science, 187(4190):1357-1359, (Jan. 31), "Low frequency [1 Hz - 10 MHz] electric field-induced changes in the shape and motility of amoebae".
2790. FRINGS, H. (1952), J. of Econ. Entomol., 45( ):396-408, (Sept. 29), "Factors determining the effects of radio-frequency electromagnetic fields on insects and materials they infest".
428. FROLOVA, L. T. (1963) Gigiena Truda i Professional'nye Zabolevaniya (Moskva) (Labor Hygiene and Occupational Disease) (2):27-29, (JPRS 19068, pp. 6-9, OTS 63-21756, N64-11858), "Hygienic evaluation of the working conditions in work with high-frequency currents"
429. FROMMER, P. L., (ed.) (1961) Digest of the 1961 Internat. Conf. on Medical Electronics. Plenum Press, New York, Biological Effects of Microwaves, I (Athermal Aspects)
430. FUCHS, G. (1952) Wiener Medizinische Wochenschrift 102:583-588, (In German) "The combined shortwave and x-ray therapy of malignant tumors"
2162. FUGITT, C. E. (1960) Office of Naval Research (London) Rept., 5 pages (AD #2448(71), on the "Fourth Annual Tri-Service Conference on the Biological Effects of Microwave Radiation"
431. FUKALOVA, P. P. (1964) Trudy Nii Gigiena Truda i Profzabolevaniya, USSR, (2):78-79, (JPRS #34,963) "The effect of short and ultrashort waves on body temperature, and the survival rate of experimental animals"
- In:
432. FUKALOVA, P. P. (1964) Biological Effects of Radio Frequency Electromagnetic Fields, Inst. of Industrial Hygiene and Occupational Diseases, Academy of Med. Sci., USSR. (Trudy Nii Gigiyena Truda i Profzabolevaniy, Moscow, USSR, (2):144-148) (In Russian) "Sensitivity of olfactory and visual analyzers in individuals exposed to continuously generated short and ultrashort waves"
433. FUKALOVA, P. P. (1964) In: Biological Effects of Radio Frequency Electromagnetic Fields, Inst. of Industrial Hygiene and Occupational Diseases, Academy of Med. Sci., USSR, Moscow (Trudy Nii Gigiyena Truda i Profzabolevaniy (2):158-163) (Transl. in: The Biological Action of Radio Frequency Electromagnetic Fields), "Hygiene characteristics of working conditions with sources of shortwave and ultrashort waves at radio and television stations"
434. FUKALOVA, P. P. (1966) Gigiena i Sanitariya, USSR, 31(2):306-308, (TT 66-51160/4-6, in English), "Effectiveness of protection against shortwave and ultrashortwave electromagnetic fields at radio and TV stations"
435. FUKALOVA, P. P., & SMUROVA, YE. I. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 57-58, "Changes in the functional condition of some analyzers (sense receptors?) in persons exposed to SHF-UHF fields"
436. FUKALOVA, P. P., TOLGSKAYA, M. S., NIKOGOSYAN, S. V., KITSOVSKAYA, I. A., & ZEMINA, I. N. (1966) Gigiena Truda i Professional'nye Zabolevaniya (Moskva) USSR, 10(7):5-9, (ATD Rpt 66-126, JPRS 38,663 (16 Nov. 1966), AD 644537), "Research data on the standardization of electromagnetic fields in the short and ultrashort wave ranges"
2386. FULK, D.W., & FINCH, E.D. (1972), Naval Medical Research Institute Research Report #5 on Project # MF51.015-0001BD7X, (AD #752452), "An examination of certain blood serum constituents in the rat following microwave irradiation".
437. FUREDI, A. A., & OHAD, I. (1964) Biochimica et Biophysica Acta 79:1-8, "Effects of high-frequency electric fields on the living cell: I. Behavior of human erythrocytes in high-frequency electric fields and its relation to their age"
438. FUREDI, A. A., & VALENTINE, R. C. (1962) Biochimica et Biophysica Acta 56:33-42, "Factors involved in the orientation of microscopic particles in suspensions influenced by radio-frequency fields"

439. FURMAN, S., PARKER, B., KRAUTHAMER, M., & ESCHER, D. J. W. (1968) *Annals of Thoracic Surgery* 6(1):90-95, "The influence of an electromagnetic environment on the performance of artificial cardiac pacemakers"
3451. GABOVICH, R.D., MINKH, A.A., & MIKHALYUK, I.A. (1975), *Vestnik Akademii Meditsinskikh Nauk SSSR*, (3):16-22, (In Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #66512), (7 Jan. 1976), pp. 33-42, "Effects of superhigh frequency fields of different intensity on the balance and metabolism of copper, manganese, molybdenum and nickel in the organism of experimental animals."
2791. GABRIEL, E., *et al.* (1967), *Confinia Neurologica* (Basel), 29( ):213-219, "Radio frequency pulsed coagulation: An improved method for controlled thermoelectrode tissue denaturation of electrical and thermal conductivity changes".
2163. GALANIN, N. F., POLYAK, B. L., VOLKOV, V. V., KRICHAGIN, V. I., & MEDVEDEV, V. I. (1956) *Voennomed Zh.* (9):25-32, "Work conditions for radar set operators and the possible preventive measures against general fatigue and eye fatigue"
440. GALE, C. K. (1935) *Arch. of Physical Therapy* 16:271-277, "Penetrative and selective heat effects of short and ultrashort waves. (An experimental study with unicellular organisms and with electrolytes)"
3193. GALIANA, H.L. (1969), Rept. No. MVLS-69-1 of the Man-Vehicle Lab., Mass. Inst. of Tech., Cambridge, MA, "Ionizing radiation and magnetic fields: A review of their effects on the nervous system".
3194. GAMBILL, R.L., & HARRIS, J.F. (1973), *Scientific American*, 228(5):94-100 & p. 120, (May), "The infrared receptors of snakes: The snakes of two large families have sensitive organs that can detect the heat radiation emitted by their prey. The performance of these detectors is investigated with the aid of an infrared laser".
2792. GANDHI, O.P. (1973?), *Proc. of IEEE*, 62(8):1171-1175 (Aug. '74), "Polarization and frequency effects on whole animal absorption of RF energy."
2793. GANDHI, O.P. (1974), (In Press), *IEEE Trans. on Biomedical Engineering* (?), "Orientational and frequency effects on whole animal absorption of RF energy."
3195. GANDHI, O.P. (1974), *Proceedings of the IEEE*, 62(8):1171-1175, (Aug.), "Polarization and frequency effects on whole animal absorption of RF energy". [See also citation #2792, this Biblio.]
3452. GANDHI, O. (1975), *IEEE Trans. on Microwave Theory & Techniques*, MTT-23(12):1021-1029 (Dec.), "Conditions of strongest electromagnetic power deposition in man and animals."
3453. GANDHI, O.P. (1975), In: *Digest of Tech. Papers, Microwaves in Service to Man; International Microwave Symposium* (Palo Alto, CA), May 12-14, 1975, (A75-36461, 17-33), pp. 282-284, "Resonant electromagnetic power deposition in man and animals."
3454. GANDHI, O.P. (1975), *IEEE Transactions on Biomedical Engineering*, BME- ( ):536-542 (Nov.), "Frequency and orientation effects on whole animal absorption of [RF] electromagnetic waves."
441. GAPEYEV, P. I. (1957) *Trudy Voenno-meditsinskoi akademii Krasnoi Armii imeni S. M. Kirova* 73:152-, "The effect of SHF-UHF fields on sight organs"
3455. GARFIELD, E. (1975), *Current Contents*, 18(25):5-6 (June 23), "Openmindedness in science and medicine" [suggests a possible relationship between "depression" and electromagnetic radiation].
442. GATEV, S. (1965) *Voenna Meditsinski delo* 20(3):30-35, (In Russian) "Treatment of tenovaginitis with microwave (radar) and hydrocortisone phonophoresis"
3196. GAVALAS, R.J., WALTER, D.O., HAMER, J., & ADEY, W.R. (1970), *Brain Research*, 18( ):491-501, "Effect of low-level, low-frequency electric fields on EEG and behavior in *Macaca Nemestrina*".
2794. GAZIVODA, N. (1970), *Vojnosanitetski Pregled*, 27( ):542-545, (In Slovak(?)), "Comparative electroencephalographic and clinical neurological studies in radar operators".
2795. GEERAETS, W.J. (1969), *Sightsaving Rev.*, 39( ):181-196, "Radiation effects on the eye", <sup>including</sup> [non-ionizing ].
443. GEL'FON, I.A. (1964) In: *Biological Effects of Radio Frequency Electromagnetic Fields*, Inst. of Industrial Hygiene and Occupational Diseases, Academy of Med. Sci., USSR, Moscow, pp. 68-69, "The effect of 10 cm low-intensity electromagnetic waves on the histamine content in the blood of animals"
444. GEL'FON, I. A., FEDOROVA, V. I., & PATUSHINSKII, G. I. (1965) *Gigiena Truda i Professional'nve Zabolevaniia* (Moskva) USSR, 9(5):28-33, (In Russian), ((JPRS 31877, English summary), "Effect of VHF-RF therapy on connective tissue proteins of the lungs in experimental silicosis"
445. GEL'FON (1960) *Trudy Nii Gigyena Truda i Profzabolevaniy*, USSR (1):46-49, (In Russian), (Also an article with similar title: *ibid.* (2):133-136, (1964); (Also in *Biological Action of UHF*, Letavet, A. A., & Gordon, Z. V., (eds.), Academy of Medical Sciences USSR, Moscow, (OTS 62-19175), (JPRS 12471, pp. 42-46), "Protein fractions and histamine of the blood under the influence of SHF-UHF and HF radio waves"
2164. GELLIN, G. A. (1971) In the Questions & Answers section of *J. Amer. Med. Assoc.* 216(10):1651 only, "Effect of microwave oven on facial radiodermatitis"

446. GEMBITSKIY, YE. V. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 14-15, "Material on the clinical aspects of chronic microwave effects"
447. GEMBITSKIY, S. V. (1968) Hovvedorvos \_2(Apr-Jun):114-115, "Some problems in the area of the biological effects of high-frequency electromagnetic fields"
448. GEMBITSKIY, YE. V., KOLESNIK, F. A., & MALYSHEV, V. M. (1969) Voyenno-Meditsinskiy Zh. (Military Medical J.) \_5(5):21-23, "Changes in the blood system during chronic exposure to a superhigh-frequency field"
449. GENTILE, N. (1934) (In Italian with English summary) Abstracts of the 1st Internat. Congress of Electro-radio-biology, Cappelli, L., (ed.), Bologna, Italy, pp. 356-359, "Induced human radiation"
450. GERNSBACH, H. (1959) Radio Electronics \_7(7):29-, "Lethal radio waves"
2387. GERSHMAN, L.C. (1972), Naval Medical Research Institute (Bethesda), Report No. 3 on Project MF12.524.015-0004B, "Effects of microwave irradiation in vivo on rabbit blood serum".
451. GERSTEN, J. W., WAKIM, K. G., HERRICK, J. F., & KRUSEN, F. H. (1949) Arch. of Physical Med. 30:7-25, "The effect of microwave diathermy on the peripheral circulation and on tissue temperature in man"
452. GERSTEN, J. W., WAKIM, K. G., & KRUSEN, F. H. (1950) Arch. of Physical Med. 31:281-286, "A method for decreasing reflection of microwaves by tissue"
2796. GETMAN, E.G. (1972), Klin. Khir., \_8(8):82-84, (In Russ.), "Experience with microwave treatment of diseases of the organs of locomotion."
3456. GHELETA, K. (1976), Microwave Systems News, 6(2):13-15 (April/May), "Moscow microwaves: Lethal intrigue."
453. GHETTI, B. (1934) (In Italian with English summary) Abstracts of the 1st Internat. Congress of Electro-radio-biology, Cappelli, L., (ed.), Bologna, Italy, pp. 360-366, "Report on tests to determine the possible influence of very short electromagnetic waves (2-3 m) on seed germination and plant development"
3457. GHOSH, S.K., & DASGUPTA, A.K. (1974), Health Physics, 27(6):616- , "Permissible levels of exposure to microwave radiation."
3197. GHOSH, S.K., & MUC, A.M. (1972), Proc. of Microwave Power Sympos. [Internat. Microwave Power Inst., Canada], (May), p. 25-28, "The biological effects of electromagnetic waves and their relationship to pending Canadian regulations". [See also citation #2629, this Biblio.]
2797. GHOSH, S.K., MUC, A.M., LECUYER, D.W., & DIOTTE, M.P. (1974), Health Physics, 26(4):360-362, "A proposal for a microwave radiation warning sign".
2798. GIAROLA, A.J., & KRUEGER, W.F. (1974), IEEE Trans. on Microwave Theory & Techniques, MTT-22(4):432-437, (Apr.), "Continuous exposure of chicks and rats to electromagnetic fields", [smaller adrenal glands observed in chicks exposed at 880 MHz at 1.0 mW/cm<sup>2</sup>, and growth depression observed in rats under same conditions. No change in adrenal weight of rats, however spleen and thymus weights were higher].
2799. GIBSON, R.S., & MORONEY, W.F. (1973), Naval Aerospace Medical Res. Lab., Pensacola, FL, Rept. No. NAMRL-1195, "The effect of extremely low frequency radiation on human performance: A preliminary study".
3458. GIBSON, R.S., & MORONEY, W.F. (1974), Naval Aerospace Medical Research Laboratory Rept., Pensacola FL (AD #A005-898), 24 pps. (Aug.), "The effect of extremely-low frequency radiation on human performance: A preliminary study."
454. GIESE, A. C. (1947) Quarterly Review of Biology 22(4):253-283, "Radiations and cell division"
2800. GILBERT, H. (1970), Amer. Industrial Hygiene Assoc. J., 31( ):772- , "A study of microwave radiation leakage from microwave ovens".
455. GILL, S. J. (1959) Univ. of Colorado, Progress Rpt. to Office of Naval Research (Nov.), (AD 229625), "Magnetic susceptibility of single biological cells"
456. GILLES, E. (1944) Comptes Rendus 123:546-547, (In French) "Lethal effects of ultrashort waves on microorganisms"
457. GILLES, E. (1944) Comptes Rendus 123:565-567, (In French) "Fungicidal and bactericidal effects of ultrashort waves are a consequence of selective thermal action under certain conditions"
3198. GINSBERG, A.J. (1934), Medical Record, \_ ( ):pp ?, (Dec. 19), "Ultrashort radio waves as a therapeutic agent".
2801. GINSBERG, A.J. (1961), Internat. Record of Medicine, 174(2):71-74, (Feb.), "Pulsed short wave [27 MHz, electromagnetic radiation] in the treatment of bursitis with calcification".
458. GINZBURG, D. A., & SADCHIKOVA, M. A. (1964) Trudy nli Gigyena Truda i Profzaboleaniy, USSR, \_2(2):126-132, (Abstr. in: The Biological Action of Radio Frequency Electromagnetic Fields, Moscow), "Changes of the electroencephalogram under continuous action of radio waves"

2388. GIORI, F., & ENGLER, P. (1972), JAAMI, 6:167- , "Techniques for testing performance of medical electronic devices in the presence of radio waves".
459. GIORI, F. A., & WINTERGERBER, A. B. (1967) Biomedical Sciences Instrumentation 3:291-308, "Remote physiological monitoring using a microwave interferometer"
3459. GLASER, P.E. (1975), Presented at the 21st Annual Meeting of the American Astronautical Society, "Space Shuttle Missions of the 80's," Denver, CO, (27 Aug.), 26 pps., "The satellite solar power station—a focus for future space shuttle missions [collecting and converting solar energy to microwave power, transmitting it to earth, then converting it to electricity; with some consideration of effects to bio-systems of microwave exposure (p. 20-21)]."
2389. GLASER, Z.R. (1972), Naval Medical Research Institute (Bethesda) Report No. 2 (Revised) on Research Task MF12.524.015-0004B, "Bibliography of Reported Biological Phenomena ('Effects') and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation", [AD #750271].
2802. GLASER, Z.R. (1973), Electromagnetic Radiation Project Office, Bureau of Medicine & Surgery, Dept. of Navy (Washington, DC), Rept., (June), "Fourth supplement to Bibliography of reported biological phenomena ('effects') and clinical manifestations attributed to microwave and radio-frequency radiation", (NTIS No. AD 770-621).
3199. GLASER, Z.R. (1974), Electromagnetic Radiation Project Office, Naval Medical Research & Development Command (Nat'l Nav. Med. Ctr., Bethesda, MD), Rept. (July), (AD #784-007), "Fifth supplement to Bibliography of reported biological phenomena ('effects') and clinical manifestations attributed to microwave and radio-frequency radiation".
3460. GLASER, Z.R. (1975), Rept., Electromagnetic Radiation Project Office, Naval Medical Research & Development Command (Nat'l Nav. Med. Ctr., Bethesda, MD), (June), (AD #A015622), "Sixth supplement to Bibliography of reported biological phenomena ('effects') and clinical manifestations attributed to microwave and radio-frequency radiation."
460. GLASER, Z. R., & HEIMER, G. M. (1971) Institute of Electrical and Electronics Engineers, Trans. on Microwave Theory and Techniques, (Special Issue on the Biological Effects of Microwaves), MTI-19(2):232-238, "Determination and elimination of hazardous microwave fields aboard Naval ships"
2165. GLASER, Z. R., & HEIMER, G. M. (1972) Bioenvironmental Safety 4(1):10-15, (Jan), "Determination and elimination of hazardous microwave fields aboard Naval ships"
2390. GLASSER, O. (1950), Year Book Publishers, Chicago; see esp. pp. 710-712, in Vol II, Medical Physics.
2803. GLENN, W.W.L., HAGEMAN, J.H., MAURO, A., EISENBERG, L., FLANIGAN, S., & HARVARD, M. (1964), Ann. of Surg., 160( ): 338-350, "Electrical stimulation of excitable tissue by radio-frequency transmission".
461. GLEZER, D. YA. (1936) Fiziologicheskii Zh., SSSR 20:5-, (Abstr. in: "The Biological Effects of Electromagnetic Fields - Annotated Bibliography", ATD Rpt P-65-17 (Apr. 1965)) [Title not given]
462. GLEZER, D. YA. (1937) In: Materials of the Leningrad Conference on VHF-HF Waves, Leningrad, pp. 5-18, [Title not given]
463. GLEZER, D. YA. (1940) Referaty rabot uchrezhdeniy otdeleniya biologicheskikh nauk za, (Abstracts of Studies by the Department of Biological Sciences for 1940), Moscow - Leningrad, pp. 318-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965) [Irradiation of the heads of dogs with 7.7 m electromagnetic waves]
464. GLEZER, D. YA. (1940) Nauchnyi Institut imen' P. F. Lesgaft, Leningrad Izvestia, 22:5-146, (In Russian with German summary pp. 142-146) (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, 1965), "Ultra short waves and their effect on the organs of the circulatory system"
465. GLEZER, D. YA. (1940) Referaty nauchno-issledovatel'skogo uchrezhd, OBNAN SSSR, Leningrad, "The effect of ultra short waves on the higher nervous activity"
2166. GLOTVA, K. V., & SARGHIKOVA, M. N. (1970) Giyeina Truda i Professional'nyye Zabolevaniya, Moscow, (7):24-27, (In JPRS 51238, E70-39485), "Development and clinical course of cardiovascular changes after chronic exposure [of humans] to microwave irradiation"
466. GLOTZ, H. C. (1951) Archiv fur Physikalische Therapie 3:45-50, "The increase in fluid production during ultrashort wave irradiation of the head"
2804. GNEVYSHEV, M.N., & NOVIKOVA, K.F. (1972), J. of Interdiscipl. Cycle Res., 3(1):99-104, "The influence of solar activity on the earth's biosphere: Part I", [heliobiology].
467. GOFF, L. G. (1957) Proc. Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.) 1: p. 76 only, "Remarks at microwave conference" (Pertinent to Navy's program of microwave research)
468. GOGIBEDASHVILI, V. G. (1954) Gosudarstvennyy nauchno-issledovatel'skiy Institut Kurortologii i Fizioterapii, Referativnyy Sbornik Trudov, Tbilisi, 22:151-178, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "Concerning the participation of the nervous system in the mechanism of UHF action on the secretory function of the stomach"
469. GOGIBEDASHVILI, V. G. (1954) Gosudarstvennyy nauchno-issledovatel'skiy Institut Kurortologii i Fizioterapii, Referativnyy Sbornik Trudov, Tbilisi, 21:176-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "Influence of UHF fields on the secretory function of the stomach"

2805. GOLD, J.H., & SCHUDER, J.C. (1973), Proc. of the 26th Ann. Conf. on Engineering in Medicine & Biology, "Theoretical analysis of tissue stimulation by implanting solid-state diode", [to produce DC currents in nerves by an RF electrical field established in the surrounding tissue], p. 94.
2167. GOLDBLITH, S. A. (1966) *Advances in Food Research* 15:277-301, "Basic principles of microwaves and recent developments"
2168. GOLDBLITH, S. A. (1967) *J. of the Amer. Dietet. Assoc.* 51:233-237, "Possible applications to food of ionizing and nonionizing radiations"
2806. GOLDBLITH, S.A., & DECAREAU, R.V. (1973), MIT Press, (Cambridge, Mass.), 356 pps., An annotated bibliography on microwaves: Their properties, production, and applications to food processing.
470. GOLDBLITH, S.A., & WANG, D.I. (1967), *Applied Microbiology*, 15(6):1371-1375, "Effect of microwave on *Escherichia coli* and *Bacillus subtilis*."
471. GOLDMAN, D. E. (1960) NMRI Lecture & Review Series, No. 60-6, 1959-1964, (Sept.) pp. 247-255, (Also AD 252582) "Short wave electromagnetic radiation as a hazard to personnel"
472. GOLENBERG, A. D., YEVSTIFEYEVA, M. I., GLAZUNOVA, YE. I., LYZKOVA, A. YA., & OSTRYAKOVA, A. N. (1965) *Voprosy Kurortologii, Fizioterapii, i Lechebnoy Fizicheskoy Kul'tury* (Problems in Health Resort Science, Physiotherapy and Medical Physical Culture) Moscow, 30(1):45-47 (JPRS #29914, pp. 9-13, TI 65-30903), "Experience with microwave therapy"
473. GOLISCHEVA, K. P. (1937) In: Problems of Metrics and Dosimetry of Ultrahigh Frequency in Biology and Medicine, Moscow, pp. 63-74
474. GOLISCHEVA, K. P. (1937) *Archiv Des Sciences Biologiques* (Ark. Biol. Nauk), 47(3):133-140, (In Russian with English Summary), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Report P-65-17) "Experimental study on the thermal effect of the electrical ultrahigh frequency field, II"; and pp.141-145, "Experimental study on the thermal effect of the electrical ultrahigh frequency field, III"
475. GOLISCHEVA, K. P. (1939) *Arkhiv patologicheskoy anatomii i patologicheskoy fiziologii* 5:5-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr.) [Title not given], [Irradiation of rabbits at UHF fields]
476. GOLISCHEVA, K. P. (1941) *Arkhiv Patologicheskoi Anatomii*, Moscow, 7(2):119-122, (In Russian), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr.), "The effect of the electric field of ultrahigh frequency upon the temperature reaction and glycogen contents in denervated liver in cats"
477. GOLISCHEVA, K. P., & ANDRIYASHEVA, N. M. (1937) In: The Biological Action of Ultrahigh Frequency Waves, Frenkel', G. L., & Kupalov, P. S., (eds.), All Union Institute for Experimental Medicine, Moscow, pp. 309-324, "The effect of ultrahigh frequency on embryonic development of white mice"
478. GOLISCHEVA, K. P., & GAL'PERIN, S. I. (1941) *Bulleten' Eksperimental'noy Biologii i Meditsiny* 12(5-6): (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17) [Title not given]
3201. GOLOBOKIY, N.K., & KROTOV, A.V. (1973), *Vrachebnoye Delo*, (7):pp 2, [Transl. in: "Effect of nonionizing electromagnetic radiation", JPRS No. 62462, July 1974, Citation #2134 this biblio, pp. 41-44], "The effect of brief exposure to a magnetic field on the blood sedimentation rate in health and disease".
3461. GOMES, A.M.F., LEONHARDT, G.F., TORLONI, M., & BORZANI, W. (1975), *J. of Microwave Power*, 10(3):265-270 (Sept.), "Microwave drying of microorganisms. I. Influence of the microwave energy and of the sample thickness on the drying of yeast."
479. GONCHAROVA, N. N., KARAMYSEV, V. B., & MAKSIMENKO, N. V. (1966) *Gigiena Truda i Professional'nye Zabelevaniia* (Moskva) USSR, 10(7):10-13 (JPRS #38653, ATD Rpt 66-125), "Occupational hygiene problems in working with ultrashort-wave transmitters used in TV and radio broadcasting"
2807. GONCHAROVA, N.N., PISKUNOVA, V.G., KARAMYSEV, V.B., MAKSIMENKO, N.V., ANATOVSKAYA, V.S., & MISHCHENKO, L.I. (1966), In: Questions on work hygiene and occupational pathology in the chemical and mechanical engineering industries, reports of the 14-18 June 1966 Scientific Session of the Institute, Khar'kov, pp. 104-106, "The clinical-hygienic characteristics of working conditions of persons operating high-frequency equipment". [The earliest and most regular shifts noted during the clinical examination of workers were those in the functional condition of the nervous system. This was exhibited as increased fatigue, asthenia, instability of vegetative reactions, disturbed reflexes and coordination, emotional disturbances, changes in the endocrine profile, etc.].
480. GONCHARUK, E. N., & PIVOVAROV, M. A. (1964) 3rd All Union Conf. on Radio Electronics, Tezisy Dokladov, Moscow, "The effect of UHF-VHF electromagnetic field on the motor reactions of man"
3462. GOODMAN, E.M., MARRON, M., & GREENEBA, B. (1974), *J. of Cell Biology*, 63(2):117- , "Long term effects of [ELF] electromagnetic fields on *Physarum polycephalum*."
3463. GOODWIN, B.C., & VIERU, S. (1975), *Physiol. Chem. & Phys.*, 2( ):89-90, "Low energy electromagnetic [U.V. and Vis.] perturbation of an enzyme substrate."
2391. GORBONOSOVA, N.B., & USPENSKAYA, N.V. (1971), *Gigiena truda i professional' nye zabelevaniya*, (7):41-44, (JPRS abstract), "Health status of ship radio operators".
481. GORDON, D. A. (1948) *Science* 102(2617):710-, "Sensitivity of the homing pigeon to the magnetic field of the earth"

2169. GORDON, S. A., & MILLER, J. S. (1962) Interim Report (NASA-R-46, X63-11540), "Growth and development of plants in compensated gravitational, magnetic, and electrical fields"
2808. GORDON, W. (1973), *Tower Internat. Technomedical Inst. J. of Life Sciences*, 3(4):127-137, "Use of dielectric phenomena in measuring the capacitance and permeability of biological membranes, with special reference to chloroplast internal membranes", [dielectric dispersion and admittance data between 0.5 and 500 kHz].
482. GORDON, Z. V. (1957) *Zh. Gigiyena Epidemiologii Mikrobiologii i Immunologii*, Prague 1(1):399-404, "Problems of labor hygiene during work with centimeter wave generators"
483. GORDON, Z. V. (1955) *Gigiyena i Sanitariya* 12(1):16-19, (Abstr. in *Biological Effects of Microwaves*, ATD P-65-68, Sept., 1965, pp. 24a-26, entitled "Effects of centimeter waves on the development of rats"), "Certain data on the action of centimeter waves"
484. GORDON, Z. V. (1957) *Gigiyena Truda i Professional'nye Zabolovaniia (Moskva)* 6(1):14-18, "Certain problems of labor hygiene related to the influence of a UHF field"
485. GORDON, Z. V. (1957) In: *Summaries of reports, Part 2, Jubilee Scientific Session of Inst. of Labor Hygiene & Occupational Diseases Dedicated to 40th Anniv. of the Great October Socialist Revolution, Moscow*, [Title not given]
486. GORDON, Z. V. (1960) *Nauchno-issledovatel'skiy institut gigiyena i profzabolovaniya* 1(1):22-25 (Abstr. in: *Biological Effects of Microwaves*, ATD P-65-68, Sept. 1965, pp. 21-22; also in: Letavet, A. A., & Gordon, Z. V., (eds.) (1960), pp. 18-21 (JPRS 12471) The Biological Action of Ultrahigh Frequencies), "Hygienic evaluation of the working conditions in the vicinity of UHF generators"
487. GORDON, Z. V. (1960) *Trudy Nii Gigiyena Truda i Profzabolovaniya, USSR*, 1(1):65-68 (also in: *The Biological Action of Ultrahigh Frequencies*, Letavet, A. A., & Gordon, Z. V., (eds.), Moscow, JPRS 12471, pp. 64-67), "Investigation of the blood pressure in rats (bloodless method) under the influence of SHF-UHF"
488. GORDON, Z. V. (1960) *Trudy Nii Gigiyena Truda i Profzabolovaniya, USSR*, 1(1):5-7, (Abstr. in *Biological Effects of Microwaves*, ATD-P-65-68, pp. 71-72; also, abstr. in: *The Biological Action of Ultrahigh Frequencies*, Letavet, A. A., & Gordon, Z. V., (eds.), Academy of Medical Sciences, USSR, Moscow, p. 2-, (JPRS 12471, OTS 62-19175), "The problem of the biological action of UHF"
489. GORDON, Z. V. (1960) In: *Physical Factors of the Environment*, Letavet, A. A., (ed.), p. 135-
490. GORDON, Z. V. (1960) *Vestnik Akademii Meditsinskikh nauk SSSR*, Moskva, 15(4):82-86, All Union Scientific Conf. on Problems of Industrial Hygiene and the Biological Action of Electromagnetic Waves
491. GORDON, Z. V. (1962) In: *Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field*. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 15-16, "Certain features of the biological effect of microwaves of various ranges"
492. GORDON, Z. V. (1964) In: *Biological Action of Radio Frequency Electromagnetic Fields*, Institute of Industrial Hygiene and Occupational Diseases, Academy of Medical Science, USSR, Moscow, (*Trudy Nii Gigiyena Truda i Profzabolovaniya, USSR*, 2(2): pp. 57-60), "The effect of microwaves on blood pressure level in test animals"
493. GORDON, Z. V. (1964) In: *Akademiya meditsinskikh nauk, Vestnik*, 19(7):42-49, (Abstr. in: *The Biological Effects of Microwaves*, ATD-P-65-68, pp. 90-92; also, *Herald of the Academy of Medical Sciences USSR*, JPRS 27032; TT 64-51288, Oct. 1964, pp. 61-71), "Problems of industrial hygiene and the biological effect produced by radio waves of various bands"
494. GORDON, Z. V. (1964) In: *Biological Action of Radio Frequency Electromagnetic Fields*, Institute of Industrial Hygiene and Occupational Diseases, Academy of Medical Science, USSR, Moscow, (*Trudy Nii Gigiyena Truda i Profzabolovaniya, USSR*, 2(2):3-9) "Results of a comprehensive study of the biological effects of radio frequency electromagnetic waves and the outlook for further research"
495. GORDON, Z. V. (1966) *Gigiyena Truda i Professional'nye Zabolovaniya (Moskva)*, 10(10):3-6, (JPRS 39820), "Electromagnetic radio frequency fields as a health factor"
496. GORDON, Z. V. (1966) (Book Review, in *Foreign Science Bulletin* 3(1):46-50, Jan. 1967), Biological Effects of Microwaves: Problems of industrial hygiene and the biological effects of ultrahigh-frequency electromagnetic waves, Izdatel'stvo "Meditsina", Leningrad Izdelenie, 134 pages, (Transl. by Israel Program for Scientific Translations, Ltd., Pub. by Nat. Aeronautics & Space Admin., and Nat. Sci. Foundation (TT-70-50087; NASA TT-7-333), (1970), Biological Effects of Microwaves in Occupational Hygiene)
3200. GORDON, Z.V. (1966), In: Z.V. Gordon. *Biological Effect of Microwaves in Occupational Hygiene*, Academy of Medical Sciences of the USSR, Izdatel'stvo "Meditsina", Leningrad, (Israel Program for Scientific Translations, Jerusalem, 1970), pp. 15-23, "Characterization of the hygiene conditions of personnel working with SHF sources".
2809. GORDON, Z.V. (1970), *Gigiyena Truda Provozabolovaniya*, 14(1):32-34, (Apr.), (In Russ.), "New data and tasks in the hygienic and experimental study of the effects of radio-frequency electromagnetic fields".
2170. GORDON, Z. V. (1970), In: *Ergonomics & Physical Environmental Factors*, (Vol. 21 of the Occupational Safety and Health Series), Internat. Labour Office, Geneva, pp. 159-172, (In Fr.), "Occupational health aspects of radio-frequency electromagnetic radiation"
3464. GORDON, Z.V. (1974), Transl. in JPRS #63321, 268 pps. (30 Oct.), "Biological effects of radiofrequency electromagnetic fields."
497. GORDON, Z. V., & BELITSKIY, B. M. (1959) In: *Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves*, Moscow, pp. 7-8

498. GORDON, Z. V., & ELISEEV, V. V. (1964) In: The Biological Action of Radio-Frequency Electromagnetic Fields, Moscow, pp. 151-, "Means of protection from SHF radiation and their effectiveness"
499. GORDON, Z.V., KITSOVSKAYA, I.A., TOLGSKAYA, M.S., & LETAVET, A.A. (1961), Digest of Internat. Conf. on Medical Electronics, In: Biological Effects of Microwaves (Athermal Aspects) I, (Frommer, P.L., ed.) Plenum Press, NY, p. 153 only.
500. GORDON, Z.V., LOBANOVA, YE.A., KITSOVSKAYA, I.A., & TOLGSKAYA, M.S. (1963), Medical Electronics and Biological Engineering, 1(1):67-69 (Presented at 4th Internat. Conf. on Medical Electronics, NY, July 1961), "Biologic effects of microwaves of low intensity."
501. GORDON, Z. V., LOBANOVA, YE. A., KITSOVSKAYA, I. A., & TOLGSKAYA, M. S. (1969) Bulletin Eksperimental'noy Biologii i Meditsiny 68(7):37-39, (In Russian with English summary), "Experimental studies of the biological effect of electromagnetic waves with wavelengths of about a millimeter"
2810. GORDON, Z.V., LOBANOVA, E.A., KITSOVSKAYA, T.A., & TOLGSKAYA, M.S. (1969), Bulletin of Experimental Biology and Medicine (Eng. Transl.), 68(7):734-736, "Investigation of the biological action of millimeter electromagnetic waves", (Engl. transl. of citation #501, this Biblio.).
502. GORDON, Z. V., LOBANOVA, YE. A., & TOLGSKAYA, M. S. (1955) Gigiena i Sanitariya USSR, (12):16-18, "Some data on the (bio) effects of microwaves"
503. GORDON, Z. V., LOBANOVA, YE. A., KITSOVSKAYA, I. A., NIKOGOSYAN, S. V., & TOMASKAYA, M. S. (1962) In: Summaries of reports, Second All Union Conf. on the Application of Electronics in Biology and Medicine, (Moscow, Niteir), p. 20-, "Data on the biological effect of microwaves of various frequencies"
504. GORDON, Z. V., & LOBANOVA, YE. A. (1960) Trudy Nii Gigiena Truda i Profzabolevaniy USSR, (1):59-60, (Abstr. in: The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V., (eds.), JPRS 12471, pp. 57-59), "Temperature reaction of animals under the influence of SHF-UHF"
505. GORDON, Z. V., & PRESMAN, A. S. (1955) Gigiena i Sanitariya USSR, (12):16-18, "Certain data on the action of centimeter waves (experimental investigation)"
506. GORDON, Z. V., & PRESMAN, A. S. (1956) Bureau of Technical Information, Ministry of the Radio Engineering Industry, Moscow, 14-, Preventative and Protective Measures in Work with Generators of Centimeter-Waves
2811. GORDON, Z.V., & TOLGSKAYA, M.S. (1971?), ref ?, "Morphophysiological changes due to the effect of electromagnetic waves at radio frequencies".
507. GORDON, Z. V., TOLGSKAYA, M. S., & ALEKSANDROVA, L. S. (1963) Abstr. of the Conf. on Industrial Hygiene and the Biological Action of Radio Frequency Electromagnetic Fields, Institute of Industrial Hygiene and Occupational Diseases, Academy of Medical Sciences, Moscow, p. 23-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt. P-65-17, Apr. 1965)
508. GORDON, Z. V., & YELISEYEV, V. V. (1964) Trudy Nii Gigiena Truda i Profzabolevaniy USSR (2):151-157 (ATD abstr., JPRS 34,963), "Devices for protection against SHF-UHF radiation and their effectiveness"
509. GORDON, Z. V., et al. (1957) In: Summaries of reports, Part 2: Jubilee Scientific Session of the Institute of Labor Hygiene and Occupational Diseases Dedicated to the 40th Anniv. of the Great October Socialistic Revolution, Moscow, "Morphological changes in animals under the action of ultrahigh frequencies"
510. GORDON, Z. V., et al. (1963) Biol. i Medits. Elektronika (6):72-, "On the biological action of microwaves of various frequencies"
511. CORE, I., & ISAACSON, N. H. (1949) Amer. J. of Pathology 25:1029-1046, "The pathology of hyperpyrexia: observations at autopsy in 17 cases of fever therapy"
2171. GORODETSKAYA, S. F., LISINA, G. G., & RAPOPORT, M. B. (1969), Fiziologicheskii Zhurnal 15:805-811, (In Ukrain.), (Abstr. #A70-18730), "Hemopoietic condition due to the action of radio waves" [rabbits and mice]
512. GORODETSKAYA, S. F. (1960) Fiziologicheskii Zh. Akad. nauk UKR SSSR, 6(5):622-628, "The effect of centimeter-band radio waves on hematogenic organs, reproduction, and the higher nervous activity"
513. GORODETSKAYA, S. F. (1961) Fiziologicheskii Zh. Akad. nauk UKR SSSR, 7(5):672-674, "The effect of 3 cm radiowaves on the functional condition of the adrenal cortex"
514. GORODETSKAYA, S. F. (1962) Fiziologicheskii Zh. Akad. nauk UKR SSSR, 8(3):390-396, (Also, FTD-TT-62-1361/1+2, AD #292205), "Morphological changes in internal organs when the organism is exposed to the effect of centimeter waves"
515. GORODETSKAYA, S. F. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, "The effect of SHF-UHF on reproductive organs"
516. GORODETSKAYA, S. F. (1963) Fiziologicheskii Zh. Akad. nauk UKR SSSR, 9(3):394-395, (Also, JPRS 21200, OTS 63-31815, and N63-22588), "The effect of centimeter radio waves on mouse fertility"
517. GORODETSKAYA, S. F. (1964) Fiziologicheskii Zh. Akad. nauk UKR SSSR, 10(4):494-500 (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), (Also, JPRS 26990, N64-33486), "Effect of a SHF-UHF field and convectional heat on the estrual cycles of mice"
518. GORODETSKAYA, S. F. (1964) In: Problems of the Biophysics and Mode of Action of Radiation, (Also, JPRS 34963), pp. 70-74, "Characteristics of the biological effect of 300 cm radio waves on animals"

519. GORODETSKAYA, S. F. (1964) In: Biological Action of Ultrasound and SHF-UHF Electromagnetic Oscillations, Gorodetskiy, A.A., (ed.), Academy of Sciences, Institute of Physiology, imeni A. A. Bogomolets, Kiev, UKR SSR, (JPRS 30860, Abstr. in: Biological Effects of Microwaves, ATD-P-65-68, (1965), pp. 53-54, and N65-28706), pp. 80-91, "Effect of a SHF-UHF electromagnetic field on the reproduction, peripheral blood composition, conditioned reflex activity, and the morphology of the internal organs of white mice"
520. GORODETSKAYA, S. F., & KEROVA, N. (1966) *Fiziologicheskii Zh. Akad. nauk UKR SSSR*, 12(2):246-253, "Changes in some functional and biochemical indices in the testicles of animals exposed to 3 cm radiowaves"
521. GORODETSKIY, A. A. (ed.) (1964) Academy of sciences, Institute of Physiol. imeni, A. A. Bogomolets, Kiev, UKR SSR, 120 pages, (JPRS 30860, IT-65-31380, and N65-28700), Biological Action of Ultrasound and Super High Frequency Electromagnetic Oscillations
522. GORODETSKIY, A. A., YEVDOKIMOV, I. R., KOLESNI, V. M., & SHEVKO, G. N. (1967) *Fiziologicheskii Zh.* 13(2):230-233, [Title?]
523. GORSHENINA, T. I. (1963) *Materialy Teoreticheskoy i klinicheskoy meditsiny (Tomsk)*, (2):pp.? "Early morphological changes after exposure to experimental electromagnetic fields"
524. GORSHENINA, T. I. (1964) Materials of the 1st Scientific Conf. of the Central Scientific Research Lab. (Tomsk), "Changes in the lungs induced by alternating electromagnetic fields"
525. GORSKI, S., KWASNIEWSKA-BLASCZYK, M., & MACKIEWICZ, S. (1967), *Polski tygodnik lekarski, Warsaw*, 22:940-943, "Isotope evaluation of the effect of microwaves on capillary circulation in muscles of the extremities"
2812. GOURNAY, L.S. (1966), *J. of the Acoustic Soc. of Amer.*, 40( ):1322- ; "Conversion of electromagnetic to acoustic energy by surface heating".
526. GRAHAM, G. D. (1935) *Arch. of Physical Therapy* 16:741-742, "Desiccation of hemorrhoids"
2813. GRAHAM, R.B., & HEMPHILL, J.M. (1972), USAF Radiological Health Laboratory, Wright-Patterson AFB, Ohio, Rept. No. 72W-51, (16 May), "Preliminary evaluation of the Narda Model 8300 power density meter".
527. GRANBERY, W. M., & JAMES, J. M. (1963) *J. of Bone and Joint Surgery* 45A:773-777, "The lack of effect of microwave diathermy on bone of the growing dog"
528. GRANOVSKAYA, R. M. (1961) *Leningrad Obshchestva Yestestvoispytateley* 72(1):pp.? "The problem of electromagnetic brain fields"
529. GRANT, E. H. (1969) *Non-Ionizing Radiation* 1(2):77-79, "Fundamental physical concepts underlying absorption of microwave energy by biological material"
530. GRANT, E. B., KEEFE, S. E., & TAKASHIMA, S. (1968) *J. of Physical Chemistry* 72:4373-, "The dielectric behavior of aqueous solutions of bovine serum albumin from radiowave to microwave frequencies"
531. GRAY, O. S. (1970) Feb. 10, U. S. Patent Office, Pat. #3,494,722, "Method and apparatus for sterilizing [using microwave radiation & heat & pressure]"; Pats. #3,494,723, and #3,494,724, "Method and apparatus for controlling microorganisms and enzymes"
532. GRAY, O. S., & SANDERS, M. (1970) Paper presented to Section of Environmental Sciences of the New York Academy of Sciences, (6 Nov.), 7 pages, "Effect of controlled electromagnetic energy [microwave] on biological systems"
533. GREBESZCHENIKOVA, A. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, p. 17-, "The effect of SHF-UHF fields in the decimeter and meter wave ranges on the motor evacuator function of the gastrointestinal tract in dogs and guinea pigs"
2392. GRECHUSHKINA, V.A. (1972), *Oftal'mologicheskii Zhurnal*, 27:226-228. (In Russ.), "Clinico-morphological and biochemical changes in experimental microwave cataracts."
2393. GRECHUSHKINA, V.A. (1972), *Voprosy Kurortologii i Fizioterapii i Lechebnoi Fizioterapii Kul'try*, 37(4):337-341 (July-Aug.), (in Russ.), "Mechanism of action of microwave therapy in ophthalmological practice."
3202. GREENBERG, B., & ASH, N. (1974), *Environmental Entomology*, 3(5):845-853, (Oct.), "Impact of extremely low frequency electromagnetic fields on soil arthropods in nature".
2814. GREENBERG, D.S. (1973), *Saturday Review of the Sciences*, 1(4):36-44, (28 Apr.), "The French concoction", [L'Affaire Priore; electromagnetic radiation and its effect on cancer in rats and African sleeping sickness (via the blood parasite Trypanosoma) in mice].
3465. GREENE, F.M. (1975), National Bureau of Standards, Technical Note 658, "Development of electric and magnetic near-field probes."
3466. GREENE, F.M. (1975), National Bureau of Standards, Rept., Boulder, CO, No. NIOSH-75-127, "Development of magnetic near-field probes" [for determination of fields emitted by sources operating in the frequency range between 10 MHz and 40 MHz].
2172. GRENELL, R. C., & McCULLOCH, D. (1967). (Abstr. #N67-26284), 25 pages, "Molecular binding in the cell surface; Progress report" [Spectral analyses of microwave absorption in protein solutions, water, and organic solvents by molecular bonding to cell surface]

534. GRIFFIN, D. R., McCUE, J. J. G., & GRINNELL, A. D. (1962) Rept., Harvard Univ. Cambridge, Mass. (AD 296493), "The resistance of bats to jamming"
2815. GRIGOR'EV, V.E., et al. (1972), Vestn. Dermatol. Venerol., 46( ):75-77, (Jul.), (In Russ. w/Eng. abstr.), "Treatment of gonorrheal and non-gonorrheal epididymitis with UHF electric fields: II".
2816. GRIGOR'IAN, D.G. (1969), Vop. Kurort. Fizioter., 34( ):52-55, (In Russ.), "A study of blood serum and myocardial proteins in animals following exposure to microwaves".
535. GRIGOR'LAN, D. G. (1969) Voprosy Kurortologii Fizioterapii i Lechebnoi Fizicheskoi Kultury (Problems in Health Resort Sci., Physiotherapy, & Medical Physical Culture), Moscow, 34(6):510-513, (In Russian) "Examination of proteins in the brain and blood serum of animals which have been exposed to microwave radiation"
536. GRIGOR'YEVA, T. A. (1937) Biologicheskoye deystviye UVCh. Simpozium. (Biological effect of ultrahigh frequencies. Symposium), Moscow, pp. 137-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept P-65-17, Apr. 1955), [Title not given], [Irradiation of sciatic nerve of cat]
537. GRINSBARG, A. G. (1959) Kazanskiy Med. Zh. Navy USSR, 40(4):59-61 and/or 63-65<sup>??</sup> (JPRS 2802), "VHF-HF therapy in certain affections of the peripheral nervous system"
2817. GRINEV, M.V., et al. (1970), Vopr. Kurortol. Fizioter. Lech. Fiz. Kult., 35( ):424-426, (Sept.-Oct.), "Role of UHF therapy in the complex treatment of chronic osteomyelitis".
1992. GRISHCHINA, K. F. (1958) Biofizika 3:358-362, (In Russian) "Significance of certain methodological conditions in a reaction to the local action of centimeter waves"
538. GRISHINA, K. F. (1958) Biofizika 3(3):358-362 (Pergamon Press Transl.), "The importance of certain procedures in the local response of tissues to centimeter waves"
539. GRISHINA, K. F., & KOMAROVA, A. A. (1963) Leningrad (Transl. of some sections are in JPRS 21725, OTS 63-41061), 320 pages, Techniques and Methods of Conducting Physiotherapeutic Procedures
540. GRISKO, F. I. (1959) Fiziologicheskij Zh. Akad. nauk UKR SSR, 5(1):31-38, (Abstr. in Biological Abstracts, No. 33058, 1964), "The effect of an ultrahigh electromagnetic field on the reflex activity of the spinal cord with differing Ca and K concentration"
3467. GRISSETT, J.D. (1971), Naval Aerospace Medical Res. Lab. (Pensacola, FL), Technical Rept. No. NAMRL-1146, "Exposure of squirrel monkeys for long periods to extremely low-frequency magnetic fields: Central-nervous-system effects as measured by reaction time."
3468. GRISSETT, J.D., & de LORGE, J. (1971), Naval Aerospace Medical Res. Lab. (Pensacola, FL), Technical Rept. No. NAMRL-1137, "Central-nervous-system effects as measured by reaction time in squirrel monkeys exposed for short periods to extremely low-frequency magnetic fields."
2818. GRISSETT, J.F. (1973), Naval Aerospace Medical Research Lab., Pensacola, FL, Rept. No. NAMRL-1177, "Technique for reducing the ambient electric field generated by inductive voltages in low-frequency magnetic field generators".
541. GRODAS, P. (1937) ACTA of 1st Internat. Congress of Shortwaves, Vienna, "Shortwave therapy; a specific heat therapy"
542. GRODAS, P., & TOMBERG, V. (1933) Wiener Klinische Wochenschrift 46(30):929-935, (In German), "Concerning shortwave therapy"; *ibid.*, 46(31):954-959, "Concerning shortwave therapy"; *ibid.*, 47, 9, (1934), "Biological effects of shortwave therapy"
543. GROSS, E. (1969) Science News (25 Oct.) 96(17):382-, "Microwaves and health effects"  
GROVE, M. E., see citation #2052
544. GROSSE, G., LINNER, G., & SCHNEIDER, P. (1969) Zeitschrift fuer Mikroskopisch-anatomische Forschung, Germany, 80(2): 260-263, (In German with English summary), "The influence of electric fields on *in vitro* cultured nerve cells"
1993. GRUSZECKI, L. (1964) Przegląd lekarski, Cracow, 20:336-338, "Influence of microwaves radiated by a radar transmitter on the human and animal organism" (In Polish)
545. GRUTENER, P., & HEIDENHAIN, R. (1878) Archives fur die Gesante Physiologie 16:1-59, (In German), [Title?]
546. GRUZEY, A. D. (1965) Biofizika 10:1091-, "The orientation of microscopic particles in electric fields"
547. GRYNBALM, B., MEGIBOW, R. S., & BIERMAN, W. (1950) Arch. of Physical Med. 31:629-631, "The effect of shortwave diathermy upon the . . . circulation as determined by microplethysmography"
1994. GRZESIK, J., KŁASZKA, F., & PARADOWSKI, Z. (1960) Med. pracy 11:323-330, (In Polish) "Influence of a medium-frequency electromagnetic field on organ parenchyma and blood proteins in white mice"
548. GRENBERGER, M. (1945) Malover Med. Acta 12:173-183, "Changes in renal function produced by shortwave irradiation of the kidneys"
2819. GUHA, S.K., et al. (1973), Phys. Med. Biol., 18( ):712-720, "Electrical field distribution in the human body".
2820. deGUILLIBON, H.F., & ELZENEINY, I. (1970), Arch. of Ophthalmology (Chicago), 83( ):489-503, "Electrical impedance of ocular coats during diathermy applications".

2871. deGUILLEBON, H.F., & ISHII, Y. (1970), Arch. of Ophthalmology (Chicago), 83( ):752-759, "Scleral changes during diathermy application".
2822. GULIAEV, P.I., et al. (1969), Nerv. Sist., 10( ):177-183, (In Russ.), "Registration of electromagnetic fields arising during the movements of insects, birds and animals".
549. GULYAYEV, P. I. (1945) Trans. of 1st Conf. on Applied Problems of Shortwaves and Microwaves in Medicine, Medgiz, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt. P-65-17, 1965), "Maximum energy absorptions in a high frequency electromagnetic field"
550. GULYAYEV, P. I. (1967) Proc. of Symposium on Physics and Biology, Moscow, pp. 19-, "The electroauragram. The electric field of organisms as a new biological connection"
551. GULYAYEV, P. I., ZABOTIN, V. P., & SHLIPPENBANK, N. YA. (1967) Paper read to the Leningrad Society of Naturalists, February 13, "The electroauragram; The electric field in the air around excited tissues"
552. GUNN, S. A., GOULD, T. C., & ANDERSON, W. A. D. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1 (Peyton, M. F., ed.), pp. 99-115, (Also, Deichmann, W. B., et al., (1959) Section in: Microwave Radiation Research), "The effect of microwave radiation (24,000 Mc) on the male endocrine system of the rat"
553. GUNN, S. A., GOULD, T. C., & ANDERSON, W. A. D. (1961) Laboratory Investigations 10:301-314, (Also in: Deichmann, W. B., et al. (1959), Section in: Microwave Radiation Research), "The effect of microwave radiation on morphology and function of rat testes"
554. GUNTER, R., et al. (1958) Arch. of Ophthalmology 60:437-442, "Some effects of diathermy currents on eye tissues"
555. GURYEV, V. N. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 20-21, "Some problems of the adjustment of people to SHF-UHF effects under industrial conditions"
556. GURYEV, V. N. (1965) Ekspertiza Trud i Trud Pri nerv i Psikhicheskikh Zabol. 18(18):121-127, (JPRS 36,164), "Diencephalic disorders in persons exposed to SHF-UHF electromagnetic fields for prolonged periods of time"
3203. GUSAROV, D.V. (1971), Voen. Med. Zh., (3):61-66, (In Russ.), "Effect of a superhigh frequency field on the physical trainability of experimental animals", [mice exposed to 12.7 cm radiation at a level of 15 mW/cm<sup>2</sup> for 2 hrs/day performed a swimming task less effectively than controls. No effect at 1 mW/cm<sup>2</sup>].
2394. GUTKIN, V.S. (1966), Materialy. In: Electrosleep and Electroanesthesia. Materials of the All-Union Symposium on Problems of Electrosleep and Electroanesthesia [Electronarcosis], Dedicated to the 20th Year of the Electrosleep Method, pp. 59-60, (In Russ.), "Morphological changes in various sections of the brain during electroanesthesia".
2395. GUY, A.W. (1961), Nat'l. Acad. of Sci., Nat'l. Res. Council, U.S. Nat'l Committee, Internat. Union of Radio Science, Spring Meeting, April 8-10, "Quantification of electromagnetic fields and their effects on biological media".
557. GUY, A. W. (1971) IEEE Trans. on Microwave Theory and Techniques (Special Issue on Biological Effects of Microwaves) MTT-19(2):205-214, "Analyses of electromagnetic fields induced in biological tissues by thermographic studies on equivalent phantom models"
558. GUY, A. W. (1971) IEEE Trans. on Microwave Theory and Techniques (Special Issue on Biological Effects of Microwaves) MTT-19(2):214-223, "Electromagnetic fields and relative heating patterns due to a rectangular aperture source in direct contact with bilayered biological tissue"
2396. GUY, A.W. (1972), Report by ANSI C.95 Sectional Committee on Radio Frequency Hazards, Subcommittee IV on safety levels and/or tolerances with respect to personnel, "Research needed for setting of realistic safety standards".
3469. GUY, A.W. (1975), In: AGARD Rept. entitled "Radiation Hazards" (Rept. #AGARD-LS-78), Aug., "On EMP safety hazards."
2397. GUY, A.W., HARRIS, F.A., & HO, H.S. (1971), Presented at the Internat. Microwave Power Inst.(IMPI) Symp., Naval Postgraduate School, May 26-28, Monterey, Calif., "Quantitation of the effects of microwave radiation on central nervous system function".
2823. GUY, A.W., JOHNSON, C.C., LIN, J.C., EMERY, A.F., & KRANING, K.F. (1973), Univ. of Washington, Seattle, Report (for the period 21 Aug 72 - 18 Jan 73), on Contract No. F41609-73-C-0002; 7757-01-30, (Doc. # SAM-TR-73-13), "Electromagnetic power deposition in man exposed to high-frequency fields and the associated thermal and physiologic consequences".
2398. GUY, A.W., & KORBEL, S.F. (1972), Presented at the Internat. Microwave Power Inst. (IMPI) Symp., Ottawa, Canada. May 24-26, "Dosimetry studies of an UHF cavity exposure chamber for rodents".
2399. GUY, A.W., & LEHMANN, J.F. (1966), IEEE Trans. on Bio-Med. Eng., BME-13(2):76-87, "On the determination of an optimum microwave diathermy frequency for a direct contact applicator".
2400. GUY, A.W., LEHMANN, J.F., McDUGALL, J.A., & SORENSEN, C.C. (1968), In: Thermal Problems in Biotechnology, ASME, New York, pp. 26-45, "Studies on therapeutic heating by electromagnetic energy".
2824. GUY, A.W., LEHMANN, J.F., & STONEBRIDGE, J.B. (1974), Proceedings of the IEEE, 62(1):55-75, (Jan.), "Therapeutic applications of electromagnetic power".

559. GUY, A. W., & LEHMANN, J. F. (1967) Digest of the 7th Internat. Conf. on Medical and Biological Engineering (Jacobson, B., ed.), Stockholm, p. 396 only, "Determination of electromagnetic heating patterns in human tissues by thermographic studies on phantom models"
2401. GUY, A.W., LIN, J.C., & HARRIS, F.A. (1972), Presented at the Internat. Microwave Power Inst. (IMPI) Symp., Ottawa, Canada, May 24-26, "The effects of microwave radiation on evoked tactile and auditory CNS response in cats".
3204. GUY, A.W., LIN, J.C., KEAMAR, P.O., & EMERY, A.F. (1974), Univ. of Washington, Scientific Report No. 2 to Office of Naval Research, (Jan.), "Quantitation of microwave radiation effects on the eyes of rabbits at 2450 MHz and 918 MHz".
560. GVOZDIKOVA, Z. M., ANAN'YEV, V. M., ZENINA, I. N., & ZAK, V. I. (1964) *Biulleten Eksperimental'nov Biologii i Meditsiny, Moscow*, **58(8):63-68**, (Abstr. in The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept P-65-17, 1965; also abstr. in Biological Effects of Microwaves, ATD-P-65-68, 1965, pp. 45-47), (JPRS 26,725, IT 64-41982, Oct. 1964, pp. 31-, N64-32782), "Sensitivity of the rabbit central nervous system to a continuous (non-pulsed) ultrahigh frequency electromagnetic field"
561. GVOZDIKOVA, Z. M., ZENINA, I. N., & ZAK, V. I. (1964) *Trudy Vii Gigiyena Truda i ProfzaboleaniyaMNN SSSR*, **(2):20-25**, (Abstr. in: The Biological Action of Radio Frequency Electromagnetic Fields, Moscow), "The effect of continuous SHF-UHF electromagnetic fields on the central nervous system"
562. HAASE, W., & SCHLIEPHAKE, E. (1931) *Strahlentherapie* **40:133-158**, (In German), "Investigations concerning the influence of short electrical waves on the growth of bacteria"
563. HADUCH, S., BARANSKI, S., & CZERSKI, P. (1960) *Lekarz Wojskowy (Army Surgeon)*, Poland, **36(2):119-125**, (Transl. NASA-TT-F-8143), "Research into the influence of high frequency electromagnetic fields on the human body"; *ibid.*, **36(8):792-803**, (FTD-IT 61-379-1, AD 270774), "Biological effect of cm and dm electromagnetic waves"
564. HADUCH, S., BARANSKI, S., & CZERSKI, P. (1962) In: Human Problems of Supersonic and Hypersonic Flight, Barbour, A. B., & Whittingham, H. F., (eds.), Pergamon Press, pp. 449-454, "The influence of ultrahigh frequency radio waves on the human organism"
565. HAGGIS, G. H., BUCHANAN, T. J., & HASTED, J. B. (1951) *Nature* **167:607-608**, "Estimation of protein hydration by dielectric measurements at microwave frequencies"
2173. HAINES, C. F., JR., & HATCH, T. (1952) *Heating and Ventilating*, (November), pp.?, "Industrial heat exposures, evaluation and control"
3470. HALBERG, F., CUTKOMP, L., NELSON, W., & SOTHERN, R. (1975), Rept., Minnesota Univ. Minneapolis Chronobiology Labs, (AD #A019-958), (28 Aug.), 66 pps., "Circadian rhythms in plants, insects and mammals exposed to ELF magnetic and/or electric fields and currents."
566. HALL, G. A., & SCHLEGEL, W. A. (1967) *Arch. of Ophthalmology* **78:521-**, "Relative bursting strength of rabbit sclera after cryosurgery and diathermy"
567. HALL, W. W., & WAKEFIELD (1927) *J. of the Amer. Medical Assoc.* **89:177-182**, "A study of experimental heat stroke"
2825. HALLENGA, K. (1972), Thesis, Groningen (Netherlands), "The dynamics of hydrophobic interaction: A microwave dielectric study".
3471. HALLGREN, R. (1973), *IEEE Transactions on Biomedical Engineering*, **BME-20(6):470-472**, (Nov.), "Inductive neural stimulator."
568. HALPHEN, A., & AUCLAIR, J. (1933) *Arch. of Physical Therapy* **14:69-71**, "A new form of D'Arsonvalization; the short waves"
2826. HAMBURY, H.J., WATSON, J., SIVYER, A., & ASHLEY, D.J.B. (1971), *Nature (London)*, **231( ):190-**, "Effects of microamp electrical currents on bone *in vivo* and its measurement using strontium-85 uptake".
2174. HAMER, J.R. (1968), Report: Space Biology Laboratory, Brain Research Institute, Univ. of Calif., Los Angeles, (N68-16115), (NASA CR or TMX C1-92700-04, AF496381387), "Effects of low level, low frequency electric fields on human reaction time."
2827. HAMID, M.A.K., & BADOUR, S.S. (1973), *J. of Microwave Power*, **8(3/4):267-273**, "The effects of microwaves on green algae".
2828. HAMID, M.A.K., et al. (1968), *J. of Microwave Power*, **3(3):**, "Control of grain insects by microwave power".
2402. HAMID, M.A., BOULANGER, R.J., HODGSON, G.C., KONDRA, P.A., SMITH, K., & BRAGG, D.B. (1969), *J. of Microwave Power*, **4( ):253-256**, "The effect of microwave radiation on the growth and reproduction of chickens".
3205. HAMID, M.A.K., BOULANGER, R.J., TONG, S.C., GALLOP, R.A., & PEREIRA, R.K. (1969), *J. of Microwave Power*, **4(4):272-277**, "Microwave pasteurization of raw milk".
3472. HAMID, M.A.K., MOSTOWY, N.J., & BHARTIA, P. (1975), *J. of Microwave Power*, **10(1):109-114** (Mar.), "Microwave bean roaster."

2080. HAMID, M. A. K., BOENER, W. M., & TONG, S. C. (1970) *J. of Microwave Power* 3:44-46, (Abstr. in: *Non-ionizing Rad.* 1(4):193 only, (1970)), "Microwave irradiation of potato-waste water"
2081. HAMID, M. A. K., & BOLLANGER, R. J. (1969) *J. Microwave Power* 4:11-18, (Abstr. in: *Non-ionizing Rad.* 1(2):102 only, (1969), Abstract #40), "New method for control of moisture and insect infestations of grain by microwave power"
2829. HAMILTON, R., KETTERER, D., HOLST, H.I., & LEHR, H.B. (1968), *Cryobiology*, 4(5): , "Rapid thawing of frozen canine kidneys by microwaves".
2830. HAMRICK, P.E. (1973), *Radiation Research*, 56(2):400-404, "Thermal denaturation of DNA exposed to 2450 MHz CW microwave radiation".
2831. HAMRICK, P.E., & BUTLER, B.T. (1973), *J. of Microwave Power*, 8(3/4):227-233, "Exposure of bacteria to 2450 MHz microwave radiation".
569. HANDELSMAN, M. (1957) *Proc. of Tri-service Conf. on Biological Hazards of Microwave Radiation* (Partishall, E. G., ed.), 1:23-31, (Abstr. in: *Naval Medical News Letter* 30(11):36-, 1957, "Microwave radiation hazards"), (AD 115603, ARDC-TR-58-51), "Future microwave radiation hazards"
3206. HANKIN, N.N. (1974), Office of Radiation Programs, U.S. Environmental Protection Agency (Silver Spring, MD 20910) Report No. EPA-520/2-74-008, (Dec.), "An evaluation of selected satellite communications (SATCOM) systems as sources of environmental microwave radiation". [With comments on potential and realistic biological hazard evaluation]
3473. HANKIN, N.N., TELL, R.A., & JANES, D.E. (1974), *Health Physics*, 27(6):633- , "Assessing potential for exposure to hazardous levels of microwave radiation from high power sources."
572. HANLON, J. J. (1970) In: *Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium*, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 116-121, "Cellular effects of microwave radiation"
3207. HANNAH, S., (1974), *Electronics Letters*, 10(14):274-276, "Continuous monitor of dangerous levels of microwave power".
573. HANNEMAN, G. D. (1967) *Aerospace Med.* :275-277, "Changes produced in urinary sodium, potassium, and calcium excretion in mice exposed to homogeneous electromagnetic stress"
2832. HANSEN, T.I., & KRISTENS, J.H. (1973), *Scandinavian J. of Rehabilitation Medicine*, 5(4):179-182, "Effect of massage, shortwave diathermy and ultrasound upon Xe-133 disappearance rate from muscle and subcutaneous tissue in human calf".
574. HARDEMAN, L. J. (1970) *Microwaves* 9(2):p. 17 and p. 24 (Feb.), "Microwave oven leakage: Federal regulations soon"
2056. HARDEMAN, L. J. (ed.) (1971) *Microwaves* 10(3):9-12, (Aug.), "Microwave imaging helps FAA foil hijackers"
575. HARDY, J. D. (1961) Report to ONR from Univ. of Penna., Moore School of Electrical Engineering, (4 pages), (AD 615472), "Physiological effects of heating the skin with microwave and infrared radiation: final report"
576. HARDY, J. D. (ed.) (1968) *Thermal Problems in Aerospace Medicine*, The Advisory Group for Aerospace Res. & Develop., NATO, Technivision Services, Maidenhead, England [including microwave radiation effects], (Abs. No. N69-25051)
577. HARDY, J. D., & MURCATROYD, D. (1958 or later) ref.?, "Responses of man to high intensity thermal radiation"
1995. HARMSEN, E. (1953) *Arch. physik. Therap.* 5:331-335, (In German), "The lethal effect of meter waves on insects"
1996. HARMSEN, E. (1954) *Arch. Hyg.* 133:278, (In German) "On the biological effect of ultra-short waves of low field strength on rats"
3208. HARRIS, F.A. (1969), Biomedical Engineering Society Task Force Rept., "A recommendation concerning the importance of quantitative studies of the effect of microwave irradiation on the central nervous system".
2403. HARRIS, J.F., & GAMOW, R.I. (1972), *Biomedical Sciences Instrumentation*, 9:187-189, (May), "An analysis of heat receptors by means of microwave radiation".
3474. HARRIS, P. (ed.) (1975), *Microwaves*, 14(6):24 only (June), "Biological effects of microwaves probed by OTP [Office of Telecommunications Policy]."
3475. HARRIS, P. (ed.) (1976), *Microwaves*, 15(4):19 only (April), "Soviet jamming prompts new health questions: Recent news accounts that the Soviet Government is beaming high-level [non-ionizing electromagnetic] energy at the U.S. embassy in Moscow to jam American listening devices is prompting a second look here at the dangers of microwave dosage to health."
2833. HARRISON, E.A. (1973), National Technical Information Service (Springfield, VA), Search No. NTIS-WIN-73-070, Document No. COM-73-11720, (Oct.), "Biological effects of microwaves: A bibliography with [authors] abstracts".

578. HARRISON, F. G. (1935) Arch. of Physical Therapy 16:393-397, "Electrosurgery in urology"
3209. HART, A.R., McQUITTY, D.W., & WAGNER, N.K. (1974), Naval Research Reviews, (May/June), (NAVSO-P-510), p. 12-16, "RF susceptibility of micro-electronic components".
579. HARTE, C. (1949) Chromosoma 3(5):440-447, "Mutation activity through ultrashort waves"
2834. HARTE, C., & ZINECKER-BRAUER, I. (1970), Chromosoma, 30( ):123-128, (In Ger.), "Mitosis in root tips of *Vicia faba*. III. Correlations between the solar radiation of radio waves and the variability of relative mitosis frequencies".
580. HARTMAN, F. W. (1937) J. of the Amer. Medical Assoc. 109:2116-2121, "Lesions of the brain following fever therapy: etiology and pathogenesis"
581. HARTMAN, F. W. (1958) Proc. 2nd Tri-service Conf. on the Biological Effects of Microwave Energy (Pattishall, E. G., & Banghart, F. W., eds.) 2:54-70, (AD 131477, ARDC-TR-58-54), "The pathology of hyperpyrexia"
582. HARTMAN, F. W. (1959) La presse medical 67:151-, (In French), "Biological effects of ultrashort electromagnetic radio waves"
583. HARTMUTH, Z. (1954) Zb. Naturforsch. 96:257-, (In German), "The electrical characteristics of biological substances at wavelengths of about 1/10 meter"
584. HARVEY, A. F. (1963) Microwave Engineering, Academic Press, New York
1997. HARVEY, A. F. (1960) Proc. of the Inst. of Electrical Engineers 107:557-566, "Industrial, biological, and medical aspects of microwave radiation"
3476. HARVEY, W.T., & HAMILTON, J.P. (1964), Thesis, School of Engineering, Air Force Institute of Technology, Air U. (Wright-Patterson AFB, Ohio), (AD #608889), GE/EE/64-11, 56 pps., "Hearing sensations in amplitude modulated radio frequency fields."
1998. HASCEH, E. (1946) Naturwissenschaften 8:613, "The action of short waves on tissue"
1999. HASTIK, J., & MIKOLAJCZYK, Z. (1960) Polski Tygodnik Lekarski 15:817-820, (In Polish), "Retention of sugar, cholesterol, and lipids in the blood of diabetics under the influence of short waves"
3477. HAUF, G. (1974), Dissertation, ETZ 26 Heft, 12( ):318-320 (Munich), "Investigations on the action of technical energy fields on man."
2835. HAUF, R., & WIESINGER, J. (1973), Internat. J. of Biometeorol., 17( ):213-215, "Biological effects of technical electric and electromagnetic VLF fields."
2404. HAWKINS, T.D., GROVE, H.M., HEIPLE, T.W., & SCHROT, J. (1973), Rept., Dept. of Microwave Res., Walter Reed Army Inst. of Res., 35 pps., "Some biological effects of microwave irradiation on the rat", [Lethality studies at 3 GHz, and studies of behavioral performance decrements].
2175. HAYASI, O. (1938) Acta Soc. Ophthalm. Jap. 42:1747-1758, (In Jap., with Ger. summary), (Abstr. in: Zentralbl. f. d. ges. Ophth. 42(12):591 (Mar 21, 1939)), "Experimental investigation on the effect of ultrashort waves on the eye. Report I. Effect on the viscosity and the refractive index of the aqueous and the vitreous humor"
2176. HAYASI, O. (1939) Acta Soc. Ophthalm. Jap. 43(7):1727-1736, (In Jap. with Ger. summary on pp. 101-102), (Abstr. in: Zentralbl. f. d. ges. Ophth. 47(2):25 (Sept 30, 1941)), "Experimental investigation on the influence of ultrashort waves on the eye. Report II. The influence of the temperature on eye tissues"
585. HAYWOOD, A. L. (1960) Wright Air Development Technical Rpt #60-551, (Oct. 1960), "Radar radiation hazards in the near field of aperture antennas"
3478. HEALD, C.M., MENGES, R.M., & WAYLAND, J.R. (1974), Plant Disease Reporter, 58(11):985-987, "Efficacy of ultra-high frequency (UHF) electromagnetic energy and soil fumigation on control of reniform nematode and common purslane among southern peas."
586. HEALER, J. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 90-97, "Review of studies of people occupationally exposed to radio frequency radiation"
2837. HEALER, J. (1973), Presented in Seminar on Prospects for Research on Biomedical Effects of Nonionizing Radiation, held by a National Research Council Ad Hoc Committee, (21 Mar.), "Research into biomedical effects of nonionizing radiation and the current government-wide program".
2838. HEALER, J. (1973), In: Environmental Exposure for Nonionizing Radiation: Session Proceedings, (Annual Meeting of the American Public Health Assoc.), published by the EPA, Doc. No. EPA/ORP 73-2, (May), "Federal program on biological effects of electromagnetic energy".
587. HEALER, J., & POLLACK, H. (1967) Allied Research Assoc., Inc. (Concord, Mass.), Final Report No. ARA 348-1, "Review of information on hazards to personnel from high frequency electromagnetic radiation"

588. HEALER, J., & SMILEY, R. (1967) Allied Research Assoc., Inc. (Concord, Mass.), Rept. No. ARA 319-3-1 (38 pages). "Bibliography on biological effects of microwave radiation - a sampling of the world literature"
589. HEALER J., & SMILEY, R. (1968) Allied Research Assoc., Inc. (Concord, Mass.), Rept. No. ARA 376-1, "Some biological effects of radio-frequency radiation"
590. HEALER, J., & SMILEY, R. (1969) Allied Research Assoc., Inc. (Concord, Mass.), Summary Rept. No. ARA 9061F, in three volumes, (AD 704712), "Bibliography on biological effects of radio-frequency electromagnetic fields"
2840. HEALER, J., & SMILEY, R. (1969), Final Tech. Rept. III, Contract DADA17-69-C-9021, U.S. Army Medical R&D Command, Washington, DC, Doc. No. ARA 9061F, (AD #706 236), Allied Res. Assoc., Inc., Concord, Mass., "Citation index for foreign language reports on biological effects of radio-frequency electromagnetic fields".
2839. HEALER, J., & SMILEY, R. (1969), Final Tech. Rept. I, Doc. No. ARA 9061F, Allied Res. Assoc., Inc., (AD #706-851), "Implementation of a prototype data retrieval system for literature on biological effects of radio-frequency fields."
591. HEARN, G. E. (1965) Thesis, Baylor Univ., 77 pages; and HEARN, G. E., & THOMPSON, W. D. (1968), In preparation (?), "Effects of UHF radio fields on visual acuity and critical flicker fusion in the Albino rat"
592. HEARON, J. Z. (1964) (Part of Ely and Goldman's (1964) report entitled "Heating characteristics of laboratory animals exposed to 10 cm microwaves"), IEEE Trans. on Biomedical Engineering, BME-11(4):135-137, "Some mathematical considerations"
2836. HEASTY, D., & HEIMER, G.M. (1973), Naval Ship Engineering Center Rept., (Dec.), "RF-burn voltmeter study".
593. HEDENIUS, P., ODEBLAD, E., & WAHLSTROM, L. (1966), Current Therapeutic Research, 8(7):317-321, "Some preliminary investigations on the therapeutic effect of pulsed short waves in intermittent claudication."
3210. HEDRICK, H.G. (1964), In: Biological Effects of Magnetic Fields, [BARNOOTHY, M.F., (ed.)], Plenum Press, NY, (Citation #63, this Biblio.), pps. 240-245, "Inhibition of bacterial growth in homogenous fields".
594. HEDVIC, P., & ZENTAI, G. (1969) The Chemical Rubber Pub. Co., Cleveland, Ohio (Transl. from Hungarian), 462 pages, Microwave Study of Chemical Structures and Reactions
2405. HEERING, H., & van OSCH, P.M.M. (1971), Rept. MBL-8, Bibliography, Biological effects of microwave radiation, Part 2, The Hague - Netherlands, 55 pp.
2406. HEERING, H., & van OSCH, P.M.M. (1971), Rept. MBL 1971-7, Biological Effects of Microwave Radiation - Part 1, The Hague-Netherlands, 40 pp.
3479. HEFCO, V., HEFCO, E., & BIRCA, C. (1969), Revue Roumaine de Biologie—Serie de Zoologie, 14( ):79-85, "Influence of the magnetic field (MF) on glycemia, pyruvic acid (PA) and lactic acid (LA) in white rat blood."
595. HEIMER, G. (1966) Unpublished Report (Naval Ship Engineering Center, Washington, D. C.), "Navy radio frequency radiation hazards program"
596. HEIMER, G. M. (1967) (Classified) "Report of shipboard (USS DECATUR (DDG-31)) electromagnetic radiation hazard measurements" (U)
597. HEIMER, G. M. (1970) Fathom (Surface Ship & Submarine Safety Review); U. S. Navy Safety Center, pp. 58-60/ "Shipboard RF burn hazards" (Winter Issue)
598. HEIMER, G., & HEASTY, D. (1969) Naval Ship Engineering Center, Washington, D. C., "Report of RF burn investigation (on the) USS WICHITA (AOR-1)"
599. HEIMER, G., & HOWARD, K. (1961) Safety Review 18(4):11-, "Navy radio frequency radiation hazards program"
600. HEINLE, R., & PHELPS, R. (1933) Amer. J. of Physiology 104:349-, "The effects of short radio-waves on perfused cats hearts"
2407. HEINLE, R.W., & PHELPS, K.R. (1933), American J. of Physiology, 104( ):347-348, "The effect of short radio waves and heat on the elasticity of the aorta".
601. HEINMETS, F., & HERSHMAN, A. (1961), Physics in Med. and Biology, 5:271-288, "Considerations of the effects produced by super-imposed electric and magnetic fields in biological systems and electrolytes."
602. HELLER, J. H. (1959) Proc. of the 12th Annual Conf. on Electrical Techniques in Med. and Biology, Digest of Tech. Papers, (Lewis Winner, pub., New York, Nov.), p. 56 only, "The effect of electromagnetic fields on uni-cellular organisms"
603. HELLER, J. H. (1959) Radio Electronics (6):6-, "Effect of high-frequency electromagnetic fields on micro-organisms"
3126. HELLER, J.H. (1960), Of Mice Men and Molecules: "A research scientist tells the story of his challenging, vastly exciting work at the frontiers of medicine", Charles Scribner's Sons Publisher, N.Y., [contains a chapter describing research on biological effects of RF/microwave radiation].

604. HELLER, J. H. (1963) U. S. Pat. 3,095,359, "High-frequency treatment of biological matter"
605. HELLER, J. H. (1969) Presented at the Hazards and Utility of Microwaves and Radiowaves Seminar, (Heller, J., Chm.), 11-12 Dec., Boston, "Chairman's remarks"; "Areas of national and industrial concern - noxious and beneficial"; and "Future research requirements"
606. HELLER, J. H. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 116-121, "Cellular effects of microwave radiation"
3211. HELLER, J.H. (1970), Proc. of the Internat. Microwave Power Inst. Symp., Scheveningen, Netherlands, (Oct.), "Non-thermal genetic effects of RF".
3212. HELLER, J.H., WILKINS, D.J., & FREEBORN, J.F. (1963), Nature, 197( ):997-998, "Effect of radio-frequency fields on the zeta-potential of a colloidal suspension".
607. HELLER, J. H., & MICKY, G. B. (1961) Digest of the 4th Internat. Conf. on Medical Electronics (July), p. 152 only, "Non-thermal effects of radio frequency in biological systems".
608. HELLER, J. H., & TELXEIRA-PINTO, A. A. (1958) Reticulo-Endothelial System Bulletin 4:10-11, "Further investigation into radio frequency effects which appear to be active on the reticulo-endothelial system in whole-body irradiations"
609. HELLER, J. H., & TELXEIRA-PINTO, A. A. (1959) Nature 183(4665):905-906, "A new physical method of creating chromosomal aberrations"
3480. HENDERSON, H.M., HERGENROEDER, K., & STUCHLY, S.S. (1975), J. of Microwave Power, 10(1):27-36 (Mar.), "Effect of 2450 MHz microwave radiation on horseradish peroxidase."
610. HENDLER, E. (1959) Proc. of the 12th Annual Conf. on Electrical Techniques in Med. and Biology, Digest of Tech. Papers, (Lewis Winner, pub., New York, 10-12 Nov.), p. 37 only, "Some observations regarding temperature sensations due to microwave irradiation"
611. HENDLER, E. (1968) In: Thermal Problems in Aerospace Medicine, (Hardy, J. D., ed.), The Advisory Group for Aerospace Research & Development, NATO, Maidenhead, England, p. 149-161, "Cutaneous receptor response to microwave irradiation"
612. HENDLER, E., & HARDY, J. D. (1960) Institute of Radio Engineers 7(3):143-152, (Presented at 12th Annual Conf. on Electrical Techniques in Med. and Biology, Nov. 1957, Philadelphia, Pa.), "Infrared and microwave effects on skin heating and temperature sensation"
570. HENDLER, E., & HARDY, J. D. (1961) Federation Proceedings 20(Part 1):401-, "Microwave heating of the human skin" (See 4th #613, this Biblio)
571. HENDLER, E., & HARDY, J. D. (1961) Digest of Internat. Conf. on Medical Electronics, Biological Effects of Microwaves I (Athermal Aspects), (Frommer, P. L., ed.), Plenum Press, New York, pp. 192-, "Heating of human skin by microwave radiation"
613. HENDLER, E., & HARDY, J. D. (1961) See citation Nos. 570 & 571; incorrectly listed under HANDLER
614. HENDLER, E., HARDY, J. D., & MURGATROYD, D. (1963) In: Temperature - Its Measurement and Control in Science and Industry, 3, Part 3, Chapt. 21, Reinhold Pub. Co., New York, p. 211-230, "Skin heating and temperature sensation produced by infrared and microwave irradiation"
2841. HENNEBERG, G., & JORDANSKI, H. (1972), Zentralblatt fur Bakteriologie, Hygiene, I. Abt. Orig., A-221( ):386-397, (In Ger.), "Experiment on the effect of cells and tissues. Part III: Effect of irradiation with red-light and microwaves on pinocytosis in FL cell cultures".
2842. HENNEBERG, G., & JORDANSKI, H. (1972), Zentralblatt fur Bakteriologie, Hygiene, I. Abt. Orig., A-221( ):398-416, (In Ger.), "Experiment on the effect of cells and tissues. Part IV: Effect of irradiation with red-light and microwaves on the reactivity of the chorioallantoic membrane".
615. HENNY, G. C., TANSY, M., KALL, A. R., WAITS, E. M., & CAMPBELLONE, R. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 65-69, "Studies of biological hazards from high-power HF band transmitters"
616. HENRIQUES, F. C., JR. (1947) Arch. of Pathology 43:489-502, "Studies of thermal injury: V. The predictability and the significance of thermally-induced rate processes leading to irreversible epidermal injury"
2408. HEPPNER, F. (1965), Medical Clinic, 60(22): p.?, "Brain-surgery experiments concerned with the nature of electro-sleep".
3213. HERMAN, W.A., & BASSEN, H. (1975), Dept. of Health, Education, and Welfare, Bureau of Radiological Health Publication (FDA) 75-8028, (Mar.), "Precise microwave power density calibration method using the power equation techniques".
2064. HERRERO, S. (1969) Amer. J. of Physiol. 217:403-410, "Radio-frequency-current and direct-current lesions in the ventromedial hypothalamus"
617. HERRICK, J. F. (1952) Presented at Institute of Radio Engineers National Convention, New York, "Application of microwaves in physical medicine"

618. HERRICK, J. (1958) Proc. 2nd Tri-service Conf. on the Biological Effects of Microwave Energy (Pattishall, E.G., & Banghart, F. W., eds.) 2:88-96, (Also, Digest of Technical Papers, 12th Annual Conf. on Electrical Techniques in Medicine and Biology (Schwan, H. P., Chm.), (1959), Lewis Winner, Pub., New York, p. 60 only), "Pearl chain formation"
619. HERRICK, J. F., JELATIS, D. G., & LEE, G. M. (1950) Federation Proceedings 9:60-, "Dielectric properties of tissues important in microwave diathermy"
620. HERRICK, J. F., & KRUSEN, F. H. (1952) Paper presented at Amer. Institute of Electrical Engineers Summer Meeting, Minneapolis, Minn., June, (Also, Electrical Engineering 72:239-244, (1953)), "Certain physiologic and pathologic effects of microwaves"
621. HERRICK, J. F., & KRUSEN, F. H. (1956) Institute of Radio Engineers Trans. on Medical Electronics, PGME-4:10-12 (and Symposium on Physiologic and Pathologic Effects of Microwaves (Krusen, F. H., Chm.), Mayo Clinic, Sept. 1955) "Problems which are challenging investigators in medicine"
622. HERRICK, J. F., MARTIN, G., KRUSEN, F., & WAKIM, K. (1950) Medical Physics 2 (Vol. or p.), "Physical medicine: microwave diathermy"
623. HETHERINGTON, A. (1957) Proc. of 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.) 1:1-4, "Introduction to biological effects of microwave radiation conference"
2177. HEUBER, R. (1961) Electromed. 6:193-209, (Transl. as AD 6467645-L), "The biological effects of microwaves"
2178. HINES, H., & RANDALL, E. (1952) Elect. Engineer. 71:379-381, "Possible industrial hazards in the use of microwave radiation"
2082. HEYDENREICH, A. (1967) Arbeitsmedizin - Sozialmedizin - Arbeitshygiene, (Stuttgart), 4:280-284, (Abstr. in: Non-ionizing Rad. 2(1):44 only, (1971)), "Radiation-induced eye lesions"
2000. HIGASHI, K. (1948) Science (Japan) 18:467-468, "Denaturation of protein by ultra-short waves"
624. HIGASHI, K. (1950) Monograph Series of the Research Institute of Applied Electricity, Hokkaido Univ., Sapporo, Japan, 1:7-19, "Physical principles of ultra-short wave therapy and other high frequency applications"  
(In Polish), (A68-80352).
625. HIGIER, J., & BARANSKA, W. (1967) Wiadomosci Lekarskie 20:1435-1438, "Examinations of the genital organs and studies of the menstrual cycle in women working in the field of microwave radiation"
2001. HILDEBRANDT, F. (1941) Arch. exp. path. Pharmak. 197:148-160, (In German), "Histamine in the blood and tissue under the influence of short waves, diathermy, and fango mud packs"
626. HILL, T. (1958) J. of the Amer. Chemical Society 80(8):2142-, "Some possible biological effects of an electric field acting on nucleic acids or proteins"
3481. HILL, G. (1975), The New York Times, Monday, Nov. 10, Pages 1 and 61, "Ultrahigh-voltage lines studied as possible peril [to humans and animals]."
3482. HILLS, G.A., KONDRA, P.A., & HAMID, M.A. (1974), Canadian J. of Animal Science, 54(4):573-578, "Effects of microwave radiations on hatchability and growth in chickens and turkeys."
3483. HILMER, H., & TEMBROCK, G. (1970), Biol. Zbl., 89( ) :1-8, (in German), "Investigations on the locomotor activity of white rats under the influence of 50 Hz high tension-alternating fields."
3214. HINDIN, H.J. (1974), Microwaves, 13(10):10 only, (Oct.), "New theory proposed [by FOSTER, K., & FINCH, E.] for hearing microwaves".
2843. HINDIN, H.J. (1974), Microwaves, 13(2):9 only, (Feb.), "Do you hear what I hear?", [Describes results of the 'RF-Hearing' experiments conducted by A. FREY].
3484. HINDIN, H.J. (1976), Microwaves, 15(3):10 & 14, (Mar.), "Microwaves probe for cancer cells."
3485. HINDIN, H.J. (ed.), (1976), Microwaves, 15(1):24 only, (Jan.), "Controversies persist over biological damage [resulting from microwave exposure]" [comments on recent paper by CZERSKI, P. (citation no. 3421, this Biblio.)].
627. HINES, E. M. (1958?) State Univ. of Iowa, College of Medicine (AF Rept. 41(657)-113), "Effects of 3, 10, and 12 cm radiation upon the avascular hollow viscera of dogs"
628. HINES, E. M., DMIG, C. J., & THOMASON, J. D. (1948) Proc. of the Society of Experimental Biology and Medicine 69:382-386, "Testicular degeneration as a result of microwave radiation"
2002. HINES, E. M., & RANDALL, J. E. (1952) Electronic Engineering 71:879-881, "Possible industrial hazards in the use of microwave radiation"
629. HIRSCH, F. G. (1952) NASE Conf. on Industrial Health, Cincinnati, Ohio, April, "Microwave cataracts"
630. HIRSCH, F. G. (1956) Institute of Radio Engineers Trans. on Medical Electronics, PGME-4:22-24 (and Symposium on Physiologic and Pathologic Effects of Microwaves, (Krusen, F. H., Chm.), Mayo Clinic, Sept. 1955), "The use of biological simulants in estimating the dose of microwave energy"

2179. HIRSCH, F. G. (1970) Lovelace Foundation for Medical Education and Research, Albuquerque, N. M., 17 pages, "Microwave cataracts - A case report reevaluation"
631. HIRSCH, F. G. (1970) Paper presented at 4th Annual Midyear Topical Symposium, Health Physics Soc., Electronic Product Radiation and the Health Physicist, Louisville, Ky., 28-30 Jan.; Bureau of Radiation Health, Div. of Electronic Products Report No. 70-26, pp. 111-140, "Microwave cataracts"
2409. HIRSCH, F.G., & BRUNER, A. (co-chm.) (1970), Proceed. of the Technical Coordination Conference on EMP (Electromagnetic Pulse) Biological Effects, (July), Sponsored by the Lovelace Foundation for Med. Educat. & Res., Albuquerque, N. Mex.
2410. HIRSCH, F.G., & BRUNER, A. (1972), J. of Occupational Medicine, 14(5):380-386, "Absence of electromagnetic pulse effects on monkeys and dogs".
2411. HIRSCH, F.G., MCGIBONEY, D.R., & HARNISH, T.D. (1968), International J. of Biometeor., 12(3):263-270, "The psychologic consequences of exposure to high density pulsed electromagnetic energy".
2003. HIRSCH, F.G., & PARKER, J.T. (1952), AMA Arch. of Industr. Health, 6(6):512-517, "Bilateral lenticular opacities occurring in a technician operating a microwave generator." [Abstr. in: Ophth. Lit., 6(7):913 (Mar. 1954)]
2844. HO, H.S., GINNS, E.I., & CHRISTMAN, C.L. (1973), IEEE G-MTT Transactions; Symposium Issue, \_\_\_( ): , (Dec.), "Environmentally-controlled waveguide irradiation facility".
3486. HO, H.S., & GUY, A.W. (1975), Health Physics, 29( ):317-324 (Aug.), "Development of dosimetry for RF and microwave radiation—II: Calculations of absorbed dose distributions in two sizes of muscle-equivalent spheres."
632. HO, H. S., GUY, A. W., SIGELMANN, R. A., & LERMANN, J. F. (1971) IEEE Trans. on Microwave Theory and Techniques (Special Issue on Biological Effects of Microwaves) MTT-19(2):224-231, "Microwave heating of simulated human limbs by aperture sources"
3487. HO, H.S., & YOUNG, H.D. (1975), Health Physics, 29( ):325-329 (Aug.), "Development of dosimetry for RF and microwave radiation—III: Dose rate distribution in tissue spheres due to measured spectra of electromagnetic plane wave."
633. HODGE, D. M. (ed.) (1968) Report of U. S. Dept. of Health, Education, and Welfare, Public Health Service, Consumer Protection and Environmental Health Service, Environmental Control Admin., Bureau of Radiological Health, Rockville, Md., Summary Report Jan. - Dec., "Radiation bio-effects"
2180. HODGE, D. M. (ed.) (1970) for Jan-Dec 1969, Div. of Biological Effects, Bur. Rad. Health, DHEW (Rept. No. DBE 70-1), (RTIS Rept. No. PB-190-110), 213 pages, Radiation Bio-Effects Summary Report
2181. HODGE, D. M. (ed.) (1970) for Jan-Dec 1970, Div. of Biological Effects, Bur. Rad. Health, DHEW (Rept. No. BRH/DBE 70-7), 267 pages, Radiation Bio-Effects Summary Report
2004. BODUCE, S., BARANSKI, S., & CZERSKI, P. (1960) Acta physiol. pol. 11:717-719, "Effect of microwave radiations on the human organism"
634. HOEFT, L. O. (1965) Aerospace Medicine 36(7):621-622, (AMRL TR-64-127, AD 624036), "Microwave heating, a study of the critical exposure variables for man and experimental animals"
2412. HOFFART, H.M. (1968), Electro-Technology, \_\_\_( ):52- , (November), "EMC [electromagnetic compatibility] and radiation hazards".
2845. HOFMANN, Von D., et al. (1969), Zbl. Gynaek., 91( ):593-607, (May), "Experimental studies on the implantation of 32P and 35S in the genital organs of the rat, and its dependence on short wave irradiation".
2413. HOLM, D.A., & SCHNEIDER, L.K. (1970), Experientia, 26:992-994, "The effects of non-thermal radio frequency radiation on human lymphocytes in vitro", [Increased incidence of chromosomal breaks at 27.1 MHz; high power density (10 W?); no dosimetry indicated].
3215. HOLT, J.A.G. (1974), Australasian Radiology, 18(1):15-17, (Mar.), "The cure of cancer: A preliminary hypothesis", [using microwave radiation therapy], and, ibid. 18(2):190 only, (June 1974), "Editorial hypotheses", [in lieu of the promised second article giving technical and clinical information].
2414. HOLZAPFEL, W. (1964), Disertation. Medical Academy, Düsseldorf, "Investigations for obtaining objective data on electrosleep".
635. HOLZER, W. (1934) (In German, with English Summary) Abstracts of the 1st Internat. Congress of Electro-Radio-Biology, (Capelli, L., ed., Bologna, Italy), pp. 367-368, "A spatial model for the thermic effects of electrical vibrations in therapy"
2182. HOOD, O. C., KESHISHIAN, J. M., SMITH, N. P. D., PODOLAK, E., HOFFMAN, A. A., & BAKER, N. R. (1972) Aerospace Med. 43(3):314-322, "Anti-hijacking efforts and cardiac pacemakers - Report of a clinical study" [using an external electromagnetic field (at 239 MHz) from a weapons detector]
2416. HOPFER, S. (1972), IEEE Transactions on Instrumentation and Measurement, IM-21(4):416-424, "The design of broad-band resistive (microwave) radiation probes".
636. HOPKINS, A. L. (1960) Annals of the New York Academy of Science 85 (vol?, page?), "Radio frequency spectroscopy of frozen biological material: dielectric heating and the study of bound water"

3127. HOPKINS, C.D. (1974), *American Scientist*, 62(4):426-437, (Jul.-Aug.), "Electric communication in fish: Certain species of fish produce electric signals that are used for identification, aggregation, and dispersal".
637. HORN, G. (1965) *Automaz. Automat.* 9:5-, (In Italian) "The passive electrical characteristics of biological systems"
638. HORNOWSKI, J. (1965) *Polski Tygodnik Lekarski (Warsaw)* 20:1906-1907, "Case of skin burns by microwaves"
2183. HORNOWSKI, J., & MARKS, E. (1964) *Neurological & Neurochirurgia Polska* 2:25-26, (In Pol.), (Abstr. #A68-81426), "Clinical observations concerning the effect of microwaves on the nervous system"
639. HORNOWSKI, J., MARKS, E., & CHMURKO, E. (1966) *Medycyna Pracy* 17:213-217, "Studies on the pathogenic effect of microwaves in men"
640. HORTEN, E. (1947) *Klinische Wochenschrift* 24-25(25/26):392-396, (In German), "The effect of electromagnetic short wave exposure of the midbrain on the vegetative functions of man"
641. HORVATH, S. M., MILLER, R. N., & HUTT, B. K. (1948) *Amer. J. of Medical Sciences* 215:430-436, "Heating of human tissues by microwave radiation"
642. HORVATH, S. M., MILLER, R. N., & HUTT, B. K. (1948) *Federation Proceedings* 7:58 only, "Heating of human muscle tissue by microwaves"
643. HOSHIKO, M. S. (1970) *Proc. 3rd Annual National Conf. of the Neuro-Electric Society*, "The nervous system and electric currents", (Wulfsohn, N. L., & Sances, A., Jr., eds.), (23-25 Mar., Las Vegas, Plenum Press, New York), pp. 85-88, "Electro-stimulation of hearing" [RF]
2418. HOUK, W.M. (1972), (Dept. of Rad. Biology & Biophysics, School of Med., U. of Rochester) Critical analysis of papers by Sadchikova, M., & Orlova, A. (1958-1960), (ref. #1386 & 1387, this Biblio.), entitled: "Changes in the nervous system as a result of exposure to microwaves".
2184. HOUK, W. (1972) Presented at Aerospace Medical Assoc. 43rd Ann. Meeting, 8-11 May, Bal Harbour, Fla., "Human responses to microwave irradiation - A review of and evaluation of published reports"
2846. HOUK, W.M. (1972), Unpublished report, School of Med. & Dent., U. of Rochester, NY, (Oct.) "Some considerations regarding the known biological effects of electromagnetic pulses, and the setting of standards".
2417. HOUK, W.M. (& MICHAELSON, S.M.) (1972), Thesis, Department of Radiation Biology and Biophysics, The University of Rochester, New York, 79 pps., "A critical evaluation of Soviet and East European literature on the human effects of microwave radiation in an occupational health environment".
2848. HOUK, W.M., & MICHAELSON, S.M. (1974), Presented at the Aerospace Medical Assoc. Meeting, Wash., DC, 6-9 May, "Metabolic and thermoregulatory responses to microwave radiation in young male rats".
- 2847. HOUK, W.M., MICHAELSON, S.M., & LONGACRE, A. Jr. (1973), *The Physiologist*, 16(3):347 only, (Abstract), "Thermal regulation in Long-Evans rats exposed to 2450 MHz microwave radiation."**
3216. HOWIND, H. (1974), *Archives of Physical Medicine & Rehabilitation*, 55(11):717-721, "Local blood flow after short-wave diathermy: Preliminary report"
644. HOWLAND, J. W., & MICHAELSON, S. M. (1959) *Digest of Technical Papers, Proc. 12th Annual Conf. on Electrical Techniques in Medicine and Biology*, 10-12 Nov., (Winnier, L., Pub.), New York, p. 40 only, "Biological effects of pulsed electromagnetic (2880 Mc) irradiation"
645. HOWLAND, J. W., & MICHAELSON, S. (1959) *Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments*, (Suskind, C., ed.), 3:191-238, (RADC-TN-59-99, AD 212110), "Studies on the biological effects of microwave irradiation of the dog and rabbit"
646. HOWLAND, J. W., & MICHAELSON, S. (1964) *Industrial Med. and Surgery* 33:500-, "The effect of microwave on the biological response to ionizing radiation"
2185. HOWLAND, J. W., & MICHAELSON, S. M. (1966) *Blood* 28:157-162, (Abstr. #A66-81394), "Leukocyte response following simultaneous ionizing and microwave (radar) irradiation"
2186. HOWLAND, J. W., MICHAELSON, S. M., & THOMSON, R. A. E. (1965) *Aerospace Medicine* 36:1059-1064, "Comparative studies on 1285 and 2800 Mc/sec pulsed microwaves" [does]
647. HOWLAND, J. W., MICHAELSON, S. M., THOMSON, R. A. E., & MERMAGEN, H. (1962) *Rept., Univ. of Rochester, RADC-IDR-62-102, (AD 274338), "The effects of microwaves on the response to ionizing radiation"*
648. HOWLAND, J. W., THOMSON, R. A. E., & MICHAELSON, S. M. (1961) *Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation*, Vol. 1 (Peyton, M. F., ed.) pp. 261-284, "Biomedical aspects of microwave irradiation of mammals"
649. HUBNER, J (1950) *Munchener Medizinische Wochenschrift* 92(37/38):1546 only, (In German), "Bedside ultrashort wave treatment"

2005. HUNTER, R. (1961) *Elektronmedizin* 6:193-209, (In German) "The biological effect of microwaves"
2006. HUNTER, R. (1962) *Schweizer Maschinenmarkt* 62:39-42, (In German) "The effect of powerful radar beams"
650. HULL, A., TIZARD, H., & LEDEN U. (1947) *British J. of Physical Med.* 10:177-184, "Preliminary studies on the healing and circulatory effects of microwaves (radar)"
651. HUNT, A. G. (1969) *Non-ionizing Rad.* 1(3):105-112, "Non-ionizing radiation: physical relationship between typical sources and human targets"
2849. HUNT, E.L., & PHILLIPS, R.D. (1971), In: Progress Report Abstracts, ONR Rept. ACR-175, Pages 70-71, Work Unit No. NR101-809, Contr. N00014-70-C-0197, Battelle-Northwest Laboratory, Richland, WA, "Effects of exposure to pulsed microwaves (radar) on central nervous system excitability in laboratory animals [Abstract]"
2850. HUNT, E.L., & PHILLIPS, R.D. (1971), In: Progress Report Abstracts, ONR Rept. ACR-175, pps. 72 & 73, Work Unit No. NR 101-811, Contr. N00014-70-C-0332, Battelle-Northwest Laboratory, Richland, WA, "Effects of microwave radiations on physiological and behavioral factors related to the performance capabilities of laboratory animals".
3217. HUNT, E.L., PHILLIPS, R.D., & KING, N.W. (1974), Final Rept. to Office of Naval Research, Contract No. N00014-70-C-0197, Battelle Memorial Inst., Pacific Northwest Laboratories, Richland, WA, (Pacific NW Lab Project No. 211800144), (Oct.), Approx. 52 pps., "Effects of exposure to pulsed microwaves (radar) on central nervous system excitability in laboratory animals".
2419. HUNYOR, S.N., NICKS, R., JONES, D., COLES, D., & HEATH, J. (1971), *Med. J. of Australia*, 2:653- . "Interference hazards with Australian non-competitive ('demand') pacemakers".
2851. HURT, W.D. (1972), USAF School of Aerospace Medicine, Rept. No. SAM-TR-72-36, (Aerospace Med. Division (AFSC), Brooks AFB, TX), (Dec.), "Cardiac pacemaker electromagnetic interference (3050 MHz)".
652. HUTT, B., MOORE, J., COLONNA, P., & HORVATH, S. (1952) *Amer. J. of Physical Med.* 31:422-428, "Influence of microwave irradiation on body temperature in dog and man"
653. HUTTON, C. C. (1962) Secret Report, AD 332918, "Biological effects of microwaves; an ASTIA report bibliography"
654. HUZZL, F., KLIMKOVA-DEUTSCHOVA, E., JANKOVA, J., MAINEROVA, J., SALCMANOVA, Z., SCHWARTZOVA, K., SUCHANOVA, L., & SYKORA, J. (1966) *Pracovni Lekarstvi, Prague*, 18(3):100-108, (ATD Abstr. A66-81307), "Examination of workers in the West Bohemia Region exposed to electromagnetic waves one meter and longer"
655. HYDE, A. S., & FRIEDMAN, J. J. (1968) In: *Thermal Problems in Aerospace Medicine*, (Hardy, J. D., ed.), The Advisory Group for Aerospace Research & Development, NATO, Technivision Services, Maidenhead, England, pp. 163-175, "Some effects of acute and chronic microwave irradiation of mice" (Abstr. A69-20678),
3218. HYMES, A.C., et al. (1973), *Surg. Forum*, 24( ):447-449, "Electrical surface stimulation for control of acute post-operative pain".
656. IAKOVLEVA, M. I. (1968) *Bulleten Eksperimental'noy Biologii Meditsiny* 66(9):9-11, (In Russian with English summary), "The study of efferent impulsion in post-ganglionic sympathetic fibers under the influence of a super-high frequency electromagnetic field" (Also cited as #1822, this Bibliography, as YAKOVLEVA)
657. IAKOVLEVA, M. I. (1968) *Zh. Evolutsionnoi Biokhimi i Fiziologii (Akademiya Nauk SSSR), Moscow*, 4(5):437-442, (In Russian with English summary), "The effect of ultrahigh frequency electromagnetic fields on regulation of the heart rate and respiration in birds"
2852. IAKOVLEVA, M.I. (1968), *Zh. Vysshei Nervnoi Deyatel'nosti imeni I.P. Pavlova, Moscow*, 18( ):418-424, (In Russ.), "The effect of ultra-high frequency electromagnetic fields on the conditioned reflex regulation of cardiac activity and respiration".
658. IAKOVLEVA, M. I., SHELIAFER, T. P., & TSVETKOVA, I. P. (1968) *Vysshei Nervnoi Deyatel'nosti imeni I p Pavlova, USSR*, 18(6):973-978, (In Russian with English abstract), "On conditioned cardiac reflexes and the functional and morphological state of the cortical neurons under the action of electromagnetic fields of superhigh frequencies" (Also cited as #1824)
3219. IASHINA, L.N. (1972), *Gig. Tr. Prof. Zabol.*, 16( ):53-56, (In Russ.), "Effect of a low-frequency impulse magnetic field on the activity of oxidation-reduction enzymes in albino rat liver: Histochemical study", [pulses of 300-900 Oe at 7 KHz, 130 usec for 3 hrs/day].
3488. IASHINA, L.N. (1972), *Gigiena Truda Professional'nye Zabolevania (Moskva)*, 16( ):53-56 (Feb.), (In Russian), "Effects of pulsed low-frequency magnetic field on activity of redox enzymes in the albino rat liver: Histochemical investigation."
659. IATSENKO, M. I. (1966) *Fiziologicheskii Zh. (Kiev)* 12:377-381, "Effect of microwaves on the absorptive capacity of the knee joint under the effect of atropine and carbocholine" (Also cited as #1831, this Bibliography, as YATSENKO)
660. IATSENKO, M. I. (1966) *Voprosy Kurortologii, Fizioterapii i Lachebnoy Fizicheskoy Kul'tury (Problems in Health Resort Science, Physiotherapy, and Medical Physical Culture)*, Moscow, 31:446-448, "The absorption capacity of the knee joint following severance of the femoral and sciatic nerves, and under the effect of microwaves"
2853. IATSENKO, M.I. (1970), *Vopr. Kurortol. Fizioter. Lech. Fiz. Kult.*, 35( ):420-430, (Sept.-Oct.), "Effect of an UHF electromagnetic field (microwaves) on the temperature and rate of blood flow in a joint".

661. IBERALL, A. S. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Suskind, C., ed.), 3:136-160, "Human body as an inconstant heat source and its relation to clothes insulation: 1. Descriptive models of heat source, 2. Experimental investigation into the dynamics of the source"
2854. IIDA, H., KO, S., MIYASHITA, Y., SAWEDA, S., MAEDA, M., NAGAYAMA, H., KAWAI, A., & KITAMURA, S. (1956), J. of Kyoto Pref. Med. Univ., 60( ):561-564, "On electric callus produced by alternating current"
2083. IIZUKA, K. (1967) Report (AD 667729) Avail. from DDC Clearing House, "Photographing microwave fields"
2187. IKEDA, H. (1966) Nippon Acta Radiol. 26:284-288, (A67-81094), "Studies on biological effects of microwave radiation (second report). Investigation of shielding effect of concrete, Lavan, and glass against microwave radiation"
3489. IL'CHEVICH, N.V., & GORODETSKAYA, S.F. (1975), Gigiyena Naselennykh Mest, (14):92-94, (In Russian). Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #L/5615), 10 Feb. 1976, pp. 5-7, "Effect of the chronic application of electromagnetic microwave fields on the function and morphology of the reproductive organs of animals."
662. IL'IN, B. I., & KOBOL'EV, V. G. (1964) Voprosy Kurortologii, Fizioterapii i Lechebnoy Fizicheskoy Kul'tury (Problems in Health Resort Science, Physiotherapy, and Medical Physical Culture), Moscow, 29(2):172-, (JPRS 25121, pp. 20-21; OTS-64-31500), "Treatment of pedal hyperhidrosis with a UHF field"
663. ILLINGER, K. H. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 112-115, "Molecular mechanisms for microwave absorption in biological systems"
664. IMIG, C. J., & SEARLE, G. W. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G., & Banghart, F. W., eds.) 2:242-253, "Review of the work conducted at State Univ. of Iowa"
665. IMIG, C. J., & SEARLE, G. W. (1959) In: Investigators' Conf. on Biological Effects of Electronic Radiating Equipments, held at Patrick Air Force Base, Florida, 14-15 Jan. (RADC-TR-59-67, Proj. 5545, pp. 3-5; AD #214693), "Report from State Univ. of Iowa, Dept. of Physiology"
666. IMIG, C. J., & SEARLE, G. W. (1962) Report, RADC TDR-62-358, AD 287160, 188 pages, "Review of work conducted at State Univ. of Iowa"; "Studies on organisms exposed to 2450 mc cw microwave irradiation"
667. IMIG, C. J., THOMSON, J. D., & HINES, H. M. (1948) Proc. of the Society for Experimental Biology and Medicine 69(2): 382-386, "Testicular degeneration as a result of microwave irradiation"
668. INGALLS, C. E. (1966) Report from Interference Consultants, Inc. (Preprint of paper, New York J. of Med. 67:7992-2997 (1967)), "The sensation of hearing in electromagnetic fields"
2420. INGELMAN-SUNDBERG, A., & ODEBLAD, E. (1965), Amer. J. of Obstet. & Gynec., 92:592-600, "Attempts to localize a carcinoma of the endometrium with the use of short radio waves"
2188. INGLIS, L. P. (1969) In: Record, 11th Electromagnetic Compatibility Symposium, Inst. of Electrical and Electronics Engineers, Asbury Park, N. J., pp. 7-11, (Abstr. #A69-42216), "The compatibility of man in the microwave environment" [human responses; thermal & nonthermal effects, eye damage, & information storage]
2189. INGLIS, L. P. (1970) In: IEEE Record of Internat. Sympos. on Electromagnetic Compatibility, Anaheim, Calif., pp. 168-172, (Abstr. #A71-38442), "Why the double standard? - A critical review of Russian work on the hazards of microwave radiation"
2855. INGRAM, M., & PAGE, L.J. (1953), Proc. of the Soc. of Applied Bacteriology, 16( ):69-, "The survival of microbes in modulated high-frequency voltage fields"
669. INMAN, E. A. (1970) NASA, Marshall Space Flight Center, Huntsville, Ala., (N70-33065, NASA-TM-X-64523), "RF radiation hazards to space station personnel"
670. IRISOVA, H. A. (1968) Vestnik Akademii Nauk SSSR (10):63-71, (In Russian), "Experimental techniques of submillimeter wave measurements"
2190. IRWIN, D. D., RUSH, S., EVERING, R., LEPESCHIN, E., MONTGOMERY, D. B., & WEGGEL, R. J. (1970) IEEE Trans. on Magnetics, MAG-6(2):321-322, "Stimulation of cardiac muscle by a time-varying magnetic field"
2421. ISKANDER, M.F., & STUCHLY, S.S. (1972), IEEE Trans. on Instrumentation and Measurement, IM-21(4):425-429, "A time-domain technique for measurement of the dielectric properties of biological substances", [At RF and microwave frequencies]
671. ISMAILOV, E. SH. (1966) Vestnik Leningradskogo Universiteta Seriya Biologiya 2(9):147-149, "Effect of microwaves on *Opalina ranarum*"
3220. ISMAILOV, E. Sh. (1971), Nauchnyye Doklady Vyshey Shkoly; Biologicheskiye Nauky, (3):pp ?, [Transl. in "Effect of nonionizing electromagnetic radiation", JPRS #62462, July 1974, Citation #3134 this Biblio., pps. 45-7], "The effect of microwaves on erythrocyte potassium and sodium ion permeability"
2422. ISMAILOV, E. Sh. (Daghestan State U., USSR), (1972), Abstr. of Fourth Internat. Cong. of the Internat. Union for Pure and Applied Biophysics, Moscow. (Aug.), p.434-435, "Changes of red cell membrane permeability under the action of microwaves, and their mechanisms", [Studies on human red cells led to conclusion that microwave radiation suppresses active transport, and increases the diffusion rate of K<sup>+</sup> and Na<sup>+</sup>, and from studies of urea "intrusion", increase the effective pore volume of the membrane. The change in cell membrane permeability is linked to a breakdown of the water structure within the membrane].

3490. ISRAEL, H., & KASEMIR, H.W. (1951), *Annales de Geophysique*, 7( ):63-68, (in German), "The shielding effect of buildings on the changes of the atmospheric electrical field."
672. IVANOV, A. I. (1962) In: *Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad*. pp. 24-26, "Changes of phagocytic activity and mobility of neutrophils under the influence of microwave fields"
673. IVANOV, V. I., et al. (1957) In: *Summaries of reports, Part 2, Jubilee Scientific Session of the Institute of Labor Hygiene and Occupational Diseases. Dedicated to the 40th Anniv. of the Great October Socialist Revolution, Moscow*, pp. 52-53, "Biochemical changes in the blood under the chronic influence of radiation"
2423. IVANOV-MUROMSKIY, K.A. (1966), In: *Conference on Effects of Diffuse Electrical Currents on Physiological Mechanisms with Application to Electroanesthesia and Electro-sleep*, Vol. 4, Milwaukee, "Physiological mechanisms of electroanesthesia".
2424. IVANOV-MUROMSKIY, K.A. (1966), Kiyev, *Naukova dumka*, 221 p. (In Russ.), (JPRS 42,233), "Electrical anesthesia and electro-sleep of man and animals".
674. IWAI, Y. (1965) Editor, *Digest of the 6th Internat. Conf. on Medical Electronics and Biological Engineering*, (Tokyo, 22-27 Aug.) (Chairman of Program and Publication of the Organizing Committee), Okumura Printing Co., Tokyo
2425. IWANOVSKY, A., & DODGE, C.H. (1968), *Foreign Service Bulletin*, FSB-4(3):1-64, Aerospace Technology Division, Library of Congress, "Electro-sleep and electroanesthesia — theory and clinical experience".
675. IZAR, G., & MORETTI, P. (1933) *Riforma Medica* 49:1611-, (In Italian), "On the biological action of short electromagnetic waves; Note 7. Action on enzymes"
676. JACKSON, A. S. (1935) *Arch. of Physical Therapy* 16:342-344, "Physical therapy in general surgery"
3491. JACKSON, S.J. (1975), National Library of Medicine (Bethesda, MD) Literature Search No. 75-19 for the period Jan. 1973 - Oct. 1975, 94 citations, "[Biological] Effects of microwave radiation."
677. JACKSON, W. (1946) *Trans. of the Parady Society* 42A:91-, "The representation of dielectric properties and the principles underlying their measurements at centimeter wavelengths"
2191. JACOBS, S. E., THORNTLEY, M. J., & MAURICE, P. (1950) *Proc. of the Soc. for Applied Bacteriology* \_\_ (2):161-169, "The survival of bacteria in high-frequency electric fields"
681. JACOBSEN, V. C., & HOSOL, K. (1931) *Arch. of Pathology* 11:744-759, "Morphological changes in animal tissues due to heating by UHF oscillators"
678. JACOBSON, B. (1967) Editor, *Organizing Committee for the 7th Internat. Conf. on Medical and Biological Engineering*, Stockholm, 14-19 Aug.
679. JACOBSON, B. S., PRAUSNITZ, S. B., & SUSSKIND, C. (1959) *Institute of Radio Engineers Trans. on Medical Electronics* :p.?, "Investigation of thermal balance in mammals by means of microwave radiation"
680. JACOBSON, B. S., & SUSSKIND, C. Z. (1958) *Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy* (Pattishall, E. G., & Banghart, F. W., eds.) 2:234-241, "Review of the work conducted at Univ. of California; Effects of microwave irradiation on internal temperature and viability in mice"
2856. JACOMB, R.P. (1971?), Rept., Carnarvon Tracking Station, Western Australia, "A partial listing of references on the biological effects of microwave radiation and magnetic fields".
2857. JAGADEESH, P., NEWMAN, P.P., HARRIMAN, D.G.F., & WILSON, D.H. (1972?), *Annals of the Assoc. for the Advancement of Med. Instrumentation*, \_\_ ( ): , "Effects of a non-thermal, pulsed electromagnetic field on the regeneration of peripheral nerves in rats", [electrophysiological studies showed resumption of (median-ulnar) nerve conduction 8 days following surgery in treated animals].
2426. JANES, D.E., HANKIN, N.N., TELL, R.A., & CHRISTIAN, J.G. (1972), Environmental Protection Agency, Office of Radiation Programs Rept., 69 pps., "Radiofrequency and microwave radiation program".
682. JANES, D. E., LEACH, W. M., MILLS, W. A., MOORE, R. T., & SHORE, M. L. (1968) *Radiation Bio-Effects*, (Hodge, D. M., ed.), Report, U. S. Dept. of Health, Education and Welfare, Bureau of Radiological Health, pp. 89-93, "Effects of microwave radiation on Chinese hamsters"
2084. JANES, D. E., LEACH, W. M., MILLS, W. A., MOORE, R. T., & SHORE, M. L. (1969) *Non-ionizing Rad.* 1(3):125-130, "Effects of 2450 MHz microwaves on protein synthesis and on chromosomes in Chinese hamsters"
2427. JANKOVICH, J.P. (1971), Rept., Naval Ammunition Depot, Crane, Indiana, RDTR No. 187, 36 pages, (AD #730105), "Effects of low intensity microwaves on performance".
2428. JANKOWSKI, W., & MEYER, J. (1972), *Patologia Polska*, 23(2):263-268, (In Pol. with Engl. summary), "Patho-mechanism of crust formation in burn wounds of the skin in rats following primary or secondary microwave irradiation". [80 mw, 2980 MHz, pulses used].

757. KINOSHITA, H. (1963) J. of the Faculty of Science, Tokyo Univ., 4:137-, "Electrical stimulation of paramecium"
758. KINOSHITA, H. (1964) J. of the Faculty of Science, Tokyo Univ., 7:1-, "Electrical potentials and ciliary response in Opalina"
759. KINOSHITA, J. H. (1966) Documenta Ophthalmologica, Netherlands, 20:91-103, "Biochemical changes in microwave cataracts"  
Verolia, L.O., DEKONK, E., & Carpenter, R. L.
760. KIRCHEV, K. K. (1937) Moskovskaja oblastnaja klinika fizicheskikh metodov lechenia. Trudy, Moscow, 3:217-, "Influence of UHF electrical fields (6.5 m) on the blood vessels of the isolated rabbit's heart"
761. KIRCHEV, K. K. (1937) Trudy III vses. siesda fizioterap., Kiev, pp. 245-, "On the problem of the influence of ultra short-waves on blood vessels in the rabbit"
762. KIRCHEV, K. K., et al. (1962) Proc. of the 5th Internat. Biochemical Congress, Section 14-28, "Biochemical changes in the muscles and blood of white rats due to microwaves"  
(EFTIMOV, , & GEREAEV, )
3509. KISELEV, R.I., & ZALYUBOVSKAYA, N.P. (1975) Voprosy Virusologii, (5):617-620, (in Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation"(JPRS #L/5615), 10 Feb. 1976, pp. 71-76, "Study of the inhibiting effect of superhigh frequency millimeter waves on adenovirus."
763. KITSOVSKAYA, I. A. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, "Changes in the higher nervous activity of rats exposed to chronic effects of radio frequency (centimeter) waves"
764. KITSOVSKAYA, I. A. (1960) Trudy Nii Gigiyena Truda i ProfzabolevaniyaAMN SSR, (1):75-80 (Also in: The Biological Action of Superhigh Frequencies, Letavet, A. A., & Gordon, Z. V., (eds.), (1960), Moscow, JPRS 12471, pp. 75-82; Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt. P-65-17, Apr. 1965), "Investigation of the interrelationships between the basic neural processes in rats under the influence of SHF-UHF of various intensities"
765. KITSOVSKAYA, I. A. (1964) Gigiyena Truda i Professional'nyye Zabolevaniya (Moskva) 8(6):14-19, (JPRS 31047, N65-28357, TT-65-31543), "The effect of centimeter waves of varying intensity on the blood and hemopoietic organs of white rats"
766. KITSOVSKAYA, I. A. (1964) Trudy Nii Gigiyena Truda i ProfzabolevaniyaAMN SSSR, (2):39-42, (In: The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V., (eds.), (1960), Moscow, JPRS 12471), "Comparative evaluation of the action of microwaves of various wavelengths on the nervous system of rats susceptible to sound stimulus"
3234. KLAINER, S.M., ARDEN, W., & HIRSCHFELD, T. (1974), final Rept. to Brooks Air Force Base under Contract F40609-73-C-0024, by Block Engineering Inc., (19 Blackstone Street, Cambridge, MA 02139), (Jan.), AD # \_\_\_\_\_, "The detection of RF damage to biological molecules using Raman spectroscopy".
767. KLASCIUS, A.F. (1971), Jet Propulsion Lab. Rept. (8 pages), [Evaluation of the Navy's] "Microwave radiation protective suit." (Also: Amer. Indust. Hygiene Assoc. J., 32(11):771-774 (Nov.))
2872. KLASCIUS, A. (1973), Amer. Industrial Hygiene Assoc. J., 34(3):97-101, (Mar.), "Microwave radiation hazards around large microwave antenna."
3235. KLEINER, A.A. (1974), Gig. Tr. Prof. Zabol., (2):15-18, (In Russ.), "Gastrointestinal function in workers exposed to the effects of electromagnetic fields in the ultrahigh frequency range". [At 5 to 10 times the max. permissible Russ. levels (for up to 10 years), disturbances of the nervous and cardiovascular system, "gastrointestinal disease", and altered liver function (among other changes) were noted in occupationally exposed workers.]
3510. KLEYNER, A.I. (1974), Gigiyena Truda i Professional'nyye Zabolevaniya, (2):15-18, (in Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation"(JPRS #66512), (7 Jan. 1976), pp. 87-89, "Digestive system in workers exposed to the effects of UHF electromagnetic fields."
3511. KLEYNER, A.I., ABRAMOVICH-POLYAKOV, D.K., MAKOTCHENKO, V.M., & others (1975), Vrachebnoye Delo, ( ):133-137, (in Russian), Transl. as JPRS #66434, 22 Dec 75, "Clinical aspects of the effect of metric range electromagnetic fields."
3512. KLIMOV, B.N., IVANCHENKO, V.A., PIS'MENNYI, B.S., KRASNIIKOV, V.V., SEMENOV, V.I., & NAUMENKO, G.Yu. (1975), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation"(JPRS #64532), p. 52 only, "Utilizing nonlinear properties of semiconductors which show up on strong electric fields for detecting emission in the millimeter and submillimeter bands."
768. KLIMKOVA-DEUTSCHOVA, E. (1963) In: Transl. of Czechoslovakian Neurology, 26(3):184-189, (FTD-TT-64-267, pp. 22-, Aug. 1964; AD #450604), "Effect of (microwave) radiation on human EEG"
769. KLIMKOVA-DEUTSCHOVA, E., & ROTH, B. (1963) Electroencephalography and Clinical Neurophysiology 15(1):170 only, (Abstr. 17 of Meeting of Czech EEG Commission, BRNO, CZECH REPUBLIC, June 1962), "The influence of a high frequency electromagnetic field on the human EEG"
770. KLIMKOVA-DEUTSCHOVA, E., & ROTH, B. (1963) International Archiv Gewerbepathol Gewerbehyg 20(1):1-10, "The effect of electromagnetic waves on the nervous system - an electroencephalographic study"
771. KLIMKOVA-DEUTSCHOVA, E., & ROTH, B. (1963) Chekchoslovatskoe Meditsinskoe Obozrenie 9:254-, "The effect of radiation on the human encephalogram"
3513. KLIMOVSKAYA, L.D., & SMIRNOVA, N.P. (1975), Space Biology and Aerospace Medicine, 9(3):18-22, (JPRS #65301), "Some autonomic reactions in rabbits exposed to a permanent magnetic field."
772. KLING, D. H. (1935) Arch. of Physical Therapy 16:88-95, "Results of short wave and ultrashort wave therapy (radiatherapy)"

773. KNAUF, G. M. (1957) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.) 1:34-46, "Program for the investigation of the biological effects of electromagnetic radiation at the Rome Air Development Center"; Also, Appendix A, pp. 89-93, "Investigation of the biological effects of electromagnetic radiation; status report"
774. KNAUF, G. M. (1958) Proc. Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G., & Banghart, F. W., eds.) 2:3-8, "Outline and purpose of meeting"; Also, pp. 49-53, (AD 131477, July 1958), "New concepts in personnel protection"; also, pp. 124-125, "Review of the biological effects program (abstract)"
775. KNAUF, G. M. (1958) AMA Arch. of Industrial Health 17:48-52, (Presented at 106th Annual AMA meeting, New York City, June 1957), "The biological effects of microwave radiation on Air Force personnel"; and *ibid.* 17:383-388, "Industrial medical problems in an electronic research center"
776. KNAUF, G. M. (1959) (Chairman), Technical Report, Investigators' Conf. on Biological Effects of Electronic Radiating Equipments (held at Patrick Air Force Base, Florida, Jan.), (RADG-TR-59-67, AD 214693, July 1959, 45 pages)
777. KNAUF, G. M. (1959) Digest of Tech. Papers, Proc. of the 12th Annual Conf. on Electrical Techniques in Medicine and Biology (Schwan, H. P., ed.), p. 34 only, "Biological effects of microwave radiation: A research progress report"
778. KNAUF, G. M. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1 (Peyton, M. F., ed.), pp. 9-12, "Chairman's remarks"
779. KNAUF, G. M. (1960) Amer. J. of Public Health 50(3):364-367, "Microwave exposure and missile propellants as occupational health problems"
780. KNAUF, G. M. (1960) Aerospace Med. 31(3):225-228, "The bio-effects of radar energy"
781. KNAUF, G. M., & SPENCER, J. L. (1957) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.) 1(Appendix B):94-103, (AD 115603, RADG-TR-58-51), "Bibliography of biological effects of radio frequency energies, 1940-1957"
782. KNAUS, H. (1940) Minerva Medica 31:322-323, "Thermal sensitivity of testes and spermatozoa"
783. KNICKERBOCKER, G. G., KOUWENHOVEN, W. B., & BARNES, H. C. (1967) IEEE Trans. on Power Apparatus and Systems 86(4):498-505, "Exposure of mice to a strong AC electric field: An experimental study"
784. KNORRE, K. G. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, p. 22 only, Title?
785. KNORRE, K. G. (1960) Trudy Riĭ Gigiyena Truda i Profzaboleaniĭ AMN SSSR, (1):11-21, (Also in: The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V., (eds.), Moscow, JPRS 912471, (562-11902, TT-62-19175), "Parameters of SHF-UHF fields determining the hygienic evaluation of working conditions and the problems of their measurement"
786. KNORRE, K. G. (1963) Referativnyy Zh., Elektronika i Yeye primeneniye, (3):11-21, (Also in: The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V. (eds.), Moscow, JPRS 12471, pp. 5-17), "Parameters of UHF fields determining the hygienic evaluation of working conditions and the problems of their measurement"
787. KNORRE, K. G., & BELITSKIY, B. M. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, p. 36 only, Title?
788. KNORRE, K. G., & GORDON, Z. V. (1960) In: Elektronika V Meditsine, Berg, A. I., (ed.), Moscow - Leningrad, pp. 374-382, "Methods of measuring SHF-UHF field parameters which determine the hygienic estimate of labor conditions during work with generators"
789. KNUDSON, A., & SCHAIBLE, P. J. (1929) Abstr. of Communications to the XIIIth Internat. Physiological Congress, held in Boston, Aug., pp. 147-148, "Chemical changes in the body resulting from exposure to UHF field. I. Blood chemical findings in the dog. II. Acid base balance in the plasma of dogs"
2011. KNUDSON, A., & SCHAIBLE, P. F. (1931) Arch. of Path. 11:728-743, "Physiological and biochemical changes resulting from exposure to an ultrahigh-frequency field"
2437. KNUDSON, R.C., HAGFORS, N.R., & MATTHEWS, J.H. (1966), In: First International Symposium on Electrotherapeutic Sleep and Electroanesthesia, Graz, Austria, (12-17 Sept.), "The effect of various electrodes and electrode placements upon the EEG's of dogs during electroanesthesia"
2201. KUBITSON, J. (1969) Iowa Acad. of Sci. 26:510-516, "The effect of an electromagnetic field on early embryogenesis in quail"
790. KOBAK, D. (1935) Arch. of Physical Therapy 16:171-173, (Editorial), "Priority in short wave therapy"; Also, *ibid.* 16:430-431, (Editorial), "Urologic electrosurgery"
791. KOCHERGA, D. O. (1940) Universitet. Instytut fiziologii, Sbornik statei, Dnepropetrovsk, (3): page?, "The effect of SHF-UHF fields on spinal cord functions"
2873. KOCK, W.E. (1959), Proc. of the Inst. of Radio Engineers, 47( ) :1192-1201, "Related experiments with sound waves and electromagnetic waves".
2874. KOCK, W.E., & HARVEY, F.K. (1951), Bell System Technical J., 30( ) :564-587, "A photographic method for displaying sound wave and microwave space patterns".

3514. KOENIG, H., & ANKERMUELLER, F. (1960) Die Naturwissenschaften, 47( ):486-490, (in German), "The effect on man of extremely low frequency electrical processes in the atmosphere."
3236. KOGAN, A.B., SACHAVA, T.S., DOROZHKINA, L.I., PAVELKO, V.M., & GOL'TSEVA, I.N. (1971), (In: KHGLODOV, Yu.A. (ed.), Influence of Magnetic Fields on Biological Objects, pp. 51-64, "The mechanism of biological effects of a constant magnetic field". [Citation #3230, this Biblio.]
792. KOGAN, A. B., & TKHONOVA, N. A. (1965) Biofizika 10(2):292-295, "The effect of a constant magnetic field on the movement of paramecia"
2012. KOHLER, F. P., & MACKINNEY, C. C. (1955) J. of the Amer. Medical Assoc. 193:855-, "Cardiac pacemakers in electrosurgery"
793. KOIWA, M. (1939) Tohoku J. of Experimental Medicine 37:202-215, (In German) "Influence of short wave irradiation on the glomerular filtration and the tubular resorption in the normal and in the denervated kidney"
794. KOKHANOVICH, N. P. (1941) Fizioterapia, Moskva, 3-4:47-49, (In Russian), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt. P-65-17, Apr. 1955), Title? [Irradiation of dogs with UHF radiation]
2875. KOLDAEV, V.M. (1970), Biull. Eksp. Biol. & Med., 70( ):69-70, (Nov.), (In Russ.), "Effect of UHF electromagnetic fields on rats during changes in the rate of oxidative processes in the organism".
3237. KOLDAEV, V.M. (1971), Vopr. Kurortol. Fizioter. Lech. Fiz. Kult., 36( ):246-248, (In Russ.), "Effect of antioxidants on protein metabolism [in rats] after microwave irradiation", [at a level of 150 mw/cm<sup>2</sup>].
2438. KOLDAEV, V.M. (1972), Farmakologiya i Toksikologiya, 35:505-507, (Jul.), (In Russ.), "Use of chemical substances during UHF electromagnetic irradiation: A review of the literature".
2439. KOLDAEV, V.M. (1972), Patologicheskaya Fiziolgiya i Eksperimental'naya Terapiya, 16:7]-73, (Mar-Apr), (In Russ., with Engl. summary), "Effect of microwaves on rats subjected to the action of gaseous media with an altered content of oxygen and chemical agents of antioxidant action". [Studies of the resistance to 150 mw/cm<sup>2</sup> irradiation at 2400 MHz during inhalation of various gas mixtures; comments on muscle redox potential, and alteration of life span].
2876. KOLDAEV, V.M. (1973), Biull. Eksp. Biol. & Med., 76(9):27-28, (Sept.), (In Russ., w/Eng. Summary), "The effect of stimulators of the central nervous system and of the adrenal hormones on the outcome of acute irradiation of mice with super high frequency field." [Survival of irradiated (wave length 12.5 cm, 62 ± 5 mw/cm<sup>2</sup>, 16 min. exposure) albino mice doubled for hydrocortisone-treated animals, and was 3/2 times greater for noradrenalin and strychnine administration.]
2877. KOLDAEV, V.M. (1974), Biull. Eksp. Biol. & Med., 77(3):79-31, (In Russ., w/Eng. summary), "The effect of ephedrine and cordiamine on the outcome of microwave exposure of mice", [Chronic as well as acute extension of 1973 paper; survival increased for pre-treatment with cordiamine; no positive effect noted with ephedrine].
3515. KOLDAEV, V.M. (1975), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation"(JPRS #64532), pp. 42-45, "The effects of ephedrine and nikethamide on microwave-exposed mice."
2878. KOLESNIK, F.A., & KOMGORTSEVA, N.A. (1973), Voeno. Med. Zh., 3(3):63-64, (Mar.), (In Russ.), "Change in the quantity of total sulphhydryl groups in the blood of persons in contact with UHF radiation generators."
795. KOLESNIK, F. A., & MALYSHEV, V. M. (1967) Voennno-meditsinskiy Zh. (USSR Military Medical J.) 2(2):28-29, ACSJ J2103), "Nomenclature of disorders caused by electromagnetic waves of ultrahigh frequency"
796. KOLESNIK, F. A., & MALYSHEV, V. M. (1967) Voennno-meditsinskiy Zh. (USSR Military Medical J.) 4(4):21-23, (Abstr. in: Soviet Radiobiology, ATD #68-105-108-9, June 1968, pp. 77-78; AD #671436), "The problem of clinical observation of injuries caused by SHF electromagnetic fields"
797. KOLESNIK, F. A., MALYSHEV, V. M., & MURASHEV, B. F. (1967) Voennno-meditsinskiy Zh. (USSR Military Medical J.) 7(7):39-41, (Abstr. in: Soviet Radiobiology, ATD 68-105-108-9, June 1968, pp. 78-79; AD 671436), "Disturbances of the endocrine system by chronic action of a super-high-frequency microwave field"
798. KOLESNIKOV, V. M. (1969) Izvestiya Vysshikh Uchebnykh Zavedeniy, Priborostroyeniye, Russ., 12(7):9-12, (JPRS 49239), "New measurement techniques in studying the effect of superhigh frequency fields on biological subjects"
799. KOLIN, A. (1959) Proc. of the 1st National Biophysics Conf., 1:125-137, "Sorting of macromolecules and micro-organisms by means of electromagnetic and electrokinetic phenomenon"
800. KOLIN, A. (1968) Physics Today 19:39-50 (Nov.), "Magnetic fields in biology"
801. KOLIN, A. (1969) Final report, May 1960 - Aug. 1969. Univ. of Los Angeles, Calif. (NONR 233-(64), NR 136-505), "Electromagnetic separation of biological particles"
3516. KOLIN, A., BRILL, N.Q., & BROBERG, P.J. (1959), Proc. Soc. Exp. Biol. & Med., 102( ):251-252, "Stimulation of irritable tissues by means of an alternating magnetic field."
2879. KOLIUKH, G.D., et al. (1971), Gig. Sanit., 36( ):113-114, (Nov.), (In Russ.), "Experimental unit for studying the biological effect of electromagnetic impulse fields (IEMP)".

2880. KOLODUB, F.A., & EVTUSHENKO\* H.I. (1972), *Ukrains'kyi Biokhimichnyi Zhurnal* (Kiev), 44( ):307-311, (In Russ., w/Eng. summary), "Characteristics of nitrogen metabolism [NH<sub>2</sub> formation and removal] in the rat brain under the action of a low frequency [7 KHz] pulsed electromagnetic field." (\* or YEVTUSHENKO)
2881. KOLODUB, F.A., & EVTUSHENKO\* H.I. (1972), *Ukrains'kyi Biokhimichnyi Zhurnal* (Kiev), 44(4):492-496, (In Russ., w/Eng. abstr.), "Peculiarities of carbohydrate energy metabolism in rat brain under the effect of pulsed electromagnetic ffields of low frequency." [7 KHz] (\* or YEVTUSHENKO)
3518. KOLODUB, F.A., & YEVTUSHENKO, G.I. (1972), *Gigiena Truda i Professional'nyye Zabolevaniya*, \_\_ (6): \_\_, (Moscow), (in Russian), (Engl. transl. as JPRS #56583 (1972)), "Biochemical aspects of the biological effect of a low-frequency pulsed electromagnetic field."
3517. KOLODUB, F.A., & YEVTUSHENKO, G.I. (1972), *Vrachebnoe Delo Nauchnyi Meditsinskii Zhurnal*, 6( ):131-134, (in Russian), "Significance of some biochemical blood indices in early detection of lesions due to pulsed low-frequency electromagnetic fields."
3238. KOLODUB, F.A., & YEVTUSHENKO, G.I. (1972), *Vrachebnoye Delo*, \_\_ ( ):131-134, (June 6), (In Russ.), "Significance of some biochemical blood indices in early detection of lesions due to pulsed low-frequency electromagnetic fields", [experiments with rats chronically exposed to 7 KHz radiation with pulses of 130 msec, 10 sec. between pulses].
3239. KOLODUB, F.A., & YEVTUSHENKO, G.I. (1973), *Ukrains'kyi Biokhimichnyi Zhurnal*, \_\_ (3):356-361, [Trans. in "Effect of non-ionizing electromagnetic radiation, JPRS No. 62462, July 1974, (citation #3134, this Biblio.), pp. 6-13], "The effects of low frequency electromagnetic field pulses on skeletal muscle metabolism in the rat", [marked decrease in conc. of creatine phosphate].
3519. KOLODUB, F.A., & YEVTUSHENKO, G.I. (1974), *Gigiyena Truda i Professional'nyye Zabolevaniya*, \_\_ (2):11-15, (in Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #66512), (7 Jan. 1976), pp. 83-86, "Metabolic disorders and the liver function under the effect of a low-frequency pulsed electromagnetic field."
3240. KOLTA, P. (1973), *Acta Physiologica Academiae Scientiarum Hungaricae*, Tomus, 43(1):89-94, "Strong and permanent interaction between peripheral nerve and a constant inhomogeneous [static] magnetic field [of 580 Oe]".
802. KOMAROVA, L. A. (1967) *Voprosy Kurortologii Fizioterapii i Lechebnoi Fizicheskoi Kulturi* \_\_ (1):9-13, "Mechanism of action of superhigh frequency magnetic fields (microwaves)"
2882. KOMAROVA, L.A. (1968), *Vop. Kurort. Fizioter.*, 33( ):503-506, (In Russ.), "Changes in arterial pressure and external respiration of animals when subjected to an ultra-high frequency electromagnetic field (microwaves)".
803. KONCHALOVSKAYA, N. H., KHMARA, S. N., & GLOTOVA, K. V. (1964) *Trudy Nii Gigiyena Truda i Profzaboleaniy AMN SSSR*, \_\_ (2):114-118, (Abstr. in: *The Biological Action of Ultrahigh Frequencies*, Letavet, A. A., & Gordon, Z. V., (eds.), Moscow, JPRS 12471), "Condition of the cardiovascular system under the action of radio waves of various ranges"
3241. KONDRA, P.A. (1973), *Canadian J. of Animal Science*, 53(4):771, "Effects of microwaves on chickens".
2440. KONDRASHENKO, V.T., ONDZULIS, P.A., & KORPS, Ya.K. (1963), In: *Grenzach-Baden, Deutsche Hoffman - La Roche AG*, pp. 251-254, "A new method of electrosleep therapy".
3520. KONIG, H. (1971), *J. Interdiscipl. Cycle Res.*, 2(3):317-323, "Biological effects of extremely low frequency electrical phenomena in the atmosphere."
3521. KONIG, H.L. (1962), *Zeitschrift für angewandte Bader und Klimaheilkunde*, 9(5):481-501, (in German), (Transl: Air Force Cambridge Research Laboratories AF19(628)-3880, Jan. 1965, T-G-232), "Environmental effects of atmospheric electric processes of very low frequency."
804. KONIN, P. M., FRANKE, V. A., et al. (1960) In: *Elektronika v Meditsine*, Berg, A. I., (ed.), Moscow, Leningrad, (FTD-TT-63-1200, AD 600581), pp. 383-392, "Electronics and industrial safety"
2202. KORAVALTHERO, V. A., & YANSHANOV, V. A. (1971) *Biophysica* 16(2):265-269, (In Russ.), "Dielectric parameters of human blood serum in the range of 1-30 "cvc/sec"
805. KORBEL, S. (1966) Report, 4 pages, "Behavioral effects of ultrahigh frequency radio waves: abstracts"
806. KORBEL, S. F. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 180-184, "Behavioral effects of low intensity UHF radiation"
807. KORBEL, S. F., & PINE, H. L. (1967) *Psychonomic Science* 9(9):527-528, "Effects of low intensity UHF radio fields as a function of frequency"
808. KORBEL, S., & THOMPSON, W. D. (1965) *Psychological Reports* 17:595-602, "Behavioral effects of stimulation by UHF radio fields"
809. KORENEVA, L. G., & GAIDUK, V. I. (1970) *Doklady Akad. Nauk, USSR*, 193(2):465-468, "Resonance effects in hemoglobin resulting from irradiation with SHF electromagnetic waves are, in principle, possible"

3242. KOREPANOV, A.M. (1971), Vopr. Kurortol. Fizioter. Lech. Fiz. Kult., 36( ):340-343, (In Russ.), "Effect of inducto-thermy [HF] on pancreatic function".
3243. KOREPANOV, A.M., & BAZHENOVA, R.V. (1973), Kazan. Med. Zh., (6):79-80, (In Russ.), "Effect of electromagnetic fields [UHF or HF (13.56 MHz)] and paraffin applications on pancreatic secretion [increased]".
810. KORNER, H. J. (1967) Zentralblatt für Arbeitsmedizin und Arbeitsschutz (Frankfort am Main), 17:(12 pages), "Potential radiation hazard in radar installations"
811. KORSUN, G. S., & MIKHAYLOV, G. V. (1956) Voenno-meditsinskoy Zh. (9):32-36 ( Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD-P-65-68, Sept. 1965, pp. 4-5, "Clinical examination of radar-set operators"; also abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD-P-65-17, Apr. 1965), "Some problems concerning the physiological and clinical evaluation of people working on UHF generators"
812. KORTELING, G. J., & BACH, S. A. (1964) Report No. 548, U. S. Army Medical Research Laboratory, Ft. Knox, Kentucky, (AD 443679), 14 pages, "Activity changes in alpha-amylase solutions following their exposure to radio-frequency energy"
2441. KORTING, G.W. (1970), Med Welt, 30:1359-1360, (In Germ.), (Abstr in: Biological Abstracts 52(11):6399, No.63803 (June 1, 1971)), "A report about two acute cases of physical skin damage", [One case, produced by a microwave apparatus, caused a burn on the masilla, which broke completely into the oral cavity in spite of treatment with cortisone and antibiotics].
813. KOSIERADZKI, K. (1936) Biochemische Zeitschrift 287:265-, "Investigations on the effect of shortwave radiation on enzymes; Report No. 1. Studies on diastase"
814. KOSLOV, S. (1969) Presented at the Hazards and Utility of Microwaves and Radiowaves Seminar, (Heller, J., Chm.), 11-12 Dec., Boston, "The U. S. -- Soviet radiation gap"
815. KOSMAN, A. J., OSBOPNE, S. L., & IVY, A. C. (1948) Arch. of Physical Med., 29:559-562, "Importance of current from and frequency in electrical stimulation of muscles"
2883. KOSUGI, Y., et al. (1973), Jap. J. of Med. Electron., 11( ):86-93, (In Jap. w/Eng. abstr.), "A technique of tissue coagulation by microwaves".
816. KOTTKE, F., KOZA, D., KUBICEK, W., & OLSON, M. (1949), Arch. of Physical Med., 30:431-437, "Studies of deep circulatory response to short wave diathermy and microwave diathermy in man."
817. KOUWENHOVEN, W. B., LANGWORTHY, O. R., SINGEWALD, M. L., & KNICKERBOCKER, G. G. (1967) IEEE Trans. on Power Apparatus and Systems 86(4):506-511, "Medical evaluation of man working in AC electric fields"
3244. KOVACH, R.I. (1973), Biomedical Engineering, 7( ):16-18, (Transl. of citation #2884, this Biblio.), "Temperature distribution with microwave heating for a two-layer model of a biological object".
2884. KOVACH, R.I. (1973), Meditsinskaya Tekhnika (USSR), 7(1):18-21, (Jan.-Feb.), "Temperature distribution with microwave heating for a two-layer model of a biological object".
818. KOVACS, R. (1935) Arch. of Physical Therapy 16:743-744, "Vacuum type wave generator of faradic and galvanic current"
2442. KOVACS, R. (1949), Lea & Febiger, 6th ed., rev. Phila., Electrotherapy and light therapy, with essentials of hydrotherapy and mechanotherapy.
819. KOVACS, R. (1951) Annals of Western Med. and Surgery (Los Angeles) 5:199-200, "Radar and ultrasound in therapy"
820. KOWLOWSKI, B. (1967) Klinika Oczna. Acta Ophthalmologica Polonica (Warszawa), 37:413-418, "Effect of electromagnetic and molecular radiation"
821. KOZENKO, G. (1942) Biulleten Eksperimental'noi Biologii i Meditsiny, Moscow, 13(3-4):57-59, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept P-65-17, Apr. 1965), (In Russian) "Effect of UHF on the function of denervated kidneys in the dog"
2443. KRAEMER, D.C., & MARK, H.M. (1966), In: First International Symposium on Electrotherapeutic Sleep and Electroanesthesia, Graz, Austria, (12-17 Sept.), "Effects of electroanesthesia on fetal EKG".
2013. KRAFT, D., EMMRICH, K., GUNTHER, K., et al. (1967) Zentralbl. Chir. 92:Suppl:1799-, (In German) "Studies on the physical influences on implanted pacemakers"
2885. KRAMAR, P.O., EMERY, A.F., GUY, A.W., & LIN, J.C. (1973), IEEE G-MIT Internat. Microwave Symp. Digest, (abstract), pp. 265-267, (Jun.), "Theoretical and experimental studies of microwave induced cataracts in rabbits".
822. KRAMER, G. (1951) Die Vogelwarze 15(2):55-59, (NRC-77-1162, N65-28550), "Experiments on the perception of ultrashort waves by birds"
823. KRASNY-ERGEN, W. (1936) Hochfrequenztechnik und Elektroakustik, Jahrbuch der Drahtlosen Telegraphie und Telephonie 48:126-133, (In German) "Non-thermic effects of alternating electrical fields on colloids"
824. KRASNY-ERGEN, W. (1937) Hochfrequenztechnik und Elektroakustik, Jahrbuch der Drahtlosen Telegraphie und Telephonie 49:195-199, (In German) "Field effects with very short waves; spontaneous alternating fields"

2014. KRATZING, C. C. (1951) *Biochem. J.* 50:253-257, "Metabolic effects of electrical stimulation of mammalian tissues *in vitro*"
825. KREBS, J. S. (1968) NRDL-TR-68-104, Sept. (AD 677924), "Analysis of the radiation-induced loss of testes weight in terms of stem cell survival"
2886. KNESCH, E., SHER, L.D., & SCHWAN, H.P. (1970), *Proc. of the Fed. of Amer. Societies for Exper. Biol.*, \_\_\_ ( ): pps 7, 953, (*Physiology Program*, ACR-175, 1971), "Transient behavior of pearl-chain formation with implications for exposure of man to pulsed, electromagnetic radiation".
826. KRICHAGIN, V. I. (1962) In: *Summaries of Reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field*. Kirov Order of Lenin Military Academy, Leningrad, "Practical points in standardization of microwave radiation fields"
2887. KRIPPNER, S., & RUBIN, D. (eds.) (1973), *Galaxies of Life: The Human Aura in Acupuncture and Kirlian Photography*, Gordon & Breach Publishers (Interface Book), New York, 182 pages.
2203. KRITIKOS, D. N., & SCHWAN, H. P. (1972) *Instr. of Electrical & Electronics Engineers, Trans. on Biomed. Eng.* BME-19(1): 53-58, "Hot spots generated in conducting spheres by electromagnetic waves and biological implications"
827. KROTOV, A. V., GAYSINSKIY, B. YE., KAL'KAYEV, M. Z., & MININA, L. A. (1967) *Meditssinskaya Tekhnika* (4):52-54, (Abstr. in: *ATD 68-105-108-9 Soviet Radiobiology*, June 1968, p. 79 only; AD 671436), "Application of an ultra-high-frequency magnetic field in radiculitis"
3522. KRUEGER, A.P., & REED, E.J. (1975), Rept. from Univ. of California, Berkeley, 10 July, "A study of the biological effects of certain ELF electromagnetic fields."
2888. KRUEGER, W.F., et al. (1972), *Biomedical Sciences Instrument.*, 9( ):183-186, "Influence of low-level electric and magnetic fields on the growth of young chickens".
2889. KRUEGER, W.F., & GIAROLA, A.J. (1972?), Ref. 7, "Safe guide of exposure to the EM pulse".
3523. KRUMPE, P.E., & TOCKMAN, M.S. (1972), Naval Medical Research Unit No. 4 (Great Lakes, IL), Tech. Rept., (Dec.), "Evaluation of the health of personnel working near Project SANGUINE Beta Test Facility from 1971 to 1972."
828. KRUSEN, F. H. (1935) *J. of the Amer. Medical Assoc.* 104:1237-1239, "Short wave diathermy: preliminary report"
2444. KRUSEN, F.H. (1941), W. B. Saunders Co., Phila., *Physical Medicine, the Employment of Physical Agents for Diagnosis and Therapy*.
829. KRUSEN, F. H. (1950) *Proc. of the Royal Society of Med.* 43:641-658, "Medical applications of microwave diathermy: laboratory and clinical studies"
830. KRUSEN, F. H. (1951) *Arch. of Physical Med.* 32:695-698, "New microwave diathermy director for heating large regions of the human body"
831. KRUSEN, F. H. (1956) *Institute of Radio Engineers Trans. on Medical Electronics*, PGME-4:3-4, (From Symposium on Physiologic and Pathologic Effects of Microwaves, Krusen, F. H., Chm., Sept. 1955), "Address of welcome, Session I, Problems which are challenging investigators"
832. KRUSEN, F. H., HERRICK, J., LEDEN, W., & WAKIM, K. (1947) *Proc. of Staff Meeting of the Mayo Clinic* 22:209-234, "Preliminary report of experimental studies of heating effect of microwaves (radar) in living tissues"
2890. KRUSEN, F.H., KOTTKE, F.J., & ELLWOOD, P. (eds.), (1971), W.B. Saunders Co., Phila., *Handbook of Physical Medicine and Rehabilitation*.
833. KRUSTANOV, L., & GOSHEV, K. (1966) *Voenna Meditsinsko Delo* (4):41-46, "The peripheral blood characteristics of personnel exposed to a superhigh frequency electromagnetic field"
834. KRYLOV, V., & SOLOVEY, A. P. (1951) *State Sci. Tech. Pub. House, Moscow*, 17 pages, (FTD-TT-62-339/1+2+4, Nov. 1962; AD 292611), *Safety Measures Recommended for Work on Radio-Frequency Generator Installations*
2445. KUCIA, H.R. (1972), *IEEE Trans. on Instrumentation and Measurement*, IM-21(4):412-415, "Accuracy limitation in measurements of HF field intensities for protection against radiation hazards".
2446. KUCIA, H.R. (1972), Presentation to XVIIth General Assembly of URSI, (Int'l. Union of Radio Science), (21-29 Aug.), Warszawa, Poland, "Electromagnetic radiation safety in Poland".
835. KULAKOVA, V. V. (1964) *Trudy Nil Gigiena Truda i Profzaboleaniy ANM SSR*, (Biological Effects of Radio Frequency Electromagnetic Fields, Inst. of Industrial Hygiene and Occupational Diseases, Academy of Medical Sci., USSR), 2(2):70-74, "The effect of microwaves in the centimeter and decimeter range on the general and specialized patterns of appetite in animals"
836. KULAKOVA, V. V. (1966) In: *Konferentsiya molodykh nauchnykh rabotnikov* (Report summaries, Conf. of Young Scientific Workers), Moscow, *Tezisy dokladov*, pp. 73-74, (Abstr. in: *ATD 68-105-108-9 Soviet Radiobiology*, June 1968, p. 80 only, AD 671436), "Methods for investigating electrolyte requirements and their content in blood and urine in studying the biological effects of microwaves"
837. KULIK, J. J. (1963) *Final Report Federal Aviation Agency* (No. RD-64-1), (AD 435491), "Microwave radiation hazard to aircraft transiting radio and radar beams"

838. KULIKOVSKAYA, YE. L. (1961) In: Materials of the Scientific Session Concerned with the Results of Work Conducted by the Leningrad Institute of Industrial Hygiene and Occupational Diseases for 1959-1960, Leningrad, "The problem of microwave radiation of ship crews of the civil ocean fleet"
839. KULIKOVSKAYA, YE. L. (1962) In: Summaries of reports, Questions of the Biological Effect of an SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, "Effects of high frequency electromagnetic fields (medium and short wave lengths) on Navy ships crews"
840. KULIKOVSKAYA, YE. L. (1963) Gigiyena Truda i Professional'nyye Zabolevaniya (Labor Hygiene and Occupational Diseases), Moscow, (2):24-27, (JPRS 19,068, OTS 63-21756, May 1963, pp. 1-5), (In Russian), "Ultra-high frequency electromagnetic waves on the decks of merchant ships"
841. KULIKOVSKAYA, YE. L. (1968) Gigiyena Truda i Professional'nyye Zabolevaniya (Moskva) (5):22-28, "Shielding radio operators on sea-going vessels from MF-LF radiation"
842. KULIKOVSKAYA, YE. L. (1970) Izd-vo "Sudostroyeniye", Leningrad, 152 pages, (JPRS 52622, Mar. 1971), (In Russian), (Zashchita ot Deystviya Radiovoln) Protection from the Effect of Radio Waves (in the maritime industry)
2015. KULIKOVSKAYA, E. L., & OSIPOV, J. A. (1960) Gigiyena truda 5:3-7, (In Russian) "Electromagnetic fields in work areas where high-frequency heating is employed"
843. KULIN, YE. T. (1965) In: Papers on the Physicochemical Basis of Autoregulation in Cells, Moscow, pp. 26-, "Concentration and radio-frequency dependence of autoregulation of functions of unicellular organisms (paramecia)"  
DEMIDOVA, S.I., & KASIMENKO, V.B.
844. KULIN, YE. T. (1968) Biofizika 13(1):81-85, "Dependence of the phagocytic function of paramecia on the frequency and intensity of the electromagnetic field"
845. KULIN, YE. T., & MOROZOV, YE. I. (1964) Doklady Akademii Sci. BSSR, 8(5):329-331, "The effect of decimeter wavelength radiation on the physiological functions of one-celled organisms"
846. KULIN, YE. T., & MOROZOV, YE. I. (1965) Vestnik Akademii Nauk BSSR, Ser. Biologich, Nauk (4):91-, "Some features of the effect of electromagnetic fields of the SHF range on the phagocytic function of paramecia"
847. KUPALOV, P. S., & FRENKEL, G. L., (Eds.), (1937) (In Russian), All Union Inst. of Experimental Medicine, Moscow, 471 pages, The Biological Action of VHF-HF-Ultrashort Waves
2204. FURZ, G. H., & EINAUGLE, R. E. (1966) Amer. J. of Ophthalm. 65:866-869, (A69-80371), "Cataract secondary to microwave radiation"
848. KUSSEL, G. (1949) Ophthalmologica (Basel), 177:299-, "Late form of electrical cataract case"
849. KUSABAYASHI, S., LARONGE, T. M., & LABES, M. M. (1967) Report (10 pages), June-Dec., (NASA, CR-91523), (N68-13316), "Mechanisms for the effects of electric and magnetic fields on biological systems"
2891. KUTTIG, H. (1960), Med. Klin., 57(1):1577-1579, (14 Sep.), (In Ger.), "Physical heat therapy in the radiation field with decimeter waves".
2447. KUZIN, M.I., LIVENTSEV, N.M., ZHUKOVSKIY, V.D., & SACHKOV, V.I. (1966), Uzbek Medical Publishing House, 172 pps. (JPRS 43,214), Electronarcosis in Surgery.
2448. KUZIN, M.I., ZHUKOVSKIY, V.D., & SACHKOV, V.I. (1963), Experimentelle chirurgie und anesthesiologie, (5):57-61, (NASA TT-F-9346), "The use of interference currents in the combined elimination of pain in surgical operations".
850. KYLEN, A. M., et al. (1964) J. of the Amer. Dietetic Assoc. 45:139-145, "Microwave and conventional cooking of meat"
651. KYUNTSSEL', A. A., & KARMILOV, V. I. (1947) Klinicheskaya Meditsina, Moscow, (24), "The problem concerning the effect of electromagnetic fields on the blood coagulation rate"
2255. LABES, M. M. (1970) Final Report on NASA Grant NGL 39-014-915, June 1967 - Sept. 1970, (N71-12313 to N71-12324), (CR-111582), 83 pages, Drexel Univ., Chemistry Dept., Philadelphia, Pa., "Mechanisms for the effect of electric and magnetic fields on biological systems" (collection of papers by LABES, et al.)
852. LACEY, B. A., WINNER, H. I., & McLELLAN, M. E. (1965) J. of Applied Bacteriology 28:331-335, "Effects of microwave cookery on the bacterial count of food"
853. LAFOND, C. (1959) Missiles and Rockets (?:)20-, (14 Dec.) "Microwave 'hazards' are exaggerated"
854. LAIRD, E. (1952) Canadian J. of Physiology 30:663-, "Dielectric properties of some solid proteins at wavelengths of 1.7 m and 3.2 cm"
855. LAIRD, E., & FERGUSON, K. (1949) Canadian J. of Research, A, 27:218-230, "Dielectric properties of some animal tissues at meter and centimeter wave lengths"
2892. LAMASTER, F.S. (1970), In: Proc. of the 4th Annual Midyear Topical Symposium, the Health Physics Soc., Louisville, KY, 28-30 Jan.; Bureau of Radiological Health, U.S. Dept. of Health, Education & Welfare, Rept. No. BEH/DEP 70-26, (Oct.), pps. 420-422, "Equipment surveys for RF radiation hazards".
2893. LAMBERT, P.D., NEALEIGH, R.C., & WILSON, M. (1972), J. of Microwave Power, 7(4):367-380, "The effects of microwaves exposures on the central nervous system of beagles".

856. LANG, O., & KOLLER, G. (1956) Zentbl. Arbeitsmed. Arbeitsschutz 6:13-, (In German) "Protective measures for working spaces in high frequency installations"
3524. LANG, S. (1970), Dissertation--Universitat des Saarlandes, (in German), "Investigation on the behavioral, physiological and metabolic physiological effects of the Faraday screening and of artificial atmospheric electrical direct and alternating fields on white mice (*Mus musculus*)."
3525. LANG, S. (1972), Arch. Met. Geoph. Biokl. (Ser. B), 20( ):109-122, (in German), "The metabolic and physiological effects of Faraday screening and of an artificial air electric field of a frequency of 10 Hz on white mice."
857. LANTSCHAN, M. N. (1965) Trans., Scientific Conf., Central Science Lab. TOMSK, (2):360-362, "The effect of an alternating magnetic field on the phagocytic function of the reticulo endothelial system in experimentation"
2894. LAPPENBUSCH, W. (1972), Presented at the Health Physics Meeting, Las Vegas, Nevada, June 12-17, "Effects of joint microwave and x-ray stress on the Chinese hamster".
2449. LAPPENBUSCH, W.L., GILLESPIE, L.J., LEACH, W.M., & ANDERSON, G.E. (1973), Radiation Research, 54(2):294-303, (May), "Effect of 2450 MHz microwaves on the radiation response of X-irradiated Chinese hamsters."
2895. LAPSHIN, V.P., POKROVSKY, G.A., FEDOROV, B.A., BOCHAROV, B.G., & TKACHENKO, B.N. (1973), Eksperimental'naya Khirurgiia i Anesteziologiya (Moskva), 18( ):63-65, (In Russ. w/Engl. abstr.), "The influence of alternating [ELF] magnetic field on the [rat] brain, used as an anti-shock measure", [3-18 Hz stimulated bioelectrical activity of brain following severe burn (80-90% body surface)].
858. LARKIN, C. R. (1957) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.) 1:47-51, "Hazards of electromagnetic radiation to ordnance"
859. LAROCHE, L. P., ZARET, M. M., & BRAUN, A. F. (1970) Arch. of Environmental Health 20:350-355, "An operational safety program for ophthalmic hazards of microwaves"
2896. LARSEN, L.E. (1973), 1973 IEEE G-MTT Internat. Microwave Symposium Digest of Technical Papers, pp. 262-264, "An RF decoupled electrode for measurement of brain temperature during microwave exposure".
2897. LARSEN, L.E., MOORE, R.A., & ACEVEDO, J. (1974), IEEE Trans. on Microwave Theory & Techniques, MTT-22(4):438-444, (Apr.), "A microwave decoupled brain-temperature transducer".
2276. LASHEY, J. (1970) In: Radiation Bio-Effects Summary Report, Hodze, D. M., (ed.), for Jan-Dec 1970, Div. of Biological Effects, Bur. Rad. Health, DHEW, (Rept. No. BRH/DBE 70-7), p. 157 only, "Lethal dose of 2450 MHz microwave irradiation at various power densities in the Sprague-Dawley rat (A preliminary report)"
2297. LASHEY, J., DAVES, D., & HONES, M. (1970) In: Radiation Bio-Effects Summary Report, Hodze, D. M., (ed.), for Jan-Dec 1970, Div. of Biological Effects, Bur. Rad. Health, DHEW, (Rept. No. BRH/DBE 70-7), pp. 167-173, "Progress report on 2450 MHz irradiation of pregnant rats and the effect on the fetus"
2298. LATTES, R. G., & BRECHER, S. (1970) In: Radiation Bio-Effects Summary Report, Hodze, D. M., (ed.), for Jan-Dec 1970, Div. of Biological Effects, Bur. Rad. Health, DHEW, (Rept. No. BRH/DBE 70-7), pp. 229-232, "Microwave irradiation of peripheral leukocyte cultures without average temperature rise of culture medium"
2898. LAVINE, L. (1973), To be presented at Symp. on "The Injured Child", Session entitled "Special Problems of Childhood Injuries", 26-28 Sept., Vanderbilt Univ., "Electrical stimulation of congenital bone defects".
2899. LAVINE, L.S., LUSTRIN, I., SHAMOS, M.H., & MOSS, M.L. (1971), Acta Orthop. Scandinav., 42( ):305-314, "The influence of electric current on bone regeneration *in vivo*".
2900. LAVINE, L.S., LUSTRIN, I., SHAMOS, M.H., RINALDI, R.A., & LIBOFF, A.R. (1972), Science, 175( ):1118-1121, (10 Mar.), "Electric enhancement of bone healing", [using D.C., in human tibia].
860. LAVRENTIEVA, B. I., & FEDOROV, B. G. (1937) Sbornik Bio. Deistvi, UHF, Moscow, pp. 145-, (Abstr. in: Biological Effect of Ultrahigh Frequencies Symposium, Moscow; also Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, AID Rpt P-65-17, Apr. 1965), "Observations on live synapses under the action of UHF on the frog's heart"
861. LAWRENCE, J. C. (1968) British J. of Industrial Med. 25:223-228, "Effect of microwaves at X-band on guinea pig skin in tissue culture. Part I. Microwave apparatus for exposing tissue and the effect of radiation on skin respiration"
862. LAWRENCE, J. C. (1969) Non-Ionizing Radiation 1(2):80-84, "Effect of pulsed microwaves at X-band on skin metabolism"
863. LAWRENCE, L. G. (1969) Electronics World 82(4):25-28, "Electronics and the living plant"
864. LAWRENS, L., SIEMS, B., KOSMAN, P., STAFFORD, L., & OSBORNE, M. (1948) Arch. of Physical Med. 29:12-, Title?
865. LAZAREV, P. P. (1935) Klinicheskaia Meditsina, Moskva, 13(11):1533-1590, "Theory of the action of short and ultrashort waves"
2901. LAZAROVICH, V.G. (1970), Buill. Eksp. Biol. Med., 20( ):44-46, (Oct.), (In Russ.), "Effect of VHF electromagnetic fields on the content of iron, copper, and some metalloproteins in the blood and tissues".
3526. LAZAROVICH, V.G., & GRITSULYAK, B.V. (1975), Nauchnyye Doklady Vysshey Shkoly, Biologicheskiye Nauki, (3):39-42, (in Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #66512), 7 Jan. 1976, pp. 19-24, "Influence of super high-frequency electromagnetic fields on the capillary bed, parenchyma, and some biochemical properties of rat testes."

2299. LAZARUS, E. D., & LEVEDAH, B. H. (1962) U. S. Atomic Energy Commission, Rept. No. TID-3912 (Biol. & Med.), Esp. section 10. (Microwaves, pp. 431-451), Effects of Radiation on the Mammalian Eye: A Literature Survey

866. LAZELL, J. A. (1960) Health Physics 15:525-, "Radiation Control for Health and Safety Act of 1968"

2902. LEACH, W.M. (1973). In: Fifth Annual National Conf. of Radiation Control, Portland, Oregon, May 6-10, Dept. of Health, Education & Welfare Pub. No. FDA 74-800H, (Oct.), "Biological research for consumer product safety seminar: Microwave ovens".

867. LEARY, P. (1959) Electronica 32(8):49-53, "Researching microwave health hazards"

868. LEAVY, I. M. (1935) Arch. of Physical Therapy 16:145-149, "Physical therapy in chronic diseases: With special reference to peripheral vascular disease and ulcerations" [diathermy]

869. LEBEDINSKIY, A. V. (1937) In: Materials of the Leningrad Conf. on VLF-HF Waves, Leningrad, pp. 45-54, "The physiological mechanism involved in the action of VLF-HF on the organism of animals and man"

870. LEBEDINSKIY, A. V. (1940) Pervoye soveshchaniye po voprosam primeneniya KV i UKV v meditsine. Trudy. (Trans. of the 1st Conf. on problems of the applications of shortwaves and ultrashort waves in medicine) Medgiz, pp. 121-129, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt. P-65-17, Apr. 1965), Title? [Discusses the exposure of humans to UHF electromagnetic fields]

2450. LEBOVITZ, R.M. (1972), The Rand Corp. Rept. R-983-RC, 28 pps., "The sensitivity of portions of the human central nervous system to 'safe' levels of microwave radiation".

3245. LEBOVITZ, R.M. (1973), IEEE Transactions on Biomedical Engineering, BME-20(2):119-126, "Caloric vestibular stimulation via UHF-microwave irradiation".

2903. LEBOVITZ, R.M. (1973), J. of Theoretical Biology (London), 41( ):209-221, "Significance of microthermal effects derived from low level UHF-microwave irradiation of the head: Indirect caloric vestibular stimulation".

2904. LECHOWICH, R.V. (1969), Appl. Microbiol., 17( ):106-110, (Jan.), "Procedure for evaluating the effects of 2,450 MHz microwaves on Streptococcus Faecalis and Saccharomyces cerevisiae".

871. LEDEY, U. M., HERRICK, J. P., WAXIM, K. G., & KRUSEN, P. H. (1947) British J. of Physical Med. 10:177-184, "Preliminary studies on the heating and circulatory effects of microwaves - 'Radar'"

2905. LEEBELVELD, H.L. (1969), Lab. Practice, 18( ):165-166, (Feb.), "The microwave oven as a tool in microbiology".

2906. LEHMANN, J.F. (1971), In: Handbook of Physical Medicine and Rehabilitation, (KRUSEN, P.H., et al. (eds.)), W.B. Saunders Co., Phila., Chapt. 11, pp. 299-327, "Microwave diathermy".

2907. LEHMANN, J.F., et al. (1965), Arch. of Physical Med. & Rehab., 46( ):307-312, "Comparison of deep heating by microwaves at frequencies of 2456 and 900 megacycles".

2451. LEHMANN, J.F., DeLATEUR, B.M., & STONEBRIDGE, J.B. (1969), Arch. of Phys. Med., 50:117-123, (Mar.), "Selective muscle heating by shortwave diathermy with a helical coil".

2452. LEHMANN, J.F., GUY, A.W., DeLATEUR, B.J., STONEBRIDGE, J.B., & WARREN, C.G. (1968), Arch. of Phys. Med., 49:193-198, (Apr.), "Heating patterns produced by short-wave diathermy using helical induction coil applicators".

872. LEHMANN, J. F., GUY, A. W., JOHNSTON, V. C., BRENNER, G. D., & BELL, J. W. (1962) Arch. of Physical Med. 43:69-76, "Comparison of relative heating patterns produced in tissues by exposure to microwave energy at frequencies of 2,450 and 900 megacycles"

873. LEHMANN, J. F., et al. (1964) Arch. of Physical Med. 45:555-563, "Modification of heating patterns produced by microwaves at the frequencies of 2456 and 900 MC by physiologic factors in the human"

2453. LEHMANN, J.F., GUY, A.W., WARREN, C.G., DeLATEUR, B.J., & STONEBRIDGE, J.B. (1970), Arch. of Phys. Med., 51:143-146 and 151, (Mar.), "An evaluation of a microwave contact applicator".

3246. LEHMANN, J.F., STONEBRI, J., WARREN, C.G., & DeLATEUR, B.J. (1974), Archives of Physical Medicine & Rehabilitation, 55(5):213-217, "Muscle heating produced in hog specimens by microwaves at 915 and 433.92 MHz".

874. LEITES, P. L., & SKIRIKHINA, L. A. (1961) Bulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 52(12):47-50, (Bulletin of Experimental Biology and Med. 52(12):1387-1390, 1961), (FTD-TT-62-277, AD 281169), (In Russian), "The effect of microwaves on the hormonal activity of the adrenal cortex"

875. LENKO, J., WANIEWSKI, Z., & WOCENA, Z. (1966) Polski Tygodnik Lekarski 39(21):1475-1477, "Studies of the effects of microwaves of low power flux density on the testicles of rabbits"

876. LENNAN, I. (1931) Arch. of Physical Therapy 12:143-, "The heating effect of short radio-waves"

3527. LENOX, R.H., GANDHI, O.P., MEYERHOFF, J.L., & GROVE, H.M. (1976), IEEE Transactions on Microwave Theory & Techniques, MTT-24(1):58-61 (Jan.), "A microwave applicator for in vivo rapid inactivation of enzymes in the central nervous system."

877. LENSCH, P., HERRICK, J., & KRUSEN, F. (1950) Arch. of Physical Med. 31:687-695, "Temperatures produced in bone marrow, bone, and adjacent tissues by diathermy: experimental study"
2908. LEONARD, P.F., RESTALL, C.J., TASWELL, H.F., et al. (1971), Anesthesia and Analgesia, 50( ):302-305, "Microwave warming of bank blood".
878. LEONTOVICH, A. V. (1937) *Fiziologicheskii Zh. SSSR*, Sechenov, 22(3,4):377-385, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt. P-65-17, Apr. 1965), "The problem of nerve excitation"
2016. LEFESCHEN, W. W. (1948) *Biochem. Z.* 318:15-43, (In German) "Electrical short waves and serum proteins"
3528. LEPOFF, J.H. (ed.) (1975), Digest of Tech Papers, Internat. Microwave Symposium sponsored by IEEE, 377 pps., "Microwaves in service to man," held in Palo Alto Calif., May 12-14, 1975.
892. LERMAN, S. (1962) *N. Y. State J. of Medicine* 62(19):3075-3085, "Radiation cataractogenesis" [ionizing and non-ionizing radiation] (Out of place, should follow citation #878)
3529. LESZCZYNSKI, B. (1973), *Wlad. Lek.*, 26( ):149-153 (Jan.), (in Polish), "The effect of amplitudes of fluctuations of magnetic field intensity on the frequency of accidents at work in the light of own investigations."
879. LETAVET, A. A., & GORDON, Z. V., (Eds.) (1960) *Institute of Labor Hygiene and Occupational Diseases, Acad. of Medical Science, USSR, Moscow*, 142 pages, (JPRS 12,471, 1962), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt. P-65-17, Apr. 1965), The Biological Action of Ultrahigh Frequencies
880. (LETAVET, A. A., & GORDON, Z. V., ?), (1960) In: The Biological Action of Ultrahigh Frequencies, Letavet, A.A., & Gordon, Z. V., (eds.), pp. 123-125, (JPRS 12471, 1962); (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt. P-65-17, Apr. 1965), "Recommendations for conducting preliminary and periodic medical examinations of workers using UHF sources"
3530. LETAVET, A.A., & GORDON, Z.V. (eds.) (1968), *Proceedings of the Laboratory of Electromagnetic Radiofrequency Fields of the Institute of Industrial Hygiene and Occupational Diseases, Academy of Medical Sciences USSR, No. 3, Moscow*, "Biological effects of electromagnetic radio frequency fields." [unable to verify]
881. LEVITINA, M. A. (1964) *Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva)*, 58(7):67-69, (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, 1965, p. 44 only, "Effect of pulsed UHF on cardiac rhythm"); (Also abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt. P-65-17, Apr. 1965), "Effect of microwaves on cardiac rhythm of rabbits during local irradiation of body areas"
882. LEVITINA, M. A. (1965) Author's abstr. of Candidate's Dissertation, Moscow, "An investigation of the nonthermal action of microwaves on the heart rate"
883. LEVITINA, M. A. (1966) *Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva)*, 62(12):64-66, "Nonthermal action of microwaves on the cardiac rhythm of the frog"
2909. LEVY, D.D. (1971), *J. of the Electrochem. Soc.*, 118( ):1438-1442, "Induced osteogenesis by electrical stimulation".
2910. LEVY, H. (1961), *Western Medicine*, 2( ):246,248,250, (Jun.), "Pulsed short wave in sinus and allied conditions in childhood".
2210. LEYTES, F.L., & SKURIKHINA, L.A. (1961), *Biull. Eksp. Biol. Med.*, 52(12):47-50, "The effect of microwaves on the hormonal activity of the adrenal cortex," (FTD-TT-62-277/1+2+4, Transl. of WP-AFB, Ohio, 27 Apr. 1962).
2911. LI, J., & NEURATH, P.W. (1969), *IEEE Trans. on Bio-Med. Engineering*, BME-16(1):96-98, (Jan.), "Electric and magnetic fields near a circular loop at 27 MHz", [and discussion of absorption of the energy by biological tissue].
2017. LI, T-C. (1961) *Chinese J. of Surgery* (11):733-724, (JPRS 44,037), "Study on treatment of abscess and cellulitis with ultra short waves"
884. LIBBER, L. M. (1970) *Bioscience* 20(21):1169-1170, "Extremely low frequency electromagnetic radiation biological research"
2454. LIBBER, L., & ROZZELL, T.C. (1972), *Naval Research Reviews*, (Feb.), pp.1-11, "A study of the possible biological effects of (Project) SANGUINE", [At frequencies below 100 Hz].
2211. LIBFENI, P. (1936) *Biology and Therapy*, Moscow, "Short and ultrashort waves"
885. LICHT, S. H. (Ed.) (1958, *Physical Medicine Library*, Vol. 2); (1967, Vol. 4, 2nd Edition), E. Licht, pub., New Haven, Conn., Vol. 2, Therapeutic Heat and Cold; Vol. 4, Therapeutic Electricity and Ultraviolet Radiation
886. LICHT, S. H. (1967) Chapt. 1 in: Therapeutic Electricity and Ultraviolet Radiation, *Physical Medicine Library*, Vol. 4, 2nd Edition; E. Licht, pub., New Haven, Conn., pp. 1-70, "History of electrotherapy"
887. LICHTER, I., BORRIE, J., & MILLER, W. M. (1965) *British Medical J.* 1(5449):1513-1518, "Radio-frequency hazards with cardiac pacemakers"

2016. LICHTLEN, P. (1966) Schweiz Med Wochenschr 96:867-, "Disturbances of cardiac pacemaker by radio frequency currents"
888. LIDMAN, B. I., & COHN, C. (1945) Air Surgeons Bulletin 2:448-449, "Effects of radar emanations on the hematopoietic system"
889. LIEBESNY, P. (1934) Abstr. of the 1st Internat. Congress of Electro-Radio-Biology, (Licunio Cappelli, ed., Bologna, Italy), pp. 369-382, (In German with English Summary), "Biological effects of Hertzian shortwaves"
890. LIEBESNY, P. (1935) Urban and Schwarzenberg, pub., Vienna, (Book Review in: Arch. of Physical Therapy 16:306 only, 1935), Short and Ultrashort Waves in Biology and Therapy
891. LIEBESNY, P. (1938) Arch. of Physical Therapy 19:736-740, "Atheraic short wave therapy"
893. LIKHETERMAN, B. V. (1933) Byull. Gosudarstvennogo Tsentral'nogo Instituta imeni Sechenova, (Bull. of the State Central Institute of Sechenova), 8(10): "The effect on attending personnel of work with high frequency electromagnetic equipment"
894. LIKHETERMAN, V. B., BORODINA, M. A., LINCHENKO, V. M., & ORLOV, L. M. (1936) Sevastopol'. Gosudarstvennyy Tsentral'nyy Nauchno-issledovatel'skiy Institute Zicheskiikh Metodov Lecheniya. Izvestiya 3(3, 4):pp. ?, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept P-65-17, Apr. 1965), "The therapeutic use of short waves"
3247. LIN, J.C. (1974), The J. of Microwave Power, 9(2):63-67, (June), "A cavity-backed slot radiator for biological effects research".
3531. LIN, J.C. (1975), IEEE Transactions on Biomedical Engineering, 22(1):74-76, "Microwave properties of fresh mammalian brain tissue at body temperature."
3248. LIN, J.C. (1975), IEEE Trans. on Electromagnetic Compatibility, EMC-17(2):93-97, (May), "Interaction of electromagnetic transient radiation with biological materials".
2912. LIN, J.C., GUY, A.W., & JOHNSON, C.C. (1973), IEEE Transactions on Microwave Theory & Techniques, MTT-21(12):791-797, "Power deposition in a spherical model of man exposed to 1-20 Mhz electromagnetic fields".
2913. LIN, J.C., GUY, A.W., & KRAFT, G.H. (1973), J. of Microwave Power, 8(3/4):275-286, "Microwave selective brain heating".
3249. LIN, J.C., & LI, C.F. (1971), J. of Microwave Power, 6(1):45-48, "Microwave sterilization of oranges in glass-pack".
3532. LIN, J.C., WU, C-L., & LAM, C.K. (1975), Proceedings of the IEEE (Proceedings Letters),  ( ):1726-1727 (Dec.), "Transmission of electromagnetic pulse into the head."
895. LINDEMANN, A., et al. (1964) Zeitschrift fur Gesamte Innere Medizin und ihre Grenzgebiete, Leipzig, 19:705-711, "Effect of short waves on some functions of the liver"
896. LINDQUIST, R. J. ( ? ) Reference?, 20 pages, "Short wave diathermy"
897. LINDQUIST, R. J. ( ? ) Reference?, 19 pages, "Galvanism"
898. LINKE, C. A., LOUNSBERRY, W., & GOLDSCHMIDT, V. (1962) J. of Urology 88(2):303-311, "Effects of microwaves on normal tissues"
899. LION, K. S. (1947) Arch. of Physical Med. 28:344-347, "The effect of the presence of metals in tissues subjected to diathermy treatment"
2914. MITVINOVA, L.I. (1972), Vrachebnoe Delo Nauchnyi Meditsinskiy Zhurnal, 6( ):137-139, (In Russ., w/Engl. summary), "An experimental study of the biological effect of a low intensity, short-wave electromagnetic field".
3533. LIU, L.M., ROSENBAUM, F.J., & PICKARD, W.R. (1975), Rept. from Washington Univ., St. Louis, MO, "The relation of teratogenesis in Tenebrio molitor to the incidence of low level microwaves" [200 microwatts in a waveguide].
900. LIVANOV, M. N. (1944) Academy of Medical Sciences, USSR, (Biol.) (6), "Cerebral cortex electrical reactivity curves for man and animal under normal and pathological conditions"
901. LIVANOV, M. N. (1960) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 49(5):478-481, "Influence of electromagnetic fields on the electrical activity of rat cerebral cortex"
902. LIVANOV, M. N., TSYPIN, A. B., GRIGORY'EV, YU. G., KRUSHCHEV, V. G., STEPANOV, S. M., & ANAN'YEV, V. M. (1960) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 49(5):63-67, "The effect of electromagnetic fields on the bioelectric activity of cerebral cortex in rabbits"
903. LIVENSON, A. R. (1959) Novosti Meditsinskoj Tekhniki, USSR,  (1):31-44, (JPRS 9409), "The use of SHF-UHF electromagnetic fields in medicine"
904. LIVENSON, A. R. (1960) (In Russian) In: Electronics in Medicine (Elektroniki v Meditsin), A. I. Berg. (ed.), Moscow, Leningrad, pp. 233-238, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "High frequency therapeutic apparatus"
905. LIVENSON, A. R. (1960) Meditsinskaya Gazeta Navy USSR  (5):57-63, "The use of microwaves in physiotherapy (The Luch 58 Apparatus)"

906. LIVENSON, A. R. (1962) Proc. of the 2nd All-Union Conf. on the Use of Radioelectronics in Biology and Medicine, Moscow, pp. 25-, "Dosimetric methods in microwave therapy"
907. LIVENSON, A. R. (1963) Trudy Vsesoyuznogo Nauchno-Issledovatel'skogo Instituta Meditsinskikh Instrumentov Oborudovaniy 3:12-, "Dosimetric methods in centimeter and decimeter-wave therapy"
908. LIVENSON, A. R. (1963) Meditsinskaya Promyshlennost, USSR Med. Industry, (11):10-17, (JPRS 23167, N64-14920), "Dosimetry methods in microwave and decimeter wave therapy"
909. LIVENSON, A. R. (1964) Voprosy Kurortologii Fizioterapii i Lechebnoi Fizicheskoi Kulturi (5):450-, "Questions of occupational hygiene relating to the operation of equipment for microwave therapy"
910. LIVENSON, A. R. (1964) Meditsinskaya Promyshlennost, USSR Med. Industry, 18(6):14-20, (JPRS 26191, TT-64-41450, N64-28092), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), (Also in: Biological Effects of Microwaves, Compilation of Abstracts, ATD P-65-68, 1965, pp. 82-90), "Electrical parameters of biological tissue in the microwave range; Part 1"
911. LIVENSON, A. R. (1964) Meditsinskaya Promyshlennost, USSR Medical Industry, 18(7):10-17, (JPRS 26429, TT-64-41687), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "Electrical parameters of biological tissue in the microwave range; Part 2, Methods of gauging electrical parameters of biological tissue"
912. LIVENSON, A. R. (1966) Meditsinskaya Promyshlennost, USSR Medical Industry, (10):17-24, (Transl. by Transl. Div., Foreign Technology Div., WP-APB, Ohio, Document # FTD-HT-23-232-68, May 1968), (In Russian) "Determination of the coefficient of reflection for multilayered systems of biological tissues in the microwave range"
913. LIVENSON, A. R., & FRENK, A. A. (1966) Meditsinskaya Promyshlennost, USSR Medical Industry, 20(4):18-24, (JPRS 36332, July 1966), "On the problem of dosimetry of the energy of decimetric waves"
914. LIVENSON, A. R., & GATRILIN, V. A. (1964) Section in: Recent Developments in Medical Instruments, State Sci. Inst. Sci. Tech. Info., Moscow, (JPRS 25587, TT-64-31859, N64-30396), "An apparatus for synchronized treatment of biological objects with modulated microwaves (Sinkhroimpuls)"
3534. LIVESAY, D.E., & CHEN, K.M. (1974), IEEE Trans. on Microwave Theory and Techniques, MTT-22(12):1273-1280, "Electromagnetic fields induced inside arbitrarily shaped biological bodies."
915. LIVSHITS, N. N. (1947) Akademiya nauk SSSR, Fiziologicheskii Institut. Trudy, 2:64-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "Visual adaptation to darkness under the action of SHF-UHF fields upon the occipital region"
917. LIVSHITS, N. N. (1954) Dissertation, Moscow, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "The effect of an ultrahigh frequency electric field and ionizing radiation on the CNS"
917. LIVSHITS, N. N. (1957) Biofizika 2(3):387-389, (In Russian), (Biophysics 2(3):372-374, 1957, (In English)), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965); (Also Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, 1965, p. 68 only, "Review of the role of the nervous system in reactions to UHF"), "The role of the nervous system in reactions to UHF electromagnetic fields"
918. LIVSHITS, N. N. (1957) Biofizika 2(2):197-208, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "Conditioned reflex activity in dogs under local influence of a VHF-HP field upon certain zones of the cerebral cortex"
919. LIVSHITS, N. N. (1957) Doklady Akademii Nauk SSSR 112:1145-1147, (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, 1965, pp. 27-28, "Effects of UHF on conditioned reflex activity"), (Also abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "Conditioned reflex activity of dogs during exposure to the cerebellum to VHF-UHF fields"
920. LIVSHITS, N. N. (1958) Biofizika 3(4):409-421, (also in England 426-436), (Abstr. in Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, 1965, pp. 70-71, "Review of the effect of UHF fields on the functions of the nervous system"), (also, abstr. in: The Biological Effects of Electromagnetic Fields, ATD Rpt P-65-17, Apr. 1965), "The effect of an ultrahigh-frequency field on the functions of the nervous system"
2915. LIVSHITS, N.N. (1958), Biophysics, 3( ):409-421, "The effect of an ultra-high frequency field on the functions of the nervous system", (Engl. transl. of citation #920, this Biblio.).
3250. LLAURADO, J.G., SANCES, A., JR., & BATTOCLETTI, J.H. (1974), Biologic and Clinical Effects of Low-Frequency Magnetic and Electric Fields, 343+ pps., Charles C. Thomas, Publisher, Springfield, IL. (Proceed. of Workshop/Conf. held Feb. 18-24, 1973, Aspen, CO; citation #3362, this Biblio.).
921. LOBANOVA, YE. A. (1959) Gig. Biol. Deystviye, Moscow, (In: Summaries of Reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, pp. 46-47), "Changes of the conditioned reflex activity in animals (rats and rabbits) under continuous exposure to centimeter waves"
922. LOBANOVA, YE. A. (1960) Trudy Sii Gigiyena Truda i Profzaboleaniya AMN SSSR, (1):61-64, (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, 1965, pp. 30-31, "Survival and development of mammals in UHF fields"), (Also abstr. in The Biological Action of Ultrahigh Frequencies, Latavet, A. A., & Gordon, Z. V., (eds.), Moscow, JPRS 12471, pp. 60-63), "Survival and development of animals exposed to various intensities and durations of pulsed SHF-UHF"
923. LOBANOVA, YE. A. (1964) Trudy Sii Gigiyena Truda i Profzaboleaniya AMN SSSR, (2):13-19, (Abstr. in: The Biological Action of Radio Frequency Electromagnetic Fields, Inst. of Industrial Hygiene & Occupational Diseases, Acad. of Med. Sciences, USSR, Moscow), "Changes in conditioned reflex activity of animals exposed to various ranges of microwaves"

924. LOBANOVA, YE. A. (1964) Trudy Nii Gigiyena Truda i Profzabolevaniya AMN SSSR, (2):75-77, (Also in: The Biological Action of Radio Frequency Electromagnetic Fields, Institute of Industrial Hygiene and Occupational Diseases, Academy of Medical Science, USSR, Moscow), "Study of temperature reaction of animals to the effects of microwaves of various wave ranges"  
Trudy Nii
925. LOBANOVA, YE. A. (1966)/Gigiyena Truda i Professional'nye Zabolevaniya (Moskva) USSR, 10(10):7-12, (JPRS 39820), "Effect of chronic exposure to pulsed and nonpulsed 10 cm waves on the conditioned reflex activity of white rats"  
Trudy Nii
926. LOBANOVA, YE. A. (1968)/Gigiyena Truda i Professional'nye Zabolevaniya (Moskva), USSR, (11):23-27, "The problem of establishing standards for periodic microwave radiation exposure: An experimental study"
2917. LOBANOVA, E.A. (1968), Rept., Lab of Radiofrequency Electromagnetic Fields, Inst. of Occupational Hygiene & Diseases, Acad. of Med. Sciences, Ukrainian SSR, 3( ):151-155, (Abstr. in Referativniya Zhurnal Biologiya, #7N50, 1968), "A study of the biological effect of continuous and pulsed radiation by microwaves in acute experiments".
2918. LOBANOVA, E.A., et al. (1971), Gig. Tr. Prbf. Zabol., 15( ):29-33, (Jan.), (In Russ.), "Study of the conditioned reflex in animals (white rats) under the influence of ultrashort and short waves".
3535. LOBANOVA, Ye.A. (1975), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation"(JPRS #64532), p. 46 only, "Investigation of the sensitivity of animals to microwave (MCW) radiation with administration of pharmacological substances."
927. LOBANOVA, YE. A., & GORDON, Z. V. (1960) Trudy Nii Gigiyena Truda i Profzabolevaniya AMN SSSR, (1):52-56, (Also in: The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V., (eds.), Moscow, 1960, JPRS 12471 (1962), pp. 50-56, ). (Also abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "Investigation of the olfactory sensitivity in persons subjected to the influence of SHF-UHF"  
v
928. LOBANOVA, YE. A., & TOLGSKAYA, M. S. (1960) Trudy Nii Gigiyena Truda i Profzabolevaniya AMN SSSR, (1):69-74, (In Russian). (Abstr. in: The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V., (eds.), Moscow, JPRS 12471, (OTS-62-19175-R-816), pp. 68-); (Also abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), also, (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, Sept. 1965, pp. 31-32, "Effect of UHF on nervous activity and inter-neuron connections"), "Change in the higher nervous activity and inter-neuron connections in the cerebral cortex of animals under the influence of SHF-UHF"  
v
2916. LOBELL, M.J. (1962), Clinical Medicine, 69(8): p. 7, (Aug.), "Pulsed high frequency [electromagnetic radiation] and routine hospital antibiotic therapy in the management of pelvic inflammatory disease: A preliminary report".
929. LOGA, S., & ZACIU, R. (1966) Fiziologia Normala Patologica 12:395-402, "Determination of the electric parameters of biological systems at microwave frequencies"
3251. LOMBARDO, S.S. (1959), Presented at Symp. given by The Dr. Abraham J. Ginsberg Foundation for Med. Research, New York, NY, (June 29), "Treatment of decubitus ulcers", [using pulsed, high frequency electromagnetic radiation].
2919. LOMMATZSCH, P., BOHNE, B.-D., ULRICH, W.-D., & KUHN, R. (1973), Albrecht v. Graefes Arch. Klin. Exp. Ophthal., 187( ):201-214, (In Ger., w/Engl. summary), "Morphological examinations of 8 mm microwave coagulations in the rabbit eye", [application to retinal detachment surgery].
3252. LONG, D.M. (1972), Minn. Med., 55( ):564, "New methods of pain relief", [including use of EMR].
3253. LONG, J.C. (1963), Amer. J. of Ophthalmology, 56( ):108-133, "Electric cataract: A clinical and experimental study", [Discussion of cataracts observed following contact with low frequency (DC to 60 Hz) voltages; comparison of effects of D.C. and 60 Hz currents; and consideration of possibility of cataract production by the therapeutic use of electricity, i.e., electroshock therapy and electroanesthesia].
2920. LORDS, J.L., DURNEY, C.H., BORG, A.M., & TINNEY, C.E. (1973), IEEE Transactions on Microwave Theory & Techniques, MTT-21(12):834-836, (Dec.), "Rate effects in isolated hearts induced by microwave irradiation", [Turtle hearts exposed to 960 MHz (cw) irradiation (in Ringer's soln.) experienced decrease in heart rate (bradycardia), in contrast to the tachycardia usually produced by generalized heating].
930. LOSHAK, A. YA. (1953) In: Aviation and Space Medicine, Paris, V. V., (ed.), Academy of Med. Sciences, USSR, Moscow, pp. 292-295, (Transl. in: NASA TT-P-228, N65-13729), "Labor hygiene and occupational pathology involved in the work with centimeter wave generators in the Civil Air Fleet"
931. LOSHAK, A. YA. (1965) Gigiyena i Sanitariya, USSR, (6):18-22, (Abstr. in ATD Press, Special Issue "Biomedical Microwave Research": Vol. 4 (43) pp. 9-10; Transl. in: CPSTI TT-66-51033, 4-6; also JPRS 31280, and N65-29246), "The effect of climatic conditions during chronic irradiation with SHF-UHF energy"
932. LOSHAK, A. YA. (1966) In: Problems of Space Medicine, Moscow, pp. 262-263, (ATD Rept. 66-116), "The problem of the combined biological effect of X-ray and UHF irradiation"
933. LOSHAK, A. YA. (1968) Gigiyena Truda i Professional'nye Zabolevaniya (Moskva) USSR, (5):15-18, "Radio frequency irradiation from aircraft communication systems as a health hazard"
934. LOSHAK, A. YA., & MAR'YECHEKIN, YE. P. (1964) Gigiyena i Sanitariya, USSR, (7):39-44, (FTD TT-65-345/1 and 4, AD 618635, N65-32139), (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-67, Sept. 1965, pp. 21-22, "Working conditions around Civil Air Fleet radar stations"); (Also abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rpt P-65-17, Apr. 1965), "Evaluation of working conditions of civilian airport radar installations"
3536. LOTMAR, R., & RANSCHT-FROEMSDORFF, W. (1968), Zeitschrift für Angewandte Bader und Klimaheilkunde, 15( ):1-10, (In German), "Problems of climatology." [Atmospheric impulse radiation felt to be connected with observed change in rabbit skin respiration.]

3537. LOVELY, R.H., & GUY, A.W. (1975), Univ. of Washington School of Medicine, Seattle (Proceedings of the 1975 IMPI Microwave Power Symposium, Waterloo, Ontario, Canada, 27-30 May 1975), (Citation #3124; this Biblio.), "Conditioned taste aversions in the rat induced by a single exposure to microwaves."
935. LUBIN, M., CURTIS, G. W., DUDLEY, H. R., BIRD, L. E., DALEY, P. F., COGAN, D. C., & FRICKER, S. J. (1960) *AMA Archives of Industrial Health* 21( ):555-558, "Effects of ultrahigh frequency radiation on animals"
2921. LUCHKOV, V., et al. (1971), *Ortop. Travmatol. Protez.*, 32( ):65-68, (Sept.), (In Russ. w/Engl. abstr.), "Comparative evaluation of the effects of ultrasound and microwaves on fracture healing in rabbits."
936. LUDFORD, J. F. (Report), (unpublished, Issuing Agency?), 17 pages, "Status of the field of biological effects of radio-frequency radiation"
937. LUDWIG, F., & RIES, J. (1944) *Manatschr. P. Gebrutsch Cymak* 118:291-298, "Influence of short electromagnetic waves on embryonic development"
3538. LUDWIG, H.W. (1968), *Int. J. Biometeor.*, 12(2):93-98, "A hypothesis concerning the absorption mechanism of atmospheric in the nervous systems."
3539. LUDWIG, H.W. (1971), *Biomedizinische Technik*, 16( ):67-72, (in German), "The effect of electromagnetic extremely low frequency alternating fields on higher organisms."
3540. LUDWIG, H.W. (1972), *Z. angew. Bader-u. Klimaheilk.*, 19( ):15-17, (in German), "Weather influence [including ions and electrical fields] on organic tissue: A theoretical consideration."
3541. LUDWIG, H.W. (1973), *Int. J. of Biometeor.*, 17(3):207-211, "Shielding effect of materials in the ULF, ELF and VLF region."
3542. LUDWIG, W., & MECKE, R. (1968), *Arch. Met. Geoph. Biokl. (Ser. B)*, 16( ):251-261, (in German), "Effect of artificial atmospheric on mammals."
3543. LUDWIG, W., MECKE, R., & SEELEWIND, H. (1968), *Arch. Met. Geoph. Biokl. (Ser. B)*, 16( ):237-250, "Electroclimatology."
3544. LUDWIG, W., PERSINGER, M.A., & OSSENKOPP, K.P. (1973), *Arch. Met. Geoph. Biokl. (Ser. B)*, 21( ):110-116, "Physiological effects of electromagnetic fields in the ELF region: II. A review."
2212. v. LUGOSSY, G. (1942) *Klin. Wsl. Augenh.* 103:319-328 (May/June), (In Ger.), "Effect of diathermy on the eye"
2213. LUKOFF, L., & LOWERS, G. (1960) *Klin. Wsl. Augenh.* 137:232-238, (In Ger.), (Abstr. in: *Zentralbl. f. d. ges. Ophth.* 31(5):295 (Mar 1961)), "The sclera after non-perforating electro-coagulation"
938. LUKYANOVA, S. N. (1967) *Zh. Vysshei Nervnoi Deyatel'nosti imeni i Pavlov, USSR*, 17(4):722-729, "The effect of a permanent magnetic field on the bioelectric activity of various brain formations in rabbit"
2455. LUND, E.J. (5 Collaborators), (1947), The U. of Texas Press, Austin, (including "Bibliography of continuous bioelectric currents and bioelectric fields in animals and plants", by Rosene, H.F.), *Bioelectric Fields and Growth*.
2922. LUTSENKO, S.M., et al. (1970), *Ortop. Travmatol. Protez.*, 31( ):76-78, (In Russ.), "Effects of electromagnetic ultra-high frequency waves on the revascularization of free skin transplants."
3545. LUTSKER, L.S. (1974), *Oftal'mologicheskii Zhurnal*, (4):249-251, (in Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #L/5615), 10 Feb. 1976, pp. 50-53, "Microwave therapy and drug electrophoresis in treatment of central serous chorioretinitis and toxoplasmosis."
939. LUZZIO, A. J. (1965) In: U. S. Army Med. Research Lab. Progress Report, pp. 37-38 (AD 470368), "Immune mechanisms [Athermal biological effect of RF energies]"
2923. LYAKH, L.A. (1973), *Gigiyena Truda i Professional'nyye Zabolevaniya*, (6):23-26, (In Russ.), (Transl. as JPRS No. 59690, 6 pps.), "Investigation of the alkaline phosphatase [a.p.] activity in persons dealing with electromagnetic emission generators of high, ultra-high, and superhigh frequency", [observed increase in a.p. of neutrophils, depending on field strength, but not on freq., over range HF, UHF, SHF].
940. LYALINA, O. V. (1937) In: All Union Inst. for Experimental Medicine, Moscow, "Hyperglycemic reaction to ultrahigh frequencies in connection with dosimetry"
941. LYSINA, G. G. (1965) *Gigiyena i Sanitariya, USSR*, (6):95-96, (ATD Press, Special Issue "Biomedical Microwave Research", Vol. 4(43), pp. 4-5 (Aug. 1965); also in: *CFSTI TT-66-51033/4-6*), "Changes in the morphological composition of blood under the influence of SHF-UHF"
3546. LYSINA, G.G. (1975), *Meditinskaya Radiologiya*, 20(11):50-54, (in Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #L/5615), 10 Feb. 1976, pp. 41-49, "Clinical physiological changes caused by job-associated radiation and radio waves."
- (or LYSCOV?)
942. LYSTSOV, V. N., FRANK-KAMENETSKI, D. A., & SHCHEDRINA, M. V. (1965) *Biophysika* 10:105-109, (In Russian), (Biophysics 10:114-119, 1965, In English), "Effect of centimeter radiowaves on vegetative cells, spores, and transforming DNA"

943. LYUDKOVSKAYA, R. G., & ALEKSEYENKO, N. YU. (1956) Materials on Evolutionary Physiology, Symposium, Moscow-Leningrad, 1:183-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept P-65-17, Apr. 1965), Title not given [Deals with exposure of muscle to UHF radiation]
944. LYUTOV, A. I. (1964) In: Some Problems of Physiological Biophysics, Voronezh, Izd-vo Voronezh, Univ., pp. 92-98, "Dynamics of excitability and efficiency of spinal cord motor neurons during brain incisions at various levels, and the action of sound and RF electromagnetic oscillations upon the CNS"
3547. MAASS, J.A., & ASA, M.M. (1970), IEEE Trans. on Magnetics, MAG-6(2):322-326 (June), "Contactless nerve stimulation and signal detection by inductive transducer."
2068. MACCIOLI, J. T. (1971) Bioenvironmental Safety Newsletter, pp. 3-5, (4th Quarter), "RF health hazards and monitoring meters -- Recent Notes"
2456. MACCIOLI, J. (1972), Bioenvironmental Safety, (3-72), (of U.S. Naval Safety Center), 4(3):6-7, "RF burns from radio frequency radiation".
2214. MacGREGOR, R. J. (1970), (Abstr. #N71-14482; AD 712694), "A brief survey of literature relating to the influence of low intensity microwaves on nervous function"
2215. MacGREGOR, R. J. (1970) The Rand Corp. Rept. P-4398 (25 pps.), AD #708815 "A direct mechanism for the influence of microwave radiation on neuroelectric potentials"
959. MACHABELI, M. YE., KHUBUTIYA, V. A., & CHINCHALADZE, J. J. (1957) Gigiena i Sanitariya 22(11):81-83, (In Russian), "Working conditions and the state of health of workers employed in radio frequency installations"
960. MACHLE, W., & LANDEEN, K. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.) 3:71 only, "The effect of repeated microwave exposures on the formed elements in the blood of rats"
961. MACKAY, R. S. (1960) Inst. of Radio Engineers Trans. ME-7:111-113, "Some electrical and radiation hazards in the laboratory"
962. MACLEOD, J., & HOTCHKISS, R. S. (1941) Endocrinology 28:780-784, "The effect of hyperpyrexia upon spermatozoa counts in man"
963. MACMURRAY, L. C. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G., & Banghart, F. V., eds.) 2:79-87, (AD 131477), "Microwave radiation hazards problems in the U. S. Army"
964. MACMURRAY, L. C., DEENE, E. J., & DUGUID, R. H. (1958) U. S. Army Environmental Hygiene Agency, Tech. Pub., "Health hazards associated with microwave radiation"
965. MADSON, R. A., CORDARD, J. T., KILLER, R. L., & VOELKER, G. E. (1970) USAF School of Aerospace Medicine Rept. SAM-TR-70-87, "Effects of microwaves on bacteria in frozen foods"
2924. MAPRICI, D., et al. (1970), Radiol. Health Data Rept., 11( ):667-670, (Dec.), "Nassau County microwave ovens study: June 1969 - March 1970"
2925. MAGIN, R.L., & BURNS, C.P. (1972), Proceedings of the IEEE 1972, Region 3 Conference, (Apr.), "Determination of biological tissue dielectric constant and resistivity from 'in vivo' impedance measurements".
3548. MAGIN, R. L., LU, S. T., & MICHAELSON, S. M. (1974) Rochester Univ. NY. Rept. No. UR-3490-671, 8 pps., "Biological effects of locally applied-microwaves on the thyroid gland of dogs."
3254. MAIOROVA, I.S. (1972), Vopr. Kurorotol. Fizioter. Lech. Fiz. Kult., 37( ):448-450, (In Russ.), "Effect of inductothermy on heart function in patients with systemic scleroderma", ["therapy reduced pain in the chest, alleviated dyspnea, and made tachycardia disappear"].
2216. MAJEWSKA, K. (1968) Polish Medical J. VII:969-994, "Investigations on the effect of microwaves on the eye"
966. MAKAROV, P. O. (1967) Vestnik Leningradskogo Universitat/ Seriya Biologii, USSR, (21):150-152, "On the resonance and selective absorption of microwaves by the Flagellate Opalina ranarum"
967. MAKSIMOV, G. A., & KRYUKOVA, I. M. (1956) Biofizika 1:201-205, (In Russian) "Study of the mechanism of heat and mass exchange in seeds of plants grown with heat provided by an rf electrical field"
968. MALAKHOV, A. N., MAKSIMOV, A. S., & NEZEDOV, YU. YA. (1965) In: Bionika (BIONICS), GAAZE-RAPOPORT, M. G., & Yakobi, V. E., (eds.), Nauka Pub. House, Moscow, pp. 377-381, (JPRS 35125, Apr. 1966), "On the electromagnetic hypothesis of biological communication"
969. MALAKHOV, A. N., ROMANOV, I. V., SMIRNOV, YU. V., & UL'YANOV, M. YU. (1965) In: Bionika (BIONICS), GAAZE-RAPOPORT, M. G., & Yakobi, V. E., (eds.), Nauka Pub. House, Moscow, pp. 302-305, (AID Transl. N66-24173; JPRS 35125: TT-66-31562), "Biological indication of a SEF-UHF electromagnetic field"
970. MALAKHOV, A. N., SMIRNOV, YU. V., & UL'YANOV, M. YU. (1963) Materials of the 3rd Povolzhskaya Conf. of Physiologists, Biochemists, and Pharmacologists, Gor'kiy, "The SEF-UHF electromagnetic field as a signal factor in the conditioned reflex of white mice"
971. MALLARD, J. R., & LAWN, D. G. (1967) Nature (London) 213:28-30, "Dielectric absorption of microwaves in human tissues"
972. MALLARD, J. R., & WHITTINGHAM, T. A. (1968) Nature (London) 218(5139):366-367, "Dielectric absorption of microwaves in human tissues"

2457. MAKOW, D., & GRICE, H. (1963), *Nature*, 200(4911):1120-1121, "Influence of radio frequency heating on sperm".
3255. MALONE, W.F. (Ed.), (1974), *Electrosurgery in Dentistry: Theory and Application in Clinical Practice*, 248 pps., Charles C. Thomas, Pub., Springfield, IL.
2020. MALYSEEV, V. M., & KOLESNIK, F. A. (1968) Izd-vo "Meditsina", Leningrad, Effects of SHF Electromagnetic Fields on Human Health
973. MANDELTSVAYG, YU. B. (1962) *Meditsinskaya Radiologiya* 7(8):100-101, (JPRS 15553), The second all union conference on the use of radio-electronics in biology and medicine
973. MANDLER, F. H. (1934) Abstr. of the 1st Internat. Congress on Electro-Radio-Biology, Cappelli, L., (ed.), Bologna, Italy, pp. 543-552, "Some aspects of combined radiation therapy"
2458. MANGANELLI, L.A. (1972), Report No. GW BSCP-72-04R of Geo. Washington Univ. Medical Ctr. (Biolog. Sciences Communication Project), performed under NASA Contract No. NSR-09-010-027, (Feb.), 195 pages, "Biomagnetism: An annotated bibliography".
3549. MANOYLOV, S.Ye., GURVICH, G.I., MANOYLOV, V.Ye., GUSEVA, T.F., & CHISTYAKOVA, Ye.N. (1975). Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation"(JPRS #64532), p. 48 only, "Possibility of using electromagnetic radiations of the millimeter wavelength to intensify the biological properties of blood proteins."
974. MANSFIEL, P. B. (1966) *Amer. J. of Medical Electronics* 5:61-65, "On interference signals and pacemakers"
975. MANYASHEN, YU. A. (1967) *Gigiyena Truda i Professional'noye Zabolvaniya* (8):47-49, (AD 671436), (Abstr. in: *Soviet Radiobiology*, ATD 66-105-108-9, pp. 80-81, June 1968), "Disturbance of aromatic amino-acid exchange products excreted with urine in persons exposed to the action of HF and UHF electromagnetic waves"
976. MAREX, E. (1959) *Pracovní Lekarství, Prague*, 11:401-403, (In Czech.) "Protective measures against the effects of centimeter radiation on the human organism"
2217. MARCETTI, V. M. (1972) *J. of the Amer. Inst. of Homeopathy* 65(1):7-20, ("to be cont'd in June '72 issue"), "The minima, man, and biomagnetism: Some contemporary concepts" ["interesting" (?) reading]
977. MARHA, K. (1963) *Pracovní Lekarství, Prague*, 15(6):238-242, (In Czech.), (AD 460316, FTD TT-64-898, N65-35916, AD 618466; A64-80C also ATD Rept. 65-56, July 1965); (Abstr. in: *The Biological Effects of Electromagnetic Fields - Annotated Bibliography*, ATD Rept. P-65-17, Apr. 1965), "Certain experimental observations of the effect of a high frequency electromagnetic field in vivo and in vitro"
978. MARHA, K. (1963) *Pracovní Lekarství, Prague*, 15<sup>(9)</sup>:387-393, (In Czech.) "Biological effects of rf electromagnetic waves"
979. MARHA, K. (1963) Final Report of the Institute of Industrial Hygiene and Occupational Diseases, Prague, (In Czech.), "Complex theory of the mechanism of the effects of electromagnetic fields on the organism"
980. MARHA, K. (1967) U. S. Govt. Res. & Dev. Reports, 25 pages (AD 642029) (Summary of Unclassified Report), "Biological effects of high-frequency electromagnetic waves" (Transl. of item #978 (above))
981. MARHA, K. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 188-196, "Maximum admissible values of HF and UHF electromagnetic radiation at work places in Czechoslovakia"
2011. MARHA, K. (1971) *IEEE Trans. on Microwave Theory and Techniques* (Special Issue on Biological Effects of Microwaves) MTT-19(C):165-168, "Microwave radiation safety standards in Eastern Europe"
982. MARHA, K., & MUSIL, J. (1962) *Slaboproudý obzor* 7:409-413, (In Czech.) "Measurement of the power density at centimeter wavelengths for health purposes"
983. MARHA, K., MUSIL, J., & TUHA, H. (1963) *Pracovní Lekarství, Prague*, 15(9):387-393, (In Czech.); (ATD Rept. 66-92; AD 642029), (Abstr. in: *The Biological Effects of Electromagnetic Fields - Annotated Bibliography*, ATD Rpt P-65-17, Apr. 1965), "Biological effects of high frequency electromagnetic waves"
984. MARHA, K., MUSIL, J., & TUHA, H. (1968) (In Czech.), State Health Publishing House, Praha, Czechoslovakia, 138 pages, (Transl. SBN 911302-13-7, Pub. by San Francisco Press, Inc., 1971), Electromagnetic Fields and the Living Environment
3550. MARINO, A.A., BERGER, T.J., BECKER, R.O., & HART, F.X. (1974), *Experientia*, 30(11):1274-1275 (Nov. 15), "Electrostatic field induced changes in mouse serum proteins."
985. MARKS, E., & HORNCOWSKI, J. (1965) *Neurologia i Neurochirurgia Polska* 2(1):25-29, (In Polish with English summary) "Clinical observations concerning the effect of microwaves on the nervous system"
986. MARKS, J., CARTER, E. I., SCARPELLI, D. G., & EISEN, J. (1961) *Ohio State Medical J.* 57(3):274-279, "Microwave radiation to the anterior mediastinum of the dog: I. Histologic and electrocardiographic observations"; pp. 1132-1135, "II. Thermal, cardiovascular, respiratory, and blood enzyme observations"
3256. MARONCELLI, M., & FERRARO, G. (1967), *La Clinica Otorinolaringoiatrica*, 3( ):249-262, (In Ital. w/ Engl. summary), "A new method of physical therapy [pulsed high frequency electromagnetic radiation] for the treatment of chronic simple otitis".

3551. MARR, M.J., RIVERS, W.K., & BURNS, C.P. (1973), Georgia Institute of Technology (Atlanta), Final Report prepared for Office of Naval Research (28 Feb.), "The effect of low energy, extremely low frequency (ELF) electromagnetic radiation on operant behavior in the pigeon and the rat."
987. MARRIOTT, I. A. (1964) Medical Service J. of Canada 20:546-552, "Three cases of apparent chemical burns of the hands following contact with a magnetron tube"
988. MARSHALL, R. (1963) *Tradex - O and M*, 11(2):pp.? "Safety notes on microwave generation hazards"
989. MARTIN, E. J., CONSTANT, P. C., JONES, B. L., FARGO, E. T., & CARTWRIGHT, E. C. (1962) Final Report on Bureau of Ships (Navy) Contract #Nobs-77142 (June) by Midwest Research Institute, Kansas City, Mo., "Survey of radio frequency radiation hazards"
990. MARTIN, G., & ERIKSON, D. (1950) J. of the Amer. Medical Assoc. 142:27-30, "Medical diathermy"
991. MARTIN, G., & HERRICK, J. (1955) J. of the Amer. Medical Assoc. 159:1286-1287, "Further evaluation of heating by microwaves and by infrared radiation as used clinically"
992. MARTIN, G., RAE, J., JR., & KRUSEN, P. (1950) Southern Medical J. 43:518-524, "Medical possibilities of microwave diathermy"
2926. MARTIN, H., *et al.* (1973), Fortschr. Zool., 21( ):211-228, (In Ger.), "Orientation in the terrestrial magnetic field".
2459. MARTIN, J.A. (1970), Rept., Stanford Research Institute, Contract F29601-69-C-0127, SRI Project 7995 - Work Order 3.4, (Tech. Memo. 6 of 30 June), "Biological effects of fields of the Siegfried array", [Results suggest no hazardous effects to man from the electromagnetic pulse device].
993. MASOERO, P., *et al.* (1965) *Minerva Pediatrica* 17:1133-, (In Italian) "Preliminary Report: Influence of electrostatic fields and of 'activated' water on weight increase"
994. MASON, J. F. (1959) *Electronics* 34:34-35, (Dec. 1), (Also in: Digest of Tech. Papers, Proc. of the 12th Annual Conf. on Electrical Techniques in Medicine and Biology (Schwan, H. P., Cha.)), "Germ-gas electronic [radiation] detectors"
3552. MATSUCHITA, S., & CAMPBELL, W.H. (1967), *Physics of Geomagnetic Phenomena*, Vol. II, Academic Press.
2927. MATSUMOTO, G., & YAMURA, T. (1971), J. of the Electrical Society (of Japan), 91(4):588-596, (In Jap.), "The biological effects of microwave irradiation".
995. MATUZOV, N. I. (1959) *Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva)* 42(7):27-30, "Changes in the excitation of the optic analyzer in man by microwaves"
2928. MAXEY, E.S. (1972), *Aviation Week & Space Technology*, 'Letters to the Editor' section,  ( ):64 only, "Electromagnetism"
2087. MAY, K. N. (1969) *J. Microwave Power* 4:54-59, (Abstr. in: Non-ionizing Rad. 1(3):151 only, (1969), Abstract #67), Applications of microwave energy in preparation of poultry convenience foods"
996. MAY, L., KAMBLE, A. B., & ACOSTA, I. P. (1970) J. of Membrane Biology 2:192-200, "The effect of electric fields on brain cephalin and lecithin films"
2460. MAYER, GLASTON; PRIORE, A.; MAYER, GUY; & PAUTRIZEL, R. (1972), *Comptes rendus des seances de l'Academie des Sciences*, 274( ):3011D-3014D, (29 May), (in Fr.), "Action of magnetic fields associated with electromagnetic waves on the rabbit trypanosomes"
3553. MAYER, J. (1975), *The Washington Post*, Sunday, Dec. 28, p. C6 only, "Ulcerative colitis, cures and treatment." [Comment in the "Nutrition" section on the safety of microwave ovens.]
997. MAYER, O. (1954) *Science Newsletter* 47:296-, "Effect of radar waves studied by Army and Navy"
2929. MAYERS, C.P. (1970), J. of Clinical Pathology, 23( ):273-275, "Histological fixation by microwave heating".
2930. MAYERS, C.P., & HABESHAW, J.A. (1973), *Internat. J. of Radiation Biology*, 24(5):449-461, "Depression of phagocytosis: A non-thermal effect of microwave radiation as a potential hazard to health".
998. MAZURKIEWICS, J. (1968) *Lekarz Wojskowy*  (3):165-170, (ATD 68-129), "Classification of the harmful effect of microwaves on man"
945. McAFEE, R. D. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.) 3:314-331, "Neurophysiological effects of microwave irradiation"
946. McAFEE, R. D. (1961) *Amer. J. of Physiology* 200(2):192-194, "Neurophysiological effect of 3 cm microwave radiation"
2461. McAFEE, R.D. (1962), Rept. from Tulane University School of Medicine, (Feb.), pp. 374-378, "Physiological effects of thermode and microwave stimulation of peripheral nerves".

947. McAFEE, R. D. (1963) Amer. J. of Physiology 203(2):374-378, "Physiological effects of thermode and microwave stimulation of peripheral nerves"
948. McAFEE, R. D. (1963) Biomedical Sciences, Instrumentation 1:167-170, "Microwave stimulation of the sympathetic nervous system"
949. McAFEE, R. D. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 150-153, "The neural and hormonal response to microwave stimulation of peripheral nerves"
2019. McAFEE, R. D. (1971) IEEE Trans. on Microwave Theory and Techniques (Special Issue on Biological Effects of Microwaves) MTT-19(2):251-252, "Analeptic effect of microwave irradiation on experimental animals"
2931. McAFEE, R.D. (1972), J. of Microwave Power, 7( ):83-85, "Low power density behavior effects of microwave irradiation of experimental animals: Real or artifact?"
950. McAFEE, R. D., BERGER, C., & PIZZOLATO, P. (1960) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Peyton, M. F., ed.) pp. 251-260, "Neurological effect of 3 cm microwave irradiation"
3257. McAFEE, R.D., BRAUS, R., JR., & FLEMING, J., JR. (1973), J. of Microwave Power, 8(1):111-116, "The effect of [chronic] 2450 MHz microwave irradiation on the growth of mice", [lack of growth stimulating effect].
3258. McAFEE, R.D., CAZENAVETTE, L.L., & SHUBERT, H.A. (1974), J. of Microwave Power, 9(3):177-180, (Sept.), "Thermistor probe error in an x-band microwave field", [absence of coupling of a stainless steel hypodermic needle containing a thermistor with the electric field in application such as measuring the temperature of biological tissue at 9.3 GHz].
3554. McCLEAVE, J.D., ALBERT, E.H., & RICHARDSON, N.E. (1974), Univ. of Maine, Final Report prepared for Office of Naval Research (31 Jan.), "Perception and effects on locomotor activity in American eels and Atlantic salmon of extremely low frequency electric and magnetic fields."
2462. McCOTY, A.S. (1967), The Kansas City Star, p.3, (Oct. 7), "That stange buzz may be radar".
2932. McCULLOUGH, J., POLESKI, H.F., NELSON, C., & HOFF, T. (1972), Anesthesia and Analgesia, 51(1):102-106, (Jan.-Feb.), "Introgenic hemolysis: A complication of blood warmed by a microwave device".
3555. McELHENY, V.K. (1975), New York Times (Oct. 10), p. 40 only, "Electricity transmitted by radio beam on [west] coast" [at microwave frequency].
951. McELHANEY, J. H., & STALNAKER, R. (1968) J. of Biomechanics 1:47-52, "Electric fields and bone loss of disease"
952. McILWAIN, H. (1953) Biochem. J. 55:618-624, "Glucose level, metabolism and response to electrical impulse in cerebral tissues from man and laboratory animals"
2933. McKAY, D.H. (1971), EID Electronic Instrumentation, 7(12):14-17, (Dec.), "Electromagnetic pollution measurement".
2463. McKAY, H.D. (1970), Rept., Fairchild/Electro-Metrics Corp. (Burbank, Calif.), (Aug.), 12 pps., "Current status [of] electromagnetic pollution management and measurement".
2464. McKERCHAR, W.D., & KING, W.M. (1972), J. for the Advan. of Med. Instrumentation, 6:178-179, "Electromagnetic susceptibility test results of heart pacemakers".
2934. McKINLEY, G.M. (1930), Trans. of the Pennsylvania Acad. of Science, 4( ):43-46, "Some biological effects of high frequency electrostatic fields".
2935. McKINLEY, G.M., & MURRAY, —. (1935), Univ. of Pittsburg Bull., 30(2):183-188, (Biol. Abstr. #13576), "The ultrahigh frequency magnetic-electric field in biology".
953. McLAUGHLIN, J. T. (1957) California Medicine 86(5):336-339, "Tissue destruction and death from microwave radiation (radar)"
2069. McLAUGHLIN, J. R. (1962) Western Medicine 3:126-132, (April), "Health hazards from microwave radiation"
954. McLEES, B. D., FINCH, E. D., & ALBRIGHT, M. L. (1971) Naval Medical Research Institute Report (Rept. No. 1 on Project MF12.524.015-0001B), "An examination of regenerating hepatic tissue following in vivo exposure to RF radiation" (Also: J. Applied Physiology 32(1):77-85 (1972))
955. McLEES, B. D., & FINCH, E. D. (1971) Naval Medical Research Institute Report (Rept. No. 2, on Project MF12.524.015-0001B), "Bibliography on the hazards of artificial cardiac pacemaker exposure to radio frequency fields and electric shock"
956. McLEES, B. D., & FINCH, E. D. (1971) Naval Medical Research Institute Report (Rept. No. 3 on Project MF12.524.015-0001B), "Analysis of the Physiologic Effects of Microwave Radiation" (Also: see citation #2086, this Bibliography)
957. McNALLY, E. M., & BENCHIMOL, A. (1968) Amer. Heart J. (Part I) 75:pp? (Mar.); (Part II) 75:679-695, (May), "Medical and physiological considerations in the use of artificial cardiac pacing", Parts I and II
958. McNALLY, J. B., NUNN, A. S., CICHON, J. V., & RICHARDSON, A. W. (1962) Federation Proceedings 21(2):1-255, "Microwave effects on glucose absorption and transfer in the rat"

2465. McREE, D.I. (1971), Health Physics, 21:763-769, "Thresholds for lenticular damage in the rabbit eye due to single exposure to CW microwave radiation: An analysis of the experimental information at a frequency of 2.45 GHz".
2466. McREE, D. I. (1972) Environmental Health Perspect., 5(2): 41-53, (Oct.), "Environmental aspects of microwave radiation"
2936. McREE, D.I. (1973), Presented at the 66th Annual Meeting of the Air Pollution Control Assoc., June 24-28, Paper No. 73-9, "Biological effects of microwave radiation".
3259. McREE, D.I. (1974), Health Physics, 26(5):385-390, "Determination of the absorption of microwave radiation by a biological specimen in a 2450 Mhz microwave field", [using the time-temperature profiles of distilled water; applicable to *in vitro* studies of small, homogeneous biological specimens].
3260. McREE, D.I. (1974), J. of Microwave Power, 9(3):263-270, (Sept.), "Determination of energy absorption of microwave radiation using the cooling curve technique".
2937. McREE, D.I., & WALSH, P. (1971), Rev. of Sci. Instruments, 42( ):1860-1864, "Microwave exposure system for biological specimens".
999. MEADE, K. (1959) The Engineer's Digest (U. S. Coast Guard Pub.) CG-133, #118, (Sept.-Oct.), p. 42, "Radio frequency radiation hazards"
1000. MEAHL, H. R. (1956) Institute of Radio Engineers Trans. on Medical Electronics, PGME-4:16 only, (Abstr. from Symposium on Physiologic and Pathologic Effects of Microwaves (Krusen, F. H., Chm.), 23-24 Sept. 1955, Mayo Clinic), "Protective measures for microwave radiation hazards: 750 to 30,000 Mc"
1001. MEAHL, H. R. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Peyton, M. F., ed.) pp. 15-22, "Basic problems in measuring RF field strength"
1002. MEAHL, H. R. (1961) Digest of the Internat. Conf. on Medical Electronics, Biological Effects of Microwaves I (Athermal Aspects), (Frommer, P. L., ed.) pp. 229-, "Ion orb omnidirectional, fixed level, visual indicator of radio frequency field strength"
2938. MEDINA, M.A., et al. (1973), In: Proceedings, Federation of American Societies for Experimental Biology, \_\_\_( ): pp. ?, "NAD levels in rat brain following tissue fixation by microwave radiation".
3556. MEDINA, M.A., JONES, D.J., STAVINOH, W.B., & ROSS, D.H. (1975), J. of Neurochemistry, 24(2):223-227, "Levels of labile intermediary metabolites in mouse brain following rapid tissue fixation with microwave irradiation."
2939. MEWVEDEV, V.P. (1973), Gigiena Truda i Professional'nyye Zabollevaniia (Moskva), 17(3):6-9, (Mar.), (In Russ., w/Engl. summary), "Cardiovascular diseases in persons with a history of exposure to the effect of an electromagnetic field of extra-high frequency", ["...study of 80 male workers with history of exposure to cm-band microwaves (& 80 controls); including medical exam, ECG, and blood lipids, Microwave workers had significantly higher incidence of ECG disorders, dyslipidemia, ischemic heart, and hypertensive disease..."].
1003. MELLON, R. R., SZYMANOWSKI, W. T., & HICKS, R. A. (1930) Science 72:174-175 (Aug. 15), "An effect of short electric waves on diphtheria toxin independent of the heat factor"
3557. MELVILLE, D., PAUL, F., & ROATH, S. (1975), Nature, 255(5511):706 only (July 26), "Direct magnetic separation of red cells from whole blood."
2467. MENCHINOV, G. (1971), Sovetskaya Rossiya, No.272 (4696), p.4, (21 Nov.), (CIRC abstract), "Magnetic therapy for cardiovascular patients".
2940. MENDELSON, J.M., RONSIVALLI, L.J., KING, F.J., CARVER, J.H., LEARSON, R.J., SPRACKLIN, B.W., & KENYON, E.M. (1969), Fishery Indust. Res., 4(7): pp. ?, (Mar.), Preprint No. 70, U.S. Depart. of the Interior, U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, Wash., DC, "Opening oysters and other bivalves using microwave energy".
3558. MENGES, R.M., & WAYLAND, J.R. (1974), Weed Science, 22(6):584-590, "UHF electromagnetic energy for weed control in vegetables."
3261. MENNIE, D. (1975), IEEE Spectrum, \_\_\_( ):34-39, (Mar.), "Microwave ovens: What's cooking? 'Only your roast' say most experts on nonionizing radiation, but consumer advocates and some researchers express doubts". [Discussion, among other items, of 'safe exposure levels', and work of IEEE Committee on Man and Radiation (COMAR), and U.S. Office of Telecommunications Policy (OTP).]
1004. MEOSKINE, B. (1948) Rev. Morrel 60:364-366, "Rapid modification of local temperature following application of short waves and its clinical significance"
2468. MERCKEL, C. (1971), Calif. Med., 117(1):20-24, "Microwaves and man: The direct and indirect hazards, and the precautions".
1005. MERJANIAN, S. V. G., & SCHWAN, H. P. (1966) ONR Tech. Rept. No. 42, and M.S. Thesis of S.V.G.M., Moore School of Electrical Engineering, Univ. of Pennsylvania, "Optimization study of an electrical method for the rapid thawing of frozen blood"
1006. MERMAGEN, H. (1959) Digest of Tech. Papers, Proc. of the 12th Annual Conf. on Electrical Techniques in Medicine and Biology, (Schwan, H. P., Chm.) p. 41 only, "Studies on the behavior of phantoms in electromagnetic (radar) fields"

1007. MERMAGEN, H. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Peyton, M. F., ed.) pp. 143-152, "Phantom experiments with microwaves at the University of Rochester"
1008. MEROLA, L. O., & KINOSHITA, J. H. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Peyton, M. F., ed.) pp. 285-291, "Changes in the ascorbic acid content in lenses of rabbit eyes exposed to microwave radiation"
1009. MERREY, J. L. (1963), AD 415814, 11 pages, "Some biological aspects of microwave radiation"
1010. MERRIMAN, J. R., HOLMQUEST, H. J., & OSBORNE, S. L. (1934) Amer. J. of Medical Science 187:677-, Title?
3559. MERRITT, J.H., MEDINA, M.A., & FRAZER, J.W. (1975), In: Research Communications in Chemical Pathology and Pharmacology, 10(4):751-754 (April), "Neurotransmitter content of mouse brain after inactivation by microwave heating."
1011. MEYERS, G. H., PARSONNET, V., ZUCKER, I. R., & LEWIN, G. (1968) Medical Research Engineering 7:13-16, "An experimental radio-frequency carotid-sinus pacemaker"
2218. MEZEHOVA, V., & SYNEK, V. (1970) Pracovní lékařství 22(1):1-5, "Evaluation of important factors influencing EEG findings in persons with a long-term exposure to electromagnetic radiation in the meter wave band"
2219. MEZEHOVA, V., SYNEK, V., & TOLATVA, J. (1970) Pracovní lékařství 21(1):5-7, "The effect of the electromagnetic radiation in meter wave band on the EEG frequency spectrum of exposed persons"
1012. MIALE, J., & LANDEEN, K. (1964) Toxicology and Applied Pharmacology 6:71-77, "Effect of microwave radiation on the hemopoietic system of the rat"
1013. MICHAELSON, S. M. (1958) Communication at the 2nd Tri-service Conf. on Biological Effects of Microwave Energy, July 1958, Univ. of Virginia, reported by Baldwin and Bach, "Dogs turned toward the beam at 2800 MHz"
1014. MICHAELSON, S. M. (1968) Report N69-25298, UR-49-1012, 28 pages, "The effect of 2800 MHz microwaves on the eye of rabbits and dogs"
1015. MICHAELSON, S. M. (1969) J. of Microwave Power 4(2):114-119, "Microwave hazards evaluation: concepts and criteria"
2220. MICHAELSON, S. M. (1969) Presented at Int. Neurol. Congr., Prague, (Abstr. #N70-12450), "Microwave standards - a comparative analysis" [between U. S. & Russia of quantification of biological responses]
1016. MICHAELSON, S. M. (1970) In: Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 35-58, "Biological effects of microwave exposure"
2058. MICHAELSON, S. M. (1970) Non-ionizing Rad. 1(4):169-176, "Pathophysiological aspects of microwave irradiation, Part 1 - Thermal effects"; Part 2, ibid. (1971) 2(1):27-38, "Critical analysis of the literature"
2221. MICHAELSON, S. M. (1971) American Industrial Hygiene Assoc. J. 32:338-345, "Biomedical aspects of microwave exposure"
1017. MICHAELSON, S. M. (1971) IEEE Trans. on Microwave Theory and Techniques (Special Issue on Biological Effects of Microwaves) MTT-19(2):131-146, "The Tri-Service Program - A tribute to George M. Knauf, USAF (MC)"
3263. MICHAELSON, S.M. (1971), J. of Microwave Power, 6(3):272-276, "Response to 'Comments'".
2469. MICHAELSON, S.M. (1971), Journal of Microwave Power, 6(3):259-267, "Biological effects of microwave exposure - An overview".
2470. MICHAELSON, S.M. (1972), Journal of Microwave Power, 7(2):67-73, "Cutaneous perception of microwaves".
2471. MICHAELSON, S.M. (1972), Proc. of IEEE (Inst. of Electrical & Electronics Engineers), 60(4):389-421, "Human exposure to nonionizing radiant energy - Potential hazards and safety standards".
2472. MICHAELSON, S.M. (1972), Amer. Industrial Hygiene Assoc. J., 33(3):156-164, (Mar.), "Microwave exposure safety standards - physiologic and philosophic aspects".
2941. MICHAELSON, S.M. (1972), Rept. UR-3480-103, Univ. of Rochester, New York, "Relevancy of experimental studies of microwave-induced cataracts to man".
2942. MICHAELSON, S.M. (1973), In: Hearings before the Committee on Commerce, U.S. Senate, Mar. 8-12, 1973, on Public Law 90-602, entitled "Radiation Control for Health and Safety Act of 1968", Serial No. 93-24, p.136-168, "Biomedical aspects of microwave exposure".
2943. MICHAELSON, S.M. (1973), In: Proceedings of the Third International Congress of the Internat. Radiation Protection Assoc., Sept. 9-14, (Wash., DC), "Biologic effects and exposure standards for non-ionizing electromagnetic energies".
2944. MICHAELSON, S. M. (1973), In: Proceedings of the Internat. Symp. on Biologic Effects & Health Hazards of Microwave Radiation, Rept. No. UR-3490-317 (Warsaw, Poland), Oct. 15-18, "Thermal effects of single and repeated exposures to microwaves: A review"

3264. MICHAELSON, S.M. (1973), *Industrial Medicine & Surgery*, 42( ):9-13, "Are your workers exposed to non-ionizing radiant energy?", [Occupational aspects of exposure to radio-frequency, microwave, infra-red, visible, and ultraviolet radiation; thresholds and standards].
2945. MICHAELSON, S.M. (1973?), *World Health Organization, Regional Office for Europe, Pub. No. EURO-3170, "Potential hazards and safety consideration in human exposure to non-ionizing radiant energies"*.
3265. MICHAELSON, S.M. (1974), *Environmental Health Perspectives*, 8(\*):133-156, (Aug.), "Effects of exposure to microwaves: Problems and perspectives".
3266. MICHAELSON, S.M. (1974), *Federation Proceedings, Fed. of Amer. Soc. of Experimental Biol.*, 33(3):461- , "Physiologic adjustments to microwave exposure".
2946. MICHAELSON, S.M. (1974), In press, "The relevancy of experimental studies of microwave-induced cataracts to man".
3267. MICHAELSON, S.M. (1974), *The J. of Microwave Power*, 9(2):147-161, (June), "Review of a program to assess the effects on man from exposure to microwaves", [Comments on presentations made at the Warsaw Symposium held Oct. 15-18, 1973, citation #3114, this Biblio.].
3560. MICHAELSON, S.M. (1975), In: AGARD Rept. entitled "Radiation Hazards" (Rept. #AGARD-LS-78), Aug., "Protection guides and standards for microwave exposure."
1018. MICHAELSON, S. M., & DODGE, C. H. (1958) 21st Annual Conf. on Engineering in Med. and Biology, 18-21 Nov., (Also, Rept. N69-25367, TR-49-976), "Soviet views on the biologic effects of microwaves"
1019. MICHAELSON, S. M., & DODGE, C. H. (1971) *Health Physics* (in press), "Soviet views on the neural effects of microwaves" (Expanded in citation #2057)
2057. MICHAELSON, S. M., & DODGE, C. H. (1971) *Health Physics* 21:108-111, "Soviet views on the biological effects of microwaves -- An analysis"
2473. MICHAELSON, S.M., & HOUK, W.M. (1972), Presented at the "7th Midyear Symposium of the Health Physics Soc. on Non-Ionizing Radiant Energy in the Healing Arts", San Juan, P.R., 11-14 Dec., "Exposure criteria for non-ionizing radiant energy in the healing arts -- Product emission standards and personnel exposure standards".
2947. MICHAELSON, S.M., HOUK, W.M., LEBDA, N.A., LU, S., & MAGIN, R. (1974), (In Press), N.Y. Academy of Sciences Symp. Proceedings on 'Biological Effects of Non-Ionizing Radiation', (Feb. 12-15, 1974), "Biochemical and neuroendocrine aspects of exposure to microwaves".
2948. MICHAELSON, S. M., HOWLAND, J. W., & DEICHMANN, W. B. (1971) *Indust. Med. & Surg.*, 40(5):18-23, "Response of the dog to 24,000 and 1285 MHz microwave exposure"
1020. MICHAELSON, S., HOWLAND, J. W., & DUNDERO, R. (1958) *Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy* (Pattishall, E. C. & Banghart, F. W., eds.) 2:175-189, "Review of work conducted at University of Rochester (USAF sponsored)"
1021. MICHAELSON, S. M., HOWLAND, J. W., THOMSON, R. A. E., & MERMAGEN, H. (1959) *Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments* (Susskind, C., ed.) 3:161-190, "Comparison of responses to 2800 MHz and 200 MHz microwaves or increased environmental temperature"
3561. MICHAELSON, S.M., MILLER, M.W., MAGIN, R., & CARSTENSEN, E.L. (eds.) (1975), *Fundamental and Applied Aspects of Nonionizing [electromagnetic and ultrasound] Radiation*, 470 pps., Plenum Press (New York). [Proceedings of the Seventh Rochester International Conference on Environmental Toxicity, 5-7 June 1974], [Program listed as citation #3120, this Biblio.].
2474. MICHAELSON, S. M., & MOSS, A. J. (1971), *J. of the Amer. Med. Assoc.*, 216:2006-2007, "Environmental influence on implanted cardiac pacemakers"
2222. MICHAELSON, S. M., & SETH, H. S. (1965) *J. of Occupational Medicine* 7:439-442, (Abstr. #A65-82061), "Microwave cataractogenesis"
3562. MICHAELSON, S.M., & SUESS, M.J. (1974), *IEEE Trans. on Microwave Theory and Techniques*, 22(12):1301-1302, "International program for microwave exposure protection."
1022. MICHAELSON, S. M., THOMSON, R. A. E., EL-TAMAMI, M. Y., SETH, H. S., & HOWLAND, J. W. (1964) *Aerospace Med.* 35(3):824-829, "The hematologic effects of microwave exposure" (Abstr. No. A64-80830)
2475. MICHAELSON, S.M., THOMSON, R.A.E., HANSEN, C.L., Jr., & HOWLAND, J.W. (1960), *Radiation Research*, Abstr. No.108, 12:456-457, "Long term effects of ionizing radiation in the dog", ["The most marked abnormalities have occurred following stress with electromagnetic irradiation in the form of 2800 megacycle microwave (radar). A marked susceptibility exists to induced hyperthermia with altered hemodynamic response, lethality and incidence of localized burns. The observed reactions are best explained by alterations in the vascular and/or nervous system"].

1023. MICHAELSON, S. M., THOMSON, R. A. E., & HOWLAND, J. W. (1959) Digest of Tech. Papers, 12th Annual Conf. on Electrical Techniques in Medicine and Biology (Schwan, H. P., Chm.) pp. 38-39, "Characterization of the thermal response among animals exposed to microwaves or increased environmental temperature"
1024. MICHAELSON, S. M., THOMSON, R. A. E., & HOWLAND, J. W. (1960) Proc. 3rd Internat. Conf. on Medical Electronics and Biological Engineering, pp. 399-400, "Biomedical aspects of microwave irradiation of mammals"
1025. MICHAELSON, S. M., THOMSON, R. A. E., & HOWLAND, J. W. (1961) Amer. J. of Physiology 201(2):351-356, "Physiologic aspects of microwave irradiation of mammals"
1026. MICHAELSON, S. M., THOMSON, R. A. E., & HOWLAND, J. W. (1962), Radiation Research 16(4):476-, "The potential influence of microwaves on injury and recovery from ionizing radiation"
1027. MICHAELSON, S. M., THOMSON, R. A. E., & HOWLAND, J. W. (1965) Aerospace Med. 36:1059-1064, "Comparative studies on 1285 and 2800 Mcz pulsed microwaves"
1028. MICHAELSON, S. M., THOMSON, R. A. E., & HOWLAND, J. W. (1966) In: Proc. of the Symposium on Biomedical Engineering, (Sances, A., Jr., ed.), (held at Marquette Univ., Milwaukee), 1:215-218, "Microwaves in biomedical investigations"
1029. MICHAELSON, S. M., THOMSON, R. A. E., & HOWLAND, J. W. (1967) Rome Air Development Center Tech. Rept. No. RADC-TR-67-461, Sept., (AD 824242L;/ (Also in Senate Hearings), "Biologic effects of microwave exposure"; Final Rept. 1958-1965 [Studies on bone marrow, thyroid function, & CNS] N69-36850; & X68-12450)
1030. MICHAELSON, S. M., THOMSON, R. A. E., KRASAVAGE, W. J., QUINLAN, W. J., & HOWLAND, J. W. (1961) Digest of the Internat. Conf. on Medical Electronics, Biological Effects of Microwaves I (Athermal Aspects), (Frommer, P. L., ed.) Plenum Press, New York, pp. 134-, "The biological effects of microwave irradiation"
1031. MICHAELSON, S. M., THOMSON, R. A. E., ODLAND, L. T., HOWLAND, J. W. (1963) Aerospace Med. 34(2):111-116, "The influence of microwaves on ionizing radiation exposure" (A66-32156),
1032. MICHAELSON, S. M., THOMSON, R. A. E., & QUINLAN, W. J., JR. (1967) Aerospace Med. 38(3):293-298/ "Effects of electromagnetic radiations on physiologic responses"
1033. MICHAELSON, S., et al. (1961) Industrial Med. and Surgery 31:238-, "Tolerance of dogs to microwave exposure under various conditions"
3268. MICKEY, G.H. (1963), Abstr. in Genetics Today, 1( ):72 only, from Proc. of the 11th Internat. Cong. of Genetics (1963), "Crossing-over in males of *Drosophila* [fruit flies] induced by radio frequency [20 MHz] treatment".
1034. MICKEY, G. H. (1963) New York State J. of Med. 63(13):1935-1942, "Electromagnetism and its effect on the organism"
1035. MICKEY, G. H. (1969) Presented at the Hazards and Utility of Microwaves and radiowaves Seminar, (Heller, J., Chm.), 11-12 Dec., Boston, "Effects of microwaves and radiowaves on plant and animal cells; human genetic and somatic damage"
2949. MICKEY, G.H. (1971), Progress Report Abstracts, Office of Naval Research, Report No. ACR-175, pps. 74-75, Work Unit No. NRL01-756, Contr. N00014-69-C-01-76, "Non-thermal hazards of exposure to radiofrequency fields".
1036. MICKEY, G. H., & HELLER, J. E. (1964) / "Radio frequency treatment for breaking dormancy and controlling virus infections of plants" Trans. of the Amer. Soc. of Agricultural Engineers 7(4):398-401
3563. MICKEY, G.H., HELLER, J.H., & SNYDER, E. (1975), New England Institute (Final Report to Office of Naval Research for the period 3/1/69 to 11/30/74), 46 pps., "Non-thermal hazards of exposures to radio frequency fields: Microwave studies."
1037. MICKEY, G. H., & KOERTING, L. (1970) Newsletter of the Environmental Mutagen Society, No. 3, pp. 25-26, "Chromosome breakage in cultured Chinese hamster cells induced by radio-frequency treatment"
1038. MIKHAILOVA, R. I. (1966) Stomatologia (Moskva) 45:49-53, "Experience with microwave therapy in stomatology"
2950. MIKOLAJCZYK, H. (1970), Medycyna Pracy, 21(1):15-20, "Corneal cell mitoses in experimental animals exposed to microwave radiation"
2951. MIKOLAJCZYK, H. (1972), Medycyna Lotnicza, 39( ):95-104, (In Pol.), (Engl. transl. avail. as, JPRS 59709, dated 3 Aug. 73, Transl. of eastern Europe scientific affairs), "Current research results and future efforts on the problem of the biological effect of microwave radiation in the department of physical injury at the institute of industrial medicine".
2952. MIKOLAJCZYK, H. (1972), Patologia Polska, \_\_ ( ): pp. ?, "Length of survival in a microwave radiation field by normal rats and rats with removed pituitary gland".
2953. MIKOLAJCZYK, H. (1973), Patologia Polska (Warszawa), 24(2):325-332, (In Pol. w/Engl. summary), "Survival periods of normal and hypophysectomized rats exposed to acute microwave irradiation".
2954. MIKOLAJCZYK, H., & HOLWEK, A. (1972), Medycyna Pracy, \_\_ ( ): , "Effect of acetylcholine, epinephrine, histamine and serotonin on length of survival of rats exposed to microwave radiation, as well as on the water content in certain tissues of these animals".
2955. MILAM, J.D., SIPEN B., REEVES, A., et al. (1971), Presented at the 13th annual meeting of the South Central Association of Blood Banks, Hot Springs, Ark., "Blood warming using radio frequency induction".

1039. MILCZAREK, H., ZALEJSKI, S., & MAZURKIEWICZ, J. (1967) *Polski Tygodnik Lekarski*, Poland, 22:1924-1927, "Changes in the nervous system in individuals working within the range of microwave radiation"
1040. MILITSIN, V. A. (1937) *Trudy III vses. S'iazda fizioterap.*, (Monograph), Kiev, pp. 199-. (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, AFD Rept. P-65-17, Apr. 1965), "Problems of using short- and ultra-short waves in medicine"
1041. MILITSIN, V. A. (1938) *Fizioterapiya*, Moskva, (1): "The first international congress on SHF-UHF radiation"
1042. MILITSIN, V. A., & VOZNYAYA, A. IS. (1937) *Fizioterapiya*, Moskva, (2):33-43, "The influence of chronic action of ultra-high frequency (in weak doses) on the morphology of the blood, hematopoietic, and reticulo-endothelial system"
1043. MILLARD, J. B. (1955) *Annals of Physical Med.* (2):248-252, "Changes in tissue clearance of radioactive sodium from skin and muscle during heating with shortwave diathermy"
2476. MILLER, B. (1971) *Aviation Week and Space Technology*, ( ):14-16, (Feb. 15), "Soviet radar expertise expands. Radar development plays integral role in USSR military strategy; nears parity, sometimes surpasses U.S. technology". [Discusses frequencies, pulse-repetition rates and -width, power outputs, etc. of current equipment].
2956. MILLER, B. (1971) *Aviation Week & Space Technology*, ( ):42-50, (Feb. 22), "Soviet radars disclose clues to doctrine", [see also citation #2476, this Biblio. for the 1st article in this series].
2957. MILLER, J.P. (1974) *Human Behavior*, 3(8):16-23, (Aug.), "Relax! The brain machines are here", [reviews the status of human 'cerebral electrotherapy', electrosleep].
1044. MILLER, J. W., & GERUSKY, T. M. (Co-Chairmen), (1959) Conf. on Federal-State Implementation of Public Law 90-602, "Radiation Control for Health & Safety Act of 1958", held in Montgomery, Alabama, 24-28 Mar., U. S. Dept. of Health, Education, and Welfare; Public Health Service; Bureau of Radiation Health, Rept. #ORO 69-4, (Sept.)
2958. MILLER, L.A. (1973) U.S. Department of Health, Education & Welfare, Rept. No. DHEW Publication (FDA) 73-8035, (Mar.), "Federal/State radiation [ionizing & non-ionizing] control legislation 1972".
2477. MILLER, H.W. (1973) Fourth Quarterly Progress Rept., U. of Rochester, N.Y., Dept. of Radiation Biology and Biophysics, (Mar.), "Effect of extremely low frequency electromagnetic radiation on chromosomes".
2959. MILLER, S.J., & SHEFTMAN, F.I. (1968) *J. of Occupational Med.*, 10(3):141-7, (Mar.), (AD #260 947), "Evaluation of three microwave densimeters".
2226. MILLS, L. F. (1970) In: Radiation Bio-Effects Summary Report, Hodge, D. M., (ed.), for Jan-Dec 1970, Div. of Biological Effects, Bur. Rad. Health, DHEW, (Rept. No. BRH/DBE 70-7), pp. 50-52, "Biological effects of diathermy"
2227. MILLS, L. F., & SEGAL, P. (1970) Div. of Biological Effects, Bur. Rad. Health, DHEW, (Rept. No. BRH/DBE 70-6), 55 pps., "Radiation incidents registry report 1970" [approx. 15% of the total number of incidents reported (133) involved microwave and/or radio frequency equipment]
1045. MILLS, W. A. (1969) Conf. on Federal-State Implementation of P.L. 90-602, "Radiation Control for Health & Safety Act of 1958", (Miller, J. W., & Gerusky, T. M., Co-Chm.), held in Montgomery, Ala., U. S. Dept. of H. E. W., P. H. S., B. R. H., Rept. #ORO 69-4, (Sept.), pp. 13-25, "Bioeffects of non-ionizing electronic product radiation"
2478. MILLS, W.A. (1971) *J. of Microwave Power*, 6(2):141-150, "A program to study the effects of microwave radiation on biological systems".
2961. MILLS, W.A., TELL, R.A., JAMES, D.E., & HODGE, D.M. (1971) In: Proc. of the Third Annual National Conf. on Radiation Control, sponsored by the Dept. of Health, Education & Welfare, Food & Drug Admn., & Bureau of Radiological Health, Rockville, MD, "Nonionizing radiation in the environment".
2223. MILROY, W. C. (1972) Presented at: Aerospace Medical Assoc., 43rd Ann. Meeting, 8-11 May, Bal Harbour, Fla., "Neuroendocrine effects of microwave radiation"
2022. MILROY, W. C., & MICHAELSON, S. M. (1971) *Health Physics* 20:567-575, (Univ. of Rochester Rept. No. UR-49-1314), "Biological effects of microwave radiation"
2224. MILROY, W. C., & MICHAELSON, S. M. (1972) *Aerospace Med.* 43(1):67-75, "Microwave cataractogenesis: A critical review of the literature"
2479. MILROY, W.C., & MICHAELSON, S.M. (1972) *Aerospace Medicine*, 43(10):1126-1131, "Thyroid pathophysiology of microwave radiation".
2225. MILROY, W. C., & MICHAELSON, S. M. (1972) *Internat. J. of Environmental Studies* 4:121-125 (1973), (In Press, Spring, 1972), "The microwave controversy"
2225. MILROY, W.C., & MICHAELSON, S.M. (1973) *Internat. J. of Environmental Studies*, 4( ) :121-125, "The microwave controversy", (listed in third Supplement, this Biblio. with only partial citation).

3269. MILROY, W.C., O'GRADY, T.C., & PRINCE, E.T. (1974), J. of Microwave Power, 9(3):214-218, (Sept.), "Electromagnetic pulse radiation: A potential biological hazard?"
3564. MINAYEV, V.V., ZHDANOVICH, N.V., UDALOV, Yu.F., & BAZILEVICH, O.I. (1975), Gigiyena i Sanitariya, (3):11-14, (In Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #66512), (7 Jan. 1976), pp. 77-82, "Effects of SHF fields on enzymatic activities and pyridoxine levels in the organs of white rats."
2228. MINECKI, L. (1959) Medycyna Pracy 10(1):57-58, (In Pol.), "Eggyenic importance of electrical currents of high and ultrahigh frequencies"
2229. MINECKI, L. (1961) Medycyna Pracy (Poland) 12:337-344, (FTD-TT-61-380), "The health of persons exposed to the effect of high frequency electromagnetic fields"
1046. MINECKI, L. (1961) Medycyna Pracy 12(4):329-335, (In Polish), (AD 271865), (FTD-TT-61-380/1, Dec. 1961, pp. 1-8), "The health of persons exposed to the effect of high frequency electromagnetic fields"
1047. MINECKI, L. (1962) Rept. of the 6th Polish Conf. of Occupational Medicine, "The thermal effect of microwave radiation"; and "Changes in activity of cholinesterase in mice subjected to single and repeated action of microwaves"
1048. MINECKI, L. (1964) Arhiv za higijenu rada i toksikologiju 15(1):47-55, (In Polish), (Delivered before the 1st Yugoslav Congress of Occupational Medicine, Beograd, Nov. 1963), "Critical evaluation of maximum permissible levels of microwave radiation"
1049. MINECKI, L. (1964) Med. pracy 15:307-315, (In Polish), "Effect of microwave radiation on the sight organs"
1050. MINECKI, L. (1964) Med. pracy 15:391-396, (In Polish), "Effect of an rf electromagnetic field on embryonal development"
1051. MINECKI, L. (1965) Medycyna Pracy 16:300-304, "Clinical symptoms in workers exposed to the effect of high frequency electromagnetic fields"
1052. MINECKI, L. (1966) Medycyna Pracy 17(2):134-136, "Critical evaluation of the health protection of personnel occupationally exposed to high frequency electromagnetic radiations"
1053. MINECKI, L. (1966) Warsaw, (In Polish), Electromagnetic Radiation: Biological Effects and Safeguarding of Health (Public Health)
1054. MINECKI, L. (1967) Zdrav Publiczna / (2):213-220, "High frequency electromagnetic fields, a new environmental hazard"
1055. MINECKI, L., & BILSKI, R. (1961) Medycyna Pracy 12(4):337-344, (In Polish), (AD 271865), (FTD-TT-61-380/1, Dec. 1961, pp. 9-15), "Histopathological changes in the internal organs of mice exposed to the effect of microwaves (S-Band)"  
(4)
1056. MINECKI, L., OLUBEK, K., & ROMANIUK, A. (1962) Medycyna pracy 13:255-264, (In Polish), "Changes in the activity of conditioned reflexes of rats under the influence of the action of microwaves (S-band): 1. Single exposure to microwaves"
1057. MINECKI, L., & ROMANIUK, A. (1963) Medycyna Pracy 14:355-360, and 361-372, "Changes in conditioned reflexes of rats under the influence of S-band microwaves (I, and II)"
3565. MININ, B.A. (1974), Microwaves and Human Safety, Moscow, (In Russian), 349 pps., (Translation as JPRS #65506, Part I and Part II (20 Aug. 1975)).
2962. MINTS, S.M., et al. (1973), Biol. Neonate., 11-D( ):46-49, (In Russ.), "Effect of a ultra high frequency electromagnetic field on the level of metals and metalloproteins in animal organs and tissues".
3567. MINTS, S.M., & LAZAROVICH, V.G. (1975), Gigiyena Truda i Profess. Zabollevaniya, (2):54- , (In Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #66512), (7 Jan. 1976), pp. 1-2, "Effect of microwave emission on the content of iron, copper, cobalt and metallic proteins bonded with them in organs and tissues of test animals."
3566. MINTS, S.M., PADALKA, Ye.S., LAZAROVICH, V.G., & ZHIBAK, Ya.D. (1975), Referativnyy Zhurnal, Biologicheskaya Khimiya, (2): , Abstr. No. 2F1482 Summary (In Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #66512), (7 Jan. 1976), p. 93 only, "The effect of microwave radiation on the metabolism of trace elements, metalloproteins, and some indicators of oxidation-reduction processes in the organism."
1058. MINTZ, M., & HEIMER, G. (1965) IEEE Trans. on Electromagnetic Compatibility 7(2):179-183, "New techniques for microwave radiation hazard monitoring"
1059. MIRAHORIAN, L. (1934) (In French with English Summary), Abstr. of the 1st Internat. Congress of Electro-Radio-Biology, (Cappelli, L., ed.) Bologna, Italy, pp. 383-386, "The possibility of clinical diagnostic differentiation of mutations due to electromagnetic energy"
1060. MIRAULT, M. (1950) Praxis, Switzerland, 39:927-931, "Microwaves (radar) in electrotherapy"
2230. MIRIMANOFF, A. (1927) Revue Gen. D'Opt. 51:97-119, (In Fr.), "Diathermy in ophthalmology"
1061. MIRO, L. (1962) Revue de Medicine Aeronatique, Paris, 1 (4):15-17, (In French), "Hematological modifications and clinical disorders observed in persons exposed to radar waves"
2963. MIRO, L., ATLAN, H., ARNAUD, Y., DELTOUR, G., & LOUBIERE, R. (1965), Revue de Medecine Aeronautique, 4(16):21 only, (4th quarter), (In Fr.), "Report on the microwave-protection of bacteria exposed to gamma irradiation", [from a Co<sup>60</sup> source].

2480. MIRO, L., DELTOUR, G., & PFISTER, A. (1968), In: AGARD Pattern Recognition. Body Armour and Aircrew Equipment Assemblies. Current Space Med. Probl. Aeromed. Evauation, 7 pps. (In Fr.), [Abstr. in STAR 7(20):3725, as N69-3477e, (Oct. 23, 1969)], "Influence of magnetic field variations on the growth of certain microorganisms".
2072. MIRO, L., DELTOUR, G., PFISTER, A., & KAISER, R. (1970) Revue de Medecine Aeronautique et Spatiale, No. 33, pp. 7-8 (in French), "Difficulties involved in describing the dangerous zones for personnel working near radar antennas"
1062. MIRO, L., LOUBIERE, R., & PFISTER, A. (1965) Revue de Medecine Aeronatique, Paris, 4:37-39, (In French), "Research on visceral lesions observed in mice and rats exposed to ultrashort waves: special study of the effects of these waves on the reproduction of the animals"
1063. MIRO, L., LOUBIERE, L., & PFISTER, A. (1966) Revue de Medecine Aeronatique, Paris, 5:9-13, "Morphological and metabolic changes observed experimentally under the influence of high frequency electromagnetic fields"
1064. MIRO, L., LOUBIERE, R., & PFISTER, A. (1967) In: Proc. of the 2nd Internat. Symposium in Basic Environmental Problems of Man in Space, (Bjurstedt, H., ed.), held in Paris, June 1965, Springer Verlag, publisher, pp. 288-297, "Effects of high frequency electromagnetic fields on the uptake of methionine S-35 by the spleen and liver of mice" (A65-26302)
1065. MIRO, L., LOUBIERE, R., & PFISTER, A. (1968) In: Thermal Problems in Aerospace Medicine, (Hardy, J. D., ed.), The Advisory Group for Aerospace Research & Development, NATO, Haidenhead, England, pp. 177-183, "Visceral lesions observed in mice and rats exposed to ultrashort waves: special study of the effects of these waves on the reproduction of the animals"
1066. MIRO, L., ATLAN, H., ARNAUD, Y., DELTOUR, G., & LOUBIERE, R. ( ? ) Ref? "A note on the radio protection experienced by bacteria exposed to ultrahigh frequency waves"
1067. MIRUTENKO, V. I. (1962) Fiziologii Zh. Akademiya Nauk UKR SSR, 8(3):382-389, (AD 292205), (FTD TT-62-1361/1+2), "Investigating local thermal effect of electromagnetic (3 cm) waves on animals"
1068. MIRUTENKO, V. I. (1964) In: The Biological Action of Ultrasound and Super-high-Frequency Electromagnetic Vibrations, Naukova Dumka, Akademiya nauk Ukrainskoy SSR. Institut Fiziologii, Kiev, pp. 62-79, (Abstr. in Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, pp. 92-93 (1965), "SHF dosimetry and nonthermal threshold determination"), "The thermal effects of a SHF electromagnetic field on animals, and some problems of SHF-field dosimetry"
1069. MIRUTENKO, V. I. (1964) Fiziologii Zh. Akademiya Nauk UKR SSR 10(5):641-646, (JPRS 29375), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Effect of blood circulation on the distribution of heat, and the magnitude of the thermal effect during action of a SHF-UHF electromagnetic field on animals"
2231. MIRUTENKO, V. I. (1964) In: Problems of the Biophysics and Mechanism of Action of Ionizing Radiation, Kiev, Zdorov'ya, pp. 79-82, "Heat distribution in the organs and tissues of animals exposed to UHF electromagnetic field"
1070. MIRUTENKO, V. I. (1965) (In Russian), In: Problems in Biophysics and the Mechanism of Action of Ionizing Radiation, Kiev, Zdorov'ya, pp. 79-82, "Heat distribution in the organs and tissues of animals exposed to a UHF electromagnetic field"
2964. MIRUTENKO, V.I., & BOGAC, P.G. (1972), In: Gigiena truda i biologiceskoje dejstvie electromagnitnyh voln radiocastot [Labour hygiene and the biological effect of electromagnetic radio frequency waves], Moscow, \_\_\_ ( ):60- , "Effect of VHF electromagnetic fields on the membranous potential of nerve cells of isolated mollusc ganglions".
3568. MIRUTENKO, V.I., & BOGACH, P.G. (1975), Fiziolohichnyy Zh., 21(4):528-531 (In Ukrainian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation"(JPRS #66512), (7 Jan. 1976), pp. 7-13, "Changes in the membrane potential of nerve cells of isolated ganglia in the mollusk Planorbis corneus under the influence of a UHF electromagnetic field."
2965. MIS, M. (1973), Klin. Oczna, 43( ):1039-1040, (In Pol.), "Magnetic cryoapplicator".
1071. MISHCHENKO, L. I. (1969) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 68(7):56-58, (In Russian with English Summary), "The influence of an ultra high frequency electromagnetic field on the carbohydrate metabolism in the brain of rats"
2966. MISHCHENKO, L.I. (1972), Gigiena Truda i Professional'nye Zabolevaniia (Moskva), 16( ):48-50, (In Russ. no Engl. summary), "Effect of UHF electromagnetic fields on energy metabolism in animal tissues".
2967. MISHCHENKO, L.I., & FRENKEL, S.R. (1972), Ukrains'kyi Biokhimichnyi Zhurnal (Kiev), 44( ):483-486, (In Russ. w/Engl. summary), "Metabolic changes in nitrogenous substances [NH<sub>2</sub>, glutamine, glutamate, protein amide N, AMP, and AMP-deaminase] in animal [rat] nerve tissue [brain] under the effect of an ultra-high frequency electromagnetic field".
1072. MISHIN, V. V. (1964) Vsesoyuznoye Fiziologicheskoye Obshchestvo. Voronezhskoye Otdeleniye Nekotoryye Voprosy Fiziologii i Biofiziki, Trudy Otdeleniye. Izd-vo Voronezh Univ., pp. 40-46, "Change of lability of the neuromuscular system under the influence of electromagnetic oscillations in the audio frequency range"
2481. MITCHELL, J. & BONNEY C. (1972), J. of the Assoc. for the Advancement of Med. Instrumentation, 6:179-180, "In vivo testing of cardiac pacemakers in electromagnetic radiation fields".
2482. MITCHELL, J.C., RUSTAN, P.L., FRAZER, J.W., & HURT, W.D. (1972), (USAF School of Aerospace Medicine, Brooks AFB, Texas), Presented at the IEEE Int'l Symposium on Electromagnetic Compatibility, Arlington Heights, Illinois, July 18, as "Electromagnetic compatibility of cardiac pacemakers".
1073. MITCHELL, J. P., & LUMB, G. N. (1960) Proceedings of the Royal Society of Medicine 53:348-354, "Hazards of diathermy in urology"

1074. MITTMANN, E. (1961) Digest of Internat. Conf. on Medical Electronics, Biological Effects of Microwaves I (Athermal Aspects), (Frommer, P. L., ed.), Plenum Press, New York, pp. 193-, "Relationship between heat sensation and high frequency power absorption"
3270. MITTLER, S. (1972), Northern Illinois Univ., DeKalb, Final Rept. (AD #749-959), (Sept. 15), "Low frequency electromagnetic radiation and genetic aberrations".
3569. MIZUSHIMA, Y., AKOAKA, I., & NISHIDA, Y. (1975), *Experientia*, 31(12):1411-1412 (Dec. 15), "Effects of magnetic field on inflammation."
2483. MOAYER, M. (1971), *Strahlentherapie*, 142(5):609-614, (In Ger.), "Morphological changes in the placenta under the influence of short-wave irradiation". [Rats, at 27 MHz; observed marked histological alterations.]
2484. MOCZULSKI, W., & JAKUBEZYK, A. (1972), *Psychiatr. Pol.*, 6(2):111-116, (In Pol.), "Diagnostic and forensic problems in cases of so-called 'microwave neuroses'", [discusses etiology of mental changes "brought about by high frequency electromagnetic radiation"].
1075. MOGENDOVICH, M. R. (1937) *Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva)* 4:246-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), Title not given, [Discusses changes in conductivity of nerves upon exposure to EMF]
2232. MOHR, G. C., & CASHIN, J. L. (1970) Aerospace Med. Res. Lab., Wright-Patterson AFB, Rept. AMRL-TR-68-32, "Biomagnetic response of simple biological systems and the implications for long duration space missions" [results indicated no significant effect on the two biologic systems studied]
1076. MOLCHAMEV, K. (1944) *Biulleten Eksperimental'noi Biologii i Meditsiny (Giesen)* 18:1-20, "Bactericidal effect of ultrashort waves on microflora of metallic foreign bodies: experimental studies"
3271. MOLCHANOVA, N.S., & GEMBITSKIY, Ye.V. (1973), In: *Voyenno-Polevaya Terapiya*, (Military Field Therapy), Chap. 5, pps. 198-206, (In Russ.), (Transl. in JPRS No. 62942, Sept. 12, 1974, pp. 14-22), "The effects of superhigh frequency electromagnetic fields (SHF-EMF) on the [human] body".
2485. MOLNAR, G.W. (1966), In: First International Symposium on Electrotherapeutic Sleep and Electroanesthesia, Graz, Austria, (12-17 Sept.), "Electronarcosis and the breathing rate in the rabbit".
1077. MONAYENKOVA, A. M., & SADCHIKOVA, M. N. (1966) *Gigiena Truda i Professional'nyye Zabolevaniya* 10(7):18-21, (JPRS 38663; ATD Rept. 66-123, Oct. 1966), (AD 644 533) "Hemodynamic indices during the action of super-high frequency electromagnetic fields"
2233. MONBRUN, A., & CASTERAN, M. (1927) *J. d'Ophth. Med. Franc.* 16:136 (April), (In Fr.), "Diathermy in ophthalmology"
2234. MONCREIFF, W. F., COULTER, J. S., & HOLMQUEST, H. J. (1932) *Amer. J. of Ophth.* 15(3):194-205, (Abstr. in: *Zentralbl. f. d. ges. Ophth.* 27(7):406-407 (1932)), "Experimental studies in diathermy applied to the eye and orbit. A. Thermal effect of diathermy"
2235. MONCREIFF, W. F., COULTER, J. S., & HOLMQUEST, H. J. (1933) *Amer. J. of Ophth.* 16(3):193-199, (Abstr. in: *Zentralbl. f. d. ges. Ophth.* 29(6):347 (1933)), "Experimental studies in diathermy applied to the eye and orbit. B. Comparison of thermal effects of diathermy, infrared radiation, and an electric heating pad"
2968. MOORE, R.L., SMITH, S.W., CLOKE, R.L., & BROWN, D.G. (1970), In: Proc. of the 4th Annual Midyear Topical Symposium, the Health Physics Soc., Louisville, KY, 28-30 Jan.; Bureau of Radiological Health, U.S. Dept. of Health, Education & Welfare, Rept. No. BRH/DEP 70-26, (Oct.), pps. 423-429, "A comparison of microwave detection instruments", [in connection with hazard surveys], (also listed in BRH/DEP Rept. No. 70-7 (Apr.)).
1078. MOORE, R. I. (1969) Presented at the Hazards & Utility of Microwaves & Radiowaves Seminar (Heller, J., Chm.), Boston, 11-12 Dec., "Government relations: problems and plans"
1079. MOCRE, W., JR. (1968) Report T53-68-4, 25 pages, U.S. Dept. of Health, Education, and Welfare, Public Health Service, Consumer Protection & Environmental Health Service, Environmental Control Admin., Bur. of Radiation Health, Rockville, Md., "Biological aspects of microwave radiation: a review of hazards"
1080. MOOS, W. (1964) *Aerospace Med.* 35:374-<sup>377</sup> "A preliminary report on the effects of electric fields on mice"
1081. MOOSSIKINS, B. (1948) *Rev. Morrel* 60:364-366, "Rapid modification of local temperature following application of short waves and its clinical significance"
1082. MORELLINI, M., & INGRAO, F. (1943) Abstr. only in: *Zentralblatt fur die gesamte radiologie*, p. 216 only, (In German), "Effect of short waves on the vegetative nervous system"
1083. MORESSI, W. J. (1964) *Experimental Cell Research* 33:240-253, "Mortality patterns of mouse sarcoma-180 cells resulting from direct heating and chronic microwave irradiation"
1084. MORGAN, W. E. (1960) *AMA Arch. of Industrial Health* 21:570-573, (Also, *Safety Maintenance* 16-, July 1959), "Microwave radiation hazards"
1085. MORRELL, R. M. (1959) Digest of Tech. Papers, 12th Annual Conf. on Electrical Techniques in Medicine and Biology (Schwan H. P., Chm.) pp. 32-33, "Radio telemetry of whole-nerve action potentials"
1086. MORTIMER, B., & OSBORNE, S. I. (1935) *J. of the Amer. Medical Assoc.* 104:1413-1419, "Tissue heating by short wave diathermy: some biologic observations"

1087. MOSES, P. (1951) *Medecine Aeronautique*, Paris, 6:143-144, "Recent investigations on the biologic effect of radar"
1088. MOSINGER, M., & BISSEOP, G. (1960) *C. r. seances soc. biol. filiales associees* 154:1016-1017, (In French), "On the histological reactions following irradiation of intratissular metal pieces by microwaves"
1089. MOSKALENKO, YU. YE. (1958) *Biofizika* 3(5):619-626, "The use of SHF-UHF fields in biological research"
2969. MOSKALENKO, Yu. Ye. (1960), *Biofizika*, 5(2):225-228, "Application of centrimetre radio waves for non-contact recording of changes in volume of biological specimens".
1090. MOSKALENKO, YU. YE. (1960) in: *Elektronika v Meditsine*, (Berg, A. I., ed.) Moscow, Leningrad, pp. 207-218, (Abstr. in: *The Biological Effects of Electromagnetic Fields - Annotated Bibliography*, ATD Rept. P-65-17, Apr. 1965), "Clinical and biological application of SHF-UHF electromagnetic fields"
1091. MOSKALENKO, J. E. (1961) *Nov. med. techn. Moskva*, 7:79-88, (In Russian), "Some of the possible biophysical mechanisms for the interaction of the energy of an electromagnetic field with living structures"
1092. MOSKALYUK, A. I. (1949) *Avtoref. Kand. Dissertation* (Author's abstract of dissertation, Candidate), Leningrad, "Latent reflex period as an indicator of SHF-UHF field effect"
1093. MOSKALYUK, A. I. (1957) *Tr. VMOLA* (Report of Military Medical "Order of Lenin", Akad. imeni S. M. Kirov) 73:133-, "Effect of a SHF field on oxidation reduction processes in some rabbit tissues"
1094. MOSKWA, W., et al. (1965) *Kosmos-Seria A Biologia* 2:277-284, (JPRS 33,500), "Biophysical effects of a constant magnetic field"
3272. MOSLAK, T. (1974), *Approach Magazine* (Navy Aviation Safety Magazine), 1(1):6-9, (Aug.), "Hazards [including biological] of high frequency radiation".
1095. MOTSNYI, P. E. (1936) *Dnepropetrovsk, Universitet. Nauchnye Zapiski* 4:4-, (Abstr. in: *The Biological Effects of Electromagnetic Fields - Annotated Bibliography*, ATD Rept. P-65-17, Apr. 1965), Title not given, [Discusses altered response in muscle following UHF exposure]
1096. MOYNIEL, G. (1950) *Revue de Medecine* 25:39-40, "Biologic effect of electromagnetic radiation (short wave) on isolated cells"
1097. MUEH, V. (1951) *Ophthalmologica (Basel)* 121:41-43, "Ultra short wave therapy following extra capsular cataract extraction"
3570. MUHLEISEN, R. (1967), *Zeitschrift für Vergleichende Physiologie*, 54(1):20-25, "Measurement of electrical fields inside of animal cages."
3571. MUKHARSKIY, M.S. (1975), *Vrachebnoye Delo*, 1(1):118-121 (in Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #66512), (7 Jan. 1976), pp. 56-59, "Hygienic evaluations of the medium wave range electromagnetic field in conditions of populated areas."
2486. MULDER, J.B. (1971), *Laboratory Animal Science*, 21(3):389-393, "Animal behavior and electromagnetic energy waves".
1098. MULLER, H. (1949) *Arch. of Physical Med.* 29:765-769, "Experimental lenticular opacities produced by microwave irradiations"
1099. MULLER, H. (1950) *Amer. Scientist* 38:33-39, "Radiation damage to the genetic material"
1100. MUMFORD, W. E. (1956) *Bell [Telephone] Labs. Progress Rept.* 717, "Hazards to personnel near high power UHF transmitting antennas"
3273. MUMFORD, W.M. (1969), *J. of Microwave Power*, 4(4):244-252, "Heat stress due to RF radiation". [See also citation #1102, this Biblio.]
1101. MUMFORD, W. W. (1961) *Proc. of the Institute of Radio Engineers* 49(2):427-447, "Some technical aspects of microwave radiation hazards"
1102. MUMFORD, W. W. (1969) *Proc. of the Institute of Electrical & Electronics Engineers* 57(2):171-178, "Heat stress due to RF radiation" (Also: *Non-Ionizing Rad.* 1(1):113-119 (1969))
1103. MUMFORD, W. W. (1970) In: *Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium*, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 21-34, "Heat stress due to RF radiation"
2058. MUMFORD, W. W. (1971) *Presentation at Meeting of N. Y. Acad. of Sci.*, 6 Oct., "Radio-frequency radiation hazards"
1104. MUNGO, A. (1962) *Folia Medica* 2(2):156-, (In Italian), "Radar: Technology, pathology, and prevention"
1105. MURASHOV, B. F. (1966) *Voenno Meditsinskiy Zh. (Moskva)* 6(6):82-83, "The lingering effect of an ultrahigh frequency field on the hypophyseal system: the cortex of the adrenal glands"
2487. MURATOV, V. I., & TURAYEVA, A. P. (1972) *Voyenno Meditsinskiy Zhurnal*, 1(1):22-24, "Changes in the cardiovascular system under the influence of the chronic action of UHF"
2970. MUROFF, L.R., & SAMARAS, G. (1969), In: *Radiation Bio-Effects: Summary report Jan.-Dec. 1969*, BRH/DBE 70-1, (HODGE, D.M. (ed.)), "Prolongation of life in a microwave field by means of an environmental chamber".

1106. MURPHY, A. J., PAUL, W. D., & HINES, H. M. (1950) Arch. of Physical Med. 31:151-156, "A comparative study of the temperature changes produced by various thermogenic agents"
2488. MURPHY, R.L.H., BLOCK, P., BIRD, K.T., & YURCHAK, P. (1973), CHEST, 63(4):578-581, (Apr.), "Accuracy of cardiac auscultation [transmitted] by microwave". [Use of the telestethoscope to detect heart murmurs, and to permit cardiac consultation by the physician when remote from the patient].
1107. MURPHY, R. M., KLAUSEN, J., JUSTESEN, D. R., & PENDLETON, R. B. (1967) Scientific Proc., Amer. Psychiatric Assoc. 123(1): 201-202, "Enhanced relearning following electroshock and fibrille (microwave) induced convulsions"
1108. MURR, L. (1965) Nature 206:467-, "Biophysics of plant growth in an electrostatic field"
1109. MURRAY, J. L. (1963) M. S. Thesis, Dept. of Radiation Biology, Univ. of Rochester, School of Med. and dentistry, Rochester, New York, 12 pages, (AD 415814), "Some Biological Aspects of Microwave Radiation"
1110. MURRAY, R. J. (1959) Safety Manual, Sperry Gyroscope Co., "Microwave safety precautions"
1111. MURRAY, R., ABRAHAM, J. D. R., CHAMBERS, J. H., ELLIOTT, P. M., FFRENCH, G. E., GILBERT, P. R., HOLDEN, H., & MUIRHEAD, A. (1969) Non-Ionizing Radiation 1(1):7-8, "How safe are microwaves?"
2236. MUSIL, J. (1970) Ceskoslovenska hygiena 15(9-10):315-320, (In Czech.), "Values of field intensity in the surroundings of high frequency industrial generators"
1112. MUSIL, J., & MARHA, K. (1963) Final Report of the Institute of Industrial Hygiene and Occupational Diseases, Prague, (In Czech), Measurement of Rf Field Intensity in Work Areas According to the Guidelines Issued by the Surgeon General
1113. MUSIL, J. (1964) Final Report of the Institute for Industrial Hygiene and Occupational Diseases, Prague, (In Czech), Reflection and Absorption of Electromagnetic Energy in a Model of the Body
1114. MUSIL, J., & MARHA, K. (1965) Czech. patent No. 115-714, "Wide-band device for measuring the intensity of an electromagnetic field for health purposes"
1115. MUSIL, J. (1965) Final Report of the Institute for Industrial Hygiene and Occupational Diseases, Prague, (In Czech.), The Effect of Clothing on the Absorption of UHF Energy in the Organism
1116. MUSIL, J. (1965) Slaboproudny Obzor, Prague, 26(7):391-397, (In Czech.), "Effect of the constitution of the body on the absorption of electromagnetic waves"
1117. MUSIL, J. (1965) Sdelovací technika 13(4):145-146, (In Czech.), (ATD 68-129), "Measurement of the intensity of an electromagnetic field for hygienic purposes"
1118. MUSIL, J. (1965) Final Report of the Institute of Industrial Hygiene and Occupational Diseases, Prague, (In Czech.), Possibilities of Using Simple Measurements of Power Density of Electromagnetic Waves for Health Purposes
1119. MUTH, E. (1927) Kolloid-Zeitschrift 41:97-102, (In German), "Concerning the appearance of the (string of) pearl chain formation of emulsion particles under the effect of an alternating field"
1120. MUTSCHALL, V. E. (1969) Foreign Science Bulletin, Library of Congress, 5(2):13-36, (ATD Rept. #66-92), (AD #642-029), "Biological effects of high frequency electromagnetic waves" (This bibliog. translation of citation #977).
1121. MUTSCHALL, V. E. (1969) Foreign Science Bulletin, Library of Congress, 5(6):18-55, (AD 689769; N69-33390), "Response of the nervous system to microwave radiation"
2971. NADASKI, M. (1961), Orthopedics, 2(5):336-338, "Inhibition of experimental arthritis by athermic pulsating short waves in rats".
1122. NADEL, A. B. (1961) General Electric Co., Technical Military Planning, Santa Barbara, Calif., Report #RM 61TMP-29, 21 pages, "Selected biologic effects of microwave radiation"
1124. NAGELSMIDT, F. (1935) Arch. of Physical Therapy 16:457-465, "The condenser field: an improved method of application" [diathermy]
3572. NAHAS, G.G., BOCCALON, H., BERRYER, P., & WAGNER, B. (1975), Aviation, Space, & Environmental Medicine, 46:1161-1163 (Sept.), "Effects in rodents of a 1-month exposure to magnetic fields" [200-1200 Gauss].
1123. NAKAMURA, H., OKAMURA, H., & TANAKA, K. (1938) Gann (Japanese J. of Cancer Research) 32:294-300, "Short and ultrashort waves, their effects on glycogen, Vitamin C, glutathione, calcium and potassium contents, and on cytochrome oxidase reaction"
1125. NALIVAVKO, G. T. (1939) Dnepropetrovsk. Universitet. Institut Fiziologii. Sbornik robot, 2:2-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), (Title not given) [Discusses alteration in muscle response following UHF irradiation]
2972. NASH, A.G. (1973), Letter: Brit. Med. J., 4( ):783 only, "Diathermy burn hazard".
2489. NEALEIGH, R.C., GARNER, R.J., MORGAN, R.M., CROSS, H.A., & LAMBERT, P.D. (1971), Journal of Microwave Power, 6(1):49-54, "The effect of microwave on Y-maze learning in the white rat". [Performance of rats in a Y-maze learning task was altered by exposures of 2.45 GHz microwaves at a measured maximum level of 50 mw/cm<sup>2</sup>].

1126. NEIDLINGER, R. W. (1971) IEEE Trans. on Microwave Theory and Techniques (Special Issue on Biological Effects of Microwaves) MTT-19(2):250-251, "Microwave cataract"
1127. NEIFELD, H. (1935) Arch. of Physical Therapy 16:544-549, "Some effects of electric currents on human respiratory movements" [Diathermy]  
In:
1128. NELSON, D. J., JR., & SOLEM, D. L. (1969)/Bureau of Radiation Health Rept. #ORO 69-4, (Conf. on Federal-State Implementation of Public Law 90-602, (Miller, J. W., & Gerusky, T. M., co-chm.)), pp. 54-56, "Laser and microwave problems"
3274. NELSON, S.O. (1962), Transactions of the Amer. Soc. of Agricultural Engineers, 5(1):20-25 & 30, "[Non-ionizing electromagnetic] Radiation processing in agriculture".
2237. NELSON, S. O. (1966) Farm, Ranch, & Home Quart., No. 132, pp. 15-16, (Summer), "New ways to control insects" [including use of r-f radiation]
2973. NELSON, S.O. (1966), Trans. of the Amer. Soc. of Acoustic Engineers, 9( ):398-403 & 405, "Electromagnetic and sonic energy for insect control".
2974. NELSON, S.O. (1967), In: Pest Control — Biological, Physical, and Selected Chemical Methods, (KILGORE, W.W., & DOUTT, R.L. (eds.)), Academic Press, NY, pp. 89-145, "Electromagnetic energy".
3275. NELSON, S.O. (1972), Cereal Science Today, 17(12):377-378 & 387, (Dec.), "Insect control possibilities of electromagnetic energy".
3276. NELSON, S.O. (1972), J. of Microwave Power, 7(3):231-240, "Possibilities for controlling store-grain insects with RF energy".
2975. NELSON, S.O. (1973), Bull. of the Entomol. Soc. of Amer., 19(3):157-163, "Insect control studies with microwaves and other radiofrequency energy."
2978. NELSON, S.R. (1973), Radiation Research, 55( ):153-159, "Effects of microwave irradiation on enzymes and metabolites in mouse brain".
2976. NELSON, S.O. (1973), Trans. of the Amer. Soc. of Agricultural Engineers, 16(5):902-905, "Microwave dielectric properties of grain and seed".
3277. NELSON, S.O. (1974), IMPI Newsletter, 2(3):19-21, (Aug.), "Agricultural microwave applications research".
2977. NELSON, S.O., & CHARITY, L.F. (1972), Trans. of the Amer. Soc. of Acoustic Engineers, 15(6):1099-1102, "Frequency dependence of energy absorption by insects and grain in electric fields."
3278. NELSON, S.O., & KANTACK, B.H. (1966), J. of Economic Entomology, 59(3):588-594, (June), "Stored-grain insect control studies with radio-frequency energy".
3279. NELSON, S.O., & SEUBERT, J.L. (1966), In: Scientific Aspects of Pest Control, Pub. No. 1402, Nat'l Acad. of Sciences-Nat'l Res. Council, Wash., DC, "Electromagnetic and sonic energy for pest control".
3573. NELSON, S.O., & STETSON, L.E. (1974), IEEE Trans. on Microwave Theory and Techniques, 22(12):1303-1305, "Possibilities for controlling insects with microwaves and lower frequency RF energy."
3280. NELSON, S.O., STETSON, L.E., & RHINE, J.J. (1966), Transactions of the Amer. Soc. of Agricultural Engineers, 9(6): 809-815, "Factors influencing effectiveness of radio-frequency electric fields for stored-grain insect control".
3281. NELSON, S.O., & WHITNEY, W.K. (1960), Transactions of the Amer. Soc. of Agric. Engineers, 3(2):133-137 & 144, "Radio-frequency electric fields for stored grain insect control".
2490. NESMENIANOVA, E.L. (1972), Voprosy Kurortologii i Fizioterapii i Lechebnoi Kul'try, 37(4):345-347, (July-Aug.), "Microwave therapy in the complex treatment of patients with acute pneumonia."
1129. NETREBA, M. I. (1963) In: Aviation & Space Medicine, (Paris, V. V., ed.), Acad. of Med. Sci., USSR, Moscow, (NASA transl. TT-F-228, pp. 321-324; N65-13739), "The sanitary aspect of the working conditions around SHF-UHF generators"
2491. NEUMANN, E., & KATCHALSKY, A. (1971), In: Eur. Biophysics Congr., 1st, held in Baden, Austria, (BRODA, E., LOCKER, A., & SPRINGER-LEDERER, H., eds.), Vienna, Wiener Medizinische Akademie, pp.91- , "Hysteretic conformational changes in biopolymers induced by high electric fields, — Model for a physical record of biological memory".
1130. NEWMAN, H. F., & WILHELM, S. F. (1950) J. of Urology 63(2):349-352, "Testicular temperature in man"
2979. NIEMEYER, H.J. (1972), Presented at the Societe Francaise d'Electrotherapie, 24 Apr., "Electrophysiology and non-thermal pulsed electromagnetic energy in tissue healing".
1131. NIEPOLOMSKI, W., & SMIGLA, K. (1966) Polish Medical J. 5:396-405, (Also, Patologie Polska (Warszawa) 16:129-139, 1965), "Visceral pathomorphology of experimental animals subjected to the action of 10.7 Mhz electromagnetic fields"
1132. NIESET, R. T., et al. (1957-1961) Progress Reports (Tulane Univ.) on Investigations of the Biological Effects of Microwave Irradiation: (1956, AD 149246; 1958, AD 225409 and 225237; 1959, AD 214693, AD 230822, RADC-TR-59-67-215, and -311; 1960, AD 229023, AD 257198; 1961, RADC-TR-61-65); (Also: Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G., & Baughart, F. W., eds.), (1953), pp. 202-214, "Review of the work conducted at Tulane University") and (Investigators' Conf. on Biological Effects of Electronic Radiating Equipments, (Knauf, G. M., (chm.), RADC-TR-59-67, pp. 6-11), "Neural effects of microwave radiation"

2980. NIKOGOSIAN, S.V. (1970), Zh. Eksp. Klin. Med., 10(1):108-110, (Jun.), (In Russ.), "Sanitary-hygienic studies of working conditions during high-frequency heating".
1133. NIKOGOSYAN, S. V. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, p. 51 only
1134. NIKOGOSYAN, S. V. (1960) Trudy Nii Gigiyena Truda i Profzabolevaniya AMN, SSSR, (1):81-84, (Also in: The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V., (eds.), Moscow, JPRS 12471, pp. 83-88, "Influence of UHF on cholinesterase activity in the blood serum and Erythrocytes"); (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965); (Also, abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD Rept. P-65-68, Sept. 1965, pp. 33-34, "Effect of UHF on blood-serum cholinesterase activity"), (In Russian), "Influence of SHF-UHF on the cholinesterase activity in the blood serum, and on the organs of animals"
1135. NIKOGOSYAN, S. V. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, "The effect of centimeter and decimeter waves on the content of protein and protein fractions in the blood serum of animals"
1136. NIKOGOSYAN, S. V. (1964) Trudy Nii Gigiyena Truda i Profzabolevaniya AMN, SSSR, (2):43-48, "A study of cholinesterase activity in the blood serum and organs of animals subjected to the chronic effects of microwaves"; *ibid.*, pp. 66-67, "Effects of 10 cm waves on the content of nucleic acids in animal organs"; *ibid.*, Issue 9, pp. 56-, "Effect of 10 cm waves on amount of protein fractions in animal blood serum"; (Also in: The Biological Action of Radio-Frequency Electromagnetic Fields, Institute of Industrial Hygiene and Occupational Diseases, Academy of Medical Sciences, USSR, Moscow)
1137. NIKOGOSYAN, S. V. (1967) Bulletin Eksperimental'noi Biologii i Meditsiny (Moskva) 64(9):56-58, (Abstr. in: Soviet Radio-biology, ATD 68-105-103-9, pp. 81-82. June 1968; AD 671435), "Changes in protein metabolism under chronic exposure to 10 cm low-intensity waves"
3574. NIKOGOSYAN, S.V. (1970), Doklady Akademii Nauk Azerbaydzhanskoj SSR, 10(6):108-110 (in Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #66512), (7 Jan. 1976), pp. 90-92, "Sanitary hygienic investigation of working conditions during high frequency heating."
2492. NIKOGOSYAN, S.V. (1971), Gigiyena Truda i Professional'nyye Zabolevaniya, (7):49-51, (JPRS abstract), "Analyzer function in persons exposed to radio waves".
1138. NIKOGOSYAN, S. V., & KITSOVSKAYA, I. A. (1968) Gigiyena Truda i Professional'nyye Zabolevaniya (Moskva) (5):53-55, "Changes in the activity of cholinesterase in the central nervous system of animals with different functional conditions under the action of low intensity decimeter waves"
1139. NIKOLAEVA, E. N. (1953) Sborn. Eksp. Klin. Neurolog. (Monograph), "On experimental basis of use of UHF currents in medical practice"
2981. NIKOLAEVSKAYA, V.P. (1971), Vopr. Kurortol. Fizioter. Lech. Fiz. Kult., 36(1):423-426, (Sep.-Oct.), (In Russ.), "Changes in the temperature of the tympanic cavity and maxillary sinus under the action of magnetic, electric, and electromagnetic fields".
1140. NIKOLOVA-TROYEVA, L. (1964) Voprosy Kurortologii, Fizioterapii i Lechebnoy Fizicheskoy Kul'tury (Problems in Health Resort Sci., Physiotherapy and Medical Physical Culture), Moscow, 29(3):239-242, (JPRS 26038; N64-27670), "Results of microwave treatment of some diseases"
1141. NIKONOVA, K. V. (1960) Gigiyena Truda i Professional'nyye Zabolevaniya (Moskva) (1):9-12, "The hygienic characteristic of labor conditions during work with high frequency heating in the electrovacuum industry"
1142. NIKONOVA, K. V. (1960) In: Physical Factors of the Environment, Letavet, A. A., (ed.), pp. 163-170, "The problem of labor hygiene during work with high frequency generators in the electrovacuum industry"
1143. NIKONOVA, K. V. (1963) Kandidatskaya Dissertatsiya, Moscow, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Materials on the hygienic assessment of high frequency electromagnetic fields (medium and long waves)"
1144. NIKONOVA, K. V. (1964) Trudy Nii Gigiyena Truda i Profzabolevaniya AMN, SSSR, (2):49-56, "Effects of high frequency electromagnetic fields on the functions of the nervous system"; *ibid.*, pp. 61-65, "Effects of high frequency electromagnetic fields on blood pressure and body temperature of experimental animals"; (Also in: The Biological Action of Radio-Frequency Fields, Institute of Industrial Hygiene and Occupational Diseases, Academy of Medical Sciences, USSR, Moscow)
1145. NIKONOVA, K. V., & FUKALOVA, P. P. (1962) Gigiyena Truda i Professional'nyye Zabolevaniya (Moskva), 6(3):8-13, (JPRS 13920; N62-12615), "Hygienic evaluation of working conditions and the effectiveness of protective (safety) measures during the induction heating of metal using high frequency tube generators"
3575. NIKORYUKINA, I.P. (1975), Vrachebnoye Delo, (1):40-43 (Dec.), (in Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #L/5787), 26 Mar. 1976, pp. 19-23, "Use of inductothermy and microwaves in integrated treatment of patients with chronic colitis."
1146. NIZENIK, G. V. (1956) Zh. Obshchei Biologii, Moscow, 17(4):311-316, "Viability changes in sexual cells of male rabbits and mice under the action of VHF-HF fields"
2493. NORTHROP, R.B. (1967), IEEE Trans. on Bio-Medical Engineering, BME-14(3):191-200, "Electrofishing".
1147. NOVAK, J. & CERNY, V. (1963) Casopis Lekarů Ceských, Prague, 102:496-497, (In Czech) "Influence of a pulsed electromagnetic field on the human organism"

2238. NOVITSKIY, Yu.I., GORDON, Z.V., PRESMAN, A.S., & KHOLODOV, Yu.A. (1971), (176 pps. Transl. of Chapt. 1, Vol. 2, Part 1 of Osnovy Kosmicheskoy Biologii i Meditsiny (Foundations of Space Biology & Medicine), Moscow, Acad. of Sciences USSR (1970), 288 pps. from Russ.), NASA TT-F-14,021, Radio Frequencies and Microwaves: Magnetic and Electrical Fields.
3282. NOVITSKIY, Yu.I., STREKOVA, V.Yu., & TARAKANOVA, G.A. (1971), In: KHOLODOV, Yu.A. (ed.), Influence of Magnetic Fields on Biological Objects, (Citation #3230, this Biblio.), pp. 65-84, "The influence of constant magnetic fields on the growth of plants".
1148. NERNORI, N., & TORRISI, S. (1930) Amer. J. of Physical Therapy, 9(9):130-, "A specific effect of high frequency electric currents on biological objects"; and ibid., 11(11):102-, "Ultra-high frequency electromagnetic vibrations: their effects upon living organisms"
3576. NUCCITELLI, R., & JAFFE, L.F. (1974), Proceedings of the National Academy of Science, 71(12):4855-4859, "Spontaneous current pulses through developing fucoïd eggs" [common seaweed eggs studied using extra-cellular vibrating electrode].
1149. NYROP, J. E. (1946) Nature 157(3976):51 only, (12 Jan.), "A specific effect of high-frequency electric currents on biological objects"
2982. OATES, W.H., Jr., SNELLINGS, D.D., Jr., & WILSON, E.F. (1973), Amer. J. of Public Health, 63(3):193-198, "Microwave oven survey results in Arkansas during 1970".
2983. OBERG, P.A. (1973), Medical & Biological Engineering, 5( ) :55-64, (Jan.), "Magnetic stimulation of nerve tissues", [using a stationary magnetic field (1 kHz to 1 MHz)].
1150. O'BRIEN, C. K., RICHARDSON, A. W., & KAPLAN, E. M. (1971), (Tower International Technomedical Institute)/J. of Life Sciences 1(1):1-8, "Histopathologic changes in rat liver following 2450 MHz microwave radiation" T.-I.-I.
1151. OBROSOV, A. N. (1960) In: Elektroniki V. Meditsin. Berg, A. I. (ed.), Moscow, pp. 197-206, "Basic trends in the application of electronics in physiotherapy"
1152. OBROSOV, A. N. (1963) Proc. of 1st Republican Conf. of Physiotherapists and Health-Resort Specialists of the Ukrainian SSR, Kiev, pp. 238-, "A pulsed UHF field - a new therapeutic factor"
1153. OBROSOV, A. N. (1967) In: Therapeutic Electricity and Ultraviolet Radiation, Licht, S. H., (ed.), E. Licht, Publisher, New Haven, Conn., 2nd Edition, (Vol. 1 of the Physical Medicine Library), Chapt. 5, pp. 179-187, "Electrosleep therapy"
1154. OBROSOV, A. N., & KROTOV, A. (1966) Meditsinskaya Gazeta, Navy, USSR, p. 3 only, "VHF-HF pulse therapy"
1155. OBROSOV, A. N., & SKURIKHINA, L. A. (1964) Klinicheskaya Meditsina 42(4):139-144, (JPRS 25235), "Experience in the treatment of patients using microwaves"
1156. OBROSOV, A. N., SKURIKHINA, L. A., & SAPIULINA, S. N. (1963) Voprosy Kurortologii, Fizioterapii i Lechebnoy Fizicheskoy Kul'tury (Problems in Health Resort Science, Physiotherapy & Medical Physical Culture), Moscow, 28(3):223-229, (JPRS 21067; N63 22435), "Effect of microwaves on the cardiovascular system of a healthy person"
1157. OBROSOV, A. N., & YASNOGORODSKI, V. G. (1961) Digest of the Internat. Conf. on Medical Electronics in Biology and Engineering, p. 156 only, "A new method of physical therapy: pulsed electric fields of ultrahigh frequency"
3283. O'CONNOR, N.F. (1974), Naval Aviation News, (Nov.), pp. 22-27, "Lightning" [and thunderstorm hazards].
1158. ODINTSOV, YU. N. (1965) Trans. of the Sci. Conf. Central Sci. Lab., TOMSK, No. 2, pp. 382-386, "The effect of an AC magnetic field on some immunobiological indices in experimental listerellosis"
2494. ODLAND, L.T. (1971), U.S. Air Force Radiological Health Laboratory (Wright-Patterson AFB) Tech. Rept. No. 71W-29, "Evaluation of ophthalmological findings in former military personnel whose work involved use of radar". [This report contains case histories and results of medical examinations. Distribution is restricted to USAF medical personnel.]
2495. ODLAND, L.T. (1972), J. of Occupational Medicine, 14(7):544-547, "Observations on microwave hazards to USAF personnel".
2984. ODLAND, L.T. (1972), USAF Radiological Health Lab. (AFLC) Wright-Patterson AFB, Ohio, Rept. No. 72W-25, (Mar.), "Consolidated report: Observations, opinions, and recommendations; U.S. medical service program for control of radio-frequency hazards".
2985. ODLAND, L.T., PENIKAS, V.T., & GRAHAM, R.B. (1973), Industrial Medicine & Surgery, 42( ) :23-26, (Jul./Aug.), "Radio-frequency energy: A hazard to workers?", [A statistical summary of results of ophthalmological examinations conducted on individuals whose occupations provided a potential for exposure, and controls].
2986. OHELENSCHLAGER, G., BERGER, I., & GRUNO, W. (1972), Biomedizinische Technik, 17(2):60-65, (In Ger. w/Engl. abstr.), "Studies on influencing the activity of cellular enzymes by irradiation with high-frequency electromagnetic waves".
3284. OHLSSON, T., BENGTSSON, N.E., & RISHAN, P.O. (1974), The J. of Microwave Power, 9(2):129-145, (June), "The frequency and temperature dependence of dielectric food data as determined by a cavity perturbation technique".
1159. OLDENDORF, W. H. (1949) Proc. of the Society for Experimental Biology and Med. 72:432-434, "Focal neurological lesions produced by microwave irradiation"

2067. OLIVER, R. (1970) *Phys. Med. Biol.* 15:217-, "Health physics in relation to the use of non-ionizing radiations"
2239. OLSEN, C. M. (1965) *Food Engineering* 37:51-54, "Microwaves inhibit bread mold"
2240. OLSEN, C.M., DRAKE, C.L., & BUNCH, S.L. (1966), *J. of Microwave Power*, 1(2):45-56, "Some biological effects of microwave energy."
3577. OLSEN, R.G. (1975), *J. of Microwave Power*, 10(3):281-296 (Sept.), "A theoretical investigation of microwave irradiation of seeds in soil."
3578. OLSON, R.G., DURNEY, C.H., LORDS, J.L., & JOHNSON, C.C. (1975), (Proceedings of the 1975 IMPI Meeting at Waterloo, Canada), (Citation #3124, this Biblio.), University of Utah, "Low-level microwave interaction with isolated mammalian hearts."
1160. ONCLEY, J. L. (1942) *Chemical Reviews* 30:433-450, "The investigation of proteins by dielectric measurements"
1161. OPREAN, R. (1966) *The Health Worker*, Bucharest, 2-, (JPRS 36,639), "The biological effect of electrostatic and magnetic fields"
3285. ORINGER, M.J. (1974), *Electrosurgery in Dentistry*, 2nd Edition, 1150 pps., W.B. Saunders Co., Phila., PA.  
In:  
1162. ORLOVA, A. A. (1957)/*Summaries of reports*, Part 2, Jubilee Scientific Session of the Institute of Labor Hygiene & Occupational Diseases Dedicated to the 40th Anniv. of the Great October Socialist Revolution, Moscow, p. 65 only, "The action of ultrahigh and high frequency fields on the internal organs"
1163. ORLOVA, A. A. (1959) In: *Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves*, Moscow, pp. 25-26, (Abstr. in: *The Biological Effects of Electromagnetic Fields - Annotated Bibliography*, ATD Rept. P-65-17, Apr. 1965), "Clinical aspects of changes in the internal organs during exposure to radiowaves of various frequencies"
1164. ORLOVA, A. A. (1960) In: *Physical Factors of the Environment*, Letavet, A. A., (ed.), pp. 171-176, "The condition of the cardiovascular system during exposure to SHF-UHF and high frequency fields"
1165. ORLOVA, A. A. (1960) *Trudy Mii Gigiyena Truda i Profzaboleaniia AMN, SSSR*, 1(1):36-40, (Also in: *The Biological Action of Ultrahigh Frequencies*, Letavet, A. A., & Gordon, Z. V., (eds.), Moscow, JPRS 12471, pp. 30-35); (Abstr. in: *The Biological Effects of Electromagnetic Fields - Annotated Bibliography*, ATD Rept. P-65-17, Apr. 1965), "Clinical aspects of changes in the internal organs caused by exposure to UHF"
1166. OSBORN, C. M. (1959) *Technical Rept., Investigators' Conf. on the Biological Effects of Electronic Radiating Equipments*, pp. 20-,
1167. OSBORN, R. R. (1943) *Lancet* 2:277-, "Findings in 262 fatal accidents"
1168. OSBORNE, S. L., & BELLENGER, J. (1950) *British J. of Physical Med.* 13:177-180, "Heating of human maxillary sinus by microwaves"
1169. OSBORNE, S.L., & FREDERICK, J.N. (1948), *J. of the Amer. Medical Assoc.*, 137(12):1036-1040, (Also, *Quarterly Bull. Northwestern Univ. Medical School*, 23:222-228 (1949)), "Microwave radiations: Heating of human and animal tissues by means of high frequency current with wavelength of twelve centimeters (the Microtherm)."
1170. OSBORNE, S. L., & HOLMQUEST, H. J. (1944) Charles C. Thomas, (Pub.), Springfield, Ill., 799 pages, *Technic of Electrotherapy and its Physical and Physiological Basis*
3579. OSBORNE, S.L., HOLMQUEST, H.J. (1944), *Technic of Electrotherapy and Its Physical and Physiological Basis*, Charles C. Thomas, Publisher, Springfield, Illinois. [Contains chapters on bio-effects of direct current electrical muscle stimulation, and HF, RF, and microwave radiation physiologic studies.]
2987. OSCAR, K.J. (1972), U.S. Army Mobility Equipment Research & Development Ctr., (Ft. Belvoir, VA), Rept. No. 2048, (Classified), "Analysis of microwave for barrier warfare(U)".
3286. OSEPCCHUK, J.M. (1971), *J. of Microwave Power*, 6(2):185 only, "Microwave power and cardiac pacemaker".
2496. OSEPCCHUK, J.M. (1971), Presented at the IEEE Int'l Symposium In Electromagnetic Compatibility, Phila., June 13-15, "Comparison of potential device interference and biological exposure hazards in microwave leakage fields".
2241. OSEPCCHUK, J. M. (1971?) Raytheon Co. Report, (Abstr. #A72-14022), "Comparison of potential device interference and biological exposure hazards in microwave leakage fields"
2497. OSEPCCHUK, J.M. (1972), *Microwaves*, 11(6):77, Letter to the editor, (Also, letter by MICHAELSON, S.M.), "[Microwave] radiation [exposure] standard off [by] 10 dB".
1171. OSIPOV, YU. A. (1952) *Gigiena i Sanitariya, USSR*, 6(6):22-23, (Abstr. in: *The Biological Effects of Electromagnetic Fields - Annotated Bibliography*, ATD Rept. P-65-17, Apr. 1965); (Abstr. in: *Biological Effects of Microwaves: Compilation of Abstracts*, ATD P-65-68, Sept. 1965, pp. 3-4, "Biological effects of ultrahigh frequencies under industrial conditions"), "The effect of VHF-HF under industrial conditions"
1172. OSIPOV, YU. A. (1952) *Vrachebnoe Delo nauchnyy meditsinskiy zh.*, Kharkov, 11:1018-1020, "High frequency currents from the standpoint of occupational pathology"
1173. OSIPOV, YU. A. (1953) *Sovetskoe Zdravookhranenie Kirgizii* 2(2):44-47, "Dispensary service offered workers engaged in work with high frequency currents"

1174. OSIPOV, YU. A. (1953) *Gigiyena i sanitaria* 8:39-42, (In Russian) "Induction heating of metals by high-frequency currents from the health point of view"
1175. OSIPOV, YU. A. (1954) Papers of the 2nd Leningrad Conf. on Industrial Use of High Frequency Currents, Moscow, pp. 26-31, "Labor hygiene problems in the industrial use of high frequency currents [fields]"
1176. OSIPOV, YU. A. (1955) *Vrachebnoe Delo nauchnykh meditsinskii zh.*, Kharkov, (4):345-346, "Potential organic lesions during work with high frequency currents"
1177. OSIPOV, YU. A. (1965) *Izd. Meditsina Publishing House, Leningrad, 220 pages, Occupational Hygiene and the Effect of Radio Frequency Electromagnetic Fields on Workers*; pp. 78-103, "Biological effect of radio frequency electromagnetic fields"; pp. 104-144, "Occupational hygiene and the health of workers exposed to radio frequency radiation"; and pp. 156-202, (JPRS 32725, TT:65-33213, Nov. 1965; and N66-11812), "Measures of protection, therapy, and prophylaxis to be taken during work with radio-frequency oscillators" [Describes "Microthermal Effects"]
1178. OSIPOV, YU. A., & KALYADA, T. V. (1962) Summaries of Reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. *Order of Lenin Military Medical Academy, Leningrad*, "Results of an experimental study into the effects of low intensity centimeter waves on man"
1179. OSIPOV, YU. A., & KALYADA, T. V. (1963) *Gigiyena i Sanitariya (Hygiene and Sanitation)*, Moscow, (10):73-78, (JPRS 23287, Feb. 1964; OTS 64-21594; & N64-15335), "Temperature response of the skin during irradiation with microwaves of low intensity"
1180. OSIPOV, YU. A., KALYADA, T. V., & KULIKOVSKAYA, YE. L. (1961) Materials of the scientific Session Concerned with the Results of Work Conducted by the Leningrad Institute of Industrial Hygiene and Occupational Diseases for 1959-1960, Leningrad, p. 24-, "Problems of industrial hygiene in work with centimeter radiowave measuring equipment"
1181. OSIPOV, YU. A., KALYADA, T. V., & KULIKOVSKAYA, YE. L. (1962) *Gigiyena i Sanitariya*, Moscow, (6):81-86, (Abstr. in: *The Biological Effects of Electromagnetic Fields - Annotated Bibliography*, ATD Rept. P-65-17, Apr. 1965), (JPRS 15644), "Observations on certain functional changes which occur in people exposed to irradiation with centimeter electromagnetic waves during work"
1182. OSIPOV, YU. A., KULIKOVSKAYA, YE. L., & KALYADA, T. V. (1962) *Gigiyena i Sanitariya*, Moscow, 27(2):100-102, (JPRS 13691), "Conditions of SHF-UHF electromagnetic field irradiation of those working on the tuning and testing of radio engineering instruments"
1183. OSIPOV, YU. A., VOLEBOVSKAYA, R. N., ASANOVA, T. P., KULIKOVSKAYA, YE. L., KALYADA, T. V., & SHCHEGLOVA, A. V. (1963) *Gigiyena i Sanitariya*, Moscow, 23(9):35-38, (JPRS 20372; N63-20695), "Concerning the problem of the combined effect of a MF-LF electromagnetic field and X-ray irradiation under industrial conditions"
3580. OSNOS, P. (1976), *The Washington Post*, (Monday Feb. 9), p. C4 only, "[Non-ionizing] Radiation bugs Moscow embassy [of U.S.]."
3581. OSNOS, P. (1976), *The Washington Post*, (Wednesday, Feb. 11), p. A25 only, "[U.S.] Embassy admits [non-ionizing] radiation exists."
3582. OSTROVSKAYA, I.S., YASHINA, L.N., & YEVTUSHENKO, G.I. (1974), *Vrachebnoye Delo*, (9):139-142, (in Russian), Transl. in: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #66512), (7 Jan. 1976), pp. 51-55, "Changes in the testes due to the effect of a low-frequency pulsed electromagnetic field on the animal organism."
1184. OTT, V. R., BUSCH, D., & RUIZ-BLANCO, B. (1964) *Arch. of Physical Therapy (Leipzig)* 18:1-17, "Experimental and clinical studies with decimeter waves"
1185. OVERMAN, H. S. (1959) U. S. Naval Proving Ground Technical Memorandum No. W-3/59, Jan., "Microwave radiation hazards to personnel from Bureau of Ordnance (Navy) radar"
1186. OVERMAN, H. S. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Peyton, M. F., ed.) pp. 47-54, "Quick formulas for radar safe distances"
1187. PACAKOVA, L., & BYTHA, M. (1962) Prague, p. 219, (In Czech.), Very Short Waves and Their Applications in Modern Technology
1188. PACELLI, M. (1959) *Annali di Medicina Navale e Tropicale* 64:533-, (In Italian) "On the biological effects of microwaves"
1189. PAFF, G.H., BOUCEK, R.J., & DEICHMANN, W.V. (1961), *Anatomical Record*, 142(2):264-, (Also, Section in: Microwave Radiation Research (1960), pp. 42-47; Univ. of Miami Annual Report, RADC-TR-61-42, AD #256-500), "The effects of microwave irradiation on the embryonic chick heart as revealed by electrocardiographic studies."
1190. PAFF, G., BOUCEK, R.J., NIEMAN, R.E., & DEICHMANN, W.V. (1963), *Anatomical Record*, 147:379-386, "The embryonic heart subjected to radar."
3583. PAHARICH, A. (1974), *Impact of Science on Society*, 24(4):353-357, "What happens when radio waves penetrate the human skin."
1191. PALIYEV, B., & GOSHEV, K. (1966) *Voenna Meditsinsko Delo* 21(4):34-41, "ERG changes occurring under the effects of a SHF-UHF electromagnetic field"
1192. PALLADIN, A. M., SPASSKAYA, I. M., & YAKUBOVICH, R. S. (1959) In: Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, "On the health of women working around intermediate frequency generators"
1193. PALLADIN, A. M., SPASSKAYA, I. M., & YAKUBOVICH, R. S. (1962) *Akusherstvo i Ginekologiya (Obstetrics and Gynecology)* 38(4):69-74, (In Russian), "The effect of SHF-UHF on the specific functions of women working with generators"

1194. PALMISANO, W. A., & PECZENIK, A. (1966) *Military Medicine* 131:611-618, "Some considerations of microwave hazards exposure criteria"
1195. PANOV, A. G., PORTNOW, A. A., LOBZEN, V. S., & POLYAK, V. P. (1966) *Voenno Meditsinskii Zh. (Moskva)*, (12):12-15, "Diencephalic asthenic conditions"
1196. PANOV, A. G., & TYAGIN, N. V. (1966) *Voyenno Med. Zh. (Military Med. J.)*, USSR, (9):13-16, "Symptomatology classification and expertise of SHF-UHF after-effects on the human organism"
2988. PAMSE, J. (1954) *Monatsschrift fur Unfallheilkunde und Versicherungsmedizin*, 57( ):225-239, (In Ger.), "How much are health injuries affected by electromagnetic waves?"
2989. PAPPASJOHN, L.D., DAVIS, K., & PLANIEKS, I.M. (1962), *Fed. Proc.*, 21(Pt 2): ?, (Sept.-Oct.), "Bibliography of the biological effects of magnetic fields"
1197. PARDZHANADZE, SH. K. (1954) Thesis, Collected Abstr. of Papers from the Research Institute of Spa Therapy and Physiotherapy of the Georgian SSR 21:199-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept P-63-17, Apr. 1965), "The mechanism of action of HF-VHF electromagnetic fields on the organism"
1198. PARIN, (1963) *Akademiya Meditsinskikh Nauk SSSR, Moscow, (NASA-TTF 228)*, "Aviation and space medicine"
1199. PARIN, V. V., & DAVYDOV, I. N. (1940) In: Problems of Physiotherapy and the Science of Health Resorts, Collection, Sverdlovsk, pp. 178-181, "The influence of a UHF field on experimental hypertension"
1200. PARKER, B., FURMAN, S., & ESCHER, D. J. W. (1969) *Annals of the N. Y. Acad. of Science* 167:823-, "Input signals to pacemakers in a hospital environment"
2499. PARKER, G.S. (1972), *New England J. of Medicine*, 286(19):1058-1059, (May 11), "Diathermy survey". Also see: HOUK, W.M., MICHAELSON, S.M. (1972), *N.E.J. of Med.*, 287(18):938, (Nov 2), Letter to the Editor, "Safety of microwave devices", and the reply from PARKER, G.S.
2498. PARKER, L.N. (1971), *ERMAC Compilation of Federal Program Reports, N.I.R.E. 1971 - Research Performed*, pp. 185-188, "Suppression of thyroid function and adrenomedullary activation by low-intensity microwave irradiation", [A preliminary report of this work was presented at the Internat. Microwave Power Inst. Symp., 26-28 May 1971, Monterey, Calif.]
2990. PARKER, L.N. (1973), *American J. of Physiology*, 224(6):1388-1390, (June), "Thyroid suppression and adrenomedullary activation by low-intensity microwave radiation." [2.45 GHz at 15 mW/cm<sup>2</sup>]
2991. PARR, W. (1970), *Symposium Chmn., Proc. of the 4th Annual Midyear Topical Symposium, the Health Physics Soc., Louisville, KY, 28-30 Jan.*, Bureau of Radiological Health, U.S. Dept. of Health, Education, & Welfare, Rept. No. BRH/DEP 70-26, (Oct.), "Electronic product radiation and the health physicist".
2242. PASCA, M. (1934) *Studi Sassar., Sec. 2.* 12:807-812, (In Ital.), (Abstr. in: *Zentralbl. f. d. res. Ophth.* 34(3):137 (1935)), "Research on the possibility of producing a cataract by trans-scleral diathermy"
1201. PATTISHALL, E. G. (ed.) (1957) *Proc. (1st) Tri-service Conf. on Biological Hazards of Microwave Radiation*, 1, (15-16 July), (ARDC-TR-58-51; AD 115603). Sponsored by Air Research & Development Command Hdqs., U. S. Air Force
1202. PATTISHALL, E. G., & BANGHART, F. W. (eds.) (1958) *Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy*, 2, (8-10 July), Sponsored by Rome Air Dev. Center, Air Res. & Dev. Command (Knauf, G. M., Chm.), 264 pages, (ARDS-TR-58-54; AD 131477)
2500. PÄTZOLD, J. (1940), (In Germ.), *Wissenschaftlich Veröffentlichungen aus den Siemens - Werken, (Berling)*, 19(2):1-31, "Studies of the absorption and focusing of short-electromagnetic waves in electrolytes and biological tissues as basis for the medical application of radiation fields".
1203. PAULY, H., PACKER, L., & SCHWAN, H. P. (1960) *J. of Biophysics & Biochemical Cytology* 7(4):589-, "Electrical properties of mitochondrial membranes"
2992. PAUTRIZEL, R. (1966), *Comptes Rendus Acad. of Sci. (Paris)*, 263( ):579-582, (Aug.), "Influence of combined electromagnetic waves and magnetic fields on the immunity of mice infested with *Trypanosoma equiperdum*".
2501. PAUTRIZEL, R., PRIORE, A., BERLUREAU, F., & PAUTRIZEL, A.N. (1969), *Comptes rendus des seances de l'Academie des Sciences*, 268( ):1889D-1892D, (9 Apr.), (In Fr.), "Stimulation, by physical methods, of the defenses of the mouse and the rat against the experimental trypanosoma".
2502. PAUTRIZEL, R., PRIORE, A., BERLUREAU, F., & PAUTRIZEL, A.N. (1970), *Comptes rendus des seances de l'Academie des Sciences*, 271( ):877-880, (In Fr.), "Action of a magnetic field combined with electromagnetic waves on the experimental trypanosomes of the rabbit".
2503. PAUTRIZEL, R., PRIORE, A., DALLOCCCHIO, M., & CROCKETT, R. (1972), *Comptes rendus des seances de l'Academie des Sciences*, 247( ):488D-491D, (17 Jan.), (In Fr.), "Action of electromagnetic waves and magnetic fields on lipid modifications brought on in the rabbit by the administration of an alimentary hypercholesterol regime."
3287. PAVLOVICH, S.Z. (1971), In: *KHOLODOV, Yu.A., (ed.), Influence of Magnetic Fields on Biological Objects*, (Citation #3230, this Biblio.), pp. 36-50, "The influence of magnetic fields on micro-organisms".
2993. PAWLUK, R.J., & BASSETT, C.A.L. (1970), *Calc. Tiss. Res. (Suppl.)*, 4( ):120-121, "Electromechanical factors in healing cortical bone defects".

3288. PAY, T.L., BEYER, E.C., & REICHELDERFER, C.F. (1972), *J. of Microwave Power*, 7(2):75-82, "Microwave effects on reproductive capacity and genetic transmission in *Drosophila melanogaster*".
1204. PAYNE, J. N. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, Peyton, M. F., (ed.), pp. 319-325, "Similarities and differences between the technical aspects of the Navy HERO (Hazards from Electromagnetic Radiation to Ordnance) program for ordnance and the personnel hazard program"
2243. PAZDEROVA, J. (1968) *Pracovní lékařství* 20(10):447-457, (In Czech.), (Transl. by A. Marosi, (ed. by F. G. Mirsch), Loveland Found. for Med. Education and Res., Albuquerque), "Effects of electromagnetic radiation of the order of centimeter and meter wavelength on human's health"
2994. PAZDEROVA, J., FISCHER, R., FORMANEK, J., JOHN, J., LUKAS, E., & STYBLOVA, V. (1969), *Pracovní lékařství*, 21(8):346-361, "Health state of workers exposed to long-term electromagnetic radiation of the order of meter waves."
3584. PEAK, D.M., CONOVER, D.L., HERMAN, W.A., & SHUPING, R.E. (1975), Div. of Electronic Products, BRH, DHEW Publication (FDA) 76-8004, July, 19 pps., "Measurement of power density from marine radar."
1205. PEAKE, W. H. (1959) Ohio State Univ. Columbus, AF 336166155, (AD 417869), "The interaction of electromagnetic waves with some natural surfaces"
1206. PEARLMAN, W., & BALDWIN, M. (19\_\_), (ref?) pp. 157-166, "Experimental designs in the study of biological effects during radio frequency transmission"
2504. PEDERSON, P.D., Jr., & BLOMQUIST, A.W. (1967), Air Force Armament Lab, Eglin AFB, Fla., Tech. Rept. APATL-TR-67-196, (AD #838754), "Microwave applications".
1207. PELIS, L., JR. (1964) *Industrial Medicine & Surgery* 33:866-868, "The hazards of low voltage radiation"
2244. PENNERS, S. (1966) *Gigiyena Truda i Professional'nyye Zabelevaniya*, Moscow, \_\_ (7):18-21, (ATD-66-123, N67-14373), "Hemodynamic indices during the action of superhigh frequency electromagnetic fields"
1208. PENNOCK, B. E., & SCHWAN, H. P. (1967), (Ph.D. Thesis), (CNR Tech. Rept. #41), (Electromedical Div., The Moore School of Electrical Engineering, Univ. of Pa., (Rept. #68-01)); (AD 655127), "The Measurement of the Complex Dielectric Constant of Protein Solutions at Ultrahigh Frequencies: Dielectric Properties of Hemoglobin Bound Water"
2995. PEPERSACK, J.P. (1970), *Bruxelles Medicale*, 50( ):243-247, (In Fr.), "A new industrial danger: Centimeter waves".
2996. PERDEL'SKII, A.A. (1956), *Usp. Sovr. Biol.*, 41( ):228-245, (In Russ.), "The problem of electrotechnical measures for combatting harmful insects".
1209. PEREIRA, F. A. (1933) *Comptes Rendus Acad. Sci.* 197:1124-1125, (In French), "Oscillatory chemical mechanics: modification of chemical reactions under the influence of waveguide oscillator circuits"
1210. PEREIRA, F. A. (1935) *Biochem. Z.* 238:53-58, (In French), "On the effect of electromagnetic waves on enzyme systems"
3585. PERSINGER, M.A. (1969), *Developmental Psychobiology*, 2(3):168-171 (July), "Open-field behavior in rats exposed prenatally to a low intensity-low frequency, rotating magnetic field."
2997. PERSINGER, M.A. (1973), *Internat. J. of Biometeorol.*, 17(3):263-266, "Possible cardiac driving by an external rotating magnetic field."
3289. PERSINGER, M.A. (ed.), (1974), ELF and VLF Electromagnetic Field Effects, Plenum Press, NY. (#ISBN-0-307-3082606)
3586. PERSINGER, M.A. (ed.) (1974), ELF and VLF Electromagnetic Field Effects, Plenum Press, New York. [Includes chapters on behavioral, physiological, histological, biochemical and circadian rhythm studies.]
3587. PERSINGER, M.A., & FOSTER, W.S., IV (1970), *Arch. Met. Geoph. Biokl. (Ser. B)*, 18( ):363-369, "ELF rotating magnetic fields: Prenatal exposure and adult behavior."
3588. PERSINGER, M.A., GLAVIN, G.B., & OSSENKOPP, K.P. (1972), *Int. J. of Biometeorol.*, 16( ):163-172, "Physiological changes in adult rats exposed to an ELF rotating magnetic field."
3589. PERSINGER, M.A., LUDWIG, H.W., & OSSENKOPP, K.P. (1973), *Perceptual and Motor Skills*, 36( ):1131-1159, (Monograph Supplement 3-V36), "Psychophysiological effects of extremely low frequency electromagnetic fields: A review."
2998. PERSINGER, M.A., & OSSENKOPP, K.P. (1973), *Internat. J. of Biometeorol.*, 17(3):217-220, "Some behavioral effects of pre- and neo-natal exposure to an ELF rotating magnetic field."
3590. PERSINGER, M.A., & PEAR, J.J. (1972), *Development Psychobiology*, 5(3):269-274, "Prenatal exposure to an ELF-rotating magnetic field and subsequent increase in conditioned suppression."
2999. PERTSOVSKII, A.I., et al. (1969), *Pat. Fiziol. Eksp. Ter.*, 13( ):64-66, (In Russ.), "The effect of an ultrahigh frequency electromagnetic field on the course of experimental atherosclerosis".

1211. PERVUSHIN, V. YU. (1957) *Bulleten Eksperimental'noy Biologii i Meditsiny* (Moskva), 43(6):87-92, (Abstr. in Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, (1965), pp. 26-27, "Changes in the cardiac nervous mechanism due to SHF"), "Changes in the cardiac nervous mechanism during exposure to an SHF-UHF field"
1212. PERVUSHIN, V. YU., & TRIUMFOV, A. V. (1957) *Trans. Milit. Med. Acad. imeni S. M. Kirov, (USSR) VMOLA*, 73:141-151, "Morphological changes in some organs of rabbits subjected to the action of a SHF field"
1213. PETERS, W. J., JACKSON, R. W., IWANO, K., & GROSS, A. E. (1970) Presented before the New York Academy of Sciences, 4 Nov. at the Symposium entitled, "Effect of Controlled Electromagnetic Energy on Biological Systems", 11 pages, "The effect of microwave electromagnetic radiation on the growth of mammalian cells in tissue culture"
3591. PETHIG, R. (1973), *J. of Biological Physics*, 1(4):193-214, "Microwave Hall effect measurements in bio-macromolecular systems."
3000. PETRUSCU, A., et al. (1967), *Digest of the 7th Internat. Conf. on Medical & Biological Engineering*, (JACOBSON, B., (ed.)), Stockholm, Sweden, August 14-19, 1967, General Session 30-13, p. 405, "Change in the morphology and infectivity of influenza virus by exposure to a high frequency oscillating magnetic field".
1214. PETROV, F. P. (1929) *New Findings in the Reflexology and Physiology of the Nervous System*, 3:pp?, Moscow, (In Russian), "The effect of electromagnetic fields on nerve stimulation"
1215. PETROV, F. P. (1935) In: Physicochemical Bases of Higher Nervous Activity, Leningrad, pp. 97-, "Effect of an electromagnetic field on isolated organs"
1216. PETROV, F. P. (1952) *Trudy Instituta fiziologii imeni I. P. Pavlova. Akademia nauk SSSR, Moskva*, 1:369-376, "Effect of a low-frequency electromagnetic field on higher nervous activity"
1217. PETROV, I. R. (Ed.), (1967) *VMOLA im. S. M. Kirov Publ. House, (USSR), Medical-Biological Problems of SHF-UHF Radiation*
2245. PETROV, I. R. (1968) *Transl. (from Russ.) of citation #1212 (this Biblio.)*, (Rept. No. M70-30464, MIL-Transl-2629-(9022.81)), "Aetiology of ultra-high frequency exposure" (combined effects of microwave radiation and rarified atmosphere on immunization reactions of human organisms)
- (In Russ.)
1218. PETROV, I. R. (1968) *Voyenno Med. Zh. (Military Med. J.)*, USSR, \_ (5):21-24, "Factors involved in the etiology of injuries due to SHF-UHF electromagnetic energy"
2246. PETROV, I. R., (ed.), (1970) (In Russ.), "Meditsina" Press, Leningrad, (NASA Transl. No. TT-F-708, (1971)), Influence of microwave Radiation on the Organism of Man and Animals
1220. PETROV, I. R., & SUBBOTA, A. G. (1964), *Voenno Meditsinskii Zh.*, \_\_ (2):16-21, (ATD Abstract (?) I-9841, pp. 21- ), (AD #744-870), "Effect of electromagnetic radiations of superhigh frequency range upon the organism" (Review of the literature).
1219. PETROV, I. R., & SUBBOTA, A. G. (1964) *Voyenno Med. Zh. (Military Med. J.)*, USSR, \_ (9):26-31, "Mechanism of the action of SHF-UHF electromagnetic radiation"
1221. PETROV, I. R., & YAROKHNO, N. Y. (1967) *Voyenno Meditsinskii Zh.*, USSR Military Med. Journal, \_ (7):26-30, (Abstr. in: Soviet Radiobiology, ATD 68-105-108-9, June 1968, pp. 83-84), "The combined effect on animal organisms of SHF-UHF electromagnetic waves, and breathing of a gas mixture with low oxygen content"
1222. PETROV, I. R., & YAROKHNO, N. Y. (1967) *Voyenno-Meditsinskii Zh.*, USSR Military Med. Journal, \_ (4):20-21, (Abstr. in: Soviet Radiobiology, ATD 68-105-108-9, June 1968, pp. 82-83), "Increased resistance to SHF-UHF irradiation under conditions of systematic muscular activity"
3592. PETROVA, V.M., DMITRIYEVA, A.P., MASSARSKAYA, F.T., DANAYEVA, F.S., KOROSTELEVA, A.Ye., & VAL'NEVA, Ye.S. (1975), *Kazanskiy Meditsinskii Zhurnal*, 56(2):59-61 (Mar./Apr.), (in Russian), *Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #66512)*, (7 Jan. 1976), p. 94 only, "Microwave therapy of inflammation of the genitals."
1223. PEYTON, M. F. (ed.) (1961) *Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation*, Vol. 1, (Knauf, G. M., Chm.) held at New York Univ. Medical Center, 16-18 Aug. 1960, (Plenum Press)
1224. PEZZI, G. (1954) *Annali di Medicina Navale e Tropicale* 59:473-, "Radar waves in therapy"
1225. PFLOMM, E. (1931) *Archiv fur Klinische Chirurgie* 166:251-305, (In German), "Experimental and clinical investigations concerning the effect of ultrashort electrical waves on inflammation"
3001. PHOTIADES, D.P., AYIVORH, S.C., RIGGS, R.J. (1970), *Proc. of the 6th Internat. Cong. on Cybernetics, Namur, Belgium*, Sept. 7-11, "Control mechanisms and the action of weak electric currents in the acceleration of wound healing and fracture union", "[...]very weak dc is the stimulus. This is produced directly and primarily by electricity from a battery or by electrostatic fields, whereas in the case of athermal pulsed high peak power alternating electromagnetic energy, the too and fro very rapid oscillations generated in molecules and dipoles will lead to the secondary production of minute dc. The end result is approximately the same in both cases, namely the speeding up of wound healing and fracture union by a process of accelerated collagen deposition, and a faster calcification and ossification, [...]".
1226. PICCARDI, G. (1959) *Ricerca sci.* 29:1252-1254, "The structure of water and the influence of low-frequency electromagnetic fields"

1227. PICKET, J., & SCHRANK, A. (1965) Texas J. of Science 17:245-, "Responses of coleoptiles to magnetic and electric fields"
1228. PICKERS, B. A., & GOLDBERG, M. J. (1969) British Medical J. 2:504-506, "Inhibition of a demand pacemaker and interference with monitoring equipment by radio-frequency transmissions"
2505. PICKHAN, A., TIMOFEEFF-RESSOVSKY, N.W., & ZIMMER, K.G. (Kaiser-Wilhelm Institute for Brain Research, Berlin), (1935), Strahlentherapie, 36:488-496, (In Germ.), "Investigations with Drosophila melanogaster to see whether the mutation rate caused by x-ray and gamma rays is changed by the use of a high frequency field (shortwaves), or under the influence of ether narcosis". [A wavelength of six meters was used, and the results show that there was no statistically significant rise in mutation rate, nor was increased sterility in the F<sub>2</sub> generation seen.]
1229. PIESLAK, W. (1967) Ochrona pracy, Warsaw, 22(8):22-24, (In Polish), (English abstr. in Nuclear Science Abstr. 22(23): #49597, 1968), "Protection from the effects of high frequency electromagnetic radiation"
1230. PINAKATT, T. L., COOPER, T., & RICHARDSON, A. W. (1963) Aerospace Med. 34(6):497-499, "Effect of onabain on the circulatory response to microwave hyperthermia in rat"
1231. PINAKATT, T. L., & RICHARDSON, A. W., (1963) Federation Proceedings 22(2):176-, "Effects of onabain on the circulatory response of the rat to microwave hyperthermia"
1232. PINAKATT, T. L., RICHARDSON, A. W., & COOPER, T. (1965) Archives Internationales de Pharmacodynamie et de Therapie, Gand, Belgium, 156(1):151-160, "The effect of digitoxin on the circulatory response of rats to microwave radiation"
1233. PINNEO, L. R., BAUS, R., McAFEE, R. D., & FLEMING, J. D. (1962) Summary rept., Tulane Univ., New Orleans, La., 24 pages, (AD 277684; RADC-TDR-62-231), "The neural effects of microwave radiation"
1234. PINNEO, L., SPEAR, V., & FLEMING, J. (1961) In: Digest of Internat. Conf. on Medical Electronics, Biological Effects of Microwaves, I (Athermal Aspects), Frommer, P. L., (ed.), p. 227 only, "Relationships involved in considering effects of microwaves in the central nervous system"
1235. PIONTKOVSKIY, I. A. (1936) Nauch Khronika GIFF, Moscow, (2), pp? "The effect of ultrashort waves on reflex excitability"
3002. PIONTKOVSKII, I.A., et al. (1970), Patol. Fiziol. Eksp. Ter., 14( ):33-38, (Mar.-Apr.), (In Russ.), "Embryologic and genetic effects of electromagnetic oscillations of ultra-high frequency"
1236. PICNTOVSKIY, I. A., & YANOSHEVSKAYA, Z. K. (1944) Moscow, (In Russian), Physical Methods of Frostbite Therapy
1237. PIROVANO, A. (1934) In: Proc. of the 1st Internat. Congress of Electro-Radio-Biology, (Cappelli, L., ed.), pp. 134-144, (In Italian with English Summary), "Interaction of electromagnetic fields with biological materials"
1238. PISH, G. W., STOREY, W. H., TRUBY, F., & BOLLWITZ, W. (1959) USAF Report RADC-TR-59-81, (AD 216431), (Also in: Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments, Susskind, C., (ed.), pp. 251-270), and (In: Investigators' Conf. on Biological Effects of Electronic Radiating Equipments, Knafl, G. M., (chn.), pp. 33-36), "A preliminary investigation of the applications of magnetic resonance absorption spectroscopy to the study of the effects of microwaves on biological materials"
1239. PISKINOVA, V. G. (1957) Gigiena Truda i Professional'nye Zabolvaniya (Moskva) \_ (6):27-30, (In Russian), "The health of workers exposed to high frequency electromagnetic fields"
1240. PISKINOVA, V. G. (1958) Sborn. Rabot i Avtores Po Voprosam Gig. Tr., Kharkov, pp. 144-146, (Also in: Papers of the Scientific Sessions of the Institute on Questions of Industrial Hygiene in Mining, Chemical, and Machine Construction Industries, Khar'kov, (1956), pp. 45-46), "The health of workers exposed to high frequency electromagnetic fields"
1241. PITENIN, I. V. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF electromagnetic field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 36-38, "Pathological and anatomical changes in animal organs and tissues during the influence of a SHF-UHF electromagnetic field"
1242. PITENIN, I. V., & SUBBOTA, A. G. (1965) Bulletin Eksperimental'noi Biologii i Meditsiny, Moskva, 60(9):55-59, "On the development of gastric ulcer in rabbits following irradiation of the epigastrium with ultrahigh frequency radiation"
1243. PIVIVAROV, M. A. (1962) In: Summaries of reports, Questions of the Biological Effect of a SHF-UHF Electromagnetic field. Kirov Order of Lenin Military Academy, Leningrad, "The effect of microwave fields of low intensity on some physiologic 'detectors'"
1244. PIZZOLATO, P., BERGER, C., & McAFEE, R. D. (1961) Digest of the Internat. Conf. on Medical Electronics, Biological Effects of Microwaves, I (Athermal Aspects), (Frommer, P. L., ed.), Plenum Press, New York, pp. 196-, "Tissue injury from microwave radiation"
1245. PLEKHANOV, G. P. (1965) In: Bionika Gaize, Rapoport, M. G., & Yakobi, V. E., (eds.), Nauka Publ. House, Moscow, pp. 273-277, (N66-24170; JPRS 35125; TT-66-31562), "Some material on interpretation of information by living systems"
1246. PLEKHANOV, G. P., & VEDYUSHEINA, V. V. (1966) Zh. Vysshei Nervnoi Deyatel'nosti imeni i p Pavlova, USSR, 16(1):34-37 (N66-26926), "Elaboration of a vascular conditioned reflex in man to a change in the intensity of an electromagnetic field of high frequency [Effect of an EMF on human reflexes]"
2090. PLHAK, M., SERVUS, V., & SCHUBERTOVA, J. (1967) Vojenske zdravotnicke listy (Prague), 38(1):7-9, (Abstr. in: Non-ionizing Rad. 1(4):194 only, (1970)), "Hazards associated with microwaves, and preventive examinations of radar specialists"

2091. PLISCHKE, E. W., & WOLFF, W. P. (196?) *J. of the American Soc. of Safety Engineers* 14(6):12-15, (Abstr. in: *Non-ionizing Rad.* 2(1):43 only, (1971)), "Tuned in or turned on — r.f. radiation study"
2247. PLITAS, P. S. (1935) *Sovet. Vestn. Oftal.* 7(4):442-447, (In Russ.), (Abstr. in: *Zentralbl. f. d. ges. Opth.* 36(1):23-24, and *Am. J. of Opth.* 19(5):449 (May 1936)), "Modification of the visual organ under the influence of ultrashort radio waves"
1247. PLURIEN, G., SEMENAG-ROUMANOU, E., JOLY, R., & BROUET, J. (1966) *Comptes Rendus des Seances de la Societe Biol., Paris*, 160:597-599, "Influence of electromagnetic radiation emitted by radar on the phagocytic function of cells in the reticulo endothelial system of mice"
2506. POCTA, J., POKORNY, J., LEBEL, M., ZDENEK, K., HANKA, R., & VESELY, F. (1967), *Vojenske Zdravotnicke Listy*, 36(2):59-61, "Autonomic reactions of the organism to experimental electroanesthesia"
1248. POKORNY, J., & JELINEK, V. (1967) *Neoplasma* 14(5):479-485, "Investigations of the effect of combined electromagnetic fields on neoplastic malignancy growth - A contribution to the problem"
1249. POKORNY, J., & JELINEK, V. (1968) *Casopis Lekaru Ceskych* 107(16):474-482, "The effect of coherent electromagnetic field on neoplastic malignant processes"
- (4)
1250. POL, W. (1962) *Lekarz Wojskowy, Poland*, 4:313-327, (AD 433135; FTD-TT-63-1070), "Effect of microwaves emitted by radar transmitters on the origin of cataracts"
1251. POLLACK, E., & HEALER, J. (1967) *Institute for Defense Analysis, Research & Engineering Support Div.*, (Internal Report No. W-451; "Review of information on hazards to personnel from high-frequency electromagnetic radiation" IBA/EQ 67-6211),
3003. POLSON, P., JONES, D.C.L., KARP, A., & KREBS, J.S. (1974), *Stanford Res. Inst.*, (Menlo Park, CA), Final Tech. Report. Prepared for U.S. Army Mobility Equipment Research & Develop. Ctr., (Ft. Belvoir, VA), under Contract DAAK02-73-C-0453, (Jan. 1974), AD # 774 823, "Mortality in rats exposed to CW microwave radiation at 0.95, 2.45, 4.54, and 7.44 GHz".
2507. POLYASHCHUK, L.V. (1972), *Doklady Akademii Nauk Ukrainsoy SSR*, (8):754-758, (In Russ.), (Trans. as JPRS #58203), "Changes in permeability of histoemetic barriers under the effect of microwaves". [Using p<sup>32</sup>, in rabbits, at 2307 MHz].
1252. PONOMAREV, A. V. (1940) In: *Papers on the Use of Short- and Ultra-short Waves in Medicine*, Medgiz, Moscow, pp. 90-, "Action of UHF on micro-organisms and on immuno-biological processes"
1253. PONOMAREV, A. V., & KAMBAROVA, O. I. (1937) In: *Biological Action of Ultrahigh Frequency Ultrashort Waves*, pp. 193-, (Abstr. in: *The Biological Effects of Electromagnetic Fields - Annotated Bibliography*, ATD Rept. P-65-17, Apr. 1965), "Influence of UHF on the nervous system in immunization reactions"
1254. POPOV, N. A., GUBAREV, F. A., VADIMOVA, M. A., & MALEVANNALA, J. T. (1940) *Trudy State Sci. Res. Inst. Fizioterap.* 6:314-, (Moscow Gosudarstvenny nauchno-issledovatel'skii institut fizioterapii), (Abstr. in: *The Biological Effects of Electromagnetic Fields - Annotated Bibliography*, ATD Rept. P-65-17, Apr. 1965), "On local action of diathermy and UHF on the so-called vegetative centers of the brain"
1255. POPOV, N. A., & MARKOVNIKOVA, YE. P. (1940) *Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva)* 6(1):pp?, (Abstr. in: *The Biological Effects of Electromagnetic Fields - Annotated Bibliography*, ATD Rept. P-65-17, Apr. 1965), "The problems of the effect of a high frequency electromagnetic field on the vegetative cerebral centers" [Discusses reduction of blood sugar level by irradiation of the head of dogs with UHF]
3004. PORTELA, A., VACCARI, J.G., & LLOBERA, O. (1974), In: *Internat. Symp. on Biologic Effects and Health Hazards of Microwave Radiation*, (CZERSKI, P., et al. (eds.)), (Warsaw, Poland), Oct. 15-18, 1973, "Transient effects of low level radiation on bioelectric muscle cell properties and on water permeability and its distribution".
3593. PORTELA, A., VACCARI, J.G., MICHAELSON, S.M., LLOBERA, O., BRENNAN, M., GOSZTONYI, A.E., PEREZ, J.C., & JENERICK, H. (1975), *Studia Biophysica*, Berlin, 53:197-224, "Transient effects of low level microwave irradiation on muscle cell bioelectric properties, water permeability, and water distribution."
2248. POSCH, N. A. (& KOLIN, A.), (1970) Ph.D. Dissertation, U. of Calif., 145 pp. (N71-36484), "Studies on magnetic field exposures of *Drosophila melanogaster* and *Pelvetia fastigiata*"
3594. POSTMES, T.J., NACKEN, G., & NELISSEN, R.G. (1974), *Experientia*, 30(12):1478-1480, "Electronic method for measuring heart frequency of *Waterfleadaphnia pulex*."
3290. POTAPOV, S.L., SEVAST'YANOVA, L.A., & VILENSKAYA, R.L. (1973-1974), *Biologicheskiye Nauki*, (3):46-49, (In Russ.), "Restorative processes of bone marrow under the effect of super-high frequency irradiation", [study on mice of combined effect of x-ray, anti-tumor chemotherapeutic agents, and (6-8 mm) microwave radiation].
3595. POTAPOV, S.L., SEVAST'YANOVA, L.A., & VILENSKAYA, R.L. (1975), *Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation"*(JPRS #64532), pp. 1-6, "Restorative processes in bone marrow in response to superhigh-frequency radiation."

1256. POTTER, R. B. (1961) U. S. Naval Weapons Laboratory, Technical Memorandum No. W-2/61 (Jan.), "Proposed Naval weapons design requirements to preclude hazards from environmental electromagnetic fields"
1257. POZVSHITKOV, V. A., TYAGIN, N. V., & GRESHECHENIKOVA, A. M. (1961) Biulleten Eksperimental'noi Biologii i Meditsiny, Moskva, 51(5):103-109 (Abstr. in: Biological Abstracts, 37, No. 12374 (1962)), "The influence of SHF pulsed electromagnetic field on conception and the course of pregnancy in white mice" \*in English transl. 51, pp. 615-618 (1961),
1258. POWELL, C. C. (1959) Amer. J. of Public Health 49:1-9, "Radiation hazards"
2059. POWELL, C. H., & ROSE, V. E. (1970) Amer. Industrial Hygiene Assoc. J. 31:358-361 (May-June), "Health surveillance of microwave hazards"
3291. POZOLOTIN, A.A. (1971), in: KHOLODOV, Yu.A. (ed.). Influence of Magnetic Fields on Biological Objects, (Citation #3230, this biblio.), pp. 85-94, "The influence of magnetic fields on radiation-induced chromosomal aberrations in plants".
1259. POZCS, R. S., RICHARDSON, A. W., & KAPLAN, E. M. (1969) Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium. (Cleary, S. F., ed.), Medical College of Va., Richmond, 17-19 Sept., Bureau of Radiological Health/Division of Biological Effects, Rept. No. 70-2, pp. 76-79, "Non-uniform biophysical heating with microwaves"
1260. PRATT, C. B., & SHEARD, C. (1935) Arch. of Physical Therapy 16:268-271, "Thermal changes produced in tissues by local applications of radiotherapy"
1261. PRATT, C. B., & SHEARD, C. (1935) Protoplasma 23:24-33, "The effects of intravenous injection into rabbits of strains of streptococci which have been exposed to the high-frequency field"
1262. PRAUSNITZ, S., & SUSSKIND, C. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments, (Susskind, C., ed.) 3:33-45, "Temperature regulation in laboratory animals irradiated with 3-cm microwaves"
1263. PRAUSNITZ, S. & SUSSKIND, C. (1962) In: "Nonthermal Effects of Microwave Radiation", Scientific Rept., Institute of Engineering Research, Univ. of Calif., Berkeley, Series No. 60, Issue No. 478, (Also, Institute of Radio Engineers Trans. on Bio-Medical Electronics, BME-9:104-108), "Effects of chronic microwave irradiation on mice"
1264. PRAUSNITZ, S., SUSSKIND, C., & VOGELHUT, P. O. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Peyton, M. F., ed.), "Longevity and cellular studies with microwaves" pp. 135-142
1265. PRESMAN, A. S. (1954) Gosenergoizdat, Moscow, Centimeter Waves
1266. PRESMAN, A. S. (1954) In: Annotations of Scientific Works of the Academy of Medical Sciences of the USSR, Moscow, pp. 479-, "An instrument for measuring the intensity of irradiation of 10-centimeter waves in industrial conditions"
1267. PRESMAN, A. S. (1956) Gigiena i Sanitariya, USSR, (9):32-37, "The electromagnetic field as a hygienic factor"
1268. PRESMAN, A. S. (1956) Uspekhi Sovremennoy Biologii, USSR, (Progress of Modern Biology) 41(1):40-54, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), (OTS-59-21107), "Physical aspects of the biological action of centimeter waves"
1269. PRESMAN, A. S. (1956) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 43(2):51-54, "Temperature changes of the human skin irradiated with low intensity waves several centimeters in length"
1270. PRESMAN, A. S. (1957) Biulleten Eksperimental'noi Biologii i Meditsiny, Moskva, 43(2):51-54, "Change in the human body and skin temperature due to irradiation with low-intensity electromagnetic waves several centimeters in length"
1271. PRESMAN, A. S. (1957) Gigiena i Sanitariya, USSR, (1):29-35, (OTS-59-21101, H-3825), "Methods of evaluation of the effective energy of the electromagnetic field under industrial conditions"
1272. PRESMAN, A. S. (1957) Proc. of the Jubilee Scientific Session of the Institute of Labor Hygiene and Occupational Diseases, Moscow, pp. 72-, "The hygienic evaluation of high-frequency electromagnetic fields"
1273. PRESMAN, A. S. (1958) Biofizika 3(3):335-338, (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, 1965, pp. 69-70, "Methods of irradiating animals with UHF fields"), (Also, Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Methods of experimentally irradiating small animals with centimeter waves"
1274. PRESMAN, A. S. (1958) Gigiena i Sanitariya, USSR, (1):21-27, "Method of protection from the action of radio frequency electromagnetic fields under industrial conditions"
1275. PRESMAN, A. S. (1960) In: Physical Factors of the Environment, (Letavet, A. A., ed.), pp. 142-151, "A hygienic evaluation of high frequency electromagnetic fields"
1276. PRESMAN, A. S. (1960) In: Elektronika v Meditsine (Electronics in Medicine), Berg, A. I., (ed.), pp. 219-227, (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, pp. 72-74, "The use of microwaves for therapeutic and biological purposes"), (Also, Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Microwaves in physiotherapy and biological investigations"
1277. PRESMAN, A. S. (1960) Novosti Meditsinskoj Tekhniki, Moskva, (4):51-55, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "An experimental device for the dosed irradiation of rabbits with microwaves in the 10 centimeter range"
1278. PRESMAN, A. S. (1961) Biofizika 6(3):370-371, (In Russian), "Experimental apparatus for microwave irradiation of protein solutions"

1279. PRESMAN, A. S. (1961) Nauka i Zhizn' (7):88-89, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "More intricate methods of investigation are needed"
1280. PRESMAN, A. S. (1962) In: Summaries of reports, 2nd All Union Conf. on the Application of Radioelectronics in Biology and Medicine, Niteir, (Publisher?), pp. 21-, "Problems concerning the mechanism of the nonthermal action of microwaves"; and pp. 23-, "Methods of measured irradiation with microwaves in biological experiments"
1281. PRESMAN, A. S. (1963) Biofizika 8(1):138-140, "Excitability in paramecium stimulated with DC and AC pulses"
1282. PRESMAN, A. S. (1963) Biofizika 8(2):258-260, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "Effect of microwaves on paramecium" (Letters to the Editor)
1283. PRESMAN, A. S. (1963) Uspekhi Sovremennoy Biologii (Progress of Modern Biology) 56(2):161-179, (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-65 (1965), pp. 78-79, "Review of the mechanism of the biological effect of microwaves"), (JPRS 22580, Jan. 1964; OIS 64-21190; N54-12357), "Problems of the mechanism of the biological effect of microwaves"
1284. PRESMAN, A. S. (1963) Biol. i Med. Elektronika (5):56-, "A method of determining the excitation thresholds of the neuromuscular apparatus of animals"; and ibid. (6):76-, "A method of comparative irradiation of protein solutions with microwaves and infrared rays"
1285. PRESMAN, A. S. (1964) Zarubezhnaya Radioelektronika (3):63-, (Part I), and (4):67-, (Part II), "Investigation of the biological effect of microwaves"
1286. PRESMAN, A. S. (1964) Biofizika 9(1):131-134, (In Russian), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), (Also abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, (1965), pp. 81-82, "The role of electromagnetic fields (EMF) in living processes"), (AD 625857; N65-18516; FSTC 381-765-601), "The role of electromagnetic fields in living processes"
1287. PRESMAN, A. S. (1965) Nauka i Zhizn' (6):82-88, (JPRS 31501; IT-65-31997; N65-31004), "Effect of electromagnetic radiations on living organisms"
1288. PRESMAN, A. S. (1965) Uspekhi Fizicheskikh nauk, Moscow, 86(6):263-302, (In: Soviet Physics Uspekhi 8(3):463-488; Amer. Inst. of Physics), (JPRS 33054; N66-12294; IT-65-33631), "The action of microwaves on living organisms and biological structures"
1289. PRESMAN, A. S. (1966) Proc. of Symposium on Problems of Neurocybernetics, Moscow, pp. 41-, "Electromagnetic fields in neurocybernetics"
1290. PRESMAN, A. S. (1966) Proc. of Conf. on the Effect of Magnetic Fields on Biological Objects, Moscow, pp. 59-, "Some general methodological questions of bioelectromagnetic investigations"
1291. PRESMAN, A. S. (1967) In: Questions of Bionics, Nauka, Moscow, pp. 341-, "Electromagnetic fields and regulation processes in biology"
1292. PRESMAN, A. S. (1967) Byulleten Moskovskogo Obshchestva Ispytatelei Prirody Otdel Biologicheskii, USSR, 52:149-, "The role of electromagnetic fields in evolution and the vital activity of organisms"
1293. PRESMAN, A. S. (1967) Proc. of Symposium on Physics and Biology, Moscow, pp. 13-, "The interaction of physics and biology in the investigation of the biological effect of electromagnetic fields"
1294. PRESMAN, A. S. (1968) Izd-vo Nauka, Moscow, 287 pages, (English transl. in: USSR Sci. Abstr., Bio-Medical Sciences 62:49-52 (1968)), (In Russian), Electromagnetic Fields and Animate Nature (See also citation #1295)
1295. PRESMAN, A. S. (1970) (Translated from Russian by Sinclair, F. L.) Brown, F. A., Jr., (ed.), Plenum Publ. Co., New York, 332 pages, Electromagnetic Fields and Life: Effects of Electromagnetic Fields on Living Organisms, (Transl. of citation #1294)
1296. PRESMAN, A. S., & KAMENSKIY, YU. I. (1961) Biofizika 6(2):231-233, (In Russian), "Experimental apparatus for studying the excitability of neuromuscular preparations during irradiation by microwaves"
1297. PRESMAN, A. S., KAMENSKIY, YU. I., & LEVITINA, N. A. (1961) Uspekhi Sovremennoy Biologii 51(1):82-103, (In Russian), (JPRS 9451), (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68 (1965), pp. 74-76, "Review of the biological effects of microwaves"), "Biological effect of microwaves"
1298. PRESMAN, A. S., & LEVITINA, N. A. (1962) Part I. Byulleten Eksperimental'noi Biologii i Meditsiny 53(1):41-44; Part II., ibid., 53(2):39-43, (1962), (In Russian), (Part I. Bulletin of Experimental Biology & Med. 52:36-39 (1962), Part II., ibid., 53(2):pp.? (1963), "Nonthermal action of microwaves on cardiac rhythm: Communication I. A Study of the action of continuous microwaves; Communication II. The action of pulsed microwaves"); (Part I: AD 288404; FTD-TT-62-278-1, 2, & 4; Part II: AD 283882); (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-68, (1965), Part I, pp. 38-39; Part II, pp. 40-41, "Nonthermal effect of pulsed microwaves on mammalian cardiac rhythm"); (Also abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "The nonthermal effect of microwaves on the systolic rhythm of animals. Report No. I, The effect of non-pulsed microwaves"; Report No. II, "The effect of pulsed microwaves"
1299. PRESMAN, A. S., & LEVITINA, N. A. (1962) Radiobiologiya 2(1):170-171, (In Russian), (AEC TR-5428, pp. 258-; TID-3912, pp. 447-), "Influence of nonthermal microwave radiation on the survivability of gamma irradiated animals"
1300. PRESMAN, A. S., & RAPPEPORT, S. M. (1964) Biologicheskie Nauki (formerly Nauchnye Doklady Vysshoi Shkoly Biologicheskie Nauki) USSR, (1):48-, "New data on the existence of an excitable system in paramecia. I. Reactions of paramecia to direct current pulses"; ibid. (3):44-, "II. Reactions of paramecia to ac pulses"
1301. PRESMAN, A. S., & RAPPEPORT, S. M. (1965) Byulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 59(4):48-52, (In Russian); (In English, Bulletin of Experimental Biology and Medicine 59(?)pp.? (1965)), "Effect of microwaves on the excitable (sensory) systems of paramecia"

2508. PRINCE, J.E., MORI, L.H., FRAZER, J.W., & MITCHELL, J.C. (1972), *Aerospace Medicine*, 43(7):759-761, "Cytologic aspect of RF radiation in the monkey."
1302. PROSTOVA, T. N. (1956) *Vysshai Nervnoi Deyatel'nosti imeni i p Pavlova, USSR*, 6(6):846-854, (Also in *Psychological Abstracts* 32(3), No. 2398 (1958)), "The effect of a continuous DEF electrical field on the higher nervous activity of dogs under normal and pathological conditions"
2249. PUGLISI-DURANTI, G. (1935) *Boll. Ocul.* 14:383-445, (In Ital.), (Abstr. in: *Zentralbl. f. d. ges. Opth.* 34(3):177-178), "Lesions due to the diathermic coagulation of the vitreous humor"
1303. PUHARICH, H. K. & LAWRENCE, J. L. (1964) Report, 77 pages, (AD 459956; RADC TDR-64-18), "Electro-stimulation techniques of hearing"
1304. PUKHOV, V. A. (1965) *Patologicheskai Fiziologia i Eksterimental'nai Terapiia (Moskva)* 9(6):72-73, (JPSS 36,906), "SHF-DEF electromagnetic wave effects on mice cause induced changes of the functional state of the central nervous system"
3005. PUNTERNEY, D.G., VETTER, R.J., WEEKS, W.L., ZIEMER, P.L., & BORN, G.S. (1974), *J. of Microwave Power*, 9(1):39-45, (Mar. "Microwave dosimetry using electrochemical effects".
2250. PUNTERNEY, I., & OSBORNE, S. L. (1939) *Arch. Opth.* (Chicago) 22(2):211-227, (Abstr. in: *Zentralbl. f. d. ges. Opth.* 45(3):148 (Apr 30, 1940)), "Temperature changes and changes in caliber of retinal blood vessels after short wave diathermy"
1305. PUSCHER, H. (1966) Springer-Verlag, New York, 337 pages, Eating with Microwaves - Fundamentals, Components, and Circuit Techniques
2509. PUTAN, G.A. (1966), In: Electrosleep and Electroanesthesia. Materials of the All-Union Symposium on Problems of Electrosleep and Electroanesthesia [Electroanarcosis], Dedicated to the 20th Year of the Electrosleep Method, pp.255-256, (In Russ.), Moscow (13-15 Oct.), "Use of interference currents as neurotropic therapy in treating hypertonic patients with electrosleep".
3596. PYE, M. (1975), *Sunday Times* (London), Sept. 21, p. 14 only, "Wolfgang Guettner's cancer cruise" [using microwave radiation as hyperthermia treatment].
1306. QUON, K. C. (1960) *U. S. Navy Medical News Letter* 36(10):29-34 (18 Nov.), (Originally in: *Industrial Med. & Surgery* 29: 313-316 (July), "Hazards of microwave radiation"
2510. RABICHEV, L.U. (1971?) Soviet Patent No. 272486, [Describes a non-contacting electrosleep apparatus (LIDA)].
2511. RABICHEV, L. Ya. (1966), *Pediatrics*, 6(6):7-10, "Sleep and electrosleep in children".
2512. RABICHEV, L. Ya., & IL'INA, T.G. (1966), In: Conference on Effects of Diffuse Electrical Currents on Physiological Mechanisms with Application to Electroanesthesia and Electrosleep. Vol. 4, Milwaukee, pp.25- , "Therapy mechanisms of electrosleep."
3292. RABINOWITZ, J.R. (1973), *IEEE Transactions on Microwave Theory & Techniques*, MTT-21(12):850 only, (Dec.), "Possible mechanisms for the biomolecular absorption of microwave radiation with functional implications".
1307. RAE, J., JR., HERRICK, J. F., WAXIM, K., & KRUSEN, F. (1949) *Arch. of Physical Med.* 30:199-211, "A comparative study of the temperatures produced by microwave and shortwave diathermy"
1308. RAE, J., JR., MARTIN, G., TREAMOR, W., & KRUSEN, F. (1950) *Proc. of Staff Meetings, Mayo Clinic*, 25:441-446, "Clinical experience with microwave diathermy"
2251. RAFAILA, E., LANCRANJAN, I., PREDI, N., POPESCO, M., ROVENTA, A., & TECOULESCO, D. (1970) In: Ergonomics and Physical Environmental Factors, (Vol. 21 of the Occupational Safety and Health Series), Internat. Labour Office, Geneva, (In Fr.), pp. 175-177, "Researches concerning changes in the organism in personnel employed in radar installations"
3293. RAI, P.S., BALL, H.J., NELSON, S.O., & STETSON, L.E. (1972), *Annals of the Entomological Soc. of Amer.*, 65(4):807-810, "Lethal effects of radio-frequency energy on eggs of *Tenebrio molitor* (Coleoptera: Tenebrionidae)".
1309. RAICHILSON, R. R., & EMERY, E. (1951) Lockheed Aircraft Corp., California, Rept. ERM 5217, "Deleterious effects of the radar beam"
1310. RAJEWSKY, V., & SCHWAN, H. (1948) *Naturwissenschaften* 10:315-, "The dielectric constant and conductivity of the blood at ultra-high frequencies"
3006. RAJOTTE, R.V., DOSSETOR, J.B., VOSS, W.A.G., & STILLER, C.R. (1974), *Proceedings of the IEEE*, 62(1):76-85, (Jan.), "Preservation studies on canine kidneys recovered from the deep frozen state by microwave thawing".
2513. RANDAL, J. (197 ), *The (Wash., D.C.) Evening Star*, in the Washington Close-up Column, "VA shuns dying ex-serviceman". [Describes alleged 'microwave cataracts' from chronic exposure to microwave radiation].

1311. RANDALL, B. F., IMIG, C. J., & HINES, M. H. (1952) Arch. of Physical Med. 33:73-81, "Effects of some physical therapies on blood flow"
3597. RANSCHT-FROEMSDORFF, W. (1968), Acta Medicotechnica, 8( ):320-322, (in German), "Electroclimate simulation apparatus for 'weather radiation'." [A carrier freq. of 10-100 kHz modulated at 1-1000 Hz and amplitude 10 mV/m to 10 V/m.]
3598. RANSCHT-FROEMSDORFF, W.R. (1962), Z. Angew. Bader und Klimaheilk., 5( ):462-477, (Nov.), (in German), "The influence of low frequency changes of environmental factors on nerve information."
3599. RANSCHT-FROEMSDORFF, W.R., & RINCH, O. (1972), Z. Angew. Bader und Klimaheilk., 19( ):169-176, (in German), "Electro-climate phenomena of the 'Fohn' (correlations of agglutination of blood and simulated spherics programs)."
1312. RASSADIN, A. M. (1965) Trans. Sci. Conf. of the Central Sci. Lab. Tomsk, (2):357-359, "Dependence of morphological changes in the kidneys on their functional load under the action of a low frequency electromagnetic field"
1313. RAWLS, O. B., GRAYSTON, C. M., & McDONALD, B. M. (1959), (AFMTC-TN-59-4 (C)), (Classified). "RF radiation hazards; Air Force Missile Test Center Ordnance - Bio-effects - Fuel"
1314. RAWLS, O. B., STILWELL, R. J., & McDONALD, B. M. (1961) RCA Service Co. report, 103 pages, (WO-047832), (AD 260721; AFMTC TR-61-14), "RF radiation hazards: fuel, ordnance, and bio-effects"
3294. REBY, M., & HAZAN, M. (1963), General Practice, 26( ):pp?, (July 12), "Diabetic ulcer of the foot. A new approach to treatment: Preliminary clinical report", [using pulsed, high frequency electromagnetic radiation].
2514. REFSHAUGE, W.D. (1971), (Letter to the Editor), Med. J. of Australia, 1:498 only, "Microwave ovens: A potential risk to patients with cardiac pacemakers."
1315. REHNBERG, G. L., MOGHISSI, A. A., & PEPPER, E. W. (1969) Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Medical College of Va., Richmond, 17-19 Sept., Bureau of Radiological Health/Division of Biological Effects, Rept. No. 70-2, pp. 101-103, "Effects of microwaves on optical activity"
2516. REIDER, D.R., EPSTEIN, D.L., & KIRK, J.M. (1971), U.S. Air Force School of Aerospace Medicine, Brooks AFB, Tex., Aeromedical Review #3-71, (AD #730922), "Possible cataractogenic effects of radiofrequency radiation", [No cataracts were formed in the eyes of rhesus monkeys exposed at 19.27 MHz for 4 hours to 180 mw/cm<sup>2</sup>. Eyes examined by slit-lamp biomicroscope over a period of 8 months showed no lenticular changes].
3600. REILLE, A. (1968), J. Physiol. (Paris), 60(1):85-92 (in French), "Evidence that pigeons are sensitive to magnetic fields."
1316. REINS, D. A., & WEISS, R. A. (1969) Work Order No. 523-003-10, Navy Clothing and Textile Research Unit, Natick, Mass., "Physiological evaluation of effects on personnel wearing the microwave protective suit and over-garment"
1317. REINER, S. (1967) In: Therapeutic Electricity and Ultraviolet Radiation, Licht, S. H., (ed.) 2nd edition, Licht, E., Publisher, New Haven, Conn., (Vol. 4 of Physical Medicine Library), Chapt. 2, pp. 70-104, "Instrumentation for electrotherapy"
1318. REITER, P. J. (1936) Zentralblatt fur die gesamte Neurologie and Psychiatrie 156:382-404, (In German), "The biological effect of shortwaves on the brain and investigation of a therapy for chronic brain diseases"
3601. REITER, R. (1960), Meteorobiology and Electricity of the Atmosphere, (in German), 424 pps., Akademische Verlagsgesellschaft, Leipzig.
3602. REITER, R. (1970), Heizung, Luftung, Haustechnik, 21(8):258-262 & 279-285, (in German), "Is it necessary to consider air-electrical properties as components of the bioclimate?"
1319. REITER, I. (1933) British J. of Physics 8:119-, "Some investigations of short waves"
2252. REMARK, D. G. (1971) USDHEW/PHS, Bur. of Rad. Health, (Pub. No. BPR/NEREL 71-1), 38 pages, "Survey of diathermy equipment use in Pinellas County, Florida"
3603. RENO, V.R. (1975), Naval Aerospace Medical Research Laboratory, Rept. No. NAMRL-1216 (May), "Some considerations concerning the use of magnetron generators in microwave biological research."
3007. RENO, V.R., & BEISCHER, D.E. (1973), Naval Aerospace Medical Research Lab., Rept. No. NAMRL-1183, (Jun.), "Microwave reflection, diffraction and transmission by man: A pilot study".
3604. RENO, V.R., de LORGE, J.O., PRETTYMAN, G.D., EZELL, C.S., & GRINER, T.A. (1974), Naval Aerospace Medical Research Laboratory (Pensacola, FL), (11 Sept.), (AD#A003948), "A primate restraint chair for use in microwave radiation studies."
3605. RENTSCH, W. (1967), In: WAGENDER, F.M., & ST. SCHURY, (eds), Electrotherapeutic Sleep and Electro-Anesthesia. Proceedings of the First International Symposium, Graz, Austria, 12-17 Sept. 1966, (Amsterdam), Excerpta Medica, pp. 161-168, "Magneto-inductive transmission of stimuli to the brain."
3008. RESTALL, C.J., LEONARD, P.F., TASWELL, H.F., et al. (1967), Anesthesia and Analgesia (Cleve.), 46( ):625-628, "A microwave blood warmer: Preliminary report".

1320. REVIGLIO, G. M. (1934) Abstr. of the 1st Internat. Congress of Electro-Radio-Biology, Cappelli, L., (ed.), Bologna, Italy, pp. 387-395, (In Italian with English summary), "On the topic of short wave diathermic generators"
1321. REVUTS'KYY, YE. L. (1964) Akademiya nauk UKR SSR, Fiziologichnyy Zh. 10(5):636-640, (JPRS 27982; N66-1505), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "The effect of high-frequency (13.56, 39 to 41, and 2375 Mc) electromagnetic oscillations on the motor function of the human stomach"
1322. REVUTS'KYY, YE. L. (1965) Akademiya nauk UKR SSR, Fiziologichnyy Zh., 11(3):360-384, (Abstr. only in ATD Press, Special Issue, "Biomedical Microwave Research", 4(43), Aug, 1965), "The effect of HF, VHF, and UHF radiation on the secretory and excretory functions of the human stomach"
1323. REVUTS'KYY, YE. L., & EYDEL'MAN, F. M. (1964) Fiziologichnyy Zh. Akademiya nauk UKR SSR, 10(3):379-383, (Abstr. in Biological Effects of Microwaves, ATD P-65-68, Sept. 1965, pp. 14-18, "Effects of meter and centimeter waves on human hemodynamics"), N64-31540; (Also, Biological Abstracts (Biophysics Section) 46:430, (196\_), #5407), "Effect of centimeter and meter waves on the content of biologically active substances in human blood"
3606. REYDER, B. Sh., AFANACYEVA, L.R., & ANTONOVA, E.F. (1973) Voprosy Pitaniya, 32(4):77-78 (July/Aug.), (in Russ.), Transl. in: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #66512), (7 Jan. 1976), pp. 43-46, "On the effect of the ultrahigh frequency field on certain pathogenic microorganisms."
1324. REYNOLDS, M. R. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Peyton, M. F., ed.) pp. 71-84, "Development of a garment for protection of personnel working in high-power RF environments"
1325. REYZIN, M. S., & MOTSYNI, P. E. (1939) Dnepropetrovsk, Universitet, Institut Fiziologii Sbornik rabot, 2:21-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), (Title not given), [Deals with induced changes in nerve upon UHF exposure]
1326. REZNIKOVA, L. (1937) Biologicheskoye deystviye UVCh. Simpozium, (Biological effect of ultra-high frequencies. Symposium) Moscow, pp. 373-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, 1965), (Title not given), [Discusses biochemical analysis of UHF irradiated tissue]
2253. RHEIM, R. W. (1972) U. S. Medicine 8(5): pp. 3 & 23 (Mar 1), [Describes work of D. R. Justesen on rats and mice], "Microwaves inhibit tumor induction"
1327. RIGGIONI, B. (1934) In: Abstr. of the 1st Internat. Congress of Electro-radio-biology, Cappelli, L., (ed.), Bologna, Italy, pp. 152-229, (In Italian with English summary), "On the increase in grain production by the preliminary electrical exposure of the seed"
1328. RICHARD, W., & LOOMIS, A. (1927) Proc. of the National Academy of Sciences 15:587-, "Dielectric losses in electrolyte solutions in high frequency fields"
3009. RICHARDS, V., & STOPPER, R. (1959). Surgery, 46(1):84-96, "The stimulation of bone growth by internal heating".
1329. RICHARDSON, A. J. (1954) J. of Physical Med. 33(2):103-107, "Effect of microwave induced heating on the blood flow through peripheral skeletal muscles"
1330. RICHARDSON, A. W. (1955) British J. of Physical Med. 18(7):143-. "The effectiveness of microwave diathermy therapy as a hyperthermic agent upon vascularized and avascular tissue"
1331. RICHARDSON, A. W. ((197) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation, (Pattishall, E. G., ed.) 1:109-110, "Abstract of report on pathologic effects of three centimeter microwaves of low magnitude, and demonstration of dosimeters to assay accumulated microwave energy"
1332. RICHARDSON, A. W. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy, (Pattishall, E. G., & Banghart, F. W., eds.), 2:169-174, "Review of the work conducted at University of St. Louis (USN sponsored)"
1333. RICHARDSON, A. W. (1959) Blood 14(11):1237-, "Blood coagulation changes due to electromagnetic microwave irradiations"
1334. RICHARDSON, A. W. (1959) In: Investigators' Conf. on Biological Effects of Electronic Radiating Equipments, (Knauf, C. M., Cha.), (RADC-TR-59-67, pp. 37-41; AD 214693; Also? AD 131477), "Review of work conducted at St. Louis Univ. School of Medicine"
1335. RICHARDSON, A. W. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments, (Suskind, C., ed.) 3:244-250, (RADC-TR-59-140; AD 234738), "New microwave dosimetry and the physiologic need"
1336. RICHARDSON, A. W. (1966) St. Louis Univ. School of Medicine, (DNR-130402), (AD 484726L), "Studies concerned with the biologic effects of microwave irradiations of different frequencies"
1337. RICHARDSON, A. W. (1968) Scientia (Milan) 103:447-453, (Abstr. in: Nuclear Science Abstracts 23(19):3978, #38860, 1969), "Biologic effects of non-ionizing electromagnetic radiations"
1338. RICHARDSON, A. W., DUANE, T. D., & HINES, H. M. (1948) Arch. of Physical Med. 29(12):765-769, "Experimental lenticular opacities produced by microwave irradiations"
1339. RICHARDSON, A. W., DUANE, T. D., & HINES, H. M. (1951) Amer. Medical Assoc. Arch. of Ophthalmology 45:382-386, "Experimental cataract produced by three centimeter pulsed microwave irradiations"
1340. RICHARDSON, A. W., IMIG, C. J., FEUCHT, B. L., & HINES, H. M. (1950) AMA Arch. of Physical Med. 31:19-25, "The relationship between deep tissue temperature and blood flow during electromagnetic irradiation"

1341. RICHARDSON, A. W., LOMAX, D. R., VICKOLS, J., & GREEN, H. D. (1952) *Amer. J. of Ophthalmology* 35:993-, "The role of energy, pupillary diameter and alloxan diabetes in the production of ocular damage by microwave irradiations"
1342. RICHARDSON, A. W., et al. (1969?) From: Systems Engineering and Consultant Corp., Tulsa, Oklahoma, "Microwave/radar radiation measuring instrument (advanced information)"
1343. RICHARDSON, P. D., & WHITELAW, J. E. (1967) In: Digest of the 7th Internat. Conf. on Medical and Biological Engineering, (Jacobson, B., ed.), Stockholm, p. 398 only, "The response of human skin to localized heat sources"
3295. RICHMOND, E.L. (1970), *J. of the Amer. Assoc. of Foot Specialists*, ( ): , (June), "Results of pulsed high frequency electromagnetic energy in the treatment of foot disorders and surgery".
1344. RICHTER, W. R. (1964) U. S. Army Medical Research Laboratory Rept. 600, (AD 440272), 12 pages, "Effects of RF energy on tissue cultures"
1345. RIEKE, F. E. (1953) *Industrial Medicine & Surgery* 23:328-, "Unplanned radio wave diathermy at place of work"
3607. RIESEN, W.H. (1971), Technical Memorandum #3, IITRI Project E6185, Contract N00039-71-C-0111, (Aug.), "A pilot study of the interaction of extremely low frequency electromagnetic fields with brain organelles."
2254. RIFFENBURGH, R. S. (1953) *U. S. Armed Forces Med. J.* 4(1):71-72, "Ocular fatigue in the radar operator"
3608. RIOCH, D.M. (1974), Institute for Behavior Research, Inc. (Silver Spring, MD), Rept. 151 (15 Oct.), (AD #A004024), "Effects of microwave irradiation on embryonic brain tissue: Final report to Army Research Office (15 Oct. 1973 to 14 Oct. 1974)."
1346. RIVIERE, M. R., PRIORE, A., & BERLUREAU, P. (1964) *Comptes Rendus acad. sci.* 259:4895-4897, (In French) "Effect of electromagnetic fields on implanted T-8 tumors in the rat"
1347. RIVIERE, M. R., PRIORE, A., & BERLUREAU, P. (1965) *Comptes Rendus acad. sci.* 260:2099-2102, (Also, *Semaine des Hopitaux Informations, Paris, 11:6-*,) "Effect of electromagnetic fields on transplantable lymphoblastic sarcoma in the rat", (In French)
1348. RIVIERE, M. R., PRIORE, A., & BERLUREAU, P. (1965) *Semaine des Hopitaux Informations Paris, 11:3-*, (In French), "Action of electromagnetic fields on skin graft of T-8 tumor in the rat"
1349. RIVIERE, M. R., PRIORE, A., & BERLUREAU, P. (1965) *Comptes Rendus acad. sci.* 260:2639-2643, (In French), "Regression phenomenon observed on the skin grafts of lymphosarcoma in mice exposed to ultra-high frequency electromagnetic radiation"
2255. ROBE, K. (1966) *Food Processing and Marketing* 27:84-86, "Improved flavor of pasteurized products [cooked with microwave radiation]"
1350. ROBERTS, A. M. (1969) *Nature (London)* 223(5206):639 only, "Effect of electric fields on mice"
1351. ROBERTS, A. M. (1970) *J. of Theoretical Biology* 27(1):97-106, "Motion of *Paramecium* in static electric and magnetic fields"
1352. ROBERTS, J. E., & COOK, H. F. (1952) *British J. of Applied Physics* 3:33-40, "Microwaves in medical and biological research"
3010. ROBERTS, P.C.B. (1972), Abstr. in *J. of Sci. Food Agriculture*, 23(4):544 only, "Viability studies on ascospores and vegetative cells of *Saccharomyces cerevisiae* exposed to microwaves at 2450 MHz".
2517. ROBINER, I.S. (1966), In: Conference on Effects of Diffuse Electrical Currents on Physiological Mechanisms with Application to Electroanesthesia and Electro-sleep. Vol. 4, Milwaukee, pp. 18- , "Clinical application of electro-sleep and a physiological mechanism of its development".
1353. ROCK, J. (1969) *Medical Aspects of Human Sexuality* 3(9):45 only, "Scrotal temperature and fertility"
3011. ROCKWAY, J.W., & HANSEN, P.M. (1973), Rept. #TR-1872, Naval Electronics Laboratory Center (San Diego), 24 Apr., "Calculated near fields of Navy HF whip antennas: Establishes preliminary guidelines on the size of personnel- and ordnance-radiation-hazard zones", [with a discussion of radiation hazards to personnel].
1354. RODICHEVA, E. K., GITELSON, I. I., & TERSKOV, I. A. (1965) *Trans. of Sci. Conf. Central Sci. Lab., TOMSK, (2):319-322*, (The Biological Effects of Electromagnetic Fields), "The effect of constant electric and alternating electromagnetic fields on the biosynthesis of chlorella during continuous culture"
1355. ROFFO, A. E., JR. (1934) In: Abstr. of the Internat. Congress of Electro-radio-biology, Cappelli, L., (ed.), Bologna, Italy, pp. 230-242, (In French with English summary), "Modification of electrocardiographic results produced by the application of high frequency electromagnetic fields"; *ibid.*, pp. 396-414, "Relation of high frequency electromagnetic fields on cellular multiplication of *in vitro* tissue cultures"; and *ibid.*, pp. 415-439, "Action of high frequency electromagnetic fields on photo-dynamics of colored materials in the heart of bacteria"
1356. ROGERS, S. J. (1969) Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., Ed.), Medical College of Virginia, Richmond, 17-19 Sept. 1969, Bureau of Radiological Health/Division of Biological Effects, Rept. No. 70-2, pp. 222-232, "Radio frequency radiation hazards to personnel at frequencies below 30 MHz"

2092. ROGERS, S. J., & KING, R. S. (1970) *Non-ionizing Rad.* 1(4):178-189, "Radio hazards in the w.f./h.f. band"
1357. ROGOVAYA, T. Z., TROITSKIY, S. A., & LASECHENKO, N. S. (1959) In: *Summaries of reports, Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves.* Moscow, p. 34 only, "The state of health of workers having long contact with high frequency electromagnetic equipment"
2518. ROGUSSKIY, S.S., ULITSKIY, L.A., BARTSEVICH, B.N., IL'YIN, A.V., & KRIVENKO, V.N. (1970), *Voyenno-Meditsinskiy Zhurnal*, 6(6):39-40, (Jun.), (Transl. #J-8892 for Army Intelligence, pp. 47-50), "Results of dynamic observation of persons working near UHF fields".
3609. ROHL, D. (1975), *Deutsche Medizinische Wochenschrift*, 100(1):26-29, "Biological effect of microwaves—possible health hazards via broadcasting transmitters, television transmitters, and radar transmitters."
3610. ROHL, D., LAUN, H.M., HAUBER, M.E.T., STAUCH, M., & VOIGT, H. (1975), *ISA Transactions*, 14(2):115-117, "The effect of radar on cardiac pacemakers."
1358. ROHRSCHNEIDER, W. (1955) *Munch. Med. Wschr.* 97:33-37, "Radiation damage and protection for the eye against radiation"
1359. ROLLWITZ, W. L. (1958) *Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy*, (Pattishall, E. G., & Banghart, F. W., eds.) 2:254-264, "Review of the work conducted at Southwest Research Institute on the use of electron paramagnetic resonance to evaluate the chemical and/or physical changes in the lenses of eyes irradiated by microwaves (USAF sponsored)"
1360. ROLNICK, H. C. (1935) *Arch. of Physical Therapy* 16:391-393, "Status of electrosurgical prostatic resection"
1361. ROMAN, J. (1958) *Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy*, (Pattishall, E. G., & Banghart, F. W., eds.), 2:70-78, "Radio frequency hazards aboard naval ships"
1362. ROMAN, J. (1959) *The Engineer's Digest*, CG-133, No. 118 (Sept.-Oct.), pp. 39-, "Calculating power densities in the vicinity of radar antennas"
1363. ROMANOV, V. I. (1940) *Trans. of the 1st Conf. on Problems in the Application of Shortwaves and Ultrashort Waves in Medicine, Medgiz*, (Abstr. in: *The Biological Effects of Electromagnetic Fields - Annotated Bibliography*, ATD Rept. P-65-17, Apr. 1965), "High frequency fields as a method of studying molecular structures"
3611. ROMERA-SIERRA, C., HALTER, S., TANNER, J.A., ROOMI, M.W., & CRABTREE, D. (1975), *J. of Microwave Power*, 10(1):59-70 (Mar.), "Electromagnetic fields and skin wound repair."
1364. RONALD, K. (1962) *Canadian J. of Zoology* 41(2):197-217, "The effects of physical stimuli on the larval stage of *Tenarova decipiens*. III. Electromagnetic spectrum galvanotaxis"
1365. ROSE, D. L., & MEAD, S. (1948) *Arch. of Physical Medicine* 29:637-642, "Electrical tests of sensation" (Voltage-duration curves of tactile sensation and pain)
2256. ROSE, V. E., GELLIN, G. A., & POWELL, C. H. (1970) In: *Ergonomics and Physical Environmental Factors*, (Vol. 21 of the Occupational Safety and Health Series), Internat. Labour Office, Geneva, pp. 132-155, "Evaluation and control of exposures in repairing microwave ovens"
2093. ROSE, V. E., GELLIN, G. A., POWELL, C. H., & BOURNE, H. G. (1969) *Amer. Industrial Hygiene Assoc. J.* 30:137-, "Evaluation and control of exposures in repairing microwave ovens"
2257. ROSE, V. E., POWELL, C. H., DENNER, M. E., & SWANSON, J. R. (1970) In: *Ergonomics and Physical Environmental Factors*, (Vol. 21 of the Occupational Safety and Health Series), Internat. Labour Office, Geneva, pp. 186-, "A review of U. S. microwave exposure criteria"
2023. ROSENSTEIN, M., BRILL, W. A., & SHOWALTER, C. K. (1969) Report No. OCS 69-1, Bureau of Radiological Health, Department of Health, Education, and Welfare, Rockville, Md., "Radiation exposure overview - microwave ovens and the public"
1366. ROSENSTEIN, M., BRILL, W. A., & SHOWALTER, C. K. (1969) U. S. Dept. of Health, Education, and Welfare; Public Health Service; Consumer Protection & Environmental Health Services, Environmental Control Admin., Bureau of Radiological Health, Rockville, Md., Rept. No. OCS 69-1, "Radiation exposure overview: Microwave ovens and the public"
2259. ROSENTHAL, D. S., & DEERING, S. C. (1968) *J. of the Amer. Medical Assoc.* 205(4):105-108, "Hypoparadism after microwave radiation"
2258. ROSENTHAL, S. W. (1970) In: *Proc. of Hungarian Acad. of Sci., & Sci. Soc. for Telecommunication, Colloq. on Microwave Communication*, 4th, Budapest, (pp. 21-24, 1970), (Abstr. #A70-43711), "Safety standards and biological effects of microwave radiation"
2024. ROSENTHAL, S. W., (Chm.) (1971) "Biological Effects of Non-Ionizing Radiation", Session of the IEEE Internat. Convention and Exposition, N. Y., (22-25 Mar)
3296. ROSENTHAL, S.W. (1971), *J. of Microwave Power*, 6(1):95 only, "More research on biological effects of microwaves needed"
2519. ROSENTHAL, S.W. (1972), *IEEE Transactions on Biomedical Engineering*, BME-19(4):299, "Introduction: Biological effects of nonionizing radiation".

1367. ROSENTHAL, S. W., BIRENBAUM, L., GROSOF, G. H., & ZARET, M. H. (1967) Digest of the 7th Internat. Conf. on Medical and Biological Engineering, (Jacobson, B., ed.), p. 399 only, "A study of the cataractogenic effect of microwave radiation"
1368. ROSENTHAL, S. W. (Moderator), FREY, A., LEMASTER, F., BOWMAN, R. R., RECHEN, H., OSEPCCHUCK, J., & MICHAELSON, S. (1969) Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Medical College of Virginia, Richmond, 17-19 Sept., Bureau of Radiological Health/Division of Biological Effects, Rept. No. 70-2, pp. 233-247, "Panel Discussion I: Microwave measurements method and standards for biological research and hazard surveys"
3612. ROSHCIN, A.V., & NIKONOVA, K.V. (1974), Gigiyena i Sanitariya, (11):111-113, (in Russian). Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #66512), (7 Jan. 1976), pp. 73-76, "International Symposium on 'Biological Effects and Health Hazards of Microwave Radiation' (Warsaw)."
2520. ROSS, N.L. (1973), The Washington Post, March 8, page E10, "Hot microwave debate". [Microwave oven leakage levels].
2521. ROSSI, G.F., & ZATTONI, J. (19 ), Excerpts, Medical International Congress, Series No. 128, "Obtaining deep sleep by electrical stimulation of the brainstem and cerebral cortex".
1369. ROTH, E. H. (Ed.) (1968) Compendium of Human Responses to the Aerospace Environment 1(1):1-22, (Document # NASA CR-1205(1); N-69-12435), "Microwave radiation"; (Also, "Magnetic Fields", Section 4, pp. 1-7, N69-12438)
1370. ROTHMEIER, J. (1970) Proc. of the 3rd Annual National Conf. of the Neuro-Electric Society, "The Nervous System and Electric Currents", (Wulfssohn, N. L., & Sances, A., Jr., eds.), 23-25 Mar., Las Vegas, Plenum Press, New York, pp. 57-69, "Effect of microwave radiation on the frog sciatic nerve"
2522. ROTKOVSKA, D., & VACEK, A. (1972), Folia Biol. (Praha), 18(4):292-297, "Effect of high-frequency electromagnetic field upon haematopoietic stem cells in mice." [<sup>59</sup>Fe incorporation, spleen cells, bone marrow, spleen-colony assays]
3297. ROTKOVSKA, D., et al. (1973), Physiol. Bohemoslov, 22(4):359-363, (In Engl.), "Non-contact determination of temperature changes in mice during microwave irradiation." [using an infra-red camera]
3012. ROWE, W.D., JANES, D.E., & TELL, R.A. (1973), 1973 Telecommunications Conf., Atlanta, GA, (Nov. 26), "An assessment of adverse health effects of telecommunications technology".
1371. ROYER, R., WAKIM, K., LEVESTEOR, S., & KRUSEN, F. (1950) Arch. of Physical Medicine 31:557-566, "Influence of microwave diathermy on swelling and trismus resulting from odontectomy"
1372. ROZANOVA, O. S. (1939) Fizioterapiya (2):pp.? "Significance of the frequency factor for the bioeffects of a HF-VHF electric field"
1373. ROZENBERG, P. A., & GELFON, I. A. (1966) Gigiyena Truda i Professional'nye Zabolevaniya (Moskva) (5):52-53, "The effect of VHF-HF therapy on the silicon content in the lungs and bifurcated lymph nodes during experimental silicosis"
3298. ROZZELL, T.C., JOHNSON, C.C., DURNAY, C.H., LORDS, J.L., & OLSEN, R.G. (1974), J. of Microwave Power, 9(3):241-249, (Sept.), "A nonperturbing temperature sensor for measurements in electromagnetic fields", [electro-optical fiber optic/liquid crystal probe].
1374. RUBIN, A., & ERDMAN, W. J. (1959) Amer. J. of Phys. Med. 38:219-220, "Microwave exposure of the human female pelvis during early pregnancy and prior to conception"
1375. RUBIN, L., & VOROG'YEV, I. (1936) Kuroortologii i Fizioterapii 1:11-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, 1965), (Title not given), [Deals with temperature rise and suppression of nervous excitation of in vitro frog muscle]
1376. RUDGE, A.W., & KNOX, R.M. (1970), U.S. Dept. of Health, Education, and Welfare, Public Health Service Publication No. BRH/DEP 70-16, 69 pps (limited distribution), "Near-field [electromagnetic radiation] instrumentation."
2523. RUDOLFSSON, C., JOELSSON, I., INGELMAN-SOUNDGERG, A., & ODEBLAD, E. (1972), Acta Obstet. Gynec. Scand., 51:137-141, "The radiofrequency field distribution surrounding coils for intrauterine diagnostic procedures: I. Geometrical factors".
3613. RUGGERA, P.S. (1975), U.S. Department of Health, Education, and Welfare, DHEW Publication (FDA) 75-8032 (April), "Changes in radiofrequency E-field strengths within a hospital during a 16-month period" [resulting from externally-located radio and TV transmitters].
2524. RUGGERA, P.S., & ELDER, R.L. (1971), U.S. Department of Health, Education, & Welfare Rept. No. BRH/DEP 71-5, "Electromagnetic radiation interference with cardiac pacemakers".
2260. RUGGERA, P. S., & ELDER, R. L. (1971) USDEW/PIS, Bur. of Pub. Health (Pub. No. BRH/DEP 71-5), 25 pages, "Electromagnetic radiation interference with cardiac pacemakers"
3614. RUGH, R., GINNS, E.I., HO, H.S., & LEACH, W.M. (1975), Radiation Research, 62( ):225-241, "Responses of the mouse to microwave radiation during estrous cycle and pregnancy."
3299. RUSINOV, V.S., & EXROKHI, V.L. (1967), Zh. Vyssh. Nerv. Deyatel, im. I. P. Pavlova, 17( ):947-955, "Possibility of ephaptic interaction of neurons through an electric field generated by them".

2251. RUSSO, F., & CALINELL, L. P. (1961) Genetic Psychology News paper, 34:177-243, "Biomagnetic phenomena: Some implications for the behavioral and neurophysiological sciences"
3013. RUSTAN, P.L., HURT, W.D., & MITCHELL, J.C. (1973), Medical Instrumentation, 1(3):175-188 (May-Aug.), "Microwave oven interference with cardiac pacemaker"
1377. RUTKOWSKI, A. & CHRISTIANSON, C. (1965) Progress Rept. 1, Naval Applied Science Lab., Brooklyn, "Development of a radiation hazard protective suit and RF measuring techniques"
3014. SAAD, T. (1969), The Microwave Journal, 1(1):19-19, (Feb.), "The action of microwaves on health implications of microwave radiation", (Editorial).
1378. SACCHITELLI, G., & SACCHITELLI, F. (1956) Folia Medica, Naples, 33:1937-, (In Italian), "The action of radar microwaves on plasma lipases and serum amylase"
1379. SACCHITELLI, G., & SACCHITELLI, F. (1958) Folia Medica, Naples 41:345-, (In Italian), "On the behavior of blood glutathione following irradiation with radar microwaves"
1380. SACCHITELLI, F., & SACCHITELLI, G. (1960) Folia Medica, Naples, 43:1219-1229, (In Italian), (FTD-TT-65-1497/1+3+4, Jan. 1967), "On the protection of personnel exposed to radar microwaves"
1381. SACCHITELLI, F., & SACCHITELLI, G. (1960) Minerva fisioterap. 5:201-203, (In Italian), "On the analgesic effect of radar microwaves on caisson disease"
1382. SADCHIKOVA, M. N. (1957) In: Summaries of reports, Part 2. Jubilee Scientific Session of the Institute of Labor Hygiene and Occupational Diseases, Dedicated to the 40th Anniv. of the Great October Socialist Revolution. Moscow. (Title not given)
1383. SADCHIKOVA, M. N. (1960) Trudy Nil Gigiyena Truda i Profzabolevaniya AMN SSSR, 1(1):32-35, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, 1965); (Also, Abstr. in: The Biological Action of UHF, (Letavet, A. A., & Gordon, Z. V., eds.), Moscow, pp. 25-29, JPRS 12471), State of the nervous system under the influence of SHF-UHF fields"
1384. SADCHIKOVA, M. A. (1960) In: Physical Factors of the Environment, (Letavet, A. A., ed.), pp. 177-183, "State of the nervous system under the influence of SHF-UHF fields"
1385. SADCHIKOVA, M. N. (1964) Trudy Nil Gigiyena Truda i Profzabolevaniya AMN SSSR, 2(2):110-113, (Abstr. in: The Biological Action of Radio-Frequency Electromagnetic Fields, Moscow), "Clinical aspects of changes within the nervous system induced by the action of radio waves of various frequencies"
2525. SADCHIKOVA, M.N., & NIKONOVA, K.V. (1971), Gigiyena Truda i Professional'nye Zabolevaniya, 15(9):10-13, "Comparative evaluation of the health of personnel working under conditions involving exposure to microwaves of different intensity". [Adverse effects, primarily cardiovascular and in the nervous system, seen in 2 groups exposed at different intensities: aathenic syndrome and vegetative-vascular dysfunction].
1386. SADCHIKOVA, M. N., & ORLOVA, A. A. (1958) Gigiyena Truda i Professional'nye Zabolevaniya (MOSKVA), 2(1):16-22, (In Russian), (JPRS U1451D; OTS-59-11437), "Clinical picture of the chronic effect of electromagnetic centimeter waves"
2526. SADCHIKOVA, M., & ORLOVA, A. (1958, 1960), (References 1386 and 1387, this Biblio.), entitled: "Changes in the nervous system as a result of exposure to microwaves"
1387. SADCHIKOVA, M. N., & ORLOVA, A. A. (1960) Nauchno-issledovatel'skiy institut gigiyeny truda i profzabolevaniy, Trudy 10: 25-29, (Abstr. in: The Biological Action of UHF, (Letavet, A. A., & Gordon, Z. V., eds., Moscow, JPRS 12471); (Also, Abstr. in: The Biological Effects of Microwaves: Compilation of Abstracts, ATD P-65-15, (1965), p. 9 only, "Effect of UHF on the human nervous system"), "State of the nervous system under the influence of UHF"
1388. SAPONOV, YU. D., PROVOTOROV, V. M., YAKIMENKOV, L. I., & LITSE, V. M. (1967) Bulletin Eksperimental'noy Biologii i Meditsiny 64(9):111-113, (ATD Abstr. 3(8454)), "Method of recording the magnetic field of a heart-magnetocardiography"
3615. SAGALOVICH, B.M., & MELKUMOVA, G.G. (1974), Vestnik otorinolaringologii, 4(4):3-8, Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #64532), 1975, pp. 23-30. "Research on the action of superhigh-frequency electromagnetic waves on evoked potentials of auditory centers in connection with prospects for using inadequate auditory stimulation."
1389. SAITO, M., & SWEAN, H. P. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Payton, M. F., ed.) pp. 85-97, "The time constants of pearl-chain formation"
1390. SAITO, M., SWEAN, H. P., & SCHWABE, G. (1966) Biophysical J. 6(5):313-327, "Response of nonspherical biological particles to alternating electric fields"
1391. SAITO, M., SHER, L. C., & SWEAN, H. P. (1961) Digest of Internat. Conf. on Medical Electronics and Medical and Biological Engineering 4:154 only, "RF field-induced forces on microscopic particles"
1392. SALATI, O. M. (1959) In: Investigators Conf. on Biological Effects of Electronic Radiating Equipments, (Knauf, C., Chm.), Patrick Air Force Base, Florida, 14-15 Jan., RADG-TR-59-67, July 1959, pp. 26-30, (AD 214693), "Microwave absorption measurements"
1393. SALATI, O. M., ANNE, A., & SWEAN, H. P. (1962) Electronic Industries, (Nov.) 11:96-101, "Radio frequency radiation hazards"
1394. SALATI, O. M., & SWEAN, H. P. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Suskind, C., ed.), 3:107-112, "A technique for relative absorption cross-section determination"

1395. SALEV, A. P. (1964) Voronezh, Izd-vo Voronezh. Univ., pp. 50-53, "The effect of the energy of an electromagnetic field of varying frequency on the secretion of the salivary glands"
1396. SALISBURY, W. W., CLARK, J. W., & HINES, A. M. (1948) Collins Radio Co., (Report #CER-153, Rand - P-58), 14 pages, "Physiological damage due to microwaves"
1397. SALISBURY, W. W., CLARK, J. W., & HINES, H. M. (1949) Electronics 22:66-67, "Exposure to microwaves"
1398. SALOTTI, A., & FIORENZI, F. (1934) Proc. of the 1st Internat. Congress of Electro-Radio-Biology (Cappelli, L., ed.), Bologna, Italy, pp. 440-444, (In Italian with English summary), "Results of research on the influence of microwaves of wavelength 60-70 cm on plants"
2025. SAMARAS, G. M., MUROFF, L. R., & ANDERSON, G. E. (1971) IEEE Trans. on Microwave Theory and Techniques (Special Issue on Biological Effects of Microwaves) MIT-19(2):245-247, "Prolongation of life during high-intensity microwave exposures"
1399. SANCES, A., JR., & LARSON, S. J. (1955) Digest of 6th Internat. Conf. on Medical Electronics and Biological Engineering, (Iwai, Y., ed.) pp. 113-114, "Electrotonic solution of rectangular electrical anesthesia currents applied to model neurons"
3300. SANCES, A., JR., & LARSON, S. J. (1970), In: Biomedical Engineering Systems, CLYNES, M., & MILSUM, J. H., (eds.), (Inter-University Electronics Series, 10, Chap. 8), McGraw-Hill Book Co., New York, "Electro-anesthesia research".
2527. SANCES, A., ZUPERKU, E., & LARSON, S. J. (1966), In: First International Symposium on Electrotherapeutic Sleep and Electroanesthesia, Graz, Austria, (12-17 Sept.), "Effects of sinusoidal and biased rectangular anesthetic currents on monkey visual pathways".
3616. SANDLER, S.S., SMITH, G.S., & ALBERT, E.N. (1975), Aviation, Space, and Environmental Medicine, 46(11):1414-1417, "Electromagnetic field effects in nerve tissue."
1400. SANTEA, A. (1968) Eonvedorvos, (Apr-Jun), (2):193-205, "Investigations on the relations between the biological effects of ionizing radiation and electroanesthesia"; "Part 2: Joint effect of ionizing radiation and electroanesthesia on the growth of the root of *Vicia Faba*"
3301. SANTOLINI, B.M., NAI FOVINO, P.L., & ROSSONI, L. (1971), Minerva Ortopedica, 22( ):459-462, (In Ital.), "Changes [decrease] in intraleukocyte [WBC] peroxidases in intraarticular exudates after irradiation with radar microwaves", [therapeutic application (to reduce inflammation) of humans suffering with rheumatoid arthritis].
1401. SAREL, M., et al. (1961) Zeitschrift fur die gesamte Hygiene und Ihre Grenzgebiete (Berlin) 7:897-, (In German) "Concerning the effect of electromagnetic radar waves (cm wavelength) on the nervous system of man"
2262. SANCINI, R., & OSTROUSKI, K. (1968) Amer. J. of Physical Medicine 47:225-234, (A69-80117), "Non-thermal effect of microwave radiation *in vitro* on peritoneal mast cells of the rat"
1402. SAWLINSKA, A., BIELSKI, J., & WALSTKOWSKI, A. (1967) Przegląd Lekarski, Cracow, 23:742-744, "Health conditions of workers at radio and television stations exposed to the high frequency electromagnetic field"
1403. SAZONOVA, T. YE. (1964) Vestnik Leningradskogo Universiteta, Seriya Biologii, USSR, 19(3):109-116, "Effect of low frequency electromagnetic fields on the motor function of animals (Biol. Ser. No. 1)"; and *ibid.*, 19(15):82-86, "The effect of a high gradient low frequency electromagnetic field on the efficiency of an altered motor structure (Biol. Ser. No. 3)"
1404. SAZONOVA, T. YE. (1964) Author's Abstr. of Candidate's Dissertation, Leningrad, "Functional Changes in an Organism Due to Work in a High-Intensity Electric Field at Industrial Frequencies"
1405. SCELSI, B. (1957) Radioterapia Radiobiologia Fisica Medica 12:133-, (In Italian), "Thermogenesis by ultrasound and ultra-high frequency electromagnetic (radar) waves on organic, not-living tissues"
1406. SCHAEFER, H., & SCHWAN, H. (1943) Annalen Physik 43:99-135, (In German), "Concerning the question of selective heating of small particles in the ultrashort wave condenser field"
1407. SCHAEFER, H., & SCHWAN, H. (1947), Strahlentherapie, 77:123-130, (in Ger.), "Concerning the question of selective overheating of single cells in biological tissue by means of ultrashort wave currents."
1408. SCHAEFER, M. b. (1962) Report (Rand-P-2558-1), 38 pages, "The thermal response of small animals to microwave radiation"
1409. SCHAEUBLE, J. P., & KNUDSEN, A. (1929) Reported at 13th Internat. Physiological Congress, "Chemical changes in the body resulting from exposure to ultra-high frequency fields"
1410. SCHASTNAYA, P. I. (1955) In: Collection of Scientific Works of Kharkov Medical Institute), 13; pp. 170-, "The effect of SHF fields on microorganisms"
- In:
1411. SCHASTNAYA, P. I. (1957) Trudy Khark'ovskogo Meditsinskogo Instituta, USSR, 15:239-, "The effect of electromagnetic waves of superhigh frequency on microorganisms"
1412. SCHASTNAYA, P. I. (1958) Trudy Khark'ovskogo Meditsinskogo Instituta, USSR, 16:359-, "The effect of SHF radiowaves on the colon bacillus"
3015. SCHECHTER, D.C. (1970), Bull. of the N.Y. Acad. of Med., 46( ):932-951, "Application of electrotherapy to non-cardiac thoracic disorders".
1413. SCHEIE, H. G., & JEROME, B. (1949) Amer. J. of Ophthalmology 32:69-78, (June, pt. 2), "Electrocoagulation of the sclera: reduction in ocular volume and pathologic changes produced"
1414. SCHERESCHESKY, J. W. (1926) Public Health Reports 41:1939-, "The physiological effects of currents of very high frequency (135,000,000 to 8,300,000 cps)"
1415. SCHERESCHESKY, J. W. (1923) Public Health Reports 43(16):927-939, "The action of currents of very high frequency upon tissue cells, A. Upon a transplantable mouse sarcoma"

2263. SCHREIFSCHEINSTEY, J. U. (1933) *Public Health Reports* 48:844-858 (July), "Heating effect of very high frequency condenser fields on organic fluids and tissues"
3016. SCHILLER, E.A., PRATT, D.E., & REBER, E.F. (1973), *Amer. Diet. Assoc. J.*, 62( ):529-533, (May), "Lipid changes in egg yolks and cakes baked in microwave ovens".
2264. SCHLEIPEN, L. (1939) Dissertation, Frankfurt a. M., 18 pages, (In Ger.), (Abstr. in: *Zentralbl. f. d. res. Omhth.* 46(11): 336 (Feb 13, 1941)), "Results of histological studies using short wave radiation"
1416. SCHLIEPHAKE, E. (1935) Actinic Press, London, (Authorized English transl. of 2nd and enlarged German edition), 238 pages, Short Wave Therapy - The Medical Use of Electrical High Frequencies
1417. SCHLIEPHAKE, E. (1950) *British J. of Physical Medicine* 13:143-152, "Supersonic and ultrashort waves"
1418. SCHLIEPHAKE, E. (1952) Stuttgart, (In German), Short-Wave Therapy
1419. SCHLIEPHAKE, E. (1960) *Zbl. Chir.* 85:1063-1066, "Endocrine influence on bleeding and coagulation time"
2528. SCHMIDT, D.E., SPETH, R.C., WELSCH, F., & SCHMIDT, M.J. (1972), *Brain Research*, 38:377-389, "The use of microwave radiation in the determination of acetylcholine in the rat brain".
2529. SCHMIDT, M.J., HOPKINS, J.T., SCHMIDT, D.E., & ROBISON, G.A. (1972), *Brain Research*, 42:465-477, "Cyclic AMP in brain areas: Effects of amphetamine and norepinephrine assessed through the use of microwave radiation as a means of tissue fixation".
2265. SCHMIDT, M. J., SCHMIDT, D. E., & ROBISON, G. A. (1971) *Science* 173:1142-1143 (17 Sept), "Cyclic adenosine monophosphate in brain areas: Microwave irradiation as a means of tissue fixation"
3017. SCHMIDT, M.J., SCHMIDT, D.E., & ROBISON, G.A. (1972), Advances in Cyclic Nucleotide Research: Vol I - Physiology and Pharmacology of Cyclic AMP, Raven Press, NY, (GREENGARD, P., ROBISON, G.A., & PAOLETTI, R., (eds.)), pp. 425-434, "Cyclic AMP in the rat brain: Microwave irradiation as a means of tissue fixation".
3129. SCHMIDT, P. (1964), U.S. Army Medical Research Lab (Fort Knox, KY) Res. Rept. #603, 24 pps., (31 Mar.), "The effects of radio-frequency energy on Corynebacterium diphtheriae and Clostridium welchii toxins", [To determine changes in toxicity and antigenicity of exotoxins after exposure to microwaves. 'C. welchii, type A toxin was not affected by radio-frequency exposure, as determined by human serum opacity and mouse lethality studies. The toxicity of C. diphtheriae toxin was slightly reduced, while no change in antitoxin combining capacity or antigenicity was apparent.'].
3018. SCHROT, J., & HAWKINS, T.D. (1973), Walter Reed Army Inst. of Research (Unpublished rept.), "Lethal effects of 3000 MHz radiation on the rat".
3617. SCHRADER, D.H., & McNELIS, D.D. (1975), *J. of Microwave Power*, 10(1):77-92 (Mar.), "Microwave irradiation of roots in soil."
3619. SCHUA, L. (1953), *Naturwissenschaften*, 10( ):514-516, "The flight reaction of hamsters from electrical fields" [900 V/m at a "few Hz" were used].
3618. SCHULMAN, J.H. (1975), *European Scientific Notes (Office of Naval Research)*, 29(12):546-549 (31 Dec.), "Hazards of non-ionizing radiations." [Comments on the Fall 1975 AGARD Meeting on "Radiation Hazards"]
3019. SCHULTEN, K.H., BALDUS, O., ROHRIG, F.R., & von SMEKAL, P. (1972), *Dtsch. Med. Wschr.*, 97( ):1539-1541, (In Ger.), [short wave electromagnetic radiation] "Interference of implanted cardiac pacemakers".
1421. SCHULTZ, C. A., GRAY, O. S., SANDERS, M., & FELLOWS, O. N. (1970) Presented before the New York Academy of Sciences at the Symposium entitled "Effect of Controlled Electromagnetic Energy on Biological Systems", (Nov), 5 pages, "The effect of electromagnetic controlled energy on viruses in human blood"
1422. SCHULTZ, F. V., BURGNER, R. C., & KING, S. (1958) *Proc. of the Institute of Radio Engineers* 46:476-, "Measurement of the radar cross section of a man"
1423. SCHWARTS, J. I. (1945) *Frunze, Local Reflex Changes Under the Influence of Local Action of UHF Fields on the Cervico-Thoracic Segments of the Spinal Cord*
1424. SCHWAN, H. (1948) *Zeitschrift fur Naturforschung (Tubingen)* 3B:361-367, (In German), "Temperature dependence of the dielectric constant of blood at low frequencies"
1425. SCHWAN, H. (1950) *Ann. Phys.* 6:253-, "Resonance method for the determination of complex resistances of substances at decimeter wavelengths"
2266. SCHWAN, H. P. (1952) *Abstr. in Federation Proceedings* 11:142 only, "Electrical properties of blood at ultrahigh frequencies"
1426. SCHWAN, H. (1953): *Amer. J. of Physical Med.* 32:144-, "Electrical properties of blood at ultrahigh frequencies"
1427. SCHWAN, H. (1953) *Zeitschrift fur Naturforschung (Tubingen)* 8B:3-10, (In German), "Measurement of electrical constants and complex-resistances in biological materials"
1428. SCHWAN, H. (1954) *Zeitschrift fur Naturforschung (Tubingen)* 9B(8):245-251, (In German), "The electrical characteristics of muscle tissue at low frequencies"
1429. SCHWAN, H. P. (1955) *Institute of Radio Engineers, Trans. PG14:75-83*, (Also: Tech. Rept. #15, Univ. of Pennsylvania, to Office of Naval Research, 23 pages), (AD 56691), "Application of UHF impedance measuring techniques in biophysics"
1430. SCHWAN, H. P. (1955) *Institute of Radio Engineers, Trans. on Medical Electronics*, 3:32-46, "Electrical properties of body tissues and impedance plethysmography"
1431. SCHWAN, H. P. (19\_\_ ) *Electromedical Lab., Moore School of Electrical Engineering, Univ. of Pennsylvania*, "Survey of microwave absorption characteristics of body tissue"

1432. SCHWAN, H. (1956) In: Handbook of Biological Data, National Research Council, Washington, D. C., "Electrical properties measured with alternating current: body tissues"
1433. SCHWAN, H. P. (1956) J. of the Amer. Medical Assoc. 160:191-197, "The biophysical basis of physical medicine"
1434. SCHWAN, H. P. (1957) Final Rept. from Univ. of Penna. on ONR Contract (1 July 1954 to 30 June 1957) 12 pages, (AD 149535); "Influence of electromagnetic radiation on biological material"
1435. SCHWAN, H. P. (1957) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.), 1: 60-63, "The physiological basis of RF injury (Abstract)"
1436. SCHWAN, H. P. (1957) In: Advances in Biological and Medical Physics, 5, (Lawrence, J. H., & Tobias, C. A., eds.), Academic Press, Inc., New York, pp. 147-209, (Tech. Rept. #20, Univ. of Penna.), (AD 132533), "Electrical properties of tissues and cell suspensions"
1437. SCHWAN, H. P. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G. & Banghart, F. W., eds.), 2, (rome Air Dev. Center, ARDC-TR-58-54, pp. 126-145 (AD-131477)); (Also: ONR Technical Rept #25), "Survey of microwave absorption characteristics of body tissue"
1438. SCHWAN, H. P. (1958) Annual Progress Rept. on ONR Contract, Univ. of Penna. (AD 207468), "Properties of biological material"
1439. SCHWAN, H. P. (1958) Proc. 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G. & Banghart, F. W., eds.), 2:33-48, (Also, ONR Technical Rept. #24 of the Univ. of Penna.; AD 220125), "Molecular response characteristics to ultra-high frequency fields"
1440. SCHWAN, H. P. (1958) In: Therapeutic Heat, Physical Medicine Library, 2, (Licht, S. H., ed.), Licht, E., Publisher, New Haven, Conn., Chapt. 3, pp. 55-115, (Also: Tech. Rept. #21 from Univ. of Penna. to ONR, AD 149534), "Biophysics of Diathermy"
1441. SCHWAN, H. P. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Suskind, C., ed.) 3:94-106, (RADC-TR-59140; AD 234788), "Theoretical considerations pertaining to thermal dose meters"
1442. SCHWAN, H. P. (Conf. Chm.) (1959) Digest of Technical Papers, 12th Ann. Conf. on Electrical Techniques in Med. & Biology, 1st Edition, 10-12 Nov., Sponsored by Institute of Radio Engineers, Amer. Institute of Electrical Engineers, and Instrument Society of Amer., Winner, L., publisher, New York
1443. SCHWAN, H. P. (1959) Proc. of the Institute of Radio Engineers 47:1841-1855, "Alternating current spectroscopy of biological substances"
1444. SCHWAN, H. P. (1960) In: Medical Physics, 3, (Glasser, O., ed.), The Year Book Publishers, Inc., Chicago, pp. 1-7, "Absorption and energy transfer of microwaves and ultrasound in tissues: characteristics"
1445. SCHWAN, H. P. (1963) In: Physical Techniques in Biological Research, (Nastuk, W. L., ed.), Academic Press, New York, from Vol. 6, Part B of "Electrophysiological Methods", pp. 323-407, "Determination of biological impedances"
1446. SCHWAN, H. P. (1964) Final Rept. (from Univ. of Penna. under ONR Contract, (AD 600263), 13 pages, "Non-thermal effects of alternating electrical fields on biological structures"
2267. SCHWAN, H. P. (1965) Technical Progress Report (AD #615661, N65-28329), "Non-thermal effects of alternating electrical fields on biological structures"
1447. SCHWAN, H. P. (1968) In: Microwave Power Engineering, (Okress, E. C., ed.), Academic Press, N. Y., 2:215-243, "Radiation, biology, medical applications, and radiation hazards"
3302. SCHWAN, H.P. (1968), Naval Weapons Laboratory (Dahlgren, VA), Technical Report TR-2199, (Aug.), (AD #842306), "Electrical impedance of the human body" [in the 1-30 MHz range].
1448. SCHWAN, H. P. (1969) J. of Non-Ionizing Radiation 1(1):23-, "Effects of Microwave radiation on tissue - a survey of basic mechanisms"
1449. SCHWAN, H. P. (1969) Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium (Cleary, S. F., ed.), Medical College of Virginia, Richmond, 17-19 Sept., Bureau of Radiological Health/Division of Biological Effects, Rept. No. 70-2, pp. 13-21, "Interaction of microwave and radio frequency radiation with biological systems"
1450. SCHWAN, H. P. (1970) Final Rept. on ONR Contract, Mar. 1964 - Dec. 1969, Univ. of Penna., "Non-thermal effects of alternating electrical fields on biological structures"
2026. SCHWAN, H. P. (1971) IEEE Trans. on Microwave Theory and Techniques (Special Issue on Biological Effects of Microwaves) MTT-19(2):146-152, "Interaction of microwave and radio frequency radiation with biological systems"
2027. SCHWAN, H. P. (1971) Proceedings of the "Biological Effects of Non-Ionizing Radiation" Symposium, IEEE Internat. Convention & Exposition, N. Y., (Rosenthal, S. W., chm.), (22-25 Mar), "Biological effects of microwave radiation"
2268. SCHWAN, H.P. (1971), Naval Weapons Lab. (Dahlgren, Va.), Tech. Rept. TR-2713, "Hazards from exposure to ELF electrical fields and potentials."
2530. SCHWAN, H.P. (1972), IEEE Transactions on Biomedical Engineering, BME-19(4):304-312, "Microwave radiation: Biophysical considerations and standards criteria".
3020. SCHWAN, H.P. (1973), Rept., Moore School of Electrical Engineering, Univ. of Pennsylvania, (Apr. 12), 30 pps., and J. of the Franklin Institute, 296(6):495-497, (1973), "Nonionizing radiation hazards".
3620. SCHWAN, H.P. (1974), Rept., Univ. of Pennsylvania, Philadelphia (AD #A001-558), 10 pps. (Oct.), "Effect of microwaves: Local 'hot spot' heating by microwaves."

1451. SCHWAN, H. P., ANNE, A., & SHER, L. (1966) U. S. Naval Air Engineering Center, Philadelphia, Pa., Aerospace Crew Equipment Lab., Rept. # NAEC-ACEL-534; "Heating of living tissues [by microwave irradiation to determine threshold sensations of warmth]; (AD 479192L; & I66-16685) Final Rept. 1963-1965"
1452. SCHWAN, H. P., & CARSTENSEN, E. L. (1953), (Trans. AIEE preprint, Paper 53-137, Winter General Meeting, Electrical Techniques in Med. and Biology), AIEE Trans. 72:106-, "Application of electric and acoustic impedance measuring techniques to problems in diathermy"
1453. SCHWAN, H. P., CARSTENSEN, E. L., & LI, K. (1953), (AIEE Technical Paper 53-206, AIEE Summer General Meeting), Electrical Techniques in Medicine and Biology, AIEE Trans. 72:483-, "Heating of fat - muscle layers by electromagnetic and ultrasonic diathermy"
1454. SCHWAN, H. P., CARSTENSEN, E. L., & LI, K. (1954) Electronics 27:172-175, "Electric and ultrasonic deep heating diathermy"
1455. SCHWAN, H. P., CARSTENSEN, E. L., & LI, K. (1954) Arch. of Physical Med. and Rehabilitation 35:13-19, "Comparative Evaluation of electromagnetic and ultrasonic diathermy"
1456. SCHWAN, H. P., & KAY, C. F. (1957) Annals of the New York Academy of Science 65(6):1007-1013, "The conductivity of living tissues"
1457. SCHWAN, H. P., & LI, K. (1953) Proc. of the Institute of Radio Engineers 41(12):1735-1740, "Capacity and conductivity of body tissues at ultrahigh frequencies"
1458. SCHWAN, H. P., & LI, K. (1955) Trans. of the AIEE (Communications and Electronics) 16:603-607, "Measurements of materials with high dielectric constant and conductivity at ultrahigh frequencies"
1459. SCHWAN, H. P., & LI, K. (1955) Electronic Engineering 74:64-, "Measurement of materials at ultra-high frequencies"
1460. SCHWAN, H. P., & LI, K. (1955) Arch. of Physical Med. & Rehabilitation 36:363-370, "Variations between measured and biologically effective microwave diathermy dosage"
1461. SCHWAN, H. P., & LI, K. (1956) Institute of Radio Engineers Trans. on Medical Electronics PGME-4:45-49, (Also, Tech. Rept. #16, ONR Contract, Univ. of Penna., AD 80164; Also, presented at Symposium on "Physiologic & Pathologic Effects of Microwaves, Mayo Clinic, Sept. 1955), "The mechanism of absorption of ultrahigh frequency electromagnetic energy in tissues, as related to the problem of tolerance dosage"
1462. SCHWAN, H. P., & LI, K. (1956) Proc. of the Institute of Radio Engineers 44(11):1572-1581, (Also Tech. Rept. #19, Univ. of Penna. on ONR Contract, AD 122467), "Hazards due to total body irradiation by radar"
1463. SCHWAN, H. P., & LI, K. (1959) Proc. of the 1st National Biophysics Conf., Columbus, (Quastler, H., & Morowitz, H., eds., Yale Univ. Press, New Haven), pp. 355-356, "Dielectric properties of hemoglobin at ultrahigh frequencies"
1464. SCHWAN, H. P., & MACZUK, J. (1959), Proc. of the 1st National Biophysics Conf., Columbus, (Quastler, H., & Morowitz, H., eds., Yale Univ. Press, New Haven), pp. 348-355, "Electrical relaxation phenomenon of biological cells and colloidal particles at low frequencies"
2531. SCHWAN, H.P., PATZOLD, J. (and others) (1948), In: FIAT Review of German Science (1939-1946), Biophysics, Part II, pp. 1-62, (In Ger.), "Biological and therapeutic effects of high frequency electric fields"
1465. SCHWAN, H. P., & PAULY, H. (1959) Digest of Technical Papers, Proc. of the 12th Annual Conf. on Electrical Techniques in Medicine and Biology (Schwan, H. P., Chm.), p. 54 only, "Dielectric constant and conductivity of the interior erythrocytes and pearl chain formation in blood"
1466. SCHWAN, H. P., & PAULY, H. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.) 3:113-123, "Electrical substitutes for human tissue"
1467. SCHWAN, H. P., PAULY, H., TWISDOM, J., & GLAZER, I. (1958) First Annual Progress Rept. to Air Force, Univ. of Penna. "Effects of microwaves on mankind"
1468. SCHWAN, H. P., & PIERSOL, G. M. (1953) Arch. of Physical Med. 33:34-, "Absorption of electromagnetic energy in body tissue; review and critical analysis"
1469. SCHWAN, H. P., & PIERSOL, G. M. (1954) Amer. J. of Physical Med. 33(6):371-404, "The Absorption of Electromagnetic Energy in Body Tissues: A Review and Critical Analysis, Part I, Biophysical Aspects"; Part II. Amer. J. of Physical Med., Internat. Review of Physical Med., 34(3):425-448 (1955), (AD 83453), "Physiological and clinical aspects - physiological effects of microwave diathermy"
1470. SCHWAN, H. P., SAITO, H., & SCHWARZ, G. (1966) Biophysical Journal 6:313-, (Also, Tech. Rept. #49 of Univ. of Pennsylvania), "Response of non-spherical biological particles to alternating electric fields."
1471. SCHWAN, H. P., & SALATI, O. M. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments, (Susskind, C., ed.) 3:107-, (Also: Rept. RADC-TR-59-140), "A technique for relative absorption cross-section determination"
1472. SCHWAN, H. P., SALATI, O. M., ANNE, A., & SAITO, H. (1960) Univ. of Penna. Progress Rept to Air Force, RADC-TN-60-158, (AD 241768), 77 pages, "Effects of microwaves on mankind"
1473. SCHWAN, H. P., SALATI, O., PAULY, H., ANNE, A., FERRIS, C. D., & TWISDOM, J. (1958) Univ. of Penna. Rept. to Air Force (RADC-TN-59-199, AD 217618), 42 pages, "Effects of microwaves on mankind"
1474. SCHWAN, H. P., & SHER, L. D. (1967) Univ. of Penna. Progress Rept. to ONR, (AD 656736), 8 pages, "Non thermal effects of alternating electric fields on biological structures"
1475. SCHWAN, H. P., SHER, L. D., & MERJANIAN, S. V. (1967) Proc. of the 20th Annual Conf. on Engineering in Medicine and Biology, (Also, Univ. of Penna. Tech. Rept. 51), "Optimization study of an electrical method for the rapid thawing of frozen blood"

1476. SCHWAN, H. P., & SHER, L. D. (1969) In: Dielectrophoretic and Electrophoretic Deposition, (Pohl, H. A., & Pickard, W. F., eds.), The Electrochemical Society, Inc., New York; pp. 107-126, "Electrostatic field-induced forces and their biological implications"
1477. SCHWAN, H. P., & SHER, L. D. (1969) J. of the Electrochemical Society: Reviews & News 116(1):22C-, "Alternating-current field-induced forces and their biological implications"
1478. SCHWAN, H. P., & SHEN, D. W. C. (1959) Digest of Technical Papers, Proc. of the 12th Annual Conf. on Electrical Techniques in Medicine and Biology, (Schwan, H. P., Chm.), Sponsored by the Institute of Radio Engineers, the Amer. Institute of Electrical Engineers, and the Instrument Soc. of Amer., (Nov.), "Relaxation parameters of a suspension of membrane covered ellipsoids"
1482. SCHWARZ, G. (1963) J. of Chemical Physics 39(9):2387-2388, "General equation for the mean electrical energy of a dielectric body in an alternating electrical field"
1483. SCHWARZ, G., SAITO, M., & SCHWAN, H. P. (1966) J. of Chemical Physics 43(10):3562-3569, (Univ. of Penna. Rept.), (AD 631617), "On the orientation of nonspherical particles in an alternating electrical field"
3021. SCHWARZ, H.F., BOSISIO, R.G., WERTHEIMER, M.R., & COUDERC, D. (1973), J. of Microwave Power, 8(3/4):303-322, "Microwave curing of synthetic rubbers".
1480. SCHWARTZ, R. F. (1966) Electronic Industries (June), pp. 88-95, "Precision microwave power measurements, a survey"
1481. SCHWARTZKOPFF, J. (1950) Die Vogelwarte 15(3):194-196, (NRC Transl. TT-1161; N65-28815), "On the question of the perception of ultra-shortwaves by migratory birds"
2532. SCOTT, J.B. (1970), MicroWaves, 9(11):14 only, "Can microwaves deliver Power? Electricity from solar power satellite proposed. Project deemed possible, but requires major advances in technology".
1484. SCOTT, J. (1971) Microwaves 10(1):9-14, "Is today's standard for microwave radiation safe for humans"
3022. SCOTT, N.W. (1973), Honolulu Star-Bulletin, 3-Part Series entitled: Microwaves: A health hazard". Part I, Dec. 28, entitled "Oven damaged her eyes", pp. 1, and "Microwave ovens are potentially harmful" pp. A-10. Part II, Dec. 29, entitled "Radar apparently a source of peril" [case history of veterans]. Part III, Dec. 31, entitled: "Lawyers, not doctors, may resolve problem [an interview with Dr. M. Zaret]".
3303. SEAMAN, R.L. (1974), Ph.D. dissertation, (with WACHTEL, H.), Department of Biomedical Engineering, Duke University. (prepared under contract FDA 73-35), "Neuronal effects of low level microwaves".
1485. SEARLE, G., DAHLEN, R. W., IMIG, C. J., WUNDER, C. C., THOMSON, J. D., THOMAS, J. A., & MORESSI, W. J. (1961) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Peyton, M. F., ed.), pp. 187-199, "Effects of 2450 mc microwaves in dogs, rats, and larvae of the common fruit fly"
1486. SEARLE, G. W., IMIG, C. J., & DAHLEN, R. W. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Susskind, C., ed.) 3:54-61, "Studies with 2450 Mc(cw) exposures to the head of dogs"
2533. SEBRANT, Yu.V., & TROYANSKII, M.P., (1969), Biologiya, Seriya 4, Moscow, 31 pps., (Nat. Res. Council of Canada Tech. Transl. #159, (1972); (N72-18073); and Izd-vo "Znaniye", 32 p. (JPRS 53265), "Radio waves and the living organism".
1487. SEDLACEK, J., & MACEK, O. (1966) Spornik Lekarsky, Prague, 58:28-35, "Attempt to analyze the substance responsible for the high frequency impedance of cerebral tissue"
1488. SEDUNOV, B. I., & FRANK-KAMENETSKII, D. A. (1963) Uspekhi Fizicheskikh/ Moscow, 79(3):617-639, (Amer. Institute of Physics Transl. 6(2):279-293 (1963)), "Dielectric constants of biological objects"
1489. de SEGUIN, L. (1947) Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences 225:76-77, (In French), "Reversibility of lesions observed in small animals exposed to ultra high frequency radiation (wavelengths of 21 cm)"
1490. de SEGUIN, L. (1949) Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences 228:135-, (In French) "Laws of heat distribution in tissues of organisms irradiated with ultrahigh frequency electromagnetic fields"
1491. de SEGUIN, L. (1949) J. de Radiologie et d'Electrologie 30:458-461, (In French), "Biophysical bases of therapeutic applications of microwaves"
1492. de SEGUIN, L., & COSTELAIN, G. (1947) Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences 224(23):1662-1663, (In French), "Effect of ultra high frequency waves (wavelengths of 21 cms) on temperature of small laboratory animals"
1493. de SEGUIN, L., & COSTELAIN, G. (1947) Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences 224(26):1850-1852, (In French), "Anatomic lesions observed in laboratory animals exposed to ultrahigh frequency radiation (wavelength of 21 cms)"
1494. de SEGUIN, L., LeFABVRE, J., & POLIETIER, H. (1949) J. de Radiologie et d'Electrologie 30:566-568, (In French), "Specific action of microwaves on tissue cultures"
1495. de SEGUIN, L., et al. (1948) Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences 227:783-, (In French), "Increase in the growth rate of tissue cultures irradiated with ultrahigh frequency electromagnetic radiation (wavelength 21 cm)"
3621. SEIDEL, D., KNOLL, M., & EICHMEIER, J. (1968), Pflueger Arch. Ges. Physiol., 299( ):11-18, "Excitation of subjective light patterns (phosphenes) in humans by sinusoidal magnetic fields."
1496. SEIPEL, J. H., & MORROW, R. D. (1960) J. of the Wash. Academy of Sciences 50(6):1-4, "The magnetic field accompanying neuronal activity: a new method for the study of the nervous system"
1497. SEMENOV, A. I. (1962) Izd-vo Moskovskogo Universiteta, Moskva, pp. 1-254, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, AID Rept. P-65-17, Apr. 1965), "Theory of electromagnetic waves"

1498. SEMENOV, A. I. (1965) *Bulleten Eksperimental'noi Biologii i Meditsiny (Moskva)* 60(7):64-66, (Abstr. in: ATD Press, Special Issue "Biomedical Microwave Research" 4(43):6-7 (1965)), "The influence of the SHF-UHF electromagnetic field on the temperature in rabbit femoral tissues"
1499. SEMENOV, S. V. (1965) *Bulleten Eksperimental'noi Biologii i Meditsiny (Moskva)* 60(4):17-19, (FTD Transl. TT-65-31496; JPRS 30998; N65-28140), "Elimination of hypothermia in dogs by means of high frequency currents" (Possibly Zenkevich)
1500. SENKEVECH, A. I. (1959) *Summaries of reports. Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves; Moscow, p. 6 only. (Title not given)*
1501. SERCL, J., et al. (1961) *Sbornik Vedeckych Praci Lekarska Fakulty Karlovy University, Czechoslovakia*, 4(4):427-440, (Also *Z. ges. Hyg.* 7:897-907, (1961), (in German)), "On the effects of cm electromagnetic waves on the nervous system of man; radar"
3622. SERDYUK, A.M. (1975), *Gigiyena Naselennykh Mest*, \_\_ (14):95-99, (in Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #L/5615), 10 Feb. 1976, pp. 8-12, "State of the cardiovascular system under the chronic effect of low-intensity electromagnetic fields."
2534. SERGEYEV, G.V. (1965), *Moskva, Izd-vo Meditsina*, 226 pps., (In Russ.), Electrosleep Therapy of Patients with Hypertension Under Controlled Study of Their Higher Nervous Activity.
2535. SERGEYEV, G.V., IL'INA, L.I., & KOSTYUKHINA, N.A. (1966), In: Electrosleep and Electroanesthesia. Materials of the All-Union Symposium on Problems of Electrosleep and Electroanesthesia [Electronarcosis], Dedicated to the 20th Year of the Electrosleep Method, pp. 154-156, (In Russ.), Moscow, (13-15 Oct.), "Selection of a mode for treating hypertonia patients as a function of the type of CNS conditions".
2536. SERVANTIE, B., BERTHARION, G., & JOLY, R. (1971), *Comptes rendus des seances de la Societe de Biologie*, 165(2):376-378, (In Fr.), "Influence of electromagnetic radiation of very high frequency on the sensitivity to the triiodoethyl salt of gallium and to the hexamethyl iodonium salt on the white rat".
2537. SERVANTIE, B., BERTHARION, G., & JOLY, R. (1971), *Comptes rendus des seances de la Societe de Biologie*, 165(9-10):1952-1956, (In Fr.), "Influence of high frequency electromagnetic radiation on the sensitivity to pentetrazol (Fr. T.M.) of the white mouse".
3023. SERVANTIE, B., BERTHARION, G., JOLY, R., SERVANTIE, A.-M., ETIENNE, J., DREYFUS, P., & ESCOUBET, P. (1973), Rept. No. 73-17 of Centre D'Etudes et de Recherches Bio-Physiologiques Appliquees a la Marine, (Toulon, France), "Pharmacological effects of a pulsed microwave field".
2538. SERVANTIE, B., JOLY, R., & BERTHARION, G. (1971), *J. of Microwave Power*, 6(1):59-62, "Experimental study of the biological effects of microwave radiation on the white rat and mouse".
2539. SERVIT, Z., BURETS, Ya., BURESHOVA, O., & PETRAN', M. (1953), *Cekhoslovatskaya fiziologiya*, 2(4):337-346, (in Russ.), "The problem of electronarcosis and electrosleep".  
[thermal & nonthermal]
1502. SETH, B. S., & MICHAELSON, S. (1964) *Aerospace Medicine* 35(8):734-739, "Microwave/hazards evaluation"
1503. SETH, B. S., & MICHAELSON, S. M. (1955) *J. of Occupational Medicine* 7(9):439-442, "Microwave cataractogenesis"
1504. SETTER, L. R., SNAVELY, D. R., SOLEN, D. L., & VAN WYE, R. F. (1969) U. S. Dept. of Health, Education, and Welfare, Public Health Service Publication No. 999-35-35 (April), 77 pages (limited distribution), (Also in: "Senate Hearings", pp. 1216-1296); "Regulations, standards, and guides for microwaves, ultra-violet radiation, and radiation from lasers and television receivers - an annotated bibliography"
1505. SEVAST'YANOV, V. V. (1965) *Voenno Meditsinskii Zh.*, USSR Military Med. Jour. \_\_ (7):21-25, "Measurement of SHF-UHF electromagnetic radiation intensities and the problem of their hygienic appraisal"
1506. SEVAST'YANOV, V. V. (1969) *Voenno Meditsinskii Zh.*, USSR Military Med. Jour., \_\_ (1):54-55, "Visual recording technique used in the assessment of SHF-UHF effects on an organism"
3623. SEVAST'YANOV, V.V. (1974), *Voen. Med. Zh.*, \_\_ (12):53-57 (in Russian), Transl. In: *Mil. Med. J.*, \_\_ (12):53-57 (Dec.), "A rapid method of visualizing the structure of an extremely high-frequency field" [using heat sensitive paints].
3624. SEVAST'YANOVA, L.A., & VILENSKAYA, R.L. (1974), *Biologicheskkiye nauki*, \_\_ (6):48-49 (in Russian), Abstr. In: *Neuroelectric News*, 5(2):4 only (July 1975), "Reaction of marrow cells of mice to parameter variations of SHF irradiation in the millimeter-wave range."
3625. SEVAST'YANOVA, L.A., & VILENSKAYA, R.L. (1975), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #64532), pp. 7-9, "Mouse bone marrow reaction to altered UHF millimeter irradiation parametric variation."
2540. SHACKLETT, D.E., TREDICI, T.J., & EPSTEIN, L. (1973), (U.S. Air Force School of Aerospace Medicine, Brooks AFB, Texas), Presented at 44th Ann. Scientific Meet., Aerospace Medical Assoc., May 7-10, Las Vegas, Nev., "Microwave lenticular effects in the United States Air Force".
3626. SHACKLETT, D.E., TREDICI, T.J., & EPSTEIN, D.L. (1975), *Aviation, Space, and Environmental Medicine*, 46(11):1403-1406, "Evaluation of possible microwave-induced lens changes in the United States Air Force."
2541. SHAKHBAZOV, V.G., CHEPEL, L.M., ZHILINA, G.E., KOTENKO, L.V., GRIGORIEVA, N.N., & POPEL, A.T. (Kharkov State Univ., USSR), (1972), Abstr. of Fourth Internat. Cong. of the Internat. Union for Pure and Applied Biophysics, Moscow, (7-14 Aug.), 114-115, "Effect of magnetic field, ultrahigh frequency fields, ultraviolet radiation and extreme temperatures upon inbred and hybrid organisms". [Genetic studies on plants and animals indicate that genotype peculiarities show differences in reaction of organisms to the physical agent.]
1507. SHAPAR, B. K. (1961) *Health Physics* 5:155-159, "Significance of health physics evidence in the trial of a case of radiation personal injury"

2028. SHAPIRO, A. R., LUTOMIRSKI, R. F., & YURA, H. T. (1971) IEEE Trans. on Microwave Theory and Techniques (Special Issue on Biological Effects of Microwaves MTT-19(2):187-196, "Induced fields and heating within a cranial structure irradiated by an electromagnetic plane wave"
3627. SHAPOSHNIKOV, Yu.G., YARES'KO, I.F., & VERNIGORA, Yu.V. (1975), Byulleten' Eksperimental'noy Biologii i Meditsiny, 53(8):116-118 (Aug.), (in Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation"(JPRS #L/5615), 10 Feb. 1976, pp. 29-32, "Histomorphological investigation of regeneration of wounds in animals exposed to the long-term action of low-intensity microwaves" [4 mW/cm<sup>2</sup>, freq. ?, guinea pigs].
1508. SHARMA, R.C. (1967), Nature, 214(5083):83-84, (Apr. 1), "Mechanism of characteristic behavior of cells in an alternating electric field."
3024. SHARP, J.C., GROVE, H.M., & GANDHI, O.P. (1974), IEEE Transactions on Microwave Theory & Techniques, MTT-22( ) :583-584, (May), "Generation of acoustic signals by pulsed microwave energy."
2542. SHARP, J.C., & PAPERIELLO, C.J. (1971), Radiation Research, 45:434-439, "The effects of microwave exposure on Thymidine-<sup>3</sup>H uptake in albino rats". [Ten-minute exposure at 32 mW/cm<sup>2</sup> to 2450 MHz decreased thymidine uptake in ovarian and intestinal tissue; at 16 mW/cm<sup>2</sup>, change noted in ovarian but not in intestinal tissue. Changes not noted in lung, liver, kidney, or heart.]
1509. SHAW, T., & WINDLE, J. (1950) J. of Applied Physics 21:956-, "Microwave techniques for measurement of the dielectric constant of fibers and films of high polymers"
3025. SHAWVER, L.J. (1973), Science News, 104(13):202-204, (29 Sept.), "Science focuses on a 'light of life': Kirlian photography, controversial and poorly understood, nevertheless could become a valuable diagnostic tool"; and cover, and p.195 "Light from the edge of science: The strange world of Kirlian photography".
1510. SHEGEGLOVA, (1961) Gigiena i Sanitariya, USSR, 28(5):18-22, (JPRS 23898), "On the combined action of a high frequency electromagnetic field and x-ray in industry"
1511. SHECHERBAK, A. YE. (1933) Biulleten Gosudarstvennogo Tsentral'nogo Instituta Sechenova (Bull. of the State Central Institute of sechenova), (2-3):pp.? "From the history of the scientific life of the Sechenov Institute"
3304. SHEALY, C.N. (1972), Surg. Forum, 23( ) :419-421, "Transcutaneous electroanalgesia".
3305. SHEALY, C.N., & MAURER, D. (1974), Surgical Neurology, 2( ) :45-47, "Transcutaneous nerve stimulation for control of pain".
2269. SHELDON, L. (1944) Bureau of Med. (U. S. Navy) News Letter 3(10):30-31, "Radar operation not harmful to the eyes"
3628. SHEMETILO, I.G., & MALLABIU, G.A. (1975), Voprosy Kurortologii Fizioterapii i Lechebnoy Fizicheskoy Kul'tury, (4):369-370, (in Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation"(JPRS #L/5615), 10 Feb. 1976, pp. 58-60, "The treatment of patients with epicondylitis of the arm by novocain electrophoresis using a rectified sinusoidal medium-frequency current and by centimeter range microwaves."
1512. SHERYAKOV, S. I. (1955) Voenno Meditsinskii Zh., USSR Military Med. Jour., (5):79-83, "Certain data of medical observations in radio technical stations"
1513. SHEN, D. W. C., & SCEWAN, H. P. (1959) Digest of Technical Papers, Proc. 12th Annual Conf. on Electrical Techniques in Medicine and Biology, (Schwan, H. P., Chm.), Nov., p. 55 only, "Relaxation parameters of a suspension of membrane-covered ellipsoids"
1514. SHER, L. D. (1970) Paper presented at 4th Annual Midyear Topical Symposium, Health Physics Soc., Electronic Product Radiation and the Health Physicist, Jan., Louisville, Ky., Bureau of Radiation Health, Div. of Electronic Products, Rept. No. 70-26, pp. 431-462, "Interaction of microwave and RF energy on biological material"
1515. SHER, L. D. (1970) Medical Research Engineering 9(1):12-16, "Symposium on biological effects and health implications of microwave radiation: a review"
1516. SHER, L. D., KRESCH, E., & SCEWAN, H. P. (1970) Biophysical Journal 10(10):970-979, "On the possibility of nonthermal biological effects of pulsed electromagnetic radiation"
1517. SHER, L. D., & SCEWAN, H. P. (1963) Ph.D. thesis of L.D.S., and Tech. Rept. #37 to ONR, the Moore School of Electrical Engineering, Univ. of Perma., (Abstr. in IEEE EME-16:1, 1969), "Mechanical Effects of AC Fields on Particles Dispersed in a Liquid; Biological Implications"
1518. SHER, L. D., SCEWAN, H. P., AND MACZUK, J. (1965) Digest of 6th Internat. Conf. on Medical Electronics and Biological Engineering, (Iwai, Y., ed.) Aug., pp. 547-548, "The electrical impedance of frozen blood and applications to electrical methods of thawing"
- ogii
1519. SHERESHEVSKAYA, L. (1966) Vestnik Oftalmol/ (3):5-9, "Centimeter-band therapy of dystrophy of the macula lutea and uveitis"
1520. SHEVCHIK, F., & VETTERL', V. (1965) Biofizika 10(3):441-446, (ATD 66-55) (Abstr. in: ATD Press, Special Issue, "Biomedical Microwave Research" 4(43):1-3, (1965)), "Complex dielectric permittivity of solutions in the centimeter wave band"
1521. SHEVELOVA, A. B. (1939) Sbornik trudov Instituta Fiziologii Dnepropetrovsk. Universitet., 1937-1940, (Subseries of the University's "Nauchnye Zapiski", monograph), 2:31-, "Influence of VEF fields on heart action in the frog"
1522. SHEYVAS, V. B., & ZUFAROV, K. A. (1958) Med. Zh. Uzbek, (6):12-15, "Biological effects of electromagnetic fields; electron microscopic research"
1523. SHEYVEKHMAN, B. YE. (1949) Problemy Fiziologicheskoy Akustiki, USSR, 1:122-127, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965); (AD 281129; FTD-TT-62-491/1+2), "Effect of the action of a VHF-HF field on the aural sensitivity during application of electrodes in the zone of projection of the aural zone of the cortex (lamella of temporal bone)"

3026. SHIFFMAN, M., & SAFFORD, F.K. (1943), *Physiotherapy Rev.*, 23( ):235-?, "Pulsating high voltage short wave: A preliminary clinical report".
3027. SHILYAYEV, V.G. (1970), In: Influence of Microwave Radiation on the Organism of Man and Animals, (PETROV, I.R., (ed.)), Leningrad, USSR, Academy of Medical Sciences of the USSR, Meditsina Press, "Effects of microwave radiation on the visual organ".
1524. SHIMKOVICH, I. S., & SHILYAYEV, V. G. (1959) *Vestnik Oftalmol.*, Moscow, 72(4):12-16, (Abstr. in Mammalian Eye, A Literature Survey, by Lazarus, H. B., & Levedahl, B. H., TID-3912, DTIC, U. S. Atomic Energy Commission, Oak Ridge, Tenn., 1962, pp. 447-), "Development of cataract of both eyes as a result of brief exposures to high density SHF-UHF electromagnetic fields"
1525. SHINDRYAYEV, A. A. (1969) *Voyenno-Meditsinski Zh.*, (USSR Military Med. J.), (5):87-88, "Nogram for determining radii of radar set danger zones"
1526. SHINN, D. H. (1958) *Nature* 182(4652):1792-1793, "Health hazards from powerful radio transmissions"
1527. SHINOWARA, G. YE., & HORAVA, A. (1962) *Inst. of Contemporary Russian Studies* 4(3):7-8, "The biological action of ultra-high frequencies"
1528. SHIPP, L. M. (1965) *J. of Occupational Medicine* 7:423-430, "Electronics and medicine"
3306. SHISLO, M.A. (1971), In: KHOLODOV, Yu.A. (ed.), Influence of Magnetic Fields of Biological Objects, (Citation #3230, this Biblio.), pp. 20-35, "Influence of magnetic fields on enzymes, tissue respiration, and some aspects of metabolism in an intact organism".
2270. SHIVELY, J. N. (1970) In: Radiation Bio-Effects Summary Report, Hodge, D. M., (ed.), for Jan-Dec 1970, Div. of Biological Effects, Bur. Rad. Health, DHEW, (Rept. No. BBE/DSE 70-7), pp. 201-203, "A pilot study of effects of microwave exposure on octogenesis" [using 2 - 3 day old eggs]
1529. SHLYAFER, T. P., & YAKOVLEVA, M. I. (1969) *Fiziologicheskiy Zh.*, SSSR, 55(1):16-21, (In Russian with English summary), "The effect of SHF-UHF electromagnetic fields on the pulsed activity of cerebro-cortical neurons"
1530. SHMELEV, V. P. (1964) In: Some Questions of Physiology and Biophysics, Voronezh, pp. 89-, "The effect of an electromagnetic field of the audio- and radio-frequency ranges on the reflex activity of the spinal cord"; and *ibid.*, pp. 98-, "The state of electric activity of the brain due to action of electromagnetic vibrations of the audio- and radio-frequency range on the organism"
1531. SHNEYVAS, V. B., & ZUFAROV, K. A. (1968) AID Press, Aerospace Technology Division, Library of Congress 7(10):4-5, (Summary in: *USSR Science Abstracts* (62):48-, (1968)), "The biological effect of electromagnetic fields (electron-microscopic study)"
1532. SHORE, M., & LEACH, W. (1969) In: Conf. on Federal-State Implementation of Public Law 90-602, (Miller, J. W., & Gerusky, T. M., Co-Chm.), Bureau of Rad. Health Rept. ORD 69-4 [LD<sub>50</sub> Studies on rats & hamsters; changes in protein synthesis; chromosomal studies following exposure to electromagnetic radiation]
3629. SHOSTAK, A. (1975), *Naval Research Reviews*, 28(12):1-12 (Dec.), "Navy telecommunications past and present [with comments on the SANGUINE system]."
3630. SHTEMLER, V.M. (1974), *Biologicheskiye Nauki*, (10):52-55 (in Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #66512), (7 Jan. 1976), pp. 60-66, "Effect of microwaves on blood serum butyryl cholinesterase activity *in vivo*."
1533. SHTOL'TSER, V. R. (1958) *Problemy Gematologii i Perelivaniia Krovi*, Moskva, 3(3):178-183, "Changes in the activity of hemostatic blood preparations caused by the electromagnetic field"
3028. SHTRIKMAN, S. (1974), *Personal Communication*, (Dept. of Electronics, Weizmann Institute, Rehovot, Israel), "Remote determination of respiration rate using a 3 GHz microwave interferometer to measure the instantaneous relative distance between the chest wall and the instrument".
3307. SHUL'PEKOV, A.A. (1971), In: KHOLODOV, Yu.A. (ed.), Influence of Magnetic Fields on Biological Objects, (Citation #3230, this Biblio.), pp. 175-186, "Peculiarities of methods and methodology of magnetobiological experiments".
2543. SHURIDHINA, A.A. (1970), Rept., 9 pps. (JPRS #1659), "Pulsed microwave therapy".
1534. SHVARTS, YA. I. (1945) Frumze, Local and Reflected Changes Due to Localized Action of HF-VHF Field Upon Cervicothoracic Segments of the Spinal Cord
1535. SIDMONS, H., & SOWTON, E. (1967) *Chas. C. Thomas, Publ.*, Springfield, Ill., pp. 99-102, [see especially p. 100 for a discussion of experimental effects on cardiac pacemakers of various types of RF/microwave/diathermy, etc. equipment ], Cardiac Pacemakers
3308. SIEKIERZYNSKI, M., CZERSKI, P., MILCZAREK, H., GIDYNSKI, A., CZARNECKI, C., DZIUK, E. & JEDRZEJCZAK, W. (1974), *Aerospace Medicine*, 45(10):1143-1145, (Oct.), "Health Surveillance of personnel occupationally exposed to microwaves: Part II - Functional disturbances", (See citation #3029, this Biblio.).
3309. SIEKIERZYNSKI, M., CZERSKI, P., GIDYNSKI, A., ZYDECKI, S., CZARNECKI, C., DZIUK, E., & JEDRZEJCZAK, W. (1974), *Aerospace Medicine*, 45(10):1146-1148, "Health surveillance of personnel occupationally exposed to microwaves: Part III - Lens translucency", (See citation #3030, this Biblio.).
3029. SIEKIERZYNSKI, M., CZERSKI, P., MILCZAREK, H., GIDYNSKI, A., CZARNECKI, C., DZIUK, E., & JEDRZEJCZAK, W. (1974), *Aerospace Medicine* (In Press), "Analysis of occupational exposure to microwaves: Part II Functional disturbances"
3030. SIEKIERZYNSKI, M., CZERSKI, P., ZYDECKI, S., CZARNECKI, C., DZIUK, E., & JEDRZEJCZAK, W. (1974), *Aerospace Medicine*, (In Press), "Analysis of occupational exposure to microwaves: Part III Lens translucency".

1536. SIEMS, L. L., KOSHAN, A. J., & OSBORNE, S. L. (1948) Arch. of Physical Medicine 29(12):759-764, "A comparative study of short wave and microwave diathermy on blood flow"
1537. SIGEL, M. M., & BURNSTEIN, T. (1959) In: Annual Rept. of Microwave Radiation Research, Univ. of Miami, (AD 232925), "Effect of microwaves on mammalian cells grown in vitro"
2271. SIGELMAN, S., & FRIEDENWALD, J. S. (1954) A.M.A. Arch. of Ophth. 52(1):46-57, (Abstr. in: Ophth. Lit. 8(3):356 (Mar 1955)), "Mitotic and wound healing activities of the corneal endothelium. Effect of sensory denervation"
1538. SIGLER, A. T., LILIENTHAL, A. M., COHEN, B. H., & WESTLAKE, J. E. (1965) Bull. of Johns Hopkins Hospital 117(6):374-400, "Radiation exposure in parents of children with Mongolism (Downs Syndrome)"
1539. SILVER, S. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments, (Suskind, C., ed.), 3:22-32, (RADC-TR-59-140; AD 234788), "Physical aspects of microwave radiation"
2544. SILVERBERG, G. (1973), The Sciences (of the N.Y. Acad. of Sciences), 13(3):6-10, "Unreasoning radiation: Do microwaves pose a hazard to mind and body?"
2272. SILVERMAN, C. (1970) In: Radiation Bio-Effects Summary Report, Hodge, D. M., (ed.), for Jan-Dec 1969, Div. of Biological Effects, Bur. Rad. Health, DEW, (Rept. No. BRE/DBE 70-1), p. 22 only, "Parental radiation exposure and Down's syndrome (mongolism)"
2273. SILVERMAN, C. (1970) In: Radiation Bio-Effects Summary Report, Hodge, D. M., (ed.), for Jan-Dec 1970, Div. of Biological Effects, Bur. Rad. Health, DEW, (Rept. No. BRE/DBE 70-7), pp. 22-23, "Parental radiation exposure and Down's syndrome (mongolism)"; and pp. 45-46, "Follow-up study of radar workers"
2545. SILVERMAN, C. (1973), J. of Epidemiology, 97(4):219-224, (Apr.), "Nervous and behavioral effects of microwave radiation in humans"
1540. SILVERS, L. J. G. (1935) Arch. of Physical Therapy 16:671-673, "Control of pain and hemorrhage in electrosurgical tonsillectomy"
1541. SIMMONS, A., & EMERSON, W. (1953) Tele-Tech and Electronic Industries 7:pp.?, "Anochoic chambers for microwaves"
1542. SIMON, C. W., & ANDERSON, L. E. (1956) Presented at 8th Annual Meeting of Flight Safety Foundation (Hughes Aircraft Co.), (AD 144744), "Potential ground hazards of high performance radar"
1543. SIMONELLI, M., & RIZZINI, V. (1951) Giornale Italiano di Oftalmologia 4(1):3-<sup>10</sup>, (In Italian), "Action of microwaves on the eye (preliminary note)" (Abstr. in: Zentralbl. f. d. ges. Ophth. 59(7):344 (July 1953))
2274. SIMONELLI, M., & RIZZINI, V. (1952) Giorn. Ital. Oftal. 5(3):190-196 (May/June), (In Ital., with Fr., Eng., & Ger. summaries), (Abstr. in: Zentralbl. f. d. ges. Ophth. 52(1):55 (Mar 1953), and Ophth. Lit. 6(3):263 (Dec 1952)), "Further contribution to the study of the effect of microwaves on the eye"
1544. SINGATULLINA, R. G. (1961) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 52(7):69-72, (In Russian), "The effect of ultrahigh frequency currents on blood serum protein fractions"
1545. SINGATULLINA, R. G. (1961) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 52(7):812-815, (Also, Biological Abstracts 38(5636), (1962)), "The effect of UHF currents on proteins in blood serum fractions"
1546. SINISI, L. (1954) Electroencephalogy & Clinical Neurophysiology 6:535-, "EEG [human] after radar application"
3310. SIVORINOVSKIY, G.A. (1973), Vorposy Kurortologii, Fizioterapii i Lechebnoy Kul'tury, 38(3):222-227, [Transl. in "Effect of nonionizing electromagnetic radiation," JPRS #62462, July 1974, Citation #3134 this Biblio., pps. 32-40], "The biological action of ultrasonic sound and super high-frequency electromagnetic fields in the three-centimeter range."
3311. SIVORINOVSKII, G.A. (1973), Vopr. Kurortol. Fizioter. Lech. Fiz. Kult., 38( ):222-227, "Mechanism involved in the biological action of ultrasound and superhigh frequency electromagnetic fields in the 3-cm range", [oxidative phosphorylation studied in rat liver and kidney mitochondria at exposure levels between 25 and 100  $\mu\text{W}/\text{cm}^2$  for 10 min].
1547. SKAGGS, G. A. (1971) Naval Research Laboratory Memorandum Report 2218, 11 pages, "High frequency exposure chamber for radiobiological research"
2546. SKIDMORE, W.D., & BAUM, S.J. (1973), Armed Forces Radiobiology Research Institute, Bethesda, Md., Scientific Rept. #SR73-10 (June), "Biological effects in rodents exposed to pulsed electromagnetic radiation".
3631. SKIDMORE, W.D., & BAUM, S.J. (1974), Health Physics, 26(5):391-398 (May), "Biological effects in rodents exposed to  $10^8$  pulses of electromagnetic radiation."
2094. SKLENSKY, B., NEDBAL, J., & ZAKOVA, L. (196?) Pracovni lekarstvi 20:363-366, (Abstr. in: Non-ionizing Rad. 1(3):152-153, (1969)), (Also CIS abstract 362-1969), "State of health of workers exposed to radiofrequency radiation in industrial establishments at Brno"
2547. SKRIPKIN, Yu.K. (1967), In: Neurodermatitis: Problems of Etiology, Pathogenesis, and Therapy, Izd-vo Meditsina, pp. 108-116, (JPRS 42,899), "Treating neurodermatitis patients with electrosleep and hypnosis".
1548. SKURIKHINA, L. A. (1961) Voprosy Kurortologii, Fizioterapii i Lechebnoy Fizicheskoy Kul'tury (Problems in Health Resort Science, Physiotherapy & Medical Physical Culture), Moscow, 4(4):338-, "The therapeutic application of microwaves (SHF electromagnetic fields)"
1549. SKURIKHINA, L. A. (1962) Novosti Meditsinskoy Tekhniki, Moskva, 3(3):9-, "Clinical and physiological bases of microwave therapy"
1550. SLASOSPITSKIY, A. A. (1964) In: Biological Action of Ultrasound and SHF-UHF Electromagnetic Oscillations, (Gorodetskiy, A. A., ed.), Academy of Sciences, Institute of Physiology, Imeni A. A. Bogomolets, Kiev, UKR SSR, (JPRS 38060; N65-28707), pp. 92-107, "The problem of microwave lesions of the skin"

1551. SLABOSPITSKIY, A. A. (1964) In: Problems of the Biophysics and Mode of Action of Radiation, Zdorovya Publ. House, Kiev, pp. 89-94, (Transl. of abstr., Zh. Biol. (19), (Oct. 1965), Abstr. 19-P-373; JPRS 34963), "Morphological changes in the skin of white rats when exposed to centimeter range radio waves"
1552. SLABOSPITSKIY, A. A. (1965) Fiziologicheskiy Zh. SSSR, 11(2):225-231, "The mechanism of action of microwaves on the skin"
1553. SLAVITSKIY, G. M. (1937) Sevastopol, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, AID Rept. P-65-17, Apr. 1965), The Experimental Foundation of Short Wave Therapy
1554. SLAVSKIY, G. M., & BURNAN, L. S. (1935) Bull. Gosudarstvennogo Tsentral'nogo Nauchno-issledovatel'skogo Inst. imeni Sechenova (6-7): "The problem concerning pathological anatomical changes occurring in the organs and tissues under total exposure to short waves"
1555. SLEPICKA, J., SLIVOVA, A., ZPPOCHODH, O., & ZAPLETALOVA, E. (1967) Pracovni Lekarstvi, Prague 19:5-11, "The effect of electromagnetic radiation in the ester wavelength on operators of short-wave radio transmitters"
2275. SLINEN, D. H., & PALMISANO, W. A. (1967) Army Environmental Hygiene Agency Rept. (M67-32384, AD 652708), "Microwave hazards bibliography"
1557. SMIRNOVA, M. I., & SACHIKOVA, M. N. (1960) Nauchno-issledovatel'skiy Institut Gigiya Truda i Profzabolevaniy Trudy (1):50-51, (Also in: The Biological Action of Radio-Frequency (UHF) Electromagnetic Fields, (Letavet, A. A., & Gordon, Z. V., eds.), (JPRS 12471, (1962), pp. 47-49); (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, AID P-65-68, Sept. 1965, pp. 18-19, "Effect of UHF on thyroid gland functions"); (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, AID Rept. P-65-17, Apr. 1965), "Determination of the functional activity of the thyroid gland by means of radioactive iodine in workers exposed to UHF fields"
1558. SMIRNOVA, M. I., & SACHIKOVA, M. N. (1962) Summaries of reports. Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, (Title not given)
1559. SMITH, E. E. (1928) U. S. Navy Medical Bulletin 20:479-502, "Heat stroke, a thermoregulatory incompetency"
1560. SMITH, G. C. (1950) British Medical J., No. 4668, (July 13-21), pp. 1466-1467, "Effects of diathermy currents on metal implants in the body wall"
1561. SMITH, G. C. (1958) Medical J. of Australia 45:313-315, "Radiation hazards in industry"
2548. SMITH, R.H. (1963), Electrical Anesthesia, Charles C. Thomas, Springfield, 54 pps. (LC: 62-21327).
3031. SMITH, S.W., & BROWN, D.G. (1973) IEEE Trans. on Electromagnetic Compatibility, EMC-15(1):2-6, "Nonionizing radiation levels in the Washington, D.C. area".
1562. SMOLYANOV, A. A. (1957) Sci. Work 1st Leningrad Military Naval Hospital, pp. 56-65, "The effect of high frequency pulsed field on the vegetative nervous system"
1563. SMEROVA, YE. I. (1959) Summaries of reports. Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, "Occupational hygiene problems in areas where MF-LF currents are used"
1564. SMEROVA, YE. I. (1966) Gigiya Truda i Professional'nye Zabolevaniya (Moskva) 10(1):17-, (JPRS 35648; TT-66-32083), "Health characteristics of conditions for medical personnel working with sources of radio frequency range electromagnetic fields"
1565. SMEROVA, YE. I. (1967) Gigiya i Sanitariya, USSR, 22(6):37-41, (TT-67-51409-2); (Also Abstr. in: Soviet Radiobiology, AID 68-105-108-9, pp. 84-85) (AD 671436), "Changes in the phagocytic and bactericidal functions of the blood in animals exposed to radio frequency electromagnetic fields"
1566. SMEROVA, YE. I., ROGOVAYA, T. Z., TROITSKIY, A. S., LASHCHENKO, N. S., & MELNIKOVA, N. D. (1962) Gigiya Truda i Professional'nye Zabolevaniya (Moskva) 6(5):22-28, (In Russian), (JPRS 14925, N62-14907), "Problems of occupational hygiene and health status of operators exposed to the effects of high frequency currents"
1567. SMEROVA, YE. I., ROGOVAYA, T. Z., YAKUB, I. L., & TROITSKIY, S. A. (1964) Gigiya i Sanitariya, USSR, (12):27-30, (Abstr. in: Biological Effects of Microwaves, AID-P-65-68, pp. 11-12 (1965)), "Industrial hygiene and the health of technicians servicing 60 - 90 kc generators"
1568. SMEROVA, YE. I., ROGOVAYA, T. Z., YAKUB, I. L., & TROITSKIY, S. A. (1966) Kazanskiy Meditsinskiy Zh. 47(2):82-84, "General health one working with HF, UHF, and VHF generators in physiotherapy machines"
2549. SMYTH, N., KESHISHIAN, J., HOOD, O., HOFFMAN, A., PODOLAK, E., & BAKER, N. (1972), J. of the Assoc. for the Advancement of Med. Instrumentation, 6:192-, "Effects of active magnetic fields on permanently implanted triggered pacemakers".
3032. SMYTH, N.P.D., KESHISHIAN, J.M., HOOD, O.C., HOFFMAN, A.A., PODOLAK, E., & BAKER, N.R. (1973), Medical Instrumentation, 7(3):189-195, (May-Aug.), "Effects of active magnetic fields [frequency of 100 Hz to 450 kHz, field strength 0.5 to 1.35 gauss] on permanently implanted triggered pacemakers", [no ill effects noted from weapons detectors].
3033. SMYTH, N.P.D., PARSONNET, V., ESCHER, D.J.W., & FURMAN, S. (1974), J. of the Amer. Med. Assoc., 227(12):1412 only, (Mar. 25), "The pacemaker patient and the electromagnetic environment".
2551. SNYDER, J.J., & GLAZIER, P.A. (1966), In: First International Symposium on Electrotherapeutic Sleep and Electro-anesthesia, Graz, Austria, (12-17 Sept.), "Hormone release during application of low-intensity current".
1569. SNYDER, S. E. (1970) Annual Summary Report, Johns Hopkins Univ. (AD 710005), June 1960 to May 1970, 18 pages, "The effect of microwave irradiation on the turnover rate of serotonin and norepinephrine in rat brain"
2550. SNYDER, S.H. (1971); Final Rept. (#2) to ARPA, from Dept. of Pharmacology, Johns Hopkins Univ., School of Med., (AD #729161), "The effect of microwave irradiation on the turnover rate of serotonin and norepinephrine and the effect on monoamine metabolizing enzymes".

1570. SOBAKIN, M. A. (1965) Digest of the 6th Internat. Conf. on Medical Electronics and Biological Engineering, (Iwai, Y., ed.) p. 654 only, "Infra-red radiations from the body surface (radio epigastrica) as an index of the state of the stomach function"
1571. SOKOLNIKOV, O. I. (1937) Tr. III Vses. S'yezda fizioterap. (Trans. of the Third All-Union Conf. of Physical Therapists), Kiev, pp. 206-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, Apr. 1965), "The character of biochemical dislocations in the organism under the effect of HF and UHF waves"
1572. SOKOLOV, S. D. (1967) Patologicheskaya fiziologiya i eksperimental'naya terapiya 11(3):69-70, (Abstr. in: Soviet Radiobiology, ATD 68-105-108-9, pp. 85-86, (AD 671436), "Anti-inflammatory effect of a constant magnetic field"
1573. SOKOLOV, V. V., & ARIYEVICH, M. N. (1960) Trudy NII Gigiyena Truda i Profzaboleaniya AMN SSSR (1):43-45, (Abstr. in: "The Biological Action of UHF, Letavet, A. A., & Gordon, Z. V., eds.), pp. 39-41, (JPRS 12471); "Changes in the blood under the influence of SHF-UHF on the organism"
1574. SOKOLOV, V. V. & CHELINA, N. A. (1964) Trudy NII Gigiyena Truda i Profzaboleaniya AMN SSSR (2):122-125, (Abstr. in: The Biological Action of Radio Frequency Electromagnetic Fields, (Letavet, A. A., & Gordon, Z. V., eds.), JPRS 12471 (1962); (JPRS 3-755); "Peripheral blood count under the action of radio waves of various wavelengths on the organism"
1575. SOKOLOV, V. V., et al. (1962) Summaries of reports. Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, p. 48 only, "The effect of centimeter waves of varying intensity on blood"
3632. SOKOLOVA, I. P. (1975), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #64532), p. 49 only, "The effects of combined exposure to SHF electromagnetic fields and soft X-ray radiation on the peripheral blood."
1576. SOLEM, D. L., RENARK, D. G., MOORE, R. L., CRAWFORD, R. E., RECHEN, H. J. L. (1968) U. S. Dept. of Health, Education, and Welfare, Public Health Service, Environmental Control Admin., Technical Service Branch Staff Rept., TSB No. 5, "Report of preliminary measurements of electromagnetic radiation fields near microwave ovens" (Also: Non-Ionizing Rad. 1(2):88-94 (1969))
1577. SOLOV'EV, N. A. (1962) In: Proc. of the 2nd All-Union Conf. on the Use of Radioelectronics in Biology and Medicine, Moscow, pp. 29-, "Differentiation of the action of an alternating magnetic field and the emfs and currents induced by it in living organisms"
1578. SOLOV'EV, N. A. (1963) Trudy Vsesoyuznogo Nauchno-Issledovatel'skogo Instituta Meditsinskikh Instrumentov, Oborudovaniya, USSR, 3:120-, "Responses of the entire living organism to an electromagnetic field"
1579. SOLOV'EV, N. A. (1963) Doklady Akademii Nauk SSSR 149:438-, "Mechanism of the biological action of a pulsed electromagnetic field"
3633. SOLOV'EV, N. A. (1963), Doklady Akademii Nauk SSSR, 149(2):438-441 (Mar.), (in Russian), "On the mechanism of the biological action of a pulsed magnetic field."
1580. SOLOVTSOVA, K. M. (1965) Fiziologicheskii Zh. Akad. Nauk UKR SSSR 11(4):489-503, "Effect of electromagnetic high-frequency oscillations on the functioning of the liver in persons with a normal or moderately pathological functional state of this organ"
1581. SOMMER, H. C., & Von GIERKE, H. E. (1964) Aerospace Med. 35(9):834-839, "Hearing sensations in electric fields"
1582. SOROKINA, YE. I. (1965) Voprosy Kurortologii, Fizioterapii i Lечеbooy Fizicheskoy Kul'tury (Problems in Health Resort Sci., Physiotherapy & Medical Physical Culture) 30(1):40-45, (JPRS 29914, pp. 1-8; TT 65-30903 (1965)), "Experience in the use of microwave therapy in patients suffering from sympathetic ganglionitis and radiculitis of the thoraco-cervical segment with a cardiac pain syndrome"
3634. SOUTHERN, W. E. (1973), Northern Illinois Univ. Final Report prepared for the Office of Naval Research (31 Dec.), "Orientation behavior of ring-billed gull chicks (Larus delawarensis) exposed to Project SANGUINE's electric and magnetic fields."
1583. SOUTHWORTH, G. (1937) J. of Applied Physics 8:660-664, "New experimental methods applicable to ultrashort waves"
1584. SOWTON, E., GRAY, K., & PRESTON, I. (1970) British Heart J. 32:626-632, "Electrical interference in non-competitive pacemakers"
1585. SPALA, M. (1961) Sbornik lekarsky 63:349-370, "Dosimetry of thermogenic effects of an rf field and its tolerable dose" in the rabbit" (In Czech.)
1586. SPALA, H., RIEDEL, O., & KACL, J. (1962) Casopis Lekarů Ceskych 101:791-795, (In Czech) "Effect of the rf field on the metabolism of bone tissue in the rabbit: Incorporation of osteotropic radioisotopes"
1587. SPARKS, R. A. (1961) Digest of the Internat. Conf. on Medical Electronics, Biological Effects of Microwaves I (Athermal Aspects), (Frommer, P. L., ed.) Plenum Press, New York, pp. 230-, "X-radiation hazards from high power traveling wave tubes"
1588. SPASSKIY, V. A. (1956) Voyenno Meditsinskii Zh. (USSR Military Med. J.) (9):25-28, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, 1965), "The objectives of the study of work conditions and hygienic facilities for the personnel of radar stations"
1589. SPECTOR, N. (1969) Medical College of Virginia Quarterly 5(1):20-, "Thermodes and theories"
1590. SPEICHER, H. W. (1958) AMA Arch. of Industrial Health 17:546-555, "Some factors to be considered in a protection program for use of radiation sources"
1591. SPENCER, J. L., & KNAUF, G. M. (1957) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation, (Pattishall, E. G., ed.) 1:52-59, "Exposure of Air Force personnel to ionizing radiation produced by radio frequency generators - summary"

3635. SPIEGEL, R.J., & JOINES, W.T. (1973), *Bulletin of Mathematical Biology*, 35( ):591-605, "A semiclassical theory for nerve excitation by a low intensity electromagnetic field."
2552. SPILLER, K.H. (1950), (In Ger. ), *Elektrotechnische Zeitschrift*, (Berlin), 71:27-30, (Jan. 15), "Ultra-short wave therapy with decimetre and centimetre waves".
3636. SPITKA, O., TAEGER, M., & TEMBROCK, G. (1969), *Biol. Zbl.*, 88( ):273-282, (in German), "Experimental investigations on the operant drinking behavior of rats in the 50 Hz high tension alternating field."
3034. SPLITTER, S.R. (1966), *Delaware Medical J.*, 38(3):83-84, (Mar.), "New approach to the management of subacute sinusitis [using pulsed electromagnetic energy]".
3314. STAMM, M.E., WINTERS, W.D., MORTON, D.L., & WARREN, S.L. (1974), *Oncology*, 29(4):294-301, "Microwave characteristics of human tumor cells", [Microwave energy (between 76 and 86 GHz) has been used to identify differences between human tumor cells and normal cells grown in tissue culture. Unique differential transmission spectra were demonstrated when various types of cultured malignant cells were compared to their autologous counterparts].
3035. STANLEY, J.L., BENTLEY, H.W., & DENTON, M.B. (1973), Rept. No. 2 for Office of Naval Research on Contract N00014-67-A-0209-0019, Task No. NR-051-549, from Dept. of Chem., Univ. of Ariz. (Tucson), AD #759 720, (Mar.), "Radiation exposure considerations when employing microwave-excited spectroscopic sources".
3036. STAPLES, P.J., & GRINER, P.F. (1971), *New England J. of Med.*, 285(6):317-319, (Aug. 5), "Extracorporeal hemolysis of blood in a microwave blood warmer".
1592. STARIKOVA, M. N. (1959) *Sovetskaya Meditsina* (3):66-68, "The use of a new physical factor - The pulsed VHF-HF electric field in cases of acute inflammatory infiltrates and lymphadenitis"
1593. STARMER, C. F., WHALEN, R. E., & McEVYOSH, E. D. (1964) *Amer. J. of Cardiology* 14:537-546, "Hazards of electric shock in cardiology"
3037. STAVINOKHA, W.B., MEDINA, M.A., & DEAN, A.P. (1973), Univ. of Texas Med. School, San Antonio, Final report under AF Contracts F41609-71-C-0035 & F410609-73-C-008, "Neurochemical alterations in specific brain areas in rodents exposed to high intensity fields".
2553. STAVINOKHA, W.B., PEPELGO, B., & SMITH, P.W. (1970), *The Pharmacologist*, 12:275 only, "Microwave radiation to inactivate cholinesterase in the rat brain prior to analysis for acetylcholine".
3038. STAVINOKHA, W.B., WEINTRAUB, S.T., MODAK, A.T. (1973), *J. of Neurochemistry*, 20( ):361-371, "The use of microwave heating to inactivate cholinesterase in the rat brain prior to analysis for acetylcholine".
3315. STEFANOV, B. (1973), *Higiens i Zdrav opazvane* (Sofia), (5):507-513, (In Bulgarian), "The biological action of super-high frequency electromagnetic waves".
3316. STEFANOV, B., ZLATAROV, I., & SOLAKOVA, S. (1973), *Higiens i Zdraveopazvane* (Sofia), (5):443-446, (In Bulgarian), "A study of the action of electromagnetic waves at various regions of the radio band on some functional indices in workers".
3637. STENZLER, M. (1975), *Electronic Engineering Times*, (Monday, Feb. 24), p. 2 only, "[Electronic cardiac] Pacemakers designed to counter [non-ionizing electromagnetic] radiation."
3317. STENZLER, M. (1975), *Electronic Engineering Times*, Mon., March 24, p. 7 only, "[Collaborative] U.S./Soviet [non-ionizing] radiation studies pending".
3638. STENZLER, M. (1975), *Electronic Engineering Times*, (Nov. 17), p. 12 only, "Americans, Soviets sign [non-ionizing] radiation pact."
1594. STEPHENS, F. H., JR. (1959) In: *Investigators' Conf. on Biological Effects of Electronic Radiating Equipments*, (Knauf, G. M., Chm.) pp. 42-45, (AD 214692), "Equipment and methods employed in the exposure of experimental animals to microwaves at 24,000 megacycles"
1595. STEPHENS, F. H., JR. (1961) *Industrial Med. & Surgery* 30:221-228, "Microwave radiation of 10 mw/cm and factors that influence biological effects at various power densities"
1596. STEPHENS, F., & LANDEEN, K. (1963) *J. of Occupational Med.* 5:418-425, "Effects on dogs of chronic exposure to microwave radiation"
1597. STEPIN, L. D. (1965) M.I.T. Press, Quantum Radio Frequency Physics
2554. STEWART, H.F., PETERSON, R.W., & VAN PELT, W.F. (1970), Southwestern Radiological Health Laboratory (Rept. #SWRHL-84), Environmental Health Services, Public Health Service, U.S. Dept. of Health, Education & Welfare, "Microwave hazard evaluation (A field survey form)".
1598. STIEBOCK, L. H. (1935) *Arch. of Physical Therapy* 16:657-661, "The fundamentals and indications of short wave therapy, fulguration and coagulation"
1599. STILLWELL, G. K. (1967) In: Vol. 4, Therapeutic Electricity and Ultraviolet Radiation, Physical Medicine Library, (Licht, S. H., ed.), Licht, E., Pub., New Haven, Conn., "Clinical electric stimulation"
1600. STOCKMAN, H. E. (1969) *Electronics* (Nov. 24), 110-, "Seeing in the dark is aim of r-f holography"
3039. STODOLNIK-BARANSKA, W. (1967), *Nature*, 214( ):102-103, (Apr.), "Lymphoblastoid transformation of lymphocytes in vitro after microwave irradiation".
1602. STOLWIJK, J. A. J., & HARDY, J. D. (1965) Rept. No. DASA-1566, "Skin and subcutaneous temperature changes during exposure to intense thermal radiation"
2276. STONER, E. (1951) *Arch. of Physical Medicine* 32:408-416, "The effect of microwave radiation on the peripheral pulse volume, digital skin temperature, and digital blood flow in man"

1603. STOPCZYK, M., & PIENIAK, M. (1968) Polish Arch. Med. Wewn 41:773-782, (In Polish), "Diagnosis of the cause of stimulation disorders in patients with implanted heart stimulators with constant rhythm"
1604. STOWELL, R. E., ARNOLD, E. A., GOLDBLATT, P. J., TAKASHIMA, S., TRUMP, B. F., & YOUNG, D. E. (1960) Armed Forces Institute of Pathology Annual Progress Rept, (AD 241314), (Also 1964 Progress Report), "Biological and biochemical effects of microwaves"
1605. STOWELL, R. E., ARNOLD, E. A., FAITH, G. C., GRIFFIN, J. L., & YOUNG, D. E. (1965) Armed Forces Institute of Pathology Annual Progress Rept., pp. 98-117, (AD 470416; RCS-MEDDR-288), "Biological and biochemical effects of microwaves and other physical agents"
1606. STRASSBURGER, A., & SCHLIEPHAKE, E. (1935) Archiv fur Experimentelle Pathologie u. Pharmakol. 177:1-17, (In German) "The influence of ultrashort waves on the beat regulation of rabbits"
2555. STRAUB, K.D., KENDRICK, J.Z., & JACKSON, H. (1972), Naval Air Development Ctr., Rept. NADC-72126-CS, "Effects of low frequency electrical current on various marine animals", [The current density which produced "startle" or "avoidance" response was determined at frequencies between 10 and 7500 Hz].
1607. STRAUB, K. D., & LYNN, W. S., JR. (1963) Federation Proc. 22, Abstr. No. 2763, p. 623 only, "Effects of oxidizing and reducing agents and A-C current on frog skin potential"
2556. STRAUS, B. (1966), In: First International Symposium on Electrotherapeutic Sleep and Electroanesthesia, Graz, Austria, (12-17 Sept.), "Electrical induction of sleep II".
3318. STRELKOVA, N.I., & ZEYNALOV, R.K. (1973), Zhurnal Neuropatologii i Psikiatrii Imeni S. S. Korsakova, 73( ): pp. ?, [Transl. in "Effect of nonionizing electromagnetic radiation", JPRS No. 62462, July 1974, Citation #3134, this Biblio., pp. 25-31], "The problem of correlating biochemical data to the condition of the neuromuscular apparatus of Parkinsonism patients subjected to decimeter wave therapy".
3639. STRUMZA, M.V. (1970), Archives des Maladies Professionnelles de Medecine du Travail et de Securite Sociale (Paris), 1.31(6):269-276, (in French), "Influence on the human health of close electric conductors at high tension: Medical inquiry result."
3040. STUCHLY, S.S. (1973), The J. of Microwave Power, 8(3/4):211 only, "Editorial: Instrumentation & measurement".
2277. STUMPFER, H., & THOM, L. (1955) Ber. dtsh. Ophthal. Ges. 90:361-363, (In Ger.), (Abstr. in: Zentralbl. f. d. res. Ophth. 65(4):353-359 (Oct 1955)), "Eye alterations in rabbits due to microwaves and eddy currents"  
(USSR Military Medical J.)
1608. STYKAN, O. A. (1967) Voyenno Meditsinskiy Zh. (7):36-38, (AD Abstr. 8(6/51)), "Problem of radiation-genetic effects of the electronic-vacuum apparatus in radar stations"
1609. SUBBOTA, A. G. (1957) Trudy Voenno Meditsinskii Akademii i Kirov, USSR, 73:35-37 (Abstr. from Zh. Biol. No. 46203, 1959), "The effect of SHF-UHF electromagnetic fields upon the higher nervous activity of dogs"; ibid., pp. 78-83, (Abstr. from Zh. Biol. No. 59927, 1959), "Changes in respiration, pulse rate and general blood pressure during irradiation of animals with SHF-UHF ibid., pp. 111-115, (Abstr. from Zh. Biol. No. 59926, 1959), "The effect of a SHF-UHF field on heart function and the lumen of vessels"; ibid., pp. 127-132, (Abstr. from Zh. Biol. No. 59922, 1959), "Effect on the blood of animals of exposure to a strong SHF-UHF field"; ibid., pp. 165-, "Some tissue reactions due to local exposure to a SHF field"
1610. SUBBOTA, A. G. (1958) Biulleten Eksperimental'noi Biologii i Meditsiny 46(10):55-61, "The effect of pulsed SHF-UHF electromagnetic fields on the higher nervous activity of dogs"
1611. SUBBOTA, A. G. (1959) In: Summaries of reports. Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow, (Title not given)
1612. SUBBOTA, A. G. (1962) In: Summaries of reports. Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 49-51, "Some problems of adjustment and accumulation under multiple exposures to microwaves"
1613. SUBBOTA, A. G., & GREBESHECHENKOVA, A. M. (1967) In: Medical and Biological Problems of SHF Radiation. (Petrov, I. R., ed.) (Title not given)
3640. SUGARMAN, R. (1976), Electronic Engineering Times, (Monday, Apr. 26), p. 10 only, "NY state . . . investigates biological effects of 765 kv lines." [Part of a "series of articles concerning the interaction of man, electronics, and the environment."]
2557. SUKHAYEV, G.V. (1971), Voyenno Meditsinskiy Zhurnal, (4):pps ?, "Assessment of injuries caused by SHF fields".
3641. SUNDERMANN, H. (1954), Archiv für Meteorologie, Geophysik und Bioklimatologie (Ser. B), 5( ):258-282, (in German), "On the possibility of biotropism in atmospheric electrical phenomena."
3642. SUNDERMAN, R., & FAHIDY, T.Z. (1976), J. of Applied Electrochemistry, 6(1):89-92, (Technical Note), "On the generation of electrolyte flow by alternating electric and magnetic fields."
1614. SUPONITSKAYA, F. M. (1933) Byull. Tsent. Nii Fiz. Metodov Lecheniya Im Sechenov (6-7):244-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, 1965), (Title not given)
1615. SUROVIEC, H. J. (1967) Arch. of Environmental Health 14:469-472, (Also in Senate Hearings, pp. 1359-1362), "Microwave oven radiation hazards in food vending establishments"
1616. SUSSKIND, C. (1958) Annual Scientific Rept. (1957-1958); (RADC TR-59-298; AD 226735) Institute of Engineering Research, Univ. of Calif. (Berkeley), Ser. No. 60, No. 205, "Biological effects of microwave radiation"
1617. SUSSKIND, C. (1959) Annual Scientific Rept. (1958-1959); (RADC TR-59-181; AD 227847), 45 pages, Inst. of Engineering Research, Univ. of Calif. (Berkeley), Ser. No. 60, No. 241, "Cellular and longevity effects of microwave radiation"

1618. SUSSKIND, C. (1959) In: Investigators' Conf. on Biological Effects of Electronic Radiating Equipments (Knauf, G. M., Chm.) (RADC TR-59-67, p. 18 only; AD 214693), "Summary of the microwave research performed at the Univ. of Calif."
1619. SUSSKIND, C., (ed.) (1959); (RADC TR-59-140, Univ. of Calif., Berkeley, AD 234788) 335 pages, "Proc. of 3rd Annual Tri-service Conf. on Biological Effects of Microwave Radiating Equipments"
1620. SUSSKIND, C., et al. (1960) Institute of Engineering Research, Univ. of Calif., Berkeley, Series No. 60, No. 285, (RADC TR-60-122; AD 245334) 39 pages, "Microwave radiation as biological hazard and tool"
1621. SUSSKIND, C. (& Staff) (1961) Annual Scientific Rept. (1960-1961); (RADC-TR-61-205; AD 269385), Inst. of Engineering Research, Univ. of Calif., Berkeley, Series No. 60, No. 382, 28 pages, "Longevity study of the effects of 3-cm microwave radiation on mice"
1622. SUSSKIND, C., (& Staff) (1962); (RADC-TR-62-624) Univ. of Calif., Berkeley, Series No. 60, No. 489, "Nonthermal effect of microwave radiation"
1623. SUSSKIND, C., & PRADSNIETZ, S. (1959) Proc. of the 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments, (Susskind, C., ed.) 3:33-, (RADC-TR-59-140), "Temperature regulation in laboratory animals irradiated with 3-cm microwaves"
1624. SUSSKIND, C., & VOGELHUT, P. O. (1959) Proc. of the 3rd Tri-service Conf. on the Biological Effects of Microwave Radiating Equipments, (Susskind, C., ed.) 3:46-53, "Analytical and experimental investigation of unicellular organisms with 3-cm microwaves"
1625. SUSSKIND, C., & VOGELHUT, P. O. (1959) Digest of Technical Papers, Proc. of the 12th Annual Conf. on Electrical Techniques in Medicine and Biology (Schwan, H. P., Chm.), p. 53 only, "Analytical and experimental investigation of unicellular organisms under microwave irradiation"
1626. SUSSKIND, C., & VOGELHUT, P. O. (1961) Presented at the Conf. on Microwave Measurement Techniques held by the Inst. of Electrical Engineers in London, Sept., (Institute of Engineering Research, Univ. of Calif., Berkeley, Series No. 60, No. 489, 1962, p. 19-); (Also in: Proc. of the Institute of Electrical Engineers 109B, Suppl. 23:668-669, and 682-685 (1961)), "Cavity perturbation measurement of the effects of microwave radiation on proteins"
1627. SUSSKIND, C., & VOGELHUT, P. O. (1963) Annual Scientific Rept. No. 63-27 (1962-1963) Univ. of Calif., Berkeley, (AD 433659) "Biological uses of non-ionizing radiation"
3643. SUTTON, C.H. (1974), Cryobiology, 11(6):584- , "Alterations in blood flow in glial tumors produced by microwave heating and temperature gradients."
3041. SUTTON, C.H., NUNNALLY, R.L., & CARROLL, F.B. (1973), Cryobiology, 10(6):513-514, "Protection of microwave-irradiated brain with body-core hypothermia".
3319. SUTTON, C.H., NUNNALLY, R.L., CARROLL, F.B., & KUBAN, K. (1974), Federation Proceedings, Fed. of Amer. Soc. of Experimental Biol., 33(3):621- , "Increased blood flow in glial tumors produced by microwave heating".
1628. SUVOROVSKAYA, N. A. (1961) Patologicheskais Piziologii i Eksperimental'nais Terapiia 5(1):38-40, (JPRS 9314), "Investigation of the effect of electromagnetic energy of centimeter waves on hemopoiesis pathology"
1629. SVETLOVA, Z. P. (1962) In: Summaries of reports. Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 43-44, "Changes in the symmetrical conditioned and unconditioned reflexes in dogs under the influence of a SHF-UHF field in the decimeter range"
1630. SWANSON, J. R., ROSE, V. E., & POWER, C. H. (1970) Paper presented at 4th Annual Midyear Topical Symposium, Health Physics Soc., Electronic Product Radiation and the Health Physicist, Louisville, Ky., 28-30 Jan.; Bureau of Radiation Health, Div. of Electronic Products Rept. No. 70-26, pp. 95-110, (Also: Amer. Industrial Hygiene Assoc. J. 31:623-629, (1970)), "A review of international microwave exposure guides"
2279. SWICORD, M.L. (1971), USDHEW/PHS, Bur. of Rad. Health (Pub. No. BRH/DEP 71-1), 33 pages, (PB #197-715), "Microwave measurements and new types of detectors for evaluation of health hazards."
1631. SYCH, G. YA. (1940) Dnepropetrovsk. Universitet. Institut fiziologii. Sbornik robot, 3:103-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, 1965), [Title not given - Discusses alteration of reflex times in frogs exposed to ultrahigh frequency electromagnetic fields]
1632. SYNGAYEVSKAYA, V. A. (1962) In: Summaries of reports. Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 52-53, "Some metabolic indices in the blood and urine of individuals following their exposure to SHF-UHF electromagnetic fields"
1633. SYNGAYEVSKAYA, V. A., & IGNATYEVA, O. S. (1962) In: Summaries of reports. Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, p. 52 only, [Title not given]
1634. SYNGAYEVSKAYA, V. A., IGNATYEVA, O. S., & PLESKINA-SINENKO, G. F. (1962) In: Summaries of reports. Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad [Title not given]
1635. SYNGAYEVSKAYA, V. A. & PLESKINA-SINENKO, G. F. (1959) In: Summaries of reports. Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow [Title not given]
1636. SYNGAYEVSKAYA, V. A., PLESKINA-SINENKO, G. F., & IGNATYEVA, O. S. (1962) In: Summaries of reports. Questions of the Biological Effect of SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 51-52, "The effect of microwave radiation in the meter and decimeter waveranges on the endocrine regulation of carbohydrate metabolism and the functional state of adrenal cortex in rabbits and dogs"

1637. SZACHNOWICZ, L. A. (1967) *Pediatrics Polska* 42:679-684, "Use of physical therapy in sequelae and late complications of infectious hepatitis (Botkin's Disease) in children"
1638. SZCZUREK, M. (1963) *Przegląd Wojskowych*, Warsaw, (3):5-15, "Effect of microwaves on living organisms"
3644. SZENT-GYÖRGI, A. ( ), *Life Sciences*, 15(5):863-875, "Electronic biology and its relation to cancer."
3042. SZMIGIELSKI, S. (1968), *Med. Lot.*, 28( ):89-?, (In Pol.), "Effect of chronic microwave irradiation on granulopoiesis"
3645. SZMIGIELSKI, S. (1975), *Annals of the New York Academy of Sciences*, 247:275-281, "Effect of 10 cm, 3 GHz electromagnetic radiation (microwaves) on granulocytes *in vitro*." [Liberation of lysosomal enzymes after irradiation at 5 mW/cm<sup>2</sup>.] (Cited also in #3117, this Biblio.)
3646. SZMIGIELSKI, S., & BIELEC, M. (1976), *Proceedings of the International Symposium on Cancer Treatment by Hyperthermia*, Washington, DC, 28-30 April 1975 (Radiology, Supplement, in press), "Microwaves as a tool for cancer treatment by hyperthermia." [Cellular effects of subthermal power densities of microwaves; use of thermography for quantitation of microwave energy absorbed in irradiated animals.]
3647. SZMIGIELSKI, S., & BIELEC, M. (1976), *Post. Hig. Med. Dosw.* (in Polish) (in press), ( ): , "Hyperthermia in therapy of malignant neoplasms." [Use of microwaves for intensive (42-44°C) local hyperthermia in cancer treatment: A review.]
3648. SZMIGIELSKI, S., BIELEC, M., & JANIĄK, M. (1976), *Cancer Letters* (in press), ( ): , "Effect of microwave hyperthermia combined with interferon and/or Poly I - Poly C on development of Sarcoma 180 in mice." [General microwave hyperthermia (2 hrs. daily) combined with interferon and interferon-inducers leads to inhibition of tumour growth in 75% of animals.]
3649. SZMIGIELSKI, S., JANIĄK, M., & BIELEC, M. (1976), *Exp. Pathologie* (in press), "Nucleic acid synthesis and cyclic AMP levels in WISH cell cultures irradiated with 3 GHz microwaves." [Temporary inhibition of <sup>3</sup>H-thymidine and <sup>3</sup>H-uridine incorporation after irradiation at 20 mW/cm<sup>2</sup>.]
3650. SZMIGIELSKI, S., JANIĄK, M., & KOBUS, M. (1976), *Exp. Pathologie* (in press), ( ): , "Effect of microwave radiation on cells treated with membrane-injuring agents." [Substances injuring cell membranes—digitonine and purified bacterial phospholipases—enhance sensitivity of cell cultures to subthermal power densities of 3 GHz microwaves.]
3651. SZMIGIELSKI, S., JELJASZEWICZ, J., & WIRANOWSKA, M. (1975), *Annals of the New York Academy of Sciences*, 247:305-311, "Acute staphylococcal infections in rabbits irradiated with 3 GHz microwaves." [Weak reaction of granulopoiesis to experimental staphylococcal infections in rabbits irradiated over 3 months at 3 mW/cm<sup>2</sup>, 6 hrs. daily.]
3652. SZMIGIELSKI, S., & LUCZAK, M. (1975), *Physics in Med. & Biol.*, 20(5): , "Autoradiographic analysis of protein synthesis and measurements of nuclear volume in WISH cell cultures irradiated with 3 GHz electromagnetic radiation." [Temporary stimulation of protein synthesis after irradiation at 5 mW/cm<sup>2</sup> and inhibition after 20 mW/cm<sup>2</sup>.]
3653. SZMIGIELSKI, S., LUCZAK, M., & WIRANOWSKA, M. (1975), *Annals of the New York Academy of Sciences*, 247:263-274, "Effect of microwaves on cell function and virus replication in cell cultures irradiated *in vitro*." [Temporary stimulation of cell function after irradiation with 3 GHz microwaves at 5 mW/cm<sup>2</sup>, and inhibition of growth rate after 20 mW/cm<sup>2</sup>.]
3654. SZMIGIELSKI, S., LUCZAK, M., & WIRANOWSKA, M. (1975), *Folia histochem. cytochem.*, 14(3/4): , "Karyometric observations of cell cultures irradiated with 3 GHz microwaves." [Changes in nuclear and nucleolar volume after irradiation at 5 or 20 mW/cm<sup>2</sup> over 30 min.]
1639. SZYMANOWSKI, W. T., & HICKS, R. A. (1932) *J. of Infectious Diseases* 50(1):1-25, (Title?)
1640. TACCARI, E., CRESPI, M., & DDAINOTTO, F. (1967), *Ressegna di medicina sperimentale*, 14(4):158-167, (in Ital.), "Experimental contribution to the study of the effects of microwaves on the mesenteric mast cells of the albino rat."
3655. TAFLOVE, A., & BRODWIN, M.E. (1975), *IEEE Transactions on Microwave Theory and Techniques*, MTT-23(11):888-896 (Nov.), "Computation of the electromagnetic fields and induced temperatures within a model of the microwave-irradiated human eye."
2558. TAJCHERT, J., & CHMURKO, E. (1972), *Klin. Oczna (Eye Clinic)*, 42(4):979-983, (In Pol. with Eng. summary), "Investigation of the cataractogenic influence of microwaves of 10 cm wavelength"
2095. TAKAHASHI, K., VASISHTH, R. C., & COTE, W. A. (1969) *J. Microwave Power* 4:64-67, (Abstr. in: *Non-ionizing Rad.* 1(3):151 only, (1969), Abstract #69), "Uniform polymer distribution in paper saturated with polymer solutions via microwave power"
1641. TAKASHIMA, S. (1966) *IEEE Trans. on Bio-Medical Engineering*, BME-13(1):28-31, "Studies on the effect of radio-frequency waves on biological macromolecules"
1642. TAKATA, H., & MURASUGI, T. (1941) *Bioklimatische Beiblätter* 8:17-26, "Disturbance of the flocculation index in healthy human blood serum: Cosmo-terrestrial sympathy"
1643. TALLARICO, R. B., & KETCHUM, J. (1959) *Annual Report to Air Force of Microwave Radiation Research at the Univ. of Miami*, (AD 232925), pp. 57-78, "Effects of exposure to microwave and infrared energy upon behavior of rats"
1644. TALLARICO, R. B., & KETCHUM, J. (1959) *Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments*, (Suskind, C., ed.) 3, pp. 7 "Effect of microwaves on certain behavior patterns of the rat"
1645. TALLMAN, O. G. (1961) *Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation*, Vol. 1, (Peyton, H. F., ed.), pp. 3-8, "Radio frequency environment"
1646. TANNER, J. A. (1966) *Nature* 210:636 only, (May 7), "Effect of microwave radiation on birds"

1647. TANNER, J. A., & ROMERO-SIERRA, C. (1968) 2nd Canadian Medicine and Biology in Engineering Conf., Toronto, (9-10 Sept.) "Microwaves vs. birds: A new approach to the bird problem in aviation"
1648. TANNER, J. A., & ROMERO-SIERRA, C. (1969) Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Medical College of Va., Richmond, Va., 17-19 Sept.; (Bureau of Radiological Health/Division of Biological Effects, Rept. No. 70-2, pp. 185-187), "Bird feathers as sensory detectors of microwave fields"
3043. TANNER, J.A., & ROMERO-SIERRA, C. (1971), Quarterly Bulletin of the Division of Mechanical Engineering, Nat'l Res. Council of Canada, Rept. No. DME/NAE 1971(4):37-45, "Non-ionizing electromagnetic radiation and pollution of the atmosphere".
1649. TANNER, J. A., ROMERO-SIERRA, C., & DAVIE, S. J. (1967) Nature 216:1139 only, (16 Dec.), "Non-thermal effects of microwave radiation on birds"
1650. TANNER, J. A., ROMERO-SIERRA, C., & DAVIE, S. J. (1969) J. of Microwave Power 4(2):122-128, "The effects of microwaves on birds: preliminary experiments"
1651. TANNER, J. A., ROMERO-SIERRA, C., & VILLA, F. (1969) Proc. of 5th Internat. Conf. on Medicine and Biology in Engineering; and 22nd Annual Conf. on Engineering in Medicine and Biology, held in Chicago, Ill., 21 July, "Changes of muscle action in birds exposed to a microwave field"
2559. TANSY, M.F., KENDALL, F.M., CHRYZANOWSKI, J., HOHENLEITNER, F.J., & KALL, A.R. (1971), *Experientia*, 27(12):1431-1432, (In Engl.), "Gastrointestinal motor activity following exposure to a high-frequency electric field".
2289. TAPIE, R. L. (1969) Pacific Missile Range (Pt. Muro, Calif.), Rept. PMT-TM-69-4(1), "A study of personnel radiation hazards created by selected high-power radar sets"
1652. TARGHEVSKIY, I. A. (1964) In: Proc. of Concluding Scientific Conf. of Kazan State University, Kazan, pp. 30-, "Change in photosynthetic carbon metabolism as a nonspecific response to the action of electromagnetic factors"
1653. TARJAN, P. P., & MURPHY, W. P., JR. (1970) J. Amer. Medical Assoc. 214(7):1328 only, "Cardiac pacemakers and microwave ovens"
1654. TARUSOV, B. N. (1938) *Arkhiv Biologicheskikh Nauk Moscow* (Archives des Sciences Biologique) 2:pp.? (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept P-65-17, Apr. 1965), "Electroconductivity as a method of determining the viability of tissues"
1655. TATAIMOV, V. V., & FRENKEL', G. L. (1939) *Medgiz, Leningrad, An Introduction to the Study of Ultrahigh Frequency Biological Effects*
1656. TAUSSIG, B. B. (1969) *Amer. Scientist* 57(3):306-316, "Death from lightning and the possibility of living again"
3044. TAYLOR, E.M., & ASHLEMAN, B.T. (1974), *Brain Research*, 74(2):201-208, "Analysis of central nervous system involvement in the microwave auditory effect."
3045. TAYLOR, E.M., GUY, A.W., ASHLEMAN, B., & LIN, J.C. (1973), Presented at the IEEE-GMTT Internat. Microwave Symposium, (MALEY, S.W. (ed.)), Univ. of Colorado, Boulder, June 4-6, "Microwave effects on central nervous system attributed to thermal factors", (Inadvertantly omitted from the listing of technical meetings, Citation #2636, this Biblio.).
1657. TAYLOR, F. J. D., FLOYD, C. F., & RAWLINSON, W. A. (1960) Proc. of the Internat. Conf. on Medical Electronics and Biological Engineering, 3:393-398, "Some aspects of the measurement of potentially hazardous electromagnetic fields"
3320. TAYLOR, J.R. (1970), U.S. Army Environmental Hygiene Agency (Edgewood Arsenal, MD) report (AD #748106), "Hazards from microwave ovens and inspection guidelines".
3321. TAYLOR, J.R. (1971), U.S. Army Environmental Hygiene Agency (Edgewood Arsenal, MD) report (AD #902853L), "Radiation protection special study No. 42-053-71, Microwave oven instrumental, Narda Model 8200 [radiation monitor]".
2560. TAYLOR, L.S. (1972), U.S. Medicine, pp. 28-29 (Sept.1), "Current standards seem adequate as protection against [ionizing] radiation".
1658. TEIXEIRA-PINTO, A. A., CUTLER, J. L., & HELLER, J. H. (1959) Investigators Conf. on Biological Effects of Electronic Radiating Equipments, held at Patrick AFB, Fla. 14-15 Jan. (Knauf, G. M. Chm.) RADC-TR-59-67, pp. 31-32, (AD 214693), "Review of work accomplished at the New England Institute for Medical Research"
1659. TEIXEIRA-PINTO, A. A., NEJELSKI, L. L., CUTLER, J. L., & HELLER, J. H. (1960) *Experimental Cell Research* 20:548-564, "The behavior of unicellular organisms in an electromagnetic field"
3130. TEIXEIRA-PINTO, A.A., NEJELSKI, L.L., Jr., CUTLER, J.L., & HELLER, J.H. (1960), *Experimental Cell Research*, 20( ):548-564, "The behavior of unicellular organisms in an electromagnetic field." [at RF]
2281. TELL, R.A. (1971) In: Radiation Bio-Effects Summary Report, Madge, D. M., (ed.), for Jan-Dec 1970, Div. of Biological Effects, Div. of Health, NRC, Rept. No. DHEW/OS 71-7), pp. 68-77, "Radio frequency and microwave energy absorption in tissue"; and Galt KINN, J. B., pp. 78-79, "Reaction with diathermy"
3046. TELL, R.A. (1971), *IEEE Spectrum*,  ( ): ?, "Environmental radiation exposure from radio and television broadcasting: A human hazard?"
2561. TELL, R.A. (1972), *IEEE Spectrum*, 9(8):43-51, "Broadcast radiation: How safe is safe?"
2562. TELL, R.A. (1972), Rept., Environmental Protection Agency, Office of Radiation Programs, No. ORP/SID 72-3, 28 pps., "Reference data for radiofrequency emission hazard analysis".
2563. TELL, R.A. (1972), Environmental Protection Agency, Technical Report PB #208-233, 53 pps., "Microwave energy absorption in tissue."
3047. TELL, R.A., & KINN, J.B. (1971), *J. of Oral Surg.*,  ( ): ?, "Ocular heating during dental diathermy".

3048. TELL, R.A., & NELSON, J.C. (1974), Radiation Data and Reports, 15(4):161-179, (Apr.), "Microwave hazard measurements near various [commercial] aircraft radars".
3049. TELL, R.A., & NELSON, J.C. (1974), Electromagnetic Radiation Analysis Branch, Office of Radiation Programs, Environmental Protection Agency, Rept. No. EPA-520/1-74-005, (May), "RF pulse spectral measurements in the vicinity of several air traffic control radars".
3050. TENGROTH, B. (1973), Lakartidningen (Stockholm), 70(23):2314-2317, (In Swedish), "Non-ionizing radiation", [general and medical aspects of potential skin and eye hazards].
1660. TEPLYAKOVA, N. L. (1965) Trans. of the Science Conf., Central Science Laboratory, Tomsk, (2):361-364, "Clinical and morphological changes in the visual organ in guinea pigs under short term exposure to alternating and constant magnetic fields"
1661. TEREENT'YEVA, YE. V. (1945) Nauchno-issledovatel'skiye ratoty biologicheskikh nauk za 1945 g. Referaty. (Research of the division of biological sciences for 1945. Abstracts), (Izd-vo AN SSSR pp. 347- (1947), (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, 1965), [Title not given; Discusses exposure of the head of dogs to RF fields (50 MHz) at thermal levels. Changes in conditioned reflex feeding effects were observed]
3322. TERNI, M., & LOMBARDINI, P. (1951), Bollettino dell'Istituto Sieroterapico, 30( ):134-150, (In Ital. w/Engl. summary) "The action of microwaves on bacteria: (of wavelength 3, 10, 142 cm., on *E. coli*)", [anti-bacterial effect decreased with increasing wavelength; thermal action].
1662. TEKNIZ, M., & LOMBARDINI, P. (1951) Bollettino Dell'Istituto Sieroterapico Milanese, Italy, 30:134-150, "Effect of microwaves on bacteria: electromagnetic waves of 3, 10, and 142 cm. wavelength on *Escherichia coli*"
2096. TERRILL, J. G. (1970) Archives of Environmental Health 19:265-271, (Abstr. in: Non-ionizing Rad. 1(4):193 only, (1970)), "Microwaves, lasers and X-rays -- adverse reactions due to occupational exposures"
1661. THERIOT, F. P. (1952) Military Medicine 111:331-344, (1952-1960), "The effect of electromagnetic radiation on tissue"
1663. THERIOT, F. P. (1953) Unpublished summary of the "Conference on the Biological Effects of Microwaves" held at the Naval Medical Research Institute, Bethesda, Md., 29 April
3051. THIMIJAN, R.W., PICKENS, L.G., & MORGAN, N.D. (1973), J. of Economic Entomology, 66(6):1269-1270, "Responses of house fly, stable fly, and face fly to electromagnetic radiant energy".
3052. THOMAS, A.M. (1952), British Electrical and Allied Industries Research Assoc. Tech. Rept. W/T23, (Thorncroft Manor, Dorking Road, Leatherhead, Surrey, UK), "Pest control by high-frequency electric fields: Critical resume".
2071. THOMAS, A., COUGET, P., & PAREILLEUX, A. (1970), French Patent No. 2,036,491, (No. 69.07475), "Procedure and techniques for destruction of micro-organisms in aqueous medium" [using low frequency (45 to 5000 Hz) alternating electromagnetic currents]
1664. THOMAS, J. A., & THOMSON, J. D. (1951) Federation Proceedings 20(1):401-, (Also, Dissertations Abstr. 22(5):1696 (1961)) "The effect of microwave irradiation on spermatogenesis and on accessory sex organs in the male Albino rat"
2564. THOMAS, P.G. (1972), FDA Papers (Food and Drug Administration), 6(4):14-17 (May), "Microwave ovens: Are they safe?"
3656. THOMPSON, J., (1974), Optical Measurements of High Electric Magnetic Fields, Ph.D. Dissertation, Texas Tech. Univ. (May), (University Microfilms, No. 74-23,069, Ann Arbor, Mich.). [Theoretical discussion and laboratory studies on the Kerr and Faraday effects.]
1665. THOMPSON, E. L. (1970) Presented at 4th Annual Midyear Topical Symposium, Health Physics Soc., Electronic Product Radiation and the Health Physicist, Louisville, Ky., 28-30 Jan., Bureau of Radiation Health, Div. of Electronic Products Rept. No. 70-26, pp. 463-464, "Microwave hazards surveillance and control"
1666. THOMPSON, W. D., & BOURGEOIS, A. E. (1965) Primate Behavior Lab., Aeronautical Research Lab. Report, (Wright-Patterson AFB, Ohio), (ARL-TR-65-20; AD 489245; 77 pages, "Effects of microwave exposure on behavior and related phenomena" [i.e., physiological processes] & X67-11057)
2283. THOMPSON, W. D., & BOURGEOIS, A. F. (1971) In: Pharmacological and Biophysical Agents and Behavior, Furchtrott, E., (ed.), Academic Press, N. Y., pp. 65-98, "Non-ionizing radiations"
3323. THOMSON, E. (1921), Nature, 107(2695):520-522, (June 23), "A novel magneto-optical effect", [early observations on a 'pearl chain effect' in a magnetic field].
1667. THOMSON, P. (1910) Proceedings, Royal Soc. (London) 82:396-, "A physiological effect of an alternating magnetic field"
1668. THOMSON, R. A. E., MICHAELSON, S. M., & HOWLAND, J. W. (1960) Federation Proceedings 19(1):71-, "Leucocyte changes in normal dogs exposed to microwaves"
1669. THOMSON, R. A. E., MICHAELSON, S. M., & HOWLAND, J. W. (1963) Report, 10 pages, (RADC-TDR-63-352, AD 424411), "Microwave modification of x-ray lethality in mice"
1670. THOMSON, R. A. E., MICHAELSON, S. M., & HOWLAND, J. W. (1965) Radiation Research 24:631-635, "Modification of x-irradiation lethality in mice by microwaves (Radar)"
1671. THOMSON, R. A. E., MICHAELSON, S. M., & HOWLAND, J. W. (1966) Blood 28(2):157-162, "Leukocyte response following simultaneous ionizing and microwave (Radar) irradiation"
1672. THOMSON, R. A. E., MICHAELSON, S. M., & HOWLAND, J. W. (1967) Aerospace Medicine 38(3):252-255, "Microwave radiation and its effect on response to x-radiation"
1673. THORPE, H. (1952) Trans. of the American Academy of Ophthalmology 56:596-599, "Microwave diathermy in ophthalmology. The various diathermy currents used in ophthalmology"

1674. TIAGIN, S. V. (1958) *Bulleten Eksperimental'noi Biologii i Meditsiny (Moskva)* 46(8):963-966, "The thermal effects of UHF electromagnetic fields" (A duplicate of TIAGIN (1958) #1718)
2284. TIKHONOV, F. D. (1970) *Voenno-Meditsinskiy Zhurnal* 44-46, (In Russ.), (Abstr. #A71-21955), "Functional disturbances of the gastrointestinal tract in [human] subjects working in a microwave field"
2565. TIKHONOV, F. D. (1970), *Voenno Meditsinskiy Zhurnal*, (12): , (Transl. No. J-9780 for Army Intelligence, pp. 61-62), "Functional disturbances in the GI tracts of people working in an SHF field".
1675. TIKHONOVA, M. A. (1968) *Problems of Experimental Physiotherapy*, Collection, Tashkent, pp. 113-119, "The problem of the action of an electromagnetic (UHF) field on the growth of young animals"
3324. TIKHONCHUK, V.S. (1974), *Kosmicheskiye Issledovaniya*, 12(3):478-482, (In Russ.), (Transl. in JPRS No. 62942, September 12, 1974, pp. 29-30), "The effects [on mice] of combined SHF [electromagnetic radiation] and gamma irradiation on hemopoiesis".
3657. TIKHONCHUK, V.S. (1975), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #64532), pp. 66-72, "The effects of combined SHF and gamma irradiation on hemopoiesis."
3325. TIMESKOVA, G.F. (1966), *Trudy VMA im S. M. Kirova*, 166( ):100- , "Influence of microwave radiation on the human and animal organism".
3053. TINGA, W.R., & NELSON, S.O. (1973), *J. of Microwave Power*, 8(1):23- ?, "Dielectric properties of materials for microwave processing — tabulated", [including biological materials].
3054. TINNEY, C.E., LORDS, J.L., & DURNNEY, C.H. (1974), (In Press), "Rate effects in isolated turtle hearts induced by microwave irradiation".
3658. TINNEY, C.E., LORDS, J.L., & DURNNEY, C.H. (1976). *IEEE Transactions on Microwave Theory & Techniques*, MTT-24(1):18-24 (Jan.), "Rate effects in isolated turtle hearts induced by microwave irradiation."
2566. TITAYEVA, M.A., & LEYZEROVICH, E.A. (1966), In: *Electrosleep and Electroanesthesia*. Materials of the All-Union Symposium on Problems of Electrosleep and Electroanesthesia [Electronarcosis], Dedicated to the 20th Year of Electrosleep Method, pp. 30-31 (In Russ.), Moscow, (13-15 Oct.), "The problem of changes in the EEG frequency spectrum during various currents/frequencies used in electrosleep".
2567. TITAYEVA, M.A., & NAROKKOVA, L.N. (1966), In: *Electrosleep and Electroanesthesia*. Materials of the All-Union Symposium on Problems of Electrosleep and Electroanesthesia [Electronarcosis], Dedicated to the 20th Year of the Electrosleep Method, pp. 28-30, (In Russ.), Moscow, (13-15 Oct.), "The problem of the mechanism of action of a pulsed electrosleep current".
1676. TITEL, J. R., & EL-ETR, A. A. (1968) *Anesthesiology* 29:845-846, "Fibrillation resulting from pacemaker electrodes and electrocautery during surgery"
1677. TRACHENKO, YE. G., & PALALKA, Y. S. (1965) *Trans. of Science Conf., Central Science Lab. Tomsk*, pp. 338-341, "Changes in the reactivity of leukocytes in the peripheral blood of Albino mice simultaneously vaccinated against anthrax under the action of an alternating electromagnetic field"
1678. TRAN, V. K., & PRIZHICHI, I. I. (1953) *Inst. Biofiz. Akad. Nauk SSSR Sci. Session Celebrating Achievements of Soviet Biophysics in Agriculture*, pp. 61-, "Peculiarities of the kinetics of electrical properties of the blood under the action of UHF, infrared rays, and high frequency fields on the organism"
3326. TO, E.C., MUDGETT, R.E., WANG, D.I.C., GOLDBLITH, S.A., & DECAREAU, R.V. (1974), *J. of Microwave Power*, 9(4):303-315, "Dielectric properties of food materials", [at frequencies of 300, 915, and 2450 MHz].
3055. TODOROV, N., & DRAGANOV, V. (1973), *Patol. Fiziol. Eksp. Ter.*, 17(1):53-54, "Effect of a pulsed UHF electromagnetic field on the serum cholesterol content in rabbits".
1679. TOLSKAYA, M. S. (1957) *Bulleten Eksperimental'noi Biologii i Meditsiny (Moskva)* 43(1):104-107, "Changes in the synaptic formations during intoxication with occupational poisons"
1680. TOLSKAYA, M. S. (1959) *Voprosy Kurortologii Fizioterapii i Lechebnoy Fizicheskoy Kul'tury (Problems in Health Resort Sci., Physiotherapy, & Medical Physical Culture)* (1):21-24, (Abstr. in: *Biological Effects of Microwaves: Compilation of Abstracts*, Sept. 1965, pp. 28-29; ATD-P-65-65), "Morphological changes in animals exposed to 10 cm microwaves"
1651. TOLSKAYA, M. S., & FUKALOVA, P. P. (1963) *Gigiena Truda i Professional'nye Zabolevaniya (Moskva)* (9):37-40, "Morphological changes in experimental animals under the action of electromagnetic fields in the HF and VHF ranges"
1682. TOLSKAYA, M. S., & GORDON, Z. V. (1959) In: *Summaries of reports. Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves*. Moscow, pp. 55-, [Title not given].
1683. TOLSKAYA, M. S., & GORDON, Z. V. (1960) *Trudy Nii Gigiyena Truda i Profzabolaniya AN SSSR* (1):99-103, (In Russian); (In: *The Biological Action of UHF*, Letavet, A. A., & Gordon, Z. V., (eds.), Moscow, Academy of Medical Sciences USSR, 1960, pp. 104-103 (OTS 52-19175-R; JPRS 12471); (Abstr. in: *The Biological Effects of Electromagnetic Fields - Annotated Bibliography*, 1965); (Also, Abstr. in: *Biological Effects of Microwaves: Compilation of Abstracts*, Effect of UHF on receptor and interoceptor mechanisms", Sept. 1965, pp. 37-38; ATD-P-65-65), "Changes in the receptor and interoceptor apparatus under the influence of SHF-UHF radiation"
1684. TOLSKAYA, M. S., & GORDON, Z. V. (1964) *Trudy Nii Gigiyena Truda i Profzaboleaniy AN SSSR* (2):80-88, (Biological Effects of Radio Frequency Electromagnetic Fields, Inst. of Industrial Hygiene & Occupational Diseases, Acad. of Med. Sciences, Moscow), "Comparative morphological characteristics of the effect of microwaves of various wavelengths"
2285. TOLSKAYA, M. S., & GORDON, Z. V. (1971) *Meditsina* Pub. House, Moscow, 135 pages, (In Russ.), "Morphophysiological Changes During the Action of Radio-Frequency Electromagnetic Waves"
2568. TOLSKAYA M.S., & GORDON, Z.V. (1973), *Pathological Effects of Radio Waves*, (Transl. from Russ. (see Citation #2285, this Biblio.) by HAIGH, B., Consultants Bureau, 146 pps.).

1685. TOLGSKAYA, M. S., GORDON, Z. V., & LOBANOVA, YE. A. (1957) In: Summaries of reports. Part 2. Jubilee Scientific Session of the Institute of Labor Hygiene & Occupational Diseases Dedicated to the 40th Anniv. of the Great October Socialistic Revolution, Moscow. [Title not given]
1686. TOLGSKAYA, M. S., GORDON, Z. V., & LOBANOVA, YE. A. (1959) Voprosy Kurortologii Fizioterapii i Lechebnoy Fizicheskoy Kul'tury y (Problems in Health Resort Sci., Physiotherapy, & Medical Physical Culture) (1):21-24, (Abstr. in: Biological Effects of Microwaves: Compilation of Abstracts (1965), ATD-P-65-68), "Morphological changes in experimental animals under the action of ten centimeter electromagnetic waves"
1687. TOLGSKAYA, M. S., GORDON, Z. V., & LOBANOVA, YE. A. (1960) In: Physical Factors of the Environment, Letavet, A. A. (ed.) [Title not given]
1688. TOLGSKAYA, M. S., GORDON, Z. V., & LOBANOVA, YE. A. (1960) Trudy Nii Gigiyena Truda i Profzaboleaniya AMN SSSR (1):80-98, (In Russian); (Abstr. in: The Biological Action of UHF, Letavet, A. A., & Gordon, Z. V., (eds.), Moscow: Academy of Medical Sciences USSR (1960), pp. 94-103; OTS 52-19175; JPRS 12471); (Also abstr. in: Biological Effects of Microwaves: Compilation of Abstracts, "Effect of pulsed and nonpulsed UHF on the organism", Sept. 1965, pp. 34-37; ATD-P-65-68), "Morphological changes in experimental animals under the influence of pulsed and continuous wave SHF-UHF radiation"
1689. TOLGSKAYA, M. S., & NIKONOVA, K. V. (1964) Trudy Nii Gigiyena Truda i Profzaboleaniya AMN SSSR (2):89-93, "Histologic changes in the organs of white rats under continuous exposure to HF-UHF electromagnetic fields"
1690. TOLGSKAYA, M. S., et al (1957) Tezisy Dokladov Yubileynoy Sessii Institut Gyg. Tr. Prof. Zabol. (2):73-74, "Morphological changes in animals exposed to SHF and UHF fields"
1691. TOLLES, W. E., & HORVATH, W. J. (1956) Trans. of Institute of Radio Engineers on Medical Electronics, PGME-4:13-15, (See also Erratum in Trans. of Inst. of Radio Engineers PGME-7:pp? 1954); (Presented at Symposium on Physiologic and Pathologic Effects of Microwaves, Krusen, F. H., (Chm.), Mayo Clinic, 23-24 Sept., 1955), "Energy densities of microwave radiating systems"
3659. TOMASHEVSKAYA, L.A., & POPOVICH, V.M. (1975) Gigiyena Naselennykh Mest, (14):103-105, (in Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #L/5615), 10 Feb. 1976, pp. 17-19, "Several indicators of the metabolic processes of organisms irradiated by a high-frequency electromagnetic field."
1692. TOMBERG, V. T. (1934) Abstracts of the 1st Internat. Congress on Electro-Radio-Biology, (Cappelli, L., ed.) Bologna, Italy, pp. 445-451, (In German with English summary) "The specific biological effects of short wavelength electrical energy"
1693. TOMBERG, V. T. (1959) Digest of Technical Papers, Proc. 12th Annual Conf. on Electrical Techniques in Medicine and Biology, (Schwan, H. P., Chm.), pp. 55-59, "Bioregative actions of microwaves"
1694. TOMBERG, V. T. (1960) Proc. 2nd Internat. Conf. on Medical Electronics, Paris, (1959), Chas. C. Thomas (Publisher), Springfield, Ill., pp. 401-407, "Ultrasonic effects compared with microwave biological effects"
1695. TOMBERG, V. T. (1960) In: Institute of Radio Engineers Internat. Convention Record, Part 9: Instrumentation, Medical Electronics and Nuclear Science Session, "Varied Views of Medical Electronics", pp. 94-97, "Biological microwave hazards"
1696. TOMBERG, V. T. (1960) Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Peyton, M. F., ed.) pp. 221-228, "Specific thermal effects of high frequency fields"
1697. TOMBERG, V. T. (1961) Digest of Internat. Conf. on Medical Electronics, Biological Effects of Microwaves, I (Athermal Aspects) (Frommer, P. L., ed.) Plenum Press, New York, p. 231-, "Specific electrical effects of radiowaves and their biomedical importance"
3327. TOMPKINS, P., & BIRD, C. (1972), Harpers Magazine, ( ):90-96, (Nov.), "Love among the cabbages: Sense and sensibility in the realm of plants", [communication with, and between, plants].
3328. TOMPKINS, P., & BIRD, C. (1973), The Secret Life of Plants, Harper & Row, Publishers, New York, 402 pages, [including chapters entitled: "Plants and ESP", "Plants and electromagnetism", "Force fields, humans and plants", and "The mystery of plant and human auras"].
1698. TOMNIKE, A. V. (1940) In: Questions on the Use of Short Waves and Ultrashort Waves in Medicine, Moscow, "The effect of HF/VHF electromagnetic fields on basal metabolism"
1699. TOMNIKE, A. V. (1941) Sborn. Physiol. Veget. Nerv. System, Leningrad, 13, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD P-65-17, 1965), "Influence of UHF electromagnetic fields on basal metabolism"
2569. TOROPTSEV, I.V. (1968), Arkhiv Patologii, 30(3):3-12 (FSTC-HT-23-349-72), "Morphological characteristics of the biological action produced by magnetic fields".
1700. TOROPTSEV, I. V., & GARGANEYEV, G. P. (1962) In: Materials of the All Union Sci. Conf., Exp. Kurortology and Physiol. Moscow, "Some morphological changes in experimental animals subject to exposures of alternating electromagnetic fields of industrial importance"
3329. TOROPTSEV, I.V., GARGANEYEV, G.P., GORSHENINA, T.I., & TEPLYAKOVA, N.L. (1971), In: KHOLODOV, Yu.A. (ed.), Influence of Magnetic Fields on Biological Objects, (Citation #3230, this Biblio.), pp. 95-104, "Pathoanatomic characteristics of changes in experimental animals under the influence of magnetic fields".
1701. TOSHEV, G., NINOV, V., & TOMOV, V. (1964) Voprosy Kurortologii Fizioterapii i Lechebnoy Fizicheskoy Kul'tury (Problems in Health Resort Sci., Physiotherapy, & Medical Physical Culture) 29(2):154-155, (JPRS 25121, pp. 17-19 (1964); OTS-64-31500), "Experience in the treatment of puerperal mastitis with decimeter waves"
1702. TRESKUNOVA, A. S., & SLIZSKIY, G. N. (1962) In: Summaries of reports. Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad, pp. 53-54, "Data on the dispensary service offered to individuals exposed in their work to microwave fields"
1703. TRIFONOV, YU. A., & UTINA, I. A. (1966) Biofizika 11(4):646-652, (Biophysics 11:740-748 (1966), (in English)), "Investigation of the mechanism of action of current on the L type cells of the retina"

3660. TROMP, S.W., & WEIHE, W.H. (eds.), Int. J. of Biometeor., 13 Supplement Biometeorology 4, Part II:127-131 (1969); and Int. J. of Biometeor. 14 Supplement Biometeorology 4, Part I:204-205 (1970), "Proceedings of the Fifth Internat. Biometeorological Congress" held at Montreux, Switzerland (31 Aug. to 6 Sept. 1969). [Bio-effects of electric, magnetic, and electromagnetic fields.]
2570. TROYANSKIY, M.P. (1972). Gigiyena i Sanitariya, (Moskva), 37(8):87-92 (in Russ.), (JPRS #57209), "Hygienic aspects of the effects of (SHF) microwave electromagnetic fields on the body."
1704. TROYANSKIY, M. P., KRUGLIKOV, R. I., KORNILOV, R. M., PETROVA-GOLUVEIKO, L. B., & KALASHNIKOVA, Z. S. (1967) *Voyenno-Meditsinskiy Zh. USSR (Military Med. Jour.)*, (7):30-35, (Abstr. in *Soviet Radiobiology*, 68-105-108-9, ATD Press, (June 1968), p. 87 only), "Some results of an investigation of the state of health of specialists working with SHF-UHF generators"
2571. TRUKHAN, E.M. (1966), *Biophysics*, 11:468-477 (In Engl.), (*Biophysika*, 11(3):412-419, (1966), (In Russ.)), "Determination of the mobility of free charged carriers in biological compounds". [Hall effect measurements using 3 cm wavelength electromagnetic radiation].
1705. TSOU, H., et al. (1962) *National Medical Journal of China* (7-12):531-533, "Observations on the clinical effectiveness of microwave therapy"
1706. TUMARKINA, L. N., & DUBROVSKIY, I. (1966) *Biophysika* 11(4):653-658 (*Biophysics* 11:750-756 (1966), (In English), "Certain aspects of the perception by man of amplitude-modulated signals"
2572. TURAYEVA, V.A. (1966), In: *Electrosleep and Electroanesthesia*, Materials of the All-Union Symposium on Problems of Electrosleep and Electroanesthesia [Electromarcosis], dedicated to the 20th Year of the Electrosleep Method, pp. 242-246, (In Russ.), Moscow (13-15 Oct.), "The significance of electrosleep in treating patients with eczema and neurodermatitis in the psychiatric clinic".
1707. TURLYGIN, S. YA. (1937) *Comptes Rendus (Doklady) de l'Acad. des Sci. de l'USSR*, 17(1):19-22, (In English), (Abstr. in: ATD Rept. P-65-68, Sept. 1965, *Biological Effects of Microwaves*, pp. 1-2, "Effect of centimeter waves on the human central nervous system"); (Also, Abstr. in: *The Biological Effects of Electromagnetic Fields - Annotated Bibliography*, ATD Rept. P-65-17, 1965), "Effect of electromagnetic centimeter waves on the central nervous system"
1708. TURLYGIN, S. YA. (1942) *Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva)* (4):63-, "Irradiation of the human organism with 2-mm microwaves"
1709. TURNER, J.J. (1962), Based on a translation of *The Biological Action of Ultrahigh Frequencies* (Based on a transl. of citation #879, this Biblio.), Letavet, A.A., & Gordon, Z.V., Moscow (1960); U.S. Army Materiel Command, ZEUS Liaison Office, Bell Telephone Labs., Whippany, N.J., 16 July, 64 pages, (AD #278-172), "The effects of radar on the human body (results of Russian studies on the subject)."
1710. TURNER, J. J. (1962) Rept. No. EN-TR-62-1 (AD 273787), U. S. Army Ordnance Missile Command, (Bell Telephone Labs.), 21 Mar., 89 pages, "The effects of radar on the human body" (Based on a transl. of citation #879, this Bibliography)
1711. TURRELL, W. J. (1935) *Arch. of Physical Therapy* 16:278-281, "Short wave therapy"
1712. TUTTLE, W. W., & JANNEY, C. D. (1948) *Arch. of Physical Med.* 29:416-421, "The construction, calibration, and use of thermocouples for measuring body temperature"
1713. TUVE, H. A., & WHITMAN, W. G. (1930) "Unpublished super-high frequency data"
1714. TYAGIN, N. V. (1957) *Trudy Voenno-Meditsinskaya Akademiya i Kirov (Leningrad) USSR*, 73:9-19, (Abstr. in: *The Biological Effects of Electromagnetic Fields - Annotated Bibliography*, ATD Rept P-65-17, Apr. 1965), "Study of the thermal effect of SHF-UHF electromagnetic fields on various animals using the thermometric method"
1715. TYAGIN, N. V. (1957) *Trudy Voenno-Meditsinskaya Akademiya i Kirov (Leningrad) USSR*, 73:84-101, "Electrocardiogram changes in dogs affected by SHF-UHF electromagnetic fields"
1716. TYAGIN, N. V. (1957) *Trudy Voenno-Meditsinskaya Akademiya i Kirov (Leningrad) USSR*, 73:116-126, (Abstr. from *Zh. Biol. No. 59923 (1959)*), "Changes in the blood of animals subjected to a SHF-UHF field"
1717. TYAGIN, N. V. (1957) In: *Summaries of reports. Part 2, Jubilee Scientific Session of the Institute of Labor Hygiene & Occupational Diseases Dedicated to the 40th Anniv. of the Great October Socialistic Revolution, Moscow*, [Title not given] 963-966 (67-),
1718. TYAGIN, N. V. (1958) *Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva)* 46(8):/ "The thermal action of a SHF electromagnetic field"
1719. TYAGIN, N. V. (1959) In: *Summaries of reports. Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves, Moscow*, "Some problems of occupational hazard caused by microwave electromagnetic fields"
1720. TYAGIN, N. V. (1960) *Voyenno Med. Zh.*, (USSR Military Med. J.), (9):14 only, [Title not given]
1721. TYAGIN, N. V. (1962) In: *Summaries of reports. Questions of the Biological Effect of a SHF-UHF Electromagnetic Field. Kirov Order of Lenin Military Medical Academy, Leningrad*, pp. 54-55, "The syndrome of the chronic effect of a microwave field" (A67-80162)
1722. TYAGIN, N. V., & USPENSKAYA, N. V. (1966) *Zh. Nervropatologii i Psikiatrii i Korsakova* 66(8):1132-1136 / "Functional changes in the nervous system and some other systems of the organism under chronic exposure to SHF-UHF radiation"
- See also TYAGIN
2573. TYLER, P.E. (1973), *IEEE Trans. on Aerospace and Electronic Systems*, AES-9(2):225-228 (Mar.), "Overview of the biological effects of electromagnetic radiation".
3330. TYLER, P.E. (Ed. and Conf. Chmn.), (1975), *Annals of the New York Academy of Sciences*, ANYAA 247, 545 pps., (Feb. 28), (Proceed. of a conference entitled 'Biologic Effects of Nonionizing Radiation', held Feb. 12-15, 1974, See Citation #3117, this Biblio.), "Biologic Effects of Nonionizing Radiation".

3331. UKOLOVA, M.A., KVAKINA, Ye.B. (1971), In: KHOLODOV, Yu.A. (ed.), Influence of Magnetic Fields on Biological Objects, (Citation #3230, this Biblio.), pp. 144-162, "Effect of magnetic fields on experimental tumors (direct and through the nervous system)".
1723. ULC, M., & SVACINA, J. (1966) *Ceskoslovenska Neurologie* 29(6):402-406, "EEG shifts in personnel working around centimeter wave sources"
1724. ULRICH, L., & FERIN, J. (1959) *Pracovní Lékarství*, Prague, 11:500-503, (In Czech.) "The effect of working in high-power transmitting stations upon certain functions of the organism"
2574. ULRICH, W.D. (1971), Naval Medical Research Institute, Res. Rept. No.2 on Project M4306.01-1010BXX9, "Ultrasound dosage for experimental use on human beings", [This rept. is listed since ultrasound has, on occasion, been included in discussions on "non-ionizing" radiation.]
1725. USPENSKAYA, N. V. (1959) In: Works of the Scientific Session Devoted to Results of Work in 1957 by the Inst. of Industrial Hygiene and Occupational Diseases, Leningrad, pp. 63-67, "Clinical aspects of the continuous action of SHF/UHF currents"
1726. USPENSKAYA, N. V. (1959) In: Summaries of reports. Labor Hygiene and the Biological Effect of Radio Frequency Electromagnetic Waves. Moscow, p. 23 only, [Title not given]
1727. USPENSKAYA, N. V. (1961) In: Materials of the Scientific Session Concerned with the Results of Work (conducted by the Leningrad Institute of Industrial Hygiene & Occupational Diseases for 1959-1960). Leningrad, pp. 116-117, "Results of the observation of workers exposed to electromagnetic waves in the centimeter range"
2575. USPENSKAYA, N.V. (1970), *Voyenno-Meditsinskiy Zhurnal*, (6):71 (June), (Transl. #J-8892 for Army Intelligence, p. 98 only), "UHF electromagnetic waves and human health".
1728. VALTELA, et al. (1964) *Geofis. Meteorol.* 13:76-, (In Italian) "The sensitivity of animal organisms to cosmic variables tested with regular water and physically 'active' water"
1729. VALILOV, M. V., & SHTELSHIL, L. V. (1958) Voenizdat, Moscow, Radio Measurements at Superhigh Frequencies
1730. VALTONEN, E. J. (1966) *Acta Rheum. Scand.* 12:291-299, "The effects of microwave radiation on the cellular elements in the peritoneal fluid and peripheral blood of the rat"
1731. VALTONEN, E. J. (1966) *Experimental Cell Research* 43:201-, "Giant mast cells - a special degenerative form produced by microwave radiation"
2286. VALTONEN, E. J. (1967) *Z. Zellforsch. Mikroskop. Anat.* 80:322-326, "Observations on the fine structure of giant mast cells produced by microwave radiation on the peritoneal fluid"
2287. VALTONEN, E. J. (1968) *Amer. J. of Physical Medicine* 47:75-83, "Effect of treatment with short wave diathermy on the histamine content of various organs"
3056. VAN DE GRIEK, A., & BRITAIN, R. (1974), *J. of Microwave Power*, 9(1): 2, (Mar.), "Amendments to the U.S. Dept. of Health, Education and Welfare microwave oven performance standard".
1733. VAN EVERDINGEN, W. A. G. (1935) *Nederlands Tijdschrift voor Geneeskunde*, Amsterdam, 82:284-, (In Dutch) "Irradiation with ultrahigh frequency radio waves"
1734. VAN EVERDINGEN, W. A. G. (1940) *Nederlands Tijdschrift voor Geneeskunde*, Amsterdam, 84:4370-4380, "Molecular changes following irradiation with Hertzian waves of a frequency of 1875 megahertz"
1735. VAN EVERDINGEN, W. A. G. (1941) *Nederlands Tijdschrift voor Geneeskunde*, Amsterdam, 85(29):3094-3104, (In Dutch), (Biol. Abstr. 16:576-577, Abstr. # 6380 (1942)), (In Dutch) "Molecular and structural alterations due to irradiation with 10 cm Hertzian waves at 3000 MHz frequency"
1736. VAN EVERDINGEN, W. A. G. (1945) *Revue Belge des Sciences Medicales (Revue de Pathologie et de Medecine Experimentale)* 17(5):261-283, (In French) "Molecular and structural changes produced by irradiation with Hertzian radio waves of 16 and 10 cm (1875 and 3000 MHz). I. Molecular transformations (hepatic metabolism and problems of cancer)"
3057. VAN OSCH, P.M.M., & HEERING, H. (1972), Medical Biological Laboratory, TNO, Rept. No. MBL 1972-5, (Apr.), "Summaries: Biological effects of microwave radiation - Part 5"
3661. VAN PELT, W.F., PAYNE, W.R., & PETERSON, R.W. (1973), U.S. Department of Health, Education, and Welfare, DHEW Publication No. (FDA) 74-8010, "A review of selected bioeffects thresholds for various spectral ranges of light [visible, ultraviolet, and infrared]."
1737. VAN POOLE, G. McD. (1935) *Arch. of Physical Therapy* 16:634 only, (Abstr. from *Arch. of Otolaryngology* 20:152-, (1934)), "Tuberculosis of the larynx" [Used electrocautery for treatment]
1738. VAN UMMESEN, C. (1961) *Proc. 4th Tri-service Conf. on the Biological Effects of Microwave Radiation*, Vol. 1, (Peyton, M. J., ed.) pp. 201-219, (Also in: *Investigators' Conf. on Biological Effects of Electronic Radiating Equipments*, Patrick AFB, (Knauf, G. M., Chm.), RADC-TR-59-57, AD 214693, July 1959, pp. 16-17), "The effect of 2450 mc radiation on the development of the chick embryo"
2576. VAN UMMESEN, C.A. (1963), Ph.D. Thesis, Tufts U., "An experimental study of developmental abnormalities induced in the chick embryo by exposure of radio-frequency waves". (A65-82039),
1739. VAN UMMESEN, A. & COGAN, F. C. (1965) *Arch. of Environmental Health* 11(2):177-178, (Also in Senate Hearings, pp. 972-973) "Experimental microwave cataracts: age as a factor in induction of cataracts in the rabbit"
1740. VAN UMMESEN, C. A., & COGAN, F. C. (1969) *Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium*, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 122 only, "Effects of microwave radiation on lens epithelial cells (summary)"

2577. VAN UMHERSEN, C.A., & COGAN, F.G. (1969), Submitted to Arch. of Opth., "Effects of microwave radiation on the lens epithelium in the rabbit eye".
1741. VAN WENT, J. (1952) *Geneeskundige Gids (Den Haag)* 30:77-88, "Ultrashort wave pituitary irradiation"
2288. VAN ZANTE, H. J., & JOHNSON, S. K. (1970) *J. of the Amer. Dietetic Assoc.* 56:133-135, "Effect of electronic cookery on thiamine and riboflavin in buffered solutions"
1742. VARIN, I. YE. (1964) *Gigiena i Sanitariya, USSR*, 29(1):25-33, (JPRS 23898), "Concerning the occupational hazards in working with medical VHF-HF oscillators"
1743. VARIN, I. YE. (1964) *Voprosy Kurortologii, Fizioterapii i Lachebnoy Fizicheskoy Kul'tury (Problems of Health Resort Science, Physiotherapy, and Therapeutic Physical Culture)*, Moscow, 29(2):183-190, (JPRS 25121, pp. 22-35; OTS-64-31500), "First all-Russian congress of health-resort specialists and physiotherapists"
3662. VARMA, M.M., & TRABOULAY, Jr., E.A. (1975), Rept., Howard Univ., Washington, DC (AD #A013-315), July, "Biological effects of non-ionizing radiation—Considering mutagenic hazard."
3663. VAROQUAUX, P., & DUPUY, P. (1975), *J. of Microwave Power*, 10(3):314 only (Sept.), "Correspondence on chemical effects of microwave energy [lack of production of H<sub>2</sub>O<sub>2</sub> from a solution of NaOH]."
1744. VASILENKO, F. D. (1937) *Moskovskaya oblastnaya klinika fizicheskikh metodov lecheniya. Trudy.*, 3, (Abstr. in: *The Biological Effects of Electromagnetic Fields - Annotated Bibliography*, ATD Rept. P-65-17, 1965), "Influence of UHF electrical fields on the isolated frog heart"
1745. VASILYEV, N. V. (1965) *Trans. of the Sci. Conf. of the Central Sci. Lab. Tomsk* (2):379-381, "The effect of static and AC magnetic fields on the immunobiological reaction of the organism"
3332. VASILYEV, N.V., SHTERNBERG, I.B., & BOGINICH, L.F. (1971), In: *Influence of Magnetic Fields on Biological Objects*, (Citation #3230, this Biblio.), pp. 105-120, "Magnetic fields, infection, and immunity".
1732. VASILEV, D. A. (1968) *Report. NT-68-01-03-68*, 58 pages, "Soviet research on the pathophysiology of ultrahigh frequency electromagnetic fields"
1746. VEDRIK, A., & VUS, J. (1958) *J. of Applied Physiology* 12(3):435-444, "Comparison of the stimulation of the thermal sense organ by microwave and infrared radiation"
1747. VELETSKIY, A. G., TOLOSHINA, M. S., & PAVLOVA, I. V. (1966) *Gigiena Truda i Professional'nye Zabollevaniya (Moskva)* 10(8):41-44, (JPRS 34632, IT-67-30211), "Changes of nucleic acids content, induced by UHF waves, in the lungs of rats with experimental silicosis"
2289. VERNICK, S. H. (1962) *Dissertation Abstr.* 23(2):1174-1175, "The effects of temperature, light, and HF radio waves upon the embryonic development of *Tilapia macrocephala*"
1748. VERSHA, F. A. (1965) In: *U. S. Army Medical Research Lab. Progress Rept.* pp. 35-36, (AD 470368), "Dosimetry of radio-frequency and microwave radiation in mammals"
3058. VETTER, R.J., ZIEMER, P.L., & PUNTENNEY, D. (1974), *Research/Development*, 24(4):22-26, (Apr.), "Microwave dosimetry: Prototype microwave dosimeter is small enough and passive - requiring no connections to integrate exposure," [using a coulometer powered by the microwave field].
1749. VISE, K. C., & PAITEL'BERG-BLANK, V. P. (1968) *Vestnik Akademi Nauk Kazanskoy SSSR*, (3):40-42, "Effect of microwaves on the content of nucleic acids in digestive organs"
2578. VILENSKAYA, R.L., SMOLYANSKAYA, A.Z., ADAMENKO, V.G., BULDASHEVA, Z.P., GELVICH, E.A., COLANT, M.B., & GOLDBABER, D.Ya. (1972), *Bull. Eksp. Biol. Med.*, 73:52-54, (Apr.), "Induction of colicine synthesis with the aid of electromagnetic waves of millimeter wavelength". [Irradiation of colicinogenic strain *E. coli* at "nonthermal" level].
1750. VINEF, Ya. I., & KHARITONOV, S. A. (1949) *Theory and Practice of Physiotherapy, Collection (Moscow)* (4):70-, "The sugar content in the blood under the action of a UHF electric field"
3664. VINOGRADOV, I.I., & DUMANSKIY, Yu.D. (1974), *Fiziologichnyy zhurnal Adakemii Nauk Ukr. SSR*, 20(3):392-394 (in Ukrainian), "Effect of SHF energy on anaphylactic shock and antibody genesis."
1751. VIOLANTI, A., TAGGARI, E., & GRESPI, M. (1964-65) *Medicina Sperimentale, Turin*, (44-), (In Italian) "Histopathologic study of abdominal organs of animals treated with microwaves"
1752. VITTEP, J. (1965) *Final Report of ZEZ Research and Development Center, Prague*, (In Czech.), "Measurement of RF-energy emission in RF equipment from the health aspect and suggestion for safety measures"
1753. VLADIMIROVA, N. A. (1958) *Nevitsinskaya Radiologiya* 4(7):14-20, "The effect of VHF-HF electric fields on the course of experimental radiation sickness in animals"
3665. VLADIMIRSKIY, B.M. (1975), *Transl. in JPRS #63992*, 40 pps. (30 Jan.), "Effects of non-ionizing electromagnetic radiation."
1754. VOCCIA, M. (1955) *Annali di Medicina Navale e Tropicale* 60:658-, (In Italian) "On the causes of ocular fatigue in radar operators"
1755. VOGELHUT, P. O. (1960) *Proc. of the Internat. Conf. on Medical Electronics* 3:409 only, "Microwaves as a tool in biological research"
1756. VOGELHUT, P. O. (1960) In: *3rd Internat. Conf. on Medical Electronics*, p. 52, "Study of enzymatic activity under the influence of 3-cm electromagnetic radiation"
1757. VOGELHUT, P. O. (1962) *Electronics Research Laboratory Rept., Series No. 60, Issue (476)*, Univ. of Calif., Berkeley, (AD 40167), "The dielectric properties of water and their role in enzyme-substrate interactions"

1758. VOGELHUT, P. O. (1968) *J. of Microwave Power* 3(3):143-147, "Microwave techniques in biophysical measurements"
1759. VOGELHUT, P. O. (1969) Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, Richmond, Va., 17 Sept., pp. 98-100, "Interaction of microwave and radio frequency radiation with molecular systems"
1760. VOGELMAN, J. H. (1958) Proc. of 2nd Tri-service Conf. on Biological Effects of Microwave Energy (Pattishall, E. G., & Banghart, F. W., eds.) 2:9-18, (AD 131477; RADG-TR-56-54), "Physical characteristics of microwaves as related to biological effects"
1761. VOGELMAN, J. H. (1959) Proc. 3rd Tri-service Conf. on Biological Effects of Microwave Radiating Equipments (Suskind, C., ed.) 3:332-333, "Comments on papers delivered at Tri-service Conference on Biological Effects of Microwave Radiation"
1762. VOGELMAN, J. H. (1959) Digest of Technical Papers, Proc. of the 12th Annual Conf. on Electrical Techniques in Medicine and Biology, (Schwan, H. P., Chm.), p. 36 only, "Physical and electrical characteristics of a microwave hazard"
1763. VOGELMAN, J. H. (1961) Proc. 4th Tri-Service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Suskind, C., ed.) 3:23-31, "Microwave instrumentation for the measurement of biological effects"
1764. VOGELMAN, J. H. (1966) Proc. of the Symposium on Biomedical Engineering, (Sances, A., Jr., ed.) Marquette Univ., Milwaukee, 1:204-210, "A comparative analysis of biological effects of microwave energy"
1765. VOGELMAN, J. H. (1969) Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 7-12, "Physical characteristics of microwave and other radio frequency radiation"
2290. VOGT, A. (1912) *Arch. f. Ophth.* 83(1):99-113 (Oct), (In Ger.), "Some measurements on the diathermancy of the human eye ball, its media, and the human eyelid, in addition to observations of the biological effects of infrared (radiation)"
1766. VOKOVA, YE. P. (1947) Candidates Dissertation, Leningrad, "Therapy with the UHF Electrical Field for Acute Inflammatory Processes"
1767. VOLFOVSKAYA, K. N., OSIPOV, YU. A., KALYADA, T. B., KULIKOVSKAYA, E. L., ASANOVA, T. P., & SHCHIGLOVA, A. V. (1961) *Gigiena i Sanitariya, USSR*, 28(5):18-23, (In Russian), (JPRS 9895) "On the combined action of RF field and x-radiation in industry"
1768. VOLKOVA, A. P., & SMUROVA, YE. I. (1967) *Gigiena i Sanitariya, USSR*, (9):107-110, (Abstr. in *Soviet Radiobiology*, ATD 68-105-108-9 (June 1968) p. 88 only), "The effect of radio frequency electromagnetic fields on phagocytosis, and the course of infectious inflammation in rats" (Also: *Hygiene & Sanitation* 32:451-454 (1967), (In English))
2291. VON EULER, C. (1947) *Acta Physiologica Scandinavica* 14, Supplement 45, pp. 1-75, "Selective responses to thermal stimulation of mammalian nerves"
1770. VOSBURGH, B. L. (1956) Institute of Radio Engineers Trans. on Medical Electronics, PGME-4:5-7, (From: Symposium on Physiologic and Pathologic Effects of Microwaves, Sept. 1955, Mayo Clinic, Krusen, F. H. (Chm.)), "Problems which are challenging investigators in industry"
1771. VOSBURGH, B. L. (1958) Proc. 2nd Tri-service Conf. on the Biological Effects of Microwave Energy (Pattishall, E. G., & Banghart, F. W., eds.) 2:118-123, "Recommended tolerance levels of microwave energy: current views of the General Electric Company's health and hygiene service"
1772. VOSS, W. A. G. (1969) *J. of Microwave Power* 4(2):120-121, "Exposure reference chart and notes on instruments"
1773. VOSS, W. A. G. (1969) Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 217-221, "Microwave hazard control in design"
3333. VOSS, W.A.G. (1972), IMPI Short Course, pps. 43-64, (May), "Microwave Safety".
3334. VOSS, W.A.G., RAJOTTE, R.V., & DOSSETOR, J.B. (1974), *J. of Microwave Power*, 9(3):181-194, (Sept.), "Applications of microwave thawing to the recovery of deep frozen cells and organs: A review".
3335. VYALOV, A.M. (1971), In: KHOLODOV, Yu.A. (ed.), *Influence of Magnetic Fields on Biological Objects*, (Citation #3230, this Biblio.), pp. 163-174, "Clinico-hygienic and experimental data on the effects of magnetic fields under industrial conditions"
1774. VYALOV, A. N., & LISICHKINA, Z. S. (1966) *Gigiena Truda i Professional'nyye Zabollevaniya (Moskva)* (5):39-43, "Characteristics of some clinical and physiological changes in workers exposed to the action of dispersed, constant magnetic fields under industrial and laboratory conditions"
1775. VYALOV, A. N., et al. (1964) In: *Questions of Occupational Pathology, Moscow*, pp. 169-, "The question of the effect of constant and variable magnetic fields on the human organism"
1776. VYALOV, A. N. (1967) *Vestnik Akad. Meditsinskikh Nauk AMN SSSR*, (8):52-58, (Abstr. in: *Soviet Radiobiology*, ATD 68-105-108-9 (June 1968) p. 88 only), "Magnetic fields as a factor in an industrial environment"
3666. VYGODNER, Ye.B., KISLINA, V.M., & FRENKEL', I.D. (1975), *Voprosy Kurortologii i Lechebnoy Fizicheskoy Kul'tury*, (5):395-399 (Sept.-Oct.), (In Russian), Transl. In: "Effect of Non-Ionizing Electromagnetic Radiation" (JPRS #L/5615), 10 Feb. 1976, pp. 61-70, "Influence of pelotherapy and microwaves on the functional condition of the adrenal cortex of peptic ulcer patients."
3336. WACHTEL, H., JOINES, W., SEAMAN, R., & WALKER, C. (1973), Abstr. of: Society for Neuroscience Third Annual Meeting, (Nov. 7-10), "Firing pattern changes induced by low intensity microwave radiation of isolated neurons from *Aplysia californica*" ["Absorbed power" of between 10 and 50 mW/cm<sup>2</sup> and frequencies of 1.5 and 2.45 GHz].

1777. WACKER, P. F. (1969) Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Rad. Health, Div. of Bio. Effects, Rept. No. 70-2, pp. 197-203, (Also: (1970) Report: NBS, Boulder, Colo., Electromagnetics Div., NBS-TN-391, (N70-32534), "Quantifying hazardous microwave fields: analysis"
1778. WACKER, P. F., & BOWMAN, R. R. (1971) IEEE Trans. on Microwave Theory and Techniques (Special Issue on Biological Effects of Microwaves) MTT-19(2):178-187, "Quantifying hazardous electromagnetic fields: scientific basis and practical considerations"
3337. WADE, N. (1972), Science, 177( ):778 only, "Fischer-Spassky charges: What did the Russians have in mind?", [low-intensity microwave radiation-produced "asthenic syndrome" during the chess match?].
2579. WAGENER, F.M., JENKER, F.L., & HAFNER, H. (1965), Deutsches Medizinisches J.,  (7):pps?, "Changes in cerebral hemodynamics during electrosleep"
2580. WAGENER, F.M., SHUY,  , & GENSE,  . (1964), Der Anaesthetist, 13(11):pps?, "Measurements of potentials in the dog brain during passage of pulse current"
2581. WAGNER, C.F., McCANN, G.D., & BECK, E. (1941), Amer. Inst. of Elect. Engr. (AIEE) Trans., 60:1222-1230, "Field investigation of lightning", [Discusses wave shape and current discharged by lightning arresters].
1779. WAJSZCZUK, W. J., MOWRY, F. M., & DUGAN, N. L. (1969) New England J. of Med. 280(1):34-35, "Deactivation of a demand pacemaker by transurethral electrocautery"
1780. WAKIM, K. G., GERSTEN, J. W., HERRICK, J. F., ELKINS, E. C., & KRUSEN, F. H. (1948) Arch. of Physical Med. 29(9):583-593, "The effects of diathermy on the flow of blood in the extremities (An experimental and clinical study)"
1781. WAKIM, K., HERRICK, J., & GERSTEN, J. (1947) Proc. Central Society for Clinical Research 20:49-, (Also: J. Laboratory Clinical Medicine 32:1511-1512 (1947)), "Effects on blood flow: clinical and experimental studies"
1782. WAKIM, K., HERRICK, J., PARKHILL, E., & BENEDICT, W. (1948) Amer. J. of Physiol. 155:432-, (Also: Amer. J. of Ophthal. 33:1241-1245, (1950)), "Effects of microwave diathermy on the eye"
1783. WAKIM, K. G., HERRICK, J. F., MARTIN, C. M., & KRUSEN, F. H. (1949) J. of the Amer. Medical Assoc. 139(15):989-992, "Therapeutic possibilities of microwaves"
3059. WALCOTT, L.E., WHELLER, P.C., HARDWICK, H.M., & ROWLEY, B.A. (1969), Sou. Med. J., 62( ):795-?, "Accelerated healing of skin ulcers by electrotherapy"
3338. WALKER, C.M.B., McWHIRTT, K.G., & VOSS, W.A.G. (1974), J. of Microwave Power, 9(3):221-229, (Sept.), "Use of a bacteriophage system for investigating the biological effects of low intensity pulsed microwave radiation", [2450 MHz, pulsed at 8 KHz, at 1 to 10 mW/cm<sup>2</sup> showed no effect on the number of infections of *E. coli* B by phage T4r<sub>11</sub>].
3339. WALLIS, R. (1959), Presented at the 87th Annual Meeting of the Amer. Public Health Assoc., Atlantic City, Oct. 19-23, "Evolution of concepts concerning the application of high-frequency currents upon living organisms".
3060. WALTER, W.H., III, MITCHELL, J.C., RUSTAN, P.L., FRAZER, J.W., & HURT, W.D. (1973), J. of the Amer. Med. Assoc., 224(12):1628-1631, (Jun. 18), "Cardiac pulse generators and electromagnetic interference"
1784. WALTHEARD, K. (1950) Medical Hygiene 8:182, 431, "Microwaves in physiotherapy"
3667. WANGEMAN, R.T. (1974), Health Physics, 27(6):633-634, "In-vivo effects of 2.45 GHz microwave radiation on rabbit serum components."
1785. WARD, G. E. (1947) The Internist 13:347-351, and p. 379, (August), "Electrosurgery"
3668. WARD, T.R., ALLIS, J.W., & ELDER, J.A. (1975), J. of Microwave Power, 10(3):315-320 (Sept.), "Measure of enzymatic activity coincident with 2450 MHz microwave exposure."
3669. WARNKE, U. (1973), Dissertation, Universität des Saarlandes, "Physical-physiological base to the atmospheric electrically-caused 'weather awareness' of the honey bee (*Apis mellifica*)."
3340. WARREN, S.L. (1935), Amer. J. of Roentgenology, 33(1):75-87, "Preliminary study of the effect of artificial fever upon hopeless tumor cases", [Brief report of use of short wave diathermy].
1786. WATAKI, H., EWANG, K. J., ASEIDA, K. (1966) Biochim. Biophys. Acta 128:256-261, "Semiquinone formation of D-amino acid oxidase by irradiation"
3670. WATSON, J., DeHAAS, W.G., & HAUSER, S.S. (1975), Nature, 254(5498):331-332 (Mar. 27), "Effect of electric fields on growth rate of embryonic chick tibiae *in vitro*." [See also DUNCAN & MACMILLAN, citation #3435, this Biblio.]
3061. WATERS, F.L. (1962), Proc. of the Entomol. Soc. of Ontario, 92( ):26-32, "Control of insects in foodstuffs by high-frequency electric fields"
3341. WAYLAND, J.R., DAVIS, F.S., YOUNG, L.W., & MERKLE, M.G. (1972), J. of Microwave Power, 7(4): pp. ?, "Thermal and non-thermal effects of UHF fields on plants and seeds of mesquite and beans".
1787. WEBB, S. J., & BOOTH, A. D. (1969) Nature 222(5199):1199-, (21 June), "Absorption of microwaves by microorganisms"
1788. WEBB, S. J., & DODDS, D. D. (1968) Nature 218(5139):374-, (27 Apr.), "Inhibition of bacterial cell growth by 136 Gc microwaves"
2060. WEBB, S. J., & BOOTH, A. D. (1971) Science 174(4004):72-74, (1 Oct.), "Microwave absorption by normal and tumor cells"
1789. WEDLICK, L.T. (1967), Medical J. of Australia, 2(23):1050-1051, "The use of heat and cold in the treatment of sports injuries."
1790. WEI, L. Y. (1969) Science 163:280-282, (19 Jan.), "Role of surface dipoles on axon membrane"

3671. WEIL, C.M. (1975), IEEE Transactions on Biomedical Engineering, *BME-22*( ):468-476 (Nov.), "Absorption characteristics of multilayered sphere models exposed to UHF/microwave radiation." [head tissue dosimetry phantom]
2582. WEISKE, W. (1963), Biomedical Sciences Instrumentation, Vol. I:467-475, "Human sensitivity to electric fields". [Primarily at power transmission frequencies; however, also describes a subject "hearing" radio waves].
1791. WEISS, J. (1935) Arch. of Physical Therapy *15*:95-96, "The flasher sinusoidal machine"
1792. WEISS, M. M., & MEMFORD, W. W. (1961) Health Physics *5*:160-168, "Microwave radiation hazards"
1793. WEISSENBERG, E. (1934) Abstracts of the 1st Internat. Congress on Electro-radio-biology, pp. 452-456, (In German with English Summary), "Effects of distance on biological hazards to man from radio waves"
2583. WEISZ, H., PICK, J., & TOMBERG, V. (1938), Archives of Physical Therapy, *19*( ):79-83, (Feb), "The problem of a specific effect of short waves on blood vessels".
1794. WESTIN, J.B. (1968), J. of Occupational Med., *10*(3):134-141, "Microwave radiation and human tolerance: a review."
1795. WEVER, R. (1967) Zeitschrift für Vergleichende Physiologie *55*:111-128, "The influence of weak electromagnetic fields on the cardiac rhythm of man"
1796. WEVER, R. (1970), Life Sciences and Space Research (Amsterdam: North Holland), *8*:177-187, "The effects of electric fields on circadian rhythmicity in men."
3062. WEVER, R. (1973), Internat. J. of Biometeorol., *17*( ):227-232, "Human circadian rhythms under the influence of weak electric fields and the different aspects of these studies".
1797. WPALEN, R. E., STAMPER, C. F., & McINTOSH, H. D. (1964) Annals of the N.Y. Academy of Sci. *111*:922-931, "Electrical hazards associated with cardiac pacemaking"
2584. WHITE, C.E. (1972), Microwave Journal, *15*(12):6 & 66, (Editorial), "A problem that won't go away", [Concern for the possible biological hazards resulting from RF and microwave radiation exposure; background, and present governmental program.]
3063. WHITEHEAD, C.T. (1973), In: Radiation Control for Health and Safety, Hearings before the Committee on Commerce, U.S. Senate, Mar. 8-12, Serial No. 93-24, U.S. Govern. Print. Office, Wash., DC, "Statement (on government activities to assess the biological effects of nonionizing EM radiation - March 9)".
3131. WHITNEY, W.K., NELSON, S.O., & WALKDEN, H.H. (1961), U.S. Dept. of Agriculture, Marketing Res. Report No. 455, 52 pps., "Effects of high-frequency electric fields on certain species of stored-grain insects".
3342. WHYTLAW-GRAY, R., & SPEAKMAN, J.B. (1921), Nature, *107*(2698):619 only, (July 14), "A novel magneto-optical effect", [early observation of a 'pearl chain effect' in a magnetic field].
3064. WILCH, M. (1974), The Palatine (Ill.) Herald, Feb. 11, "She's engaged in microwave research: Effects on behavior interest Harper professor [describes work of S. KORBEL]."
1798. WILDERVANCK, A., MAKIM, K.G., HERRICK, J.F., & DRUSEN, F.H. (1959), Arch. of Physical Med., *40*:45-55, (Feb.), "Certain experimental observations on a pulsed diathermy machine."
1799. WILKE, E., & MÜLLER, R. (1933) Kolloid Z. *65*:257-260, (In German), "Effect of electrical waves on colloids"
1800. WILKINS, D. J., & HELLER, J. H. (1963) J. of Chemical Physics *39*(12):3401-3405, "Effect of radio-frequency fields on the electrophoretic mobility of some colloids"
1801. WILLIAMS, C. (1955) Annual Meeting of the Industrial Hygiene Foundation, Mellon Inst., Pittsburgh, Pa., 16-17 Nov. "Industrial hygiene aspects of microwaves"
1802. WILLIAMS, D. B., & FIXOTT, R. S. (1957) Proc. 1st Tri-service Conf. on Biological Hazards of Microwave Radiation (Pattishall, E. G., ed.) *1*:6-19, (AD 115603), "A summary of the SUMASAF program for research on the biomedical aspects of microwave radiation"
1803. WILLIAMS, D. B., & FIXOTT, R. S. (1957) Medical News Letter (Navy) *30*(10):35-, "Biological hazards of microwave radiation"
1804. WILLIAMS, D. B., MONAHAN, J. P., NICHOLSON, W. J., & ALDRICE, J. J. (1956) Institute of Radio Engineers Trans. on Medical Electronics *PGME-4*:17-22, (From: Symposium on Physiologic and Pathologic Effects of Microwaves (Krusen, F. H., Chm.) Sept. 1955); (Also, A.M.A. Arch. Ophthalmol. *54*:863-874 (1955), and Report 55-94 of Air University, USAF School of Aviation Med., Randolph AFB, Texas, Aug. 1955), (AD 80072), "Biologic effects studies on microwave radiation: time and power thresholds for the production of lens opacities by 12.3 cm microwaves"
1805. WILLIAMS, D. B., & NICHOLSON, W. J. (19\_\_ ) Report (Classified): Air University, School of Aviation Medicine, USAF, Randolph AFB, Texas, "Biological effects studies on microwave radiation" An appraisal of the biological effects potential of current USAF 'S' band ground radar transmitters"
1806. WILLIAMS, R. B., & CARPENTER, H. M. (1957) Naval Medical Research Institute Report (by Ely, T. S., & Goldman, D. E.), Appendix B of "Heating characteristics of laboratory animals exposed to ten-centimeter microwaves", NMRI Research Reports *15*:124-137, "Early lesions in dog testes due to microwaves"
1807. WILLIAMS, D. B., et al. (19\_\_ ) Institute of Radio Engineers Trans. on Medical Electronics, Ref?, "An observation on the detection by the ear of microwave signals"
3065. WILLIAMS, R.J., & FINCH, E.D. (1974), Aerospace Medicine, *45*(4):393-396, "Examination of the cornea [of rabbits] following exposure to microwave radiation", (at 2.45 GHz (CW) or 2.86 GHz (pulsed) of average power density of 225 mW/cm<sup>2</sup>. 'Radiation did not appear to influence the normal cornea, or the healing process in the wounded cornea.')

2585. WILLIAMS, R.J., & MCKEE, A. (1973), Naval Medical Research Institute (Juna), submitted for publication "Microwave induced lens damage: Evaluation by scanning and transmission electron microscopy".
1608. WILMER, M. R., & MILLER, M. M. (1935) Arch. of Physical Therapy 16:674-677, "Physical therapy in allergic diseases"
2292. WINTER, F. C., & BOOMER, R. B. (1959) Am. J. of Ophth. 48(3)II:336-337, "Changes in corneal astigmatism observed following surface diathermy to rabbit corneas"
2586. WILSON, A.S., SANCES, A., & LARSON, S.J. (1966), In: First International Symposium on Electrotherapeutic Sleep and Electroanesthesia. Graz, Austria, (12-17 Sept.), "Effects of electroanesthesia on acquisition and retention of behavior patterns in primates".
3066. WILSON, C.L. (1970), J. of Bone & Joint Surg., 52-A( ):1033-1040, "Experimental attempts to stimulate bone growth".
3067. WILSON, D.H. (1972), British Med. J., 2( ):269-270, (29 Apr.), "Treatment of soft-tissue injuries by pulsed [high frequency] electrical energy".
1809. WILSON, G. (1951) North Carolina Medical J. 12(1):19-23, "Treatment of fibrositis in the neck and shoulder with micro-therapy (radar)"
3672. WILSON, G.C. (1975), The Washington Post, (Wednesday, Dec. 10), p. A5 only, " '73 Report cites biological effects in radio project" [SANGUINE].
1810. WILTSCHEKO, W. (1968) Zeitschrift fur Tierpsychologie 25:537-, (In German), "A study of the influence of static magnetic fields on the migratory orientation of the robin (*Erethacus rubecula*)"
1811. WILTSCHEKO, W., & MERKEL, F. W. (1966) Zoologischer Anzeiger Suppl. 29:362-, (In German), "Orientation and migratory behavior of the robin in a static magnetic field"
1812. WIMMER, R. (1954) Report: (ERD-CRRC-TM-55-118) Atomic Warfare Directorate, Air Force Cambridge Research Center, Air Research and Development Command, "A survey and analysis of ultra-high-frequency measurement of dosimetry techniques"
1813. WINDLE, J., & SHAW, T. (1954) J. of Chemical Physics 22:1752-, "Dielectric properties of wool-water system at 3000 and 9300 MHz"
1814. WINDLE, J., & SHAW, T. (1956) J. of Chemical Physics 25:435-, "Dielectric properties of wool-water system at 26,000 MHz"
1815. WINGO, W. (1958) Washington Daily News, p. 6 only, (Sept. 3), "Navy warns of strange antenna"
1816. WISE, C. S. (1948) Arch. of Physical Med. 29:17-21, "Effect of diathermy on blood flow: plethysmographic studies"
1817. WISE, C. S., Castleman, B., & Watkins, A. L. (1949) J. of Bone & Joint Surgery, 31A(3):487-, "Effect of diathermy on bone growth in the Albino rat"
1818. WORDEN, R. E., HERRICK, J. F., WAKIM, K. G., & KRUSEN, F. H. (1948) Arch. of Physical Med. 29(12):751-758, "The heating effects of microwaves with and without ischemia"
3068. WRIGHT, G.G. (1973), Physiotherapy (British), 59(12):385-387, (Dec.), "Treatment of soft-tissue and ligamentous injuries in professional footballers [using pulsed, electromagnetic radiation]".
3343. WROBLEWSKI, T.E., ZARZECKI, K., & DENISIEWICZ, R. (1973), Mater. Med. Pol., 5( ):209-212, (In Engl.), "Duodenal ulcer in persons occupationally exposed to microwave radiation".
1819. WROMBLE, R. F. (Editor), (1968) Proc. of a Meeting to Discuss "Technical Considerations in the Measurement and Evaluation of Radiation Emissions from Microwave Ovens", National Center for Radiological Health, U. S. Dept. of Health, Education, and Welfare, Public Health Service, Rockville, Maryland
1820. WUDKA, E., & LEOPOLD, I. H. (1957) Arch. of Ophthalmology 58:829-849, "Experimental studies of the choroidal vessels: VI: Observations on the effects of physical agents"
3673. WULFSOHN, N.L., & SANCES, Jr., A. (eds.) (1970), The Nervous System and Electric Currents, (Proceedings of the 3rd Annual Nat. Conf. of the Neuro-Electric Soc., held in Las Vegas, Nev., Mar. 23-25, 1970), 184 pps., Plenum Press, New York.
3674. WULFSOHN, N.L., & SANCES, Jr., A. (eds.) (1971), The Nervous System and Electric Currents, Volume 2, (Proceedings of the 4th Annual Nat. Conf. of the Neuro-Electric Soc., held in San Antonio, Tex., Mar. 10-12, 1971), 228 pps., Plenum Press, New York.
3675. WYCKOFF, J.M. (1973), Proceedings of the Annual Meeting of the Institute of Environmental Sciences (19th), (Anaheim, Calif., 2-5 Apr.), pp. 130-135, "Measurements for radiation [ionizing and non-ionizing] safety."
3676. YADRINTSEV, V.A. (1975), Gigiyena Truda i Profess. Zabol'evaniya, (2):18-21, (In Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation"(JPRS #66512), (7 Jan. 1976), pp. 3-6, "Cerebral and peripheral circulation in persons handling sources of ultrahigh radio frequencies based on the results of rheographic examinations."
2293. YAGI, K. (1970) Nippon Acta Radiol. (Jap.) 30:184-204, (In Jap., with Eng. abstr., fig. titles, and biblio.), "Local aplastic bone marrow induced by microwave irradiation in rabbits; especially histological and histochemical studies"
2029. YAKIMENKO, D. I. (1961) Vest. derm. vener. 35:33-36, (In Russian) "Treatment of certain neurotrophic skin diseases with ultraviolet radiation and high-frequency currents in small doses"
1821. YAKOVLEVA, M. I. (1964) Section in: Chapter 8 of Outline of the Evolution of Nervous Activity, Meditsina Publ. House, Leningrad, pp. 202-, "The functional state of the sympathetic-adrenal system during the action of microwave electromagnetic fields."
1822. YAKOVLEVA, M. I. (1968) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva)69(9):9-11, "The study of efferent impulsion in postganglionic sympathetic fibres under the action of a SHF-UHF electromagnetic field" (Also cited as #656, this Biblio.)

1823. YAKOVLEVA, M. I. (1968) Zh. Vyshei Nervnoi Deyatel'nosti imeni i Pavlova, USSR, 18(3):418-424, (JPRS 46632; N68-37285), "The effect of SHF-UHF electromagnetic fields of conditioned reflex control of cardiac and respiratory activity"
3677. YAKOVLEVA, M. I. (1973), Physiological Mechanisms of the Action of Electromagnetic Fields, "Meditsina" Publishing House, Leningrad.
1824. YAKOVLEVA, M. I., SHLYAFER, T. P., & TSVETKOVA, I. P. (1968) Zh. Vyshei Nervnoi Deyatel'nosti imeni i Pavlova, USSR, 18(6):973-978, "Conditioned cardiac reflexes and the functional and morphological status of cortical neurons under the action of SHF-UHF electromagnetic fields" (Also cited as #658, this Biblio.)
1825. YAMAURA, I., & CHICHIBU, S. (1967) Tohoku J. of Experimental Med. 93(3):249-259, "Superhigh frequency electric field and crustacean ganglionic discharges"
3069. YAMAURA, I., & MATSUMOTO, G. (1972), Japanese J. of Medical Electronics, 10( ):25-32, (Jun.), (In Jap. w/Engl. abstr.), "Dynamic characteristics of crayfish stretch receptor for microwave radiation".
1826. YAO, K. T. S., & JILES, M. M. (1969) Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.), Bur. of Radiological Health, Division of Biological Effects, Rept. No. 70-2, pp. 123-133, "Effects of 2450 MHz microwave radiation on cultivated rat kangaroo cells"
2294. YAO, K. T. S., & JILES, M. M. (1970) In: Radiation Bio-Effects Summary Report, Hodge, D. M., (ed.), Jan-Dec 1969, Div. of Biological Effects, Bur. Rad. Health, DHEW (Rept. No. DHEW 70-1), pp. 185-187, "Effects of 2450 MHz microwave radiation on cultivated rat kangaroo cells"
2295. YAO, K. T. S., & JILES, M. M. (1970) In: Radiation Bio-Effects Summary Report, Hodge, D. M., (ed.), Jan-Dec 1970, Div. of Biological Effects, Bur. Rad. Health, DHEW, (Rept. No. DHEW 70-7), pp. 233-235, "Mortality patterns of microwave irradiated rat kangaroo cells in culture"
3070. YARRINGTON, C.T., Jr., & JAQUISS, G.W. (1969), Arch. of Otolaryng., 89( ):856-860, "Electrical control of bone growth in ossicles"
2588. YASHINA, L.N. (1972), Gigiyena Truda i Professional'nyye Zabolevaniya, (2):53-56 (LC Abstract), "Effect of low frequency pulsed magnetic field on the activity of oxidizing-deoxidizing enzymes in the liver of albino rats (histochemical investigation)".
3344. YASHINA, L.N. (1972), Gigiyena Truda i Professional'nye Zabolevaniya, 16(2):53-56, (Feb.), (In Russ.), "Effects of a pulsed low frequency magnetic field on the activity of redox enzymes in the albino rat liver: Histochemical investigation", [Inhibition of succinate dehydrogenase in hepatic tissue of rats exposed acutely to 900 Oe fields, or chronically to 300 Oe fields, pulse of 130 usec duration, 10 sec. between pulses, at a pulse modulation of 7 KHz]. (See also citation #2588, this Biblio.)
1827. YASNOGORODSKIY, Y. (1959) Voprosy Kurortologii, Fizioterapii i Lechebnoy Fizicheskoy Kul'tury (Problems in Health Resort Sci., Phyiotherapy, & Medical Physical Culture), Moscow, (6):563-567, (JPRS 3039D), "Conferences devoted to problems concerning the application of radioelectronics in medicine and biology"
1828. YASNOGORODSKIY, V. G. (1960) In: Elektronika v Meditsine (Electronics in Medicine), Gosenergizdat, Leningrad, pp. 228-232, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17, (Apr. 1965)), "Specifications for a high-frequency therapeutic apparatus; hygienic estimate of labor conditions during work with HF generators"
1829. YASUICHI, H. (1952) J. Chem. Soc. of Japan (Pure Chem. Sec.) 73:644-645, "Effect of ultra-high-frequency waves on the crystallisation process of salts"
- Zh.  
1830. YATSENKO, M. I. (1965) Fiziologicheskii/Akad. Nauk UKR SSR 11(4):516-519, "Effect of microwaves on the absorptive capacity of the synovial membrane of the knee joint when the spinal cord has been severed"
- Zh.  
1831. YATSENKO, M. I. (1966) Fiziologicheskii/Akad. Nauk UKR SSR 12(3):377-381, "Effect of microwaves on the absorptive capacity of the knee joint under the effect of atropine and carbocholine" (Also cited as #659, this Biblio.)
- Zh.  
1832. YATSENKO, M. I. (1968) Fiziologicheskii/Akad. Nauk UKR SSR 14(2):261-264, "Effect of microwaves on the absorptive capacity of the knee joint under conditions where adrenalin and aminazine have been introduced into the organism"
1833. YATTEAU, R. F. (1970) New England J. of Med. 283(26):1447-1448, "Radar-induced failure of a demand pacemaker"
1834. YEFIMOV, V. V. (1942) Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva) 14(2):61-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17 (Apr. 1965)), (Title not given) [A UHF field causes drowsiness in some species of animals]
1835. YELEAZAROVA, M. P. (1940) Klinika Fizicheskikh Metodov Lecheniya. Trudy, Moscow oblast', (4):177-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17 (Apr. 1965)), "Change in protein metabolism under the influence of a UHF field"
1836. YELISEYEV, V. V. (1964) Trudy Nii Gigiyena Truda i Profzabolevaniy AN SSSR (2):94-104, "Method of animal irradiation in the experimental study of the effects of radio frequency electromagnetic waves"
1837. YELISEYEVA, M. I. (1937) Biological Effect of Ultrahigh Frequencies, Symposium, Moscow, pp. 261-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept P-65-17 (Apr. 1965)), "Glycemic reactions of rabbits to a UHF field"
1838. YERMAKOV, Y. V. (1969) Voyenno Meditsinskiy Zh. (USSR Military Med. J.), (3):42-44, "Developmental mechanism of atheno-vegetative disorders in case of chronic exposure to UHF fields"
1839. YERMOLAYEV, YE. A. (1964) Voyenno-Meditsinskiy Zh. (USSR Military Med. J.), (9):22-26, (Abstr. in: Biological Effects of Microwaves, (ATD-P-65-68, (Sept. 1965), pp. 23-24, "Industrial Hygiene and Radiation Dosimetry Around UHF Sources"), "Evaluating the danger of SHF-UHF and x-radiation in the vicinity of radar stations"

1840. YERMOLAYEV, Y. A., & KOVACE, R. I. (1968) *Voyenno Meditsinskiy Zh.*, (USSR Military Med. J.), (1):55-59, "On the problems of the methods of estimating irradiation by SEP-UHF radiowaves"
1841. YERMOLAYEV, YE. A., SUBBOTA, A. G., & CHUKHLOVIN, B. A. (1967) *Voyenno Meditsinskiy Zh.* (USSR Mil. Med. J.) (7):45-49, (ACSI J3145), "The degree of standardization of microwave radiation in foreign armies - a literature review"
3678. YERSHOVA, L.K., & DUMANSKIY, Yu.D. (1975), *Gigiyena Naseleennykh Mest.*, (14):89-92, (in Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #L/5615), 10 Feb. 1976, pp. 1-4, "Physiological changes in the central nervous system of animals under the chronic effect of continuous microwave fields."
1842. YEVDOKIMOV, I. R. (1964) In: Biological Action of Ultrasound and Superhigh Frequency Electromagnetic Oscillations, Gorodetskiy, A. A., Academy of Sciences, Institute of Physiology, imeni A. A. Bogomolets, Kiev, "Ultraacoustic parameters of the blood in the dynamics of acute radiation sickness"
1843. YOUMANS, C. R., JR., BOURLIASOFF, G., ALLENSWORTH, D. C., MARTIN, W. L., & DERRICK, J. R. (1969) *Amer. J. of Surgery* 118:931-937, "Electroshock therapy and cardiac pacemakers"
3679. YOUMANS, H.D., & HO, H.S. (1975), *Health Physics*, 29( ):313-316 (Aug.), "Development of dosimetry for RF and microwave radiation—I: Dosimetric quantities for RF and microwave electromagnetic fields."
3680. YOUNG, L.B., & YOUNG, H.P. (1974), *Bulletin of the Atomic Scientists*, ( ):34-38 (Dec.), "Pollution by electrical transmission: The environmental impact of high voltage lines" [up to 765 KV].
3071. YOUNG, R.G. (1964), Presented at the 26th Annual General Motors Medical Conference, held in conjunction with the Industrial Health Conference, Pittsburgh, PA, (Apr. 12 & 13), "Value and limitations: [in the use of] Pulsed high frequency", [electromagnetic radiation in the treatment of injuries].
1844. ZABOTIN, A. I. (1965) In: Questions of Hematology, Radiobiology, and the Biological Action of Magnetic Fields, Tomsk, pp. 323-, "The effect of magnetic and electric fields on the rate and chemistry of photosynthesis"
1845. ZAGORCEL'KO, L. T. (1948) *Uspekhi sovremennoy biologii* 25:231-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, AFD Rept. P-65-17 (Apr. 1965)), (Title not given) [Exposure of occipital regions to UHF produces alterations in the course of consecutive visual images]
3681. ZAHNER, R. (1964), *Zeitschrift für vergleichende Physiologie*, 49( ):172-190, (in German), "Effects of the electrical field on the behavior of hamsters (*Mesocricetus auratus* Waterhouse)."
1846. ZABRACNIK, J. W., & CHEN, C. S. (1967) Digest of the 7th Internat. Conf. on Medical and Biological Engineering, (Jacobson, B., ed.), Stockholm, p. 402 only, "Bacterial lethality predictions during heating based on principles of similitude"
1847. ZAKRZHEVSKIY, YE. B., & MALYSEEV, V. M. (1964) *Voyenno Meditsinskiy Zh.* (USSR Military Med. J.), (10):15-19, (Abstr. ACSI-17232), "The chronic effect of an SEP-UHF electromagnetic field on the human organism - review of literature"
3682. ZALYUBOVSKAYA, N.P., GORDIYENKO, O.I., & KISELEV, P.I. (1975), *Problemy Gematologii i Perelivaniya Krovi*, 20(4):31-33, (in Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #66512), (7 Jan. 1976), pp. 30-32, "Action of electromagnetic fields of superhigh frequencies on erythrocytes preserved at low temperature."
1848. ZANINI, A. (1943) *Zentralblatt für die gesamte radiologie* 37:216 only, (Originally appeared in *Med. Ital.* 24:73-83, (1943); (In Italian)), Abstr. only, (in German), "Shortwave therapy in the non-expectorant bronchopneumonia in children"
1849. ZARET, M. M. (1959) Proc. 3rd Tri-Service Conf. on Biological Effects of Microwave Radiating Equipments (Suskind, C., ed.) 3:334-335, "Comments on papers delivered at Tri-Service Conference on Biological Effects of Microwave Radiation"
1850. ZARET, M. M. (1962) *Industrial Hygiene Review* 5:11-, "The biological effects of microwave radiation"
1851. ZARET, M. M. (1964) Report, 25 pages, (AD 608746; RADC TDR-64-273), "An experimental study of the cataractogenic effects of microwave radiation"
1852. ZARET, M. M. (1965) In: Life in Spacecraft, Proc. of the 16th Internat. Astronautical Congress, Athens, (A67-30769; Abstr. available as A66-10793), "Ophthalmic effects associated with ionizing and non-ionizing electromagnetic radiation fields"
1853. ZARET, M. M. (1965) *Annual Progress Report* (AD 615469), "Effects of electromagnetic radiation on biological systems"
1854. ZARET, M. M. (1966) *Annual Progress Report*, Zaret Foundation Inc., Scarsdale, N. Y., 22 pages, (AD 635943), (Also, Progress Rept. for 1967, 5 pages, (AD 654447; N67-86176)), "Ocular effects of microwave radiation"
1855. ZARET, M. M. (1967) *Annual Progress Report*, The Zaret Foundation, Inc., June 1966 to May 1967, 10 pages, (AD 654523; N67-35537), "Ophthalmic hazards of microwave and laser environments"
1856. ZARET, M. M. (1969) *Final Report on ARPA Project*, The Zaret Foundation, Inc., (AD 856712), "Effects of low-level microwave irradiation on heart rate in rabbits"
2296. ZARET, M. (1969) 40th Annual Sci. Meeting of the Aerospace Med. Assoc., San Francisco, "Ophthalmic hazards of microwave and laser environments"
3346. ZARET, M.M. (1971), *J. of Microwave Power*, 6(3):269-271, "Comments on 'Biological effects of microwaves - An overview'"
2030. ZARET, M. M. (1971) Proceedings of the "Biological Effects of Non-Ionizing Radiation" Symposium, IEEE Internat. Convention and Exposition, N. Y., (Rosenthal, S. W., chm.), (22-25 Mar), "Clinical aspects of non-ionizing radiation"
2589. ZARET, M.M. (1972), *IEEE Transactions on Biomedical Engineering*, BME-19(4):313-316, "Clinical aspects of non-ionizing radiation"
3072. ZARET, M.M. (1973), *Medical Trial Technique Quarterly*, 19( ):246-252, "Microwave cataracts".

3347. ZARET, M.M. (1974), New York State J. of Medicine, 74(11):2032-2048, (Oct.), "Cataracts following use of microwave oven", and letters of comment (pro and con) from: MICHAELSON, S.M., & OSEIPCHUCK, J. (pp. 2034-2035); CAFFENTER, R.L. (pp. 2035-2036); MERRIAM, G.R., Jr. (pp. 2036-2037); DONALDSON, D.D. (pp. 2037); APPLETON, B. (pp. 2037-2038); BOUCHAT, J.A. (pp. 2038-2039); and, response by ZARET, M. (pp. 2039-2048).
3683. ZARET, M.M. (1975), Eye, Ear, Nose, & Throat Monthly (for Otolaryngologist, p. 291-294), 54:49-52 (July), "Blindness, deafness, and vestibular dysfunction in a microwave worker."
1857. ZARET, M. M., CLEARY, S. F., PASTERNAK, B., EISENBUD, M., & SCHMIDT, H. (1961) Report (RADC TN-61-226), 110 pages, (AD 266831), "Occurrence of lenticular imperfections in the eyes of microwave workers and their association with environmental factors"
1858. ZARET, M. M., CLEARY, S. F., PASTERNAK, B., EISENBUD, M., & SCHMIDT, H. (1963) Institute of Industrial Medicine, N. Y. Univ. Medical Center, Final Report (RADC-TDR-63-125), (AD 413294), 142 pages, "A study of lenticular imperfections in the eyes of a sample of microwave workers and a control population"
1859. ZARET, M. M., & EISENBUD, M. (1961) Proc. 4th Tri-Service Conf. on the Biological Effects of Microwave Radiation, Vol. 1, (Payton, M. F., ed.) pp. 293-308, "Preliminary results of studies of the lenticular effects of microwaves among exposed personnel"
1860. ZARET, M. M., KAPLAN, I. T., & KAY, A. M. (1969) Proc. of the "Biological Effects and Health Implications of Microwave Radiation" Symposium, (Cleary, S. F., ed.) Bur. of Radiological Health, Division of Biological Effects, Rept. No. 70-2, pp. 82-84, "Clinical microwave cataracts"
1861. ZARET, M. M., MARTIN, C., & LYCIS, W. (1965) Ref?, "Investigation of hazard due to exposure to microwave radiation fields encountered in Naval operations"
1863. ZARZHEVSKIY, S. YA., & KARELIN, O. N. (1966) Voenno Meditsinskiy Zh., (USSR Military Med. J.), (12):pp?, (ACSI J1642), "The methods of calculating the protective zones in radar station areas"
1864. ZDECKI, S. (1967) Lekarz Wojskowy (Poland) 43(2):124-129, (PTD HT-23-1500-67; ATD Abstr. 20(5/124); & AD 845280), "Examination and rating of the organ of vision of persons exposed to microwave radiation with particular attention to the lenses of the eye"
1865. ZELLER, E.A., WAKIM, K.G., HERRICK, J.F., BENEDICT, W., & DAILY, L. (1951), Amer. J. of Ophthalmology, 34(9):1301-1304, "Influence of microwave on certain enzyme systems in the lens of the eye."
2590. ZEMAN, G.H., CHAPUT, R., GLASER, Z.R., & GERSHMAN, L.C. (1973), Armed Forces Radiobiology Research Institute, Bethesda, Md., Tech. Note #TN 73-5, (June), (AD #769-299), "Gamma-aminobutyric acid metabolism in rats following microwave exposure."
3073. ZEMAN, G.H., CHAPUT, R.L., GLASER, Z.R., & GERSHMAN, L.C. (1973), J. of Microwave Power, 8(3/4):213-216, [absence of changes in], "Gamma Aminobutyric acid metabolism in rats following microwave exposure".
1866. ZENDLE, R., & GOODALE, E. E. (1959) Health Physics 2:78-80, "Some unusual x-radiation dosimetry problems associated with radar installations"
1867. ZENINA, I. N. (1964) Trudy Nii Gigiyena Truda i Profzabolebniyamy SSSR (2):26-32, (Abstr. in: The Biological Action of Radio Frequency Electromagnetic Fields, Institute of Industrial Hygiene and Occupational Diseases, Academy of Medical Science, Moscow, USSR), "The effect of pulsed SHF-UHF fields on the central nervous system during single and continuous radiation"
3074. ZERVINS, A. (1973), Amer. Industrial Hygiene Assoc. J., 34(3):120-127, (Mar.), "Chick embryo development in a 26 KHz electromagnetic field." [The fertilized eggs developed normally in the EM field; the field did not affect the early differentiation of the organ systems; ...development, growth, and subsequent survival was within bounds of control group.]
1868. ZHUKHIN, V. A. (1938) Works of the Turkmens Med. Inst. 2(3-4):1-247, "Pathological and anatomical changes in certain animals under the general exposure to UHF electromagnetic fields"
1869. ZHUKHIN, V. A. (1967) Tr. Nauchno-issledovatel'skogo Inst. Fizich. Metodov Lecheniya, SSSR, (2) pp.?, "Pathomorphological changes occurring in the central nervous systems of animals exposed to ultrashort waves"
3684. ZHURAKOVSKAYA, N.A. (1975), Gigiyena Naselennykh Mest, (14):99-103, (in Russian), Transl. In: "Effects of Non-Ionizing Electromagnetic Radiation" (JPRS #L/5615), 10 Feb. 1976, pp. 13-16, "Effect of low-intensity high frequency electromagnetic energy on the cardiovascular system."
3348. ZHURAVLEV, V.A. (1973), Voen. Med. Zh. (3):64-67, (In Russ.), "The combined effects of a superhigh frequency field and an unfavorable microclimate on the body", [rats exposed to 10 cm radiation at 5 mW/cm<sup>2</sup> for 1 hr/day then to 40°C incubator showed increased WBC and hemoglobin content, a decrease in the no. of animals producing progeny, and in the size of the litter, altered sex ratio (more males), and histological changes (myocardium, liver, and spleen), compared to the "heat-stressed-only" group].
2591. ZHURAVLEV, V.A., & SEVAST'YANOV, V.V. (1972), Voenno Meditsinskiy Zhurnal, (3):pps?, "Method of exposing animals to UHF"
1870. ZILITINKEVICH, S. I., BALOBEI, F. P., BOGDANOVA, E. K., IVANOV, P. P., & KUZNETSOV, YU. V. (1967) Biomedical Engineering 1(3):177-179, (Translation of Med. Tekh. 1(3):59-62, 1967, (In Russian)), "Measuring apparatus for biological and medical investigations in centimeter range of radiowaves"
1871. ZIMMER, R. P., ECKER, H. A., & POPOVIC, V. P. (1971) IEEE Trans. on Microwave Theory and Techniques (Special Issue on Biological Effects of Microwaves) MTT-19(2):238-245, "Selective electromagnetic heating of tumors in animals in deep hypothermia"
2297. ZINJA, A. M., CORNOIU, M., VOICU, A., STRATIAT, I., & BUCUR, I. (1967) Cercet Balneol Fiziolter 8:612-621, (AG6-80778), "Histochemical studies on some alterations of the animal organism under the action of microwaves"

1872. ZORE, V. A., KIMEL'FEL'D, O. D., SUZDALEVA, V. V., KOBZYJEVA, L. P., & GENKINA, YE. S. (1967) *Biofizika* 12(1):124-126, (Abstr. ATD 15 (5/117); AP 7006956), "Complex dielectric permittivity of human blood serum in the 100-500 MHz range under normal conditions and during some diseases"
1873. ZUBENKO, P. M. (1940) Dnepropetrovsk Universitet. Institut. Fiziologii. Sbornik robot, (3):63-, (Abstr. in: The Biological Effects of Electromagnetic Fields - Annotated Bibliography, ATD Rept. P-65-17 (Apr. 1965)), "Mechanism of the action of UHF on gas exchange"
1874. ZUBKOVA, S. M. (1967) Author's Abstract of Candidate's Dissertation, Moscow, "Reaction of Excitable System of Paramecia to Microwave Irradiation"
1875. ZUBKOVA, S. M. (1968) *Trans. of the Moscow Society of Naturalists* 28:130-136, "Effects of electromagnetic fields on the regulation of motor functions in paramecia"
3075. ZUBKOVA, S.M., & NIKONOVA, V.A. (1969), *Trudy CNII Kurortologii i Fizioterapii*, 14( ) :34- ?, "Changes in the excitability of paramecia during chronic exposure to low-level microwaves".
3076. ZUBKOVA, S.M., & NIKONOVA, V.A. (1970), *Trudy Moskovskogo Obshchestva Ispytatelej Prirody*, 45( ) :79- ?, "Study of the possibility of a regulatory effect of microwaves on the excitability of paramecia".
1876. ZUBKOVA-MIKHAYLOVA, ?, & ALEKSEYEV, YU. N. (1968) *Biulleten Eksperimental'noi Biologii i Meditsiny (Moskva)* (1):115-118, "The effect of electromagnetic oscillations in the radio frequency spectrum on neurosecretion of the hypothalamus and on endocrine glands"  
(or *Istolozhnia*)
2298. ZUFAROV, K. A., & SIRKAIVAIS, V. B. (1979) *Zytologia* 12(2):144-151, (In Russ.), "Reactions of the mitochondria of the liver of white mice to the action of electromagnetic fields" [Swelling, lysis, and appearance of giant cells, at 10<sup>11</sup> Hz]
3349. ZULLI, L.P. (1968), *J. of the Amer. Podiatry Assoc.*, 58(8): pp. ?, (Aug.), "Pulsed high frequency electromagnetic energy for adjunctive care of foot lesions".

ZYDECKI, S. (See ZDECKI, S.)

3077. ZYDECKI, S. (1972), *Klinika Oczna (Warsaw)*, 42(1A):411-415, (Abstr. in *Excerpta Medica (Occupat. Hygiene & Industr. Health Section)*, 3(3):141 only (Apr. 1973)), "Ophthalmologic certification of physical fitness to work in the range of microwave radiation".
2592. ZYSS, R., & BOCYNSKI, W. (1972), *Otolaryngol. Pol.*, 26(4):398-406, (In Pol. with Engl. Summary), "Morphological changes in the cells of the organ of Corti following exposure to microwaves", [Developmental and morphological changes observed in the cells of the organ of Corti following exposure of Guinea pigs to 10 cm rad. at a level of 2 mw/cm<sup>2</sup> for 4 hrs/day over 25 or 50 days. Reported are: swelling or vacuolar degeneration of cytoplasm, pyknosis or swelling of nuclei, decreased content of glycogen and nucleic acid, and congestion and extravasations in the vascular stria. The authors suggest these changes have an influence on the decrease of bioelectric activity of the cochlea. The changes regressed within 30 days following cessation of the irradiation.]

#### UNSIGNED REPORTS AND ARTICLES

1877. Opening (and Closing) Speech made by the regent at the First Meeting of the S. I. R. B. (Soc. Internat. of Electro-Radio-Biology). Abstr. of the 1st Internat. Congress of Electro-Radio-Biology, Venice, (Cappelli, L., ed., Bologna, Italy), pp. 82-85, (1934) (English Translation)
1878. "Those most sensitive to electricity stand shock best", *Arch. of Physical Therapy* 16:625-626, (1935), (Abstr. in: *Science NewsLetter*, date?)
1879. "Ultrashort waves in medicine and biology", *Proc. of the 1st Ukrainian Conf. on Shortwave Studies*, Kharkov, *Comedizdat* (1936)
1880. Problems of the Metrics and Dosimetry and Ultrahigh Frequency in Biology and Medicine, Moscow (1937)
1881. Materials of the Leningrad Conference on VHF-MF Waves, Leningrad, (1937)
1882. Proceedings of First All-Union Conference (of Physicians, Biologists, & Physiologists) on the Problems of the Use of short and Ultrashort Waves in Medicine, Mediz, (Moscow), (1940)
1883. "Biological and therapeutic effect of a magnetic field and strictly-periodical vibrations", Perm, Molotov (1948)
1884. "Radar and cataracts", *J. Amer. Medical Assoc.*, 150(3):528 (4 Oct. 1952), (Also, *Nuc. Sci. Abs.* 4:339 (1957))
1885. "Health hazards in microwave radiation", *U. S. Military Air Transport Service Medical Information Letter*, No. 113, pp. 10-12 (1953)
1886. "Council on Physical, Medical, and Rehabilitation Therapy: Illegal Operations of Medical Diathermy Equipment", *J. Amer. Medical Assoc.* 156:1583-, (1954)
1887. "Critique of the biological hazards of microwave radiation", *Geo. Washington Univ., Washington, D. C.*, Rept. 36-21, (Nov. 1956)
1888. "Electromagnetic radiation hazards" (Classified), *Naval Air Defense Center, Proj. 4554*, (Oct. 1956)
1889. "Biomedical aspects of microwave radiation", (Classified), *School of Aviation Medicine, U. S. Air Force, Proj. 7783*, (Mar. 1956)

1890. "Symposium on Physiologic and Pathologic Effects of Microwaves", Institute of Radio Engineers Trans. on Medical Electronics PGME-4, 52 pages, (Feb. 1956)
1891. "Radar death calls for caution", Electronics (Business Edition), p. 26, (20 June 1957)
1892. "Health hazards; Information on microwave radiation (including ionizing radiation from electronic equipment)", Environmental and Occupational Health Information Letter No. 58; Headquarters Air Materiel Command, Wright-Patterson AF Base, Ohio, (Nov. 1957)
1893. Conference on Radio-Frequency Hazards; Minutes, Sponsored by Navy Dept., Bureau of Ships, Electronics Div. (Code 960), (Aug. 1957), (Also Minutes of 1958 Conf.)
1894. "Bibliography of microwaves and their biological effects", Prepared in cooperation with the Directorate of Technical Services, Rome Air Defense Center; Appendix E, p. 111-114, Proc. 1st Tri-Service Conf. on Biological Hazards of Microwave Radiation, (Pattishall, E. C., ed.) 1, (1957) (AF 1860011, AD 115603)
1895. "The biological effect of a SEF-CMF electromagnetic field, Trudy Voy. Med. Akad. i Kiroi, USSR, Leningrad (1957)
1896. "Microwave (radar) health hazards; health precautions for prevention of", Bureau of Medicine and Surgery, Department of Navy, Bused Notice 6260, (1958)
1897. "Radar radiation hazards", Electronics (Business Edition) 15-, (April 18, 1958)
1898. "Hazards of microwave electromagnetic radiation", New York Univ. College of Engineering, N. Y., (1958) 8 pages, (AD 624221; SETE-210-14)
1899. "Control of potential hazards to health from microwave energy", Army Regulation (A.R.) No. 40-583, (Sept. 1958), Superseded by Regulations of Sept. 1961)
1900. "Radio frequency hazards handbook", Bur. of Aeronautics of U. S. Air Force, T. O. 31-1-80, (Apr. 1958), (Revised Jan. 1959)
1901. "Hazards of microwave electromagnetic radiation", Report, N. Y. Univ. School of Eng. Sci. (AD 624221), (1958)
1902. "Health Hazards Information: Microwave radiation", U. S. Air Force Rept. AFP 160-613, pp. 1-10, (May 1958)
1903. "New biological effects of E-F radiation", Electronics 32:38-39, (1959), (From Proc. of the 12th Annual Conf. on Electrical Tech. in Med. and Biology)
1904. "Investigator's Conference on Biological Effects of Electronic Radiating Equipments", Tech. Report on Proj. 5543, RADC-TR-59-67, 45 pages, (AD 214693), (Jan. 1959)
1905. "Biological, Clinical, and Research Aspects of the New Bio-Electrical Approach to the Treatment of the Whole Patient", The Abraham J. Ginsberg Foundation, Invitational Symposium, New York, (June 1959)
1906. "Medical considerations of exposure to microwaves (radar)", Medical News Letter (Navy) 34(7):35-40, (Oct. 1959)
1907. "Radar hazards", National Safety News, Data Sheet 461, (1959)
1908. "Blood coagulation changes due to electromagnetic microwave irradiations", Report, St. Louis Univ., (DA-36039, SC-78122), (AD 229267), (1959)
1909. "Labor hygiene and the biological effect of radio frequency electromagnetic waves, summaries of reports", Moscow (1959)
1910. Digest of Technical Papers of 12th Annual Conf. on "Electrical Techniques in Medicine and Biology", (Schwan, H. P., Chm.), Rome Air Development Center, N. Y., TR-59-227, (Sponsored by Institute of Radio Engineers, AIEE, and Instrument Soc. of America; Phila., Pa.), (Nov. 1959)
1911. "Biological effects of radio frequency radiation: bibliography", Prepared by Rome Air Development Center and Midwest Research Institute, Kansas City, Mo., (ZADC TR 60205), (AD 244003), (1960)
1912. "How dangerous are microwaves?", British Medical J., pp. 1420-1421, (1960)
1913. Discussion on Ultrasonics and Microwave Radiation (at 3rd Internat. Conf. on Medicine & Electronics), Proc. of the Internat. Conf. on Med. Electronics in Medicine & Biol. Engineering 3:459-461, (1960);
1914. "Safety precautions relating to intense radio-frequency radiation", Her Majesty's Stationery Office, London (1960); Reprinted in: Radiation Control for Health and Safety Act of 1957 ("To provide for the protection of the public health from radiation emissions"), Hearings before the Committee on Commerce, United States Senate, 90th Congress, Second Session, Part 2, Serial No. 90-49, pp. 1571-1574, (May, 1958)
3350. "Hi-fi and living cells", Think. (Int. Bus. Mach.), pps. June 31-32, 1960, [unable to verify].
2299. "Important areas of electronic research; Compilation of statements by leaders in the field", (AD 253881), (1961).
1915. "Interim standard definitions of terms related to radio frequency radiation hazards", Prepared under Navy, Bureau of Ships, Contract with Midwest Research Institute, Contract No. NCB5-77142, (May 1961)
1916. "Electromagnetic radiation hazards", U. S. Air Force T. O. 31E-10-4, (Oct. 1961), Superseded by: "Ground Electronics Engineering - Installation Agency Standard", Tech. Manual, (May 1957)

3078. Report of "near-fatalities...directly or indirectly attributed to microwave energy" (p.2), and as described on pages 30-34 of the General Electric Report, Light Military Electronics Dept., Utica, entitled "RADHAZ (RF radiation hazard) Instrumentation", Approx. date 1962.
1918. "Questions of the Biological Effect of a SHF-UHF Electromagnetic Field, Summaries of Reports", Kirov Order of Lenin Military Medical Academy, Leningrad (1962)
1919. Methods of Protection Against the Action of Electromagnetic Fields with the Use of High-Frequency Generators, Moscow, (1962) (In Russian)
1920. "Bulletin on health hazards due to radar and similar installations and their prevention", Dusseldorf, (1962), (In German)
1921. In: The Biological Action of Ultrahigh Frequencies, Letavet, A. A., & Gordon, Z. V., (Eds.), (JPRS 12471), (N62-11902), (Feb. 1962), "Recommendations for conducting preliminary and periodic medical examination of workers using UHF sources", pp. 123-125; "Sanitary regulations in work with generators of centimeter waves", pp. 126-130; "Instructions on the method of measuring the power flux density of UHF energy at working positions", Appendix, pp. 131-133; "Bibliography of biological effects of UHF", pp. 134-142
1922. "Microwave effects on the human body: bibliography", (AD/46950), (1962) [Not presently avail. from DDC; "withdrawn by controlling agency"]
1917. "Final report: on biological effects of R-F radiation on macromolecules", Melpar, Inc., Falls Church, Va., (AD 284373), (Aug. 1962)
1923. "The 'Hyfrecator' for electro-desiccation, fulguration, and coagulation", Symposium on Electrodesiccation and Bi-active Coagulation; The Birtcher Corp., Los Angeles, 32 pages, (1963)
1924. "Neurological responses to external electromagnetic energy (A critique of available data and hypotheses)", Compilation of Material Presented at the Conf. at the Brain Research Inst., UCLA, (Adey, W. R., Chm.), 101 pages, (July 1963)
1925. Abstracts of the Conference on "Industrial Hygiene and the Biological Action of Radio Frequency Electromagnetic Fields", Inst. of Indust. Hygiene and Occup. Diseases, Acad. of Med. Sci., Moscow, (1963)
1926. Protection Against the Action of Electromagnetic Fields and Electric Current in Industry, Leningrad, (1963) (In Russian)
3132. "'Wake-up waves' [RF] being used on bulbs", [exposed gladiolus sprout], Science News Letter, 84( ):25 only, July 13, 1963.
2300. "The biological action of radio frequency electromagnetic fields and magnetic fields: Summary report" of the Panel on Magnetic, Radio Frequency, and Other Field Effects. Environmental Biology Committee, Space Science Board, 196-1, (163-23561), (Nov. 1963)
1927. "Soviets design clothing to protect workers from the effects of electric fields", Technical Digest (Czech) (9):79-, (Sept. 1964)
1928. "Threshold limit values for toxic chemicals and certain electromagnetic radiation", U. S. Army Report (TB MED-265), (April 1964)
1929. "Some biochemical changes in workers exposed to centimeter waves", Trans. of Soviet Bloc Sci. and Tech. Lit. (ATDP 6495; AD 460106), (1964)
1930. "Biological Effect of Ultrasound and UHF Electromagnetic Waves", Kiev, (1964), (In Russian)
1931. The Biological Effects of Electromagnetic Fields - An Annotated Bibliography of Soviet-Bloc Literature, Aerospace Technology Division, Library of Congress, ATD Rept. P-65-17, 45 pages, (AD 460705), (April 1965) [by DODGE, C. H.]
1932. Biological Effects of Microwaves: Compilation of Abstracts, (Survey of Soviet Scientific & Tech. Lit.), Aerospace Technology Div., Library of Congress, ATD Rept. P-65-68, 98 pages, (AD 621648), (Sept. 1965) [by DODGE, C. H.]
1933. "Biomedical microwave research", "Aerospace Technology Division Press, Library of Congress, 4(43):pp.?, (August 1965)
1934. "Radiation hazards", California Public Health, (Berkeley), pp. 1-12, (1965)
1935. "A standard method of determining field intensity and irradiation by electromagnetic waves in the RF and UHF bands for health purposes, preventive medical examinations of personnel and possibly of persons exposed to such radiation", Decree of the Czechoslovak Surgeon General, (1965), (In Czech.)
1936. "Control of hazards to health from microwave radiation", U. S. Army/Air Force, TB-MED-270/AFM-161-7, (Dec. 1965)
1937. "Effects of R-F energy on biological macromolecules, II", by Melpar, Inc., Falls Church, Va., for U. S. Army, Edgewood Arsenal, Md., (AD 618472), (1965)
3079. "Radiation hazards from electronic equipment", Rept., Canadian Standards Association, CSA Standard Z65-1966, (1966).
1940. "Sanitary regulations in work with sources of MF-LF and VHF-HF electromagnetic fields" (USSR No. 615-66), (1966), 11 pages.
1942. "UHF electromagnetic fields change behavior", Radiation 90(20):389-412, (1966)
1943. "UHF changes behavior", Science News 90(20):394 only, (1966)
1944. "Dog tests increase microwave concern", Technology Week, pp. 33-34, (1966)
1939. "Technical manual for radio frequency radiation hazards", NAVSHIPS 0900-005-8000, Dept. of the Navy, Naval Ship Systems Command, (July 1966)

2052. "Electromagnetic waves speed up potato growth rate", Glos Wybrzeza, (Rumania), \_:4-, (29 May 1966)
1941. "Safety level of electromagnetic radiation with respect to personnel", Report of U. S. of A. Standards Institute, Sponsored by U. S. Navy and Inst. of Electrical & Electronics Engineers, (USAS C95.1), (Nov. 1966); Also IEEE Trans. on Biomedical Engineering, BME-14(2):pp.?, (1967)
1938. "Ground electromagnetic interference and radiation hazards", Air Force Regulation AFR-100-6, (Supersedes AFR-66-19 of Oct. 1961), (Dec. 1966)
1949. "Report of shipboard electromagnetic radiation hazard measurements (aboard the USS DECATUR (DDG-31))", (U), (Classified), Naval Ship Systems Command, Dept. of the Navy, (March 1967).
1945. "Electronic (RF) safety", Abstr. from 'Safety Precautions for Shore Activities', Dept. of the Navy, NAVSO P-2455, (June 1967)
1947. "Radiation hazards", Abstr. from: 'Electronics Installation and Maintenance Book', Dept. of the Navy, NAVSHIPS 0967-000-0106, (formerly 900,000.100), (June 1967)
1946. "Microwave equipment", Chapt. G, p. 25-, in: Electrical Safety Guides for Research; Safety and Fire Protection Technical Bulletin #13, (Div. of Operational Safety, U. S. Atomic Energy Commission), (Dec. 1967)
3080. "Soviet Radiobiology", Aerospace Technology Division, Library of Congress, Rept. ATD-68-105-108-9, (AD #671 436), 12 March 1968, [Contains a number of abstracts of repts on electric, magnetic, and RF-microwave studies].
2301. "Resolution of Radio-Frequency Hazards Problems", Chief of Naval Operations Instruction (OPNAVINS 5191.10) of 24 Feb. 1968, ("To promulgate policy pertaining to the resolution of radio frequency hazard problems involving ordnance, personnel, and volatile materials, and to assign responsibilities in connection therewith")
1948. "The microwave oven - a benefit and a potential hazard", In Congressional Record - Senate, (8 July 1968), pp. 8231-8234
1950. "Radiation Control for Health and Safety Act of 1957" (to provide for the protection of the public health from radiation emissions), Hearings before the Committee on Commerce, U. S. Senate, 90th Congress, 2nd Sessions on S. 2067, S. 3211, and H.R. 10790, Part 1, 28, 29, 30 Aug. 1967; Part 2, 6-15 May 1968, Ser. No. 90-49; Government Printing Office (Referred to in this bibliography as "Senate Hearings 1967"), (1968)
1951. "Evaluation of microwave radiation hazard measurement equipment and techniques", Georgia Institute of Technology Research Proposal submitted to: National Center for Radiological Health, Department of Health, Education, and Welfare, (Dec. 1968)
1952. "Effects of radar on the human body", (AD 278172), (1969)
1953. "Biological effects of low intensity radio-frequency radiations", (bibliography), Allied Research Associates, Inc., Concord, Mass. Rept. No. ARA-5366, 104 pages, (1969)
2098. "Non-ionizing radiation - an introduction", Non-ionizing Fac. 1(1):5-6, (1969)
3081. "Microwave radiation called growing hazard [to man]", Electronic Design, 14( ):p. 28 only, (Jul. 5, 1969).
1954. Report of Chief of Naval Research, Chief of Naval Development (CNR-CND) Technical Working Group on Biological Effects of Non-Ionizing Radiation, Department of the Navy, (Aug. 1969)
3082. "Radiation biology: [Information] gathered at the 'Symposium on the Biological Effects of Microwave Radiation' Sept., 1969, in Richmond, VA", Science News, 96( ):276 only, (27 Sept.).
3083. "R-f pollution: A rising concern", Electronics, Editorial Comment, p. 31 only, Dec. 8, 1969.
3084. "Electromagnetic radiation hazard study at Site 487L, Silver Creek, Nebraska", EMC/Measurements Engineering Section, Engineering Division, Central GEEIA Region, Tinker AFB, Oklahoma, 1969.
2048. "Microwave conference", Proc. of the European Microwave Conf. held in London Sept. 1969, 570 pages. (1969 European Microwave Conf., IEE Conf. Publication 58, Dept. S 100, Institute of Electrical Engineers, Savoy Place, London WC2R OBL, England)
2053. "Electronic device for treating nervous system diseases", Nedelya, (Bulgaria), \_ (7):8-, (5 Feb. 1967)
2051. "A low field electron spin resonance study of the effect of radiation in living animals", Final report on Project No. 05-1927-01, Contract No. DA-49-146-XZ-560, Defense Atomic Support Agency, Wash., D. C., DASA-1952, (AD 816130), (June 1967)
1961. "Safety procedures for RF and microwaves (equipment)", Abstr. of Stanford Univ., in: Electrical Safety Guide/Crossfeed, Naval Aviation Safety Newsletter, Dept. of the Navy, NAVELIOS 7-35, (7), p. 2 only, (1970)
2594. "Industrial Heating: Putting power where it counts economically", Ref.?, [Discusses use of microwave power, with mention of control of radiation leakage, and emission control standard.], (1970?).
2595. "Survey of radiation levels generated by equipment used on EC-121 Aircraft, and clinical evaluation of selected crew members", U.S. Air Force Radiological Health Lab., (Wright-Patterson AFB) Tech. Rept. No. 70W-109, (1970).
2596. "The radar radiation hazard", Ref ?, pp. 77-78, (1970).
3086. "Microwave heating of human blood for massive transfusion", Items and Topics (Ohio Medical Products), 16( ):9-, (1970).  
(Madison, Wisconsin)
1957. "Voltage and violets for the insane", The World's Most Socialized Medicine (USSR), Life (Magazine) 68(2):42-43, (23 Jan. 1970)
1962. "Radarange (R) Microwave Oven Radiation Standards, Testing and Quality Control", Prepared for the 4th Annual Midyear Symposium of the Health Physics Soc., (Louisville, Ky., Jan. 1970), by Anaana Refrigeration, Inc.
1963. "Microwave cooker hazards", New Scientist 45(628):293 only, (19 Feb. 1970)

2606. "Public Law No.153 of May 25, 1972", J. of Statutes, No.21, Polish Peoples Republic, Warsaw, (June 8, 1972), [Concerning the safety of workers using equipment which generates electromagnetic fields in the microwave range].
2607. "Can microwaves hurt?" Microwave, 11(7):33, (Jul. 1972).
2608. "Microwaves and Pacemakers — Just how well do they go together?", J. of the Amer. Medical Assoc., 221(9):957-959, (Aug. 28, 1972).
2609. "Anti-Sex Machines", Parade Magazine (in The Washington Post, P.7, Sunday, Oct. 8, 1972), [Report of impotency experienced by male employees in an Italian furniture plant that uses high frequency electromagnetic tools].
3092. "A housewife's dream [i.e., microwave oven] is sick man's [cardiac electronic pacemaker wearer] nightmare", The Wall Street Journal, \_\_\_():34 only, Nov. 8, 1972.
3685. "Microwave health hazard; control of," BUMED INSTRUCTION 6470.13, Dept. of the Navy, Bureau of Medicine & Surgery, 10 November 1972.
2610. "Microwave Health Hazard; control of", Bureau of Medicine and Surgery (BUMED), Dept. of the Navy, BUMED Instruction 6470.13 of 10 Nov. 1972. [To outline the potential health hazards associated with the use of microwave equipment, including radar; to specify maximum personnel exposure levels, to provide medical surveillance guidance, and to require reporting of microwave overexposure incidents].
2611. "Research and development sources sought on [biological and behavioral] effects of [CW and pulsed] radio waves", Commerce Business Daily, No.PSA-5712, p. 18 only, (Dec. 6, 1972).
2612. "Microwaves — A public menace?", Medical World News, 13(46):4-5, (Dec. 8, 1972).
2613. "Radio waves cut hearing loss", Research/Development, News Notes Section, 23(12):8 & 10, (Dec. 1972).
3100. "Cargo hook RF-burn prevention", Fathom: Surface Ship & Submarine Safety Review (Navy), p. 7 only, Fall 1973.
3101. "Health hazards through microwaves: Dangers for [electronic] heart pacemakers", Z. Allgemeinmed, 49( ):1299-?, (In Ger.), 1973.
3102. "We want you to know about microwave oven radiation", Food & Drug Admn. Rept. DHEW Publication No. (FDA)73-8049, [including statement on 'radiation injuries']., 1973.
2615. "Microwave TV: Is a little too much?", Medical World News, 14(2):5-6, (Jan. 12, 1973).
2616. "Electric current sparks mammalian tissue regeneration", (Discusses work of BECKER, R.O. at the V.A. Hosp., Syracuse, N.Y., "Using electrical stimulation, he was able to get two types of human cells (stem cells and lymphocytes) to produce blastocytes, showing that regeneration is theoretically possible."), J. of the Amer. Med. Assoc., 223(5):483-484 & 494, (Jan. 29, 1973).
2618. "Program for control of electromagnetic pollution of the environment: The assessment of biological hazards of nonionizing electromagnetic radiation," Rept., Office of Telecommunications Policy, Executive Office of the President, 48 pps., (Mar. 1973).
3094. "Radiation Control for Health and Safety" Act of 1968 Hearings before the Committee on Commerce, U.S. Senate, 93rd Congress, 1st session on Public Law 90-602, Radiation Control for Health and Safety Act of 1968, held Mar. 8, 9, and 12, 1973 (U.S. Government Printing Office, Wash., DC, Serial No. 93-24).
2617. "Microwave oven safety", The Washington Post, Page 7, (Mar. 10, 1973).
2619. Electromagnetic News Report, Vol. 1, No. 1, March/April 1973, A bimonthly publication of R&B Enterprises (P. O. Box 328, Plymouth Meeting, Pa., 19462).
2620. "Microwaves", In: Lifeline, The Naval Safety Journal, 2(2):9 only, (Mar.-Apr. 1973). [An outline of the hazards from microwave equipment, as described in BUMED Instruction 6470.13 of 10 Nov. 1972 entitled "Microwave health hazards; control of", and a brief listing of safety precautions].
3095. "Techniques and instrumentation for the measurement of potentially hazardous electromagnetic radiation at microwave frequencies", American National Standard (American National Standards Inst., Inc., New York, NY), No. ANSI C95.3-1973, Apr. 20, 1973.
2621. "Microwave ovens: Not recommended. The popular models we tested leaked radiation at levels we can't be sure are harmless", Consumer Reports, 38(4):221-230, (Apr. 1973).
2622. "Biological effects, hazards, and medical uses of non-ionizing radiation", Short Course, Dept. of Mechanical Engineering, Massachusetts Institute of Technology, (June 25-29, 1973).
3686. Radiation Health Protection Manual, NAVMED P-5055, Dept. of the Navy, Bureau of Medicine & Surgery, 4 May 1973, and CHANGE TRANSMITTAL 1, "Personnel dosimetry requirements," 7 Feb. 1975, and CHANGE TRANSMITTAL 2, "Medical examinations," 19 June 1975.
3096. "The U.S. Navy is experimenting with electromagnetic radiation devices which, experts say, can disrupt operations of an enemy warship without damaging the vessel or injuring its crew", from the 'Wash. Whispers' column of U.S. News & World Report, \_\_\_():8 only, Aug. 20, 1973.
3097. [Voluntary] "Performance standard on leakage from industrial microwave systems", Internat. Microwave Power Institute (IMPI) Publication No. IS-1, August 1973.
3098. "What about microwave oven safety?", Advertisement of the General Electric Co. in Better Homes & Gardens, \_\_\_():116 only, September 1973.
3099. "Health hazards from exposure to microwaves", Report (No. EURO-3170) on an Evaluation Group convened (in Copenhagen, 22-23 Oct. 1973) by the Regional Office for Europe of the World Health Organization on 'Long-term Programme in Environmental Pollution Control in Europe'.

2061. "And now, microwave pollution—An expose of the damage wrought to humans by radar, electronic ovens, and TV transmission;" In: Moneysworth Magazine (In: Issue to be published, Dec. 73), (110 West 40th Street, New York, NY 10018).
3361. "Effects of electromagnetic radiation" [on biological materials], In: Interference Technology Engineers' Master (ITEM) - [GOLDBLUM, R.D., (ed.)], Directory and Design Guide, (Pub. by R&B Enterprises, P.O. Box 328, Plymouth Meeting, PA 19462), pp. 130-132, 1974.
3687. "The Navy research program in nonionizing radiation," Rept. prepared by: Ad Hoc Committee on the Navy Nonionizing-Radiation Research Program, Committee on Naval Medical Research, Division of Medical Sciences, Assembly of Life Sciences, National Academy of Sciences-National Research Council; Supported by: Office of the Surgeon General, U.S. Dept. of the Army, Contract DADA17-69-C-9084; 44 pps., 1974.
3103. "Electric fields influence sleep", in the Research Trendletter section of Industrial Research, 16(1):15 only, Jan. 1974, [weak VHF fields, in air, at brainwave frequencies, 'may even effect...emotions and behavior through action on harmones'; at UCLA School of Med.].
3355. "Screening procedure [using transcutaneous electrical stimulation or dorsal column stimulation at radio frequency] relieves chronic pain", J. of the Amer. Med. Assoc., 223(9):968-969, (Feb. 26, 1973).
3356. "Microwave Oven Radiation Protection Program", (Effective March 1, 1974), U.S. Army Regulation No. AR-40-44, (Jan. 21, 1974).
3688. "BUMED radiation effects advisory board; appointment, functions, and responsibilities of," BUMED INSTRUCTION 6470.12A, Dept. of the Navy, Bureau of Medicine & Surgery, 28 March 1974.
3104. "Electromagnetism and bone repair", Science News, 105(18):287 only, May 4, 1974, [describes work of BASSETT, PAWLUK, & PILLA].
3105. "Second report on 'Program for control of electromagnetic pollution of the environment: The assessment of biological hazards of non-ionizing electromagnetic radiation'", Office of Telecommunications Policy, May 1974.
3106. "Danger: Heavy waves", [concern for non-ionizing electromagnetic radiation bio-effects], Newsweek, p. 59 only, June 3, 1974.
3357. "Biological effects of electromagnetic radiation", BEEMR Digest, 1(1):40 pps., (A digest of current literature and a forum of communication produced quarterly for the U.S. Army Research Office by the Franklin Institute Research Labs. [Science Information Services], June 1974); Issue (2) dated Sept. 1974.
3358. "Changes in metabolism of nitrogenous substances in animal nerve tissue subjected to an electromagnetic field of ultrahigh frequency", Ukrain's'kyi Biokhimichnyy Zhurnal, 4(4):483-486, 1972, [Transl. in "Effect of nonionizing electromagnetic radiation", JPRS No. 62462, (July 1974), citation #3134, this Biblio., pps. 1-5].
3133. "Microwaves: Hazardous to your health?", Microwaves, 13(7):21 only, July, 1974.
3134. "Effect of non-ionizing electromagnetic radiation", Transl. of current Russ. language articles in the biological and medical sciences, JPRS #62462, 12 July 1974.
3135. "Radio waves: More harm than expected", Industrial Research, 16(8):34 only, August 1974.
3136. "Microwave emissions in the air: Are they a biological time bomb?", [brief rept. of the Rochester "Environmental Toxicity" Meeting, citation #3120, this Biblio.], Medical World News, ( ):22-23, August 2, 1974.
3360. "More radiation [microwave and laser] protection," [considered by British National Rad. Protection Board], Nature, 250( ):528 only. (Aug. 16, 1974).
3359. "How unseen microwaves are changing your life", U.S. News & World Report, pp. ? only, December 9, 1974.
3689. "Health hazards from exposure to microwaves," Health Physics, 28(1):69-73 (1975).
3690. "A summary of the ERMAC work session on nervous system and behavioral effects of nonionizing electromagnetic radiations," J. of Microwave Power, 10(2):127-140 (1975).
3691. "Compilation of Navy sponsored ELF biomedical and ecological research reports, Volume 1," Naval Medical Research and Development Command, Bethesda, MD, EMR Project Office, 747 pps. (AD #A015068 EMPRO-2-VOL-1), Feb. 1975.
3692. "Compilation of Navy sponsored ELF biomedical and ecological research reports, Volume 2," Naval Medical Research and Development Command, Bethesda, MD, EMR Project Office, 736 pps. (AD #A015069 EMPRO-2-VOL-2), Feb. 1975.
3693. Proceedings of the Fourth International Symposium on Electro-sleep and Electroanesthesia, associated with the Eighth Conference of the Neuroelectric Society, held in Paris, France, March 18-24, 1975.
3694. "Third report on 'Program for control of electromagnetic pollution of the environment: The assessment of biological hazards of nonionizing electromagnetic radiation'," Office of Telecommunications Policy, Executive Office of the President (April 1975). [See citation #2618, this Biblio., for 1st Report, and #3105 for 2nd Report.]
3695. "Microwave ovens: Caution urged," The Washington [DC] Star, p. C-3, April 2, 1975.
3696. "Effects of Non-Ionizing Electromagnetic Radiation," Collection of Soviet reports (in Russian), (Transl. as JPRS #64532, 72 pps.), 11 April 1975.
3697. "Radiation Hazards," Advisory Group for Aerospace Research and Development (AGARD), Paris (France), Aug. 1975. Presented at a Lecture Series in the Netherlands, 22-23 Sept. 1975, Germany, 25-26 Sept. 1975, and Norway, 29-30 Sept. 1975 sponsored by the Aerospace Med. Panel, and the Consultant and Exchange Program of AGARD (Report #AGARD-LS-78), 149 pps.
3698. "Laser hazards and safety in the military environment," AGARD Lecture Series No. 79 (AGARD-LS-79), Sept. 1975.

3109. (Continued)

- CZERSKI, P., & PIOTROWSKI, M. "Principles for evaluation safety doses of electromagnetic radiation at the range of 300-300,000 MHz".
- EDELWEJN, Z. "Investigations on the effect of microwave radiation on the functional state of the central nervous system".
- GIDYNSKI, A. "Use of thin-layer metallic shields for eye protection [from HF electromagnetic radiation]".
- KOLAKOWSKI, Z.E. "Audiometric tone perception in people working in microwave fields at various power densities".
- KOLAKOWSKI, Z.E., KRYCH, J., ZYDECKI, S., & YARECKI, R. "Evaluation of the transparency of human lenses exposed to microwave radiation".
- KUCIA, H. "Activity of the Central Institute for Labor Protection in the protection against electrical hazards".
- KUCIA, H. "Principles for evaluation of safety doses of electromagnetic radiation in the range of 0,1-300 MHz".
- MANCZARSKI, S. "Early studies in Poland of the biological action of electromagnetic fields, and future perspectives".
- MIKOLAJCZYK, H. "Endocrine reactions and changes in endocrine glands under the influence of microwaves".
- MIKOLAJCZYK, H. "Results obtained and future plans for investigation into the biological effects of microwave radiation, in the Department of Physical Hazards of the Institute of Professional Medicine in Lodz".
- MIKOLAJCZYK, H. "Thermal effect of microwaves on the chromogenic reaction of adrenaline in neutral solution".
- SIEKIERZYNSKI, M. "The effect of microwaves on iron metabolism in rabbits".
- SIEKIERZYNSKI, M., DZIUK, E., & FORGALSKI, W. "Studies of the iron binding capacity in human serum following exposure to microwave radiation".
- SZUBSKI, A. "Measurement of dielectric penetration of fluid substances and biological fluids with the use of waveguide".
2628. Proceedings of "Third Annual Meeting of the Joint Services Ad Hoc Committee on Microwave Ocular Effects", APPLETON, B. (Chmn.), held at Airlie House, Warrenton, Va., (Jan. 6-7, 1972).
2629. Proceedings of the 7th Annual Microwave Power Symposium, Sponsored by the International Microwave Power Inst., Ottawa, Canada, (24-26 May 1972),

Session 8 - "Biological Effects of Microwaves, I", OSEPCZUK, J.M. (Chmn.):

- CARPENTER, R.L., FERRI, E.S., & HAGAN, G.J., pp. 143-144, "Lens opacities in eyes of rabbits following repeated daily irradiation at 2.45 GHz".
- EVERTS, J.M., HERMAN, W.A., COLVIN, M.C., PORTER, C.R., & PHILLIPS, C.R., pp. 139-142, "Cytogenetic effect of microwave radiation in Chinese hamsters".
- FREY, A.H., & FELD, S., pp. 130-138, "Perception and avoidance of illumination with low power RF electromagnetic energy".
- GUY, A.W., LIN, J.C., & HARRIS, F.A., pp. 120-129, "The effect of microwave radiation on evoked tactile and auditory CNS response in cats".
- HUNT, E.L., PHILLIPS, R.D., CASTRO, R.D., & KING, N.W., p. 119, "General activity of rats immediately following exposure to 2450 MHz microwaves".
- MICHAELSON, S.M., pp. 145-147, "The relevancy of experimental studies of microwave-induced cataracts to man".
- PHILLIPS, R.D., HUNT, E.L., & KING, N.W., p. 118, "Vital functions of rats after exposure to 2450 MHz microwaves".

Session 10 - "Biological Effects of Microwaves, II", ROSENTHAL, S.W. (Chmn.):

- CARPENTER, R.L., FERRI, E.S., & HAGAN, G.J., pp. 196-197, "Perturbation of the microwave field by experimental animal and apparatus in biological research".
- FRAZER, J.W., MITCHELL, J.C., GASS, A.E., & HURT, W.D., pp. 167-168, "Exposure of biological specimens to high power HF band fields".
- FREY, A.H., & MESSENGER, R., pp. 169-177, "Psychophysical data on the RF hearing effect".
- GUY, A.W., & KORBEL, S.F., pp. 180-193, "Dosimetry studies on a UHF cavity exposure chamber for rodents".
- KRITIKOS, H., & SCHWAN, H., pp. 194-195, "The differential temperature rise at hot spots generated in lossy spheres by electromagnetic waves".
- RAJOTTE, R., VOSS, W.A.G., DOSSETOR, J.B., & STILLER, C.R., pp. 178-179, "Microwave defreezing of canine kidneys".

2630. Presentations made at the "Microwave Hazards Measurement and Dosimetry Workshop", held at Georgia Institute of Technology, Atlanta; Sponsored by Walter Reed Army Institute of Research and the Engineering Experiment Station of Georgia Tech., (1 & 2 June, 1972):

- BASSETT, H.L., & HUDDLESTON, G.K. (Engineering Experiment Station, Georgia Tech.), "Design of a microwave dosimeter".
- BOWMAN, R.R. (Nat'l Bureau of Standards), "Probes for measurements of electromagnetic fields".
- BURNS, C.P., & MAGIN, R.L. (Engineering Experiment Station, Georgia Tech.), "Potential medical and biological applications of electromagnetic radiation".
- GROVE, H.M. (Walter Reed Army Institute of Research), "An overview of the problem of microwave hazards measurement and dosimetry".
- GUY, A.W. (U. of Washington School of Medicine), "Infrared thermography in microwave/biological research".
- HIATT, R.E., & KNOTT, E.P. (U. of Michigan), "Use of RF magnetic probes for measurement of penetration of microwave energy in biological specimens".
- HOLLIS, J.S. (Scientific-Atlanta), "Pitfalls in electromagnetic field measurements".
- HOPFER, S. (General Microwave Corp.), "An ultrabroad band probe for RF radiation measurements".
- HUNT, E.L. (Battelle-Northwest Laboratories), "Absolute dosimetry for whole animal experiments".
- JUSTESEN, D.R. (Kansas City Veterans Administration Hospital), "Biodosimetry, [use of animal physiological or behavioral responses as indications of dose]".
- LARSEN, L.E. (Walter Reed Army Institute of Research), "Temperature and electro-physiological measurements in the presence of electromagnetic fields".
- MEYERS, B. (Hewlett-Packard Corp.), "Electromagnetic interference effects on medical instrumentation".

3712. Proceedings of the Symposium on Biological Effects of Natural Electric, Magnetic and Electromagnetic Fields (REITER, R., Chmn.), held during the 6th International Biometeorological Congress at Noordwijk, The Netherlands, 3-9 September 1972 (Published in Internat. J. of Biometeor., 17(3):205-308, (1973)).

- BACHMAN, C.H. (Syracuse U., NY), & REICHMANIS, M., "Barley leaf tip damage resulting from exposure to high electrical fields," pp. 243-251.
- BACHMAN, C.H. (Syracuse U., NY), & REICHMANIS, M., "Some effects of high electrical fields on barley growth," pp. 253-262.
- CALLOT, F., LECOEUR, J., & RIVOLIER, J. (Service Médical, Terres Australes et Antarctiques Française, Boulogne, France). (in French), "Study of a varying electrical field and its pathophysiological effects on the people wintering over in Kerguelen," pp. 233-238.
- GILBERT, G.O. (Pacific Lutheran U., Tacoma, WA), "Effect of negative air ions upon emotionality and brain serotonin levels in isolated rats," pp. 267-275.
- GOMERSALL, J.D. (U. of Sheffield, Whiteley Wood Clinic, England), & STUART, A., "Variations in migraine attacks with changes in weather conditions," pp. 285-299.
- HAUF, R. (Im Gärtle, Freiburg, Germany), & WIESINGER, J., "Biological effects of industrial electric and electromagnetic VLF fields," pp. 213-215.
- KITAGAWA, N. (Saitama U., Japan), KINOSHITA, K., & ISHIKAWA, T., "Discharge experiments using dummies and rabbits simulating lightning strokes on human bodies," pp. 239-241.
- KROGMAN, K.K. (Agriculture Canada Research Station, Lethbridge, Alberta, Canada), & HOBBS, E.H., "Evapotranspiration by beans during low-volume sprinkling," pp. 301-306.
- LOTT, J.R. (North Texas State U., Denton), & McCAIN, H.B., "Some effects of continuous and pulsating electric fields on brain wave activity in rats," pp. 221-225.
- LUDWIG, H.W. (D-2000 Norderstedt 3, Postfach 1349, Germany), "Shielding effect of materials in the ULF, ELF, and VLF region," pp. 207-211.
- OLIVEREAU, J.M. (Université de Paris, France), (in French), "Influence of negative air ions on the adaptation of the male rat to an anxiety-producing situation," pp. 277-284.
- PERSINGER, M.A. (Laurentian U., Sudbury, Ontario, Canada), & OSSENKOPP, K.P. (U. of Manitoba, Winnipeg, Canada), "Some behavioral effects of pre- and neo-natal exposure to an ELF rotating magnetic field," pp. 217-220.
- PERSINGER, M.A. (Laurentian U., Sudbury, Ontario, Canada), "Possible cardiac driving by an external rotating magnetic field," pp. 263-266.
- REITER, R. (Institut für atmosphärische Umweltforschung der Fraunhofer-Gesellschaft), "Introductory remarks," pp. 205-206.
- WEVER, R. (Max-Planck-Institut für Verhaltensphysiologie, Germany), "Human circadian rhythms under the influence of weak electric fields, and the different aspects of these studies," pp. 227-232.

2634. (Continued)

Session 22. Symp. on Magnetics in Bioengineering (MAASS, J.A., Chmn.):

- BATTOCLETTI, J.H., SANCES, A., Jr., LARSON, S.J., & HALBACH, R.E. (Medical College of Wisconsin), and BOWMAN, R.L., & KUDRAVCEV, V. (NHLI, Bethesda, Md.), "NMR Detection of low magnetization levels in flowing fluids".
- COHEN, D. (Massachusetts Inst. of Technology), "Technique for measuring ferromagnetic contamination in the human body".
- DRILLER, J. (Riverside Research Inst., N.Y.), "Magnetic materials as biological implants — Criteria for selection".
- GRYNSZPAN, F. (COPPE, Brazil), "Relationship between the magnetocardiogram and the electrical activity of the heart".
- HORACEK, M. (Dalhousie Univ., Halifax, Nova Scotia, Can.), "A digital model for studies in magnetocardiography".
- NEWBOWER, R.S. (Harvard Anesthesia Center, Boston, Mass.), "Magnetic fluids in the blood".
- WEISMAN, I.D., BENNETT, L.H. (National Bureau of Standards), & MAXWELL, L.R., Sr. (Naval Ordnance Lab.), "In vivo NMR relaxation studies of tumors".

2635. Workshop on "Electromagnetic Pollution", McKAY, H.D. (Chmn.), Rockville, Md., Hosted by: Bureau of Radiological Health (FDA/HEW), Office of Rad. Programs (EPA), and Committee AE-4 on Electromagnetic Compatibility (SAE), (May 7-8, 1973).

3363. International Committee of Military Medicine and Pharmacy Conference, May 22-26, 1973, Bucharest, Romania; Sponsored by the Internat. Committee of Mil. Med. & Pharm. and the Union of Societies of Med. Science (relevant presentations):

OLTEANU, M. (S.R. of Romania), "Effects of microwaves on the human eye: Radar chorioretinopathy".

2636. Digest of Tech. Papers, 1973 IEEE G-MTT Internat. Microwave Symp. (MALEY, S.W., ed.), "Applications in the 70's", held in Boulder, Colo., (4-6 June 1973):

Session 11. Microwave Techniques in Biological Research (ALTSCHULER, H.M., Chmn.):

- BIGU DEL BLANCO, J., & ROMERO-SIERRA, C. (Queens University, Kingston, Ontario, Canada), & TANNER, J.A. (National Research Council of Canada, Ottawa, Can.), pp. 268-270, "Bird feathers as dielectric receptors of RF fields".
- HO, H.S., GINNS, E.I., & CHRISTMAN, C.L. (Bureau of Radiological Health, Rockville, Md.), pp. 255-256, "Environmentally controlled waveguide irradiation facility".
- KRAMAR, P., EMERY, A.F., GUY, A.W., & LIN, J.C. (Univ. of Washington, Seattle, Wash.), pp. 265-267, "Theoretical and experimental studies of microwave induced cataracts in rabbits".
- LARSEN, L.E. (Walter Reed Army Inst. of Res., Wash., D.C.), MOORE, R.A., & ACEVEDO, J. (Westinghouse Defense & Electronic Systems Center, Baltimore, Md.), pp. 262-264, "An RF decouples electrode for measurement of brain temperature during microwave exposure".
- LIN, J.C., JOHNSON, C.C., & GUY, A.W., (Univ. of Washington, Seattle, Wash.), pp. 257-259, "Power deposition in a spherical model of man exposed to 1-20 MHz EM fields".
- TRZASKA, H., (Tech. Univ. of Wroclaw, Poland), p. 254, "Geoelectric discontinuity detector".
- VETTER, R.J., ELLE, D.R., & ZIEMER, P.L. (Purdue University, West Lafayette, Ind.), pp. 260-261, "Application of nonthermal effects in high dielectric materials to microwave dosimetry".

Session 15. Biological Effects of Microwave Radiation, (MILLS, W.A., Chmn.):

- CHOU, C.K., & GUY, A.W. (Univ. of Washington, Seattle, Wash.), pp. 318-320, "Effect of 2450 MHz microwave fields on peripheral nerves".
- GUY, A.W., TAYLOR, E.M., ASHLEMAN, B., & LIN, J.C. (Univ. of Washington, Seattle, Wash.), pp. 321-323, "Microwave interaction with the auditory systems of humans and cats".
- HAIDT, S.J., & McTIGHE, A.J. (Bureau of Radiological Health, Rockville, Md.), pp. 324-325, "The effect of chronic, low-level microwave radiation on the testicles of mice".
- RABINOWITZ, J.R., (N.Y. Univ. Med. Ctr.), pp. 314-315, "Possible mechanisms for the biomolecular absorption of microwave radiation with functional implications".
- SCHMIDT, D.E., SCHMIDT, M.J., ROBISON, G.A., & WILSON, L.K. (Vanderbilt Univ., Nashville, Tenn.), pp. 326-327, "Microwave irradiation sacrifice: Application in neurochemical research".

(Continued)

2636. (Continued)

Workshop: Biological Effects of Microwave Radiation, (ROSENTHAL, S.W., Moderator):

GIAROLA, A.J., & KRUEGER, W.F. (Texas A&M Univ.), pp. 337-338, "Continuous exposure of chicks to electromagnetic fields".

LIU, L.M., SKEWES, G.W., ROSENBAUM, F.J. (Washington Univ., St. Louis, Mo.), & LINDAUER, G.A. (Emerson Electric Co., St. Louis), pp. 333-334, "Further experiments seeking evidence of nonthermal biological effects of microwave radiation".

LORDS, J.L., DURNEY, C.H., BORG, A., & TINNEY, C. (Univ. of Utah, Salt Lake City), pp. 335-336, "Bradycardia in isolated hearts induced by microwave irradiation".

MICHAELSON, S.M. (Univ. of Rochester, N.Y.), & SCHWAN, H.P. (Univ. of Pennsylvania, Phila.), pp. 330-332, "Comparative aspects of radiofrequency and microwave biomedical research".

3364. Digest of Tech. Papers, 1973 IEEE G-MTT Internat. Microwave Symp. (MALEY, S.W., ed.), "Applications in the 70's", held in Boulder, Colorado, (June 4-6, 1973): (presentation inadvertently omitted from citation #2636, this Biblio.)

TAYLOR, E.M., GUY, A.W., ASHLEMAN, B., & LIN, J.C. (U. of Washington, Seattle, WA), pp. 316-317, "Microwave effects on central nervous system attributed to thermal factors".

3365. First Prague Symposium on Rheumatology, June 13-15, 1973; Sponsored by the Czechoslovak Medical Society (relevant paper presented):

SVARCOVA, J. "Treatment of joint diseases with microwaves".

3366. 18th Annual Meeting of Health Physics Society, Miami Beach, FL, June 17-21, 1973 (relevant presentation):

TAYLOR, J. (USAHA, Dept. of the Army, Aberdeen Proving Ground, MD), "Review of microwave standards".

2637. IEEE Internat. Symp. on Electromagnetic Compatibility, New York, N.Y., (relevant presentations), (June 20-22, 1973)

Session 1B. "Electromagnetic Pulse (EMP)", (SHERMAN, R., Chmn.):

DAHLEN, G., "A survey of Swedish electromagnetic pulse (EMP) research".

Session 2B. "Biological Hazards from RF energy", (ROSENTHAL, S., Chmn.):

BIGU DEL BLANCO, J., ROMERO-SIERRA, C., & TANNER, J.A., "Radio Frequency fields: A new ecological factor".

KALL, A.R., "Studies of RF biological hazards from high power transmitters operating in the HF band".

RASHID, A., "Mathematics of interaction between blood and electromagnetic fields".

SCHMITT, O.H., & TUCKER, R.D., "Human perception of moderate — strength, low frequency magnetic field".

Session 3B. "Radio Frequency Radiation Hazards to Ordnance EED'g", (SETH, C., Chmn.):

CAINE, S., "Overview of the DoD electromagnetic hazards program".

Session 4A, MILLER, D. (Chmn), SMYTH, N., FLINK, R., MITCHELL, J., MALIK, J., & FRAZIER, M., "EMC and the Pacemaker — A Panel Discussion".

3110. International Symposium on Dynamics and Controls in Physiological Systems; and, The American Physiological Society 24th Annual Fall Meeting, August 19-24, 1973, University of Rochester, Rochester, New York.

APS Session 53. "Hyperbaria and Radiation" (MICHAELSON, S.M., Chmn.)

HOUK, W.M., MICHAELSON, S.M., & LONGACRE, A. Jr. (University of Rochester, Rochester, NY), "Thermal regulation in Long-Evans rats exposed to 2450 MHz microwave radiation".

PHILLIPS, R.D., HUNT, E.L., & KING, N.W. (Battelle Pacific Northwest Laboratories, Richland, WA), "Physiologic response of rats to hypothermia induced by exposure to 2450 MHz microwave radiation".

3367. International Genetics Society of America, "13th International Congress", August 20-29, 1973, Berkeley, California (relevant presentations):

MITTLER, S. (Northern Illinois Univ., DeKalb), "Low frequency electromagnetic radiation and genetic aberrations in *Drosophila melanogaster*".

COHEN, B.H. (Johns-Hopkins University School of Hygiene and Public Health, Baltimore, MD), "Paternal radiation, radar exposure and mongolism".

3368. Institute of Electrical & Electronics Engineers G-AP Internat. Symposium and USNC/URSI Meeting, Boulder, Colorado, August 21-24, 1973 (relevant presentations):

- BELDEN, L.H. "Diode probe for detection of microwave leakage".
- BOWMAN, R.R., & BELSHER, D.R. (National Bureau of Standards, Boulder), "Isotropic electric-field probes: Three new models".
- CHEN, K.H. (Michigan State U., E. Lansing), & HOOPINGARNER, T. "Cytological damage to chromosomes of living cells due to microwave radiation".
- CRAWFORD, M.L. (Nat'l Bureau of Standards, Boulder), "Generation of standard EM fields using TEM transmission cells".
- DURNEY, C.H. (U. of Utah, Salt Lake City), GROW, R.W., SORENSON, K.L., & URE, R.W., Jr. "A microwave cumulative radiation personnel dosimeter".
- ECKER, H.A., & CAIN, F.L. (Georgia Inst. of Technology, Atlanta), "Illumination systems for research on biological effects of electromagnetic radiation".
- GIAROLA, A.H., KRUEGER, W.F., BRADLEY, J.W., & SHREKENHAMER, A. (Texas A&M Univ., College Station), "Preliminary results of the effect of electromagnetic fields on fecundity in birds".
- GREENE, F.H. (Nat'l Bureau of Standards, Boulder), & FRAZER, J.W. (USAF School of Aerospace Medicine, Brooks AFB, TX), "Development and construction of an electromagnetic near-field synthesizer for the HF band".
- GUY, A.W. (U. of Washington, School of Medicine, Seattle), "Electromagnetic interactions with biological materials".
- HERMAN, W.A., & BASSEN, H.I. (Bureau of Radiological Health, Rockville, MD), "Microwave power density calibration utilizing the power equation concept".
- JOHNSON, C.C., & DURNEY, C.H. (U. of Utah, Salt Lake City), "A theoretical estimation of tissue anisotropy effects on electromagnetic power deposition (0.1 to 100 MHz)".
- OLSEN, R.G., JOHNSON, C.C. (U. of Utah, Salt Lake City), ROZZELL, T.C. (Office of Naval Research, Arlington, VA), DURNEY, C.H., & LORDS, J.L. (U. of Utah, Salt Lake City), "Microwave transparent temperature sensor".

3111. "Third Internat. Cong. of the International Radiation Protection Association (IRPA), Washington, D.C., Sept. 9-14, 1973.

Session 2A. "Non-Ionizing Radiation", (JANNET, H. (France) Chmn.)

- CARPENTER, R.L., FERRI, E.S., & HAGAN, G.J. (Bureau of Radiological Health), "Pitfalls in the assessment of microwave radiation as a hazard".
- MICHAELSON, S.M. (Univ. of Rochester), "Biological effects and exposure standards for non-ionizing electromagnetic energies".
- SUESS, M.J. (World Health Organization), "The long-term programme on non-ionizing radiation protection of the World Health Organization, Regional Office for Europe".

Session 2A. Rapporteur Presentations, (CLEARY, S. (USA) Rapporteur)

- IIDA, H., & KOSHIJIMA, T. (Japan), "Public health and control of non-ionizing radiation in Japan".
- LEITH, I.S. (Australia), "A calibration facility for microwave monitors; design and operating experience".
- LIBERMAN, A.N., BRONSHTEYN, I.E., OROBEY, V.V., SAKOVSKAYA, M.S., CHESNOKOVA, A.P., & SHUBIK, V.M. (USSR), "Combined effect of ionizing radiation and a superhigh-frequency field on the body".
- WUKASCH, M.C., & THIEL, J.F. (USA), "Progress in the reduction of microwave exposure from microwave ovens, used in commercial food vending operations".

Plenary Session. (VILLFORTH, J.C. (USA), Chmn.)

- JANNET, H. (France), "Protection problems involved by non-ionizing radiation".

3112. International Microwave Power Institute (IMPI) "Symposium on Microwave Power", Sept. 10-13, Univ. of Technology, Loughborough, U.K.

Session 1B. "Biomedical Applications and Effects" (VOSS, W.A.G., Univ. of Alberta, Canada, Chmn.)

- ALMASSY, G., & MISIK, S. (TKI, Budapest, Hungary), "Determination of the properties of the bound water in biological samples by microwave methods".
- BAILLIE, H.D. (Ancoats & Crumpsall Hospitals, Manchester, UK), "A limited review of the recent biological effects of microwave radiation".
- FERRI, E.S., CARPENTER, R.L., & HAGAN, G.J. (Northeastern Radiological Health Laboratory, Winchester, MA), "Use of a dielectric lens in microwave irradiation of animal subjects".
- GRANT, E.H. (Queen Elizabeth College, London, UK), "Dielectric studies on biological materials near 1 GHz: Biophysical and medical implications".

(Continued)

3112. (Continued)

Session 2A. "Microwave Heating Applications" (Relevant to this Biblio.), (TINGA, W.R., Univ. of Alberta, Canada, Chmn.)

KASHYAP, S.C., & LEWIS, J.E. (Univ. of New Brunswick, Fredericton, Can.), "Microwave processing of tree seeds", [for germination enhancement].

Session 2B. "Biomedical Effects I", (ROSENTHAL, S.W., Polytechnic Inst. of Brooklyn, NY, Chmn.)

CZERSKI, P., & PAPROCKA-SLONKA, E. (National Res. Inst. of Mother & Child, Warsaw, Poland), "Microwave irradiation and the circadian rhythm of bone marrow cell mitoses".

GINNS, E.I., RUGH, R., HO, H.S., LEACH, W., GILLESPIE, L., BUDD, R., & HAZZARD, D.D.G. (U.S. Dept. of Health Education & Welfare, Rockville, MD), "Microwave biological effects under reproducible dosimetric environmental conditions".

ROZZELL, T.C. (Office of Naval Research, Arlington, VA), JOHNSON, C.C., DURNEY, C.H., LORDS, J.L., & OLSEN, R.G. (Univ. of Utah, Salt Lake City), "A nonperturbing temperature sensor for measurements in electromagnetic fields".

TOLER, J.C. (Georgia Institute of Technology, Atlanta), "Accurate measurement of microwave fields for medical and biological applications".

Session 3A. "Microwaves In the Food Industry" (KENT, M., Torry Res. Station, Aberdeen, UK, & DECAREAU, R.V., U.S. Army Natick Labs., Natick, MA, Chmn.)

ALEXANDER, D.W. (US Army Natick Labs.), "Process parameters for continuous microwave sterilization".

ARMBRUSTER, G., & ECROYD, L. (Cornell Univ., Ithaca, NY), "The use of pulsed heating periods in 915 MHz and 2450 MHz microwave cooking of meat".

MUDGETT, R.E., TO, E., WANG, D.I.C., & GOLDBLITH, S.A. (Massachusetts Inst. of Technology, Cambridge), & DECAREAU, R.V. (US Army Natick Labs, Natick, MA), "Dielectric measurements of food materials".

OHLSSON, T., & BENGTSSON, N. (Swedish Institute for Food Preservation Res., Goteborg, Sweden), "Development of a Pilot-Plant microwave food sterilizer and results of preliminary experiments".

OHLSSON, T., BENGTSSON, N. (Swedish Inst. for Food Preservation Res., Goteborg, Sweden), & RISMAN, P.O. (Husqvarna AB, Husqvarna, Sweden), "Dielectric data of foods at 915 MHz and 2.8 GHz as a function of temperature: A comparison".

RZEPECKA, M.A., & PEREIRA, R.R. (Univ. of Manitoba, Winnipeg, Can.), "Dielectric properties of dairy products at 2450 MHz".

Session 3B. "Biomedical Effects II", (RICKETTS, C.R., Medical Res. Council, UK; & MICHAELSON, S.M., Univ. of Rochester, N.Y., Chmn.)

BIGU del BLANCO, J., ROMERO-SIERRA, C. (Queen's Univ., Ontario, Can.), & TANNER, J.A. (National Res. Council, Ottawa, Can.), "Effect of microwave radiation on the nastic response of some sensitive plants".

LANGLEY, J.B., YEARGERS, E.K., SHEPPARD, A.P., & HUDDLESTON, G.K. (Georgia Inst. of Technology, Atlanta), "Effects of microwave radiation on enzymes".

LAWRENCE, J.C. (Medical Res. Council Unit, Birmingham, UK), "Effect of microwaves on isolated skin".

McAFEE, R.D., CAZENAVETTE, L.L., & HOLLAND, M.G. (University School of Medicine, New Orleans, LA), "Screening for cataracts".

MILROY, W.C., O'GRADY, T.C., & PRINCE, E.T. (Naval Weapons Laboratory, Dahlgren, VA), "Electromagnetic pulse radiation: A potential biological hazard?".

PHILLIPS, R.D., KING, N.W., HUNT, E.L. (Battelle Northwest Labs, Richland, WA), "Thermoregulatory, cardiovascular and metabolic response of rats to single or repeated exposures to 2450 MHz microwaves".

Session 4B. "Equipment Safety and Interference", (OSEPCHUK, J.M., Raytheon Company, Waltham, MA, Chmn.)

ASLAN, E. (Narda Microwave Corp., Plainview, NY), "A broad-band isotropic probe for microwave power density measurements".

McREE, D.I. (National Inst. of Environmental Health Sciences, Res. Triangle Park, NC), "Determination of energy absorption of microwave radiation using the cooling curve system".

MOBLEY, M.C. (Federal Communications Commission, Laurel, MD), "Revisions of Federal Communications Commission type-approval test procedures".

OSEPCHUK, J.M. (Raytheon Res. Division, Waltham, MA), FOERSTNER, R.A., & McCONNELL, D. (Amana Refrigeration, Inc., Amana, IA), "Computation of personnel exposure in microwave leakage fields and comparison with personnel exposure standards".

(Continued)

3114. (Continued)

ROHL, D., LAUN, H.M., HAUBER, M.E.T., VOIGT, H., & STAUNCH, M. (Univ. of Ulm & AEG-Telefunken Co., Ulm, Ger.), "Susceptibility of cardiac pacemakers to radar interference".

VAN de GRIEK, A., & BRITAIN, R.G. (U.S. Department of Health, Education, & Welfare, Rockville, MD), "Amendments to the US Department of Health, Education, and Welfare microwave oven performance standard".

Panel Discussion. "Biological Effects - Radiation Standards - Equipment Limitations", (GALLAGHER, J.C., Univ. of Bradford, UK, Chmn.).

3113. "Conference on Electrically Mediated Growth Mechanisms in Living Systems", The New York Academy of Sciences, Sept. 19-21, 1973, New York, (LIBOFF, A.R., & RINALDI, R.A., Conf. Chmn.).

Session I. "Biological Studies", (MINKIN, C., Univ. of Southern Calif., Los Angeles, CA, Chmn.)

BASSETT, C.A.L., PAWLUK, R.J., & PILLA, A.A. (Columbia Univ., NY), "Electrical effects in biological systems".

BECKER, R. (Veterans Administration Hospital, Syracuse, NY), "The basic biological data transmission and control system influenced by electrical forces".

BECKER, R., CONE, C.C., JAFFEE, L.F., PARSEGLIAN, V.A., POHL, H., & WEISS, L. "Panel Discussion: The role of electrical potential at the cellular level in growth and development".

BRICK, I., SHAEFFER, B., SHAEFFER, H., & GENARO, J.F. (New York Univ.), "Electrokinetic properties and morphological characteristics of amphibian embryo gastrula cells".

BRIGHTON, C., & FRIEDENBERG, Z. (Univ. of Pennsylvania, Phila.), "Electrical stimulation and oxygen tension".

CONE, C.D. (Eastern Virginia Medical School, Hampton), "The role of the surface electrical transmembrane potential in normal and malignant mitogenesis".

ERIKSSON, C. (Karolinska Institutet, Stockholm, Sweden), "On electrically induced bone formation".

FREY, A.H. (Randomline, Inc., Willow Grove, PA), "Differential biological effects of pulsed vs. continuous electromagnetic fields of the same carrier frequency".

GENSLER, W. (Univ. of Arizona, Tucson), "Bioelectric potentials in higher plants and their relation to growth factors".

GUZELSU, A.M. (Scientific & Technical Res. Council), & AKCASU, A. (Univ. of Istanbul, Turkey), "A piezoelectric model for nerve conduction".

HARRINGTON, D.B. (New York Univ.), "Effects of small amounts of electric current at the cellular level".

JAFFEE, L.F., NUCCITELLI, R., & ROBINSON, K.R. (Purdue Univ., Lafayette, IN), "Transcellular currents, self-electrophoresis and cell development".

PARSEGLIAN, V.A. (National Inst. of Health, Bethesda, MD), "Changes in electrostatic potential expected from cell contact".

RINALDI, R.A., SHAMOS, M.H. (New York Univ.), & LAVINE, L. (S.U.N.Y. Downstate Medical Center, Brooklyn, NY), "Uptake of tritiated thymidine during electrical stimulation of living tissue".

ROMERO-SIERRA, C. (Queen's Univ., Kingston, Can.), & TANNER, J.A. (National Res. Council, Ottawa, Can.), "Biological effects of non-ionizing radiation: An outline of fundamental laws".

TANNER, J.A. (National Res. Council, Ottawa, Can.), & ROMERO-SIERRA, C. (Queen's Univ., Kingston, Can.), "Beneficial and harmful accelerated growth induced by the action of non-ionizing radiation".

TELFER, W., & WOODRUFF, R. (Univ. of Pennsylvania, Phila.), "Electrical potential and transport across inter-cellular bridges".

WEISS, L. (Roswell Park Memorial Inst., Buffalo, NY), "Electrical heterogeneity of cell surfaces".

Session II. "Physical and Chemical Studies", (ROSENBERG, B., Michigan State Univ., Chmn.)

ATHENSTADT, H.A. (Inst. of Physical Chemistry, Julich, W. Germany), "Pyro and piezoelectric properties of vertebrates".

BLACK, J. (Univ. of Pennsylvania, Phila.), "Strain related potentials in living bone".

DIGBY, P.S.B. (McGill Univ., Montreal, Can.), "Electric fields in calcifying tissue".

FUKADA, E. (Inst. of Physical & Chemical Res., Saitama, Japan), "Piezoelectric properties of organic polymers".

FUKADA, E., LANG, S.B., MASCARENHA, S., PILLA, A., SHAMOS, M.H., & STANLEY, H.E., "Panel Discussion: The electro-physical and electrochemical properties of living tissue".

(Continued)

3113. Session **II** (Continued)

- LANG, S.B. (Univ. of The Negev, Beersheba, Israel), SOREMI, E.A., & STIPANICH, N. (McGill Univ., Montreal, Can.), "Mass transfer of bone in vitro under the effect of applied stress".
- LIBOFF, A.R. (Oakland Univ., Rochester, Mich.), & FURST, M. (Hunter College, C.U.N.Y., New York), "Pyroelectric effect in collagenous structures".
- MASCARENHAS, S. (Inst. of Physics & Chemistry, San Carlos, Brazil), "The electret effect in bone and biopolymers and the bound water problem".
- MENEFEFEE, E. (U.S. Dept. of Agriculture, Berkeley, Calif.), "Charge separation associated with dipole disordering in protein".
- OSTROWSKI, K. (Medical School, Warsaw, Poland), "Electromagnetic phenomena of normal and pathological mineralized tissues".
- PILLA, A. (Electric Storage Battery Co., Yardley, Pa.), "Electrochemical phenomena at platinum junctions".
- ROYCE, B.S.H. (Princeton Univ., NJ), "Field induced transport mechanisms in hydroxyapatite".
- SHAMOS, M.H., RINALDI, R.A. (New York Univ.), & LAVINE, L. (S.U.N.Y. Downstate Medical Center, Brooklyn, NY), "Passive electric properties of tissue in vivo".
- STOCKEM, W., HABEREY, M., & BRAATZ-SCHADE, K. (Univ. of Bonn, W. Germany), "Electrophysiological studies of amoeboid movement".
- WILLIAMS, W., & BREGER, L. (Univ. of Illinois, Urbana), "Analysis of stress distribution and piezoelectric response in cantilever bending of bone and tendon".

Session III. "Clinical Studies", (RADIN, E.L., Harvard Univ., Cambridge, MA, Chmn.)

- BAKER, B., SPODARO, J.A., & MARINO, A. (S.U.N.Y. Upstate Medical Center, Syracuse, NY), "Electrical stimulation of articular cartilage regeneration".
- BASSETT, C.A.L., BECKER, R., BRIGHTON, C., FRIEDENBERG, Z.B., & LAVINE, L. "Panel Discussion: To what extent can electrical stimulation be used in treatment of human disorders?".
- FRIEDENBERG, Z.B., & BRIGHTON, C. (Univ. of Pennsylvania, Phila.), "Electrical fracture healing".
- HAMBURY, H.J. (Singleton & Morriston Hospitals, Swansea, UK), & WATSON, J. (Univ. College, Swansea), "Effect of microamp electrical currents on bone in vivo".
- KLAPPER, L., & STALLARD, R. (Boston Univ., MA), "Investigation into the mechanism of electrical stimulation of bone growth".
- LAVINE, L., LUSTRIN, I. (S.U.N.Y. Downstate Medical Center, Brooklyn, NY), SHAMOS, M.H., & RINALDI, R.A. (NY Univ.), "Electrical treatment of congenital pseudarthrosis".
- LEVY, D.D. (Hydron Labs, Inc., New Brunswick, NJ), "A pulsed stimulation electrical technique for inducing bone growth".
- NORTON, L.A. (Univ. of Kentucky, Lexington), "Bone growth in a controlled electric field".
- ORTIZ, J., CONNOLLY, J., BAYUZICK, R.J., & PRICE, R. (Vanderbilt Univ., Nashville, TN), "Effect of electrical stimulation on physical properties of healed fractures".
- ROWLEY, B.A., MCKENNA, J.M., CHASE, G.R., & WOOLCOTT, L.E. (Texas Tech. Univ., School of Medicine, Lubbock), "The influence of electric current on infecting microorganisms in wounds".
- SMITH, S.D. (Univ. of Kentucky, Lexington), "Electrically induced morphogenesis".
- YASUDA, I. (Kyoto Second Red Cross Hospital, Kyoto, Japan), "Mechanical callus and electrical callus".

3369. 26th Annual Conference on Engineering in Medicine and Biology; Sponsored by the Alliance for Engineering in Medicine and Biology, Minneapolis, Minnesota, September 30 - October 4, 1973 (relevant presentations):

- BIGU DEL LANCO, J. (Queen's U., Kingston, Ont., Canada), "Active and passive properties of bird feathers: Their role as piezoelectric transducers and as receptors of microwave radiation".
- SCHWAN, H.P. (U. of Pennsylvania, Philadelphia), "Selective heating, localized heating, and scaling theory".
- STACK, D.B. "Microwave sterilization of water".
- SUESS, M.J. (World Health Organization, Copenhagen, Denmark), "Overview of standards for safety from exposure to nonionizing radiation".

3115. Seventh Annual Winter Conference on Brain Research, held Jan. 19-26, 1974, in Steamboat Springs, Colorado, sponsored by Barrow Neurological Inst., Michigan State Univ., and the Univ. of California at L.A. (Relevant presentations)

Session 10. "The Effects of Low Intensity Microwaves Upon the Brain", (WACHTEL, H., Chmn.)

BARNES, F.S. (Univ. of Colorado, Boulder), "Threshold effects of microwave radiation on embryo cell systems".

GAMOW, I. (Univ. of Colorado, Boulder), "An analysis of a heat sensor via microwave stimulation".

POSTOW, E. (Bureau of Medicine & Surgery (Navy), Washington, DC), "Two views of microwave effects on the CNS: East and West".

WACHTEL, H. (Duke Univ., Durham, NC), "Immediate effects of low intensity microwaves on isolated neurons".

3116. San Diego Biomedical Symposium, "Innovations in Biomedicine", held Feb. 6-8, 1974, Mission Valley, San Diego, California, (Relevant presentations)

EDRICH, J., & HARDEE, P.C. (Denver Res. Inst., CO), "Thermograms of the human body from millimeter wavelength signals".

GIAROLA, A.J., KRUEGER, W.F., BRADLEY, J.W., & SHREKENHAM, A. (Texas A&M Univ., College Station), "Effect on fecundity in birds exposed to various electromagnetic fields".

3117. Conference on the Biological Effects of Non-Ionizing Radiation, Sponsored by the New York Academy of Sciences, Feb. 12-15, 1974, New York, (TYLER, P.E., Conf. Chmn.)

Introductory Remarks

TYLER, P.E. (Bureau of Medicine & Surgery (Navy), Washington, DC), "Overview of electromagnetic radiation research: Past, present, and future".

Session I. "Electromagnetic Radiation Effect on the Nervous System", (ADEY, W.R., Chmn.)

ALBERT, E.N. (G. Washington Univ. Medical Center, Washington, DC), & DeSANTIS, M.E. (Georgetown Univ. Medical & Dental School, Washington, DC), "Do microwaves alter nervous system structure?".

BARANSKI, S., & EDELWEJN, Z. (Inst. of Aviation Medicine, Warsaw, Poland), "Experimental morphologic and electroencephalographic studies on microwave effects on the nervous system".

BAWIN, S.M., CAVALAS-MEDICI, R., ADEY, W.R., & KACZMAREK, L. (Brain Res. Inst., UCLA, Los Angeles, CA), "Effects of modulated VHF fields on the central nervous system".

GRODSKY, I.T. (Cleveland State Univ., OH), "Possible physical substrates for the interaction of electromagnetic fields with biological membranes".

GUY, A.W. (Univ. of Washington, Seattle), "Microwave interactions with the auditory systems of humans and cats".

LEBOVITZ, R.M. (Univ. of Texas, Dallas), "Detection of weak electromagnetic radiation by the mammalian vestibulo-cochlear complex".

MALCOLM, J.E. (Central Med. Establishment, London, UK), "A new theory of the action of the organ of corti and of the cochlea".

MICHAELSON, S.M., LU, S.-T., HOUK, W., LEBDA, N., & MAGIN, R. (Univ. of Rochester, NY), "Biochemical and neuroendocrine aspects of exposure to microwaves".

SERVANTIE, B., SERVANTIE, A.-M., & ETIENNE, J. (ESSAM-CERB/Hopital I.A. Sainte Anne, Toulon, France), "Synchronization of cortical neurons by a pulsed microwave field: Evidenced by spectrum analysis of electrocorticogram of the white rat".

TAYLOR, E.M., ASHLEMAN, B.T., & GUY, A.W. (Univ. of Washington, Seattle), "Some effects of electromagnetic radiation on the brain and spinal cord of cats".

WACHTEL, H., SEAMAN, R., & JOINES, W. (Duke Univ., Durham, NC), "The effects of microwaves on isolated neurons".

Session II. "Electromagnetic Radiation Effect on Special Senses", (DONALDSON, D.D., Chmn.)

APPLETON, B., & HIRSCH, S. (Walter Reed Army Medical Center, Washington, DC), "Experimental microwave cataractogenesis".

CARPENTER, R.L., FERRI, E.S., HAGAN, G.J. (Northeast Radiological Lab., Winchester, MA), "Some current studies on microwave ocular effects".

KRAMAR, P. (Univ. of Washington, Seattle), "Theoretical and experimental studies of microwave cataracts in rabbits".

3117. Session II. (Continued)

MCAFEE, R.D., CAZENAVETTE, L.L. (Veterans Admn. Hospital, New Orleans, LA), & HOLLAND, M.G. (Tulane Univ. School of Medicine, New Orleans), "Screening for cataracts".

WEITER, J.J., FINCH, E.D., SCHULTZ, W., & FRATTALI, V. (Naval Medical Res. Inst., Bethesda, MD), "Ascorbic acid changes in cultured rabbit lenses following microwave irradiation".

WILLIAMS, R.J., MCKEE, A., & FINCH, L.D. (Naval Medical Res. Inst., Bethesda, MD), "Ultrastructural changes in the rabbit lens induced by microwave radiation".

Session III. "Biochemical and Biophysical Effects", (STRAUB, K.D., Chmn.)

ALLIS, J.W. (Nat'l Environmental Res. Center, Res. Triangle Park, NC), "Discussion Paper: The effects of cross-illumination".

CZERSKI, P. (National Res. Inst. of Mother & Child, Warsaw, Poland), "Microwave effects on the blood-forming system with particular reference to lymphocytes".

ELDER, J.A., & ALI, J.S. (Nat'l Environmental Res. Center, Res. Triangle Park, NC), "The effect of microwaves on isolated rat liver mitochondria".

FRAZER, J.W., RUPP, T., & MONTET, J. (USAF School of Aerospace Med., Brooks AFB, TX), "A comparison of thermal and RF exposure effects on trace metal content of blood plasma and liver cell fractions of rodents".

ROTKOVSKA, D., & VACEK, A. (Czechoslovak Academy of Sciences, Brno, Czech.), "The effect of electromagnetic radiation on the hematopoietic stem cells of mice".

STRAUB, K.D. (Univ. of Arkansas Med. School, Little Rock), "Effects on microsomal and mitochondria preparations".

SZMIGIELSKI, S. (Inst. of Aviation Medicine, Warsaw, Poland), & JELJASZEWICZ, J. (Nat'l Inst. of Hygiene, Warsaw, Poland), "Acute staphylococcal infections in animals irradiated with 3 GHz microwaves".

SZMIGIELSKI, S. (Inst. of Aviation Medicine, Warsaw, Poland), & LUCZAK, M. (Univ. Medical School, Warsaw, Poland), "Effect of microwaves (3 GHz) on cell function and virus replication in cell cultures irradiated *in vitro*".

YEARGERS, E.K. (Georgia Inst. of Technology, Atlanta), "Effects of microwaves on enzymes".

Session IV. "Electromagnetic Radiation Effects on Genetics and Development", (LEACH, W.M., Chmn.)

BLACKMAN, C.F., BENANE, S.G., WEIL, C.M., & ALI, J.S. (Nat'l Environmental Res. Center, Res. Triangle Park, NC), "Effects of non-ionizing electromagnetic radiation on single cell biological systems".

DIETZEL, F. (Wilhelm-Conrad-Rontgen-Klinik, Giessen, Fed. Republic of Germany), "Effects of electromagnetic radiation on implantation and intra-uterine development of the rat".

KRUEGER, W.F., GIAROLA, A.J., BRADLEY, J.W., & SHREKENHAMER, A. (Texas A&M Univ., College Station), "The effect of electromagnetic fields on fecundity in the chicken".

MCREE, D.I., HAMRICK, P., ZINKL, J. (Nat'l Inst. of Environmental Health Sciences, Res. Triangle Park, NC), THAXTON, P., & PARKHURST, C. (North Carolina Univ., Raleigh), "Some effects of exposure of the coturnix quail embryo to 2.45 GHz microwave radiation".

PYLE, S., NICHOLS, D., GAMOW, E., & BARNES, F.S. (Univ. of Colorado, Boulder), "Threshold effects of microwave radiation on embryo cell systems".

WEBB, S.J. (Univ. of Saskatchewan, Saskatoon, Canada), "Genetic continuity and metabolic regulation as seen by the effects of various frequencies of microwaves on these phenomena".

Session V. "Behavioral Effects of Electromagnetic Radiation", (JUSTESEN, D.R., Chmn.)

FREY, A.H. (Randomline, Inc., Willow Grove, PA), "Neural function and behavior: Defining the relationship".

GALLOWAY, W.D. (Bureau of Radiological Health, Rockville, MD), "Microwave dose-response relations on two behavioral tasks".

HEEBELS, G.H. (Lab. of the Armed Forces, Oegstgeest, The Netherlands), ROBERTI, B., & WOLTHUIS, O.L. (Medical Biological Lab. (TNO), Rijswijk, The Netherlands), "Preliminary investigations of the influence of low-level microwave irradiation on the spontaneous motor activity of rats".

HUNT, E.L., KING, N.W., & PHILLIPS, R.D. (Battelle Pacific NW Labs., Richland, WA), "Behavioral effects of pulsed microwave irradiation".

THOMAS, J.R., FINCH, E.D., & FULK, D.W. (Naval Medical Res. Inst., Bethesda, MD), "Effects of microwave radiation on behavioral baselines".

Session VI. "Dosimetry of Electromagnetic Radiation", (BAIRD, R.C., Chmn.)

ALLEN, S.J. (USAF School of Aerospace Medicine, Brooks AFB, TX), "Measurement of power absorption by human phantoms immersed in radiofrequency fields".

BEISCHER, D.E., & RENO, V.R. (Naval Aerospace Medical Res. Lab., Pensacola, FL), "Microwave energy distribution measurements in the proximity of man and their practical application".

3117. Session VI. (Continued)

- BOWMAN, R.R., & BELSHER, D.R. (Nat'l Bureau of Standards, Boulder, CO), "A discussion of three new models of isotropic electromagnetic hazard meters".
- GHANDI, O.P. (Univ. of Utah, Salt Lake City), "Discussion Paper: Polarization and frequency effects".
- HO, H.S. (Bureau of Radiological Health, Rockville, MD), "Contrast of dose distribution in phantom heads due to aperture and plane wave sources".
- RUDDLESTON, G.K. (Georgia Inst. of Technology, Atlanta), & McREE, D.I. (Nat'l Inst. of Environmental Health Sciences, Res. Triangle Park, NC), "A pyroelectric probe for measurement of microwave power density under far-field conditions".
- JOHNSON, C.C. (Univ. of Utah, Salt Lake City), "Discussion Paper: Fiberoptic liquid crystal probe for absorbed RF power measurement".
- PHILLIPS, R.D., HUNT, E.L., & KING, N.W. (Battelle Pacific NW Labs., Richland, WA), "Field measurements, absorbed dose, and biological dosimetry of microwaves".
- SWICORD, M.L., BASSEN, H. (Bureau of Radiological Health, Rockville, MD), & ABITA, J. (Johns Hopkins Applied Physics Lab., Silver Spring, MD), "A broadband, miniature electric field probe".

Panel Discussions

- CZERSKI, P., GUY, A.W., JUSTESEN, D.R., SERVANTIE, B., & STRAUB, K.D. "Future research directions and needs in biological electromagnetic radiation research".
- APPLETON, B., BARANSKI, S., BOWMAN, R.C., ELDER, R.L., MICHAELSON, S.M., SHORE, M.L. "Results of the Polish conference".

3118. Proceedings of Conference on "Biomedical Aspects of Non-ionizing Radiation", held 10 July 1973 in conjunction with the opening and dedication of the Biomedical Research Lab., U.S. Naval Weapons Laboratory, Dahlgren, VA, (MILROY, W.C., (ed.)), (NWL Tech. Rpt. TR-3110, Mar. 1974)

- BAUM, S.J., SKIDMORE, W.D., & EKSTROM, M.E. (Armed Forces Radiobiology Res. Inst., Bethesda, MD), "Continuous exposure of rodents to  $10^8$  pulses of electromagnetic radiation".
- DIACHENKO, J.A., ELLIS, R.L., LAWTON, L.E., MILROY, W.C., O'GRADY, T.C., & PRINCE, E.T. (Naval Weapons Laboratory, Dahlgren, VA), "Biomedical aspects of non-ionizing radiation: An overview of the NWL effort".
- MICHAELSON, S.M. (Univ. of Rochester, NY), "Comparative biology in assessment of electromagnetic bioeffects".
- RENO, V.R., & BEISCHER, D.E. (Naval Aerospace Med. Res. Lab., Pensacola, FL), "Microwave reflection, diffraction, and transmission by man".
- ROSE, M.F. (Naval Weapons Laboratory, Dahlgren, VA), "High power pulse transmitters".
- SCHWANN, H.P. (Univ. of Pennsylvania, Philadelphia), "Some guidelines for the development of EM radiation standards".
- TYLER, P.E. (Bureau of Medicine & Surgery, Washington, DC), "Where are we and where are we going?".

3370. Aerospace Medical Association 45th Annual Meeting, held in Washington, D.C., May 6-9, 1974 (relevant sessions):

Panel: "Aerospace Medical Implications of Non-Ionizing Radiation", (PICKERING, J.E., Moderator)

- APPLETON, B. (Walter Reed Army Med. Ctr., Washington, D.C.), "Ocular status of personnel occupationally exposed to microwaves", (not presented).
- BEISHER, D.E. (Naval Aerospace Med. Res. Lab., Pensacola, FL), "Results of human exposure to non-ionizing radiation"
- FRAZER, J.W. (U.S. Air Force School of Aerospace Med., Brooks AFB, TX), "Interactions of man and animals with radio-frequency fields".
- MITCHELL, J.C. (U.S. Air Force School of Aerospace Med., Brooks AFB, TX), "Special problems of general public exposure to RF radiation".
- PICKERING, J.E. (USAF School of Aerospace Med., Brooks AFB, TX), "Overview of the problem".
- TYLER, P.E. (Naval Med. R&D Command, Bethesda, MD), "U.S. and Eastern standards for exposure to electromagnetic radiation".

Session: "Electromagnetic Radiation", (FRIEDBERG, W., & BURNER, A.M., Co-Chan)

- GRISSETT, J.D. (Naval Aerospace Med. Res. Lab., Pensacola, FL), "Exposure of man to magnetic fields alternating at extremely low frequency".
- HOUK, W.M. (Naval Aerospace Med. Res. Lab., Pensacola, FL), "Metabolic and thermoregulatory responses to microwave radiation in young male rats".

3119. Ninth Annual Symposium on Microwave Power, Sponsored by the Internat. Microwave Power Inst., 28-31 May 1974, Marquette Univ. Milwaukee, Wisconsin, (BOSISIO, R.G., Tech. Prog. Chmn.), (Bio-medically relevant presentations)

Plenary Session. (OSEPCHUK, J.M., Chmn.)

NELSON, S.O., & STETSON, L.E. (Univ. of Nebraska, Lincoln), "Use of microwave and lower frequency RF energy for improving alfalfa seed germination".

Session B2. "Biological Effects of Microwaves", (BIGU DEL BLANCO, J., Chmn.)

ALBERT, E.N. (The G. Washington Univ., Washington, DC), & DeSANTIS, M.E. (Georgetown Univ., Washington, DC), "Histological alterations in central nervous system after microwave irradiation".

FANSLON, G.E., TOLLEFSON, J.J., & OWENS, J.C. (Iowa State Univ., Ames), "Ovicidal effects of electromagnetic energy at 2.45 GHz on eggs Diabrotica undecimpunctata howardi barber".

GANDHI, O.P. (Univ. of Utah, Salt Lake City), "A method of measuring RF absorption of whole animals and bodies of prolate spheroidal shapes".

GLASER, Z.R. (Bureau of Medicine & Surgery, Washington, DC), "Studies on the bio-medical effects of microwave radiation: Past, present, and future". (Invited paper)

KING, N.W., HUNT, E.L., & PHILLIPS, R.D. (Battelle Pacific NW Labs., Richland, WA), "Biological dosimetry of 2450 MHz microwave irradiation with mice".

LASZLO, T.S., & STEPHENS, W.K. (Philip Morris (USA) Res. Center, Richmond, VA), "The effect of microwaves on the tobacco beetle".

Session No. A3. "Medical and Biological Applications", (BAILLIE, H.D., Chmn.)

BIGU DEL BLANCO, J., ROMERO-SIERRA, C. (Queen's Univ., Kingston, Ont., Can.), & TANNER, J.A. (National Res. Council of Canada, Ottawa), "Colour-thermography: A powerful technique in the evaluation of microwave field radiation patterns in biological systems. Its use as a microwave energy density monitor".

CARTER, J.L., FLEISCHPRESSER, D.A., & ISHII, T.K. (Marquette Univ., Milwaukee, WI), "Microwave oven techniques for biological solids determination of wastewater samples".

LENOX, R.H. (Walter Reed Army Inst. of Res., Wash., DC), GANDHI, O.P. (Univ. of Utah, Salt Lake City), MEYERHOFF, J.L., & BROWN, P.V.K. (Walter Reed Army Inst. of Res.), "Modifications of in vivo rapid microwave inactivation of enzymes in the central nervous system".

THOUREL, L., PAREILLEUX, A., THOUREL, B., & AUGE, C. (Department d'Etudes et de Recherches en Micro-Ondes, Toulouse, France), "Microwaves specific effects on beer yeast".

Session No. B3. "Microwaves in the Food Industry", (DECAREAU, R.V., Chmn.)

STONE, W.R. (Raytheon Company, Waltham, MA), "Multi-energy source cooking device (oven) with programming means", [incorporating 915 and 2450 MHz microwave energy, infrared, and steam].

TO, E.C., GOLDBLITH, S.A., WANG, D.I.C., & DECAREAU, R.V. (Massachusetts Inst. of Technology, Cambridge), "Dielectric properties of food stuffs".

WATANABE, M. (Hitachi, Ltd.), SUZUKI, M. (Hokkaido Univ.), KIKUCHI, I. (Hitachi Heating Appliance Co.), FUKUI, Y. (Hitachi, Ltd.), & HIRAKAWA, K. (Bunmeido Ltd., Yokohama, Japan), "A means of detecting temperature of food in microwave electromagnetic field".

Session No. B5. "Microwave Applicators", (HAMID, M.A.K., Chmn.)

HAMID, M.A.K., MOSTOWY, N.J. (Univ. of Manitoba, Winnipeg, Can.), & BHARTIA, P. (Univ. of Saskatchewan, Regina, Can.), "Microwave bean roaster", ["to destroy the anti-trypsin enzyme (or growth inhibitor), thus facilitating safe nutritional consumption by humans and animals"].

3120. "Fundamental and Applied Aspects of Non-Ionizing Radiation", Seventh Rochester International Conference on Environmental Toxicity, June 5-7, 1974, Univ. of Rochester, Rochester, N.Y., (Proceeding to be pub. by Plenum Publishing Corp., N.Y., NY), (MICHAELSON, S.M., Conf. Chmn.).

Session I. "Biophysics & Dosimetry", (BEISCHER, D.E., Chmn.)

BABIJ, T.M. (Technical Univ. of Wroclaw, Poland), "Synthesis of frequency response of electric field probes".

BOWMAN, R.R. (Nat'l Bureau of Standards, Boulder, CO), "Dosimetry of electromagnetic Radiation".

DUNN, F. (Univ. of Illinois, Urbana), "Acoustic properties of biological materials".

SCHWAN, H.P. (Univ. of Pennsylvania, Philadelphia), "Dielectric properties of biological materials".

STEWART, H.F. (Bureau of Radiological Health, Rockville, MD), "Dosimetry of ultrasound".

(Continued)

3120. (Continued)

Session II. "Energy Absorption", (HARDY, J.D., Chmn.)

BLIGH, J. (Inst. of Animal Physiology, Babraham, Cambridge, UK), "Physiological responses to heat".

LELE, P.P. (Massachusetts Inst. of Technology, Cambridge), "Ultrasonic heating of tissues".

PORTELA, A., et al. (National Council of Scientific & Technical Investigations, Buenos Aires, Argentina), "Transient effects of low-level microwave radiation on bioelectric properties of muscle".

Session III. "Microwaves — Biological Effects", (LOWY, K., Chmn.)

GUY, A.W., & LIN, J. (Univ. of Washington, Seattle), "Electrophysiological effects in animals".

LEHMANN, J.F. (Univ. of Washington, Seattle), "Therapeutic heat".

MICHAELSON, S.M. (Univ. of Rochester, New York), "Review of the biological effects of microwaves".

Session IV. "Ultrasound — Biological Effects", (CASARETT, G.W., Chmn.)

HILL, C.R. (Inst. of Cancer Res., Belmont, Sutton, Surrey, UK), "Effects of ultrasound on isolated cells and cell cultures".

NYBORG, W., GERSHOY, A., & MILLER, D. (The Univ. of Vermont, Burlington), "Effects of ultrasound on plant tissues".

SAVAGE, J.R.K. (MRC Radiobiology Unit, Harwell, Didcot, Berks, UK), "Are chromosomal aberrations reliable indicators of environmental hazards?".

TAYLOR, K.J.W. (The Royal Marsden Hospital, London, UK), "The biological effects of ultrasound on intact tissues".

Session V. "Medical Applications", (GRAMIAK, R., Chmn.)

HILL, C.R. (Inst. of Cancer Res., Belmont, Sutton, Surrey, UK), "Safety of ultrasound in diagnosis".

LELE, P.P. (Massachusetts Inst. of Technology, Cambridge), "Uses of ultrasound in surgery".

MITCHELL, J.C., HURT, W.D., & STEINER, T.O. (USAF School of Aerospace Med., Brooks AFB, TX), "EMR design effectiveness in electronic medical prosthetic devices".

Session VI. "Occupational Aspects", (TYLER, P.E., Chmn.)

CZERSKI, P., & SIEKIERZYNSKI, M. (Nat'l Res. Inst. of Mother & Child, Warsaw, Poland), "Analysis of occupational exposure to microwave radiation".

ELY, T. (Eastman Kodak Company, Rochester, NY), "Control of occupational exposure to non-ionizing radiation".

ODLAND, L.T. (Wright-Patterson Air Force Base, Dayton, Ohio), "Military role in safe use of microwaves".

Session VII. "Future Applications and Controls", (TOMPkins, E., Chmn.)

MAYNARD, O., & GLASER, P.E. (A.D. Little, Inc., Cambridge, MA), "Satellite solar power station: An option for large scale power generation on earth".

OSEPCHUK, J.M. (Raytheon Company, Waltham, MA), "Prospects for expansion of industrial and consumer uses of microwaves".

SUESS, M.J. (World Health Organization, Regional Office for Europe, Copenhagen, Denmark), "Overview of standards for safety from exposure to non-ionizing radiation".

(Presents: underlined)

3121. "International Microwave Symposium, 1974 IEEE S-MIT", June 12-14, 1974, Georgia Inst. of Technology, Atlanta, Georgia, (Bio-Medically Related Presentations).

Special Session. "Technical Forecasting and Assessment"

GUARRERA, J.J. (Guide Scientific Inds., Sun Valley, CA), "Microwave sensors for military and civil use", (Invited).

SAAD, T.S. (Sage Labs., E. Natick, MA), "Microwave applications for material and food processing", (Invited).

(Continued)

3121. (Continued)

Session 2: "Analysis and Application of Microwaves in Biology and Medicine", (ECKER, H.A., Chmn.)

- BIGU DEL BLANCO, J., ROMERO-SIERRA, C. (Queen's Univ., Kingston, Ont., Can.), & TANNER, J.A. (NRC of Canada, CSL, Ottawa), "Some theory and preliminary experiments on microwave radiometry of biological systems".
- BURNS, C.P., & BURDETTE, C.E. (Georgia Inst. of Technology, Atlanta), "Multi-frequency electromagnetic thawing of frozen kidneys".
- JOHNSON, C.C., DURNEY, C.H., & LORDS, J.L. (Univ. of Utah, Salt Lake City), "Liquid crystal fiberoptic temperature probe for the measurement of electromagnetic power absorption in tissue".
- JOHNSON, C.C., LORDS, J.L., & COOMBS, M.A. (Univ. of Utah, Salt Lake City), "Nerve stimulation by implanted diode".
- LIVESAY, D., & CHEN, K.-M. (Michigan State Univ., East Lansing), "Electromagnetic fields induced inside of biological bodies".
- NELSON, S.O. (Univ. of Nebraska, Lincoln), "Insect control possibilities using microwaves and lower frequency RF energy".
- OSEPCCHUK, J.M. (Raytheon Co., Waltham, MA), "A survey of the potential for beneficial applications of microwaves in medicine and biology", (Invited).

Session 5. "Biological Effects of Microwaves", (GUY, A.W., Chmn.)

- CHRISTMAN, C.L., HO, H.S., & YARROW, S. (Bureau of Radiological Health, Rockville, MD), "A microwave dosimetry system for measuring sampled integral dose rate".
- COURTNEY, K., LIN, J.C., GUY, A.W., & CHOU, C.K. (Univ. of Washington School of Med., Seattle), "Microwave effect on rabbit superior cervical ganglion".
- CZERSKI, P. (Nat'l Inst. of Mother & Child, Warsaw, Poland), "Experimental models for the evaluation of microwave biological effects", (Invited).
- LIN, J.C., GUY, A.W., & CALDWELL, L.R. (Univ. of Washington Med. School, Seattle), "Behavioral changes of rats exposed to microwave radiation".
- LU, S.-T., BOGARDUS, R., COHEN, J., JONES, J., KINNEN, E., MICHAELSON, S., & MAGIN, R. (Univ. of Rochester, NY), "Thermogenetic and cariodynamic regulation in dogs cranially exposed to 2450 MHz (cw) microwaves".
- MICHAELSON, S.M. (Univ. of Rochester, NY), & SUESS, M.J. (World Health Organization, Regional Office for Europe, Copenhagen, Denmark), "An international program for microwave exposure protection".
- WEIL, C.M. (Environmental Protection Agency, Res. Triangle Park, NC), "Absorption characteristics of multi-layered sphere models exposed to UHF/microwave radiation".

(Presente: Underlined)

3122. Conference on Precision Electromagnetic Radiation Measurements, London, England, July 1-5, 1974.

- BASSEN, H. (Bureau of Radiological Health, Rockville, MD), "An optically-linked telemetry system for use with electromagnetic hazard probes".

3371. 19th Annual Meeting of the Health Physics Society, Houston, TX, July 7-11, 1974 (relevant presentation):

- BANKIN, N.N., TELL, R.A., & JAMES, D.E. (U.S. Environmental Protection Agency, Silver Spring, MD), "Assessing the potential for exposure to hazardous levels of microwave radiation from high power sources".

3123. Fifth International Congress of Radiation [including non-ionizing] Research, Seattle, Washington, July 14-20, 1974.

- CUNITZ, R.J., GALLOWAY, W.D., & BERMAN, C.M. (Bureau of Radiological Health, Rockville, MD), "Behavioral suppression by 383 MHz radiation".
- ANDERSEN, F.A., & PAY, T.L. (Bureau of Radiological Health, Rockville, MD), "Survival of drosophila eggs exposed to microwave energy and to heat".
- EDWARDS, W.P., & HO, H.S. (Bureau of Radiological Health, Rockville, MD), "Microwave cavity irradiation dosimetry".

3372. "The Physics of Nonionizing Radiation"; summer school conference sponsored by the Amer. Assoc. of Physicists in Medicine, U. of Colorado, Boulder, July 21-26, 1974 (relevant presentations):

- BARNES, F.S. (U. of Colorado, Boulder), & CENKOVIICH, F. "Clinical applications and bio-effects of microwaves".
- CHANNEY, E.L. (U. of Colorado Medical Center, Denver), "Fundamental principles of microwaves".

3373. Conference on "Biological Effects, Hazards, and Medical Uses of Non-Ionizing Radiation", held at the Massachusetts Inst. of Technology, Cambridge, July 29 - August 2, 1974.

3374. "Earth Environment and Resources Conference (EERC)"; sponsored by the Institute of Electrical and Electronics Engineers, Philadelphia, PA, Sept. 12, 1974:

CORY, W.E., & FREDERICK, C.L. (Southwest Res. Inst., San Antonio, TX), "Environmental health effects caused by non-ionizing electromagnetic energy".

3375. National Academy of Science/National Research Council, 1974 Annual U.S. National Committee/International Union of Radio Science (USNC/URSI) Meeting, University of Colorado, Boulder, October 14-17, 1974:

Session #34 - URSI Commission I, Sess. 5 (ROSENTHAL, S.W., Chmn.)

BOWMAN, R.R. (National Bureau of Standards, Boulder), "Electromagnetic field measurements for bioeffects experiments and the control of potential hazards".

GUY, A.W. (University of Washington, Seattle), "Measurement of power absorbed in the tissues of man and animals exposed to electromagnetic fields".

DURNEY, C.H., JOHNSON, C.C., & MASSOUDI, H. (University of Utah, Salt Lake City), "Long wavelength analysis of plane-wave electromagnetic power absorption by a prolate spheroidal tissue body".

BARBER, P.W. (U. of Utah, Salt Lake City), "Electromagnetic fields in a homogeneous model of man".

3376. Meeting of the Electromagnetic Radiation Management Advisory Council (ERMAC), Executive Office of the President, Washington, D. C., October 31 - November 1, 1974:

Work Session on: "Nervous System and Behavioral Effects of Nonionizing EM Radiation".

GALLOWAY, D. (Bureau of Radiological Health, Rockville, MD)

BAWIN, S.M. (Brain Research Inst., UCLA, Los Angeles, CA)

FRASER, J., STAVINOHAN, & MITCHELL, J. (USAF School of Aerospace Medicine, Brooks AFB, TX)

GUY, A.W., & LOVELY, R. (U. of Washington, Seattle)

HAWKINS, T.D. (Walter Reed Army Inst. for Res., Washington, DC)

THOMAS, J. (Naval Medical Res. Inst., Bethesda, MD)

JUSTESEN, D. (Veterans Admn. Hospital, Kansas City, MO)

HUNT, E.L. (Battelle Pacific NW Labs., Richland, WA)

FREY, A. (Randomline Inc., Huntington Valley, PA)

SEAMAN, R. (Duke University, Durham, NC)

ALBERT, E. (G. Washington University, Washington, DC)

3377. Neurosciences Research Program of the Mass. Inst. of Tech., Boston, Work Session on "Brain interactions with weak electric and magnetic fields", November 10-12, 1974.

3378. The University of New Orleans School of Engineering Short Course on "The Biological Effects of Microwave Radiation: Sense and Nonsense", New Orleans, LA, February 18-21, 1975:

SCHWAN, H.P. (U. of Pennsylvania), "Biological effects of microwave radiation".

MICHAELSON, S.M. (U. of Rochester, New York), "The Tri-Service Conferences: Basis of the presently accepted microwave radiation safety recommendations of the Armed Services", "A comparison of soviet and western microwave bioeffects research".

JUSTESEN, D.D. (Veterans' Administration Hospital, Kansas City, MO), "Behavioral effects of microwave radiation".

CARPENTER, R. (Bureau of Radiological Health NE Lab, Winchester, MA), "Cataractogenic effects of microwave radiation".

OSEPCHUCK, J. (The Raytheon Co., Waltham MA), "The 'microwave controversy': Congressional investigation and federal regulation".

3124. 1975 Microwave Power Symposium, sponsored by the International Microwave Power Institute, May 28-30, 1975, to be held at the Univ. of Waterloo, Ontario, Canada.

3713. Proceedings of the 1975 International IEEE/AP-S Symposium and URSI Meeting, University of Illinois, Urbana, 2-5 June 1975.

CHUNG, A. (Univ. of Maryland), & SWICORD, M.L. (Div. of Electronic Products, DHEW), "Development of electromagnetic modeling materials for X-band dosimetry studies."

KANTOR, G., SWICORD, M.L., & BLAIR, M.J. (Div. of Electronic Products, DHEW), "Heating patterns of enclosed and direct contact microwave diathermy applicators."

KELLOGG, R. (Univ. of Maryland), & NEUDER, S. (Div. of Electronic Products, DHEW), "A finite element method for calculating electromagnetic fields in complex geometries."

3714. North Atlantic Treaty Organisation/Advisory Group for Aerospace Research and Development (AGARD) Lecture Series No. 78 on "Radiation Hazards," presented in the Netherlands (22-23 Sept. 1975), Germany (25-26 Sept. 1975), and Norway (29-30 Sept. 1975). (In: AGARD-LS-78, August, 1975, 158 pps.)

- GUY, A.W. (U. of Washington School of Medicine, Seattle), "Biophysics—energy absorption and distribution," p. 4, 1-14.
- GUY, A.W. (U. of Washington School of Medicine, Seattle), "Engineering considerations and measurements," p. 9, 1-36.
- GUY, A.W. (U. of Washington School of Medicine, Seattle), "On EMP safety hazards," p. 11, 1-7.
- GUY, A.W., & CHOU, C-K. (U. of Washington School of Medicine, Seattle), "Microwave induced acoustic effects in mammalian auditory systems," p. 7, 1-17.
- HILL, C.R. (Royal Cancer Hospital, Sutton, Surrey, UK), "Biological effects of ultrasound," p. 8, 1-4.
- MICHAELSON, S.M. (U. of Rochester, Rochester, NY), "Biologic and pathophysiological effects of exposure to microwave or ultrasonic energy—an overview," p. 1, 1-2.
- MICHAELSON, S.M. (U. of Rochester, Rochester, NY), "Pathophysiological aspects of exposure to microwaves," p. 2, 1-7.
- MICHAELSON, S.M. (U. of Rochester, NY), "Endocrine and central nervous system effects of microwave exposure," p. 6, 1-8.
- MICHAELSON, S.M. (U. of Rochester, NY), "Protection guides and standards for microwave exposure," p. 12, 1-6.
- MITCHELL, J.C. (USAF School of Aerospace Medicine, Brooks AFB, TX), "Electromagnetic radiation: effects on the eye," p. 5, 1-6.
- MITCHELL, J.C. (USAF School of Aerospace Medicine, Brooks AFB, TX), "Electromagnetic interference of cardiac pacemakers," p. 10, 1-10.
- WELLS, P.N.T. (Bristol General Hospital, Bristol, UK), "Physical aspects—ultrasound," p. 3, 1-7.
- Bibliography, p. B, 1-22.

3715. Proceedings of the 5th European Microwave Conference, held 1-4 Sept. 1975 in Hamburg, Federal Republic of Germany.

Session B6—Medical/Biological Applications

- AGARWAL, R., HANNAH, S., HARTNAGEL, H., & KENNAIR, J.T. (U. of Newcastle upon Tyne, UK), "A pocket-sized monitor of dangerous microwave power levels."
- DEFICIS, A. (O.N.E.R.A.-C.E.R.T., Toulouse, France), "Use of dielectric microprobes for electromagnetic fields measurement."
- EDRICH, J. (U. of Denver, CO), "Microwave absorption of living human skin between 8 and 96 GHz."
- GRANT, E.H., SHEPPARD, R.J. (Queen Elizabeth College, London), & SOUTH, G.P. (Bradfield College, UK), "The importance of bound water studies in the determination of energy [absorption] by biological tissue."
- GUY, A.W., & LOVELY, R.H. (U. of Washington School of Medicine, Seattle), "A system for quantitative chronic exposure of a population of rodents to UHF fields."
- ROZZELL, T.C. (Office of Naval Research, Arlington, VA), "Measurement of temperature and microwave power using liquid crystal/optic fiber probes."

Session A3—Invited Papers

- CZERSKI, P., & SZMIGIELSKI, S. (Dept. of Human Genetics, National Research Inst. of Mother and Child, Warsaw, Poland), "Microwave bioeffects: Current status and concepts" (p. 348-357).

3716. Proceedings of the Eighteenth Navy Occupational Health Workshop, held October 6-10, 1975, San Diego, Calif.

- BAKER, \_\_\_, "Medical Aspects of ionizing and non-ionizing radiation."

3717. Proceedings of 1975 IEEE International Symposium on Electromagnetic Compatibility, San Antonio, TX, 7-9 Oct. 1975.

Session 2A - II. EMC and Spectrum Management in Electro-Optics; A Panel Discussion (AASEN, M.D., & ATKINSON, J.H. (co-chmn)).

- HAM, W.T., Jr. (Medical College of VA, Richmond), "Hazards: The effects of optical radiation on biological environments and materials."
- RICHARDS, W. (Naval Electronics Laboratory Center, San Diego, CA), "Standards: Systems, components, safety, etc."

(Continued)

3717. (Continued)

Session 5B - II. EMC Related Bio-Instrumentation (MITCHELL, J.C., Chmn.).

- BASSEN, H.I. (Bureau of Radiological Health, Rockville, MD), "A broadband miniature, isotropic electric field measurement system."
- BRONAUGH, E.L., & KERNS, D.R. (Southwest Research Institute, San Antonio, TX), "Calibration of a multimode microwave exposure chamber."
- HOFF, R.J. (McDonnell Douglas Astronautics Co., St. Louis, MO), "EMC measurements in hospitals."
- RUGGERA, P.S. (Bureau of Radiological Health, FDA, Rockville, MD), "Radiofrequency E-field measurements within a hospital environment."
- TOLER, J.C. (Georgia Institute of Technology, Atlanta), "Electromagnetic interference levels in hospitals."

3718. National Academy of Science/National Research Council, 1975 Annual U.S. National Committee/International Union of Radio Science (USNC/URSI) Meeting, University of Colorado, Boulder, October 20-23, 1975: (Relevant Presentations)

Session B-1a: Auditory Effects (FREY, A.H., Chmn.)

- CAIN, C.A., & RISSMANN, W.J. (U. of Illinois, Urbana), "Microwave hearing in mammals at 3.0 GHz."
- CHOU, C.K., GUY, A.W. (U. of Washington School of Medicine, Seattle), & GALAMBOS, R. (U. of California, San Diego, CA), "Microwave-induced auditory response—cochlear microphonics."
- EICHERT, E.S., & FREY, A.H. (Randomline, Inc., Huntingdon Valley, PA), "RF sound: possible mechanisms as defined by recent research." (withdrawn)
- JOHNSON, R.B., MEYERS, D., GUY, A.W., LOVELY, R.H. (U. of Washington, Seattle), & GALAMBOS, R. (U. of California, San Diego, CA), "Discriminative control of appetitive behavior by pulsed microwave radiation in rats."
- LIN, J.C., & LAM, C-K. (Wayne State U., Detroit, MI), "A theoretical study of microwave-generated auditory phenomena in mammalian cranial structures."

Session B-1b: Microwave Cataractogenesis (ROSENTHAL, S., Chmn.)

- AL-BADWAIHY, K.A., & YOUSSEF, A-B. (Cairo U., Egypt), "Biological thermal effect of microwave radiation on human eyes." (not given)
- BIRENBAUM, L. (Polytechnic Institute of New York, Brooklyn), KAPLAN, I.T. (Zaret Foundation, CUNY, New York), METLAY, W. (Hofstra U., Hempstead, NY), ROSENTHAL, S.W. (Polytechnic Institute of New York, Farmingdale), & ZARET, M.M. (Zaret Foundation, Scarsdale, NY), "Effects of 35 and 107 GHz CW microwaves on the rabbit eye."
- KRAMAR, P., HARRIS, C., GUY, A.W., & EMERY, A. (U. of Washington School of Medicine, Seattle), "Mechanism of microwave cataractogenesis in rabbits."
- RABINOWITZ, J.R. (New York U. Medical Center, New York), "The effect of cataractogenic doses of microwave radiation on lenticular transport."

Combined Session: (RICHARDSON, J.M., Chmn.)

- JUSTESEN, D.R. (V.A. Hospital, Kansas City, MO), "A rose by another name is a cabbage."

Session B-2a: Therapeutic Applications (LEHMANN, J.F., Chmn.)

- AL-BADWAIHY, K.A., & YOUSSEF, A-B.A. (Cairo Univ., Egypt), "Steady state temperature profiles in microwave diathermy" [paper not presented].
- GORDON, G.A., LIVINGSTON, G., & DETHLEFSEN, L.A. (Univ. of Utah, Salt Lake City), "Microwave-induced hyperthermia and radiation sensitivity of mouse intestine."
- GUY, A.W., McDUGALL, J.A., & WEBB, M.D. (Univ. of Washington, Seattle), "Shortwave diathermy applicators."
- KANTOR, G., BASSEN, H., & SWICORD, M. (BRH, Rockville, MD), "Mapping of free space and scattered fields in microwave diathermy."
- LEHMANN, J.F., GUY, A.W., & STONEBRIDGE, J.B. (Univ. of Washington, Seattle), "Physiologic design criteria for therapeutic applicators operating at 915 MHz."
- WEST, B., & REGELSON, W. (M.C.V./V.C.U., Richmond, VA), "Biologic effects of pulsed high frequency electromagnetic radiation" [using a Diapulse Machine].

Session B-2b: Diagnostic Applications (JOHNSON, C.C., Chmn.)

- LANDT, J.A. (U. of California, Los Alamos, NM), "Antenna design for a passive temperature monitoring and identification system for livestock."
- PEDERSEN, P.C., JOHNSON, C.C., DURNEY, C.H., & BRAGG, D.G. (U. of Utah, Salt Lake City), "Microwave radiation as a diagnostic tool."
- SPELMAN, F.A., KINDT, C.W., BOWDEN, D.M., SACKETT, G.P., SPILLANE, J.E. (Regional Primate Research Center at the U. of Washington, Seattle), & BLATTMAN, D.A. (RACON, Inc., Seattle), "Remote measurement of respiration in infant primates using an X-band doppler radar."

(Continued)

3718. (Continued)

Session B-3: Field Survey Instruments (BOWMAN, R., Chmn.)

- ASLAN, E. (Narda Microwave, Plainview, NY). "A low frequency H-field radiation monitor."
- BASSEN, H., & PETERSON, R. (BRH, Rockville, MD). "Complete measurement of hazardous electromagnetic fields with electro optical crystals."
- CONOVER, D.L., PARR, W.H., SENSINTAFFAR, E.L., & MURRAY, W.E., Jr. (NIOSH, Cincinnati, OH). "Measurement of electric and magnetic field strengths from industrial radiofrequency (10-40 MHz) power sources."
- RUGGERA, P.S. (BRH, Rockville, MD). "E- and H-field instrumentation and calibration below 500 MHz."
- SWICORD, M.L., BASSEN, H.I., HERMAN, W.A., DUFF, J.E., & BING, J.R. (FDA, Rockville, MD). "Methods and instrumentation for the evaluation and calibration of microwave survey instruments."
- SWICORD, M.L. (FDA, Rockville, MD), & CHEUNG, A.Y. (U. of Maryland, College Park). "Mutual coupling between linear antennas."
- TRZASKA, H. (Technical U. of Wroclaw, Wroclaw, Poland). "Magnetic field standard at frequencies above 30 MHz."

Session B-4: Cellular and Mutagenetic Effects (McREE, D., Chmn.)

- BLACKMAN, C.F., SURLES, M.C., & BENANE, S.G. (EPA, Research Triangle Park, NC). "The effect of microwave exposure on bacteria: mutation induction."
- ELDER, J.A., ALI, J.S., & LONG, M.D. (EPA, Research Triangle Park, NC). "Respiratory activity of mitochondria exposed in a coaxial airline to 2000-4000 MHz microwave radiation."
- FRAZER, J.W. (USAF School of Aerospace Medicine, Brooks AFB, TX). "A summary of cell and tissue level events produced by RF fields predicted from consideration of regional hyperthermia."
- HSIEH, S.T., & SETO, Y.J. (Tulane U., New Orleans, LA). "Microwave perturbation on cellular enzymatic reactions."
- LIN, J.C., & CHEN, K.C. (Wayne State U., Detroit, MI). "Effects of microwave radiation on mammalian cells *in vitro*."
- SMIALOWICZ, R.J. (EPA, Research Triangle Park, NC). "The effect of microwaves (2450 MHz) on lymphocyte blast transformation *in vitro*."
- VARMA, M.M., DAGE, E.L., & JOSHI, R. (Howard U., Washington DC). "Mutagenicity induced by non-ionizing radiation in Swiss male mice."
- VARMA, M.M., & TRABULAY, E.A., Jr. (Howard U., Washington, DC). "Evaluation of dominant lethal test and DNA studies in measuring mutagenicity caused by non-ionizing radiation."

Session B-5: Exposure Systems (SHORE, M., Chmn.)

- GRAF, E.R., BURKS, D.G. (Auburn U., AL), & COLE, F.E. (Ochsner Medical Foundation, New Orleans, LA). "A unique electromagnetic environmental simulator."
- GUY, A.W., CHOU, C.K., & LOVELY, R.H. (U. of Washington School of Medicine, Seattle). "Chronic exposure of a rat population by circularly polarized guided waves."
- HO, H.S., FOSTER, M.R., & SWICORD, M.L. (Bureau of Radiological Health, Rockville, MD). "Microwave irradiation apparatus design and dosimetry."
- HOUK, W.M., GRISSETT, J.D., & LONGACRE, A., Jr. (Naval Aerospace Medical Research Laboratory, Pensacola, FL and U. of New Orleans, New Orleans, LA). "Considerations of chamber design, environmental control, and microwave field interactions in small animal experimentation."
- LEICHER-PREKA, A. (Inst. Physiol. Biochem. Med. Fac., Sarajevo, Yugoslavia), & HO, H.S. (BRH, Rockville, MD). "Dependence of total and distributed absorbed microwave energy upon size, shape, and orientation of rat phantoms in waveguide."
- LOTZ, W.G., & MICHAELSON, S.M. (U. of Rochester, Rochester, NY). "Adrenocortical response in rats exposed to microwaves."
- RENO, V.R., & deLORGE, J.O. (Naval Aerospace Medical Research Laboratory, Pensacola, FL). "Field measurements for a series of behavioral studies."

Session B-6a: Behavioral Effects (Low Level Exposure), (JUSTESEN, D., Chmn.)

- CLEARY, S.F. (Virginia Commonwealth U., Richmond). "The effects of 1.7 and 2.45 GHz microwaves on drug-induced sleeping time in the rabbit."
- GILLARD, J., SERVANTIE, B., BERTHARION, G., SERVANTIE, A.M., OBRENOVITCH, J., & PERRIN, J.C. (Hopital d'Instruction des Armées Sainte-Anne, Toulon Naval, France). "Study of the microwave-induced perturbations of the behaviour by the open-field test into the white rat." [read by S. Rosenthal]
- HUNT, E.L. (Walter Reed Army Institute of Research, Washington, DC), KING, N.W., LOVELY, R.H. (U. of Washington, Seattle), & PHILLIPS, R.D. (Battelle Pacific Laboratory, Richland, WA). "'Avoidance' by rats of a 2.88 GHz pulse microwave field."

(Continued)

3718. (Continued)

MANTHEI, R.C., & GLASER, Z.R. (Naval Surface Weapons Center, Dahlgren, VA), "Alterations in the sleep process of the rabbit as a function of chronic low intensity electromagnetic radiation exposure."

THOMAS, J.R., YEANDLE, S.S., & BURCH, L.S. (Naval Medical Research Institute, Bethesda, MD), "Modification of internal discriminative stimulus control of behavior by low levels of pulsed microwave radiation." [not presented]

Session B-6b: Behavioral Effects (High Level Exposure), (HUNT, E., Chmn.)

D'ANDREA, J.A., GANDHI, O.P., & KESNER, R.P. (U. of Utah, Salt Lake City), "Behavioral effects of resonant electromagnetic power absorption in rats."

deLORGE, J.O. (Naval Aerospace Medical Research Laboratory, Pensacola, FL), "The effects of microwave radiation on behavior and temperature in Rhesus monkeys."

McAFEE, R.D., ELDER, S.T., LIPSCOMB, T.J., MAY, J.G., & HOLLAND, M.G. (Veterans Administration Hospital, New Orleans, LA), "Microwave and infrared radiation effects on an operant response in Rhesus monkeys."

MOE, K.E., LOVELY, R.H., & GUY, A.W. (U. of Washington, Seattle), "Physiological and behavioral effects of chronic low level microwave radiation of rats."

MONOHAN, J.C., & HO, H.S. (Bureau of Radiological Health, Rockville, MD), "Microwave-induced avoidance behavior in the mouse."

Session B-7a: Assessment of Power Deposition in Tissues by Mathematical and Phantom Models (SCHWANN, H., Chmn.)

ALLEN, S.J., HURT, W.D., KRUPP, J.H., RATLIFF, J.A. (USAF School of Aerospace Medicine, Brooks AFB, TX), DURNEY, C.J., & JOHNSON, C.C. (U. of Utah, Salt Lake City), "Measurement of radio frequency power absorption in monkeys, monkey phantoms, and human phantoms exposed to 10-30 MHz fields."

GANDHI, O.P., SEDIGH, K., BECK, G.S. (U. of Utah, Salt Lake City), & HUNT, E.L. (Walter Reed Army Institute of Research, Washington, DC), "Distribution of electromagnetic energy deposition in models of man with frequencies near resonance."

MacDOUGAL, J., WEBB, M. (U. of Washington, Seattle), & FRAZER, J.W. (USAF School of Aerospace Medicine, Brooks AFB, TX), "Models of biologic interaction with electromagnetic fields."

MASSOUDI, H., DURNEY, C.H., JOHNSON, C.C. (U. of Utah, Salt Lake City), & ALLEN, S. (Brooks AFB, TX), "Theoretical calculations of power absorbed by monkey and human spheroidal and ellipsoidal phantoms in an irradiation chamber."

NEUDER, S.M. (BRH, Rockville, MD), HILL, D.H., & KELLOGG, R.B. (U. of Maryland, College Park), "Power deposition in a multilayered spherical model of the human head."

Session B-7b: Dielectric Properties of Tissues (SCHWANN, H., Chmn.)

CHEUNG, A.Y., KOOPMAN, D.W., & SWICORD, M.L. (U. of Maryland, College Park), "Wide-band characterization of dielectric and heat properties of simulated tissues."

ILLINGER, K.H. (Tufts U., Medford, MA), "The attenuation function for biological fluids at millimeter and far-infrared wavelengths."

PLYLE, S.D., HU, C.L., CALDWELL, R., & BARNES, F.S. (U. of Colorado, Boulder), "Electric dipole interactions for microwave pulses and damage to embryos."

SWICORD, M., SAFFER, J. (BRH, Rockville, MD), & CHEUNG, A. (U. of Maryland, College Park), "A two impedance method for wide range dielectrometry."

Session B-8a: CNS Effects—I (ADEY, R., Chmn.)

ALBERT, E.N. (The George Washington U. Medical Center, Washington, DC), "Light and electron microscopic investigation of brains exposed to non-ionizing radiation." [Read by E. Postow]

HAWKINS, T.D., & HUNT, E.L. (Walter Reed Army Institute of Research, Washington, DC), "Reduction in sensitivity to audiogenic seizure following a single, 2450 MHz, CW irradiation of rats."

KRITIKOS, H., & TAKASHIMA, S. (U. of Pennsylvania, Philadelphia), "Nonthermal effects of electromagnetic fields on the central nervous system." [Read by H. Schwann]

OSCAR, K.J. (U.S. Army Mobility Equipment R&D Center, Fort Belvoir, VA, and American U., Washington, DC), & HAWKINS, T.D. (Walter Reed Army Institute of Research, Washington, DC), "Electromagnetic radiation effects on the blood-brain barrier system in rats."

Session B-8b: CNS Effects—II (CLEARY, S., Chmn.)

CHAMNESS, F., SCHOLES, H., SEXAUER, S., & FRAZER, J.W. (USAF School of Aerospace Medicine, Brooks AFB, TX), "The effect of 1.6 GHz CW fields on trace metal content of specific regions of rat brain."

MERRITT, J.H., HARTZELL, R., & FRAZER, J.H. (USAF School of Aerospace Medicine, Brooks AFB, TX), "The effect of 1.6 GHz radiation on neurotransmitters in discrete areas of the rat brain."

MIKOLAJCZYK, H. (Institute of Occupational Medicine, Lodz, Poland), "Microwave-induced shifts of gonadotropic activity in anterior pituitary gland of rats." [withdrawn]

WU, C-L., & LIN, J.C. (Wayne State U., Detroit, MI), "Interaction of modulated electromagnetic fields with nervous structures."

(Continued)

3718. (Continued)

Session B-9a: Assessment of Power Deposition in Tissues by Numerical Methods (GUY, A.W., Chmn.)

- BARBER, P.W. (U. of Utah, Salt Lake City), "Numerical study of electromagnetic power deposition in biological tissue bodies."
- EMERY, A.F., GUY, A.W., KRANING, K.K., & SHORT, R. (U. of Washington, Seattle), "Numerical simulation of the effects of non-ionizing RF radiation upon the human body."
- NEUDER, S.M. (BRH, Rockville, MD), & MEIJER, P.H.E. (Catholic U. of America, Washington, DC), "Finite element-variational calculus approach to the determination of electromagnetic fields in irregular geometry."
- SPEIGEL, R.J. (ITT Research Institute, Washington, DC), "High voltage electric field coupling to humans using moment method techniques."
- UMASHANKAR, K.R., & BUTLER, C.M. (U. of Mississippi, University), "Electromagnetic power absorption in lossy wire model of man."

Session B-9b: Polarization Effects (GUY, A.W., Chmn.)

- GITHENS, S.H., HAWKINS, T.D., & SCHROT, J. (Walter Reed Army Institute of Research, Washington, DC), "Colonic temperature changes during microwave exposure."
- SCHROT, J., & HAWKINS, T.D. (Walter Reed Army Institute of Research, Washington, DC), "Microwave frequency and E-field orientation interact with animal size."

Session B-10a: Effect of ELF Fields on Biological Systems—I (PHILIPS, R., Chmn.)

- BAWIN, S.M., & ADEY, W.R. (U. of California, Los Angeles), "Effects of weak low frequency electric fields on calcium efflux from isolated chick and cat brain."
- BLISS, V., & HEPPNER, F. (U. of Rhode Island, Kingston), "Effects of the field free space on the circadian activity rhythm of the house sparrow, *Passer domesticus*, and of the song sparrow, *Melospiza melodia*."
- DURFEE, W.K., PLANTE, P.R., MARTIN, P., MUTHUKRISHNA, S., & POLK, C. (U. of Rhode Island, Kingston), "Exposure of domestic fowl to ELF electric and magnetic fields."
- GREENEBAUM, B., GOODMAN, E.M., & MARRON, M.T. (U. of Wisconsin-Parkside, Kenosha), "Long-term effects of weak 45-75 Hz electromagnetic fields on the slime mold *Physarum polycephalum*."
- MATHEWSON, N.S., OOSTA, G.M., OLIVA, S.A., & BLASCO, A.P. (AFRRI, Defense Nuclear Agency, Bethesda, MD), "Effects of 45 Hz electric field exposure on rats."

Session B-10b: Effect of ELF Fields on Biological Systems—II (BIRENBAUM, L., Chmn.)

- MEDICI, R.G. (U. of California, Los Angeles), "The effects of weak ELF electric fields on schedule-controlled behavior of monkeys."
- MORAN, W.P. (U. of Tulsa, OK), "Physiological basis of human electric shock threshold."
- SUGIYAMA, S., & MIZUNO, K. (Kwansei Gakuin U., Hyogo, Japan), "Effect of AC electric field application upon human visual threshold."
- GREENBURG, B. (U. of Illinois at Chicago Circle, Chicago), "Impact of extremely low frequency electromagnetic fields on animals in nature."

Session B-11: Measurement of Power Deposition in Biological Tissues (ROZZELL, T., Chmn.)

- BOWMAN, R.R. (National Bureau of Standards, Boulder, CO), "A temperature probe for RF heated material."
- CETAS, T.C. (BRH, Rockville, MD), "A birefringent crystal optical thermometer for measurements of electromagnetically induced heating."
- CHEN, K.M., GURU, B.S., & NYQUIST, D.P. (Michigan State U., East Lansing), "Quantification and measurement of induced fields inside finite biological bodies."
- CHEUNG, A.Y. (U. of Maryland, College Park), SWICORD, M.L., & BASSEN, H.I. (BRH, Rockville, MD), "Experimental calibration of a miniature electric field probe within muscular tissues."
- CHRISTENSEN, D.A. (U. of Utah, Salt Lake City), "Optical etalon temperature sensor for microwave tissue heating applications."
- DEFICIS, A. (O.N.E.R.A.-C.E.R.T., France), "Use of dielectric microprobes for electromagnetic fields measurement."
- LIVINGSTON, G.K., JOHNSON, C.C., DURNEY, C.H. (U. of Utah, Salt Lake City), & ROZZELL, T.C. (Office of Naval Research, Arlington, VA), "Performance of the LCOF probe in calorimetric and tissue temperature monitoring applications."

(Continued)

3718. (Continued)

Session B-12: General Biological Effects (MICHAELSON, S., Chmn.)

- BURKS, D.G., & GRAF, E.R. (Auburn U., AL), "Investigation of electromagnetic effects of a 1000-foot TV tower on migratory birds."
- HOUK, W.M., MICHAELSON, S.M., & BEISCHER, D.E. (Naval Aerospace Medical Research Laboratory, Pensacola, FL, and U. of Rochester, Rochester, NY), "The effects of environmental temperature on thermoregulatory, serum lipid, carbohydrate and growth hormone responses of rats exposed to microwave."
- KINDT, C.W., BOWDEN, D.M., SPELMAN, F.A., & MORGAN, M.K. (Regional Primate Research at the U. of Washington, Seattle), "Some developmental and behavioral factors of low intensity X-band radiation."
- MAXEY, E.S. (Miami Heart Institute, Miami, FL), "Critical aspects of human versus terrestrial electromagnetic symbiosis."
- MITCHELL, J.C., & HURT, W.D. (USAF School of Aerospace Medicine, Brooks AFB, TX), "The biological significance of radiofrequency radiation emission characteristics on cardiac pacemaker performance."
- O'GRADY, T.C., MILROY, W.C., & GLASER, Z.R. (Naval Surface Weapons Center, Dahlgren, VA), "Long term exposure studies of high peak power (HPP) pulsed electromagnetic radiation on mice."
- STAVINOHAN, W.B., MEDINA, M.A., WEINTRAUB, S.T., ROSS, D.H., & MODAK, A.T. (U. of Texas Health Science Center, San Antonio), "The effects of 19 megacycle irradiation on mice and rats."
- TELL, R.A., & JANES, D.E. (EPA, Washington, DC), "Broadcast radiation: A second look."
- WOOLAS, K.D. (MOD, United Kingdom), "Health hazards in microwave fields."

Session B-13: Selected Topics (ALTSCHULER, H.M., Chmn.)

- ALLIS, J.W., & FROMME, M.L. (EPA, Research Triangle Park, NC), "Pseudosubstrate binding to ribonuclease during exposure to microwave radiation at 1.70 and 2.45 GHz."
- CARPENTER, R.L., & HAGAN, G.J. (BRH, Winchester, MA), "Comparison of thermal effects in the rabbit eye from microwave radiation and from external heating."
- FERRI, E.S., & HAGAN, G.J. (BRH, Winchester, MA), "Chronic low-level exposure of rabbits to microwaves."
- GLASER, Z.R. (Naval Surface Weapons Center, Dahlgren, VA), & DODGE, C.H. (Library of Congress, Washington, DC), "Biomedical aspects of radiofrequency and microwave radiation: A review of selected Soviet, East European, and Western references."
- GUILLET, R., LOTZ, W.G., & MICHAELSON, S.M. (U. of Rochester, NY), "Time-course of adrenal response in microwave-exposed rats."
- HAGAN, G.L., & CARPENTER, R.L. (BRH, Winchester, MA), "Microwave frequency as a factor in the induction of lens opacities in the rabbit eye."
- MAGIN, R.L., LU, S-T., & MICHAELSON, S.M. (U. of Rochester, NY), "Thyroid response to localized microwave exposure."
- MASSOUDI, H., DURNEY, C.H., JOHNSON, C.C. (U. of Utah, Salt Lake City), & ALLEN, S. (Brooks AFB, TX), "Theoretical calculations of power absorbed by an ellipsoidal model of man and animals in an electromagnetic plane wave."
- MICHAELSON, S.M. (U. of Rochester, NY), "The influence of microwave exposure on neuroendocrine function in the rat and dog."
- MIRACA, G.J., Jr., & FERRI, E.S. (BRH, Winchester, MA), "A study of the effects of microwave irradiation of the rabbit testes."
- SANDLER, S.S. (Northeastern U., Boston, MA), "Electromagnetic field effects on isolated nerve tissue."
- SEAMAN, R.L., WACHTEL, H., & JOINES, W.T. (Duke U., Durham, NC), "The use of stripline to study microwave biological effects."

3719. The Congenital Anomalies Research Association of Japan and the Japan Society of Human Genetics—Joint Conference, Tokyo, Japan, November 7-9, 1975. (Presentation given by title only.)

RUGH, R., & LEACH, W.M. (Division of Biological Effects, BRH), "Microwave teratogenesis in mice."

3720. American Public Health Association Annual Conference, Chicago, Illinois, November 16-20, 1975.

LANDAU, E. (American Public Health Assoc.), & ALBRECHT, R.M. (Division of Biological Effects, BRH), "Microwave radiation: An epidemiologic assessment."

3721. Proceeding of the Ninth Midyear Topical Symposium, Health Physics Soc., Denver, Colorado, February 9-12, 1976.

CZERSKI, P. (FDA Visiting Scientist, Division of Biological Effects, and Dept. of Genetics, National Research Inst. of Mother & Child, Warsaw, Poland), "Comparison of the USA, USSR, and Polish microwave permissible exposure standards."

3722. "Measurements for Safe Use of Radiation," National Bureau of Standards 75th Anniversary Symposium, March 1-4, 1976, Gaithersburg, MD.

Session on Measurement System

SWICORD, M.L., BASSEN, H.I., & HERMAN, W.A. (Bureau of Radiological Health, FDA), "Methods for the evaluation and calibration of microwave survey instruments."

Session on Standardization and Measurement Assurance

BAIRD, R.C. (National Bureau of Standards), "Non-ionizing radiation and standardization."

Session on Environment and Personal Protection

TELL, R.A., HANKIN, N.N., NELSON, J.C., ATHEY, T.W., & JAMES, Jr., D.E. (U.S. Environmental Protection Agency), "An automated measurement system for determining environmental radiofrequency field intensities."

THIEL, J.F. (Texas Dept. of Health Resources), "Radio-frequency electromagnetic radiation from portable and mobile telecommunication transmitters."

3723. American Industrial Hygiene Association Conference, Atlanta, Georgia, May 16-21, 1976.

ALBRECHT, R.M. (Division of Biological Effects, BRH), "Potential adverse effects of exposure to nonionizing radiation."

(Fins)

17. Alterations in the Biocurrents (EEG?) of the Cerebral Cortex (in animals)
18. Changes in the Rate of Clearance of Tagged Ions from Tissue
19. Reversible Structural Changes in the Cerebral Cortex and the Diencephalon
20. Electrocardiographic (EKG) Changes
21. Alterations in Sensitivity to Light, Sound, and Olfactory Stimuli
19. Reversible Structural Changes in the Cerebral Cortex and the Diencephalon
20. Electrocardiographic (EKG) Changes
21. Alterations in Sensitivity to Light, Sound, and Olfactory Stimuli
22. Functional (a) and Pathological (b) Changes in the Eyes: (a) decrease in size of blind spot, altered color recognition, changes in intraocular pressure, lacrimation, trembling of eyelids; (b) lens opacity and coagulation, altered tissue respiration, and altered reduction-oxidation processes
23. Myocardial Necrosis
24. Hemorrhage in Lungs, Liver, Gut, and Brain
25. Generalized Degeneration of all Body Tissue
26. Loss of Anatomical Parts
27. Death
28. Dehydration
29. Altered Rate of Calcification of Certain Tissue

} At Fatal Levels  
of Radiation

#### C. Central Nervous System Effects

1. Headaches
2. Insomnia
3. Restlessness (Awake and During Sleep)
4. Electroencephalographic (EEG) Changes
5. Cranial Nerve Disorders
6. Pyramidal Tract Lesions
7. Conditioned Reflex Disorders
8. Vagomimetic Action of Heart; Sympaticomimetic Action
9. Seizures, Convulsions

#### D. Autonomic Nervous System Effects

1. Neuro-vegetative Disorders (e.g., alteration of heart rhythm)
2. Fatigue
3. Structural Alterations in the Synapses of the Vagus Nerve
4. Stimulation of Parasympathetic Nervous System (Bradycardia), and Inhibition of the Sympathetic Nervous System

#### E. Peripheral Nervous System Effects

Effects on Locomotor Nerves

F. Psychological Disorders ("Human Behavioral Studies") - the so-called "Psychophysiologic (and Psychosomatic) Responses"

1. Neurasthenia - (general "bad" feeling)
2. Depression
3. Impotence
4. Anxiety
5. Lack of Concentration
6. Hypochondria
7. Dizziness
8. Hallucinations
9. Sleepiness
10. Insomnia
11. Increased Irritability
12. Decreased Appetite
13. Loss of Memory
14. Scalp Sensations
15. Increased Fatigability
16. Chest Pain
17. Tremor of the Hands

G. Behavioral Changes (Animal Studies)

Reflexive, Operant, Avoidance, and Discrimination Behaviors

H. Blood Disorders

(V = in vivo)  
(v = in vitro)

Changes in:

1. Blood and Bone Marrow
2. Phagocytic (polymorphs) and Bactericidal Functions of Blood (V,v)
3. Hemolysis Rate (increase), (a shortened lifespan of cells)
4. Sedimentation Rate (increase), (due to changes in serum protein levels or amount of fibrinogen (??))
5. Number of Erythrocytes (decrease), also number of Lymphocytes
6. Blood Glucose Concentration (increase)
7. Blood Histamine Content
8. Cholesterol and Lipids
9. Gamma (also  $\alpha$  and  $\beta$ ) Globulin, and Total Protein Concentration
10. Number of Eosinophils
11. Albumin/Globulin Ratio (decrease)
12. Hemopoiesis (rate of formation of blood corpuscles)
13. Leukopenia (increase in number of white cells), and Leukocytosis
14. Reticulocytosis

I. Vascular Disorders

1. Thrombosis
2. Hypertension

## J. Enzyme and Other Biochemical Changes

### Changes in activity of:

1. Cholinesterase (V,v)
2. Phosphatase (v)
3. Transaminase (v)
4. Amylase (v)
5. Carboxydismutase
  
6. Protein Denaturation
7. Toxin, Fungus, and Virus Inactivation (at high radiation dose levels), Bacteriostatic Effect
8. Tissue Cultures Killed
9. Alteration in Rate of Cell Division
10. Increased Concentration of RNA in Lymphocytes, and Decreased Concentration in Brain, Liver, and Spleen
11. Changes in Pyruvic Acid, Lactic Acid, and Creatinine Excretions
12. Change in Concentration of Glycogen in Liver (Hyperglycemia)
13. Alteration in Concentration of 17- Ketosteroids in Urine

## K. Metabolic Disorders

1. Glycosuria (sugar in urine; related with blood sugar?)
2. Increase in Urinary Phenol (derivatives? DOPA?)
3. Alteration of Rate of Metabolic Enzymatic Processes
4. Altered Carbohydrate Metabolism

## L. Gastro-Intestinal Disorders

1. Anorexia (loss of appetite)
2. Epigastric Pain
3. Constipation
4. Altered Secretion of Stomach "Digestive Juices"

## M. Endocrine Gland Changes

1. Altered Pituitary Function
2. Hyperthyroidism
3. Thyroid Enlargement
4. Increased Uptake of Radioactive Iodine by Thyroid Gland
5. Altered Adrenal Cortex Activity
6. Decreased Corticosteroids in Blood
7. Decreased Glucocorticoidal Activity
8. Hypogonadism (usually decreased testosterone production)

## N. Histological Changes

1. Changes in Tubular Epithelium of Testicles
2. Gross Changes

O. Genetic and Chromosomal Changes

1. Chromosome Aberrations (e.g., linear shortening, pseudochiasm, diploid structures, amitotic division, bridging, "sticky" chromosomes, irregularities in chromosomal envelope)
2. Mutations
3. Mongolism
4. Somatic Alterations (changes in cell not involving nucleus or chromosomes, cellular transformation)
5. Neoplastic Diseases (e.g., tumors)

P. Pearl Chain Effect (Intracellular orientation of subcellular particles, and orientation of cellular and other (non-biologic) particles)

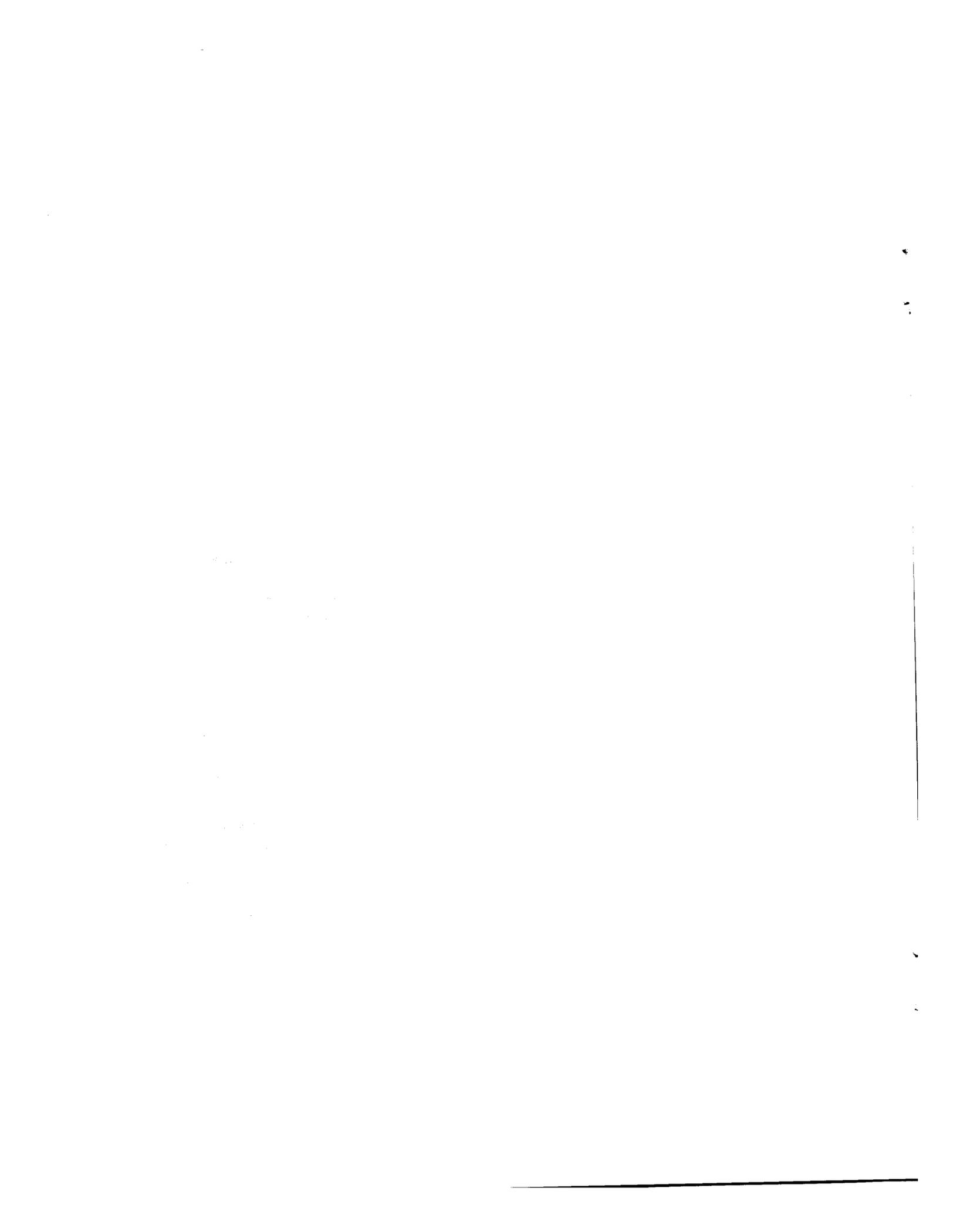
Also, orientation of animals, birds, and fish in electromagnetic fields

Q. Miscellaneous Effects

1. Sparking between dental fillings
2. Peculiar metallic taste in mouth
3. Changes in Optical Activity of Colloidal Solutions
4. Treatment for Syphilis, Poliomyelitis, Skin Diseases
5. Loss of Hair
6. Brittleness of Hair
7. Sensations of Buzzing Vibrations, Pulsations, and Tickling About the Head and Ears
8. Copious Perspiration, Salivation, and Protrusion of Tongue
9. Changes in the Operation of Implanted Cardiac Pacemakers
10. Changes in Circadian Rhythms

---

The Outline of Reported Biological Phenomena ('Effects') and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation, is patterned after that given by R. Murray, et al., in an article entitled, "How safe are microwaves", which appeared in Non-Ionizing Radiation 1(1):7-8 (1969). Some of the "effects" were listed in the report by S. F. Cleary and W. T. Ham, Jr., entitled, "Considerations in the evaluation of the biological effects on exposure to microwave radiation", (Background document, Part I, 1969, for the Task Force on Research Planning in Environmental Health, Subtask Force on Physical Factors in the Environment). The discussion and suggestions offered by Byron McLees, Edward Finch, Lewis Gershman, and Christopher Dodge relating to the Outline are also gratefully acknowledged.





UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

## 19. KEY WORDS (cont'd)

Electric-Field Bio-Effects  
 Magnetic Bio-Effects  
 Human Factors

Pulsed Electromagnetic Radiation  
 Stress Physiology  
 Radar Safety

## 20. ABSTRACT (cont'd)

This report is a compilation and integration of the first seven supplements, and the alphabetical addenda (appended to the original bibliography), with the revised bibliography of April 1972. The report is a successor to Naval Medical Research Institute (NMRI, Bethesda, MD 20014) Research Report No. 2, completed under Research Work Unit MF12.524.015-0004B in October 1971, by the senior author, and available from National Technical Information Service (Springfield, VA 22151) as AD #734-391. The original report was revised and reprinted in April 1972, and also contains the first three supplements; No. 1 dated October 1971, No. 2 dated November 1971, and No. 3 dated April 1972. The revised report which consists of more than 2300 literature citations, is available from NTIS as AD #750-271, and includes, as the first chapter, an outline of the effects which have been attributed to radio frequency and microwave radiation. Supplement No. 4 (containing 327 citations) was completed in June 1973, as an Electromagnetic Radiation (EMR) Project Office Report, Bureau of Medicine and Surgery (Navy), (Washington, DC 20372), and is available from NTIS as AD #770-621. Supplement No. 5 (containing 497 citations) was completed in July 1974 as an EMR Project Office Report, Naval Medical Research and Development Command (NMR&DC, Bethesda, MD 20014), and is available from NTIS as AD #784-007. The sixth Supplement (containing 241 citations) was completed in June 1975 (also as an EMR Project Office, NMR&DC Report), and is available from NTIS as AD #A015-622. The seventh Supplement (containing 345 citations) was completed in May 1976 as a NMRI Report, and is available from NTIS as AD #A025-354. Supplement No. 8 (not included in this report, but containing 331 citations), was completed in August 1976 as a NMRI Report, and is available from NTIS as AD #A029-430.

Relevant presentations made at technical meetings are included in a separate section.

The "outline of bio-effects" which appeared in the original Bibliography has been included in this report as an Appendix.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

02 5

02 5

1914

1914

## A Basic Summary of the Neurological Effects of Radiofrequency Sickness

Utility companies nationwide are moving toward installing transmitting electrical, gas, and water meters at each customer's service. The new digital meters being installed on electrical services are a type of meter being called "smart" meters because they can do time of day metering, keep very close track of energy usage, and potentially perform other functions. In the case of We Energies, and most other utilities, the "smart" meters selected are **transmitting** "smart" meters. The transmitting electrical rate meters We Energies is using transmit in strong bursts every 6 seconds 24 hours per day 7 days a week. The other utility meters also transmit similarly. This is potentially dangerous in the long-term for everyone; however, for people who already have radiofrequency sickness this exposure can cause disability nearly immediately.

Radiofrequency sickness results from overexposure to radiofrequency radiation. (See Appendix 1 for symptoms.) Radiofrequency sickness is not a disease. It is an environmentally induced functional impairment. Radiofrequency sickness has real and disabling consequences. People with radiofrequency sickness experience illness (or even death) upon exposure to radiofrequency radiation.<sup>1,2,3,4</sup> The most common sources are electrical pollution – high frequencies that travel on building wiring – and transmitters – all wireless devices.

Detrimental biological effects, distinct from tissue heating effects, have been extensively documented in studies at a range of different frequencies and at levels below the current United States safety standard.<sup>5</sup>

**Our current safety regulations are not designed to protect people from the non-thermal hazards posed by transmitting meters or other devices.** The FCC "safety" guidelines are solely designed to protect a 6 ft 185 lb man from tissue heating during a short (6 minute) exposure. They are not designed to protect even a 6 ft man from biological effects during a continuous exposure.<sup>6,7</sup> Exposures from transmitting utility meters and other transmitters are continuous, so these "safety" standards are meaningless. Transmitting devices compliant with current safety standards should not be allowed to portray themselves as "safe". The fact that these transmitters are represented as being "safe" because they comply with FCC guidelines is part of the reason that people are being required to have transmitting utility meters. Additional studies are now available. The data warrant complying with the precautionary principle and establishing lower exposure standards for safe levels of exposure for chronic exposures to radio frequency radiation for the population as a whole.<sup>8</sup> Exposure is often involuntary. For instance, exposure to radiofrequency radiation from neighbors often causes sensitive people in town to be chronically ill, unable to recover.

Microwave and radiofrequency radiation are now being associated with attention deficit disorder, autism, sleep disorders, multiple sclerosis, Alzheimer's disease and epilepsy, as well as asthma, diabetes, malignant melanoma, breast cancer, and other illnesses that have become increasingly more common. Please see [www.bioinitiative.org](http://www.bioinitiative.org)<sup>1</sup> to read a 2007 review of the peer-reviewed science on the long-term risks of exposure to transmitted microwave and radio frequency

---

<sup>1</sup> Sections of *The BioInitiative Report* was updated in 2009 and published in a special issue of the peer-reviewed journal *Pathophysiology* available at:  
[http://www.sciencedirect.com/science?\\_ob=PublicationURL&\\_tockey=%23TOC%235138%232009%23999839997%231345066%23FLA%23&\\_cdi=5138&\\_pubType=J&\\_auth=y&\\_acct=C000050221&\\_version=1&\\_urlVersion=0&\\_userid=10&md5=46db922ea4d2a2352e7490de7de6c78](http://www.sciencedirect.com/science?_ob=PublicationURL&_tockey=%23TOC%235138%232009%23999839997%231345066%23FLA%23&_cdi=5138&_pubType=J&_auth=y&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=46db922ea4d2a2352e7490de7de6c78)  
5

radiation. Studies finding no health effects are predominantly industry funded.<sup>9</sup> A report by Hallberg and Johansson<sup>10</sup> published recently in *Pathophysiology* asks the provocative question about whether the recent (1997 and later) increase in exposure to microwave frequencies may be responsible for the recent decline in public health in Sweden. The data seem to say that public exposure to microwave frequencies is a likely culprit.

In addition to transmitting in strong bursts, transmitting “smart” meters can also overexpose the general population to high frequencies by putting high frequencies on home and building wiring, either deliberately through signaling or inadvertently through poor engineering. High frequency signals on power lines are also biologically active. Milham and Morgan found a dose-response relationship between high frequencies present on building wiring and cancer<sup>11</sup>. Recent analysis of historical epidemiological data indicates a relationship to cancer, diabetes, heart disease, and suicide<sup>12</sup>. Removing high frequencies on building wiring has improved MS symptoms, blood sugar levels, asthma, sleep quality, teacher health, student attentiveness, headaches, ADD, and numerous other health problems<sup>13,14,15</sup>. Technical papers provide a solid electrical and biomolecular basis for these effects. A recent paper by Ozen showed that transients induce much stronger current density levels in the human body than does the powerline 60Hz signal<sup>16</sup>. A technical paper by Vignati and Giuliani discusses the authors’ findings that high frequency communication signals on power lines also induce much stronger electrical currents in the human body than a low frequency signal of the same strength<sup>17</sup>. The induced currents disturb normal intercellular communications. This causes harmful short-term and long-term effects. Additional information can be found on [www.electricalpollution.com](http://www.electricalpollution.com). Information necessary to properly measure the high frequencies causing these health problems can be found on the Technical page. A simple meter is also available that can provide accurate measurements of electrical pollution levels in most situations.

The precautionary principle dictates that only utility meters that do not increase public exposure to microwave and radiowave radiation and “dirty” power should be used while conservative standards to protect the health of the general population during continuous exposure are researched and established. Safe technology is available that can be used to perform the same functions as transmitting “smart” meters. There are non-transmitting meters that can do variable rates and meter both incoming and outgoing power. Meters can easily be engineered that do not put high frequencies on electrical wiring either inadvertently or deliberately, while still performing all necessary functions. Directly wired connections could be used to shut off key loads. Alternate technologies may cost a bit more up front, but the precautionary principle should apply. In fact, the Health Department in New Mexico agrees. They recently persuaded a local water utility to use wired connections between monitoring stations, instead of wireless, based on the precautionary principle. If you have questions, you can contact John McPhee, Childhood Injury Prevention Coordinator for the New Mexico Department of Health (505-827-2582).

The only “cure” for radiofrequency sickness is not to be exposed to radiofrequency radiation. People with radiofrequency sickness often become ill almost immediately upon exposure, although the severity of the illness depends on how often the exposure occurs, the frequency and amplitude of the radiation signal and the duration of the exposure. Studies show pulsed microwaves, as utilized by modern communication devices, including transmitting electrical meters, are very potent biologically.<sup>1,2,3,4</sup>

In fact, data presented at the recent conference “Electromagnetic Radiation Impacts on Human Health” sponsored by The EMR Policy Institute showed that radiofrequencies, specifically pulsed modulated microwaves from a DECT cordless telephone base unit can have an instantaneous effect on heart rhythm in susceptible individuals. This technology is the same as that used by cellphones, WiFi internet access, and transmitting utility meters. See: <http://www.youtube.com/user/EMRPolicyInstitute> presentation of Prof. Magda Havas in three segments.

A number of studies show that electromagnetic radiation, including radiofrequency radiation, alters heart rate variability, blood pressure (including inducing hypertension with microwave exposure – smart meters transmit in the microwave range) and increases risk of arrhythmia related heart disease and heart attack.<sup>4,5</sup>

There is extensive documentation in the literature of alterations of  $\text{Ca}^{2+}$  homeostasis.<sup>5</sup> This is likely to be responsible at least in part for the profound effects that radiofrequency radiation has on the heart and neurological function.  $\text{Ca}^{2+}$  regulates gap junction opening. Gap junctions are key in many intercellular communications.

Exposure to radiofrequency radiation also interferes with the action of enzymes, signaling pathways, and makes the immune system simultaneously hyperactive and less effective.<sup>5,18</sup> Immune impairment results in part from the disruptive effect of radiofrequency radiation on calcium ion homeostasis. In addition to radiofrequency radiation-induced immune impairment increasing risk of various types of infection, it is likely to increase the risk of getting cancer from the DNA breakages radiofrequency radiation is well-documented to induce.<sup>5</sup> While radiofrequency radiation is non-ionizing, the metabolic changes it can cause result in oxidative damage to DNA and subsequent breakage. Direct interactions between radiofrequency radiation and DNA can have similar results, as well as causing changes in gene transcription, through changes in electron flows induced by the radiation.<sup>19</sup>

Neurological function can be seriously impaired by radiofrequency radiation. Cholinesterase enzyme activity is impaired by exposure to radiofrequency radiation in a manner similar to impairment caused by organophosphate pesticides often rendering a person with radiofrequency sickness particularly sensitive to small amounts of chemicals.<sup>20</sup> Radiofrequency radiation can lower the pain threshold, slow reaction times, cause fatigue, muscle weakness, headaches, difficulty concentrating, short-term memory problems and even memory loss.<sup>1,2,3,4</sup> These may be caused by disruption of  $\text{Ca}^{2+}$ , disruption of various enzyme pathways, induction of the stress response and associated effects, increased permeability of the blood-brain barrier, or various other effects of over exposure to radiofrequency radiation.<sup>4,5,20</sup>

Radiofrequency radiation significantly decreases melatonin levels and decreases the ability of existing melatonin to fight cancer.<sup>5</sup> Good sleep is essential for good mental and physical health. Good sleep is very difficult, if not impossible to obtain if your melatonin levels are abnormally low. Sleep deprivation along with impaired neurological function and enzyme impairment are likely to be behind the brain fog and cognitive difficulties those with radiofrequency sickness experience.

More detailed information can be found in the following references, in *The BioInitiative Report* at [www.bioinitiative.org](http://www.bioinitiative.org), and at [www.electricalpollution.com](http://www.electricalpollution.com).

## References

- 1) Johnson Liakouris AG. Radiofrequency (RF) sickness in the Lilienfeld study: An effect of modulated microwaves Archives of Environmental Health; May/Jun 1998; 53, 3.
- 2) Santini R, Santini P, Le Ruz P, Danze JM, and Seignel M. 2003 Survey Study of People Living in the Vicinity of Cellular Phone Base Stations. Electromagnetic Biology and Medicine Vol. 22, No. 1, pp. 4149.
- 3) Hyland GJ. Physics and biology of mobile telephony. The Lancet, Vol 356, November 25, 2000.
- 4) Marha K, Musil J, and Tuha H. Electromagnetic Fields and the Life Environment. Institute of Industrial Hygiene and Occupational Diseases, Prague, Czechoslovakia. English Translation 1971
- 5) Cherry, N. 2000 Criticism of the Health Assessment in the ICNIRP Guidelines for Radiofrequency and Microwave Radiation (100 kHz- 300 GHz)
- 6) Letter from Norbert Hankin, Center for Science and Risk Assessment, Radiation Protection Division, EPA, regarding the limitations and purpose of the FCC exposure standards.  
[http://www.emrpolicy.org/litigation/case\\_law/docs/noi\\_epa\\_response.pdf](http://www.emrpolicy.org/litigation/case_law/docs/noi_epa_response.pdf)
- 7) Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communication, 2008, National Academy of Science. [http://www.nap.edu/catalog.php?record\\_id=12036#toc](http://www.nap.edu/catalog.php?record_id=12036#toc)
- 8) Sage C, Carpenter DO. 2009. Public health implications of wireless technologies, Pathophysiology Aug; 16(2-3):233-46.
- 9) Huss et al., "Source of Funding and Results of Studies of Health Effects of Mobile Phone Use: Systematic Review of Experimental Studies", Environmental Health Perspectives, 115(1): 1-4, 2007.  
<http://www.ehponline.org/members/2006/9149/9149.pdf>.
- 10) Hallberg O, Johansson O, Apparent decreases in Swedish public health indicators after 1997 – Are they due to improved diagnostics or to environmental factors? Pathophysiology Volume 16, Issue 1, June 2009, Pages 43-46.
- 11) Milham S, Morgan L. A new electromagnetic exposure metric: High frequency voltage transients associated with increased cancer incidence in teachers in a California school, American Journal of Industrial Medicine, Volume 51, Issue 8, Date: August 2008, Pages: 579-586
- 12) Milham S. Historical evidence that electrification caused the 20th century epidemic of “diseases of civilization”. Medical Hypotheses DOI: 10.1016/j.mehy.2009.08.032
- 13) Havas M, Olstad A. Power quality affects teacher wellbeing and student behavior in three Minnesota Schools, Science of the Total Environment, Volume 402, Issues 2-3, 1 September 2008, pp. 157-162.
- 14) Havas M. 2008. Dirty Electricity Elevates Blood Sugar Among Electrically Sensitive Diabetics and May Explain Brittle Diabetes. Electromagnetic Biology and Medicine, 27:135-146.  
<http://www.informaworld.com/smpp/content~db=all?content=10.1080/15368370802072075>
- 15) Havas M. 2006. Electromagnetic hypersensitivity: biological effects of dirty electricity with emphasis on diabetes and multiple sclerosis. Electromagnetic Biology Medicine 25(4):259-68.
- 16) Ozen, S. 2007. Low-frequency Transient Electric and Magnetic Fields Coupling to Child Body, Radiation Protection Dosimetry (2007), pp. 1–6. <http://rpd.oxfordjournals.org/cgi/content/full/ncm315>
- 17) Vignati, M. and L. Giuliani, 1997. Radiofrequency exposure near high-voltage lines. Environ Health Perspect 105(Suppl 6):1569-1573 (1997) <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1469914>

- 18) Johansson O. Disturbance of the immune system by electromagnetic fields—A potentially underlying cause for cellular damage and tissue repair reduction which could lead to disease and impairment, *Pathophysiology*, Volume 16, Issues 2-3, August 2009, Pages 157-177.
- 19) Blank M and Goodman R. Electromagnetic Fields May Act Directly on DNA, *Journal of Cellular Biochemistry* 75:369-374 (1999)
- 20) Grant L. Microwaves Imitate Pesticides. U.S. Department of Energy Risk Management Quarterly, Volume 5-3

**Appendix 1- Symptoms of Radio Wave Sickness** (excerpted from *No Place To Hide* April 2001):

- **Neurological:** headaches, dizziness, nausea, difficulty concentrating, memory loss, irritability, depression, anxiety, insomnia, fatigue, weakness, tremors, muscle spasms, numbness, tingling, altered reflexes, muscle and joint pain, leg/foot pain, "Flu-like" symptoms, fever. More severe reactions can include seizures, paralysis, psychosis and stroke.
  - **Cardiac:** palpitations, arrhythmias, pain or pressure in the chest, low or high blood pressure, slow or fast heart rate, shortness of breath.
  - **Respiratory:** sinusitis, bronchitis, pneumonia, asthma.
  - **Dermatological:** skin rash, itching, burning, facial flushing.
  - **Ophthalmologic:** pain or burning in the eyes, pressure in/behind the eyes, deteriorating vision, floaters, cataracts.
- Others:** digestive problems; abdominal pain; enlarged thyroid, testicular/ovarian pain; dryness of lips, tongue, mouth, eyes; great thirst; dehydration; nosebleeds; internal bleeding; altered sugar metabolism; immune abnormalities; redistribution of metals within the body; hair loss; pain in the teeth; deteriorating fillings; impaired sense of smell; ringing in the ears.

February 2014

## New Best Practices Optimize Wi-Fi

By Joe Zeto

*For The Record*

Vol. 26 No. 2 P. 8

With the rapid growth of mobile computing and Wi-Fi-enabled devices, today's medical institutions have gone from viewing wireless as a matter of convenience to a matter of life and death.



Medical staffs now routinely use wireless networks and devices to communicate and gain instant access to EMRs, test results, and provider information throughout a facility. Wireless local area networks support mobile patient monitoring, infusion pumps, medical imaging systems, and other specialized devices and applications. And the bring-your-own-device trend continues to gain steam among clinicians, patients, and visitors who favor using smartphones, tablets, laptops, and the like.

All in all, Wi-Fi networks in health care facilities are being pushed to their limits while the risks associated with poor performance—dropped calls, choppy videos, low patient satisfaction ratings—are on the rise. The modernization of facility networks to comply with health care reform introduces still more risk that must be monitored and mitigated.

With user expectations higher than ever and applications growing in complexity, the health care industry as a whole is adopting new best practices for approaching major Wi-Fi product launches and initiatives. As the volume and diversity of mobile devices continue to grow, health care facility IT teams and medical device manufacturers alike must become more proactive and aggressive in guaranteeing performance out of the gate and over time.

### The Challenge

Patient care depends on the secure exchange of accurate, actionable information. Many hospitals have become full-service facilities, offering emergency and intensive care to thousands of patients per month and requiring hospital IT staff to ensure high quality and availability of that care. Doing so is rife with challenges, including the following:

- verifying network capacity;
- providing high bandwidth in all areas requiring wireless connectivity;
- measuring individual Wi-Fi client device performance (eg, roaming, coexistence, throughput);

- assessing the quality of experience users can expect for voice, video, and other real-time mobile applications (eg, determining the voice quality at nurses' stations where voice-over Internet protocol handsets are concentrated); and
- evaluating future upgrades needed to support industry regulations and individual hospital IT road maps.

For hospital IT departments and their integration partners, the pressure to achieve hospital-grade Wi-Fi connectivity translates into the need to thoroughly assess environments and measure the impact of new mobile medical devices on existing hospital wireless local area networks and vice versa. As the sheer volume and diversity of mobile devices continue to grow, facility administrators must know how each new system, device, or application will perform; interact with other devices; and impact existing ecosystems before they're deployed.

Fortunately, the quality challenge does not rest solely with IT staff. Manufacturers of life-critical mobile devices must work in conjunction with hospital teams to optimize device and application performance for specific needs and environments.

With many medical devices going mobile for the first time, manufacturers new to Wi-Fi must adopt strategies for ensuring products can maintain wireless connectivity in challenging health care environments and under diverse traffic and environmental scenarios.

Even with strict compliance to standards and routine certification by the Wi-Fi Alliance, deployments in health care facilities face unique complexities and challenges that must be modeled early in development. Manufacturers must validate in advance that new devices will meet user and regulatory expectations for intended use or risk an adverse event. For example, missed alerts resulting in a delay in patients receiving critical care can lead to financial loss, liability, regulatory recalls, and damage to brand reputation.

Both device makers and those deploying Wi-Fi networks in health care environments are adopting new strategies for evaluating performance prior to introducing products and applications.

### **Prepare for Increased Traffic**

In many hospitals, wireless local area networks already support hundreds of devices used by nurses, clinicians, and other staff members as well as patients and guests. In optimizing networks to support these and other life-critical devices, the best practice is to assess network readiness for additional clients and services, and the quality each is likely to expect. The following factors must be addressed to help ensure success:

- **Capacity vs. coverage:** When wireless access first was introduced into health care environments, any connectivity was considered better than none, and virtually any level of application performance was deemed acceptable. Focusing primarily on connectivity, network architects attempted to minimize installation costs by using the minimum number of access points required to blanket an area. Unfortunately, this typically created an unsatisfactory user experience. Modern health care networks must be designed with actual network capacity in mind to ensure the necessary quality in high-density, heavily trafficked areas.
- **Device selection and interoperability:** During network design and vendor/device selection, site surveys must be conducted using actual devices to measure their impact on each other and the existing or intended network and applications. Those designing Wi-Fi networks must determine the best choices for both

wireless local area network infrastructure equipment and specialized wireless medical devices based on their individual performance requirements.

- **Optimal roaming:** Because people and devices both are constantly on the move, roaming tests must be conducted. Actual traffic and devices should be used to benchmark the impact of various roaming procedures on users and applications.
- **Target rates and service-level agreements:** A comprehensive evaluation of an intended site should be conducted during the planning stages to help set and gauge performance against target rate and service-level agreements for each traffic type. Traditional site surveys conducted prior to embarking on Wi-Fi initiatives must evolve into comprehensive site assessments.

Modern site assessments eclipse traditional surveys with their ability to generate real application traffic to measure the quality of the experience from the user perspective instead of inferring it from rudimentary signal strength measurements; replicate live network environments, including facilities' unique traffic mixes, environmental challenges, and peak conditions; assess true network capacity to allow IT teams to determine optimal repositioning of access points and the power configurations needed to maximize capacity; and model what-if scenarios to assess growth and future upgrades.

Fortunately, modern site assessments can be conducted quickly and cost-effectively, often assessing multiple devices and variables impacting performance during a single sweep through a facility.

### **Increased Mobility on the Horizon**

For health care device makers, the new best practices center chiefly on re-creating live network conditions in development and quality assurance labs. By simulating deployment conditions, various access points, and traffic from numerous other devices, manufacturers can fine-tune the capabilities of new devices to roam, interoperate with existing Wi-Fi networks, and deliver a high-quality user experience.

Early evaluation of real-world performance in the design and development cycles aids in choosing the appropriate radio-frequency components that play a pivotal role in determining a device's ultimate performance. Manufacturers also can tweak and recommend configurations that are optimized for specific application and service-level requirements.

### **The Future of Mobile Health Care**

If the risks associated with poor performance can be effectively mitigated, innovations in mobility will continue to revolutionize health care. With network and data system health affecting patient health like never before, reliability precludes liability. But armed with actionable insights gleaned from new best practices, the industry can look forward to leaps in speed, efficiency, and accuracy that only new degrees of mobility can deliver.

— *Joe Zeto is director of product marketing for Ixia.*

## NIH STUDY FINDS CELL PHONE/SMART METER RADIATION CAUSES BRAIN & HEART CANCERS

The National Toxicology Program (NTP) under the National Institutes of Health has completed the largest-ever animal (rats and mice) study on nonionizing radiation and cancer. Partial results released on May 26th confirm whole body exposures to low level radiofrequency radiation (RFR) of the type emitted by cell phones, smart meters and other wireless devices and within currently allowable safety limits, are the “*likely cause*” of brain and heart cancers in these animals, according to Dr. John Bucher, Associate Director of the NTP.

The \$25 million dollar study planned since 1999 showed one in twelve (12) male rats (8.3%) developed either malignant cancer (brain and rare heart tumors) or pre-cancerous lesions that can lead to cancer. Tumors called schwannomas were induced in the heart, and in the same kind of brain cells that have led to acoustic neuromas seen in human studies. The NTP says it is important to release these completed findings now given the implications to global health. No cancers occurred in the control group.

Dr. Lennart Hardell, MD, PhD of Sweden’s Orebro University and an expert witness in the Maine Smart Meter Health Investigation says “(T)he animal study confirms our findings in epidemiological studies of an increased risk for glioma and acoustic neuroma among people that use wireless phones, both cell phones and cordless phones (DECT). Acoustic neuroma is a type of Schwannoma, so interestingly this study confirms findings in humans of increased risk for glioma and acoustic neuroma. In 2013 we called for upgrading the risk in humans to Group 1, the agent is carcinogenic to humans. It is now time to re-evaluate both the cancer risk and other potential health effects in humans from radiofrequency radiation and also inform the public,” says Hardell. “This NTP evidence is greatly strengthening the evidence of risk, is sufficient to reclassify cell phone radiation as a known cancer-causing agent, and confirms the inadequacy of existing public safety limits.”

Dr. Christopher Portier, formerly with the NTP commented this is not just an associated finding—but that the relationship between radiation exposure and cancer is clear. “I would call it a causative study, absolutely. They controlled everything in the study. It’s [the cancer] because of the exposure. This is by far—far and away—the most carefully done cell phone bioassay, a biological assessment. This is a classic study that is done for trying to understand cancers in humans”.

We have written in Merrymeeting News since 2011 about the dangers of radiofrequency radiation from wireless devices, particularly smart meters which bring exposures to rural Maine. Birds, bees, other insects and mammals all show adverse responses to low-level electromagnetic field exposures. As levels of “electrosmog” grow with wireless proliferation not only from land sources but now also space-based platforms, the harbinger of an “Electronic Silent Spring” should alarm anyone who cares about our wildlife and civilization, much the same as Rachel Carson’s alarm did in bringing the effects of pesticide exposure to the public eye.

Dr. Jerry Phillips, PhD, is biochemist and director of the Excel Science Center at the University of Colorado at Colorado Springs. An educator and research scientist, Phillips conducted Motorola-funded research into the potential health impacts of cell phones during the 1990s while he was with the U.S. Department of Veterans Affairs’ Pettis VA Medical Center in Loma Linda, California. Phillips and his colleagues looked at the effects of different radiofrequency signals on rats, and on cells in a dish. Phillips also testified for health advocates in Maine’s smart meter investigation.

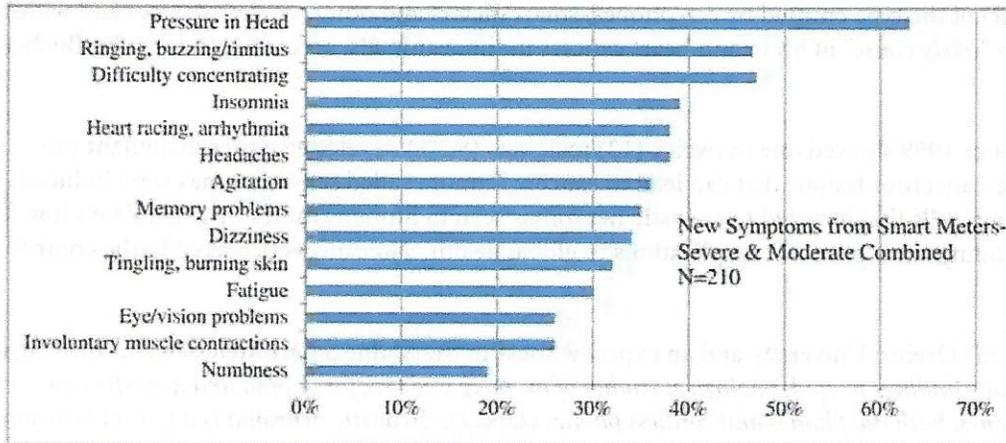
“The most troublesome finding to Motorola at the time is that these radiofrequency signals could interact with living tissues, which is what we saw in the rats,” he said in a recent [Scientific American](#) interview, adding:

“But you have to realize that this issue opens up a much bigger can of worms than cell phones. If this radiation, this form of energy can interact with biological tissue then it’s going to reopen a lot of what were supposedly settled issues regarding the safety of wireless communications. If we’re going to be bathed in a whole new electromagnetic environment, how safe is it?”

While cancers from RFR are certainly of great concern, perhaps of greater concern are debilitating non-cancer symptoms disorienting and causing avoidance behavior and other biological and behavioral responses in wildlife and humans. In people,

## NTP STUDY (CONTINUED)

relationships have commonly been stressed and destroyed, jobs have been lost and homes of many years sold or abandoned as a result of sensitivities to RFR. Consider if you suffer any or a number of the common RFR symptoms found in an international survey of those affected by smart meters as shown in this chart:



Conrad & Friedman, 2013. Smart Meter Health Effects Survey & Report

Smart meters in particular have sensitized many to any wireless device including routers and cell phones. The inability to use these common tools severely inhibits folks in their personal and economic lives. Their ability to live normal lives in the 21st century has been severely compromised immediately versus 10-30 year latency periods typical in cancer development. This change in ability to use these devices is directly correlated to smart meter exposure.

The suffering and the social and economic effects of chronic debilitating symptoms victims have experienced since smart meter exposure simply cannot be ignored, and provides ample evidence there is something about smart meters (evidence suggests the RF from up to 170,000 transmissions/day is conducted on home wiring) causing extreme harm to at least some, and possibly eventually all persons. While there is obviously only a portion of our population manifesting acute electromagnetic hypersensitivity (EHS) symptoms now (the canaries), and even fewer recognizing their source, we are all being exposed and are all susceptible.

*"This is a game changer, there is no question,"* said Dr. David Carpenter, MD, PhD, director of the Institute for Health and the Environment at the University of Albany and also an expert witness in Maine. *"It confirms what we have been seeing for many years — though now we have evidence in animals as well as in humans."* Quoted in *Microwave News*, Carpenter went on to add, *"The NTP has the credibility of the federal government. It will be very difficult for the naysayers to deny the association any longer."*

## KENNEBEC AND ANDROSCOGGIN PROPOSED CRITICAL HABITAT FOR ATLANTIC STURGEON

NOAA Fisheries announced June 2, two proposed rules designating critical habitat for five distinct population segments [DPS] of federally listed Atlantic sturgeon. The proposed areas provide important protected river habitats for the threatened Gulf of Maine population segment and the endangered population segments of the New York Bight, Chesapeake Bay, Carolina and South Atlantic. NOAA Fisheries listed the Atlantic sturgeon under the Endangered Species Act in 2012. The two local designations include the Kennebec to Lockwood dam in Waterville and the Androscoggin to the Brunswick-Topsham dam.

The ESA requires NOAA Fisheries [formerly and often still known as the National Marine Fisheries Service or NMFS] designate critical habitat when a species is listed as threatened or endangered. Under the ESA, critical habitat is defined as geographic areas occupied by the species, and containing features essential to the conservation of that species. Critical habitat can also include geographical areas that are not currently occupied by the species, but that are essential to its conservation, historical habitat for example.

Critical habitat does not create preserves or refuges. Instead, when a federal agency is carrying out funding or authorizing an activity that may affect the critical habitat, the federal agency works with NOAA NOAA Fisheries to avoid or minimize

[Cancer Epidemiology](#)

[Volume 39, Supplement 1](#), December 2015, Pages S93–S100

European Code against Cancer 4th Edition: 12 ways to reduce your Cancer risk (<http://cancer-code-europe.iarc.fr>) — Editorial Board of the European Code against Cancer: Joachim Schüz, Nereo Segnan, Lawrence von Karsa

<http://www.sciencedirect.com/science/article/pii/S1877782115000983>



## European Code against Cancer 4th Edition: Ionising and non-ionising radiation and cancer



- [Neil McColl<sup>a</sup>](#),
- [Anssi Auvinen<sup>b, c</sup>](#),
- [Ausrele Kesminiene<sup>d</sup>](#),
- [Carolina Espina<sup>d</sup>](#),
- [Friederike Erdmann<sup>d</sup>](#),
- [Esther de Vries<sup>c</sup>](#),
- [Rüdiger Greinert<sup>f</sup>](#),
- [John Harrison<sup>a</sup>](#),
- [Joachim Schüz<sup>d, g</sup>](#),

Show more

[doi:10.1016/j.canep.2015.03.016](https://doi.org/10.1016/j.canep.2015.03.016)

[Get rights and content](#)

Open Access funded by International Agency for Research on Cancer

Under a Creative Commons [license](#)

Open Access

---

## Abstract

Ionising radiation can transfer sufficient energy to ionise molecules, and this can lead to chemical changes, including DNA damage in cells. Key evidence for the carcinogenicity of ionising radiation comes from: follow-up studies of the survivors of the atomic bombings in Japan; other epidemiological studies of groups that have been exposed to radiation from medical, occupational or environmental sources; experimental animal studies; and studies of cellular responses to radiation. Considering exposure to environmental ionising radiation, inhalation of naturally occurring radon is the major source of radiation in the population – in doses orders of magnitude higher than those from nuclear power production or nuclear fallout. Indoor exposure to radon and its decay products is an important cause of lung cancer; radon may cause approximately one in ten lung cancers in Europe. Exposures to radon in buildings can be reduced via a three-step process of identifying those with potentially elevated radon levels, measuring radon levels, and reducing exposure by installation of remediation systems. In the 4th Edition of the European Code against Cancer it is therefore recommended to: “Find out if you are exposed to radiation from naturally high radon levels in your home. Take action to reduce high radon levels”. Non-ionising types of radiation (those with insufficient energy to ionise molecules) – including extremely low-frequency electric and magnetic fields as well as radiofrequency electromagnetic fields – are not an established cause of cancer and are therefore not addressed in the recommendations to reduce cancer risk.

## Keywords

- Radon;
- Ionizing radiation;
- Cancer;
- Radiation-induced cancer;
- Electromagnetic fields;
- Primary prevention;
- Europe

## Abbreviations

- AGIR, Advisory Group on Ionising Radiation;
  - CT, computerised tomography;
  - EMF, electromagnetic fields;
  - IARC, International Agency for Research on Cancer;
  - ICRP, International Commission on Radiological Protection;
  - ICNIRP, International Commission on Non-Ionising Radiation Protection;
  - RF, radiofrequency;
  - UVR, ultraviolet radiation;
  - UNSCEAR, United Nations Scientific Committee on the Effects of Atomic Radiation
-

# 1. Sources and physical and biological properties of radiation

## 1.1. Introduction

Natural and man-made sources generate radiant energy in the form of electromagnetic waves; these are characterised by their wavelength, frequency and photon energy. The electromagnetic spectrum includes static (non-alternating) electric and magnetic fields, low-frequency electric and magnetic fields (low energy, long wavelengths), intermediate and radiofrequency (RF) electromagnetic fields (EMF), microwaves, optical radiation (infrared, visible light, ultraviolet radiation) and gamma- and X-rays (ionising radiation with high energy and very short wavelengths) (Fig. 1). In addition to electromagnetic waves, ionising radiations include particulate sources: notably neutrons, electrons (beta particles) and alpha particles. While non-ionising and ionising electromagnetic waves and neutrons can penetrate the body from external sources, charged particles – including alpha and beta particles – have limited ability to penetrate body tissues, and risks are generally associated with their entry into the body by inhalation or ingestion.

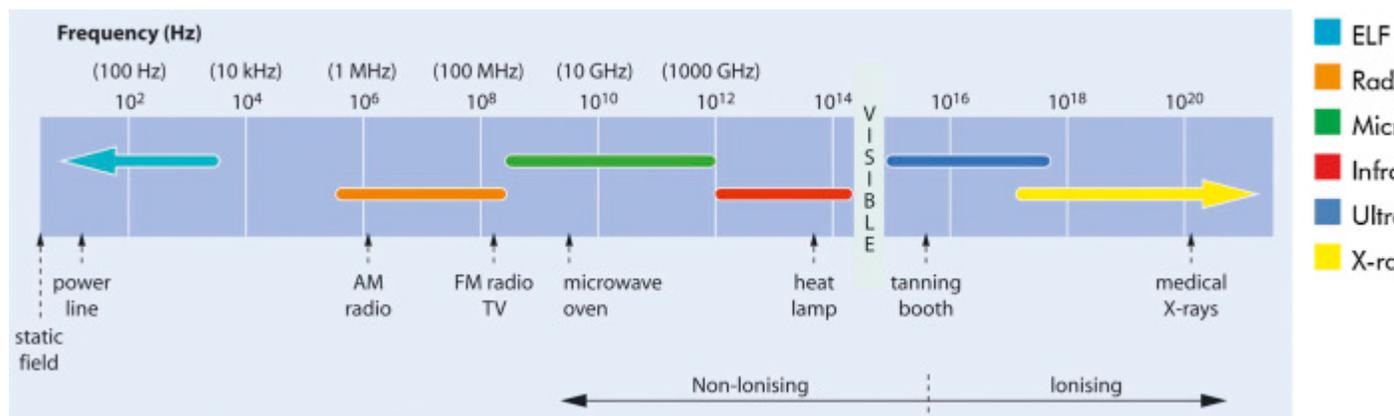


Fig. 1.

Electromagnetic spectrum. The electromagnetic spectrum extends from below the low frequencies used for modern radio communication to gamma radiation at the shortest wavelength and highest frequency. Reproduced from the European Commission, Research Directorate-General, European Communities (2005). Health and Electromagnetic Fields: EU-funded research into the impact of electromagnetic fields and mobile telephones on health. © European Communities, 2005.

### [Figure options](#)

Ionising radiation and ultraviolet radiation (UVR) are known to cause cancer [1] and [2], but the evidence regarding non-ionising radiation is equivocal [3] and [4]; while there is a mechanistic understanding of the cellular effects of ionising radiation and UVR, plausible mechanisms have not been established for the effects of non-ionising radiation. The cancer risk from ionising radiation, in particular radon, justifies the recommendation of the 4th edition of the European Code against Cancer (Box 1). Ionising radiation from medical diagnostics and treatment is discussed elsewhere, together

with other medical exposures [5]. UVR, also subject to a recommendation, is discussed elsewhere [6]. In this paper, we also cover non-ionising radiation (the EMF part), for which the scientific evidence has been evaluated and shows that it is not an established cause of cancer, and is therefore not addressed by a recommendation of the Code.

Box 1.

European Code Against Cancer.

## EUROPEAN CODE AGAINST CANCER

### **12 ways to reduce your cancer risk**

1. Do not smoke. Do not use any form of tobacco
2. Make your home smoke free. Support smoke-free policies in your workplace
3. Take action to be a healthy body weight
4. Be physically active in everyday life. Limit the time you spend sitting
5. Have a healthy diet:
  - Eat plenty of whole grains, pulses, vegetables and fruits
  - Limit high-calorie foods (foods high in sugar or fat) and avoid sugary drinks
  - Avoid processed meat; limit red meat and foods high in salt
6. If you drink alcohol of any type, limit your intake. Not drinking alcohol is better for cancer prevention
7. Avoid too much sun, especially for children. Use sun protection. Do not use sunbeds
8. In the workplace, protect yourself against cancer-causing substances by following health and safety instructions
9. Find out if you are exposed to radiation from naturally high radon levels in your home; take action to reduce high radon levels
10. For women:
  - Breastfeeding reduces the mother's cancer risk. If you can, breastfeed your baby
  - Hormone replacement therapy (HRT) increases the risk of certain cancers. Limit use of HRT
11. Ensure your children take part in vaccination programmes for:
  - Hepatitis B (for newborns)
  - Human papillomavirus (HPV) (for girls)
12. Take part in organised cancer screening programmes for:
  - Bowel cancer (men and women)
  - Breast cancer (women)
  - Cervical cancer (women)

The European Code Against Cancer focuses on actions that individual citizens can take to help prevent cancer. Successful cancer prevention requires these individual actions to be supported by governmental policies and actions.

## [Table options](#)

### **1.2. Exposure to sources of ionising radiation**

Radioactive substances are a source of ionising radiation. An important characteristic of these radioactive materials is the rate at which they decay, either into another radioactive nuclide or into a stable (i.e. non-radioactive) nuclide. The decay rate is normally expressed in terms of the nuclide's half-life, namely, the time taken for the radioactivity of any given amount of the particular radionuclide to decay to half of its initial value. The amount of a radioactive substance is generally measured in terms of its activity or radioactive decay rate, with units of becquerel (Bq); 1 Bq equals one nuclear decay event per second. Each radionuclide, depending on its degree of nuclear instability, has a characteristic radioactive half-life, and nuclear decay is accompanied by a specific yield of energy depending on the radiations emitted (e.g. alpha, beta).

Many radioactive materials exist naturally. Primordial radioactive elements include uranium-238 that has a radioactive half-life of around  $4.5 \times 10^9$  years leading to the radioactive decay chain that includes radon-222 (which together with its progeny/daughter isotopes/decay products is referred to as 'radon' below). Some human activities create radioactive materials either deliberately or as a by-product. Nuclear fission of uranium-235 in nuclear reactors is a source of man-made radionuclides. Some devices, such as x-ray sets used in medicine and in industrial inspection, generate and emit ionising radiation without the presence of radioactive material.

Radioactive materials external to the body can result in radiation exposure and cancer risk if the emitted radiations can penetrate to body organs and tissues, as is the case for gamma rays, X-rays and neutrons [7]. Entry of radioactive materials into the body, mainly by inhalation or ingestion, can lead to their deposition and retention in body organs and tissues, resulting in continued irradiation. For so-called non-penetrating radiations – including beta and alpha particles – risk to health is largely the result of such internal exposures. The extent to which specific organs and tissues are exposed from a radionuclide within the body depends on various factors: the mode of entry into the body; the physical and chemical properties of the incorporated radionuclides; the radiations emitted; the radioactive half-lives of the incorporated radionuclide and its decay products; and the distribution within and elimination from the body [7]. A short-lived, insoluble, alpha-emitting radionuclide that is ingested would irradiate the gut more than other tissues. In contrast, a long-lived, highly soluble, gamma-emitting radionuclide that is inhaled may be distributed around and irradiate most of the body's tissues before being excreted.

For all types of ionising radiation exposure, radiation dose is defined as the energy deposited as a result of ionisations and excitations per unit mass of material. This quantity is referred to as the absorbed dose and has the unit of gray (Gy), where 1 Gy equals 1 J/kg. At sufficiently high doses, the predominant effect is cell killing, leading to gross organ damage and potentially to death. If an individual escapes death (from exposure-related cell killing) and at all lower doses, the predominant effect of concern is an increased probability of cancer (see below). For radiological protection purposes, the International Commission on Radiological Protection (ICRP) has defined the quantity, the effective dose (unit of Sievert, Sv), as a risk-adjusted dosimetric quantity for use in the control of radiation exposures. The effective dose is calculated from absorbed dose, adjustments being made for differences between radiation types in their ability to cause cancer (per Gy) and differences between

organs and tissues in their sensitivity to the induction of cancer. For example, alpha particles are more effective in causing cancer per Gy of radiation than gamma rays, and this is recognised for protection purposes using a radiation weighting factor of 20. The greater sensitivity of the colon than the liver to radiation-induced cancer (as suggested, for instance, by the higher risk of colon cancer than liver cancer in the atomic bomb survivors in Japan, shown in [Fig. 2](#)), for example, is recognised in tissue weighting factors of 0.12 and 0.04, respectively [\[7\]](#). It should be appreciated, however, that these are simplified risk adjustments applied for protection purposes and they do not fully reflect our scientific understanding and would not be used in the calculation of risks to specific population groups or individuals. Thus, for example, radiation effectiveness is known to be dependent on cancer type and organ/tissue sensitivity and is age- and sex-dependent [\[8\]](#) and [\[9\]](#).

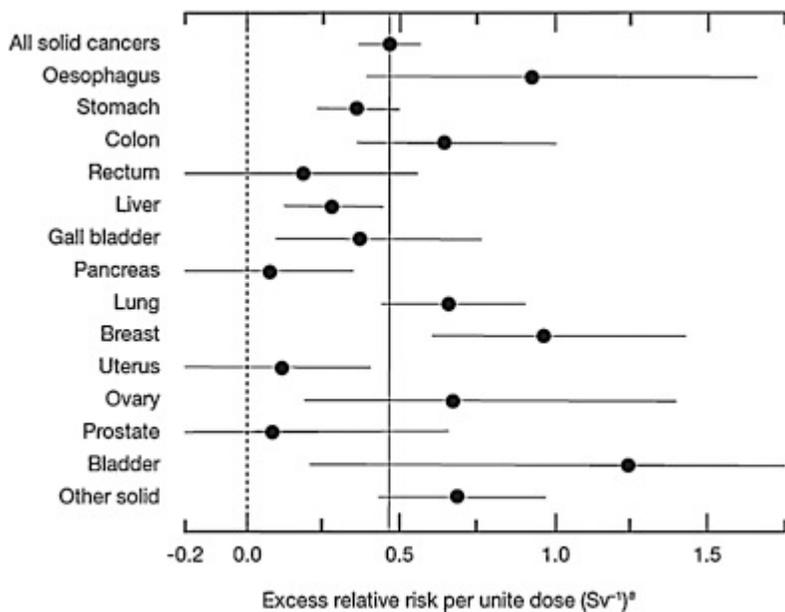


Fig. 2.

Estimates of solid cancer mortality risk for different organs from studies of the survivors of the atomic bombings in Japan. The figure shows the excess relative risk per unit dose ( $\text{Sv}^{-1}$ ) of various cancer types from radiation exposure among the survivors of the atomic bombings in Japan. Reproduced with permission from United Nations/UNSCEAR [\[18\]](#). <sup>a</sup>While the absorbed dose is expressed in gray (Gy), because radiations differ in their ability per Gy to cause cancer, a radiation-weighted quantity, equivalent dose, is used, expressed in Sievert (Sv) (see Section [1.2](#)). The horizontal bars represent 90% confidence intervals.

### [Figure options](#)

Estimates are made, nationally and internationally, of the sources and distribution of radiation exposures of populations. According to the latest periodic review of radiation exposures by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) [\[10\]](#), reference individuals receive an average of about 3 mSv effective dose annually but, within a population, there may be a wide range of individual exposures from less than 1 to more than several tens of mSv. For any individual, the absolute and relative contributions of different sources of radiation exposure will depend on many factors, including their home location (e.g. radon and cosmic ray exposure), exposure

as patients during medical diagnostic procedures (e.g. X-rays, computerised tomography (CT) scans) or radiotherapy, their job (workplace exposure), and dietary choices (ingestion of radionuclides). However, everybody is exposed to ionising radiation to some extent owing to the abundance of natural sources. [Fig. 3](#) shows the relative contributions from different sources to the estimated average annual exposure estimated for the global population. Much of the radiation exposure of a typical individual comes from natural radiation sources, including internal exposure from inhaling radon decay products when indoors, external exposure from gamma-emitting radionuclides in rocks, soil and building materials, and internal exposure from ingestion of natural radionuclides in food and drink [\[10\]](#).

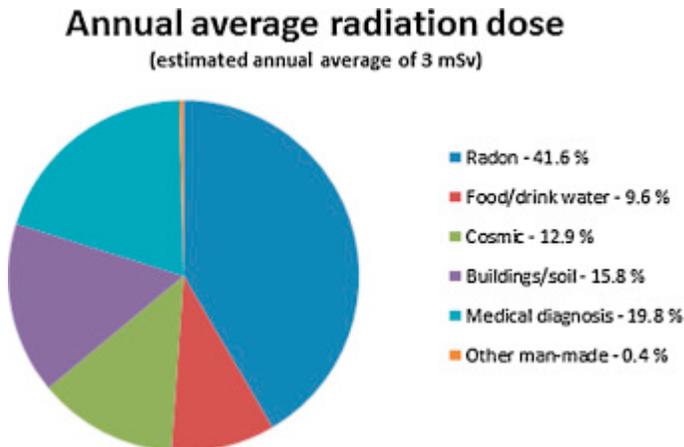


Fig. 3.

Components of worldwide annual average individual radiation dose. The pie chart shows the annual average dose to the representative individual from the different radiation sources. Inhalation of radon (=Radon); ingestion of radionuclides in food and drink (=food/drink water); external irradiation from cosmic rays (=Cosmic); external irradiation from radionuclides in building materials and soil (=Buildings/soil); external and internal irradiation from medical diagnosis (=Medical diagnosis); external radiation and ingestion/inhalation from other man-made sources (=Other man-made). Reproduced from [\[10\]](#).

#### [Figure options](#)

The predominant source of man-made radiation exposure is the use of radiation for medical diagnostic and therapeutic purposes [\[10\]](#); medical exposure to ionising radiation will be discussed in a separate article [\[5\]](#). Other anthropogenic sources include: external and internal exposure of the public to radionuclides released into the environment from nuclear power plants, both low-level releases during normal operations and exposures resulting from past accidents (such as those at Chernobyl and Fukushima); exposures to fallout from nuclear weapons testing; and occupational radiation exposures of workers including those in the health care, nuclear industry, airline pilots and some miners [\[10\]](#). Together, these non-medical man-made sources make only a minor contribution to the overall population exposure. For most people, radon is the largest individual component of exposure to ionising radiation.

### 1.3. Exposure to radon

Radon is an inert gas with several radioactive isotopes. Radon-222 is formed by the radioactive decay of uranium-238 that is present in small quantities in all soils and rocks. Other radon isotopes are generally less important for health than radon-222 because their short half-lives limit their presence in inhaled air. Radon-222 has a 3.8-day half-life, sufficient to allow time for accumulation above ground in homes and other buildings. In outdoor air, it is generally diluted to negligible concentrations [11].

Buildings, including homes, have slightly reduced air pressure relative to outdoor air, due to indoor heating and air movement. Soil air, containing radon, is drawn from the ground into a building through openings and minor defects in the foundations such as in seams and utility entry points. It may be retained within the building unless removed by ventilation, and this can lead to elevated concentrations in indoor air which can reach hundreds or thousands of becquerels per cubic metre ( $\text{Bq m}^{-3}$ ) [12]. As an inert gas, inhaled radon is mostly exhaled. However, radon has a number of radioactive decay products with very short half-lives which include alpha-particle-emitting isotopes of polonium (218 and 214) which are deposited within the lungs and are a recognised cause of lung cancer.

Radon is present in most rocks and soil. The concentrations in homes and workplaces depend on a number of factors, including: the abundance of radium-226 (a long-lived intermediate decay product of uranium-238) in the ground; the permeability of the soil; the openings in the foundations of the building through which radon can enter a building from the ground; and the extent to which a particular building retains radon. These variations can result in a wide range of indoor radon concentrations even in a small geographical area. Two apparently identical adjacent homes can have very different indoor radon levels. UNSCEAR [13] estimated a worldwide population-weighted geometric mean indoor level of  $30 \text{ Bq m}^{-3}$ . Fig. 4 shows the geographical distribution means of long-term radon concentrations in ground floors across Europe. A small proportion of radon exposure arises from its presence in and emanation from building materials and water supplies.

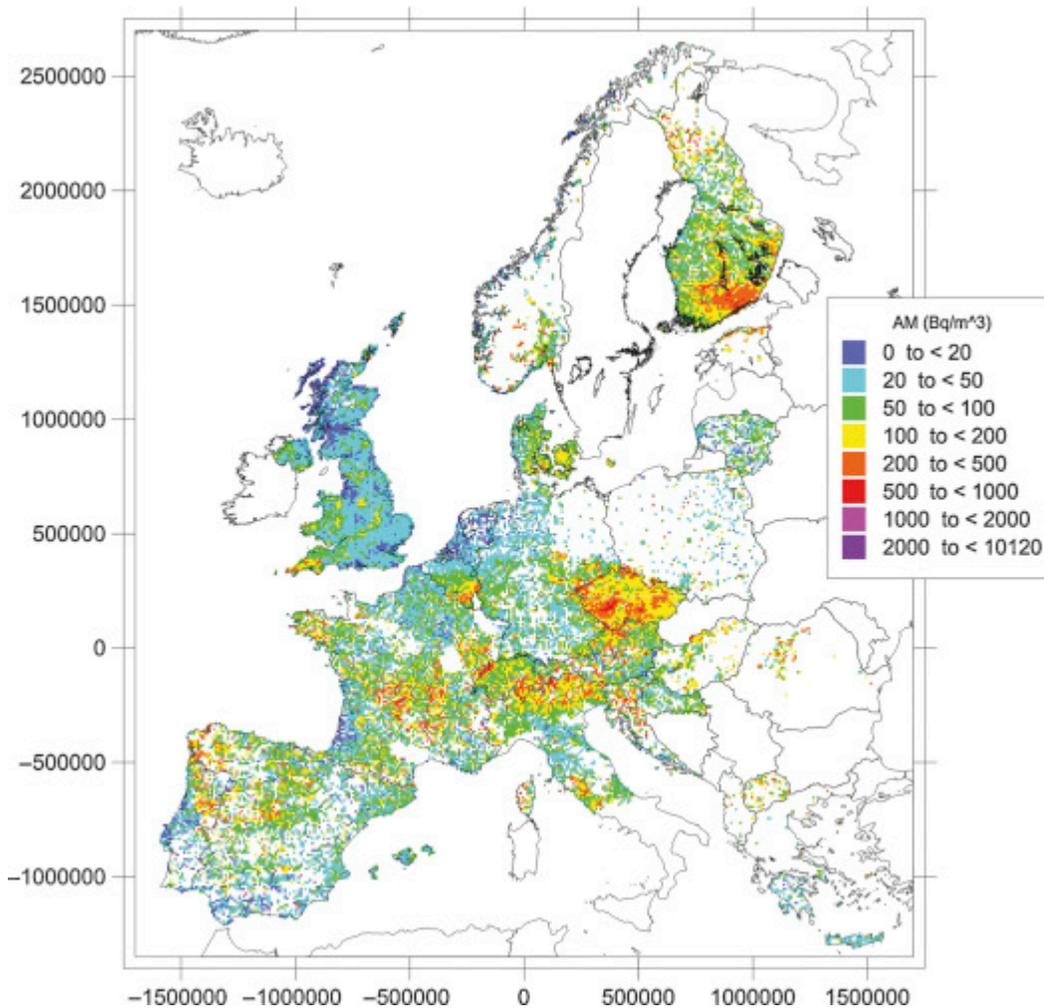


Fig. 4.

Map of radon in Europe. Arithmetic means over  $10 \text{ km} \times 10 \text{ km}$  cells of long-term radon concentration in ground-floor rooms. Data available up until May 2014 included. Reproduced with permission of Oxford University Press [52].

[Figure options](#)

## 1.4. Exposure to non-ionising radiation

Exposure to static and to extremely low-frequency electric and magnetic fields is ubiquitous due to natural phenomena and power transmission and the use of electrical appliances. Examples of natural sources of exposure include the geomagnetic field of the earth and, as extreme phenomena, thunder and lightning. Normal residential background exposure to extremely low-frequency magnetic fields is usually below  $0.1 \mu\text{T}$  (flux density or magnetic field strength) [14]. A small fraction of households located very close to high-voltage power lines or other sources (including indoors) can have higher exposures, but usually well below protection limits – defined by the International Commission for Non-Ionising Radiation Protection (ICNIRP) – for the general population [15]. Higher but short-term exposures occur in particular jobs such as those of electricians.

For the majority of people, highest exposures to radiofrequency electromagnetic fields occur when using mobile phones because the source of emission is held close to the head. Much lower levels of exposure arise from high-power TV and radio transmitters, but the electric field strength may exceed 1 V/m even at points several kilometres from transmitters [16]. Exposures from smaller transmitters – such as mobile phone base station antennas – are normally even lower except in their immediate vicinity [17]. The number of sources continues to increase with further utilisation of the whole electromagnetic frequency spectrum and further development of new wireless technologies.

## 2. Cancer risk from ionising radiation

### 2.1. Ionising radiation and cancer

Large numbers of studies have investigated the effects of ionising radiation exposure as a cause of haematological malignancies and solid cancers. Ionising radiation has been classified by the International Agency for Research on Cancer (IARC) as an established or class I carcinogen [1]. Key evidence for the carcinogenicity of ionising radiation has been reviewed by IARC, the United Nations Scientific Committee on the Effects of Atomic Radiation [11], and the International Commission on Radiological Protection [7]; it includes: the Life Span Study of survivors of the atomic bombings in Japan exposed at the end of the second world war; other epidemiological studies of groups that have been exposed to radiation from medical, occupational or environmental sources; experimental animal studies; and studies of cellular responses to radiation including DNA damage.

[Fig. 2](#) illustrates some of the evidence for radiation-associated cancer and the magnitude of risk to different tissues. It shows the excess relative risk per dose unit (Sv) of various cancer types among the survivors of the atomic bombings in Japan.

In its 2011 summary report of low-dose radiation effects on health [18], UNSCEAR stated that “... the energy deposited in the cell after irradiation can damage all subcellular components. The main subcellular targets for radiation-associated cellular change are the DNA molecules residing in the chromosomes... The cell may survive but with DNA mutations that affect cellular behaviour. A small fraction of such mutations can contribute to cancer development... Complex DNA damage is difficult to repair correctly, and even at low doses of radiation it is likely that there is a very small but non-zero chance of the production of DNA mutations that increase the risk of cancer developing. Thus, the current balance of available evidence tends to favour a non-threshold response for the mutational component of radiation-associated cancer induction at low doses and dose-rates.”

ICRP judges [7] that the weight of evidence supports the view that it is “scientifically plausible to assume that the incidence of cancer... will rise in direct proportion to an increase in the equivalent dose in the relevant organs and tissues.”

These conclusions from UNSCEAR and ICRP embody what is generally referred to as the linear, no-threshold (LNT) dose–response model. It implies that there is no level at which the risk is zero, but any additional exposure to ionising radiation increases the lifetime cancer risk, adding to the underlying cancer risk from other causes. The ICRP risk factor [7] for cancer induction in a mixed age population is 5.5% per Sv of effective dose delivered at low dose and dose rate.

## 2.2. Radon and cancer

There is substantial epidemiological evidence that indoor exposure to radon and its decay products is an important cause of lung cancer, second only to tobacco smoking. Several large-scale epidemiological studies – including pooled analyses of uranium miners and populations exposed to elevated radon levels at home [19], [20], [21] and [22] – have demonstrated that long-term exposure to radon increases the risk of lung cancer. Pooled case–control studies have also shown that the excess relative risk of lung cancer is proportional to long-term radon exposure levels for smokers, non-smokers and ex-smokers, as illustrated in Fig. 5[20] and [23]. The UK independent Advisory Group on Ionising Radiation (AGIR) reported a 16% excess relative risk from long-term (30 years) exposure to radon in air at a concentration of  $100 \text{ Bq m}^{-3}$ , with a 95% confidence interval of 5–31% [23]. The results provide direct evidence of increased lung cancer risk at radon levels below  $200 \text{ Bq m}^{-3}$ . The greatest absolute lung cancer risks from radon exposure were to continuing smokers, primarily because smoking induces a much higher baseline lung cancer risk, and radon acts multiplicatively with other lung cancer risks. In other words, the vast majority of radon-induced cancers develop among smokers as a joint effect of radon and smoking. Darby et al. [19] and [20] estimated the fraction of the lung cancer burden attributable to indoor radon in Europe to be about 9%. The World Health Organization (WHO) [12] reported estimates ranging from 3% to 14% across some selected populations around the world, including some from Europe, based on a large pooling study for the UK (3.3%), Germany (5%), France (5%), and Switzerland (8.3%).



Fig. 5.

Relative risk of lung cancer in relation to long-term residential radon concentrations in the European pooling study (with 95% confidence intervals). Relative risks and 95% confidence intervals are shown for categorical analyses and also the best-fitting straight line. Risks are relative to that at  $0 \text{ Bq m}^{-3}$ . From Radon and Public Health [23]. © Crown copyright. Reproduced with permission of Public Health England.

[Figure options](#)

### 2.3. Other relevant sources of ionising radiation and cancer

Studies of nuclear workers exposed mainly to low doses of external radiation under relatively well controlled conditions demonstrated a small increase in cancer mortality associated with exposure at work [24] and [25]. In a study of nuclear workers from 15 countries, 1–2% of deaths from solid cancers were considered to be possibly related to their occupational exposure [24]. Analysis of cancer incidence in the very large cohort of workers included in the UK National Registry for Radiation Workers showed a significant dose–response relationship consistent with the extrapolation of the A-bomb risk factors to low doses [25]. Studies of cancer incidence in plutonium workers at the Russian Mayak plant have shown plutonium-239-related excesses of lung and liver cancers [26] and [27]. Comparisons of lung cancer incidences following exposures to radon progeny (uranium miners), plutonium and external gamma rays show that risk estimates are consistent when account is taken of the relative biological effectiveness (RBE) of alpha particles and gamma rays [28]. The data are consistent with alpha particle RBE values of around 10–20, although Marsh et al. [28] noted the considerable uncertainties associated with these estimates.

Excesses of childhood leukaemia incidence in populations near nuclear installations in the UK, Germany and other countries have been recorded, but a number of similar studies have failed to show any increased risks [9] and [29]. The radiation doses in these populations are well below the levels that might cause any discernible excess risk of cancer in the light of current understanding, particularly as doses from natural sources have been shown to dominate and exceed any contributions from radioactive discharges from nuclear facilities. Overall there is no good evidence that any step in the production of nuclear power under controlled conditions is related to any cancer excess in the populations of the adjacent areas. However, nuclear accidents such as that at the Ukrainian Chernobyl plant can result in exposure to radiation doses resulting in elevated cancer risks, depending on the release of radionuclides and the location [10]. In addition, radioactive discharges from the Mayak plant into the Techa River were sufficiently high in the early years of operation to lead to increases in both haematological malignancies and solid cancers [30] and [31]. The recent accident at the Fukushima plant in Japan resulted in exposures that were an order of magnitude or more below those experienced following the Chernobyl reactor, and discernible increases in cancer incidence are not expected [32] and [33].

### 2.4. Non-ionising radiation and cancer

Epidemiological studies have consistently shown a positive association of extremely low-frequency magnetic fields with an approximately two-fold higher childhood leukaemia risk at average exposure levels exceeding 0.3–0.4  $\mu\text{T}$  [15]. A causal relationship, however, has not been established due to the potential for bias and confounding in the studies and because supporting evidence from experimental studies and mechanistic data are lacking. The 2002 IARC Monograph [3] on extremely low-frequency magnetic fields classified them as possibly carcinogenic to humans (group 2B) based on the findings for childhood leukaemia; the evidence for other types of malignancy was evaluated to be inadequate. This view was recently confirmed by the European Commissions' Scientific Committee on Emerging and Newly Identified Health Risks [34]. Radiofrequency electromagnetic fields (group 2B) have also been classified by the IARC [4] as possibly carcinogenic to humans on the basis of findings for glioma and acoustic neuroma. Case–control studies on mobile phone use and cancer have reported increased risks of glioma and acoustic neuroma in heavy users of mobile phones, based on self-reported mobile

phone use [35] and [36]. Cohort studies have shown no associations, but had fewer data on heavy users [37] and [38]. Time trends in glioma incidence based on Nordic countries excluded any significant increased incidence attributable to mobile phone usage of up to 10 years [39]. With regard to environmental exposures from transmitters – including television, radio, and military transmissions as well as mobile phone base stations – the evidence is inadequate due to paucity of high-quality studies with accurate individual exposure assessment [40]. Some large studies on childhood cancer and fields generated by high-output TV and/or radio transmitters reported no associations [15]. Overall, currently available information does not provide unequivocal evidence that non-ionising radiation at low and high frequencies is a cause of cancer.

### **3. Scientific justification of the recommendation on radon**

The carcinogenicity of ionising radiation is well documented [1]. Ionising radiation can cause many types of cancer and haematological malignancies. Some exposure to ionising radiation is unavoidable – for instance that from cosmic radiation or terrestrial radiation. The major source of man-made radiation is medical exposure; the exposure is intentional and brings benefit through diagnoses or treatment. Therefore controlled and judicious use of radiation in medicine is associated with risks that are counterbalanced with benefits [5]. Man-made radiation also occurs in some occupational settings for which regulations are in place, such as the Euratom 2014 Basic Safety Standards [41]. These regulations provide a range of controls, including: risk assessment; control of radiation use and procedures for radiation safety and protection; and personal and environmental radiation monitoring where appropriate. The recommendation of the Code to follow health and safety advice to reduce occupational exposure defined elsewhere also applies to ionising radiation [42]. Other man-made exposures – such as for example those related to the use of nuclear energy under normal conditions – are sometimes of concern in the population. Nevertheless, they generally contribute little to overall radiation exposure (Fig. 3). This does not apply to major nuclear accidents with major radionuclide releases.

The major source of exposure to ionising radiation, modifiable by the individual, comes from naturally occurring radon. While this naturally occurring exposure cannot be eliminated, it can be substantially reduced at places where people spend much of their time, namely in their own homes or at their workplaces. Radon is estimated to account for about one in ten lung cancers in Europe [18], therefore causing a major cancer burden. The respective recommendation is: “Find out if you are exposed to radiation from naturally high radon levels in your home. Take action to reduce high radon levels”.

#### **3.1. Individual action for protection against radon**

##### **3.1.1. Variation in radon exposure**

Radon concentrations in homes and other buildings vary substantially, as discussed in Section 1.3. The radon exposures of building occupants depend primarily on the proportion of time they spend in the building. Over the course of a year, most people spend a majority of their time in their home, mostly in living rooms and bedrooms. Homes are therefore the primary source of indoor radon exposure, with workplaces presenting the second most important source of exposure with radon concentrations typically similar to or slightly lower than those in homes (although high concentrations can occur in particular workplaces, especially underground).

It is not generally possible to accurately predict the indoor radon concentration in a specific building, and measurements are required. However, a number of countries (see for example [43], [44] and [45]) have used radon or related measurements or geological information to identify radon-prone areas where high radon levels are more common. Maps indicating radon-prone areas are used in some countries to provide guidance on whether radon measurements should be made in existing properties to inform remediation decisions (Fig. 4).

### 3.1.2. Measuring radon in the home

Indoor radon levels vary considerably over short periods (hours and days) [46], and seasonally through the year [47]. Within any home, there is often a variation in concentration between rooms. Measurements of radon are generally intended to represent the long-term average concentration in the home. For this reason, radon measurements in homes are often made using two detectors placed in regularly occupied rooms, including a bedroom, for several weeks. Measurements made during different times of the year can be adjusted to reflect seasonal variations [47]. Shorter duration measurements may be made but the results are less accurate and have greater uncertainties.

### 3.1.3. Managing individual risks from radon exposure

The distribution of residential radon exposures in a population reflects the geometric mean of indoor radon concentrations with a log-normal distribution. A large proportion of the population exposure to radon will therefore arise from the many homes that have relatively modest indoor radon concentrations [12]. The modest cost of including radon preventative measures in new buildings is sufficiently low as to support preventive measures in new buildings [12]. Maps of radon-prone areas can be used to support policies on radon preventative measures in new buildings, such as requiring the installation of impermeable membranes at the building foundation level.

Most radon strategies focus on identifying and managing the homes with the highest radon concentrations. International guidance is available from the ICRP [48] and the WHO [12] on radon concentration levels (termed “reference levels” by the ICRP), above which action should be taken to reduce indoor radon concentrations, and below which concentrations should be reduced as far as is reasonably achievable. The WHO and ICRP have advised that relevant national authorities should establish radon reference levels for homes in the range 100–300 Bq m<sup>-3</sup>. The ICRP system of radiological protection [7] advises that reference levels of radiation dose for “existing exposure situations” such as radon in buildings, should be implemented using dose criteria in the range 1–20 mSv y<sup>-1</sup>. ICRP has advised [48] that a derived reference level of 300 Bq m<sup>-3</sup> for homes is consistent with this aspect of its system of radiological protection.

A European Union directive, setting out requirements for protection against ionising radiation [41], has established criteria for managing indoor radon, setting an upper limit of 300 Bq m<sup>-3</sup> on national reference levels unless there are extenuating circumstances. Means to manage high individual radon exposures in the home include provision of resources and funding for radon risk assessments, measurements or remediation [49] and provision of information to the householder [50]. The European Code Against Cancer recommendation concerning radon in the home expects the householder to take responsibility for managing the radon risk in their home. Such an approach complements programmes

to encourage or support householders in radon management and complements responsibilities that landlords have to provide safe housing for their tenants.

### 3.1.4. Reducing high indoor radon levels

Practical methods are available for reducing high radon levels in existing properties [12], usually at modest cost. These generally work by either reducing the radon concentration at the point where it enters the building from the ground, or reducing the air pressure differential between the building and the ground that is the driving force for soil air and radon to enter the home. Experience to date [51] suggests that the most effective solutions are based on low-power electrical air pumps, typically consuming a few tens of watts that work continuously and can achieve reductions in radon concentration to a tenth of the original level. The most commonly used remediation systems include: (1) a “radon sump” – a small, engineered, partially depressurised void beneath the building from which soil air and radon are continually pumped through pipes and expelled to atmosphere; and (2) positive pressure ventilation, in which air is pumped into a central area of the home to reduce the pressure differential between indoor air and soil air. Some passive (non-powered) methods are available but these generally result in smaller concentration reductions and are therefore not suitable for reducing the highest radon levels [52] and [53].

## 4. Conclusions

Ionising radiation has been shown to be carcinogenic and everyone is exposed to a range of natural and man-made sources. Radon is the single biggest source of ionising radiation exposure for most people, with most exposure occurring in the home. Radon is the second leading cause of lung cancer after smoking, with long-term exposure shown to result in excess lung cancers. Radon levels vary between regions and even between neighbouring buildings. A suitable radon measurement is needed to determine the radon level in any specific property. National agencies can prepare maps indicating the geographical variation of indoor radon. In areas where high indoor radon levels are more common, radon measurements should be made comprehensively, particularly in homes. International organisations, including the WHO, have advised that countries should establish reference levels of indoor radon in the range 100–300 Bq m<sup>-3</sup>, above which steps should be taken to reduce concentrations. Minor building modifications can be made to reduce high indoor radon levels. For new buildings, techniques should be employed to minimise radon levels, as this can be achieved easily and also reduces other hazards such as moisture damage.

Householders should:

- - take ownership of the radon issue for their home;
- - use the available national information to decide whether to test their home for radon;
-

test their home for radon where this is advised, reduce high radon levels in the home.

## Conflict of interest

The authors declare no conflicts of interest.

## Acknowledgments

The European Code against Cancer project was co-funded by the European Union [grant agreements numbers: [2011 53 05](#); [2010 53 04](#) and [2007IARC01](#)] and the International Agency for Research on Cancer. The authors alone are responsible for the views expressed in this manuscript.

## References

1.
  - [\[1\]](#)
  - International Agency for Research on Cancer
  - IARC Monographs on the Evaluation of Carcinogenic Risks to Humans; Vol. 100D. A Review of Human Carcinogens. Part D: Radiation/IARC Working Group on the Evaluation of Carcinogenic Risks to Humans WHO, Lyon, France (2012)
  -
2.
  - [\[2\]](#)
  - International Agency for Research on Cancer
  - IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man, Vol. 55. Solar and Ultraviolet Radiation
  - WHO, Lyon, France (1992)
  -
3.
  - [\[3\]](#)
  - International Agency for Research on Cancer
  - IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Vol. 80. Non-Ionizing Radiation, Part 1: Static and Extremely Low-Frequency (ELF) Electric and Magnetic Fields WHO, Lyon, France (2002)
  -
4.
  - [\[4\]](#)
  - International Agency for Research on Cancer
  - IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Non-Ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields, vol. 102, WHO, Lyon, France (2013)
  -
5.
  - [\[5\]](#)
  - S. Friis, A. Kesminiene, C. Espina, A. Auvinen, K. Straif, J. Schüz

- European Code against Cancer 4th Edition: medical exposures, including hormone therapy, and cancer
- Cancer Epidemiol, 39 (2015), pp. S107–S119
- [Article](#)

|

[PDF \(710 K\)](#)

6.

- [\[6\]](#)
- R. Greinert, E. de Vries, F. Erdmann, C. Espina, A. Auvinen, A. Kesminiene, *et al.*
- European Code against Cancer 4th Edition: ultraviolet radiation and cancer
- Cancer Epidemiol, 39 (2015), pp. S75–S83
- [Article](#)

|

[PDF \(1349 K\)](#)

7.

- [\[7\]](#)
- The International Commission on Radiological Protection. The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103, Ann. ICRP 37 (2–4).

○

8.

- [\[8\]](#)
- J.D. Harrison, P. Day
- Radiation doses and risks from internal emitters
- J. Radiol. Prot., 28 (2008), pp. 137–159
- [Full Text via CrossRef](#)

|

[View Record in Scopus](#)

|

[Citing articles \(36\)](#)

9.

- [\[9\]](#)
- S.F. Mobbs, C.R. Muirhead, J.D. Harrison
- Risks from ionising radiation: an HPA viewpoint paper for Safegrounds
- J. Radiol. Prot., 31 (2011), p. 289

- [Full Text via CrossRef](#)

|

[View Record in Scopus](#)

|

[Citing articles \(11\)](#)

10.

- [\[10\]](#)
- United Nations Scientific Committee on the Effects of Atomic Radiation
- UNSCEAR 2008 Report: Sources and Effects of Ionizing Radiation. Report to the General Assembly with scientific annexes
- United Nations, New York (2010)

○

11.

- [\[11\]](#)
- United Nations Scientific Committee on the Effects of Atomic Radiation
- UNSCEAR 2006 Report to the General Assembly, Volumes I and II, with Scientific Annexes
- United Nations, New York (2008)

○

12.

- [\[12\]](#)
- World Health Organisation
- WHO Handbook on Indoor Radon. A Public Health Perspective
- WHO Press, Geneva (2009)

○

13.

- [\[13\]](#)
- United Nations Scientific Committee on the Effects of Atomic Radiation
- UNSCEAR 2000 Report. Sources and Effects of Ionizing Radiation
- United Nations, New York (2000)

○

14.

- [\[14\]](#)
- World Health Organisation
- Environmental Health Criteria 238: Extremely Low Frequency Fields
- WHO Press, Geneva (2007)

○

15.

- [\[15\]](#)
- J. Schüz, A. Ahlbom
- Exposure to electromagnetic fields and the risk of childhood leukaemia: a review

- Rad. Prot. Dosimetry, 132 (2) (2008), pp. 202–211
- [Full Text via CrossRef](#)

|

[View Record in Scopus](#)

|

[Citing articles \(53\)](#)

16.

- [\[16\]](#)
- H. Merzenich, S. Schmiedel, S. Bennack, H. Brüggemeyer, J. Philipp, M. Blettner, *et al.*
- Childhood leukemia in relation to radio frequency electromagnetic fields in the vicinity of TV and radio broadcast transmitters
- Am. J. Epidemiol., 168 (10) (2008), pp. 1169–1178
- [Full Text via CrossRef](#)

|

[View Record in Scopus](#)

|

[Citing articles \(25\)](#)

17.

- [\[17\]](#)
- J. Schüz, S. Mann
- A discussion of potential exposure metrics for use in epidemiological studies on human exposure to radiowaves from mobile phone base stations
- J. Expo Anal. Environ. Epidemiol., 10 (2000), pp. 600–605
- [View Record in Scopus](#)

|

[Citing articles \(44\)](#)

18.

- [\[18\]](#)
- United Nations Scientific Committee on the Effects of Atomic Radiation
- UNSCEAR 2010 Report: Fifty-Seventh Session: Includes Scientific Report: Summary of Low Dose Radiation Effects on Health
- United Nations, New York (2011)

- 
- 19.
  - [\[19\]](#)
  - S. Darby, D. Hill, A. Auvinen, J.M. Barros-Dios, H. Baysson, F. Bochicchio, *et al.*
  - Radon in homes and risk of lung cancer: collaborative analysis of individual data from 13 European case-control studies
  - Br. Med. J., 330 (2005), pp. 223–227

- 
- 20.
  - [\[20\]](#)
  - S.S. Darby, D. Hill, H. Deo, A. Auvinen, J.M. Barros-Dios, H. Baysson, *et al.*
  - Residential radon and lung cancer-detailed results of a collaborative analysis of individual data on 7148 persons with lung cancer and 14208 persons without lung cancer from 13 epidemiologic studies in Europe
  - Scand. J. Work Environ. Health, 32 (Suppl. 1) (2006), pp. 1–84
  - [View Record in Scopus](#)

|

[Citing articles \(158\)](#)

- 1.
  - [\[21\]](#)
  - J.H. Lubin, Z.Y. Wang, J.D. Boice Jr., Z.Y. Xu, W.J. Blot, L. De Wang, *et al.*
  - Risk of lung cancer and residential radon in China: pooled results of two studies
  - Int. J. Cancer, 109 (1) (2004), pp. 132–137
  - [Full Text via CrossRef](#)

|

[View Record in Scopus](#)

|

[Citing articles \(127\)](#)

- 2.
  - [\[22\]](#)
  - D. Krewski, J.H. Lubin, J.M. Zielinski, M. Alavanja, V.S. Catalan, R.W. Field, *et al.*
  - A combined analysis of North American case-control studies of residential radon and lung cancer
  - J. Toxicol. Environ. Health Part A, 69 (2006), pp. 533–597
  - [Full Text via CrossRef](#)

|

[View Record in Scopus](#)

|

[Citing articles \(164\)](#)

3.

- [\[23\]](#)
- Health Protection Agency
- Radon and Public Health. Report of the independent Advisory Group on Ionising Radiation. Documents of the Health Protection Agency. Radiation, Chemical and Environmental Hazards, RCE-11
- HPA, Chilton, Didcot (2009)

○

4.

- [\[24\]](#)
- E. Cardis, M. Vrijheid, M. Blettner, E. Gilbert, M. Hakama, C. Hill, *et al.*
- The 15-Country Collaborative Study of Cancer Risk among Radiation Workers in the Nuclear Industry: estimates of radiation-related cancer risks
- Radiat. Res., 167 (4) (2007), pp. 396–416
- [Full Text via CrossRef](#)

|

[View Record in Scopus](#)

|

[Citing articles \(347\)](#)

5.

- [\[25\]](#)
- C.R. Muirhead, J.A. O'Hagan, R.G. Haylock, M.A. Phillipson, T. Willcock, G.L. Berridge, *et al.*
- Mortality and cancer incidence following occupational radiation exposure: third analysis of the National Registry for Radiation Workers
- Br. J. Cancer, 100 (1) (2009), pp. 206–212
- [Full Text via CrossRef](#)

|

[View Record in Scopus](#)

|

[Citing articles \(179\)](#)

6.

- [\[26\]](#)
- M.E. Sokolnikov, E.S. Gilbert, D.L. Preston, E. Ron, N.S. Shilnikova, V.V. Khokhryakov, *et al.*
- Lung, liver and bone cancer mortality in Mayak workers
- Int. J. Cancer, 123 (2008), pp. 905–911
- [Full Text via CrossRef](#)

|

[View Record in Scopus](#)

|

[Citing articles \(49\)](#)

7.

- [\[27\]](#)
- E.S. Gilbert, M.E. Sokolnikov, D.L. Preston, S.J. Schonfeld, A.E. Schadilov, E.K. Vasilenko, *et al.*
- Lung cancer risks from plutonium: an updated analysis of data from the Mayak worker cohort
- Radiat. Res., 179 (3) (2013), pp. 332–342
- [Full Text via CrossRef](#)

|

[View Record in Scopus](#)

|

[Citing articles \(17\)](#)

8.

- [\[28\]](#)
- J.W. Marsh, J.D. Harrison, D. Laurier, A. Birchall, E. Blanchardon, F. Paquet, *et al.*
- Doses and lung cancer risks from exposure to radon and plutonium
- Int. J. Radiat. Biol., 90 (11) (2014), pp. 1080–1087
- [Full Text via CrossRef](#)

|

[View Record in Scopus](#)

|

[Citing articles \(1\)](#)

9.
  - [\[29\]](#)
  - D. Laurier, B. Grosche, A. Auvinen, J. Clavel, C. Cobaleda, A. Dehos, *et al.*
  - Childhood leukaemia risks: from unexplained findings near nuclear installations to recommendations for future research
  - J. Radiol. Prot., 34 (2014), pp. R53–R68
  - [Full Text via CrossRef](#)
10.
  - [\[30\]](#)
  - L.Y. Krestinina, S. Epifanova, S. Silkin, L. Mikryukova, M. Degteva, N. Shagina, *et al.*
  - Chronic low-dose exposure in the Techa River Cohort: risk of mortality from circulatory diseases
  - Radiat. Environ. Biophys., 52 (1) (2013), pp. 47–57
  - [Full Text via CrossRef](#)

|

[View Record in Scopus](#)

|

[Citing articles \(15\)](#)

11.
  - [\[31\]](#)
  - S.J. Schonfeld, L.Y. Krestinina, S. Epifanova, M.O. Degteva, A.V. Akleyev, D.L. Preston
  - Solid cancer mortality in the Techa river cohort (1950–2007)
  - Radiat. Res., 179 (2) (2013), pp. 183–189
  - [Full Text via CrossRef](#)

|

[View Record in Scopus](#)

|

[Citing articles \(21\)](#)

12.
  - [\[32\]](#)
  - World Health Organisation
  - Health Risk Assessment from the Nuclear Accident after the 2011 Great East Japan Earthquake and Tsunami based on a Preliminary Dose Estimation

- WHO Press, Geneva (2013)
- 
- 13.
  - [\[33\]](#)
  - United Nations Scientific Committee on the Effects of Atomic Radiation
  - UNSCEAR 2013 Report to the General Assembly with Scientific Annexes. Sources, EFFECTS and Risks of Ionizing Radiation: Volume I Scientific Annex A. Levels and Effects of Radiation Exposure due to the Nuclear Accident after the 2011 Great East-Japan Earthquake and Tsunami
  - United Nations, New York (2014)
  -
- 14.
  - [\[34\]](#)
  - Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR), Health Effects of Exposure to EMF, European Commission Health & Consumer Protection DG, Luxembourg, 2009, Available at: [http://ec.europa.eu/health/archive/ph\\_risk/committees/04\\_scenihr/docs/scenihr\\_o\\_022.pdf](http://ec.europa.eu/health/archive/ph_risk/committees/04_scenihr/docs/scenihr_o_022.pdf).
  -
- 15.
  - [\[35\]](#)
  - INTERPHONE Study Group
  - Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study
  - Int. J. Epidemiol., 39 (3) (2010), pp. 675–694
  -
- 16.
  - [\[36\]](#)
  - INTERPHONE Study Group
  - Acoustic neuroma risk in relation to mobile telephone use: results of the INTERPHONE international case-control study
  - Cancer Epidemiol., 35 (5) (2011), pp. 453–464
  -
- 17.
  - [\[37\]](#)
  - P. Frei, A.H. Poulsen, C. Johansen, J.H. Olsen, M. Steding-Jessen, J. Schüz
  - Use of mobile phones and risk of brain tumours: update of Danish cohort study
  - Br. Med. J., 343 (2011), p. d6387
  - [Full Text via CrossRef](#)
- 18.
  - [\[38\]](#)
  - V.S. Benson, K. Pirie, J. Schüz, G.K. Reeves, V. Beral, J. Green, *et al.*
  - Mobile phone use and risk of brain neoplasms and other cancers: prospective study
  - Int. J. Epidemiol., 42 (3) (2013), pp. 792–802
  - [Full Text via CrossRef](#)

|

[View Record in Scopus](#)

|

[Citing articles \(37\)](#)

19.

- [\[39\]](#)
- I. Deltour, A. Auvinen, M. Feychting, C. Johansen, L. Klæboe, R. Sankila, *et al.*
- Mobile phone use and incidence of glioma in the Nordic countries 1979–2008: consistency check
- *Epidemiology*, 23 (2) (2012), pp. 301–307
- [Full Text via CrossRef](#)

|

[View Record in Scopus](#)

|

[Citing articles \(37\)](#)

20.

- [\[40\]](#)
- P. Elliott
- Mobile phone base stations and early childhood cancers: case-control study
- *Br. Med. J.*, 340 (2010), p. c3077
- [Full Text via CrossRef](#)

1.

- [\[41\]](#)
- Council of Europe
- Council Directive 2013/59/EURATOM of 5 December 2013 laying down basic safety standards for the protection against the dangers arising from exposure to ionising radiation
- *Official Journal of European Union* (2014) L 13/1–73, 17.1
- 

2.

- [\[42\]](#)
- C. Espina, K. Straif, S. Friis, M. Kogevinas, R. Saracci, H. Vainio, *et al.*
- European Code against Cancer 4th Edition: environment, occupation and cancer
- *Cancer Epidemiol*, 39 (2015), pp. S84–S92
- [Article](#)

|  
[PDF \(633 K\)](#)

|  
[View Record in Scopus](#)

3.

- [\[43\]](#)
- J.C.H. Miles
- Mapping radon-prone areas by lognormal modelling of house radon data
- Health Phys., 74 (1998), pp. 370–378
- [Full Text via CrossRef](#)

|  
[View Record in Scopus](#)

|  
[Citing articles \(59\)](#)

4.

- [\[44\]](#)
- J.C.H. Miles, J.D. Appleton
- Mapping variation in radon potential between and within geological units
- J. Radiol. Prot., 25 (2005), pp. 257–276
- [Full Text via CrossRef](#)

|  
[View Record in Scopus](#)

|  
[Citing articles \(64\)](#)

5.

- [\[45\]](#)
- V. Gruber, T. Tollefsen, M. De Cort, P. Bossew
- Status of the European Atlas of Natural Radiation
- 10th International Workshop on the Geological Aspects of Radon Risk Mapping, September 22–25, Prague, Czech Republic (2010)

- 
- 6.
  - [\[46\]](#)
  - J.C.H. Miles
  - Temporal variation of radon levels in houses and implications for radon measurement strategies
  - Rad. Prot. Dosim., 93 (4) (2001), pp. 369–375
  - [Full Text via CrossRef](#)

- 7.
  - [\[47\]](#)
  - J. Pinel, T. Fearn, S.C. Darby, J.C.H. Miles
  - Seasonal correction factors for indoor radon measurements made in the United Kingdom
  - Rad. Prot. Dosim., 58 (1995), pp. 127–132
  - [View Record in Scopus](#)

|

#### [Citing articles \(67\)](#)

- 8.
  - [\[48\]](#)
  - The International Commission on Radiological Protection, Radiological Protection against Radon Exposure (2014) Publication 126. Ann. ICRP 43(3), 2014

- 9.
  - [\[49\]](#)
  - S.A. Hodgson, E.J. Bradley, G.R. Wasson, L.J. Peake
  - Radon in Northern Ireland Homes: Report of a Targeted Survey. HPA-CRCE-046
  - Health Protection Agency, Chilton, United Kingdom (2013)

- 10.
  - [\[50\]](#)
  - Environmental Protection Agency (USA), National Radon Action Month, [www.epa.gov/radon/nram](http://www.epa.gov/radon/nram) (accessed 11.03.14).

- 11.
  - [\[51\]](#)
  - S.A. Hodgson, W. Zhang, E.J. Bradley, *et al.*
  - An Analysis of Radon Remediation Methods. HPA-CRCE-019
  - Health Protection Agency, Chilton, United Kingdom (2011)

- 12.
  - [\[52\]](#)
  - G. Dubois
  - An overview of radon surveys in Europe. EUR 21892 EN

- Publications Office of the European Union, Luxembourg (2005)
- 
- 13.
- [\[53\]](#)
- T. Tollefsen, G. Cinelli, P. Bossew, V. Gruber, M. De Cort
- From the European indoor radon map towards an atlas of natural radiation
- Radiat. Prot. Dosimetry, 162 (November (1–2)) (2014), pp. 129–134
- [Full Text via CrossRef](#)

|

[View Record in Scopus](#)

|

[Citing articles \(4\)](#)



This is an Open Access article published under the CC BY NC ND 3.0 IGO license which permits users to download and share the article for non-commercial purposes, so long as the article is reproduced in the whole without changes, and provided the original source is properly cited. This article shall not be used or reproduced in association with the promotion of commercial products, services or any entity. There should be no suggestion that IARC endorses any specific organisation, products or services. The use of the IARC logo is not permitted. This notice should be preserved along with the article's original URL.

Corresponding author at: IARC European Code against Cancer Secretariat, 150 cours Albert Thomas, 69372 Lyon Cedex 08, France. Tel.: +33 0 4 72 73 84 85.

Copyright © 2015 International Agency for Research on Cancer.

# Novartis Pharmaceuticals announces a joint investment company with Qualcomm, leading innovation in digital medicines for physicians and patients

Jan 12, 2015

- Novartis establishing a joint investment company with Qualcomm Ventures, the venture investment group of Qualcomm Incorporated, of up to USD 100 million to support early stage companies with technologies, products or services that "go beyond the pill"
- Digital technologies can optimize the value of innovative medicines by providing integrated solutions for physicians and patients and advancing the practice of medicine
- Qualcomm Ventures, is a leading global investor in wireless technologies and one of the most active strategic investors in digital health

**Basel, January 12, 2015** - Novartis Pharmaceuticals announced today the plans to establish of a joint investment company with Qualcomm Ventures, the investment arm of Qualcomm Incorporated, to target early stage companies who offer technologies, products or services that "go beyond the pill" to benefit physicians and patients.

"By working with Qualcomm Ventures, Novartis sees the opportunity to take a greater leadership role in introducing new mobile or digital technologies that have the potential to change the practice of medicine and bring more breakthroughs with real benefits to patients and society," said David Epstein, Division Head, Novartis Pharmaceuticals. "We are excited by the potential of digital medicines to further enhance our mission of the right drug for the right patient at the right time helping people live longer with a better quality of life giving more time to do the things that matter to them."

Digital and mobile technologies are expected to make a significant difference in the pharmaceutical industry. New technologies are emerging such as telephone enabled devices, mobile applications, wearable devices, and technologies for big and small data to enable delivery of the right medicine to the right patients and more robust pharmacoeconomic analyses. The plan to establish the joint investment company combines the knowledge of Novartis' innovation in the research, development and manufacturing of innovative medicines with Qualcomm's expertise in digital and mobile technologies.

## Disclaimer

This press release contains expressed or implied forward-looking statements, including statements that can be identified by terminology such as "can," "target," "opportunity," "potential," "mission," "expected," or similar expressions. Such forward-looking statements reflect the current views of the Group regarding future events, and involve known and unknown risks, uncertainties and other factors that may cause actual results to be materially different from any future results expressed or implied by such statements. These expectations could be affected

by, among other things, risks and factors referred to in the Risk Factors section of Novartis AG's current Form 20-F on file with the US Securities and Exchange Commission. Novartis is providing the information in this press release as of this date and does not undertake any obligation to update it in the future.

### **About Novartis**

Novartis provides innovative healthcare solutions that address the evolving needs of patients and societies. Headquartered in Basel, Switzerland, Novartis offers a diversified portfolio to best meet these needs: innovative medicines, eye care, cost-saving generic pharmaceuticals, preventive vaccines and over-the-counter products. Novartis is the only global company with leading positions in these areas. In 2013, the Group achieved net sales of USD 57.9 billion, while R&D throughout the Group amounted to approximately USD 9.9 billion (USD 9.6 billion excluding impairment and amortization charges). Novartis Group companies employ approximately 130,000 full-time-equivalent associates and sell products in more than 150 countries around the world. For more information, please visit <http://www.novartis.com>.

Novartis is on Twitter. Sign up to follow @Novartis at <http://twitter.com/novartis> (link is external).

### **Novartis Media Relations**

**Central media line :** +41 61 324 2200

#### **Eric Althoff**

Novartis Global Media Relations

+41 61 324 7999 (direct)

+41 79 593 4202 (mobile)

[eric.althoff@novartis.com](mailto:eric.althoff@novartis.com)

e-mail: [media.relations@novartis.com](mailto:media.relations@novartis.com)

For Novartis multimedia content, please visit [www.thenewsmarket.com/Novartis](http://www.thenewsmarket.com/Novartis) (link is external)

For questions about the site or required registration, please contact: [journalisthelp@thenewsmarket.com](mailto:journalisthelp@thenewsmarket.com).

### **Novartis Investor Relations**

**Central phone:** +41 61 324 7944

Samir Shah +41 61 324 7944 **North America:**

Pierre-Michel Bringer +41 61 324 1065 Richard Pulik +1 212 830 2448

Thomas Hungerbuehler +41 61 324 8425 Susan Donofrio +1 862 778 9257

Isabella Zinck +41 61 324 7188

e-mail: [investor.relations@novartis.com](mailto:investor.relations@novartis.com) e-mail: [investor.relations@novartis.com](mailto:investor.relations@novartis.com)



# **ELECTRIC AND MAGNETIC FIELDS AND YOUR HEALTH**

**Information on electric and magnetic fields  
associated with transmission lines,  
distribution lines and electrical equipment**



Copyright: 2008, National Radiation Laboratory, Ministry of Health,  
New Zealand.

First edition: *Your health and fields from electric lines*, 1989.

Revised as: *Electric and magnetic fields and your health*, 1991, 1994, 1996, 1997.

Supplement: 1998, 2000.

Revised edition: 2001.

Published with the permission of the Director-General of Health.



## **CONTENTS**

<b>Introduction and summary</b>	<b>1</b>
What are electric and magnetic fields?	1
Do they present health risks?	1
<b>What are electric and magnetic fields?</b>	<b>2</b>
Magnetic fields	2
Electric fields	2
Units of measurement	3
<b>Sources of ELF electric and magnetic fields</b>	<b>4</b>
ELF electric fields	4
ELF magnetic fields	4
<b>Health effects of ELF electric and magnetic fields</b>	<b>8</b>
ELF electric fields	8
ELF magnetic fields	8
ELF magnetic fields and cancer	9
ELF magnetic fields and other health effects	10
<b>Exposure guidelines</b>	<b>11</b>
<b>Should I be worried about ELF fields affecting my health?</b>	<b>14</b>
Prudent avoidance	14
Cardiac pacemakers	15
<b>Frequently asked questions</b>	<b>17</b>
<b>Static electric and magnetic fields around DC lines</b>	<b>22</b>
Naturally occurring static fields	22
Artificial static fields	22
Health effects of static fields	23
<b>Further reading</b>	<b>24</b>
<b>Appendix: Summary of conclusions from recent reviews</b>	<b>27</b>





## **Introduction and summary**

---

### **What are electric and magnetic fields?**

Electric and magnetic fields are produced by any wiring or equipment carrying electric current. This includes overhead and underground power lines carrying electricity, wiring in buildings, and electrical appliances. The strengths of the fields decrease rapidly with increasing distance from the source.

Electric and magnetic fields are fundamentally different, in their physical nature and in the way they interact with the body, from true electromagnetic radiation such as radio waves and microwaves. Information on the health effects of these radiations is available in other National Radiation Laboratory publications. This booklet relates only to electric and magnetic fields around power lines, electrical wiring and appliances.

### **Do they present health risks?**

Most research into this question has concentrated on finding out whether the magnetic fields can cause cancer or could assist the development of a cancerous condition. Other effects investigated include miscarriages, Alzheimer's disease and depression.

In spite of all the studies that have been carried out over the past thirty years there is still no persuasive evidence that the fields pose any health risks. The results obtained show that if there are any risks, they must be very small. A review published by the World Health Organization in June 2007 recommended using exposure guidelines published by the International Commission on Non-Ionizing Radiation Protection, along with low cost measures to reduce exposures where this can be readily achieved. The National Radiation Laboratory and Ministry of Health support these recommendations.

## What are electric and magnetic fields?

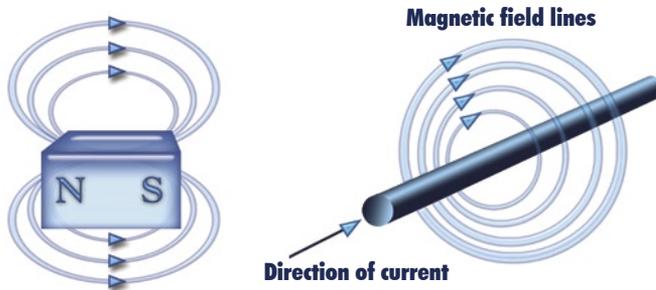
---

### Magnetic fields

A small piece of iron held near a magnet will move towards and attach itself to that magnet. The magnet produces a magnetic field around it, which attracts the iron. The field can be pictured by sprinkling iron filings on a sheet of paper and holding the sheet over the magnet. When the sheet is tapped gently the filings align themselves in a pattern around the magnet.

The earth is a natural magnet, which enables a compass to be used for direction finding.

Magnetic fields are also produced by an electric current. The magnetic field encircles the current-carrying wire, as illustrated in the diagram.



Magnetic field lines around a bar magnet (left) and a current-carrying wire (right)

If the current through the wire is not steady, but changes in strength and direction, these changes cause changes in the strength and direction of the magnetic field.

Mains electricity in New Zealand houses, and in almost all power lines, is an *alternating current* (AC)\*. An alternating current does not flow steadily in one direction, but oscillates backwards and forwards, making 50 complete cycles every second. Therefore, the magnetic field produced by such a current also oscillates at the same rate. This frequency is commonly

expressed as 50 Hertz (Hz), and falls into a range referred to as *extremely low frequency* (ELF). The magnetic fields can be referred to as *ELF magnetic fields*.

### **Electric fields**

The voltage on a current-carrying wire or electrically charged surface produces an electric field around it.

Like the current, the voltage on a cable or appliance carrying mains electricity is not constant but alternates 50 times every second. Therefore, the electric field also alternates and can be referred to as an *ELF electric field*.

### **Units of measurement**

ELF magnetic fields are normally quantified in terms of the *magnetic flux density*. The international (SI) unit of measurement is the tesla (T) or microtesla ( $\mu\text{T}$ ). 1 tesla = 1,000,000 microtesla. Some literature on the subject uses an older unit, the milligauss (mG). There is a factor of 10 difference between the microtesla and milligauss units:  $1 \mu\text{T} = 10 \text{ mG}$ ,  $0.1 \mu\text{T} = 1 \text{ mG}$ , etc. In this booklet, magnetic flux densities are given in microtesla, with the equivalent value in milligauss given in brackets.

Electric field strengths are measured in units of volts per metre (V/m) or kilovolts per metre (kV/m), where  $1 \text{ kV/m} = 1000 \text{ V/m}$ .

\* The exception is the power line linking the north and south islands. This is discussed in the section about static fields near the end of this booklet.

## **Sources of ELF electric and magnetic fields**

---

Electric and magnetic fields are present around all wires carrying electricity, whether they are high voltage power lines, house wiring, or wires inside domestic appliances. The strength of the electric field depends on the voltage, while the strength of the magnetic field depends on the size of the current carried. The strengths of the fields reduce rapidly with distance from the wires.

### **ELF electric fields**

Electricity transmission and distribution lines in New Zealand operate at voltages between 230 volts (normal household voltage) and 220,000 volts (220 kV). Lines operating at 400 kV have also been proposed. In other countries, high voltage (HV) transmission lines at voltages up to or above a million volts (1000 kV) are in use.

Under the highest voltage transmission lines currently used in New Zealand, the electric field strength can reach 3 kV/m\*. Trees and buildings shield electric fields, which can reduce their strength considerably. Field strengths inside buildings may be only a small fraction of the field strength outside, and be lower than the fields around electrical appliances.

Typical ELF electric field levels in different situations are presented over the page.

### **ELF magnetic fields**

The strength of the ELF magnetic field beneath a high voltage transmission line may reach up to around 5 microtesla (50 milligauss). The field may vary over the day and through the year as more or less current flows through the line.

\* 400 kV lines are discussed in the *Frequently Asked Questions* section at the end of this booklet.

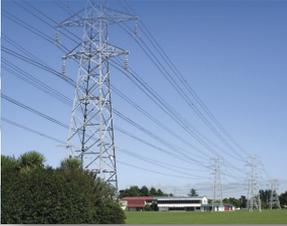
The field strength decreases quite rapidly with increasing distance from the line. Typically, within 50 to 100 metres of the line the magnetic field decreases to the levels found in many houses which are far away from any power lines.

Under low voltage (LV) distribution lines (that is, overhead street wires) the magnetic field may reach 2 microtesla (20 milligauss). Here too, the strength of the field decreases with increasing distance from the line. Magnetic fields are not shielded by trees, buildings or iron roofs. Magnetic fields around small “kiosk” transformers sited on the ground decrease to low levels within 2–3 metres.

Within a few centimetres of some electrical appliances, ELF magnetic fields may be much stronger than those under power lines. However, the fields normally decrease to much lower levels within a metre. The fields are strongest near appliances which contain an electric motor, such as hair dryers and food processors. For most people, their principal sources of exposure to ELF magnetic fields are electrical appliances and house wiring.

Typical magnetic field levels found in various locations are presented over the page.

## High voltage transmission lines



### Directly beneath line:

Electric fields: 0.3–3 kV/m

Magnetic fields: 0.5–5  $\mu\text{T}$  (5–50 mG)

### 40 metres from line:

Electric fields: 0.01–0.1 kV/m

Magnetic fields: 0.1–1  $\mu\text{T}$  (1–10 mG)

Generally, magnetic fields decrease to around 0.1  $\mu\text{T}$  (1 mG) within 50–100 metres of the line.

## Near street distribution lines



Electric fields: 0.01–0.1 kV/m

Magnetic fields: 0.05–2  $\mu\text{T}$  (0.5–20 mG)

## Substations



Electric fields: generally less than 0.1 kV/m except near where overhead supply lines enter or leave the station.

Magnetic fields: generally decrease to around 0.1  $\mu\text{T}$  (1 mG) within 5 metres of equipment except near where supply lines enter or leave the station.

## Local supply ('kiosk') transformers



Electric fields: less than 0.1 kV/m

Magnetic fields:

300 mm from transformer: 1–10  $\mu\text{T}$  (10–100 mG)

2–3 metres from transformer: around 0.1  $\mu\text{T}$  (1 mG)

### Near switchboard



#### Electric fields:

300 mm away: 20–100 V/m  
1–2 metres away: 10–30 V/m

#### Magnetic fields:

300 mm away: 1–3  $\mu\text{T}$  (10–30 mG)  
1–2 metres away: 0.1  $\mu\text{T}$  (1 mG)

### Inside a house or office (away from transmission lines and appliances)



Electric fields: 0.003–0.03 kV/m

Magnetic fields: 0.05–0.15  $\mu\text{T}$  (0.5–1.5 mG)

### Near appliances

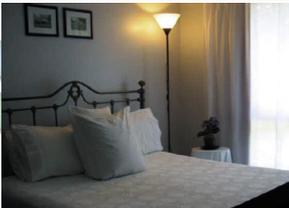


Electric fields: 0.01–0.05 kV/m

#### Magnetic fields:

300 mm away: 0.05–5  $\mu\text{T}$  (0.5–50 mG)  
1 metre away: 0.05–0.3  $\mu\text{T}$  (0.5–3 mG)

### Above electric blanket



Electric fields: 0.06–0.6 kV/m

Magnetic fields: 0.02–0.5  $\mu\text{T}$  (0.2–5 mG)

## **Health effects of ELF electric and magnetic fields**

---

The principal hazard to be avoided with electrical equipment is fatal electric shock from direct contact with conductors. Particular care should be taken by crane and yacht operators and agricultural contractors near power lines.

### **ELF electric fields**

When a person is in an ELF electric field, an alternating electric current flows in the body. Even in fields of 50 kV/m (well above the highest fields present under AC transmission lines), the induced currents are so small they cannot be felt.

In fields of several kV/m, sensitive individuals might feel minute vibrations of skin, hair or clothing. Some people may experience small shocks when touching large ungrounded objects (eg, a large bus) in these fields. These effects are harmless but can be irritating, especially if experienced persistently. However, they can be avoided by simple means such as earthing and screening, and normally people do not feel any sensation, even under even the highest voltage lines.

Studies of people and animals who have been exposed to ELF electric fields show that, at the strengths normally encountered in the home and under power lines, ELF electric fields do not cause health problems.

### **ELF magnetic fields**

ELF magnetic fields also induce very small electric currents in the body. The minute currents produced by fields near transmission and distribution lines and domestic appliances are far too weak to be felt, and are much lower than currents which occur naturally in the body.

Most laboratory studies have found that exposure to ELF magnetic fields has no effect on a wide range of biological processes. However, a few effects have been reported, such as changes in the flow of calcium in and out of cells, changes in hormone production and cell growth.

Although these changes are interesting to study, it is not clear whether they have any implications for health. Some of the effects reported only occurred under conditions quite different from everyday exposures, and many could not be replicated in other laboratories.

### **ELF magnetic fields and cancer**

A lot of research has been carried out to determine whether ELF magnetic fields might be a potential cause of cancer. This work has involved laboratory experiments with cell cultures and animals, and epidemiological studies of people who, because of where they live or work, may have higher exposures to magnetic fields than other people.

Overall, there is a wide consensus that there is a weak but relatively consistent association (correlation) between prolonged exposure to relatively strong magnetic fields and childhood leukemia. For example, a pooled analysis of the results from several studies, published in 2000, found that there was an increased incidence of childhood leukemia associated with exposure to time-averaged magnetic fields greater than 0.4  $\mu\text{T}$ . The fact that there is a correlation does not necessarily mean that there is a cause and effect relationship. The authors of the pooled analysis commented that “the explanation for the elevated risk estimates is unknown, but selection bias may have accounted for some of the increase.” (Selection bias is an artefact arising from the way the studies were carried out.)

The research findings have been reviewed by several panels of experts around the world\*, including the World Health Organization (WHO). Overall, these groups doubt that long term exposure to magnetic fields causes cancer. Although the relationship between childhood leukemia and magnetic field exposures suggests that there may be a link, laboratory research does not indicate any effect of magnetic fields on cancer. This includes several studies on animals exposed over their lifetimes. There are also considerable doubts that ELF magnetic fields, at the levels found around power lines and electrical appliances, could produce any effect at all.

\* Findings from recent reviews are summarised in the section *Summary of Conclusions from Recent Reviews*.

Other research has looked at cancer in adults who may be exposed to relatively high levels of ELF magnetic fields at home or in the course of their work. The review groups have concluded that there is no consistent evidence of a relationship between adult exposure and cancer risk.

### **ELF magnetic fields and other health effects**

There have been some studies of other health effects (such as Alzheimer's disease, suicide, depression, or altered melatonin levels) to see whether they might be related to magnetic field exposure. The findings from these studies, too, have been reviewed and found to give no persuasive evidence of any effects.

## Exposure guidelines

---

The National Radiation Laboratory recommends the use of guidelines published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). ICNIRP is an international scientific body and is recognised by the World Health Organization (WHO) for its expertise in this area.

The ICNIRP guidelines are based on a careful examination of the research data on the health effects of exposure to ELF fields, and include margins for safety. They were first proposed in 1990, and reconfirmed in 1993 and 1998 after consideration of more recent research. ICNIRP has continued to review new research published since 1998, but has not seen any need to amend their guidelines.

ICNIRP concluded that the only effects clearly evident in the research data were those caused by currents induced in the body by ELF electric and magnetic fields. In very strong fields, these induced currents could interfere with the body's nervous system, and so should be limited to levels where no effects can occur. For electric fields, ICNIRP also wished to limit the possibility of experiencing small shocks in strong electric fields.

While acknowledging the results of studies which found a weak association between ELF magnetic field exposures and the risk of childhood leukemia, ICNIRP considered that the results were too tenuous, and lacking support from other sources, to form the basis for exposure guidelines. Other recent reviews, including the 2007 WHO review, came to the same conclusion, and found that the data currently available did not justify setting more stringent exposure limits. The 2007 WHO review supported use of the ICNIRP guidelines.

The ICNIRP guidelines set a *basic restriction* on the density of electric current induced in the body by ELF fields. As induced current density is difficult to measure in the body, the guidelines also prescribe *reference levels* in terms of the more easily measured field strengths. Compliance

with the reference levels ensures compliance with the basic restrictions, and in most applications the reference levels can effectively be regarded as “exposure limits” (although this term is not used as such). If exposures exceed the reference levels, this does not necessarily mean that the basic restriction is also exceeded. However, a more comprehensive analysis is required in order to verify compliance with the basic restrictions.

**Basic restrictions and reference levels for occupational and public exposures to 50 Hz ELF electric and magnetic fields**

Exposure characteristics	Basic restriction Induced current density (mA/m <sup>2</sup> )	Reference levels		
		Electric field strength (kV/m)	Magnetic flux density	
			microtesla	milligauss
Occupational	10	10	500	5000
General public	2	5	100	1000

Note: All values are rms (root-mean-square, a kind of average)

Different limits are set for persons exposed occupationally and for the general public. The main reason for this is that people exposed occupationally are adults, exposed under controlled conditions, who should receive training to inform them of potential risks, and precautions they should be taking. They should be aware, for example, of the possibilities of receiving small shocks when touching objects in a strong electric field. Occupational exposures are limited to the duration of the working day and over the working lifetime.

The general public, on the other hand, includes individuals of all ages and in all states of health, who will not normally be aware of the exposure they are receiving. They can be exposed for twenty-four hours per day, and over a whole lifetime, and should not be expected to accept effects such as annoyance or pain due to small shocks and discharges.



The National Radiation Laboratory recommends that the occupational limits should only be applied to people like electricians or others who are aware of their exposures. In offices and most other work sites, the public limits should apply. In practice, exposures exceeding the public limits are extremely rare.

Compliance with the ICNIRP guidelines has been recommended in many countries. In countries where other recommendations are used, they generally have the same basis as ICNIRP, and recommend very similar exposure limits.

In New Zealand, a *National Policy Statement on Electricity Transmission* published in 2008 under the Resource Management Act requires that planning provisions dealing with ELF fields be based on the ICNIRP Guidelines and the 2007 WHO recommendations.

ICNIRP plans to publish revised Guidelines in 2009. While there may be changes in the detail, it is not anticipated that there will be significant changes to the basis of the Guidelines or the Reference Levels. Information on the changes will be posted on the NRL website ([www.nrl.moh.govt.nz](http://www.nrl.moh.govt.nz)) when it is available.

## **Should I be worried about ELF fields affecting my health?**

---

After some thirty years of research, there is still only weak evidence suggesting that ELF fields might be linked with childhood leukemia. The recent WHO review considered that if there were a true cause and effect relationship, there would be a “limited impact on public health”. Assuming a link does exist, worldwide the fields might be responsible for 0.2–4.9% of all childhood leukemia.

Put another way, although research may never give an absolute yes or no answer about the safety of ELF magnetic fields, we can say with some assurance that if a link is eventually proved, almost all cases of childhood leukemia would be caused by other factors. The pooled analysis of leukemia studies referred to previously included a New Zealand study, and found that none of 86 cases of childhood leukemia reported over a four year period had been exposed to strong magnetic fields (ie, average fields greater than 0.4  $\mu$ T). While this does not prove that there is no risk from magnetic fields, it does give an idea of the magnitude of any risk which may exist.

There is no persuasive evidence that magnetic fields which comply with the ICNIRP guidelines are associated with other health effects.

### **Prudent avoidance**

Different perceptions of risks can lead to different actions. Some people conclude that the current evidence for health risks from ELF fields is so tenuous, and the possible risks so small, that no action is necessary. They feel that there are plenty of known risks in life, and that it would be more worthwhile to direct their energies towards reducing these. Others find even the slight possibility of a risk sufficiently disturbing that they would like to take precautions anyway, just in case.

The idea of *prudent avoidance* has been suggested as a means to control exposures to ELF fields if there is any doubt that they are harmless. Prudent avoidance involves limiting exposures which can be avoided with small investments of money and effort, but not doing anything drastic or expensive.

For example, ELF magnetic fields within 50 centimetres of the switchboard in the house may reach one to three microtesla (10–30 milligauss). If someone's bed is situated very close to the switchboard, they may decide to move the bed a little further away to reduce their exposure while they sleep. However, deciding to switch off electricity at the mains every night or to rewire the house would not be seen as necessary.

When buying a new house, proximity to power lines might be one of many things considered. However, even if ELF fields were eventually shown to pose a health risk, factors such as traffic patterns in nearby streets, air quality, and hazards such as open fires, pools and common household appliances are likely to be more important for the health and safety of adults and children. Moving home to get away from power lines goes beyond what would be considered prudent avoidance.

The National Radiation Laboratory and Ministry of Health encourage the use of low or no cost measures to reduce or avoid exposures, and also promote this approach for the siting of new electrical facilities. This is consistent with a recommendation in the 2007 WHO review of ELF fields to take very low cost precautionary measures to reduce exposures, which has effectively been mandated in planning provisions by the 2008 *National Policy Statement on Electricity Transmission* made under the Resource Management Act.

### **Cardiac pacemakers**

A very small proportion of cardiac pacemakers has been found to be sensitive to 50/60 Hz electric and magnetic fields close to the ICNIRP limits for public exposure. (These same devices are also likely to be sensitive to other sources of electromagnetic interference, such as car ignition systems.) It is most likely that they will revert to a fixed pacing mode, which poses no immediate threat to the wearer. Since the field levels at which these effects occur are close to the ICNIRP limits for public exposure, the risk to members of the general public is thought to be extremely small. However, in workplaces where field strengths approaching the occupational limits are expected, precautions may need to be taken to alert or exclude pacemaker wearers.

There are no known instances of adverse effects on pacemaker users around power lines, or in other areas where exposure limits comply with the ICNIRP reference levels for the public.

## FREQUENTLY ASKED QUESTIONS

---

**Q** *Do power lines and electrical appliances emit radiation?*

**A** The electric and magnetic fields around power lines and electrical appliances are not a form of radiation. The word “radiation” is a very broad term, but generally refers to the propagation of energy away from some source. For example, light is a form of radiation, emitted by the sun and light bulbs.

ELF fields do not travel away from their source, but are fixed in place around it. They do not propagate energy away from their source. They bear no relationship, in their physical nature or effects on the body, to true forms of radiation such as x-rays or microwaves.

**Q** *Are ELF fields strongest around power line pylons?*

**A** On flat ground, ELF fields are weaker near the pylons than between them, because the cables are at their highest point above the ground. The fields are produced by the voltage on, and electric current through, the cables supported by the pylons. The pylons are simply there to keep the cables well above the ground.

**Q** *Does lead shield against ELF fields?*

**A** Lead is very good at shielding x-rays, but has no special shielding properties for ELF fields. Like other metals, lead is a conductor and so can shield electric fields. However, it does not shield magnetic fields. Special grades of steel or alloys are required to shield magnetic fields.

**Q** *In the past, it was thought that things like asbestos or smoking were safe, but many years later they were found to be harmful. How do we know that some time from now ELF fields are not going to pose the same problems that, say, asbestos does today?*

**A** Research on ELF fields shows that if they do pose a health risk, it must be very much lower than that due to asbestos or smoking. The health risks of both asbestos and smoking showed very strongly in initial investigations, and were confirmed by subsequent studies. Similar studies on ELF fields have not shown any clear, unambiguous evidence of health risks.

**Q** *How do the New Zealand exposure guidelines compare with those in other countries?*

**A** The International Commission on Non-Ionizing Radiation Protection exposure guidelines recommended by the National Radiation Laboratory have been adopted by many overseas bodies, including the European Union. All these bodies have considered research investigating the possibility that there may be an association between exposure to weak ELF magnetic fields and some types of cancer. However, they have concluded that, taken together, the evidence does not demonstrate a cause and effect relationship, and does not form a basis from which exposure guidelines can be formulated.

In the United States, there are no national guidelines. However, some individual states have set limits on the ELF magnetic field levels at the edges of power line rights of way. These vary from 15 to 25 microtesla (150 to 250 milligauss).

Some countries, in addition to adopting the ICNIRP guidelines, have also proposed lower “precautionary” limits in what are considered “sensitive areas”. Such areas generally include places like houses, parks and schools. The levels adopted tend to be based on what is

technically achievable (based on existing levels), and apply to new installations. Switzerland, for example, has set an “installation limit value” of 1  $\mu\text{T}$  (ie, the maximum field from any one installation should be less than 1  $\mu\text{T}$ ), and Italy has set an “attention value” of 10  $\mu\text{T}$  and a “quality goal” of 3  $\mu\text{T}$ . All these are time-averaged values.

The Ministry of Health and National Radiation Laboratory do not support the adoption of arbitrary limits which have no basis in the research data. On the one hand, they risk creating unnecessary alarm should exposures exceed the arbitrary level chosen. On the other, if there are genuine adverse health effects, an arbitrarily chosen exposure limit could create a false sense of security if those effects actually occur at a lower exposure level. Some research suggests that “precautionary limits” such as these can actually heighten concerns rather than alleviate them. The WHO does not support such arbitrary reductions either.

**Q** *Aren't exposures greater than 0.4  $\mu\text{T}$  quite common?*

**A** While there are many places where exposures might exceed 0.4  $\mu\text{T}$  (near an electric range, near many appliances, beneath low or high voltage power lines), these periods of high exposure are normally quite short. Research shows that when exposures are averaged over periods of a day or more, very few people have average exposures greater than 0.4  $\mu\text{T}$ .

**Q** *If I am concerned about possible health effects, what simple steps can I take to reduce my exposures to ELF fields?*

**A** In the home, fields are elevated near operating electrical appliances and meter boards and switchboards. The strength of the fields decreases quite rapidly with increasing distance from these sources, and generally decreases to levels found elsewhere in the home

within 0.5 to 1 metre. Simple means to reduce exposures (especially prolonged exposures) include the following:

- Keep beds more than one metre away from fuse boards, meter boards and electric heaters which operate at night.
- If you have a mains-powered motor driven bedside clock (eg. an older style clock with hands), keep it at arm's length from the bed.
- Switch off electric blankets when in bed (unless the electric blanket is used to remedy health problems).
- Switch off appliances when not in use.

**Q** *If I live near a high voltage transmission line, am I exposed to dangerous field levels?*

**A** Measurements on power lines in New Zealand have shown that even directly beneath the line, the electric and magnetic fields are well below the recommended exposure limits. Typically, the field levels decrease to the background levels found in many houses (from house wiring and domestic appliances) within 50–100 metres of the line.

**Q** *What about the proposals for new 400 kV transmission lines in New Zealand?*

**A** Transpower (the owner and operator of the national high voltage electricity grid) have made a commitment to comply with the ICNIRP guidelines in all publicly accessible areas near new transmission lines. They have also stated that the conductors will be arranged so as to ensure a rapid decrease in field strengths with distance from the line (an arrangement referred to as “reverse phasing”, generally regarded as a prudent avoidance measure). Calculations of the fields based on Transpower’s design confirm that they will comply with the ICNIRP guidelines.

**Q** *Does a transformer on the street affect exposures in my house?*

**A** Magnetic field levels around small “kiosk” transformers decrease to low levels within 2–3 metres, and have no effect on field levels in nearby houses.

**Q** *Who is monitoring the research in New Zealand?*

**A** The National Radiation Laboratory, a unit of the Ministry of Health, monitors research and briefs the Minister of Health on significant developments. Research is also reviewed regularly by the *Inter-Agency Committee on the Health Effects of Non-ionising Fields*, which includes representatives from government agencies, local government, health researchers, consumer groups and industry.

**Q** *When will we know whether ELF fields are safe or not?*

**A** It is actually very hard to prove that something is safe. Experiments can prove whether there are harmful effects, and the levels at which these effects occur. However, the absence of some effect under particular exposure conditions does not necessarily prove safety for all possible exposure conditions. If there were harmful effects from exposure to ELF fields, it is not at all clear what feature of the field – average level, exposure added up over time, variations in exposure, etc – might be important.

Nevertheless, the absence of a wide range of potentially harmful effects over a variety of exposure conditions gives good grounds for believing that adverse effects are unlikely.

## **Static electric and magnetic fields around DC lines**

---

For some long-distance transmission lines it is more economic to transmit electrical power as *direct current* (DC), where the current flows steadily in one direction. These lines produce static electric and magnetic fields.

The Benmore-Haywards line which links the North and South Islands via the Cook Strait cable is a High Voltage DC (HVDC) line.

### **Naturally occurring static fields**

Magnetic and electric fields which are largely unchanging or static over time, occur naturally. The most significant magnetic field is the geomagnetic field of the earth which varies between 35 and 70 microtesla (350 to 700 milligauss) depending on location.

In fair weather the lower atmosphere contains a static electric field of approximately 0.15 kV/m. During a thunderstorm the electric field strength between the ground and clouds can reach up to a few kV/m.

Static fields and charges are also commonly created by friction through the movement of clothing. Their presence can be felt when a small shock is experienced on touching a bare metal surface, as when touching a metal object after walking on some carpets. These shocks can be unpleasant but are harmless, even though voltages of up to 20 kilovolts may be generated.

### **Artificial static fields**

The static electric field strengths below the HVDC line in open country may reach up to about 30 kV/m. However, in built-up or wooded areas the field strengths can be much lower because of screening by trees, vegetation and buildings. The electric field is due to both the voltage on the line, and also due to the production of air ions (groups of molecules with a small electric charge) around it. The production and movement of air ions is greatly influenced by weather conditions, particularly the presence of wind and rain, so that the electric field under the line also varies.

Air ions are also produced by storms, waterfalls and flames, and as a result of air movement. The maximum ion concentration under the DC line is similar to higher levels found in some natural circumstances.

The static magnetic field beneath the HVDC line linking the North and South Islands has a strength of about half that of the earth's natural magnetic field. Similar static magnetic fields are usually present in electrified trolley buses, suburban rail systems, and much larger fields are experienced by operators in processes such as electrolytic smelting. Patients undergoing diagnostic magnetic resonance imaging examinations are exposed to even stronger fields, about 50,000 times greater than those present under DC lines.

### **Health effects of static fields**

Large metal objects beneath the line, such as vehicles or long fence wires, may build up enough electric charge to cause small shocks when they are touched. Often, however, car tyres and fence posts conduct enough electricity to keep these effects to a minimum.

Extensive overseas studies have not produced any good evidence of adverse health effects attributable to either DC electric fields or air ions associated with HVDC lines.

The static magnetic field beneath the HVDC line is smaller than the earth's magnetic field of around 50 microtesla. No health effects are expected at this level.

## Further reading

---

This booklet has given only a brief coverage of a complex subject. Below are some further references which provide additional information.

- ***ELF electromagnetic fields and the risk of cancer***  
This report was published in 2001 by the British National Radiological Protection Board Advisory Group on Non-Ionising Radiation (v 12, no. 1 in the series *Documents of the NRPB*). It updates previous reviews by that group published between 1992 and 1994 and is quite technical, but includes simpler summaries.
- ***Exposure to electromagnetic fields (0 Hz–10 MHz)***  
The Health Council of the Netherlands has set up an Electro-magnetic Fields Committee to review research on ELF fields. They published this report in March 2000 and it is available on the internet at [www.gr.nl/engels/welcome/frameset.htm](http://www.gr.nl/engels/welcome/frameset.htm) – follow links to publications and reports. Updates, also available at the same site, were published in 2001 and 2004.
- ***Interagency advisory committee on the health effects of electromagnetic fields: Report to Ministers. November 2004***  
This report reviews the health research available through to 2004, covering both ELF and radiofrequency fields, and sets out the Ministry of Health's recommendations on protection measures. It is available at <http://www.nrl.moh.govt.nz/publications/elf-rfreporttoministers.pdf>.

- ***Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)***

This document presents the ICNIRP exposure guidelines which are recommended for use in New Zealand. It is very technical and not an easy read. Originally published in the journal Health Physics volume 74, No 4, p. 494-522, 1998. It can also be downloaded on the internet at [www.icnirp.de](http://www.icnirp.de) – select “downloads”.

- ***Exposure to static and low frequency electromagnetic fields, biological effects and health consequences (0–100 kHz)***

This report was published by ICNIRP in 2003 and is a comprehensive review of laboratory and epidemiological studies of exposures to static and ELF fields.

- ***Fields from electric power. What are they? What do we know about possible health risks? What can be done?***

This is a set of three brochures prepared in 1995 by the Department of Engineering and Public Policy at Carnegie Mellon University, Pittsburgh, USA. Although not covering the most recent research, much of the discussion (on the nature and occurrence of ELF fields, possible health effects, and possible courses of action) is still relevant. They are written in non-technical language.

Publications not available on the internet may be available from local libraries. If your library does not hold them, they can be borrowed from the National Radiation Laboratory through the library interloan service.

Information is also available on the internet at:

- [www.who.int/peh-emf/](http://www.who.int/peh-emf/)  
This is the home page of the International EMF project, set up by the WHO in 1996 to coordinate a programme to review the scientific literature on health effects of electric and magnetic fields, encourage focused research to fill gaps in knowledge, assess possible health risks and encourage internationally acceptable, uniform exposure standards. A series of fact sheets is available.
- <http://www.microwavenews.com/www.html>  
This site, operated by Microwave News, contains links to many other sites of interest.
- [www.nrl.moh.govt.nz](http://www.nrl.moh.govt.nz)  
This is the web site of the National Radiation Laboratory.
- [www.emf-portal.de](http://www.emf-portal.de)  
This site, set up and operated by the University of Aachen, provides a database of information on studies into the effects of electromagnetic fields. It also covers the radiofrequency fields from radio transmitters.

## **Appendix: Summary of conclusions from recent reviews**

---

### **World Health Organization (2007)**

- There are established short-term effects of exposure to ELF fields, and compliance with existing international guidelines provides adequate protection.
- Epidemiological studies suggest an increased risk of childhood leukemia for chronic exposures greater than 0.3–0.4  $\mu\text{T}$ . Some aspects of the methodology of these studies introduce uncertainties in the hazard assessment. Laboratory evidence and mechanistic studies do not support a causal relationship, but the evidence is sufficiently strong to remain a concern. If the relationship is causal, the global impact on public health, if any, is limited and uncertain.
- Scientific data suggesting a linkage with other diseases (other childhood and adult cancers, depression, suicide, reproductive problems, developmental and immunological disorders, and neurological disease) is much weaker, and in some cases (eg, cardiovascular disease, breast cancer) sufficient to rule out a causal relationship.
- Exposure limits such as those recommended by ICNIRP should be implemented to protect against the established acute effects of exposure to ELF fields. In view of the conclusions on childhood leukemia, the use of precautionary approaches is reasonable and warranted but exposure limits should not be reduced arbitrarily in the name of precaution.
- Precautionary approaches should not compromise the health, social and economic benefits of electric power. Given the weakness of the link between exposures to ELF fields and childhood leukemia, and the limited impact on public health if the relationship is causal, the benefits of exposure reductions are unclear, so the cost of precautionary measures should be very low.

- Very low cost measures should be implemented when constructing new facilities and designing new equipment (including appliances). When contemplating changes to existing ELF sources, ELF field reduction should be considered alongside safety, reliability and economic aspects.

The WHO report can be downloaded from [http://www.who.int/peh-emf/publications/elf\\_ehc/en/index.html](http://www.who.int/peh-emf/publications/elf_ehc/en/index.html). An information sheet is available at <http://www.who.int/mediacentre/factsheets/fs322/en/index.html>.

### **International Agency for Research on Cancer (2001)**

- There is a fairly consistent statistical association between childhood leukemia and exposure to comparatively high ELF fields. This is unlikely to have been due to chance, but may be affected by selection bias.
- There is no consistent relationship between exposures to ELF fields and the incidence of other childhood cancers, or adult cancers.
- Laboratory studies have shown no consistent enhancement of tumours in experimental animals, and other results have been generally negative.
- Overall, ELF magnetic fields fall within Class 2B (“possibly carcinogenic to humans”) of the IARC classification scheme. This puts them in the same class as car exhaust, coffee and pickled vegetables. Class 2A (probably carcinogenic) includes diesel exhaust, sun lamps and PCBs, and Class 1 (carcinogenic) includes alcoholic drinks, benzene and asbestos.

### **(British) National Radiological Protection Board (2004)**

- Studies on the effects of ELF fields on the central nervous system provide a basis for setting quantitative exposure limits.
- Evidence on other possible effects, mostly from studies into possible effects on cancer, are insufficient to make a conclusive judgement on causality or to provide quantitative exposure limits. However, such studies taken together with people's concerns provide a basis for considering the possible need for further precautionary measures in addition to quantitative restrictions on exposures.
- The ICNIRP basic restrictions and reference levels should be used for controlling exposures.

The report can be downloaded from [www.hpa.org.uk/radiation/publications/documents\\_of\\_nrpb/abstracts/absd15-3.htm](http://www.hpa.org.uk/radiation/publications/documents_of_nrpb/abstracts/absd15-3.htm). Related publications produced by the NRPB (now the Radiation Protection Division of the Health Protection Agency) include *Advice on Limiting Exposure to Electromagnetic Fields (0-300 GHz)* (which was based on the review discussed above), available at [http://www.hpa.org.uk/radiation/publications/documents\\_of\\_nrpb/abstracts/absd15-2.htm](http://www.hpa.org.uk/radiation/publications/documents_of_nrpb/abstracts/absd15-2.htm), and *Power Frequency Electromagnetic Fields, Melatonin and the Risk of Breast Cancer*, published in 2006 and available at <http://www.hpa.org.uk/publications/PublicationDisplay.asp?PublicationID=31>.

For further information contact:

**National Radiation Laboratory**

PO Box 25-099, Christchurch

[www.nrl.moh.govt.nz](http://www.nrl.moh.govt.nz)

Phone 03 366 5059

Fax 03 366 1156

### **National Radiation Laboratory**

The National Radiation Laboratory (NRL) is a unit of the Ministry of Health. It is based in Christchurch.

Its role is to provide a regulatory function in the radiation health area, and to provide independent radiation protection advice.





**National Radiation Laboratory**

**108 Victoria Street, Christchurch, New Zealand**

**(03) 366 5059, [www.nrl.moh.govt.nz](http://www.nrl.moh.govt.nz)**



## Original Contribution

# Occupational Exposure to Radio Frequency/Microwave Radiation and the Risk of Brain Tumors: Interphone Study Group, Germany

**Gabriele Berg<sup>1</sup>, Jacob Spallek<sup>1</sup>, Joachim Schüz<sup>2,3</sup>, Brigitte Schlehofer<sup>4</sup>, Eva Böhler<sup>2,5</sup>, Klaus Schlaefer<sup>4</sup>, Iris Hettinger<sup>4</sup>, Katharina Kunna-Grass<sup>1</sup>, Jürgen Wahrendorf<sup>4</sup>, and Maria Blettner<sup>2</sup>**

<sup>1</sup> Department of Epidemiology and International Public Health, Faculty of Public Health, University of Bielefeld, Bielefeld, Germany.

<sup>2</sup> Institute of Medical Biostatistics, Epidemiology and Informatics, Johannes Gutenberg-University of Mainz, Mainz, Germany.

<sup>3</sup> Institute of Cancer Epidemiology, Danish Cancer Society, Copenhagen, Denmark.

<sup>4</sup> Unit of Environmental Epidemiology, German Cancer Research Center, Heidelberg, Germany.

<sup>5</sup> Institute for Occupational, Social, and Environmental Medicine, University of Mainz, Mainz, Germany.

*Received for publication November 29, 2005; accepted for publication March 7, 2006.*

It is still under debate whether occupational exposure to radio frequency/microwave electromagnetic fields (RF/MW-EMF) contributes to the development of brain tumors. This analysis examined the role of occupational RF/MW-EMF exposure in the risk of glioma and meningioma. A population-based, case-control study including 381 meningioma cases, 366 glioma cases, and 1,494 controls aged 30–69 years was performed in three German regions in 2000–2003. An exposure matrix for occupational activity was constructed by using information on RF/MW-EMF exposure collected in a computer-assisted personal interview. “High” exposure was defined as an occupational exposure that may exceed the RF/MW-EMF exposure limits for the general public recommended by the International Commission on Non-Ionizing Radiation Protection. Multiple conditional logistic regressions were performed separately for glioma and meningioma. No significant association between occupational exposure to RF/MW-EMF and brain tumors was found. For glioma, the adjusted odds ratio for highly exposed persons compared with persons not highly exposed was 1.21 (95% confidence interval: 0.69, 2.13); for meningioma, it was 1.34 (95% confidence interval: 0.64, 2.81). However, the slight increase in risk observed with increasing duration of exposure merits further research with larger sample sizes.

brain neoplasms; case-control studies; electromagnetic fields; occupations; radiation

Abbreviations: CI, confidence interval; RF/MW-EMF, radio frequency/microwave electromagnetic fields.

The question of whether occupational exposure to radio frequency/microwave electromagnetic fields (RF/MW-EMF) contributes to the development of brain tumors is still under debate. Interest in this specific frequency of RF/MW-EMF in the whole range of EMF, including extremely low frequency EMF or static fields, has risen, particularly because of cellular telephones. In 1988, Milham et al. (1) reported a nonsignificantly increased standardized mortality ratio of 1.39 (95 percent confidence interval (CI): 0.93, 2.00)

for amateur radio operators. In subsequent years, several ad hoc analyses on this issue were published (2). As of now, seven cohort studies (1, 3–8) are known to have been published, but results are not consistent (table 1). A study of military personnel in Poland showed a significantly increased relative risk of several nervous system tumors, including brain cancer, in persons exposed to RF/MW-EMF (7). However, few details were given on the study methods used, and the increased risk of so many cancer types

Correspondence to Dr. Gabriele Berg, Department of Epidemiology and International Public Health, Faculty of Public Health, University of Bielefeld, P.O. 100131, 33501 Bielefeld, Germany (e-mail: gabriele.berg@uni-bielefeld.de).

**TABLE 1. Results of cohort studies and case-control studies of the association of occupational exposure and other activities to RF/MW-EMF\* with the occurrence of brain tumors**

Exposure	Study design	Method	Measure	Brain tumors				Source, year (reference no.)
				Classification (code(s))	No. of cases	Value	95% CI*	
RF	Cohort with mortality data	Amateur radio operators ( $n = 67,829$ ), follow-up: 1979–1984; exposure: having a license	SMR*	ICD-8* (191)	29	1.39	0.93, 2.00	Milham, 1988 (1)
RF/ELF*	Cohort with incidence data	Norwegian male electrical workers ( $n = 37,945$ ), follow-up: 1961–1985; exposure: job description from census data	SIR*	ICD-7 (193)†	119	1.09	0.90, 1.41	Tynes et al., 1992 (6)
RF	Cohort with incidence data	Female radio and telegraph operators ( $n = 2,619$ ), follow-up: 1961–1991; exposure: job histories	SIR	ICD-7 (193)†	5	1.0	0.3, 2.3	Tynes et al., 1996 (8)
Radar/RF	Cohort	Military career personnel ( $n = 128,000$ ), follow-up: 1971–1985; exposure: job description from the military	OER*	Nervous system, including brain tumor†	85	1.91	1.08, 3.47	Szmigielski, 1996 (7)
Radar	Cohort with incidence data	Ontario, Canada, police officers ( $n = 22,197$ ); exposure: job histories	SIR	ICD-9 (191)	16	0.84	0.48, 1.36	Finkelstein, 1998 (5)
RF	Cohort with mortality data	Employees of Motorola Inc. (Schaumburg, Illinois) ( $n = 195,775$ ), follow up: 1950–1997; exposure: job-exposure matrix with job descriptions	SMR	Nervous system, including brain tumor†	51	0.53	0.21, 1.09	Morgan et al. 2000 (4)
Radar	Cohort with mortality data	US Naval personnel ( $n = 40,890$ men), follow up: 1950–1997; exposure: all expected to be exposed	SMR	ICD-9 (191.0–191.9)	88	0.71	0.51, 0.98	Groves et al., 2002 (3)
Radar	Nested case-control with incidence data	US Naval personnel, 230 cases, 920 matched controls (by year of birth and race); exposure: occupational histories from Air Force personal records	OR*	ICD-9 (191)	230	1.39	1.01, 1.90	Grayson, 1996 (11)
MW/RF	Case-control with mortality data	435 cases, 386 controls selected from death certificates; exposure: job description from census data	OR	No information given on the ICD; glioma, meningioma	435	1.6	1.0, 2.4	Thomas et al., 1987 (10)

\* RF/MW-EMF, radio frequency/microwave electromagnetic fields; CI, confidence interval; SMR, standardized mortality ratio; ICD-8, *International Classification of Diseases*, Eighth Revision (other ICD references are defined similarly); ELF, extremely low frequency; SIR, standardized incidence ratio; OER, observed/expected ratio; OR, odds ratio.

† Included malignant neoplasm of the brain and malignant neoplasm of other parts of the nervous system.

associated with radio frequency radiation has raised concerns about the validity of the results (9). In two case-control studies, a significant association between occupational exposure to RF/MW radiation and the risk of brain cancer was found (10, 11). One of these studies (10) even found a significant dose-response relation between duration of exposure and brain cancer risk. The other case-control study was nested in a cohort study of male members of the US Air Force. An increased risk for persons ever exposed to occupational RF/MW-EMF was reported, with an odds ratio of 1.39 (95 percent CI: 1.01, 1.90). However, there was no trend with either intensity of exposure or duration of exposure (11).

None of these studies analyzed the association between occupational RF/MW-EMF and nonmalignant brain tumors. Experimental, up-to-date research provides no convincing evidence that low-level RF/MW-EMF exposure is involved in carcinogenesis. However, most of the discussion on the effect of RF/MW-EMF exposure refers to the hypothesis of a possible promoting effect of the exposure but not on the genetic mutation itself (12).

The aim of this analysis of the German part of the international Interphone Study was to investigate the association between RF/MW-EMF exposure and the risk of brain tumors in glioma and meningioma patients and in population controls. This paper focuses especially on occupational exposure

to RF/MW-EMF, which was assessed by using information from a comprehensive personal interview including questions about job titles and specific occupational activities.

## MATERIALS AND METHODS

### Study population

A population-based, case-control study (the German part of the international Interphone Study) was performed in line with the core protocol of the international Interphone Study (13). Incident meningioma and glioma cases aged 30–59 years (later extended to age 69 years) at the date of diagnosis were selected from four neurosurgical clinics located in Bielefeld, Heidelberg/Mannheim, and Mainz (covering some 6.6 million inhabitants). These four large clinics cover the metropolitan and rural areas surrounding these cities. Cases were eligible if their tumor was diagnosed between October 1, 2000, and October 31, 2003. On October 1, 2001, after receiving additional funding for the German part of the Interphone Study, the study was extended to include cases and controls aged 60–69 years at the date of diagnosis. Cases were all patients with histologically confirmed diagnoses of primary glioma or meningioma (benign or malignant) to ensure that no other brain tumors—for example, metastases, embryonic tumors, or tumors of the hemopoietic system—were included in the study. Therefore, 22 cases without histologic confirmation of their diagnosis were excluded. The following types of brain tumors (*International Classification of Diseases for Oncology*, Third Edition) were included for glioma: topography codes C71.0–C71.9 and morphology codes 9380–9383, 9390–9393, 9400–9401, 9410–9411, 9420–9421, 9424, 9440–9442, and 9450–9451. For meningioma, *International Classification of Diseases for Oncology*, Third Edition, topography code C70.0 and morphology codes 9530–9539 were included.

In total, 891 eligible patients were identified for the study. All were contacted by an interviewer after approval by the physician responsible for their treatment. The overall response rate for cases was 83.8 percent ( $n = 747$ ) and was slightly lower for glioma patients (79.6 percent) than for meningioma cases (88.4 percent). For the analysis, data for 366 glioma patients and 381 meningioma patients were available. For glioma patients, the causes for not participating were death ( $n = 42$ ), being too ill to answer the questions ( $n = 24$ ), refusal ( $n = 22$ ), or loss of contact after discharge from the hospital ( $n = 6$ ). For some patients who were not able to answer, proxy interviews with relatives were performed ( $n = 40$ ). The reasons for nonparticipation of meningioma patients were refusal ( $n = 21$ ), being too ill to answer the questions ( $n = 16$ ), loss of contact after discharge from the hospital ( $n = 9$ ), and death ( $n = 4$ ). Proxy interviews were performed for five meningioma cases.

A total of 2,449 eligible controls frequency matched to the cases by sex, age, and center were drawn from the compulsory population registries in the three regions. Participating in the study were 62.7 percent of them ( $n = 1,535$ ). Contact by letter and telephone was made several times to improve the response rate. The reasons for nonparticipation in the study were refusal ( $n = 747$ ), loss of contact ( $n =$

118), being too ill ( $n = 48$ ), and death ( $n = 1$ ). At the end of the data collection phase, a post hoc 1:2-person matching was performed by assigning two controls to each case matched by sex, birth year ( $\pm 2$  years), and region (Bielefeld, Heidelberg/Mannheim, Mainz; few exceptions) to adjust for the time lag in interviewing cases and controls. By using this method, the exposure period for the controls was censored at the date of diagnosis of the matched case. Two corresponding controls were matched to each case. For the analyses, data for 732 individually matched controls for the 366 glioma cases and 762 controls for the 381 meningioma cases were available. More details on the materials and methods are published elsewhere (14).

### Data collection

Computer-assisted personal interviews were conducted by trained interviewers and included questions on demographic characteristics; use of cellular telephones, transmitters, and ham radios; smoking and medical histories; diagnostic treatment; and occupational activities related to EMF and ionizing radiation. Most cases were interviewed during their stay in the hospital or, if this option was not possible, at home, after their surgery. The controls were mostly interviewed at home. Each interviewer questioned cases as well as controls. The duration of the interview was compared between cases and controls. Mean duration was 52.0 minutes for controls (standard deviation, 18.9) and 55.1 minutes for cases (standard deviation, 19.7). At the beginning of the study, the computer-assisted personal interview was not available. Therefore, a printed version was used for the first 7 months for interviews with 122 cases and 202 controls. However, unlike the computer-assisted personal interviews, the printed version did not include all details of occupational history. For these first 7 months, only so-called screening questions on occupational history were asked. Persons who reported any of the activities listed in these screening questions were approached later for a more detailed telephone interview when the computer program was available. Sensitivity analyses were performed to test for differences in the results by data collection method.

### Occupational exposure assessment

A detailed questionnaire on occupational activities related to RF/MW-EMF and the whole range of EMF, including static fields and very low frequency EMF, as well as ionizing radiation, was constructed by the International Exposure Assessment Committee of the Interphone Study. In this analysis, only RF/MW-EMF details were assessed. Information on the following occupational activities was derived from this questionnaire; screening questions about possible activities with RF/MW-EMF exposure asked about 1) using industrial heating equipment to process food; to bond, seal, and weld materials; or to melt, dry, and cure materials; 2) manufacturing semiconductor chips or microelectronic devices; 3) using radar; 4) maintaining electromagnetic devices used to treat or diagnose diseases; 5) working with or nearby broadcasting and telecommunications antennae and masts; 6) using different kinds of transmitters; and 7) using

a ham radio. The following screening questions were not considered because the activities mentioned were not related to RF/MW-EMF exposure: 1) working next to electrical motors; 2) being employed by an electric company; 3) working directly on or around any electric transport; 4) constructing, maintaining, or repairing electrical machinery or equipment; 5) using industrial machinery powered by electric motors; 6) using other electrical equipment not mentioned before; 7) working with ionizing radiation; and 8) being employed as an airline pilot or crew member.

Occupations associated with the following frequency ranges were considered: radio transmission (30–300 MHz); cellular and personal communication, including ham radio use (800 MHz–2GHz); and industrial applications such as microwave heating and medical applications, and rarely for ham radio use (up to 2.45 GHz) (15). Because of the small numbers of observations, we included all frequency ranges in one exposure category. However, most of the considered exposures were related to personal communication devices (800 MHz–2 GHz).

The following procedure was used to estimate exposure to RF/MW-EMF. First, all persons who marked one of the activities listed in the above-mentioned screening questions were selected.

Second, all activities mentioned by at least one person were classified with regard to possible exposure to RF/MW-EMF. The computer-assisted personal interviews included some detailed questions to determine whether the occupation led to a measurable exposure to RF/MW-EMF. All activities were classified into four categories based on the scientific literature (16–26) as well as on a review by two German industrial hygienists. Some occupational activities mentioned in these screening questions were categorized as “no RF/MW-EMF” exposure. Examples included a physician working with an electrocardiogram, a cook working in a kitchen, all types of metal welding, and binding and gluing plastic and nylon without microwave heating.

The remaining activities were classified according to the degree or the likelihood of exposure. If the exposure existed and was probably present continuously during the mentioned working hours, the activity was categorized as “probable” exposure. If the exposure surely existed continuously during the mentioned working hours and sometimes exceeded 0.08 W/kg (which corresponds to the exposure limits of RF/MW-EMF for the general population (27)), this activity was categorized as “high” exposure. The International Commission on Non-Ionizing Radiation Protection guidelines allow these exposure limits for the general public to be exceeded by a factor of five for occupational exposures (27). A certain exposure that did not exceed the general exposure limits was considered a probable exposure because it occurred only rarely. Finally, activities were grouped as “not probable” when the activity mentioned was related to RF/MW-EMF but it was presumed that the person was not exposed to RF/MW-EMF. For example, the use of a transmitter inside a car was regarded as an exposure to RF/MW-EMF only when it was mentioned that the transmitter antenna was located inside the car.

Third, the different activities were grouped together for each person, and duration of exposure in each summarized

category was calculated. For example, a person who worked from 1980 to 1989 in an RF/MW-EMF exposed job categorized as probable exposure and from 1990 to 1995 in an RF/MW-EMF exposed job categorized as high exposure was considered RF/MW-EMF exposed for 15 years, including 5 years with high RF/MW-EMF exposure. Only those activities up to 2 years prior to the date of diagnosis of the tumor or the reference date for controls, respectively, were taken into account.

A description of probable and high exposure activities is presented in table 2, and a flow chart of the exposure categorization used is shown in figure 1. The activities were categorized without knowledge of the disease status of the participant. The activity exposure matrix includes 277 activities; among those, 130 are classified as high exposure, 147 as probable exposure, and 212 as not probable exposure.

### Statistical analysis

Conditional logistic regression was performed to account for frequency matching by using SAS software (version 9.1; SAS Institute, Inc., Cary, North Carolina). All regression models were stratified for the three regions and for sex. Adjusting variables were socioeconomic status, urban ( $\geq 100,000$  inhabitants) vs. rural ( $< 100,000$  inhabitants) area, corresponding age at diagnosis, smoking history, and ionizing radiation exposure. Socioeconomic status was based on educational and occupational training in Germany, yielding three levels. Smoking history was considered current smoker, former smoker, or nonsmoker. Ionizing radiation was categorized into four groups: (0) no exposure; (1) at least five lifelong radiographic examinations but no computed tomography (excluding radiographic examinations of a single tooth); (2) more than five radiographic examinations or at least one computed tomography, angiography, and/or szintigraphy; and (3) occupational exposure to ionizing radiation for at least 5 years, or any radiation therapy. Only those examinations considering the head and neck were included. The use of cellular telephones was not deemed a confounder. Sensitivity analyses were performed to consider the use of cellular telephones as a confounder. However, the results were very similar to those presented here and are therefore not shown. Occupational exposure was analyzed with three different models:

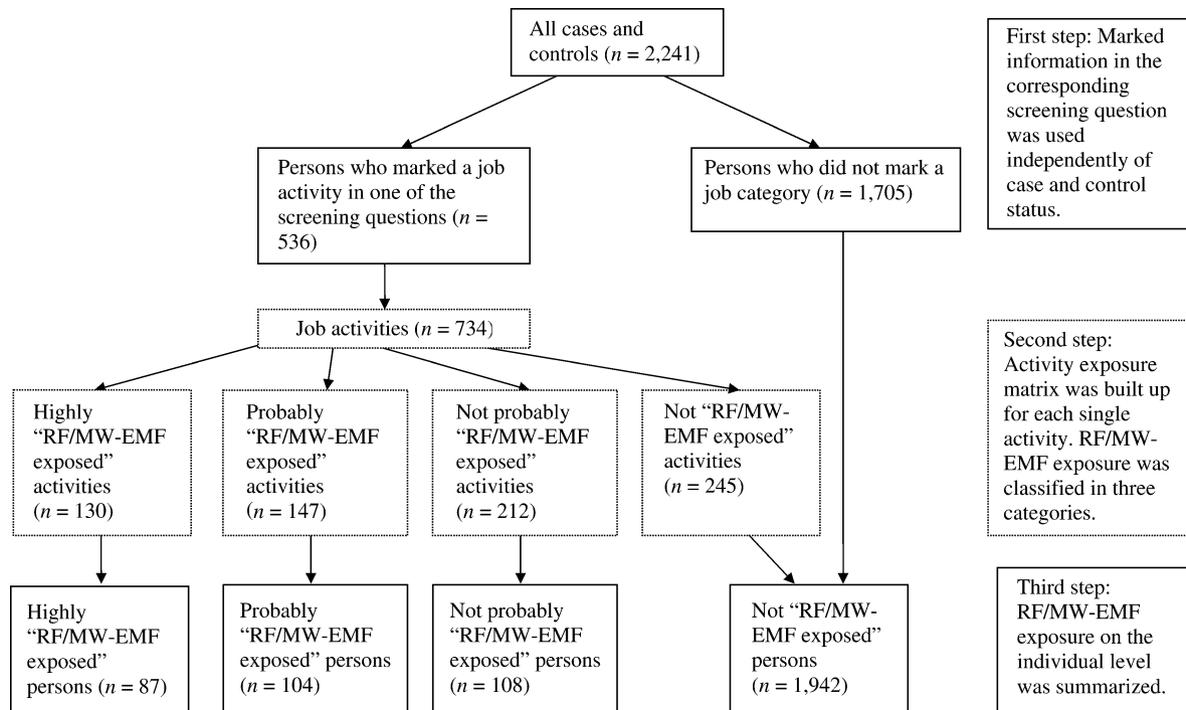
1. Model 1: any RF/MW-EMF exposure (no/yes).
2. Model 2: four categories—no exposure, not probable, probable, and high.
3. Model 3: three categories considering duration of exposure—no high exposure (including no exposure, not probable, and probable), less than 10 years of high exposure, and 10 or more years of high exposure. The category of high exposure was introduced to increase sensitivity by taking into account duration of exposure. All other potential exposure categories were considered not exposed because they do not exceed the exposure limits for the general population. By doing so, a potential threshold above the limits of the general population was examined.

**TABLE 2. Job activities and their grouping according to intensity of RF/MW-EMF\* exposure, German Interphone Study (Bielefeld, Heidelberg/Mannheim, and Mainz), 2000–2003**

Activity and gradient†	Activity title	No. of activities	Reference no(s).
Industrial heating			
Probable	Wood veneer with glue heat curer	4	23
Probable	Vulcanization of rubber	3	19
Probable	Rubber glued, bonded, sealed, welded, or cured with microwave heating equipment	2	16, 18, 19
Probable	Heating of rubber with pressure-sealed applicator	1	18, 19
Probable	Heating of metal with dielectric heating equipment	1	16, 26
High	Dielectric radio frequency heating equipment	1	16, 19, 22, 23, 25, 26
Treatment or diagnosis of disease			
Probable	Use of microwave therapy equipment	4	23
Probable	Use of shortwave therapy equipment	3	19
Probable	Operator of hyperthermia devices (e.g., electrocautery)	1	26
High	Use of microwave therapy or diathermy equipment	2	24
Radar			
Probable	Use of radar during military service, at the airport, or in other civil services; no adjusting, no technical work with the radar equipment	27	16, 19, 20, 22
Probable	Radar used by hand or by a technician maintaining and controlling radar	3	16, 18
Broadcasting			
Probable	Working in civil and military telecommunication services, but not working on the antenna while operating antennas and not for home or private use	14	16, 20, 26
Probable	Technician for cellular telephone base stations or for personal communication services	2	16, 26
High	Telecommunication in telecommunication/mobile communication services, military, and radio broadcasting, working one third of the time on the antenna while operating it	9	16, 21, 26
Ham radio			
Probable	Ham radio operator using private equipment less than 5 hours per week	11	17
High	Ham radio operator and working on the antenna while operating it	4	17
Transmitter			
Probable	Use of walkie-talkies	71	17, 19, 24
High	Use of communication devices (CB* radios, satellite telephones, UHF/VHF* used on boats and other marine vessels' radios on ships, other personal radios for professional use, for example, aviation and private security, with antennas held in the hand, beside the head, or inside the car)	114	17, 19, 24
Total			
Probable	Number of "probable" "RF-EMF exposed" activities	147	
High	Number of "high" "RF-EMF exposed" activities	130	

\* RF/MW-EMF, radio frequency/microwave electromagnetic fields; CB, citizens band; UHF/VHF, ultra high frequency/very high frequency.

† Gradient: probable means probable RF/MW-EMF exposure, high means high RF/MW-EMF exposure.



**FIGURE 1.** Flow chart of the structure of the exposure matrix for specific activities involved in occupations. Data were derived from the German Interphone Study (Bielefeld, Heidelberg/Mannheim, and Mainz), 2000–2003. Boxes with solid lines indicate individual data, boxes with broken lines indicate data based on each mentioned activity. RF/MW-EMF, radiofrequency/microwave electromagnetic fields.

The analyses were repeated after excluding data from proxy interviews. The results were very similar to those presented here and are therefore not shown. Sensitivity analyses were conducted after excluding persons for whom the full computerized personal interview was impossible. For gliomas, the results were very similar to those presented here. For meningioma, possibly because of small numbers, differences within the random variation of the results were found.

## RESULTS

The distribution of major characteristics of the study population is presented in table 3. The median age was 53 years for glioma cases and 55 years for meningioma cases and did not differ between cases and controls. Nearly 60 percent of glioma cases were male, whereas only 27 percent of meningioma cases were male. Compared with that for cases, socioeconomic status of controls in both diagnostic groups was slightly higher. Most of the cases and controls were recruited from urban areas.

Overall, 104 persons were considered probably exposed to RF/MW-EMF and 87 as highly exposed. The results of the crude and adjusted conditional logistic regressions are presented in table 4 for glioma and in table 5 for meningioma. RF/MW-EMF exposure was not associated with occurrence of glioma or meningioma in the total study population. For glioma (table 4), the adjusted odds ratio

was 1.04 (95 percent CI: 0.68, 1.61). However, when we included duration of RF/MW-EMF exposure and focused solely on high exposure, the odds ratios for gliomas increased slightly. For persons who worked less than 10 years, the adjusted odds ratio for high exposure compared with not high exposure was 1.11 (95 percent CI: 0.48, 2.56); for persons who worked 10 years or more, the corresponding odds ratio was 1.39 (95 percent CI: 0.67, 2.88).

The results of the conditional logistic regressions with regard to the association between RF/MW-EMF exposure and occurrence of meningioma were similar (table 5). The adjusted odds ratio for exposure to RF/MW-EMF was 1.12 (95 percent CI: 0.66, 1.87). The adjusted odds ratios for high exposure compared with not high exposure were 1.14 (95 percent CI: 0.37, 3.48) for an exposure of less than 10 years and 1.55 (95 percent CI: 0.52, 4.62) for an exposure of 10 years or more.

## DISCUSSION

To our knowledge, our case-control study is the first in which exposure to RF/MW-EMF has been investigated among a large number of persons by using a detailed interview on occupational history and particular job activities. No significant association between occupational exposure to RF/MW-EMF and brain tumors was found in the data from the German part of the Interphone case-control study.

**TABLE 3. Description of the study population, German Interphone Study (Bielefeld, Heidelberg/Mannheim, and Mainz), 2000–2003**

	Glioma				Meningioma			
	Cases		Controls		Cases		Controls	
	No.	%	No.	%	No.	%	No.	%
Total	366	100	732	100	381	100	762	100
Age category (years)								
<40	60	16.4	122	16.7	39	10.2	77	10.1
40 to <50	83	22.7	173	23.6	78	20.5	166	21.8
50 to <60	113	30.9	209	28.6	133	34.9	259	34.0
≥60	110	30.1	228	31.2	131	34.3	260	34.1
Sex								
Male	216	59.0	432	59.0	103	27.0	206	27.0
Female	150	41.0	300	41.0	278	73.0	556	73.0
Study region								
Mainz	87	23.8	180	24.6	89	23.4	189	24.8
Heidelberg/Mannheim	179	48.9	349	47.7	193	50.7	369	48.4
Bielefeld	100	27.3	203	27.7	99	26.0	204	26.8
Socioeconomic status								
Low	26	7.1	35	4.8	37	9.7	54	7.1
Medium	217	59.3	433	59.2	238	62.5	453	59.4
High	123	33.6	264	36.1	106	27.8	255	33.5
Living surroundings								
Urban	92	25.1	164	22.4	101	26.5	172	22.6
Rural	274	74.9	568	77.6	280	73.5	590	77.4
Smoking history								
Current smoker	101	27.6	221	30.2	92	24.2	189	24.8
Former smoker	96	26.2	210	28.7	97	25.5	202	26.5
Never smoker	169	46.2	301	41.1	192	50.4	371	48.7
Ionizing radiation								
No exposure to ionizing radiation	188	51.4	303	41.4	131	34.4	273	35.8
5 or fewer radiographic examinations	54	14.8	153	20.9	58	15.2	143	18.8
More than 5 radiographic examinations or at least 1 computed tomography	123	33.6	268	36.6	184	48.3	336	44.1
More than 5 years of occupational exposure or radiation therapy	1	0.3	8	1.1	8	2.1	10	1.3
Cellular telephone use								
No regular use	228	62.3	449	61.3	277	72.7	528	69.3
Regular use	138	37.7	283	38.7	104	27.3	234	30.7

A slightly increased risk was observed for high exposure in comparison with probable exposure as well as an increasing odds ratio with increasing duration of years in high-exposure jobs. However, this result should be interpreted with caution, particular because of the small number of exposed persons.

Our results resemble those from the other case-control studies analyzing the association between RF/MW-EMF exposure and development of brain tumors. Thomas et al. (10) found an odds ratio of 1.6 (95 percent CI: 1.0, 2.4) for persons ever exposed to occupational RF radiation and a significant dose-response association between years of working

and brain cancer death. Grayson (11) analyzed persons ever exposed to occupational RF/MW-EMF and found an odds ratio of 1.39 (95 percent CI: 1.01, 1.90). However, in contrast to our results, a dose response, in this study measured by a potential exposure score, was not found in that study (11). Five cohort studies revealed no association between occupational RF/MW-EMF exposure and the occurrence of brain tumors (3–6, 8). For amateur radio operators, a non-significant standardized mortality ratio of 1.39 (95 percent CI: 0.93, 2.00) was found (1). However, there is currently little evidence from cellular and animal studies of the carcinogenicity of RF/MW-EMF (15).

**TABLE 4. Crude odds ratios and odds ratios from multiple conditional logistic regressions for the association of RF/MW-EMF\* exposure with glioma, German Interphone Study (Bielefeld, Heidelberg/Mannheim, and Mainz), 2000–2003**

	No.		Crude		Adjusted†	
	Cases	Controls	OR*	95% CI*	OR	95% CI
Total exposure						
No/not probable exposure	328	653	1		1	
Probable/high exposure	38	79	0.96	0.62, 1.47	1.04	0.68, 1.61
Probable exposure						
No exposure	308	607	1		1	
Not probable	20	46	0.86	0.45, 1.52	0.84	0.48, 1.46
Probable	16	42	0.75	0.40, 1.40	0.84	0.46, 1.56
High	22	37	1.17	0.66, 2.08	1.22	0.69, 2.15
Duration of high exposure						
Not highly exposed	344	695	1		1	
Highly exposed for <10 years	9	17	1.07	0.44, 2.57	1.11	0.48, 2.56
Highly exposed for ≥10 years	13	20	1.31	0.61, 2.80	1.39	0.67, 2.88

\* RF/MW-EMF, radio frequency/microwave electromagnetic fields; OR, odds ratio; CI, confidence interval.

† Conditional logistic regression with frequency matching for center and sex, adjusted for socioeconomic status, urban vs. rural area, ionizing radiation exposure, smoking history, and age at diagnosis.

Measurement of RF/MW-EMF exposure was subject to some methodological discussion; cohort studies that are analyzing a large number of persons acknowledge the difficulty in identifying actually exposed persons rather than occupational groups (28). Thus, no data on individual shielding systems and day-to-day duration of individual exposure were available. This limitation might have led to an exposure classification with high specificity but low sensitivity. This type of nondifferential misclassification in dichoto-

mous exposure assessment is associated mostly with an outcome measure biased toward the null effect (29). The older case-control study (10) used two methods of classifying RF/MW-EMF: first, subjects' occupational history was assigned a three-digit code for industry and a census code for occupations; second, each job listed in the occupational history was categorized by a certified industrial hygienist as high, moderate, or low. In the nested case-control study performed among the US Air Force population, a subgroup

**TABLE 5. Crude odds ratio and odds ratio from multiple conditional logistic regressions of the association of RF/MW-EMF\* exposure with meningioma, German Interphone Study (Bielefeld, Heidelberg/Mannheim, and Mainz), 2000–2003**

	No.		Crude		Adjusted†	
	Cases	Controls	OR*	95% CI*	OR	95% CI
Total exposure						
No/not probable exposure	355	714	1		1	
Probable/high exposure	26	48	1.09	0.65, 1.83	1.12	0.66, 1.87
Probable exposure						
No exposure	340	687	1		1	
Not probable	15	27	1.12	0.56, 2.23	1.11	0.57, 2.15
Probable	15	31	1.01	0.51, 1.98	1.01	0.52, 1.93
High	11	17	1.31	0.57, 2.98	1.34	0.61, 2.96
Duration of high exposure						
Not highly exposed	370	745	1		1	
Highly exposed for <10 years	5	9	1.12	0.32, 3.67	1.14	0.37, 3.48
Highly exposed for ≥10 years	6	8	1.51	0.46, 4.83	1.55	0.52, 4.62

\* RF/MW-EMF, radio frequency/microwave electromagnetic fields; OR, odds ratio; CI, confidence interval.

† Conditional logistic regression with frequency matching for center and sex, adjusted for socioeconomic status, urban vs. rural area, ionizing radiation exposure, smoking history, and age at diagnosis.

of persons exposed to RF/MW-EMF above permissible exposure limits ( $10 \text{ mW/cm}^2$ ) was identified by a historical list of incidents. All other job titles were assigned to the non-exposed category (11).

Our assessment of occupational exposure was based on individual activities during employment instead of job titles. Doing so enabled us to consider individual exposure to RF/MW-EMF and the use of shielding systems. In particular, the category of high-exposure activities derived from the comprehensive questionnaire was established to consider the specific exposure situation during an activity. This method was used to allow a more sensitive exposure estimation of the real situation and a more specific exclusion of a nonexposure situation during a possible-exposed occupation.

This study has some limitations, which is common in case-control studies. First, recall bias may have been present, particularly because of the extensive questionnaire used. It might be that cases, because of their preoccupation with disease, overestimated their exposure compared with that of controls (recall bias type A). It could also happen that, because of their disease, cases were unable to answer accurately (recall bias type B). Recall bias A might lead to an overestimation of occupational exposure and should be particularly obvious in occupational screening questions. However, because we constructed the activity exposure matrix from given information in the computer-assisted personal interviews, participants did not know which answer was used to determine RF/MW-EMF exposure. Thus, in the high RF/MW-EMF exposed group, recall bias A is unlikely. Recall bias B was also analyzed by performing a sensitivity analysis for all interviews, excluding proxy interviews. As mentioned above, the results for both analyses did not differ. The potential impact of selection bias also needs to be discussed in case-control studies. The response rate differed between cases (83.8 percent) and controls (62.4 percent). Selection bias related to exposure to occupational RF/MW-EMF may not be as obvious in this analysis of the Interphone Study as it is for the exposure in connection with cellular phone use. Analysis of a short nonresponder questionnaire showed that male, but not female, controls were more likely to refrain from regular cellular phone use as well as to refuse to participate in this study (14).

The number of observed cases in cohort studies of RF/MW-EMF exposure is small because brain tumors are rare (table 1). Until now, the number of cases included in this case-control study (366 glioma cases and 381 meningioma cases) is the highest of all published case-control studies investigating occupational RF/MW-EMF exposure. Nevertheless, the number of people with high exposure among cases and controls identified is still small (22 glioma cases and 11 meningioma cases). Hence, there might not be enough statistical power to find a possible small risk, particularly for patients with a long duration of exposure.

All frequency ranges of RF/MW-EMF were included in one exposure category. In the high-exposure group, 114 of 130 activities (table 2: area transmitter) occurred in the context of personal communication devices representing the frequency range of 800 MHz–2 GHz (15). To our knowledge, there is no different etiologic mechanism in discus-

sions of the different frequency ranges of RF/MW-EMF and the stated promoting effect on tumors. Furthermore, in the group with high exposure, we considered the limit among the general public recommended by the International Commission on Non-Ionizing Radiation Protection. These limits are equal for all considered frequency ranges (specific absorption rate of  $0.08 \text{ W/kg}$ ) and are based on the established thermal effect in all of these RF/MW-EMF frequency ranges (27).

To our knowledge, this is the first time that the association between RF/MW-EMF exposure and nonmalignant brain tumors such as meningioma has been considered. The results for meningiomas and gliomas were virtually identical. Meningiomas and gliomas are of different tissue origin; meningiomas arise from meningotheia cells, whereas gliomas arise from glial cells. Compared with gliomas, meningiomas might be associated with a longer latency period. Up to now, no previously published study has been known to show an association between RF/MW-EMF exposure from cellular phone use and meningioma. Positive associations with glioma have been reported in two of six studies, but methodological considerations limited interpretability of the findings (30). Therefore, the similar association we found for long-duration exposure among highly exposed participants concerning both brain tumor types and the exposure of RF/MW-EMF found in our analysis should be discussed. The stated tumor-promoting effect of RF/MW-EMF might be the same for meningiomas and gliomas. In our study, the high-exposure category was defined so we could look for a potential effect of an RF/MW-EMF exposure above the exposure limits for the general population. Although doing so may strengthen the plausibility of the results, it leads to the effect that only a few persons are regarded as "exposed." Furthermore, it cannot be excluded whether potential information bias or selection bias could lead to a similar increase in risk of both brain tumor entities. For confirmation of these results, further analysis of the pooled Interphone data set is awaited.

This study shows the first known results concerning exposure to RF/MW-EMF in the frame of occupational activities and occurrence of glioma and meningioma. We did not find a significant association between occupational exposure to RF/MW-EMF and brain tumors, but odds ratios for both glioma and meningioma were slightly increased for long-duration and high exposure. These results were based on low numbers of exposed participants and need be confirmed by the results of the pooled analyses of the Interphone Study. In a larger data set, it will also be possible to perform a stratified analysis of different types of brain tumors such as high-grade or low-grade gliomas, of gender, of different exposure estimates for activities associated with particular RF/MW-EMF frequency ranges, and of a higher number of expected long-term RF/MW-EMF exposed workers.

## ACKNOWLEDGMENTS

The authors acknowledge funding from the European Fifth Framework Program, "Quality of Life and Management

of Living Resources" (contract QLK4-CT-1999-01563); the "Deutsches Mobilfunkforschungsprogramm" of the German Federal Ministry for the Environment, Nuclear Safety, and Nature Protection; the Ministry for the Environment and Traffic of the state of Baden-Württemberg; the Ministry for the Environment of the state of North Rhine-Westphalia; the MAIFOR Program of the University of Mainz; and the International Union against Cancer (UICC). The UICC received funds for this purpose from the Mobile Manufacturers' Forum and GSM Association. Provision of funds to the Interphone Study investigators via the UICC was governed by agreements that guaranteed Interphone's complete scientific independence. These agreements are publicly available at the following website: <http://www.iarc.fr/pageroot/UNITS/RCA4.html> (accessed July 1, 2005).

The authors thank Dr. Hauke Brüggemeyer of the Lower Saxony State Agency for Ecology and Markus Fischer from the Professional Association for Safety and Health at Work (BFGA) for their scientific support in building the activity exposure matrix. They also thank Marianne Brömmel, Stephanie Estel, Melanie Hetzer, and Anna Wilms for organizing the field phase and all of the interviewers for their skillful work. The authors thank the clinical Interphone Study team for their support and collaboration: *Bielefeld*: Prof. Falk Oppel (Neurosurgical clinic), Dr. Uwe Dietrich (Neuroradiology), and Dr. Volkmar Hans (Neuropathology); *Heidelberg*: Prof. Andreas Unterberg, Prof. Stefan Kunze, Dr. Karsten Geletneky (Neurosurgical clinic), and Prof. Marika Kiessling (Neuropathology); *Mannheim*: Prof. Peter Schmiedek, Dr. Jochen Tüttenberg (Neurosurgical clinic), and Prof. Uwe Bleyl (Neuropathology); *Mainz*: Prof. Axel Pernecky, Prof. Nico Hopf, Dr. Dorothee Koch (Neurosurgical clinic), Prof. Wolf Mann, Prof. Nickalaos Marangos (ENT clinic), Dr. Wibke Müller-Forell (Neuroradiology), and Prof. Hans Hilmar Göbel (Neuropathology). They also thank the coordination team at the International Agency for Research on Cancer in Lyon, Switzerland, for their support.

Conflict of interest: none declared.

## REFERENCES

- Milham S Jr. Increased mortality in amateur radio operators due to lymphatic and hematopoietic malignancies. *Am J Epidemiol* 1988;127:50-4.
- Blettner M, Schlehofer B. Is there a high risk for leukemia, brain tumor or breast cancer during the exposure of high frequency radiation? (In German). *Med Klin* 1999;94:150-9.
- Groves FD, Page WF, Gridley G, et al. Cancer in Korean War Navy technicians: mortality survey after 40 years. *Am J Epidemiol* 2002;155:810-18.
- Morgan RW, Kelsh MA, Zhao K, et al. Radio frequency exposure and mortality from cancer of the brain and lymphatic/hematopoietic systems. *Epidemiology* 2000;11:118-27.
- Finkelstein MM. Cancer incidence among Ontario police officers. *Am J Ind Med* 1998;34:157-62.
- Tynes T, Andersen A, Langmark F. Incidence of cancer in Norwegian workers potentially exposed to electromagnetic fields. *Am J Epidemiol* 1992;136:81-8.
- Szmigielski S. Cancer mortality in subjects occupationally exposed to high-frequency (radio frequency and microwaves) electromagnetic radiation. *Sci Total Environ* 1996;180:9-17.
- Tynes T, Hannevik M, Andersen A, et al. Incidence of breast cancer in Norwegian female radio and telegraph operators. *Cancer Causes Control* 1996;7:197-204.
- Elwood JM. A critical review of epidemiologic studies of radiofrequency exposure and human cancers. *Environ Health Perspect* 1999;107(suppl 1):155-68.
- Thomas TL, Stolley PD, Stemhagen A, et al. Brain tumor mortality risk among men with electrical and electronic jobs: a case control-study. *J Natl Cancer Inst* 1987;79:233-8.
- Grayson JK. Radiation exposure, socioeconomic status, and brain tumor risk in the US Air Force: a nested case control study. *Am J Epidemiol* 1996;143:480-6.
- IEGMP. Steward W, chairman. Mobile phones and health. Report of an Independent Expert Group on Mobile Phones. Chilton, United Kingdom: National Radiological Protection Board, 2000.
- Cardis E, Kilkeny M. International case-control study of adult brain, head and neck tumours: results of the feasibility study. *Radiat Prot Dosimetry* 1999;83:179-83.
- Schüz J, Böhler E, Berg G, et al. Cellular phones, cordless phones, and the risk of gliomas and meningiomas in Germany. *Am J Epidemiol* 2006;163:512-20.
- Habash RWY, Brodsky LM, Leiss W, et al. Health risks of electromagnetic fields. Part II: evaluation and assessment of radiofrequency radiation. *Crit Rev Biomed Eng* 2003;31:197-254.
- National Radiological Protection Board (NRPB). Health effects from radiofrequency electromagnetic fields. London, United Kingdom: NRPB, 2003. (Documents of the NRPB: vol 14, no. 2).
- Bundesamt für Umwelt, Wald und Landschaft (UWAL). High frequency radiation and health. (In German). Umwelt-Materialien Bern: Nichtionisierende Strahlung, 2003:162.
- Floderus B, Stenlund C, Carlgren F. Occupational exposures to high frequency electromagnetic fields in the intermediate range (>300 Hz-10 MHz). *Bioelectromagnetics* 2002;23:568-77.
- Fachverband für Strahlenschutz e V (FVSS): Brüggemeyer H, Eichhorn KF, Eggert S, et al: Leitfaden. Guide: nonionizing radiation. (In German). Elektromagnetische Felder, 1999. (FS 07-90-AKNIR Köln).
- Richter E, Berman T, Ben Michael E, et al. Cancer in radar technicians exposed to radiofrequency/microwave radiation: sentinel episodes. *Int J Occup Environ Health* 2000;6:187-93.
- Minister of Public Works and Government Services (MPWGS). Limits of human exposure to radiofrequency electromagnetic fields in the frequency range from 3 kHz to 300 GHz—safety code 6. Ottawa, Canada: MPWGS, 1999.
- Allgemeine Unfallversicherungsanstalt (AUVA). Measurement and safety related evaluation of electromagnetic fields in induction furnace. (In German). 1998: Report (2).
- Allgemeine Unfallversicherungsanstalt (AUVA). Analysis of workplaces in high frequency radiation. (In German). 1998: Report (1).
- Bundesministerium für Gesundheit und Konsumentenschutz (BGK). Study on documented research results about the effect of electromagnetic fields. (In German). 1997; (2): Hochfrequente elektromagnetische Felder.
- Brüggemeyer H. Electric and magnetic fields on workplaces with high frequency plastic welding machines. (In German).

- Niedersächsisches Sozialministerium, Landesamt für Ökologie Hannover, 1996.
26. National Council on Radiation Protection and Measurements (NCRP). A practical guide to the determination of human exposure to radiofrequency fields. Bethesda, MD: NCRP, 1993.
  27. Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). International Commission on Non-Ionizing Radiation Protection. *Health Phys* 1998;74:494–522.
  28. Breckenkamp J, Berg G, Blettner M. Biological effects on human health due to radiofrequency/microwave exposure: a synopsis of cohort studies. *Radiat Environ Biophys* 2003; 42:141–54.
  29. Brenner H, Savitz DA, Gefeller O. The effects of joint misclassification of exposure and disease on epidemiologic measures of association. *J Clin Epidemiol* 1993;46: 1195–202.
  30. Lönn S, Ahlbom A, Hall P, et al. Long-term mobile phone use and brain tumor risk. *Am J Epidemiol* 2005;161:526–35.

<https://nationandstate.com/2020/11/23/pandemic-is-over-former-pfizer-chief-science-officer-says-second-wave-faked-on-false-positive-covid-tests/>

## **“Pandemic is Over” – Former Pfizer Chief Science Officer Says “Second Wave” Faked On False-Positive Tests**

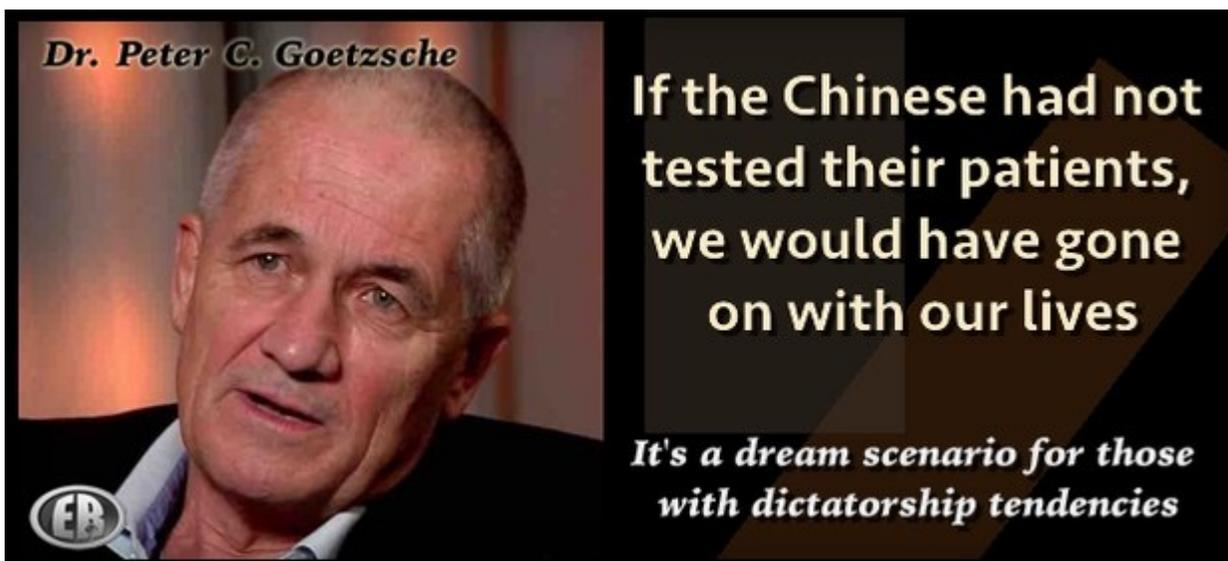
[Mon 9:24 am +00:00, 23 Nov 2020](#)

posted by Weaver



**ER Editor:** We’re linking to a piece we published on April 1, 2020, which brings us full circle, with a boatload of experts back then questioning the virus hype: [TWENTY-TWO Experts Questioning the Coronavirus Panic \[VIDEOS & Scientific Common Sense\]](#). And this from March 30 by the esteemed Dr. Peter Goetsche of the Cochrane Institute: [Coronavirus: An Epidemic of Mass Panic](#).

March was the time of the greatest number of infections, with the greatest number of deaths following on in April. Data experts said we locked down during March when it was already evident that the number of infections were about to decline. As Goetsche said back then, ‘it’s a dream scenario for those with dictatorship tendencies.’



The video by Dr. Mike Yeadon below is well worth listening to closely for his both expert opinion and common sense reasoning about the virus.

\*\*\*\*\*

## **“Pandemic is Over” – Former Pfizer Chief Science Officer Says “Second Wave” Faked On False-Positive COVID Tests**



## TYLER DURDEN

This video provides one of the most erudite and informative looks at Covid-19 and the consequences of lockdowns. As [AIER notes](#), **it was remarkable this week to watch as it appeared on YouTube and was forcibly taken down only 2 hours after posting.**

The copy below is hosted on LBRY, a blockchain video application. In a year of fantastic educational content, this is one of the best we've seen.



Consider the presenter's [bio](#):

**Dr. Michael Yeadon is an Allergy & Respiratory Therapeutic Area expert with 23 years in the pharmaceutical industry. He trained as a biochemist and pharmacologist, obtaining his PhD from the University of Surrey (UK) in 1988.**

Dr. Yeadon then worked at the Wellcome Research Labs with Salvador Moncada with a research focus on airway hyper-responsiveness and effects of pollutants including ozone and working in drug discovery of 5-LO, COX, PAF, NO and lung inflammation. With colleagues, he was the first to detect exhaled NO in animals and later to induce NOS in lung via allergic triggers.

**Joining Pfizer in 1995**, he was responsible for the growth and portfolio delivery of the Allergy & Respiratory pipeline within the company. He was responsible for target selection and the progress into humans of new molecules, **leading teams of up to 200 staff across all disciplines** and won an Achievement Award for productivity in 2008.

Under his leadership the research unit invented oral and inhaled NCEs which delivered multiple positive clinical proofs of concept in asthma, allergic rhinitis and COPD. He led productive collaborations such as with Rigel Pharmaceuticals (SYK inhibitors) and was involved in the licensing of Spiriva and acquisition of the Meridica (inhaler device) company.

**Dr. Yeadon has published over 40 original research articles** and now consults and partners with a number of biotechnology companies. **Before working with Apellis, Dr. Yeadon was VP and Chief Scientific Officer (Allergy & Respiratory Research) with Pfizer.**

What likely triggered the Silicon Valley censor-mongers is the fact that a former Chief Science Officer for the pharmaceutical giant Pfizer says **“there is no science to suggest a second wave should happen.”** The “Big Pharma” insider asserts that false positive results from inherently unreliable COVID tests are being used to manufacture a “second wave” based on “new cases.”

[As Ralph Lopez write at HubPages](#), Yeadon warns that half or even “almost all” of tests for COVID are false positives. Dr. Yeadon also argues that the threshold for herd immunity may be much lower than previously thought, and may have been reached in many countries already.

[In an interview last week](#) (see below) Dr. Yeadon was asked:

**“we are basing a government policy, an economic policy, a civil liberties policy, in terms of limiting people to six people in a meeting...all based on, what may well be, completely fake data on this coronavirus?”**

Dr. Yeadon answered with a simple “yes.”

Even more significantly, even if all positives were to be correct, Dr. Yeadon said that given the “shape” of all important indicators in a worldwide pandemic, such as [hospitalizations](#), ICU utilization, and deaths, “the pandemic is fundamentally over.”

Yeadon said in the interview:

**“Were it not for the test data that you get from the TV all the time, you would rightly conclude that the pandemic was over, as nothing much has happened. Of course people go to the hospital, moving into the autumn flu season...but there is no science to suggest a second wave should happen.”**

In a paper published this month, which was co-authored by Yeadon and two of his colleagues, [“How Likely is a Second Wave?”](#), the scientists write:

**“It has widely been observed that in all heavily infected countries in Europe and several of the US states likewise, that the shape of the daily deaths vs. time curves is similar to ours in the UK. Many of these curves are not just similar, but almost super imposable.”**

In the data for UK, Sweden, the US, and the world, it can be seen that in all cases, deaths were on the rise in March through mid or late April, then began tapering off in a smooth slope which flattened around the end of June and continues to today. The case rates however, **based on testing**, rise and swing upwards and downwards wildly.

**Media messaging in the US is already [ramping up expectations](#) of a “second wave.”**

The survival rate of COVID-19 has been upgraded since May to [99.8% of infections](#). This comes close to ordinary flu, the survival rate of which is 99.9%. Although COVID can have serious after-effects, [so can flu](#) or any respiratory illness. The present survival rate is far higher than initial grim guesses in March and April, cited by Dr. Anthony Fauci, of 94%, or 20 to 30 times deadlier. The Infection Fatality Rate (IFR) value accepted by Yeadon *et al* in the paper is .26%. The survival rate of a disease is 100% minus the IFR.

**Dr. Yeadon pointed out that the “novel” COVID-19 contagion is novel only in the sense that it is a new type of coronavirus. But, he said, there are presently four strains which circulate freely throughout the population, most often linked to the common cold.**

In the scientific paper, Yeadon *et al* write:

**“There are at least four well characterised family members (229E, NL63, OC43 and HKU1) which are endemic and cause some of the common colds we experience, especially in winter. They all have striking sequence similarity to the new coronavirus.”**

The scientists argue that much of the population already has, if not antibodies to COVID, some level of **“T-cell” immunity from exposure to other related coronaviruses**, which have been circulating long before COVID-19.

The scientists write:

“A major component of our immune systems is the group of white blood cells called T-cells whose job it is to memorise a short piece of whatever virus we were infected with so the right cell types can multiply rapidly and protect us if we get a related infection. Responses to COVID-19 have been shown in dozens of blood samples taken from donors before the new virus arrived.”

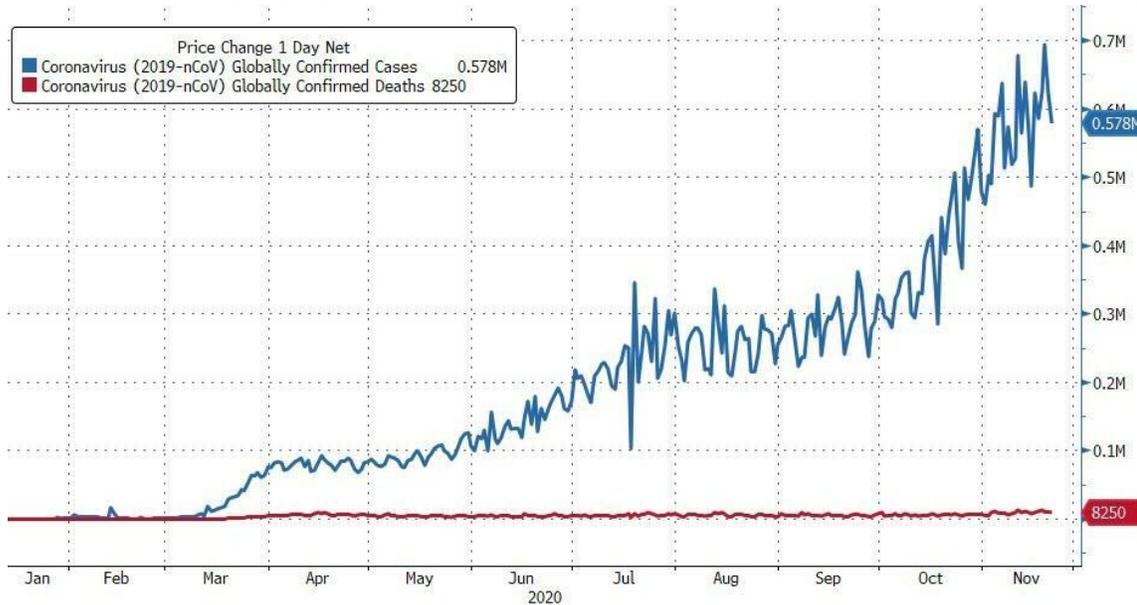
Introducing the idea that some prior immunity to COVID-19 already existed, the authors of “How Likely is a Second Wave?” write:

**“It is now established that at least 30% of our population already had immunological recognition of this new virus, before it even arrived...COVID-19 is new, but coronaviruses are not.”**

They go on to say that, because of this prior resistance, **only 15-25% of a population being infected may be sufficient to reach herd immunity:**

“...epidemiological studies show that, with the extent of prior immunity that we can now reasonably assume to be the case, only 15-25% of the population being infected is sufficient to bring the spread of the virus to a halt...”

In the US, accepting a death toll of 200,000, and a survival rate of 99.8%, this would mean for every person who has died, there would be about 400 people who had been infected, and lived. This would translate to around 80 million Americans, or 27% of the population. **This touches Yeadon’s and his colleagues’ threshold for herd immunity.**



**Finally, the former Pfizer executive and scientist singles out one former colleague for withering rebuke for his role in the pandemic, Professor Neil Ferguson (pictured). Ferguson taught at Imperial College while**



**Yeadon was affiliated.** Ferguson's [computer model](#) provided the rationale for governments to launch draconian orders which turned free societies into virtual prisons overnight. Over what is now estimated by the CDC to be a 99.8% survival rate virus.

Dr. Yeadon said in the interview that “no serious scientist gives any validity” to Ferguson’s model.

Speaking with thinly-veiled contempt for Ferguson, Dr. Yeadon took special pains to point out to his interviewer:

**“It’s important that you know most scientists don’t accept that it [Ferguson’s model] was even faintly right...but the government is still wedded to the model.”**

Yeadon joins other scientists in castigating governments for following Ferguson’s model, the assumptions of which all worldwide lockdowns are based on. One of these scientists is [Dr. Johan Giesecke](#), former chief scientist for the European Center for Disease Control and Prevention, who **called Ferguson’s model “the most influential scientific paper” in memory, and also “one of the most wrong.”**

It was Ferguson’s model which held that “mitigation” measures were necessary, i.e. social distancing and business closures, in order to prevent, for example, over 2.2 million people dying from COVID in the US.

**Ferguson predicted that Sweden would pay a terrible price for no lockdown, with 40,000 COVID deaths by May 1, and 100,000 by June. Sweden’s death count is under 6,000.** The [Swedish government says](#) this corresponds to a mild flu season. Although initially higher, Sweden now has a lower death rate per-capita than the US, which it achieved without the terrific economic damage still ongoing in the US. [Sweden never closed](#) restaurants, bars, sports, most schools, or movie theaters. The government never ordered people to wear masks.



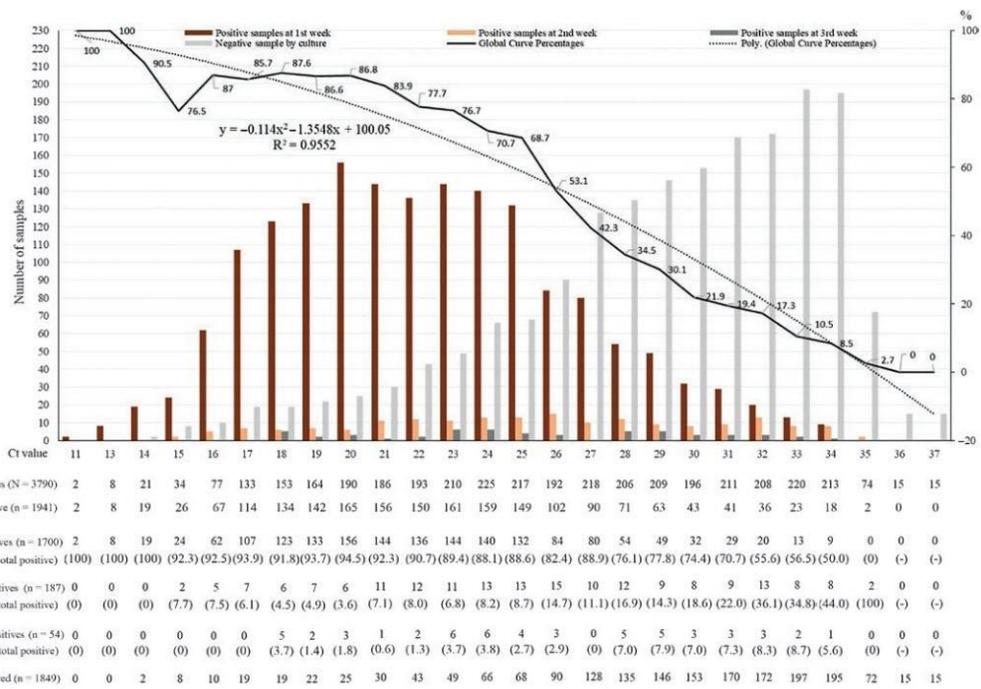
**Dr. Yeadon speaks bitterly of the lives lost as a result of lockdown policies, and of the “saveable” countless lives which will be further lost, from important surgeries and other healthcare deferred, should lockdowns be reimposed.**

Watch the full discussion below:

Yeadon’s warnings are confirmed by a new study from [the Infectious Diseases Society of America](#)., summarized succinctly in the following [twitter thread from al gato malo \(@boriquagato\)](#)

**Anyone still presuming that a Positive PCR test is showing a COVID case needs to read this very carefully:**

- even with 25 cycles of amplification, 70% of “positives” are not “cases.” Virus cannot be cultured; it’s dead.
- by 35: 97% non-clinical.
- the US runs at 40, 32X the amplification of 35. (*ER: France is using cycle thresholds of 35-40*)

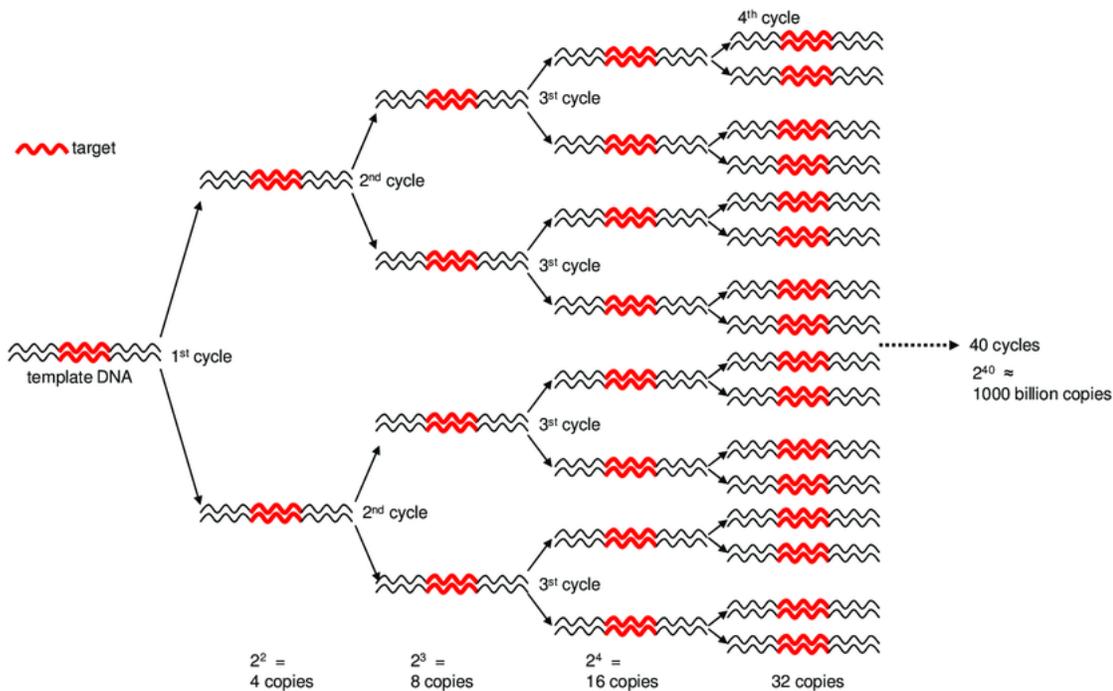


**Figure 1.** Percentage of positive viral cultures of severe acute respiratory syndrome coronavirus 2 polymerase chain reaction–positive nasopharyngeal samples from coronavirus disease 2019 patients, according to Ct value (plain line). The dashed curve indicates the polynomial regression curve. Abbreviations: Ct, cycle threshold; Poly., polynomial.

**A lot of people still seem to not understand what this means, so let's lay that out for a minute.**

PCR tests look for RNA. There is too little in your swab, so they amplify it using a primer-based heating and annealing process.

**Each cycle of this process doubles the material**



**The US (and much of the world) is using a 40 Ct (cycle threshold). So, 40 doublings, 1 trillion X amplification.**

**This is absurdly high.**

The way that we know this is by running this test, seeing the Ct to find the RNA, and then using the same sample to try to culture virus.

If you cannot culture the virus, then the virus is “dead.” It’s inert. If it cannot replicate, **it cannot infect you or others.** It’s just traces of virus, remnants, fragments, etc.

**PCR is not testing for disease, it’s testing for a specific RNA pattern** and this is the key pivot.

When you crank it up to 25, 70% of the positive results are not really “positives” in any clinical sense.

I hesitate to call it a “false positive” because it’s really not. It did find RNA, but that RNA is not clinically relevant.

**It cannot make you or anyone else sick**

So let’s call this a non-clinical positive (NCP).

- if 70% of positives are NCP’s at 25, imagine what 40 looks like. 35 is 1,000X as sensitive.
- this study found only 3% live at 35
- 40 Ct is 32X 35, 32,000X 25

**No one can culture live virus past about 34** and we have known this since March. yet no one has adjusted these tests.

**This is more very strong data refuting the idea that you can trust a PCR+ as a clinical indicator.**

That is NOT what it’s meant for. At all.

**Using them to do real time epidemiology is absurd.**

At the beginning of the outbreak, we correlated Ct values obtained using our PCR technique based on amplification of the E gene and the results of the culture [8]. Since the beginning of the pandemic, we have performed 250 566 SARS-CoV-2 RT-PCR for 179 151 patients, of whom 13 161 (7.3%) tested positive. Up to the end of May, 3790 of these samples, reported as positive on nasopharyngeal samples, were inoculated and managed for culture as previously described [8]. Of these 3790 inoculated samples, 1941 SARS-CoV-2 isolates could be obtained after the first inoculation or up to 2 blind subcultures. The correlation between the scanner values and the positivity of the culture allows us to observe that the image obtained with 10 times more isolates than in our preliminary work (1941 vs 129) does not change significantly (Figure 1). It can be observed that at Ct = 25, up to 70% of patients remain positive in culture and that at Ct = 30 this value drops to 20%. At Ct = 35, the value we used to report a positive result for PCR, <3% of cultures are positive. Our Ct value of 35, initially based on the results obtained by RT-PCR on control negative samples in our laboratory and initial results of cultures [8], is validated by the results herein presented and is in correlation with what was proposed in Korea [9] and Taiwan [10]. We could observe that subcultures, especially the first one, allow an increasing percentage of viral isolation in samples with Ct values, confirming that these high Ct values are mostly correlated with low viral loads. From our cohort, we now need to try to understand and define the duration and frequency of live virus shedding in patients on a case-by-case basis in the rare cases when the PCR is positive beyond 10 days, often at a Ct >30. In any cases, these rare cases should not impact public health decisions.

The FDA would never do it, the drug companies doing vaccine trials would never do it... it's **because it's nonsense.**

**And this same test is used for “hospitalizations” and “death with covid” (itself a weirdly over inclusive metric)**

PCR testing is not the answer, it's the problem.

**It's not how to get control of an epidemic, it's how to completely lose control of your data picture and wind up with gibberish and we have done this to ourselves before.**

**A quick word what this data does and does not mean.**

Saying “a sample requiring 35 Ct to test + has a 3% real clinical positive rate” does not mean “97% of + tests run at 35 Ct are NCP's”

People seem to get confused on this, so let's explain:

**Most tests are just amplified and run. They don't test every cycle as these academics do. That would make the test slow and expensive, so you just run 40 cycles then test.**

Obviously, a real clinical positive (RCP) that would have been + at 20 is still + at 40.

But when you run the tests each cycle as the academics do, that test would already have dropped out.

So saying that only 3% at 35 are RCP really means that 3% of those samples not PCR + at 34 were PCR and RCP + at 35.

This lets us infer little about overall NCP/RCP rate.

***So we cannot say "at 25 Ct, we have a 70 NCP rate." In fact, it's hard to say much of anything. It depends entirely on what the source material coming in looks like.***

You cannot even compare like to like.

***This is what i mean by "the data is gibberish"***

Today at 40 Ct, 7% PCR positive rate could be 1% RCP prevalence when that same thing meant 6% RCP prev in april.

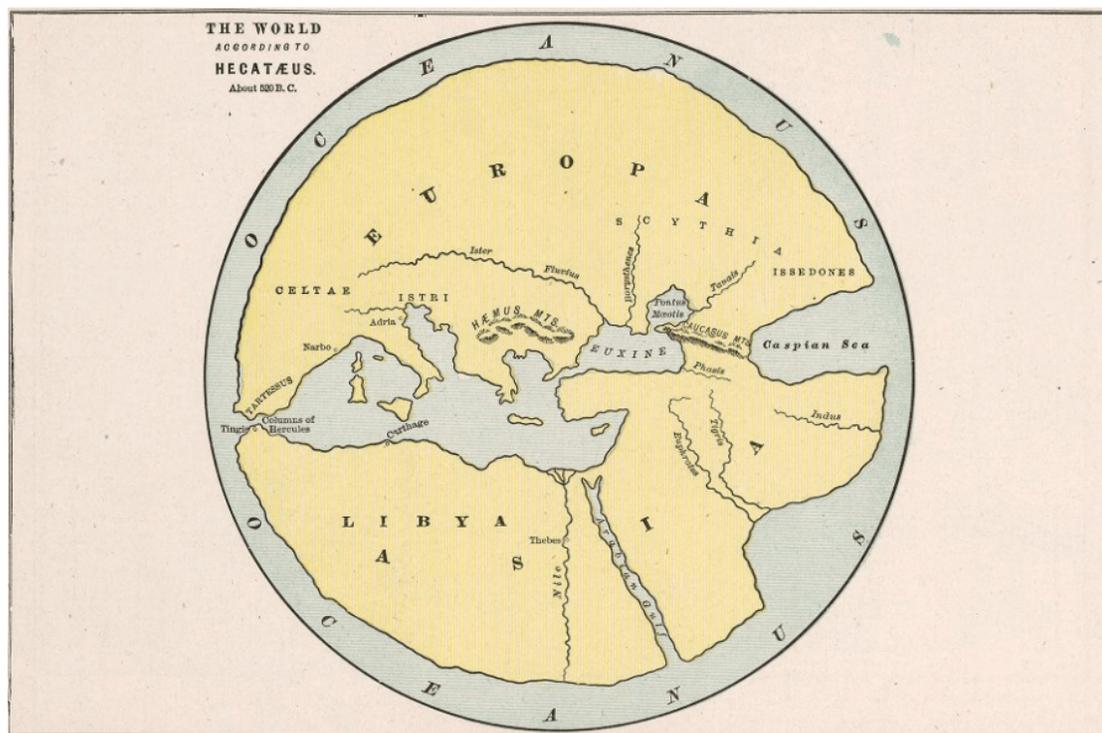
**If there is lots more trace virus around, more people who have recovered and have fragments left over, etc, this test could be finding virus you killed 4 months ago.**

So if we consider RCP rate/PCR+ rate, we would expect that number to drop sharply late in an epidemic because there is more dead virus around for PCR to find, but we have no idea what that ratio is or how it changes.

**This spills over in to deaths, reported hospitalization, etc.**

Testing is being made out to be like the high beams on a car, but when it's snowing like hell at night, that is the LAST thing you want. It is not illuminating our way, it's blinding us.

**A bad inaccurate map is much worse than no map at all, and this is a world class bad map...**



**We're basing policy that is affecting billions of humans on data that is uninterpretable gibberish.**

It's a deranged technocrat's wet dream, but for those of us along for the ride, it's a nightmare.

**Testing is not the solution, it's the problem.**

Any technocrat or scientist that does not know this by now is either unfit for their job or has decided that they just don't care and prefer power to morality.

This is, of course, precisely the kind of person who winds up running a gov't agency... oopsie.



**The head of the NIH is not the best scientist, it's the best politician.**

All this wild and reckless government policy has never been about the science.

**It's politics and panic.**

You can read the whole paper here: <https://academic.oup.com/cid/advance-article/doi/10.1093/cid/ciaa1491/5912603>

**Correlation Between 3790  
Quantitative Polymerase Chain  
Reaction-Positives Samples and  
Positive Cell Cultures, Including  
1941 Severe Acute Respiratory  
Syndrome Coronavirus 2  
Isolates**

\*\*\*\*\*

<https://www.thelibertybeacon.com/pandemic-is-over-former-pfizer-chief-science-officer-says-second-wave-faked-on-false-positive-tests/>

[News](#)

# Nobel Laureate, PCR Inventor Said Fauci Was a Liar, Abusing Test Data For An Agenda And Afraid To Debate

Published December 11, 2020 By [David Knight](#)

The Nobel Laureate inventor of the PCR test, Kary Mullis, died at the age of 74 back in August of 2019 but prior to his death, he had a lot of interaction with Fauci.

He'd already gone to war with Fauci for misusing his PCR test. Mullis and other scientists said Fauci was magnifying the retrovirus HIV using PCR to "prove" it was the cause of AIDS. Mullis was furious that Fauci refused to debate him on science but argued from authority.

Does this all sound familiar? It's another reason why this COVID "novel" was not credible from the beginning. In the past, Fauci, CDC, etc, had abused test methods many times to push pandemics and pharmaceuticals.

"The strategy for locking us down again is based on these fraudulent tests. The magnified tests that don't measure the quantity of anything. It's the same strategy Fauci used to make a lot of money for a lot of people. It's not just the PCR test, all these rapid tests, every one of them, they're all NON-QUANTITATIVE tests. There's no such thing as a non-quantitative test, it's a lie, an obvious fraud. We're locking everybody down over brainless lies. The only reason they were able to get away with this is because they've turned us into an idiocracy, that was the whole point of the government schools."

"[Mullis] always said you couldn't use [PCR] to diagnose a disease but in this particular clip, he goes directly after Fauci and tells what a liar he is," reported David Knight on 12/10/2020's show.

Knight then played the clip (here: <https://twitter.com/libertytarian/status/1336993923076665346>) where Mullis said, "These guys like Fauci get up there and start talking to me, you know, he doesn't know anything really about anything, and I'd say that to his face. Nothing. The man thinks you can take a blood sample and stick it in an electron microscope and if it's got a virus in there you'd know it. He doesn't understand electron microscopy, and he doesn't understand medicine, and he shouldn't be in the position he's in. Most of those guys up there on the top are just total administrative people, and they don't know anything about what's going on at the bottom. Those guys have an agenda, which is not what we would like them to have, being that we pay for them to take care of our health in some way. They've got a personal kind of agenda, they make up their own rules, they change them as they go. And Tony Fauci doesn't mind going on television in front of the people who pay his salary and lie directly into the camera."

Knight comments, "Fauci didn't want to have the debate because he only argues from AUTHORITY. Mullis didn't believe that there was a connection between HIV and AIDS and said they're making this connection by misusing his test. He said we all have retroviruses and they're, literally, blowing this way out of proportion. They're amplifying it a TRILLION times, that's what a PCR cycle of 40 does." The FDA requires PCR testing of COVID to be 40 CT (cycle threshold).

"There's an excellent article about Mullis and his conflict with Fauci by Celia Farber (here: <https://uncoverdc.com/2020/04/07/was-the-covid-19-test-meant-to-detect-a-virus/>).

Knight comments, “Mullis didn’t believe that AIDS was caused by HIV, partly because it was barely detectable in AIDS patients. When PCR was used, they were able to see viral particles in quantities they couldn’t see before.”

Farber reports, ”Mullis himself was unimpressed. ‘PCR made it easier to see that certain people are infected with HIV,’ Mullis told Spin in 1992, ‘and some of those people came down with symptoms of AIDS. But that doesn’t begin even to answer the question — Does HIV cause it?’ ”

“Does that sound familiar?” asked Knight. “They misuse the PCR test and all of a sudden we’ve got cases everywhere. They did a complete media blackout of the HIV debate for over 7 years. Just like with vaccines right now.”

“Remember that the first thing Fauci did as director of the NIH was to make sure that BigPharma had legal immunity for any damage from vaccines. And remember, this was less than 10 years after we’d been rushed into a swine flu vaccine over a fake pandemic and a lot of people were injured by it. That was the reason he had to do it, it had nothing to do with science, it’s all about politics and money.”

But Fauci also took the reins of NIH’s infectious diseases as AIDS/HIV was pushed to the front by him and by media.

Mullis said “The mystery of [AIDS] has been generated by the \$2 billion a year they spend on it. You take any other virus, and you spend \$2 billion, and you can make up some great mysteries about it too.”

Knight compares the financial incentives of the AIDS industry in 1990s with GreatReset financial and political incentives with COVID. “What if you spend \$20 billion on it? What if you were to reorder society and take everything from everyone over it? What if the pot at the end of all this is worth TENS of TRILLIONS of dollars to the bankers, globalists, and the politicians who work for them? For TRILLIONS of dollars, they could reset the whole world.” And all it takes is magnifying a virus a trillion times with a PCR of 40 CT.

“There are many parallels between what Fauci did with AIDS and what he’s doing with COVID. Mullis pointed out that the misuse of his test was just being done because there’s money involved. For 7-years the media stopped anyone questioning what Fauci said about AIDS. They’ve been censoring the debate over vaccines for quite some time and they’re going to step it up. YouTube was bragging about how they’re going to pull down any videos of anyone who questions the election now.”

“It’s a clear violation of the First Amendment, they’re taking our right to know, to debate. These people don’t want to debate, Mullis was saying he’d challenged Fauci but he wouldn’t show up. They will control the press, just like they did a blackout on AIDS, they’ll do a blackout on this vaccine,” concluded Knight.

# Peer Reviewed Published Research Studies on Wi-Fi and 2.4 GHz Wireless Frequencies

Many people ask “What research has been done on Wi-Fi frequencies? Do we know that they are as harmful as cell phone radiation frequencies?”

There are several research studies done on W-Fi specifically that have found adverse effects. However it is important to recognize that Wi-Fi is radio frequency radiation. Almost all the wireless frequencies long used by the public are categorized as radio frequency radiation.

People have not been using Wi-Fi for as long as they have been using cell phones, so the research on humans that has looked at long term use of cell phones is very important to understand the long term health risks from wireless and Wi-Fi.

A 2017 study [“Measurements of Radiofrequency Radiation with a body-borne exposimeter in Swedish schools with Wi-Fi”](#) concluded that, “The risk for cancer may be accentuated for children partly because of their likely longer life-time use of wireless devices, but also since their smaller size and thinner skull bone give higher RF radiation to the brain. Children are also growing and have more immature cells which can be more sensible to RF radiation.” This study higher RF levels when students streamed videos.

[Lahham 2019](#) followed adults from the West Bank, Palestine and found their total daily exposure from all radiofrequency electromagnetic field sources varied widely depending on their location, the mobile network they use, their activities, and their mode of transportation. The main contribution to the mean exposure was from WiFi 2G (45%), GSM900 uplink (19%), GSM900 downlink, and FM radiobroadcasting (each by 11%). GSM1800, UMTS2100, WiFi 5G, DECT, TETRA, WiMAX, and TV bands all together contributed 14%. During different activities, participants were exposed to the highest exposure level while traveling and to the lowest exposure while they were sleeping.

A [2019 publication](#) in the industry journal Building and Environment summarizes the scientific evidence showing harmful effects at low levels- well below government limits and details best practices in buildings to reduce radiofrequency as including wired technology instead of Wi-Fi, and corded phones in buildings.

The World Health Organization [International Agency for the Research on Cancer’s classification](#) of wireless radiofrequency frequencies a Class 2B carcinogen includes wireless radiation from any transmitting source such as cellphones, baby monitors, tablets, cell towers, radar, other wifi, etc. The radiofrequency classification applies to RF-EMF in the range of 30 KHz to 300 GHz emitted from any device. Cell phone frequencies commonly start at 900 MHz (with some cell phones having up to 7 antennas all at different frequencies) and Wi-Fi device frequencies are at 2.45 GHz and 5GHz.

A study entitled [Radiofrequency at 2.45 GHz increases toxicity, pro-inflammatory and pre-apoptotic activity caused by black carbon in the RAW 264.7 macrophage cell line](#) published in Science of the Total Environment found a sub thermal exposure of 2.45 GHz – the frequency used in Wi-Fi- combined with fine/coarse black carbon prolong innate and inflammatory immune responses. “Radiofrequency (RF) dramatically increased BC-induced toxicity at high doses in the first 24 h and toxicity levels remained high 72 h later for all doses.” The paper concludes, “Our results indicate that the interaction of BC and RF modifies macrophage immune response, activates apoptosis, and accelerates cell toxicity, by which it can activate the induction of hypersensitivity reactions and autoimmune disorders.”

Many scientists now conclude that the [scientific evidence](#) is [substantial](#) enough to conclude that radiofrequency radiation (including radiation from cell phones, Wi-Fi and other wireless devices) is a human carcinogen.

While cell phones localize the highest microwave exposure to the brain, Wi-Fi exposures are often localized with more intense exposures to the abdomen, leg and chest area. However this is not always the case as some people sleep in rooms with Wi-Fi baby monitors, Wi-Fi routers or Wi-Fi gaming devices near their pillow. Wi-Fi printers may be in offices next to a person's desk and most people are unaware that they transmit continuously.

Wi-Fi devices emit continuous radiation bursts, just like cell phones, as they always stay in contact with their router or base station. The Wi-Fi radiation patterns can be quite erratic when the device is in use and this can further impact biological effects.

### **Compendium of Research studies on Wi-Fi and 2.4 GHz Wireless Frequencies**

Pall M., [Wi-Fi is an important threat to human health](#), Environmental Research Volume 164, July 2018, Pages 405-416

- (Review paper) "Repeated Wi-Fi studies show that Wi-Fi causes oxidative stress, sperm/testicular damage, neuropsychiatric effects including EEG changes, apoptosis, cellular DNA damage, endocrine changes, and calcium overload. Each of these effects are also caused by exposures to other microwave frequency EMFs, with each such effect being documented in from 10 to 16 reviews." Wi-Fi is thought to act via voltage-gated calcium channel activation.

Clegg, Frank M. et al. 2019. ["Building Science and Radiofrequency Radiation:What Makes Smart and Healthy Buildings."](#) Building and Environment: 106324.

Fahmy, H., & Mohammed, F. (2020). [Hepatic injury induced by radio frequency waves emitted from conventional Wi-Fi devices in Wistar rats.](#) *Human & Experimental Toxicology*. <https://doi.org/10.1177/0960327120946470>

- The present data revealed that Wi-Fi exposure leads to severe oxidative stress in the rat liver. Furthermore, Wi-Fi exposure resulted in deleterious effects in the liver function and alters its molecular structure. Moreover, severe histological and ultrastructural alterations are reported in the hepatic tissues points to hepatotoxic effects induced by Wi-Fi exposure.

Ibitayo, A., Afolabi, O., Akinyemi, A., Ojiezeh, T., Adekoya, K. and Ojewunmi, O., 2017. [RAPD Profiling, DNA Fragmentation, and Histomorphometric Examination in Brains of Wistar Rats Exposed to Indoor 2.5 Ghz Wi-Fi Devices Radiation.](#) BioMed Research International, 2017, pp.1-6.

- The present study was conducted to investigate the injurious effect of radiofrequency emissions from installed Wi-Fi devices in brains of young male rats. Animals were divided into four equal groups; group 1 served as control while groups 2, 3, and 4 were exposed to 2.5 Ghz at intervals of 30, 45, and 60 consecutive days with free access to food and water ad libitum. Alterations in harvested brain tissues were confirmed by histopathological analyses which showed vascular congestion and DNA damage in the brain was assayed using agarose gel electrophoresis. Histomorphometry analyses of their brain tissues showed perivascular congestion and tissue damage as well."

Adejoke Olukayode Obajuluwa, Ayodele Jacob Akinyemi, Olakunle Bamikole Afolabi, Khalid Adekoya, Joseph Olurotimi Sanya, Azeez Olakunle Ishola, [Exposure to radio-frequency electromagnetic waves alters acetylcholinesterase gene expression, exploratory and motor coordination-linked behaviour in male rats.](#) Toxicology Reports, Volume 4, 2017, Pages 530-534, ISSN 2214-7500,

- “The results revealed that WiFi exposure caused a significant increase in anxiety level and affect locomotor function. Furthermore, there was a significant decrease in AChE activity with a concomitant increase in AChE mRNA expression level in WiFi exposed rats when compared with control. In conclusions, these data showed that long term exposure to WiFi may lead to adverse effects such as neurodegenerative diseases as observed by a significant alteration on AChE gene expression and some neurobehavioral parameters associated with brain damage.”

Afolabi Olakunle Bamikole, Obajuluwa Adejoke Olukayode, Tiwa Obajuluwa, Okiki Pius, Oloyede Omotade Ibidun, Fadaka Oluwaseun Adewale, Ojo Oluwafemi Adeleke. [Exposure to a 2.5 GHz Non-ionizing Electromagnetic Field Alters Hematological Profiles, Biochemical Parameters, and Induces Oxidative Stress in Male Albino Rats](#) [J]. *Biomedical and Environmental Sciences*, 2019, 32(11): 860-863.

- In the current study, alterations were noted in hematological and biochemical parameters of groups exposed to a 2.5 GHz EMF emission from an indoor Wi-Fi device over a period of 4-8 weeks.

Hedendahl, Lena K., et al. [“Measurements of Radiofrequency Radiation with a body-borne exposimeter in Swedish schools with Wi-Fi.”](#) *Frontiers in Public Health* 5 (2017): 279.

- The environmental exposure to RF radiation in some schools is higher than reported levels for non-thermal biological effects. In order to reduce children’s exposure to RF radiation, schools should prefer wired network connections, allow laptop, tablets, and mobile phone usage only in flight mode and deactivate Wi-Fi access points when internet is not needed for learning purposes.
- All values were far below International Commission on Non-Ionizing Radiation Protection’s (ICNIRP) reference values, but most mean levels measured were above the precautionary target level of 3–6  $\mu\text{W}/\text{m}^2$  as proposed by the Bioinitiative Report ...however the ICNIRP guidelines are based on short-term heating (thermal) effects, and are therefore not relevant to decide on the appropriateness of long-term exposure.
- “The risk for cancer may be accentuated for children partly because of their likely longer life-time use of wireless devices, but also since their smaller size and thinner skull bone give higher RF radiation to the brain. Children are also growing and have more immature cells which can be more sensible to RF radiation.”

Li ZQ et al., [Testing of behavioral and cognitive development in rats after prenatal exposure to 1800 and 2400 MHz radiofrequency fields.](#) *J Radiat Res.* 2020 Mar 23;61(2):197-206.

- The objective of the study was to explore the effects of behavioral and cognitive development in rats after prenatal exposure to 1800 and 2400 MHz radiofrequency fields. The 1800 MHz + WiFi group displayed an increased trend in path length, duration, entry times and stationary time in the central area. In both the 1800 MHz + WiFi and WiFi groups, NR2A and NR2B expression was down-regulated, while NR2D, NR3A and NR3B were up-regulated. Moreover, NR1 and NR2C in the WiFi group were also up-regulated. Prenatal exposure to 1800 MHz and WiFi radiofrequency may affect the behavioral and cognitive development of offspring rats, which may be associated with altered mRNA expression of NMDARs in the hippocampus.

Siervo, B. [Numerical evaluation of human exposure to WiMax patch antenna in tablet or laptop,](#) *Bioelectromagnetics.* 2018

- This paper reports the estimation of the interaction between an E - shaped patch antenna (3.5 GHz) and human models, by means of finite - difference time - domain (FDTD) method. Specifically, four different human models (young adult male, young adult female, pre - teenager female, male child) in different exposure conditions (antenna at different distances from the human model, in different positions, and

orientations) were considered and whole - body, 10 and 1 g local SAR and magnetic field value (Bmax) were evaluated. From our results, in some worst - case scenarios involving male and female children's exposure, the maximum radiofrequency energy absorption (hot spots) is located in more sensitive organs such as eye, genitals, and breast

Gupta SK, Patel SK, Tomar MS, Singh SK, Mesharam MK, Krishnamurthy S. [Long-term exposure of 2450 MHz electromagnetic radiation induces stress and anxiety like behavior in rats.](#) Neurochemistry International. Publ. online Apr 4, 2019.

- EMR-2450 MHz induces stress and aggravates anxiety-like symptoms in rats. Exposure of EMR-2450 MHz increases plasma corticosterone level and, expression of CRH-2 and GR in amygdala. Increased expression of cytochrome-C and caspase-9 indicating mitochondrial dysfunction and activation of apoptosis. Change in expression of mitochondrial Bax: Bcl2 ratio indicating modulation of apoptosis. EMR-2450 MHz exposure causes both amygdalar necrotic and apoptotic cell death.

Sueiro-Benavides RA, Leiro-Vidal JM, Salas-Sánchez AÁ, Rodríguez-González JA, Ares-Pena FJ, López-Martín ME. [Radiofrequency at 2.45 GHz increases toxicity, pro-inflammatory and pre-apoptotic activity caused by black carbon in the RAW 264.7 macrophage cell line.](#) Sci Total Environ. 2020 Oct 4:142681. doi: 10.1016/j.scitotenv.2020.142681. Epub ahead of print. PMID: 33071139.

- Environmental factors such as air pollution by particles and/or electromagnetic fields (EMFs) are studied as harmful agents for human health.
- We analyzed whether the combined action of EMF with fine and coarse black carbon (BC) particles induced cell damage and inflammatory response in RAW 264.7 cell line macrophages exposed to 2.45 GHz in a gigahertz transverse electromagnetic (GTEM) chamber at sub-thermal specific absorption rate (SAR) levels. Radiofrequency (RF) dramatically increased BC-induced toxicity at high doses in the first 24 h and toxicity levels remained high 72 h later for all doses.
- Our results indicate that the interaction of BC and RF modifies macrophage immune response, activates apoptosis, and accelerates cell toxicity, by which it can activate the induction of hypersensitivity reactions and autoimmune disorders.

Shahin, Saba, et al. [“2.45 GHz Microwave radiation impairs hippocampal learning and spatial memory: Involvement of local stress mechanism induced suppression of iGluR/ERK/CREB signaling.”](#) *Toxicological Sciences* (2017).

- “Our findings led us to conclude that 2.45 GHz MW radiation exposure induced local stress suppresses signaling mechanism(s) of hippocampal memory formation.”

Hassanshahi, A., et al. [“The effect of Wi-Fi electromagnetic waves in unimodal and multimodal object recognition tasks in male rats.”](#) *Neurological Sciences*, 2017, pp. 1-8.

- This study aimed to investigate the effect of 2.4 GHz Wi-Fi radiation (12 h/day for 30 days) on multisensory integration in male rats. Results demonstrated that rats in Wi-Fi exposure groups could not discriminate significantly between the novel and familiar objects in any of the standard SOR, tactile SOR, visual SOR, and CMOR tests and the expression of M1 receptors increased following Wi-Fi exposure. In conclusion, results of this study showed that chronic exposure to Wi-Fi electromagnetic waves might impair both unimodal and cross-modal encoding of information.

Akdag, M.Z., et al. [“Does prolonged radiofrequency radiation emitted from Wi-Fi devices induce DNA damage in various tissues of rats?”](#) *Journal of Chemical Neuroanatomy*, vol. 75, pt. B, 2016, pp. 116-22.

- The purpose of this study was to reveal whether long term exposure (over a year) of 2.4GHz frequency RF radiation will cause DNA damage of different tissues such as brain, kidney, liver, and skin tissue and testicular tissues of rats. Based on the DNA damage results determined by the single cell gel electrophoresis (Comet) method, it was found that the % tail DNA values of the brain, kidney, liver, and skin tissues of the rats in the experimental group increased more than those in the control group. The increase of the DNA damage in all tissues was not significant ( $p>0.05$ ), however the increase of the DNA damage in rat testes tissue was significant ( $p<0.01$ ). In conclusion, long-term exposure to 2.4GHz RF radiation (Wi-Fi) does not cause DNA damage of the organs investigated in this study except testes indicating that testes are more sensitive organ to RF radiation.

Kuybulu, A.E., et al. [“Effects of long-term pre- and post-natal exposure to 2.45GHz wireless devices on developing male rat kidney.”](#) Renal Failure, vol. 38, no. 4, 2016, pp. 571-80.

- The aim of the present study was to investigate oxidative stress and apoptosis in kidney tissues of male Wistar rats that pre- and postnatally exposed to 2.45 GHz wireless electromagnetic field (EMF) for 1 h/day until puberty. Based on this study, it is thought that chronic pre- and post-natal period exposure to wireless internet frequency of EMF may cause chronic kidney damages; staying away from EMF source in especially pregnancy and early childhood period may reduce negative effects of exposure on kidney.

Celik, O., M.C. Kahya and M. Naziroglu. [“Oxidative stress of brain and liver is increased by Wi-Fi \(2.45GHz\) exposure of rats during pregnancy and the development of newborns.”](#) Journal of Chemical Neuroanatomy, vol. 75, pt. B, 2015, pp. 134-9.

- An excessive production of reactive oxygen substances (ROS) and reduced antioxidant defence systems resulting from electromagnetic radiation (EMR) exposure may lead to oxidative brain and liver damage and degradation of membranes during pregnancy and development of rat pups. In the EMR groups, lipid peroxidation levels in the brain and liver were increased following EMR exposure; however, the glutathione peroxidase (GSH-Px) activity, and vitamin A, vitamin E and  $\beta$ -carotene concentrations were decreased in the brain and liver. Glutathione (GSH) and vitamin C concentrations in the brain were also lower in the EMR groups than in the controls; however, their concentrations did not change in the liver. In conclusion, Wi-Fi-induced oxidative stress in the brain and liver of developing rats was the result of reduced GSH-Px, GSH and antioxidant vitamin concentrations. Moreover, the brain seemed to be more sensitive to oxidative injury compared to the liver in the development of newborns.

Ciftci, Z.Z., et al. [“Effects of prenatal and postnatal exposure of Wi-Fi on development of teeth and changes in teeth element concentration in rats.”](#) Biological Trace Element Research, vol.163, no. 1-2, 2015, pp. 193-201.

- The present study determined the effects of prenatal and postnatal exposure to 2.45 GHz Wi-Fi-induced electromagnetic radiation (2h/day for 21 days during pregnancy and 21 days during lactation) on tooth and surrounding tissue development as well as the element levels in growing rats. Histological and immunohistochemical examinations between the experimental and control groups showed that exposure to 2.45 GHz EMR for 2 h per day does not interfere with the development of teeth and surrounding tissues. However, there were alterations in the elemental composition of the teeth, especially affecting such oxidative stress-related elements as copper, zinc, and iron, suggesting that short-term exposure to Wi-Fi-induced EMR may cause an imbalance in the oxidative stress condition in the teeth of growing rats.

Cig, B. and M. Naziroglu. [“Investigation of the effects of distance from sources on apoptosis, oxidative stress and cytosolic calcium accumulation via TRPV1 channels induced by mobile phones and Wi-Fi in breast cancer cells.”](#) *Biochemica et Physica Acta*, vol. 1848, pt B, 2015, pp. 2756-65.

- We aimed to investigate the effects of distance from sources on calcium signaling, cytosolic ROS production, cell viability, apoptosis, plus caspase-3 and -9 values induced by mobile phones and Wi-Fi in breast cancer cells. The cytosolic ROS production, Ca<sup>2+</sup> concentrations, apoptosis, caspase-3 and caspase-9 values were higher in groups exposed to 900 MHz, 1800 MHz and 2450 MHz compared to controls at 0 cm, 1 cm and 5 cm distances although cell viability (MTT) values were increased by the distances. There was no statistically significant difference in the values between control, 20 and 25 cm. Wi-Fi and mobile phone EMR placed within 10 cm of the cells induced excessive oxidative responses and apoptosis via TRPV1-induced cytosolic Ca<sup>2+</sup> accumulation in the cancer cells. Using cell phones and Wi-Fi sources which are farther away than 10 cm may provide useful protection against oxidative stress, apoptosis and overload of intracellular Ca<sup>2+</sup>.

Dasdag, S., et al. [“Effect of long-term exposure of 2.4 GHz radiofrequency radiation emitted from Wi-Fi equipment on testes functions.”](#) *Electromagnetic Biology and Medicine*, vol. 34, no. 1, 2015, pp. 37-42.

- The aim of this study was to investigate long-term effects of 2.4 GHz radiofrequency radiation (24 h/day for 1 year) emitted from a Wireless Fidelity (Wi-Fi) system on the testes of male rats. Results showed that sperm head defects increased in the exposure group ( $p < 0.05$ ) while weight of the epididymis and seminal vesicles, seminiferous tubules diameter and tunica albuginea thickness were decreased in the exposure group ( $p < 0.01$ ,  $p < 0.001$ ,  $p < 0.0001$ ). However, other alterations of other parameters were not found significant ( $p > 0.05$ ). We suggest Wi-Fi users to avoid long-term exposure of RF emissions from Wi-Fi equipment.

Dasdag, S., et al. [“Effects of 2.4 GHz radiofrequency radiation emitted from Wi-Fi equipment on microRNA expression in brain tissue.”](#) *International Journal of Radiation Biology*, vol 91, no. 7, 2015, pp. 555-61.

- The aim of this study was to investigate the long-term effects of 2.4 GHz radiofrequency radiation (24h/day for 12 months) emitted from a Wireless Fidelity (Wi-Fi) system on some of the miRNA in brain tissue in male rats. The results revealed that long-term exposure of RFR radiation can alter expression of some of the miRNAs, indicating that this type of exposure may lead to adverse effects such as neurodegenerative diseases originated from the alteration of some miRNA expression and more studies should be devoted to the effects of RF radiation on miRNA expression levels.

Deshmukh, P.S., et al. [“Cognitive impairment and neurogenotoxic effects in rats exposed to low-intensity microwave radiation.”](#) *International Journal of Toxicology*, vol. 34, no. 3, 2015, pp. 284-90.

- The present study aimed to investigate the effects of chronic low-intensity microwave exposure (900, 1800 or 2450 MHz for 180 days) on cognitive function, heat shock protein 70 (HSP70), and DNA damage in the rat brain. The results showed declined cognitive function, elevated HSP70 level, and DNA damage in the brain of microwave-exposed animals. The results indicated that, chronic low-intensity microwave exposure in the frequency range of 900 to 2450 MHz may cause hazardous effects on the brain.

Megha, K., et al. [“Low intensity microwave radiation induced oxidative stress, inflammatory response and DNA damage in rat brain.”](#) *Neurotoxicology*, vol. 51, 2015, pp. 158-65.

- The present study was undertaken to determine the influence of low intensity microwave radiation (900, 1800, or 2450 MHz for 2h/day, 5days/week, for 60 days) on oxidative stress, inflammatory response and DNA damage in rat brain. Low intensity microwave exposure resulted in a frequency dependent significant increase in oxidative stress markers, reduced levels of GSH and SOD, increased levels of pro-inflammatory cytokines, and significant DNA damage in microwave exposed groups compared to controls. In conclusion, the present study suggests that low intensity microwave radiation induces oxidative stress, inflammatory response and DNA damage in brain by exerting a frequency dependent effect. The study also indicates that increased oxidative stress and inflammatory response might be the factors involved in DNA damage following low intensity microwave exposure.

Misa-Agustiño, M.J. et al. [“Exposure to non-ionizing radiation provokes changes in rat thyroid morphology and expression of HSP-90.”](#) *Experimental Biology and Medicine*, vol. 240, no. 9, 2015, pp. 1123-35.

- Non-ionizing radiation at 2.45 GHz may modify the morphology and expression of genes that codify heat shock proteins (HSP) in the thyroid gland. The present study used a diathermy model – the therapeutic application of non-ionizing radiation – on laboratory rats subjected to maximum exposure non-ionizing radiation (30 min, 10 times in two weeks) in the left front leg, in order to study the effects of radiation on the nearby thyroid tissue. Ninety minutes after radiation with the highest SAR, the central and peripheral follicles presented increased size and the thickness of the peripheral septa had decreased. Twenty-four hours after radiation, only peripheral follicles radiated at 12 W were found to be smaller. Morphological changes in the thyroid tissue may indicate a glandular response to acute or repeated stress from radiation in the hypothalamic-pituitary-thyroid axis.

Misa-Augustiño, M.J., et al. [“EMF radiation at 2450 MHz triggers changes in the morphology and expression of heat shock proteins and glucocorticoid receptors in rat thymus.”](#) *Life Sciences*, vol. 127, 2015, pp. 1-11.

- This study analyzed cellular stress levels in rat thymus after exposure to a 2.45 GHz radio frequency (RF) using an experimental diathermic model in a Gigahertz Transverse Electromagnetic (GTEM) chamber. The thymus tissue presented several morphological changes, including increased distribution of blood vessels along with the appearance of red blood cells and hemorrhagic reticuloepithelial cells, while the glucocorticoid receptors presented greater immunomarking on the thymic cortex in exposed animals. These results indicate that non-ionizing sub-thermal radiation causes changes in the endothelial permeability and vascularization of the thymus, and is a tissue-modulating agent for Hsp90 and GR.

Saili, L., et al. [“Effects of acute exposure to WIFI signals \(2.45GHz\) on heart variability and blood pressure in Albinos rabbit.”](#) *Environmental Toxicology and Pharmacology*, vol. 40, no. 2, 2015, pp. 600-5.

- Electrocardiogram and arterial pressure measurements were studied under acute exposures to WIFI (2.45GHz) during one hour in adult male rabbits. Acute exposure of rabbits to WIFI increased heart frequency (+22%) and arterial blood pressure (+14%). Moreover, analysis of ECG revealed that WIFI induced a combined increase of PR and QT intervals, but failed to alter maximum amplitude and P waves. After intravenously injection of dopamine (0.50ml/kg) and epinephrine (0.50ml/kg) under acute exposure to RF we found that, WIFI alter catecholamines (dopamine, epinephrine) action on heart variability and blood pressure compared to control. These results suggest for the first time, as far as we know, that exposure to WIFI affect heart rhythm, blood pressure, and catecholamines efficacy on cardiovascular system; indicating that radiofrequency can act directly and/or indirectly on cardiovascular system.

Sangun, O., et al. 2015. [“The effects of long-term exposure to a 2450 MHz electromagnetic field on growth and pubertal development in female Wistar rats.”](#)Electromagnetic Biology and Medicine, vol. 34, no. 1, 2015, pp. 63-7.

- The aim of this study was to investigate the effects of prenatal and postnatal 2450 MHz electromagnetic field exposure (1h/day from intrauterine or postnatal period) on the growth and development of female Wistar rats. Birth masses of the groups were similar ( $p > 0.05$ ), however mass gain per day was significantly lower and the puberty was significantly later in the prenatal group. Brain and ovary TOS and OSI values in the prenatal group were significantly increased ( $p < 0.05$ ) compared to the control group and serum LH levels of the prenatal and postnatal groups were increased, although serum FSH, and E2 values did not differ among the groups ( $p > 0.05$ ). Histological examinations of the specimens revealed no statistically significant difference between the groups ( $p > 0.05$ ). Exposure to 2450 MHz EMF, particularly in the prenatal period, resulted in postnatal growth restriction and delayed puberty in female Wistar rats. Increased TOS and OSI values in the brain and ovary tissues can be interpreted as a sign of chronic stress induced by EMF.

Saygin, M., et al. [“Impact of L-carnitine and selenium treatment on testicular apoptosis in rats exposed to 2.45GHz microwave energy.”](#)West Indian Medicine Journal, vol 64, no. 2, 2015, pp. 55-61.

- This study investigated if supplemental selenium (Se) and L-carnitine may reduce the adverse effect 2.45 GHz electromagnetic radiation can have on testicular apoptosis using rats as a study animal. Electromagnetic radiation exposure resulted in testicular apoptosis in rats, mainly by the intrinsic pathways by down-regulated expression of caspase-8. Reduction in the activation of the intrinsic pathway of apoptosis was found higher with selenium administration compared with L-carnitine administration.

Saygin, M. et al. [“Impact of 2.45GHz microwave radiation on the testicular inflammatory pathway biomarkers in young rats: The role of gallic acid.”](#)Environmental Toxicology, 2015.

- The aim of this study was to investigate electromagnetic radiation (EMR) transmitted by wireless devices (2.45 GHz, 3h/day for 30 days), which may cause physiopathological or ultrastructural changes, in the testes of rats and address if the supplemental gallic acid (GA) may reduce these adverse effects. EMR only group was shown to have higher oxidative stress, decreased testosterone and VEGF levels, increased prostaglandin E2 and CGRP, as well as decreased numbers of spermatozoa. Long term EMR exposure resulted in testicular physiopathology via oxidative damage and inflammation. GA may have ameliorative effects on the prepubertal rat testes physiopathology.

Farah Hanan Fathihah Jaffar, Khairul Osman, Nur Hilwani Ismail, Kok-Yong Chin, Siti Fatimah Ibrahim, [Adverse Effects of Wi-Fi Radiation on Male Reproductive System: A Systematic Review](#), The Tohoku Journal of Experimental Medicine, 2019, Volume 248, Issue 3, Pages 169-179, Released July 26, 2019, Online ISSN 1349-3329

- Sperm count, motility and DNA integrity were the most affected parameters when exposed to RF-EMR emitted by Wi-Fi transmitter. Unfortunately, sperm viability and morphology were inconclusive. Structural and/or physiological analyses of the testes showed degenerative changes, reduced testosterone level, increased apoptotic cells, and DNA damage. These effects were mainly due to the elevation of testicular temperature and oxidative stress activity. In conclusion, exposure towards 2.45 GHz RF-EMR emitted by Wi-Fi transmitters is hazardous on the male reproductive system.

Shahin, S., et al. [“2.45GHz microwave radiation impairs learning and spatial memory via oxidative/nitrosative stress induced p53 dependent/independent hippocampal apoptosis: molecular basis and underlying mechanism.”](#) Toxicology Science, vol. 148, no. 2, 2015, pp. 380-99.

- This study was performed to understand the effect of short (15 days) and long-term (30 and 60 days) low-level 2.45 GHz MW radiation exposure on hippocampus with special reference to spatial learning and memory and its underlying mechanism in Swiss strain male mice, *Mus musculus*. We observed that, short-term as well as long-term 2.45 GHz MW radiation exposure increases the oxidative/nitrosative stress leading to enhanced apoptosis in hippocampal subfield neuronal and nonneuronal cells. Present findings also suggest that learning and spatial memory deficit which increases with the increased duration of MW exposure (15 < 30 < 60 days) is correlated with a decrease in hippocampal subfield neuronal arborization and dendritic spines. These findings led us to conclude that exposure to CW MW radiation leads to oxidative/nitrosative stress induced p53-dependent/independent activation of hippocampal neuronal and nonneuronal apoptosis associated with spatial memory loss.

Shokri, S., et al. [“Effects of Wi-Fi \(2.45 GHz\) exposure on apoptosis, sperm parameters and testicular histomorphometry in rats: a time course study.”](#) Cell Journal, vol. 17, no. 2, 2015, pp. 322-31.

- This study aimed to investigate the major cause of male infertility during short- (1h/day for 2 months) and long-term (7h/day for 2 months) exposure of 2.45 GHz Wi-Fi radiation. Both 1-hour and 7-hour groups showed a decrease in sperm parameters in a time dependent pattern and the number of apoptosis-positive cells and caspase-3 activity increased in the seminiferous tubules of exposed rats. The seminal vesicle weight reduced significantly in both 1-hour or 7-hour groups in comparison to the control group. Researchers concluded that there should be a major concern regarding the time dependent exposure of whole-body to the higher frequencies of Wi-Fi networks existing in the vicinity of our living places.

Taheri, M., et al. [“Klebsiella pneumonia, a Microorganism that Approves the Non-linear Responses to Antibiotics and Window Theory after Exposure to Wi-Fi 2.4 GHz Electromagnetic Radiofrequency Radiation.”](#) Journal of Biomedical and Physical Engineering, vol. 5, no. 3, 2015, pp. 115–20.

- This study was aimed at investigating the alteration of antibiotic resistance of *Klebsiella pneumonia*, after exposure to Wi-Fi 2.4 GHz electromagnetic radiofrequency radiation from a Wi-Fi router for 3, 4.5 or 8 hours. The findings of this study show a statistically significant rise in the sensitivity of *Klebsiella pneumoniae* to different antibiotics after 4.5 hours of exposure to 2.4 GHz Wi-Fi radiation, followed by a fall after 8 hours of exposure. These observations can be interpreted by the concept of non-linearity in the responses of *Klebsiella pneumoniae* to different antibiotics after exposure to electromagnetic radiofrequency radiation.

Yildirim, M.E., et al. [“What is harmful for male fertility: Cell phone or the wireless internet?”](#) Kaohsiung Journal of Medical Science, vol 31, no. 9, 2015, pp. 480-4.

- This study aimed to assess the potential harmful effects of radiofrequency-electromagnetic radiation on sperm parameters. There was no significant difference between sperm counts and sperm morphology excluding sperm motility, due to mobile phone usage period, however total motile sperm count and the progressive motile sperm count decreased due to the increase of internet usage and progressive motile sperm count also decreased with wireless Internet usage compared with the wired Internet connection usage.

Yüksel, M. et al. [“Long-term exposure to electromagnetic radiation from mobile phones and Wi-Fi devices decreases plasma prolactin, progesterone, and estrogen levels but increases uterine oxidative stress in pregnant rats and their offspring.”](#) *Endocrine*, vol. 52, no. 2, 2015, pp. 352-62.

- This study investigated the effects of mobile phone (900 and 1800 MHz)- and Wi-Fi (2450 MHz)-induced electromagnetic radiation (EMR) exposure (60 min/day during pregnancy and growth periods) on uterine oxidative stress and plasma hormone levels in pregnant rats and their offspring. Although EMR exposure decreased the prolactin, estrogen, and progesterone levels in the plasma of maternal rats and their offspring, EMR-induced oxidative stress in the uteri of maternal rats increased during the development of offspring. Mobile phone- and Wi-Fi-induced EMR may be one cause of increased oxidative uterine injury in growing rats and decreased hormone levels in maternal rats.

Ghazizadeh, V. and M. Naziroglu. [“Electromagnetic radiation \(Wi-Fi\) and epilepsy induce calcium entry and apoptosis through activation of TRPV1 channel in hippocampus and dorsal root ganglion of rats.”](#) *Metabolic Brain Disease*, vol. 29, no. 3, 2014, pp. 787-99.

- The present study tested the effects of Wi-Fi (2.45 GHz for 1h) exposure on Ca(2+) influx, oxidative stress and apoptosis through TRPV1 channel in the murine dorsal root ganglion (DRG) and hippocampus of pentylenetetrazol (PTZ)-induced epileptic rats. The cytosolic free Ca(2+), reactive oxygen species production, apoptosis, mitochondrial membrane depolarization, caspase-3 and -9 values in hippocampus were higher in the PTZ group than in the control although cell viability values decreased. The Wi-Fi exposure induced additional effects on the cytosolic Ca(2+) increase. However, pretreatment of the neurons with CPZ, results in a protection against epilepsy-induced Ca(2+) influx, apoptosis and oxidative damages. In conclusion, epilepsy and Wi-Fi in our experimental model is involved in Ca(2+) influx and oxidative stress-induced hippocampal and DRG death through activation of TRPV1 channels, and negative modulation of this channel activity by CPZ pretreatment may account for the neuroprotective activity against oxidative stress.

Gürler, H.S. et al, 2014. [“Increased DNA oxidation \(8-OHdG\) and protein oxidation \(AOPP\) by Low level electromagnetic field \(2.45 GHz\) in rat brain and protective effect of garlic.”](#) *International Journal of Radiation Biology*, vol 90, no. 10, 2014, pp. 892-6.

- The purpose of this study was to investigate the oxidative damage and protective effect of garlic (daily 500 mg/kg during study period) on rats exposed to low level of electromagnetic fields (EMF) at 2.45 GHz Microwave radiation (MWR) for 1 h/day for 30 consecutive days. Researchers concluded that low level EMF at 2.45 GHz MWR increases the DNA damage in both brain tissues and plasma of the rats whereas it increases protein oxidation only in plasma. They also be argued that the use of garlic decreases these effects.

Margaritis, L.H. et al. [“Drosophila oogenesis as a bio-marker responding to EMF sources.”](#) *Electromagnetic Biology and Medicine*, vol. 33, no. 3, 2014, pp. 165-89.

- This study used *Drosophila* as model organisms to assess the effects of various EMF sources (short time daily for 3-7 days) on apoptotic cell death of follicles during oogenesis and reproductive capacity (fecundity) decline. Sources included: 900/1800 MHz mobile phone, 1880-1900 MHz wireless base, wireless handset, mobile phone-handset combination, 2.44 GHz wireless network (Wi-Fi), 2.44 GHz bluetooth, 92.8 MHz FM generator, 27.15 MHz baby monitor, 900 MHz CW RF generator and microwave oven's 2.44 GHz RF and magnetic field components. All EMF sources used created statistically significant effects regarding fecundity and cell death-apoptosis induction, even at very low intensity levels well below

ICNIRP's guidelines, suggesting that *Drosophila* oogenesis system is suitable to be used as a biomarker for exploring potential EMF bioactivity.

Meena, R., et al. [“Therapeutic approaches of melatonin in microwave radiations-induced oxidative stress-mediated toxicity on male fertility pattern of Wistar rats.”](#) *Electromagnetic Biology and Medicine*, vol. 33, no. 2, 2014, pp. 81-91.

- The present study aimed to investigate the protective effects of melatonin against oxidative stress-mediated testicular impairment due to long-term exposure (2 h/day for 45 days) of 2.45 GHz Microwave Radiation. Result shows that melatonin prevented oxidative damage biochemically by significant increase ( $p < 0.001$ ) in the levels of testicular LDH-X, decreased ( $p < 0.001$ ) levels of MDA and ROS in testis ( $p < 0.01$ ). Meanwhile, it reversed the effects of MWs on XO, protein carbonyl content, sperm count, testosterone level and DNA fragmentation in testicular cells. These results concluded that the melatonin has strong antioxidative potential against MW induced oxidative stress mediated DNA damage in testicular cells.

Oksay, T., et al. [“Protective effects of melatonin against oxidative injury in rat testis induced by wireless \(2.45 GHz\) devices.”](#) *Andrologia*, vol. 46, no. 1 2014, pp. 65-72.

- The present study was designed to determine the possible protective effects of melatonin on oxidative stress-dependent testis injury induced by 2.45-GHz electromagnetic radiation exposure (60 min/day for 30 days). Lipid peroxidation levels were shown to be higher in melatonin-supplemented group compared to EMR only and controls, as well as reduced glutathione and glutathione peroxidase levels. Vitamin A and E concentrations decreased in exposure group, and melatonin prevented the decrease in vitamin E levels. In conclusion, wireless (2.45 GHz) EMR caused oxidative damage in testis by increasing the levels of lipid peroxidation and decreasing in vitamin A and E levels. Melatonin supplementation prevented oxidative damage induced by EMR and also supported the antioxidant redox system in the testis.

Senavirathna, M.D., et al. [“Nanometer-scale elongation rate fluctuations in the \*Myriophyllum aquaticum\* \(Parrot feather\) stem were altered by radio-frequency electromagnetic radiation.”](#) *Plant Signal Behavior*, vol. 9, no. 4, 2014.

- This study investigated the effect of 2GHz EMR (1h) on the growth dynamics of *Myriophyllum aquaticum* (Parrot feather) by measuring the nanometric elongation rate fluctuation (NERF) using a statistical interferometry technique. After continuous exposure to EMR, *M. aquaticum* plants exhibited a statistically significant reduction in NERF standard deviation, therefore, the reduced NERF was due to a non-thermal effect caused by EMR exposure. The alteration in NERF continued for at least 2.5 h after EMR exposure and no significant recovery was found in post-EMR NERF during the experimental period.

Shahin, S., et al. [“Microwave irradiation adversely affects reproductive function in male mouse, \*Mus musculus\*, by inducing oxidative and nitrosative stress.”](#) *Free Radical Research*, vol 48, no. 5, 2014, pp. 511- 25.

- This study investigated the long-term effects of low-level 2.45GHz MW irradiation (2h/day for 30 days) on the reproductive function of male mice and its mechanism of action. Researchers observed that MW irradiation induced a significant decrease in sperm count and sperm viability along with the decrease in seminiferous tubule diameter, degeneration of seminiferous tubules, reduction in testicular 3 $\beta$  HSD activity and reduction in plasma testosterone levels. Increased expression of testicular i-NOS was observed in the

MW-irradiated group of mice. These adverse reproductive effects suggest that chronic exposure to nonionizing MW radiation may lead to infertility via free radical species-mediated pathway.

Soran, M.-L., et al. [“Influence of microwave frequency electromagnetic radiation on terpene emission and content in aromatic plants.”](#)Journal of Plant Physiology, vol 171, no. 15, 2014, pp. 1436-43.

- Here we studied the influence of microwave irradiation at bands corresponding to wireless router (WLAN) and mobile devices (GSM) on leaf anatomy, essential oil content and volatile emissions in *Petroselinum crispum*, *Apium graveolens* and *Anethum graveolens*. Microwave irradiation resulted in thinner cell walls, smaller chloroplasts and mitochondria, and enhanced emissions of volatile compounds, in particular, monoterpenes and green leaf volatiles. There was a direct relationship between microwave-induced structural and chemical modifications of the three plant species studied. These data collectively demonstrate that human-generated microwave pollution can potentially constitute a stress to the plants.

Tök, L., et al. [“Effects of melatonin on Wi-Fi-induced oxidative stress in lens of rats.”](#)Indian Journal of Ophthalmology, vol. 62, no. 1, 2014, pp. 12-15.

- The present study was designed to determine the effects of 2.45 GHz Wi-Fi exposure (60min/day for 30 days) on the lens oxidant and antioxidant redox systems of rats, as well as the possible protective effects of melatonin on the lens injury induced by electromagnetic radiation (EMR). Results showed poor oxidative toxic effects of one hour of Wi-Fi exposure on the lens in the animals. However, melatonin supplementation in the lens seems to have protective effects on the oxidant system by modulation of GSH-Px activity.

Aynali, G., et al. [“Modulation of wireless \(2.45 GHz\)-induced oxidative toxicity in laryngotracheal mucosa of rat by melatonin.”](#)European Archives of Otorhinolaryngol, vol. 270, no. 5, 2013, pp. 1695-700.

- The aim of this study was to investigate the possible protective role of melatonin on oxidative stress induced by Wi-Fi (2.45 GHz, 60min/day for 28 days) EMR in laryngotracheal mucosa of rat. In comparison to control and sham groups, RFR-exposed animals had higher lipid peroxidation levels and lower glutathione peroxidase levels, while the RFR-exposed animals treated with melatonin had significantly lower lipid peroxidation levels and increased glutathione peroxidase activity compared with controls. Results show that there is an apparent protective effect of melatonin on the Wi-Fi-induced oxidative stress in the laryngotracheal mucosa of rats by inhibition of free radical formation and support of the glutathione peroxidase antioxidant system.

Desmunkh, P.S., et al. [“Detection of Low Level Microwave Radiation Induced Deoxyribonucleic Acid Damage Vis-a-vis Genotoxicity in Brain of Fischer Rats.”](#)Toxicology International, vol. 20, no. 1, 2013, pp. 19-24.

- The present study was designed to investigate the possible DNA damaging effects of low-level microwave radiation (900, 1800, or 2450 MHz for 30 days) in brain of Fischer rats. Researchers demonstrated DNA damaging effects of low level microwave radiation in brain and concluded that low SAR microwave radiation exposure at these frequencies may induce DNA strand breaks in brain tissue.

Eser, O. [“The effect of electromagnetic radiation on the rat brain: an experimental study.”](#) Turkish Neurosurgery, vol. 23, no. 6, 2013, pp. 707-15.

- The aim of this study was to determine the structural changes in the frontal cortex, brainstem and cerebellum in the male rat brain due to electromagnetic wave exposure (900, 1800, 2450 MHz, 1h/day for 2 months). While the histopathological changes in the frontal cortex and brainstem were normal in the control group, there were severe degenerative changes, shrunken cytoplasm and extensively dark pyknotic nuclei in the EMR groups. Biochemical analysis demonstrated that the Total Antioxidative Capacity level was significantly decreased in the EMR groups and also Total Oxidative Capacity and Oxidative Stress Index levels were significantly increased in the frontal cortex, brainstem and cerebellum. Researchers concluded that EMR causes structural changes in the frontal cortex, brainstem and cerebellum and impairs the oxidative stress and inflammatory cytokine system. This deterioration can cause to disease including loss of these areas function and cancer development.

Ozorak, A., et al. [“Wi-Fi \(2.45 GHz\)- and mobile phone \(900 and 1800 MHz\)- induced risks on oxidative stress and elements in kidney and testis of rats during pregnancy and the development of offspring.”](#) Biological Trace Elements Research, vol. 156, no. 103, 2013, pp. 221-9.

- The present study was designed to determine the effects of both Wi-Fi (2.45 GHz)- and mobile phone (900 and 1800 MHz)-induced electromagnetic radiation (60 min/day during pregnancy and growth) on oxidative stress and trace element levels in the kidney and testis of growing rats from pregnancy to 6 weeks of age. In conclusion, Wi-Fi- and mobile phone-induced EMR caused oxidative damage by increasing the extent of lipid peroxidation and the iron level, while decreasing total antioxidant status, copper, and GSH values. Wi-Fi- and mobile phone-induced EMR may cause precocious puberty and oxidative kidney and testis injury in growing rats.

Salah, M.B., et al. [“Effects of olive leaf extract on metabolic disorders and oxidative stress induced by 2.45 GHz WIFI signals.”](#) Environmental Toxicology and Pharmacology, vol. 36, no. 3, 2013, pp. 826-34.

- We investigated the effect of olive leaves extract administration on glucose metabolism and oxidative response in liver and kidneys of rats exposed to 2.45 GHz radiofrequency radiation (1h/day for 21 days). This exposure was shown to induce a diabetes-like status and also decreased the activities of glutathione peroxidase, catalase, superoxide dismutase, and groups thiol amount in liver and kidneys. Olive leaves extract administration (100 mg/kg, ip) in RF-exposed rats prevented glucose metabolism disruption and restored the activities of GPx, CAT and SOD and thiol group amount in liver and kidneys and was able to bring down the elevated levels of MDA in liver but not in kidneys. Our investigations suggested that RF exposure induced a diabetes-like status through alteration of oxidative response, while olive leaves extract was able to correct glucose metabolism disorder by minimizing oxidative stress induced by RF in rat tissues.

Shahin, S., et al. [“2.45 GHz Microwave Irradiation-Induced Oxidative Stress Affects Implantation or Pregnancy in Mice, Mus musculus.”](#) Applied Biochemistry and Biotechnology, vol. 169, 2013, pp. 1727–51.

The present experiment was designed to study the 2.45 GHz low-level microwave irradiation-induced stress response (continuous wave exposure for 2h/day for 45 days) and its effect on implantation or pregnancy in female mice. Researchers observed that implantation sites were affected significantly in MW-irradiated mice as compared to control and in addition to a significant increase in ROS, hemoglobin, RBC and WBC counts, N/L ratio, DNA damage in brain cells, and plasma estradiol concentration, a significant decrease was observed in NO level and antioxidant enzyme activities of MW-exposed mice. Our findings led us to conclude that a low level of MW

irradiation-induced oxidative stress not only suppresses implantation, but it may also lead to deformity of the embryo in case pregnancy continues. We also suggest that MW radiation-induced oxidative stress by increasing ROS production in the body may lead to DNA strand breakage in the brain cells and implantation failure/resorption or abnormal pregnancy in mice.

Akar A., et al. [“Effects of low level electromagnetic field exposure at 2.45 GHz on rat cornea.”](#) International Journal of Radiation Biology, vol. 89, no. 4, 2012, pp. 243-9.

- The purpose of this study was to investigate the effects of low level electromagnetic field (low level-EMF) exposure, as frequently encountered in daily life (2.45 GHz, 2h/day for 21 days), on the normal adult male rat cornea using histological and stereological method. There was no statistically significant difference in mean corneal thicknesses between the groups ( $p > 0.05$ ), however there were statistically differences between the groups with regard to the thickness of anterior epithelium ( $p < 0.05$ ). Results of this preliminary study show that exposure to MW radiation might cause alterations in the rat cornea.

Atasoy H.I. et al. [“Immunohistopathologic demonstration of deleterious effects on growing rat testes of radiofrequency waves emitted from conventional Wi-Fi devices.”](#) Journal of Pediatric Urology, vol. 9, no. 2, 2012, pp. 223-9.

- The objective of this study was to investigate effects of 2.437 GHz radiofrequency radiation (24h/day for 20 weeks) emitted from indoor Wi-Fi Internet access devices on rat testes using histological and immunohistochemical methods. Researchers observed significant increases in serum 8-hydroxy-2'-deoxyguanosine levels and 8-hydroxyguanosine staining in the testes of the experimental group indicating DNA damage due to exposure ( $p < 0.05$ ) as well as decreased levels of catalase and glutathione peroxidase activity in the experimental group, which may have been due to radiofrequency effects on enzyme activity ( $p < 0.05$ ). These findings raise questions about the safety of radiofrequency exposure from Wi-Fi Internet access devices for growing organisms of reproductive age, with a potential effect on both fertility and the integrity of germ cells.

Avendaño, C., et al. [“Use of laptop computers connected to internet through Wi-Fi decreases human sperm motility and increases sperm DNA fragmentation.”](#) Fertility and Sterility, vol. 97, no. 1, 2012, pp. 39-45.

- The objective of this study was to evaluate the effects of radiofrequency radiation emitted from an internet-connected laptop via Wi-Fi for 4 hours on human sperm motility, viability, and DNA fragmentation. Donor sperm samples, mostly normozoospermic, exposed to a wireless internet-connected laptop showed a significant decrease in progressive sperm motility and an increase in sperm DNA fragmentation. We speculate that keeping a laptop connected wirelessly to the internet on the lap near the testes may result in decreased male fertility.

Ceyhan, A.M., et al. [“Protective effects of  \$\beta\$ -glucan against oxidative injury induced by 2.45-GHz electromagnetic radiation in the skin tissue of rats.”](#) Archives of Dermatological Research, vol. 304, no. 7, 2012, 521-527.

- The aim of the present study was to investigate the effect of 2.45-GHz electromagnetic radiation (60min/day for 4 weeks) on the oxidant and antioxidant status of skin and to examine the possible protective effects of  $\beta$ -glucans (50 mg/kg/day before each EMR exposure) against the oxidative injury in male rats. EMR exposure caused a significant increase in malondialdehyde levels and catalase activity, while the activities of superoxide dismutase and glutathione peroxidase decreased in skin tissues. Systemic

$\beta$ -glucan significantly reversed the elevation of MDA levels and the reduction of SOD activities.  $\beta$ -glucan treatment also slightly enhanced the activity of CAT and prevented the depletion of GSH-Px activity caused by EMR, but not statistically significantly. The present study demonstrated the role of oxidative mechanisms in EMR-induced skin tissue damages and that  $\beta$ -glucan could ameliorate oxidative skin injury via its antioxidant properties.

Kesari, K.K., et al. [“Pathophysiology of microwave radiation: effect on rat brain.”](#) Applied Biochemistry and Biotechnology, vol. 166, no. 2, 2012, pp. 379-88.

This study investigated the effect of 2.45 GHz microwave radiation (2 h/day for 45 days) on biomarkers within Wistar rats. A significant decrease ( $P < 0.05$ ) was recorded in the level of pineal melatonin of exposed group as compared with sham exposed, while a significant increase ( $P < 0.05$ ) in creatine kinase, caspase 3, and calcium ion concentration was observed in whole brain of exposed group of animals as compared to sham exposed. The study concludes that a reduction in melatonin or an increase in caspase-3, creatine kinase, and calcium ion may cause significant damage in brain due to chronic exposure of these radiations. These biomarkers clearly indicate possible health implications of such exposures.

Misa-Augustiño, M.J., et al. [“Electromagnetic fields at 2.45 GHz trigger changes in heat shock proteins 90 and 70 without altering apoptotic activity in rat thyroid gland.”](#)Biology Open, vol. 1, no. 9, 2012, pp. 831-39.

- This study examined the possible ability of 2.45 GHz microwave radiation exposure (30 min) to modify the expression of genes that codify heat shock proteins (HSP) in the thyroid gland. Ninety minutes after radiation, HSP-90 and HSP-70 had decreased significantly ( $P < 0.01$ ); Twenty-four hours after radiation, HSP-90 had partially recovered and HSP-70 had recovered completely. There were few indications of lesions in the glandular structure and signs of apoptosis were negative in all radiated animals. The results suggest that acute sub-thermal radiation at 2.45 GHz may alter levels of cellular stress in rat thyroid gland without initially altering their anti-apoptotic capacity.

Nazıroğlu, M., et al. [“2.45-Gz wireless devices induce oxidative stress and proliferation through cytosolic Ca<sup>2+</sup> influx in human leukemia cancer cells.”](#)International Journal of Radiation Biology, vol. 88, no. 6, 2012, pp. 449–56.

- The present study was designed to determine the effects of 2.45 GHz radiation (1, 2, 12, or 24 hours) on the antioxidant redox system, calcium ion signaling, cell count and viability in human leukemia 60 cells. The extent of lipid peroxidation, cytosolic free Ca<sup>2+</sup> and cell numbers were higher in 2.45 GHz groups than in the controls and was time-dependent. 2.45 GHz electromagnetic radiation appears to induce proliferative effects through oxidative stress and Ca<sup>2+</sup> influx although blocking of transient receptor potential melastatin 2 channels by 2-aminoethyl diphenylborinate seems to counteract the effects on Ca<sup>2+</sup> ions influx.

Nazıroğlu, M., et al. [“Melatonin modulates wireless \(2.45 GHz\)-induced oxidative injury through TRPM2 and voltage gated Ca\(2+\) channels in brain and dorsal root ganglion in rat.”](#)Physiology & Behavior, vol. 105, no. 3, 2012, pp. 683-92.

- We aimed to investigate the protective effects of melatonin and 2.45 GHz electromagnetic radiation (60 min/day for 30 days) on brain and dorsal root ganglion (DRG) neuron antioxidant redox system, Ca(2+)

influx, cell viability and electroencephalography (EEG) records in the rat. Lipid peroxidation (LP), cell viability and cytosolic Ca(2+) values in DRG neurons were higher in EMR-exposed groups than in controls, although their concentrations were increased by melatonin, 2-aminoethyl-diphenyl borinate (2-APB), diltiazem and verapamil supplementation. Lower numbers of EEG spikes were recorded in EMR+melatonin groups than in EMR only, while brain cortex vitamin E concentrations were higher in the melatonin-supplemented group. In conclusion, Melatonin supplementation in DRG neurons and brain seems to have protective effects on the 2.45 GHz-induced increase Ca(2+) influx, EEG records and cell viability of the hormone through TRPM2 and voltage gated Ca(2+) channels.

Chaturvedi, C.M., et al. [“2.45GHz \(CW\) microwave irradiation alters circadian organization, spatial memory, DNA structure in the brain cells and blood cell counts of male mice, \*Mus musculus\*.”](#) Progress in Electromagnetics Research B, vol. 29, 2011, pp. 23-42.

- The present study examined the biological effects of continuous wave 2.45 GHz microwave radiation (2h/day for 30 days) in Parkes strain mice. The results show that microwave radiation caused an increase in erythrocyte and leukocyte counts, a significant DNA strand break in brain cells and the loss of spatial memory in mice. This report for the first time provides experimental evidence that continuous exposure to low intensity microwave radiation may have an adverse effect on the brain function by altering circadian system and rate of DNA damage.

Jorge-Mora, T., et al. [“The effects of single and repeated exposure to 2.45 GHz radiofrequency fields on c-Fos protein expression in the paraventricular nucleus of rat hypothalamus.”](#) Neurochemical Research, vol. 36, no. 12, 2011, pp. 2322-32.

- This study investigated the effects of 2.45 GHz microwave radiation (exposed once or repeatedly – ten times in two weeks) on the cellular activation within the paraventricular nucleus of the hypothalamus, extracted from rat brains. High SAR triggered an increase of the c-Fos marker 90 min or 24 h after radiation, and low SAR resulted in c-Fos counts higher than in control rats after 24 h. Repeated irradiation at 3 W increased cellular activation of PVN by more than 100% compared to animals subjected to acute irradiation and to repeated non-irradiated repeated session control animals. The results suggest that PVN is sensitive to 2.45 GHz microwave radiation at non-thermal SAR levels.

Kumar, S., K.K. Kesari and J. Behari. [“The therapeutic effect of a pulsed electromagnetic field on the reproductive patterns of male Wistar rats exposed to a 2.45-GHz microwave field.”](#) Clinics (Sao Paulo), vol. 66, no. 7, 2011, pp. 1237-45.

- This study aimed to examine the therapeutic effects of a 100 Hz pulsed electromagnetic field (2 h/day for 60 days) on the reproductive systems of male Wistar rats (70 days old). The results showed significant increases in caspase and creatine kinase and significant decreases in testosterone and melatonin in the exposed groups. This finding emphasizes that reactive oxygen species (a potential inducer of cancer) are the primary cause of DNA damage. However, pulsed electromagnetic field exposure relieves the effect of microwave exposure by inducing Faraday currents.

Oni, M.O., D.B. Amuda and C.E. Gilbert. [“Effects of radiofrequency radiation from WiFi devices on human ejaculated semen.”](#) International Journal of Recent Research and Applied Studies, vol. 9, no. 2, 2011, pp. 292-4.

- This study was an in-vitro pilot study which established the effect of radiofrequency radiation from 2.4 GHz laptop antenna on human semen. A test of significance between results of semen parameters using Mann-Whitney U- test at 0.05 level of significance showed a significant effect of RFR exposure on sperm concentration, motility and morphology grading.

Papageorgio, C.C., et al. "[Effects of Wi-Fi signals on the p300 component of event-related potentials during an auditory haying task.](#)" Journal of Integrative Neuroscience, vol. 10, no. 2, 2011, pp. 189-202.

The present study focused on the possible gender-related effects of Wi-Fi electromagnetic fields on these processes in human males and females. P300 amplitude values at 18 electrodes were found to be significantly lower in the response inhibition condition than in the response initiation and baseline conditions and independent of this effect, within the response inhibition condition there was also a significant gender X radiation interaction effect of males in comparison to female subjects only at the presence of EMF. In conclusion, the present findings suggest that Wi-Fi exposure may exert gender-related alterations on neural activity associated with the amount of attentional resources engaged during a linguistic test adjusted to induce WM.

Türker, Y., et al. "[Selenium and L-carnitine reduce oxidative stress in the heart of rat induced by 2.45-GHz radiation from wireless devices.](#)" Biological Trace Element Research, vol 143, no. 3, 2011, pp. 1640-50.

- The aim of this study was to investigate the possible protective role of selenium and L-carnitine on oxidative stress induced by 2.45-GHz radiation (60min/day for 28 days) in heart of rat. Electromagnetic radiation exposure was found to cause oxidative stress in the heart of rats. There is also an apparent protective effect of selenium and L-carnitine by inhibition of free radical formation and support of the antioxidant redox system.

Grigoriev, Y.G., et al. "[Confirmation studies of Soviet research on immunological effects of microwaves: Russian immunology results.](#)" Bioelectromagnetics, vol. 31, no. 8, 2010, pp. 589-602.

- This paper presents the results of a replication study performed to investigate earlier Soviet studies conducted between 1974 and 1991 that showed immunological and reproductive effects of long-term low-level exposure of rats to radiofrequency electromagnetic fields (continuous wave 2450 MHz for 7h/day, 5days/week for 30 days). The RF exposure resulted in minor increases in formation of antibodies in brain tissue extract and the exposure did not appear to be pathological. In addition, a study was conducted to replicate a previous Soviet study on effects from the injection of blood serum from RF-exposed rats on pregnancy and foetal and offspring development of rats, using a similar animal model and protocol. Our results showed the same general trends as the earlier study, suggesting possible adverse effects of the blood serum from exposed rats on pregnancy and foetal development of intact rats, however, application of these results in developing exposure standards is limited.

Kesari, K.K., et al. "[Mutagenic response of 2.45 GHz radiation exposure on rat brain.](#)" International Journal of Radiation Biology, vol. 86, no. 4, 2010, pp. 334-43.

- The purpose of the study was to investigate the effect of 2.45 GHz microwave radiation (2 h/day for 35 days) on the male rat brain. MWR-exposed rats showed significantly increased comet head, tail length and tail movement, as well as decrease of antioxidant enzymes. Researchers conclude that the chronic exposure to these radiations may cause significant damage to brain, which may be an indication of possible tumour promotion.

Kesari, K.K. and J. Behari. [“Effects of microwave at 2.45 GHz radiations on reproductive system of male rats.”](#) Toxicological and Environmental Chemistry, vol. 92, no. 6, 2010, pp. 1135-47.

- The present study was performed to investigate the effect of 2.45 GHz microwave radiation (2 h/day for 35 days) on reproductive pattern of male Wistar rats. Chronic exposure to these radiations produced formation of apoptotic cells in testis. In addition, a significant decrease in the levels of antioxidant enzymes glutathione and superoxide dismutase activities as well as an increase in catalase activity was observed in the exposed group. These results indicate that a low level exposure of microwave radiations exerts a negative impact on male reproductive system function.

Maganioti, A. E., et al. [“Wi-Fi electromagnetic fields exert gender related alterations on EEG.”](#)6th International Workshop on Biological Effects of Electromagnetic fields, 2010.

- The present study investigated the influence of 2.4GHz electromagnetic fields, similar to that emitted by Wi-Fi system, on human brain activity. The presence of radiation had no effect on the energies of alpha and beta band of male subjects, while it reduced these energies of female subjects, resulting in significantly lower energies, as compared to those of males. Delta and theta band energies did not experience any noteworthy effect from gender, radiation condition and their interaction. Conversely, there was a significant interaction effect (gender x radiation) on the energies of alpha and beta rhythms. The present data support the idea that Wi-Fi signal may influence normal physiology through changes in gender related cortical excitability, as reflected by alpha and beta EEG frequencies.

Gumral, N., et al. [“Effects of selenium and L-carnitine on oxidative stress in blood of rat induced by 2.45-GHz radiation from wireless devices.”](#)Biological Trace Elements Research, vol. 132, no. 1-3, 2009, pp. 153-63.

- This study measured the levels of blood lipid peroxidation, glutathione peroxidase, reduced glutathione, and vitamin C to follow the level of oxidative damage caused by 2.45 GHz electromagnetic radiation exposure (60 min/day for 28 days) in rats. The possible protective effects of selenium and L-carnitine were also tested and compared to untreated controls. Researchers found that 2.45 GHz electromagnetic radiation caused oxidative stress in blood of rat. L-carnitine seems to have protective effects on the 2.45-GHz-induced blood toxicity by inhibiting free radical supporting antioxidant redox system although selenium has no effect on the investigated values.

Naziroğlu, M. and N. Gumral. [“Modulator effects of L-carnitine and selenium on wireless devices \(2.45 GHz\)-induced oxidative stress and electroencephalography records in brain of rat.”](#)International Journal of Radiation Biology, vol 85, no. 8, 2009, pp. 680-9.

- The present study was designed to determine the effects of 2.45 GHz EMR (60 min/day for 28 days) on the brain antioxidant redox system and electroencephalography (EEG) records in rat, as well as examine the possible protective effects of selenium and L-carnitine. EMR-exposed animals showed lower concentration of vitamins A, C, and E than controls, although their concentrations were increased by selenium and L-carnitine supplementation. Animals which received selenium and L-carnitine in addition to EMR also showed lower levels of lipid peroxidation. Results indicate that L-carnitine and selenium seem to have protective effects on the 2.45 GHz-induced decrease of the vitamins by supporting antioxidant redox system.

Sinha, R.K. [“Chronic non-thermal exposure of modulated 2450 MHz microwave radiation alters thyroid hormones and behavior of male rats.”](#) International Journal of Radiation Biology, vol. 84, no. 6, 2008, pp. 505-13.

- The purpose of this investigation was to analyze the effects of chronic 2.45 GHz leakage microwave irradiation on thyroid hormones and behavior of male rats. Behavioral changes were found to be significantly changed from controls for immobilization, rearing and ambulation behavior. Changes in behavioral parameters are also correlated with the trend of changes, compared to control animals, in hormonal blood levels of T3 and T4. Researchers concluded that low energy microwave irradiation may be harmful as it is sufficient to alter the levels of thyroid hormones as well as the emotional reactivity of the irradiated compared to control animals.

Paulraj R. and J. Behari. [“Single strand DNA breaks in rat brain cells exposed to microwave radiation.”](#) Mutation Research, vol 596, no. 1-2, 2006, pp. 76-80.

- This investigation concerns with the effect of low intensity microwave (2.45 and 16.5 GHz, SAR 1.0 and 2.01 W/kg, respectively) radiation on developing rat brain when exposed for 35 days. Results showed that the chronic exposure to these radiations caused statistically significant ( $p < 0.001$ ) increase in DNA single strand breaks in brain cells of rat.

Paulraj R. and Behari J. [“Protein kinase C activity in developing rat brain cells exposed to 2.45 GHz radiation.”](#) Electromagnetic Biology and Medicine, vol. 25, no. 1, 2006, pp. 61-70.

- This experiment investigated the effects of 2.45 GHz microwave radiation exposure (2h/day for 35 days) on the developing rat brain. The study revealed a statistically significant ( $p < 0.05$ ) decrease in protein kinase C activity in hippocampus as compared to the remaining portion of the whole brain and the control group, while a similar experiment conducted on hippocampus and the whole brain gave a similar result. Electron microscopic study shows an increase in the glial cell population in the exposed group as compared to the control group. This present study is indicative of a significant change after exposure to the above-mentioned field intensity, which suggests that chronic exposures may affect brain growth and development.

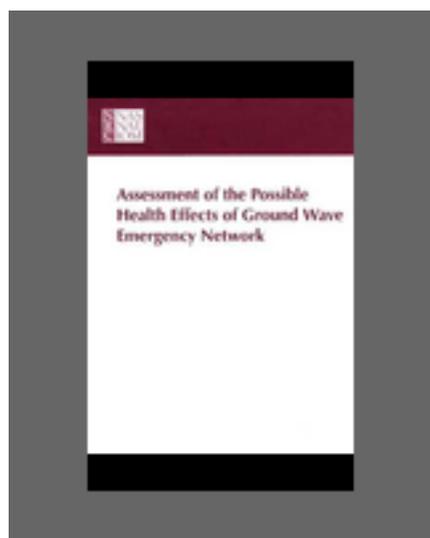
Chou, C.K., et al. [“Long-term, low-level microwave irradiation of rats.”](#) Bioelectromagnetics, vol. 13, no. 6, 1992, pp. 469–96.

- This study investigated the effects of long-term exposure to 2.45 GHz pulsed microwave radiation. The major emphasis was to expose a large sample of experimental animals throughout their lifetimes (21.5h/day for 25 months, starting at 8 weeks) and to monitor them for effects on general health and longevity. Results showed negative overall effects of RFR on general health, longevity, cause of death, or lesions associated with aging and benign neoplasia. Positive findings of effects were found on corticosterone levels and immune system. A statistically significant increase in primary malignancies in exposed rats vs. incidence in control was also found.

Somogyi, Z., et al. [“Effects of modulated and continuous microwave irradiation on the morphology and cell surface negative charge of 3T3 fibroblasts.”](#) Scanning Microscope, vol. 5, no. 4, 1991, pp. 1145-55.

- Mouse embryo 3T3 cells were irradiated with 2450 MHz continuous and low frequency (16 Hz) square modulated waves of absorbed energy. The low frequency modulated microwave irradiation yielded more morphological cell changes than did the continuous microwave fields of the same intensity. The amount of

free negative charges (cationized ferritin binding) on cell surfaces decreased following irradiation by modulated waves but remained unchanged under the effect of a continuous field of the same dose. Modulated waves of 0.024 mW/g dose increased the ruffling activity of the cells, and caused ultrastructural alteration in the cytoplasm. Similar effects were experienced by continuous waves at higher (0.24 and 2.4 mW/g) doses.



## Assessment of the Possible Health Effects of Ground Wave Emergency Network.

# 4 Perception and Behavioral Effects of Electromagnetic Fields

Some animals respond to extremely low levels of electromagnetic fields (EMF), usually at frequencies ranging from DC to extremely-low-frequency (ELF) and usually with specialized receptors.<sup>1</sup> Although the responses have been described and can be demonstrated at will, the mechanisms are not understood. Perceptual and behavioral responses to very low levels of EMFs at low frequency and above have not been reported in humans, and there are no mechanisms at DC or ELF that might imply as yet unreported responses, although they cannot be excluded. There is a considerable literature on perception and behavioral responses to stimulation at magnitudes consistent with direct electrical stimulation of nervous tissues by induced currents in the tissue, but they are limited to the frequency ranges that stimulate excitable membranes.

In the radiofrequency (RF) range of concern for assessment of GWEN sites, there have been many reports of sensory perception. The responses may be organized in the following categories:

- Stimulation of nervous structures by electric and magnetic fields and associated currents in the body. Above a threshold that is frequency-dependent, these currents are perceived as a painful stimulus that increases with current intensity.

Electroencephalographic (EEG) activity in cats and rabbits has been reported to be altered by exposure to amplitude-modulated RF. Exposure to 147-MHz fields, amplitude-modulated between 1 and 25 Hz, altered the ability of cats to produce selected EEG rhythms. Changes in EEG frequency spectrum were also observed in rabbits chronically exposed to 1-10 MHz fields that were amplitude-modulated at 14-16

Hz.<sup>2</sup> Other studies have shown small changes in EEG patterns, particularly desynchronization, in rats and rabbits after exposure to 12.95-GHz field at 1 W/kg.<sup>3,4</sup> In some later studies failed to find an effect. The lowest levels used, in the above studies are 10,000 times that which would be encountered near GWEN installations.

- Shocks and burns. When the human body is in an EMF of suitable frequency and intensity and it makes contact with a conducting body in the same field, an electrical current is produced that can cause perceptible electrical shock, muscular contractions, burns, and possible death.
- Heating. If enough RF power is absorbed in human tissue, especially skin, it can raise the tissue temperature and cause a sensation of warming that will be due to thermal stimulation of temperature receptors. Thermal perception of absorbed RF energy is frequency-dependent: the threshold energy decreases as the frequency increases.<sup>5</sup> There is a delay in the perception of warmth after the start of irradiation; the delay may vary from 5 sec or more at GHz frequencies to as little as 1 sec for infrared radiation.<sup>6</sup> Justesen et al.<sup>7</sup> compared thermal perception in human volunteers who were irradiated on the forearm in a 100-cm<sup>2</sup> area with far-infrared radiation or 2.45-GHz microwave radiation. The thresholds of perception for a 10-sec exposure were 1.7 mW/cm<sup>2</sup> for far infrared radiation and 26.7 mW/cm<sup>2</sup> for microwave radiation.
- Auditory perception. A special effect has been reported in which microwave RF emitted in the form of very short pulses (1-20 μsec) is perceived by humans and animals as clicks or other sounds. This perception could well result when thermal absorption leads to thermoelastic expansion of tissues and fluids in the head and is sensed by auditory receptors. If the energy flux in the pulse exceeds about 40 μJ/cm<sup>2</sup>, delivered in a few microseconds, auditory perceptions occur.<sup>8</sup>

The auditory perception of pulsed microwave fields was first reported in 1947 and has been studied extensively. Frey<sup>9</sup> reported on controlled experimental exposures at frequencies of 0.2-8.9 GHz and pulse widths of 1-1,000 μsec. He found that, depending on the characteristics of the field, sensations were perceived as buzzing, ticking, hissing, or knocking sounds. Sound was perceived at all frequencies up to 8.9 GHz. Guy et al.<sup>10</sup> demonstrated that the threshold for auditory perception was four times higher at 3.75 kHz in subjects with neurosensory deficits compared with normal subjects, thus indicating that the effect was in the acoustic elements involved in hearing.

- Behavioral changes. Epidemiologic studies of groups of people occupationally or environmentally exposed to electromagnetic fields in the RF and ELF range have yielded perceptual and behavioral responses, including fatigue, difficulty in concentrating, and increased frequency of headaches. A number of researchers have used disruption of behavior patterns, such as work stoppage, to study the effect of RF fields on animals, including rodents<sup>11-13</sup> and monkeys.<sup>14</sup> Several carrier frequencies, field zones, and modulation characteristics were used. A relatively narrow range of threshold of specific absorption rates (SARs), about 4-9 W/kg, was found. Lebovitz<sup>15</sup> examined the effect of repeated exposures to a pulsed 1,300-MHz field on behavioral performance in rats. He exposed animals to SARs of 1.6, 3.6, or 6.7 W/kg for 3 h/day, 5 d/wk for 6-9 wk and found that rates of lever-pressing for food were slightly reduced at the highest SAR. However, the ability of the rats to discriminate improved as a positive function of SAR when lever-pressing was not reinforced by the presence of food. DeLorge<sup>16</sup> used a different experimental paradigm and showed a disruption in performance of rats at an SAR of 2.5 W/kg when they were exposed to a pulsed 1,300-MHz field. Behavioral studies performed by Hjeresen et al.<sup>17</sup> showed that rats placed in a shuttlebox tended to remain in the side shielded from pulsed RF fields. Because the rats also tended to avoid pulsed sound waves, the investigators suggested that the rats' avoidance of the RF fields might be related to the hearing of the pulsed fields. The response to a pulsed field is stronger than that to a continuous field. For example, Carroll et al.<sup>18</sup> found that rats exposed to an intense field that was not

pulse-modulated did not readily learn to escape from it. It appears that hearing the pulses is a more effective cue for escaping than is the warming that results from a continuous field.

Studies in Eastern Europe have investigated populations exposed to EMFs ranging from 50 Hz to microwave frequencies.<sup>19</sup> Complaints included irritability, lethargy, insomnia, impotence, headaches, loss of memory, and inability to concentrate. The syndrome was identified as neurasthenia or "microwave sickness." Energy magnitudes associated with the syndrome have been reported for a few microwatts to a few thousand microwatts per square centimeter. An epidemiologic study of the personnel in the American embassy in Moscow found an excess of the same neurasthenic symptoms, but the symptoms were not correlated with measured individual exposures.<sup>20</sup>

Eastern European investigators have also reported on rats and rabbits exposed for one to several hours a day over periods of weeks or months. Power densities ranging from 0.6 to 30,000  $\mu\text{W}/\text{cm}^2$  were reported to alter conditional reflexes<sup>21</sup> and decrease latency of audiogenic seizures.<sup>22</sup> Attempts to confirm the findings were made by several investigators; some effects of exposure to RF fields were found, but most were at higher field intensities, and in general the results did not support the findings from Eastern Europe.

Studies with ELF fields have suggested that behavior can be influenced by exposure to either magnetic or electric fields. Persinger<sup>23</sup> reported that prenatal exposure of rats to 0.5-Hz, 0.05-to 3-mT fields, resulted in changes in juvenile or adult rats' emotionality and ability to perform a conditioned-suppression test. Frey<sup>24</sup> found that prenatal exposure of rats to a 60-Hz field at 3.5 kV/m caused changes in open-field activity.

McGivern et al.<sup>25</sup> studied male rats that had been exposed prenatally on days 15-21 of gestation. Exposures were for 15 min twice a day, to a 15-Hz, 800- $\mu\text{T}$  pulsed magnetic field. Exposed animals showed a significant reduction in scent marking, compared with sham-exposed or caged controls. Exposed males had larger seminal vesicles, prostates, and epididymides than did control males.

Transient neurobehavioral changes in rats exposed prenatally and postnatally to a 60-Hz electric field (65-kV/m effective field) were reported by Sikov et al.<sup>26</sup> Exposed animals showed significantly more motility than did controls. Development of righting reflex and negative geotropism was also delayed in exposed rats; the percentage of pups that failed to show these behaviors was increased on day 14 of postnatal life, but not on day 21.

Lovely et al.<sup>27</sup> exposed gravid Sprague-Dawley rats to a 60-kV/m, 60-Hz electric field and then tested the offspring at the age of 90 days in three tasks: shuttlebox avoidance, a residential maze, and a preference-avoidance test. No differences were noted between exposed and sham-exposed animals.

Changes in learning have been reported in rats exposed to a combination of 60-Hz electric fields (30 kV/m and 0.1 mT) and magnetic fields (10 kV/m and 0.033 mT) throughout gestation and during the first 8 days of postnatal life.<sup>28</sup> Both acquisition and extinction of a schedule-controlled response were affected in the exposed animals. In contrast, other studies failed to find an effect of exposure to ELF fields on behavior.<sup>29,30</sup>

Exposure to 60-Hz electric fields (30 or 60 kV/m) has been reported to affect the social behavior of baboons.<sup>31,32</sup> The investigators used a number of measures of social behavior, but found that passive affinity, tension, and stereotypy performance were significantly increased in exposed groups. The authors suggested that the changes might indicate a stress response to the fields.

Although there is evidence that exposure of experimental animals to electric or magnetic fields can influence neurobehavioral function, there is a paucity of direct observations at the 175-kHz frequency and at the ultra-high frequencies of 200400 MHz used in the GWEN system. Moreover, magnitudes of the exposure usually required to produce an effect are substantially higher than those likely to be encountered as a result of operation of the GWEN system. It therefore seems unlikely that electromagnetic fields from GWEN will affect neurosensory or neurobehavioral function in persons living around GWEN sites.

## References

1. Kalmijn, A. J. 1978. Experimental evidence of geomagnetic orientation in elasmobranch fishes. Pp. 347-353 in *Animal Migration, Navigation and Homing*, K. Schmidt-Konig, editor; , and W. K. Keeton, editor. , eds. New York: Springer Verlag.
2. Takeshima, S., B. Onaral, and H. P. Schwan. 1979. Effects of modulated RF energy on the EEG of mammalian brains: effects of acute and chronic irradiations. *Radiat. Environ. Biophys.* 16:15-27. [[PubMed](#)]
3. Baranski, S., and Z. Edelwejn. 1975. Experimental morphologic and electroencephalographic studies of microwave effects on the nervous system. *Ann. N.Y. Acad. Sci.* 277:109-116. [[PubMed](#)]
4. Servantie, B., A.M. Servantie, and J. Etienne. 1975. Synchronization of cortical neurons by a pulsed microwave field as evidenced by spectral analysis of electrocorticograms from the white rat. *Ann. N.Y. Acad. Sci.* 247:82-86. [[PubMed](#)]
5. Hendler, F., J. D. Hardy, and D. Murgatroyd. 1963. Skin temperature and temperature sensation produced by infrared and microwave irradiation. *Biology and Medicine Vol. 3, Temperature: its measurement and control in Science and Industry*, C. M. Hertzfeld, editor. , ed. New York: Reinhold Publishing Corp.
6. Eijkman, E., and A. J. H. Vendrik. 1961. Dynamic behavior of the warmth sense organ. *J. Exp. Psychol.* 62:403-408. [[PubMed](#)]
7. Justesen, D. R., E. R. Adair, J. C. Stevens, and V. Bruce-Wolfe. 1982. A comparative study of human sensory thresholds: 2450-MHz microwaves vs. far-infrared radiation. *Bioelectromagnetics* 3:117-125. [[PubMed](#)]
8. Lin, J. C. 1990. Auditory perception of pulsed microwave radiation. Pp. 277-318 in *Biological Effects and Medical Applications of Electromagnetic Energy*, O. P. Ghandi, editor. , ed. Englewood Cliffs, New Jersey: Prentice Hall.
9. Frey, A. H. 1961. Auditory system response to modulated electromagnetic energy. *J. Appl. Phys.* 17:689-692. [[PubMed](#)]
10. Guy, A. W., C.-K. Chou, J. C. Lin, and D. Christensen. 1975. Microwave induced acoustic effects in mammalian auditory systems and physical materials. *Ann. N.Y. Acad. Sci.* 247:194-218. [[PubMed](#)]
- 11.

- Justesen, D. R., and N. W. King. 1970. Behavioral effects of low level microwave irradiation in the closed space situation. Pp. 154-179 in *Biological Effects and Health Implications of Microwave Radiation*, S. F. Cleary, editor. , ed. HEW Publication BRH/DBE; 70-2.
12. Lin, J.C. 1977. On microwave-induced hearing sensation. *IEEE Trans. Microwave Theory Tech.* 25:605-613.
13. D'Andrea, J. A., O. P. Gandhi, and J. L. Lords. 1977. Behavioral and thermal effects of microwave radiation at resonant and nonresonant wavelengths. *Radio Sci.* 12:251-256.
14. DeLorge, J. O. 1979. Operant behavior and rectal temperature of squirrel monkeys during 2.45 GHz microwave irradiation. *Radio Sci.* 12:217-225.
15. Lebovitz, R. M. 1981. Prolonged microwave irradiation of rats: effects on concurrent operant behavior. *Bioelectromagnetics* 2:169-185. [[PubMed](#)]
16. DeLorge, J. O. 1983. The thermal basis for disruption of operant behavior by microwaves in three species. Pp. 379-399 in *Microwaves and Theroregulation*, E. R. Adair, editor. , ed. Academic Press: New York.
17. Hjeresen, D. L., S. R. Doctor, and R. L. Sheldon. 1979. Pp. 194-214 in *Proceedings of the Symposium on Electromagnetic Fields in Biological Systems*, S. S. Stuchly, editor. , ed. International Microwave Power Institute, Edmonton, Canada.
18. Carroll, D. R., D. M. Levinson, D. R. Justesen, and R. L. Clarke. 1980. Failure of rats to escape from a potentially lethal microwave field. *Bioelectromagnetics* 1:101-115. [[PubMed](#)]
19. Sadchikova, M. W. 1974. Clinical manifestations of reactions to microwave irradiation in various occupational groups. Pp. 261-268 in *Biological Effects and Health Hazards of Microwave Radiation*, P. Czernski, editor; , K. Ostrawski, editor; , C. Silverman, editor; , M. L. Shore, editor; , M. J. Suess, editor; , and B. Waldeskog, editor. , eds. Warsaw: Polish Medical Publishers.
20. Lilienfeld, A.M., J. Tonascia, S. Tonascia, C. H. Libauer, G. M. Cauthen, J. A. Markowitz, and S. Weida. 1978. Foreign Service Health Status Study-Evaluation of the Health Status of Foreign Service and Other Employees from Selected Eastern European Posts. Final Report Contract 6025-619073. Washington, D.C.: Department of State.
21. Lobanova, E. A. 1974. The use of conditional reflexes to study microwave effects on the central nervous system. Pp. 109-118 in *Biologic Effects and Health Hazards of Microwave Radiation*, P. Czernski et al., editor. , eds. Warsaw: Polish Medical Publishers.
22. Stverak, I., K. Marha, and G. Pafkova. 1974. Some effects of various pulsed fields on animals with audiogenic epilepsy. 1974. Pp. 141-144 in *Biologic Effects and Health Hazards of Microwave Radiation*, P. Czernski, editor; , K. Ostrowski, editor; , C. Silverman, editor; , J. L. Shore, editor; , M. J. Suess, editor; , and B. Waldeskog, editor. , eds. Warsaw: Polish Medical Publishers.
23. Persinger, M. A. 1969. Open field behavior in rats exposed prenatally to a low intensity-low frequency, rotating magnetic field. *Developmental Psychobiol.* 2:168-171. [[PubMed](#)]
- 24.

25. Frey, A. H. 1982. Neural and behavioral consequences of prenatal exposure to 3.5 kV/m 60 Hz fields. Abstr. 4th Annual Meeting Bioelectromagnetics Society, Los Angeles, California.
26. McGivern, R. F., R. Z. Sokol, and W. R. Adey. 1990. Prenatal exposure to low-frequency electromagnetic field demasculinizes adult scent marking behavior and increases accessory sex organ weights in rats. *Teratology* 41:1-8. [[PubMed](#)]
27. Sikov, M. R., L. D. Montgomery, L. G. Smith, and R. D. Phillips. 1984. Studies on prenatal and postnatal development in rats exposed to 60-Hz electric fields. *Bioelectromagnetics* 5:101-112. [[PubMed](#)]
28. Lovely, R. H., J. A. Creim, and R. D. Phillips. 1984. a. Adult behavioral effects of prenatal and early postnatal exposure to 60-Hz electric fields in rats. In *Interaction of Electromagnetic Fields with Biological System*. Twenty-first General Assembly of the International Union of Radio Science (URSI), August 27-30, 1984, Florence, Italy: (abstract).
29. Salzinger, K., S. Freimark, M. McCullough, D. Phillips, and L. Birenbaum. 1990. Altered operant behavior of adult rats after perinatal exposure to a 60-Hz electromagnetic field. *Bioelectromagnetics* 11:105-116. [[PubMed](#)]
30. Lovely, R. H., J. A. Creim, and R. D. Phillips. 1984. Effects of prenatal exposure to 60-Hz electric fields on open field and maze performance of F-2 generation Hanford Miniature swine. Pg. 10 in *Sixth Annual Scientific Session of the Bioelectromagnetics Society*, July 15-19, Atlanta, Georgia: (abstract).
31. Durfee, W. K., P. R. Plante, P. Martin, S. Muthukrishnan, and C. Polk. 1976. Exposure of domestic fowl to ELF electric and magnetic fields. In *Biological Effects of Electromagnetic Waves*, C. C. Johnson, editor; , and M. L. Shore, editor. (eds). Selected papers of the USNC/URSI Annual Meeting, Boulder, CO, October 20-23, 1975. Vol. 1. Washington, D.C.: U.S. Government Printing Office.
32. Easley, S. P., A. M. Coelho, Jr., and W. R. Rogers. 1991. Effects of exposure to a 60 kV/m, 60-Hz electric field on the social behavior of baboons. *Bioelectromagnetics* 12:361-375. [[PubMed](#)]
- Coelho, A. M., Jr., G. P. Easley, and W. R. Rogers. 1991. Effects of exposure to a 60 kV/m, 60-Hz electric field on the social behavior of baboons. *Bioelectromagnetics* 12:361-375. [[PubMed](#)]

[Copyright](#) 1993 by the National Academy of Sciences. All rights reserved.

Bookshelf ID: NBK208988

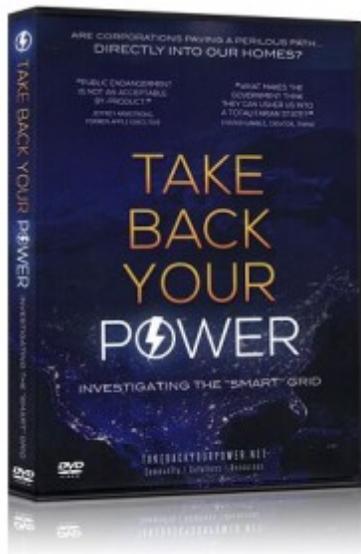
# Power Takeover: What's Wrong With "Smart" Meters?

September 30, 2013 [Comments](#)

"Under my plan of a cap-and-trade system, electricity rates would necessarily skyrocket"

**Josh del Sol**  
Infowars.com  
Sept. 30, 2013

On January 17, 2008, President Obama famously said, "**Under my plan of a cap-and-trade system, electricity rates would necessarily skyrocket.**" It's now becoming evident that the new so-called "smart" meter your utility is attempting to force on you, is the culprit technology for the government-sponsored extortion that Obama was referring to. But this is just the beginning of a hornet's nest of alarming details unveiled in our new documentary, Take Back Your Power ([now available at the Infowars shop](#)).



**Billions of tax dollars... no benefits?**

**In a time of economic crisis, the US government allocated \$11B of taxpayer funds** from the 2009 bailout package to develop a "smart" grid, including "smart" meters for every home's electricity, gas and water. And recently, the European Union has announced plans to blow a mind-numbing \$700B on building out this centralized control grid. The ostensible reasons for "smart" metering and grid technology:

- a) to save energy and thus aid the environment;
- b) to increase power reliability; and
- c) to give you more control of energy use in your own home.

It is now easily demonstrated that all three of these claims are patently false. “Smart” meters and grids typically use more energy, they are extremely hackable (making the entire power grid vulnerable), and customers suffer increased utility bills virtually across the board immediately following a “smart” meter installation – a fact even acknowledged now by some utilities.

In the words of Dr. Timothy Schoechle, a leading digital technology engineer and author of “Getting Smarter About The Smart Grid:”

“The smart meter is a canard—a story or a hoax based on specious and grandiose claims about energy benefits ostensibly derived from the promise of “two-way” communication with the customer... There is essentially no possibility that most smart meters or meter networks will lead to greater sustainability.”

### **Clear evidence of health damage**

**Tens of thousands of individuals are reporting officially, to governments and utilities, that they are experiencing illness or functional impairments** following the installation of “smart” meters. Reported symptoms include headaches, sleep problems, ear ringing, focus difficulties, fatigue, heart palpitations, nausea and statistically abnormal recurrences of cancer. According to court-ordered documentation, and independent testing, utilities have been proven to be lying about how often “smart” meters transmit bursts of microwave radiation. Depending on the utility their claim is typically something like “4-6 times per day” (Pepco), or “45-60 seconds per day” (PG&E) — whereas courts and independent testing reveal that meters are transmitting in the range of **10,000 to 190,000** pulsed microwave transmissions per day.

The amount of transmitted microwave radiation has been measured up to 200 times greater (if one is standing next to the meter) than the Building Biology standard threshold for “extreme concern.” The radiation standards set by national agencies such as the FCC are literally thousands of times higher than science-based levels, because they actually assume that harm can only be done from electromagnetic radiation (EMR) if cells heat up by a certain amount. This is called a “thermal effect”. The reality is that more than 6,000 peer-reviewed, published studies have indicated functional impairment, symptoms of illness or disease (ie. “non-thermal effects”) from levels of EMR as much as 10,000 times lower than “safety” standards set by organizations such as the FCC, Health Canada, ICNIRP, etc.

But the health effects don’t end with the pulsed microwave radiation – from the meters and all future “smart” appliances – under this multinational plan of total control. Every “smart” digital electric meter has what’s known as a “switching mode power supply”, which is proven to directly create large amounts of dirty electricity – or high-frequency energy radiating throughout your home’s electric circuits, essentially creating an antenna cage. The levels of DE caused by “smart” meters can be several hundred times higher than some international safety standards. When confronted, one government agent would not talk about this on his work phone, but confirmed the awareness and concern of the DE health hazard on a private call.

As stated by Dr. De-Kun Li, a respected Kaiser Permanente scientist whom I interviewed, **utilities and industry simply haven't done any studies to show that "smart" meters are safe. Not one.** In this complete void of responsibility or conscience, independent research is now starting to clearly show negative biological effects. One such example is demonstrated in our film – the effects of a single "smart" meter on live human blood – and the visual results are staggering, to say the least.

Additionally, by many reports there are now **well over a thousand home fires** linked to "smart" meters, and tens of thousands have experienced other appliance breakages in their home. Incredulously, almost none of these meters, made mostly in China, have been tested or approved by UL or an equivalent standards body. Thus, the homeowner has no guarantee of coverage, and is often left to deal with the damage and expense to repair.

### **"Smart" spy state**

As if all this is not enough, "smart" meters – in combination of "smart" appliances also chronically transmitting low-level microwave radiation – are functionally designed to **collect swaths of in-home private data on everyone.**

According to a US Congressional Research Service report, "Police will have access to data that might be used to track residents' daily lives and routines while in their homes, including their eating, sleeping, and showering habits, what appliances they use and when, and whether they prefer the television to the treadmill, among a host of other details."

But it gets worse.

Utilities and public utilities commissions (such as California's PUC) are actually **encouraging the sale of this private data** – everything you do in your own home – to 3rd-party corporate interests, for a profit.

And incredulously, even former CIA Director David Patraeus boasted (in Wired, March 2012) that government will be routinely spying on through their "smart" appliances. Thus, with CISPA's focus on legalizing private data transfer deals for corporations to government agencies, the primary motivation behind the push for such legislation starts to become clear.

And not only would every detail of your life be tracked, but your access to electricity would be totally controlled: your appliances or entire home could be shut down at any time – without notice – by any utility, or government agency, or as former CIA director James Woolsey states, "a hacker on a cellphone in China."

Newsflash: the NSA phone spying scandal is just the tip of the globalist iceberg.

The good news: this master plan of control and order-out-of-chaos cannot be achieved if enough people simply refuse to participate in this federally-sponsored voluntary microwave and surveillance program.

### **The rising tide of awakening**

This is the first time in known history that either governments or corporations are attempting to force a device (on entire populations) which has been openly proven to **cause direct harm to health, rights, security and property**. And this agenda rips apart the 4th, 5th and 10th Constitutional Amendments.

The installation of “smart” meters is either underway or planned in virtually all western countries, despite existing foundational laws which have heretofore served as protection for the people. It does, in fact, appear that the corrupted powers-that-be truly are going for broke on this one folks.

However, as documented in *Take Back Your Power*, there is a **growing widespread awareness** and resistance to this anti-freedom, anti-life program. **Hundreds of local governments have issued a moratorium** on the installation of “smart” meters, and in California alone, 15 councils have criminalized the installations. Several such as Sebastopol have additionally issued an ordinance fining PG&E \$500 fine per installed meter in their city.

But PG&E and other utilities around the world still are not backing down. In almost all regions where people are beginning to rise to their feet, utilities are moving toward an extortive “opt-out” program, charging customers through the nose for the privilege of not being microwaved and surveilled in their home. Last week the rogue British Colombian government floated the idea to more than 60,000 hold-outs, to pay them an initial fee of \$100, and then pay them an ongoing fee of \$35 per month, just to keep their analog meter.

According to some legal experts we interviewed, the trick is to realize that it’s just a poker game.

**There is no law** requiring you to accept a so-called “smart” meter on your home, or to participate in extortion, even though utilities and governments are intimidating people into believing they have no choice. Strangely enough, paying criminals to minimize the harm they are doing does not sit well with most people.

Legal actions and claim-of-right processes against installations are sprouting up and becoming almost ubiquitous. In many local governments that are still not listening to the people, individual councilors and mayors are now beginning to be on the receiving end of civil and criminal litigation, and processes based in contract law. As one rights group put it,

“No longer can a department head say they were just following orders. No longer can a mayor or city council member say they didn’t know, especially when an avalanche of information is presented to them indicating their position on an issue is detrimental to the health their constituency.”

Because virtually all of us have utility meters, we all now have direct leverage against a central pillar of the planetary control system, perhaps for the first time in any social movement, ever.

This is why we made *Take Back Your Power*. This is why we put up with two years of corporate witchcraft and BS. To let people know – in a highly credible, inspiring and hugely entertaining way – that you no longer have to be silenced by a faceless, soulless enemy. And to provide a tool that can be used like a light saber of awakening on personal networks – or entire regions.

The curtain’s pulled back. Time to connect-the-dots and turn the tables. Let’s start by reaching the 20% who are more-or-less already awake.

## High stakes, big opportunity

What's at stake is nothing less than our basic rights to life, health, choice and freedom itself. When finally understood, this situation is a crisis, but it is also a **truly momentous opportunity** to claim power back into the hands of the people, by decentralizing energy production within the community, and vetoing the old dinosaurs of leechlike extraction. The insanity of these systems is becoming evident, no matter how well-trained the oligarchy's PR department.

What helps to make sense of this whole thing, is coming to the understanding that governments have become corporate puppets and have been systematically suppressing any tangible solution for decades. The Federation of American Scientists acknowledges that more than 5,000 technology patent applications have been "secretized." And the US Patent Office actually has a publicly-visible internal law for the suppression of inventions. With 6 of the 7 world's richest companies in the oil/gas/energy industry, should it be surprising that corporate governments have (in Spain) actually passed laws to prohibit the "illegal use of sunlight for energy generation," setting a fine of \$30M Euros for violating homeowners?

The fact is, in order for human civilization to make it through this time of terrible corruption – and to realize a world of decentralized power and restoration of rights to health, privacy and life itself – we are now required to transition to higher awareness of our situation. We are being asked to confront our existential fear of authority; to go through the proverbial eye of the needle. This requires a realization of the tremendous magnitude of fraud that has been perpetrated by the corporate-government power centers – and then a willingness to take a stand and move our innate Creative force through this awareness. To commit to a solution that burns off the parasite, and benefits the living.

In the end, there is no other way but to stand against corruption, and reveal who we are.

For more information check out [takebackyourpower.net](http://takebackyourpower.net).

Don't forget to pick up your copy of Take Back Your Power at the Infowars online store! [Click here to purchase](#).

Sources:

<http://dimension9.net/bennett/tbypscreens-ids.zip>

<https://www.youtube.com/watch?v=FDMYc1qlhFY>

<https://www.youtube.com/watch?v=eAjX6Ap02dU>

<http://takebackyourpower.net/presskit/TBYP-Press-Kit.pdf>

<http://business.time.com/2012/07/26/obamas-smart-electrical-grid-plan/>

[http://www.smartgridnews.com/artman/publish/Business\\_Markets\\_Pricing/European-Commission-wants-another-700-billion-for-smart-grid-upgrades-5868.html#.Ukb52uuBH-Y](http://www.smartgridnews.com/artman/publish/Business_Markets_Pricing/European-Commission-wants-another-700-billion-for-smart-grid-upgrades-5868.html#.Ukb52uuBH-Y)

<http://www.cpuc.ca.gov/PUC/energy/Demand+Response/benefits.htm>



PRINCETON  
BIOPHARMA  
CAPITAL  
PARTNERS, LLC



## INVESTMENT TEAM

### Michael Wells



Michael is a Managing Director at Princeton Biopharma Capital Partners, LLC a boutique private equity firm focused on providing growth capital and operating expertise to commercial stage healthcare companies. He is a veteran of the pharmaceutical industry with extensive expertise in licensing and commercialization of prescription pharmaceuticals around the world. Prior to forming Princeton Biopharma Capital, LLC, he was the founder and CEO of Aton Pharma, Inc., a specialty pharmaceutical company with products that treated orphan diseases. Michael started the company in 2004 with a blank piece of paper and a dream. By 2010, the company was on track to surpass \$100 million in revenue and \$35 million of EBITDA with 11 products sold in over 30 countries. In 2010 the company was sold to Valeant Pharmaceuticals International for \$330 million. In 2009 Michael was a winner of the Ernst & Young Entrepreneur of the Year Award.

Prior to forming Aton, Michael co-founded Lathian Systems Inc., a venture-backed company that provides online data and marketing services to pharmaceutical and biotech companies. At Lathian, he held several senior management positions, including Vice President of Marketing, Vice President of Sales, Vice President of Operations and Director. His career began at Merck & Co. Inc., where he held positions ranging from hospital sales to brand management. He holds a BS and MS from the University of Pittsburgh and an MBA from The Wharton School.

### George Parise



George is a Managing Director at Princeton Biopharma Capital Partners, LLC with strong experience in the pharmaceutical industry and in private equity. Prior to co-founding Princeton Biopharma Capital Partners, LLC, George was the Chief Financial Officer of Aton Pharma, Inc., a specialty pharmaceutical company with products that treated orphan conditions and ophthalmology. George provided financial leadership to Aton through two acquisitions, a \$30MM credit facility entered into in the difficult credit environment of 2009, and the sale of Aton to Valeant Pharmaceuticals in the Spring of 2010.

Prior to joining Aton, George was an operating executive with Cerberus Operations and Advisory Company, leading diligence efforts and assuming key operating roles within portfolio companies. During his tenure with Cerberus, George's positions included Chief Financial Officer of Velocita Wireless, where he led the complex standalone transition of this Cingular Wireless carve-out and spearheaded the eventual successful sale to Sprint. Prior to his time at Cerberus, Mr. Parise was the Senior VP of Finance for CAI Wireless Systems, a publicly held wireless telecommunication services provider, where he offered financial leadership to the organization through

several business plan changes, a financial restructuring through Chapter 11 of the US Bankruptcy Code, and the successful sale of the company. Prior to CAI, Mr. Parise was the Chief Financial Officer of CellularVision, a pioneer in the development of wireless telecommunication services, where he led the company's successful initial public stock offering. Mr. Parise has also held the position of Staff Vice President of Accounting at TriCon Leasing Corporation (a former subsidiary of Verizon), and has held several progressing positions with Ernst & Young. Mr. Parise holds a BS in Accounting from Seton Hall University and is a CPA (inactive).

## Barry Levinson



Barry is a Managing Director at Princeton Biopharma Capital Partners, LLC with over 25 years of biotech and pharmaceutical industry experience combined with a distinguished scientific career. Prior to joining Princeton Biopharma Capital Partners, LLC, Barry was Vice President of Business Development at Valeant Pharma North America LLC, responsible for the business development activities of its specialty pharmaceutical businesses in dermatology, CNS, orphan conditions and ophthalmology. Before Valeant, Barry was a founding employee of Aton Pharma, Inc., a specialty pharmaceutical company with products that treated orphan conditions and ophthalmology. As its Vice President of Business Development, Barry identified and acquired several key products for Aton and put in place its international partnerships. In addition, he was responsible for recognizing opportunities to expand the application of Aton's products to new medical uses, and spearheaded programs to develop these new indications.

Before Aton, Barry was Founder and President of Park Life Science Advisory, LLC, where he provided outsourced business development capabilities for life science companies. He was previously a Managing Director at CPP Advisors (now Apeiron Partners), a boutique life sciences strategic advisory group and before that a Director in the Life Sciences Group at KPMG Corporate Finance, LLP, an investment bank. For the 10 years prior to KPMG, Dr. Levinson held increasingly senior positions in cardiovascular research and then in business development at Berlex Laboratories, the US subsidiary of Schering A.G. (now Bayer Healthcare Pharmaceuticals), most recently as Associate Director of Schering's Office of Technology. Before Berlex, Dr. Levinson initiated and developed the Protein Biochemistry Group at the biotech startup Ecogen, and served as the company's Radiation Safety Officer. Dr. Levinson received his PhD and Master's degrees in Molecular Biophysics and Biochemistry from Yale University, and was granted his BA, with highest honors, in Biochemistry from Princeton University.

# Self-reporting of symptom development from exposure to radiofrequency fields of wireless smart meters in victoria, australia: a case series.

[Lamech F.](#)

## Abstract

### CONTEXT:

In 2006, the government in the state of Victoria, Australia, mandated the rollout of smart meters in Victoria, which effectively removed a whole population's ability to avoid exposure to human-made high-frequency nonionizing radiation. This issue appears to constitute an unprecedented public health challenge for Victoria. By August 2013, 142 people had reported adverse health effects from wireless smart meters by submitting information on an Australian public Web site using its health and legal registers.

### OBJECTIVE:

The study evaluated the information in the registers to determine the types of symptoms that Victorian residents were developing from exposure to wireless smart meters.

### DESIGN:

In this case series, the registers' managers eliminated those cases that did not clearly identify the people providing information by name, surname, postal address, and/or e-mail to make sure that they were genuine registrants. Then they obtained consent from participants to have their deidentified data used to compile the data for the case series. The author later removed any individual from outside of Victoria.

### PARTICIPANTS:

The study included 92 residents of Victoria, Australia.

### OUTCOME MEASURES:

The author used her medical experience and judgment to group symptoms into clinically relevant clusters (eg, pain in the head was grouped with headache, tinnitus was grouped with ringing in the ears). The author stayed quite close to the wording used in the original entries. She then calculated total numbers and percentages for each symptom cluster. Percentages were rounded to the nearest whole number.

### RESULTS:

The most frequently reported symptoms from exposure to smart meters were (1) insomnia, (2) headaches, (3) tinnitus, (4) fatigue, (5) cognitive disturbances, (6) dysesthesias (abnormal sensation), and (7) dizziness. The effects of these symptoms on people's lives were significant.

## **CONCLUSIONS:**

Review of some key studies, both recent and old (1971), reveals that the participants' symptoms were the same as those reported by people exposed to radiofrequency fields emitted by devices other than smart meters. Interestingly, the vast majority of Victorian cases did not state that they had been sufferers of electromagnetic hypersensitivity syndrome (EHS) prior to exposure to the wireless meters, which points to the possibility that smart meters may have unique characteristics that lower people's threshold for symptom development.

<http://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2016/02/05/amid-health-privacy-fears-states-are-letting-people-reject-smart-meters>

## Amid Health, Privacy Fears, States Are Letting People Reject 'Smart Meters'

- February 05, 2016
- By [Sarah Breitenbach](#)



© The

Associated Press

A Burlington Electric employee checks the radio frequency of a smart meter in Vermont, which in 2012 became the first state to allow electric customers to refuse smart meters at no added cost.

Shortly after Joe Davidson moved into his Cincinnati apartment, he noticed his joints were achy and he wasn't sleeping well. Then he needed two root canals.

Davidson is among a small but outspoken group of people who say the radio frequencies coming from so-called smart meters installed in their homes are making them sick. The wireless devices — designed to measure gas and electricity consumption and help consumers save money — have other critics, such as privacy advocates who argue they could violate customers' privacy and consumer advocates who complain they could lead to higher utility bills.

Driven by these concerns, legislators in several states have moved to give consumers options when it comes to installing smart meters in their homes.

According to the National Conference of State Legislatures, at least 15 states allow customers to opt out of smart meter installation, although many permit utility companies to impose a fee on customers who don't want the meters.

This year, lawmakers in Maryland, [Massachusetts](#), [Ohio](#), Pennsylvania and [Texas](#) are expected to consider bills that would allow consumers to keep their existing analog meters; require customers to opt in to smart meter programs; or allow them to refuse the devices, sometimes at no cost.

Smart meters measure the consumption of energy as customers use it and submit that information to utility companies, eliminating the need to estimate bills and to visit homes and businesses to read meters.

The meters also allow consumers to track their own energy use. And energy industry representatives say the devices make it easier to pinpoint and respond to power outages, and could lead to more accurate pricing that reflects how gas and electricity costs fluctuate throughout the day.

The meters are touted as a way to cut energy use and save customers money by allowing better monitoring of consumption so utilities can adjust production and consumers can change their habits.

Buoyed by \$200 million in federal [funding](#) in 2009, utilities had installed nearly [52 million](#) smart meters by 2013, according to the U.S. Energy Information Administration (EIA). Eighty-nine percent of those were installed in homes.

But opponents say the meters have been forced upon consumers who don't want the digital devices and the fees many utility companies charge those customers are unjust.

"There's no reason to charge someone for something they don't want," said Del. Glen Glass, a Republican from Maryland who plans to introduce legislation that would prevent utility companies from charging extra to customers who refuse smart meters.

Maryland residents who reject smart meters pay a \$75 one-time fee and an additional \$5.50 each month. But few people actually choose to opt out of smart meters, said Marc Harnish, an analyst with the EIA.

## **Expectation of Privacy**

Because smart meters convey information over wireless networks, some opponents worry the data they transmit could be stolen and used by criminals to target individual homes. For example, by looking at when power is being used, a thief could determine when a house is empty, said Bradley Shear, a Maryland-based privacy lawyer.

"I don't see these issues going away. In fact I see them becoming more complex as more utility companies install these technologies," said Shear, who also worries that hackers could steal customers' personal and financial information.

But advocates for smart meters — such as the nonprofit [Smart Grid Consumer Collaborative](#), which is supported by utility companies, and consumer and conservation groups — say those worries are misplaced.

Patty Durand, the group's director, said the meters don't transmit that kind of data and only send information about how much electricity is being used. She said utility companies have had no data breaches, and though she expects they will eventually, she says consumers are at very little risk because the meters aren't transmitting personal financial information such as credit card numbers.

And, proponents say, criminals looking to rob a home are much more likely to lurk outside someone's house than they are to hack their network.

Eventually more people will have appliances that hook into a home's smart meter to use power more efficiently, saving them money on utility bills, Harnish said. For example, a refrigerator could use information from a smart meter to cool down at a point in the day when energy is relatively cheap.

But bringing appliances online will just give utility companies and potential hackers a more intimate portrait of what's going on in a person's home, Shear said. This detailed data could be sold to outside companies for marketing or other purposes, he said.

"I don't expect the minutiae of what I did in my house to be fair game," Shear said.

To avoid that, Pennsylvania state Rep. Mike Reese, a Republican, has introduced [legislation](#) that would reverse a state smart meter mandate and limit how and when utility companies can share information gleaned from the meters.

"This gives a level of confidence to our customers that their information is private," Reese said.

All states have privacy laws that require utility companies to protect consumer data and the companies generally can't share that information without a customer's permission, said Puesh Kumar, engineering and operations director for the American Public Power Association ([APPA](#)), which represents more than 2,000 publicly owned electric utilities. Utility companies aren't sharing data with marketers, he said.

## **Who saves money?**

Utility companies like smart meters because they save money in multiple ways, Harnish said.

Because the devices are on wireless networks, a power company can see exactly where a power outage occurs instead of relying on customer phone calls and dispatching people to look for the outage, he said.

"They're able to get electricity back up quicker," Harnish said. "That's a big revenue saver."

The price of energy also changes throughout the day as demand rises and falls, and smart meters allow utility companies to adjust what they charge customers for energy as they use it.

But most utilities are not using this kind of pricing yet, APPA officials said. Some offer rebates for people who use less energy during times of high demand, but most bill consumers at a flat rate.

## Smart Meters and Health

Davidson is convinced the smart meters made him sick and the wireless radiation they emit continues to make other people sick.

“The two root canals were the biggest issue,” he said. “I never had any dental issues in my life and all of a sudden I need two root canals.”

A doctor certified that Davidson was sensitive to the radio frequency of the meter and it was removed by his power company after he lobbied the Ohio Public Utilities Commission. Slowly, he started to feel better.

Now an Ohio state senator is pushing [legislation](#) that would require that utility companies get permission from property owners before installing smart meters.

Based on surveys from the Smart Grid Consumer Collaborative, worries about safety and health are the biggest consumer qualm about smart meters, director Durand said.

Kate Kheel, the director of Maryland Smart Meter Awareness, a group that opposes smart meters, points to [surveys](#) in which people in the U.S. and Australia say they have had headaches, dizziness and fatigue after being exposed to the meters.

“It’s not right to force this kind of exposure 24/7 on someone’s home without knowledge of the science,” Kheel said.

The International Agency for Research on Cancer reports that the kind of radio frequency given off by the meters may be carcinogenic to humans. But the American Cancer Society says it is [unclear](#) if smart meters put people at risk for developing cancer.

Durand’s group says the meters emit much [weaker](#) radio frequencies than other common devices such as cellphones, baby monitors and microwaves.

“We’re confident there is no health risk associated with electrical pulses that smart meters are sending,” she said.

# RADIATION INHIBITION OF AMINO ACID UPTAKE BY *Escherichia coli*

E. S. KEMPNER and E. C. POLLARD

*From the Biophysics Department, Yale University, New Haven. Dr. Kempner's present address is National Institute of Arthritis and Metabolic Diseases, National Institutes of Health, Bethesda*

**ABSTRACT** The inhibition of macromolecular synthesis in *Escherichia coli* by ionizing radiation has been investigated. The survival of the ability to incorporate arginine, leucine, isoleucine, histidine, uracil, and glucose after various doses of gamma radiation, deutron and alpha particle bombardment has been measured. All amino acids are incorporated by processes which show the same radiation sensitivity. The sensitivity of uracil corresponds to a volume which is roughly spherical, of radius about 160A, whereas the amino acids possess sensitive regions which are long and thin in character. The uptake of glucose is concerned with a smaller, roughly spherical unit. The possible identification of the radiation-sensitive targets with cellular constituents is discussed. The long thin character observed for amino acids suggests that the sensitive region affected by radiation is an unfolded form of a ribosome, or alternatively a long nucleic acid molecule. For uracil the sensitive region fits with a 70S ribosome, while for glucose a smaller particle would fit the data.

## INTRODUCTION

Studies on the uptake of amino acids by bacterial cells have begun to reveal some of the aspects of the cellular synthetic mechanism. Roberts and coworkers at the Carnegie Institution, in particular, have exploited the method in a sustained series of studies (Roberts *et al.*, 1957). Recently McQuillen, Roberts, and Britten (1959) have shown, by rapid pulse-labeling methods, that fractions of the particulate structure of *Escherichia coli*, the 70S and 85S ribosomes, are the site of first synthesis of protein in the cell. It is of great interest to determine the actual nature of the macromolecular organelle responsible for this process. It is possible that within the cell the ribonucleoprotein particles do not all possess the character of being spherical. Instead they may be extended in some way, or at least might be expected to be a mixed population, some being unfolded and others not. Alternatively, some of the processes of amino acid uptake may be concerned with large RNA molecules themselves.

Preliminary indications regarding these questions can be made by studying the

way ionizing radiation inhibits the uptake of amino acids. Such studies employ a simple statistical analysis of the inhibition, taking advantage of the fact that ionizing radiation produces energy releases which are largely localized, either in small separate clusters occupying a region not more than a few Angstrom units across, or along lines of relatively dense ionization, with ionizations spread apart to a greater or lesser extent depending on the kind of ionization source used. The technique of such irradiation studies has been under development in this laboratory for some time and the validity of some of the necessary assumptions has also been the subject of much research (Pollard *et al.*, 1955). Recent work supporting this method of analysis may be found in the papers of Pollard (1959), Hutchinson (1957), and Pollard and Barrett (1959).

Comparative studies of various kinds of cell damage by radiation have been made and are briefly reviewed by one of the authors (Pollard, 1960). The uptake of amino acids is quite insensitive, by comparison with cell division or uptake of phosphate, and it therefore seems probable that amino acid uptake (and so probably protein synthesis) is thus a measure of ribosomal damage, or at any event, of a process which does not require the whole organization of the cell. On the other hand, ionizing radiation is not disruptive of the entire cellular contents, as is the case for extractive techniques, and therefore the statistical study of inhibition should be informative of the character of the synthetic units.

Preliminary experiments on the incorporation of certain amino acids have been reported (Hutchinson *et al.*, 1957; Kempner and Pollard, 1958); these have now been extended to include four other amino acids, and glucose and uracil for comparative purposes. In this paper we report the extended work and include a summary of all the findings.

## MATERIALS AND METHODS

Cultures of *Escherichia coli* B (A.T.C.C. No. 11303) were grown with aeration at 37°C in Roberts' (1957) minimal "C" medium containing five gm of glucose per liter. Growth was measured turbidimetrically in a Bausch and Lomb "spectronix 20" colorimeter at 650 m $\mu$ . When the cultures reached a concentration of 3.0 to 5.0  $\times 10^8$  cells/ml, samples were removed and treated as follows:—

1. Irradiation in a cobalt<sup>60</sup> source. Twenty ml samples of the bacterial culture were placed in screw-top culture tubes and placed in a 1500 curie cobalt<sup>60</sup> source. The dose rate was found to be 330,000 r/hr. by ferric sulfate dosimetry. Irradiations were performed at 30°C, and also at dry ice temperatures. For the latter experiments, the bacterial samples were rapidly frozen and then placed in the cooled cobalt source.

2. Cyclotron irradiations. Samples of 1  $\times 10^8$  or 1  $\times 10^9$  cells were drawn through "HA" millipore filters. The excess liquid was removed, and the filters carrying the bacteria were kept moist with a porous backing containing minimal medium with no glucose added. The samples were irradiated in the Yale cyclotron at 2°C as described elsewhere (Kempner and Pollard, 1958; Pollard *et al.*, 1955). After irradiation, the bacteria were resuspended in minimal C medium and equilibrated to 37°C.

3. Incubation with isotopically labeled compounds. Irradiated bacterial suspensions were added to an equal volume of minimal medium containing glucose and  $0.1 \mu\text{c}$  of carbon per 20 ml of incubation medium.

The isotopically labeled compounds used in these studies and their specific activities are listed below. All were commercially available and checked for chromatographic purity.

L—Arginine— $\text{C}^{14}$	13.1 mc/millimole
L—Histidine—2 (ring)— $\text{C}^{14}$	0.284 mc/millimole
L—Isoleucine— $\text{C}^{14}$	12.6 mc/millimole
L—Leucine— $\text{C}^{14}$	5.13 mc/millimole
Uracil—2— $\text{C}^{14}$	2.94 mc/millimole
Glucose— $\text{C}^{14}$	1.0 mc/millimole

Studies on the incorporation of glucose were performed in the same medium without the addition of carrier (C-12) glucose. Incubation was conducted with aeration in a  $37^\circ\text{C}$  water bath. During an incubation period of 15 minutes, 2.0 ml samples were withdrawn after various time intervals. Half of the samples were drawn through individual collodion membrane filters with an average pore size of  $0.85 \mu$ . The filters were washed with 2.0 ml of minimal medium and dried in air. These constituted the "intact cell" samples. The remaining samples were added to 2.0 ml of cold 10 per cent trichloroacetic acid (TCA) and placed at  $2^\circ\text{C}$  for 1 hour. These were then drawn through membrane filters, washed with 2.0 ml cold 5 per cent (TCA), and air-dried. These are referred to as the (TCA) insoluble samples.

The dried filters were counted under a thin-window Geiger tube on an automatic sample changer (Kempner and Bisbee, 1958).

## RESULTS

After various doses of radiation, cultures of *E. coli* all showed increases in optical density during a 90 minute growth period in minimal glucose medium. As an example, after 360,000 r the optical density rose from 0.35 to 0.40. At the doses used in these experiments there is essentially no colony-forming ability left.

To see whether any great redistribution of activity among fractions took place, the proportion of radioactive label in the cold TCA-insoluble material was further extracted with 75 per cent ethanol, ethanol-ether, and hot TCA by the method of Roberts *et al.* (1957). This method of study did not reveal any differential effect in amino acid or uracil uptake.

In Fig. 1 we show the incorporation of  $\text{C}^{14}$ -leucine as a function of time for unirradiated cells and cells which had received various doses of gamma radiation. The control cells show a normal uptake behavior, with a small difference (which we will refer to as the pool) between whole cell and (cold) TCA-insoluble fractions. The tracer quantity of exogenous label is soon exhausted and the activity of each fraction reaches a plateau. After 665,000 r the cellular uptake has been depressed markedly and similarly the labeled TCA-soluble fraction is lower. The pool size is also decreased. After still greater radiation doses (1,110,000 r) the pool size is unmeasurable.

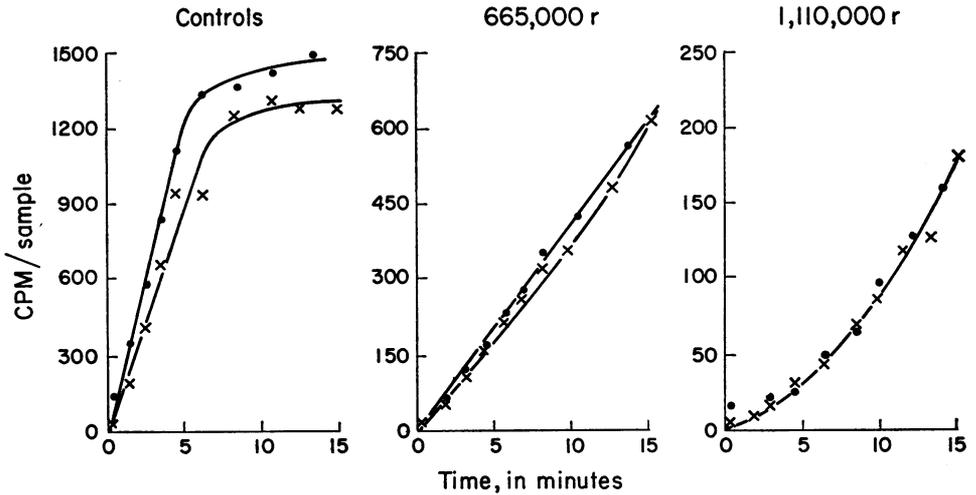


FIGURE 1 Incorporation of L-leucine into the whole cell (upper) and TCA-insoluble (lower curve) fractions as affected by various doses of  $\text{Co}^{60}$  gamma radiation. There is always a steady increase in the TCA-insoluble fraction even after massive radiation dosage.

The data of Fig. 1 are from a single experiment of five different radiation doses. We generally completed at least two or three such experiments and drew conclusions from the average of all.

In Fig. 2, the incorporation of uracil by *E. coli* after irradiation by cobalt<sup>60</sup> is shown. The depression of cellular activity is similar to that shown with leucine in Fig. 1, except that although the pool-forming ability is diminished by radiation, it is not completely destroyed.

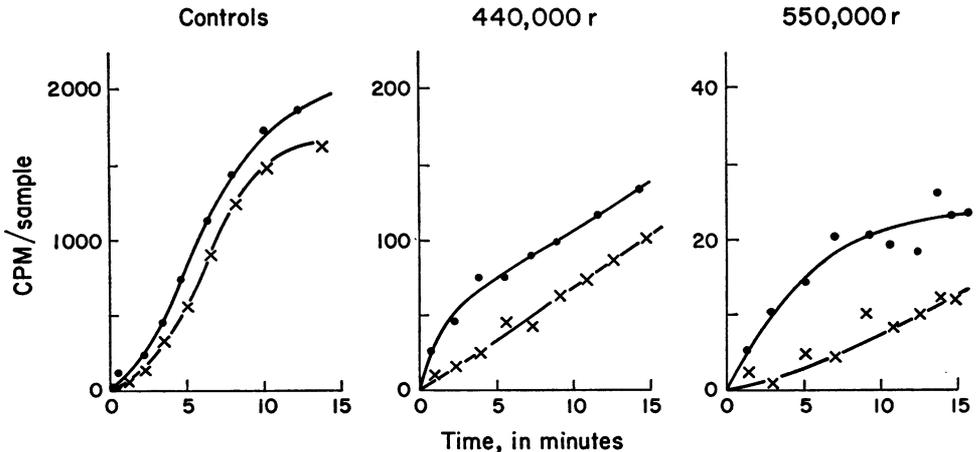


FIGURE 2 Incorporation of  $\text{C}^{14}$ -uracil into the whole cell (upper) and TCA-insoluble (lower curve) fractions as affected by various doses of  $\text{Co}^{60}$  gamma radiation.

In order to have some estimate of the relative effects of different doses, we adopted the procedure of plotting the ratio of uptake to that of the control for several different doses, choosing also several different times. Such a set of points for 7 minutes' incorporation of leucine and uracil into the TCA-insoluble fraction is shown in Fig. 3.

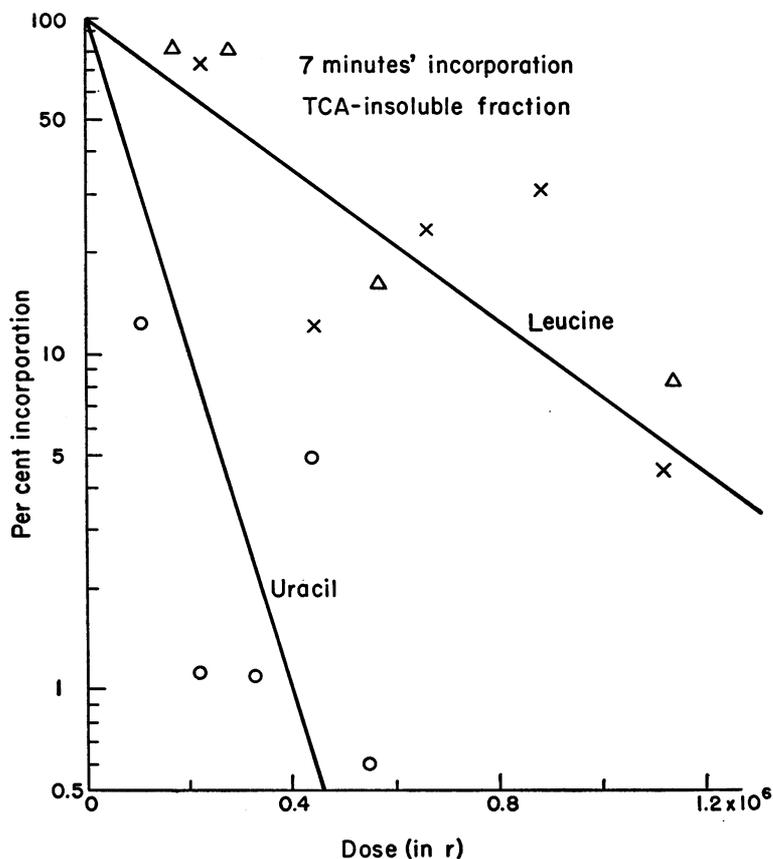


FIGURE 3 The percentage uptake of L-leucine and uracil into the TCA-insoluble fraction at 7 minutes, as a function of gamma radiation dose. Leucine data ( $\times$ ) from experiment shown in Fig. 1. Triangles from a duplicate experiment. The plot of the per cent is on a logarithmic scale and it can be seen that if  $n/n_0$  is the ratio of uptake to original uptake, then the relation  $\ln n/n_0 = \text{constant} \times \text{dose}$  is obeyed.

The ordinate in this graph is plotted logarithmically, and it can be seen that although there is considerable scatter in the points, there is a plausible relationship between the logarithm of the ratio, so plotted, and the dose. If different times are chosen, essentially the same slope is found. The agreement between different times and duplicate experiments was usually 20 per cent or better.

In some experiments the uptake was carried out in the presence of all exogenous

**TABLE I**  
**SUMMARY OF RADIATION TARGETS ASSOCIATED**  
**WITH THE INCORPORATION OF METABOLITES INTO**  
**THE TCA-INSOLUBLE MATERIAL OF *E. coli***

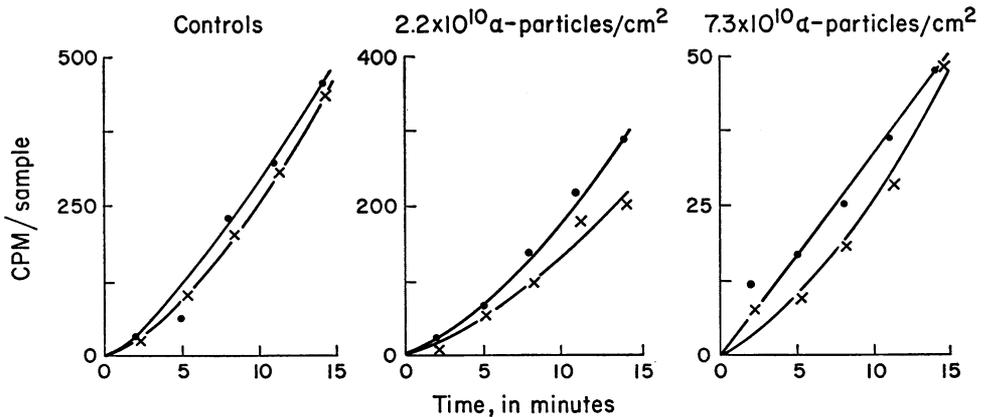
Metabolite	Sensitive volume ( $V$ ) $\text{cm}^3$	Corrected maximum cross-section ( $S_0$ ) $\text{cm}^2$	Length ( $\text{\AA}$ )*	Radius ( $\text{\AA}$ )*
L-Arginine	$5.3 \times 10^{-18}$	$32 \times 10^{-12}$	16,000	10
L-Isoleucine	$6.9 \times 10^{-18}$	$25 \times 10^{-12}$	7800	18
L-Leucine	$5.6 \times 10^{-18}$	$25 \times 10^{-12}$	9000	14
L-Histidine	$5.6 \times 10^{-18}$	$25 \times 10^{-12}$	9000	14
L-Proline	$4.3 \times 10^{-18}$	$30 \times 10^{-12}$	17,000	9
L-Cystine	$4.3 \times 10^{-18}$	Not available		
L-Methionine	$10.0 \times 10^{-18}$	$10.0 \times 10^{-12}$	Spherical	150
Uracil	$15.1 \times 10^{-18}$	$10.0 \times 10^{-12}$	Spherical	160
D-Glucose	$5.9 \times 10^{-18}$	$1.5 \times 10^{-12}$	Spherical	90

\* The calculation of the length  $l$  and the radius  $r$  was made by equating  $\pi r^2 l$  to  $V$  and  $2rl$  to  $S_0$ .

unlabeled amino acids, as well as the labeled one under study. Within 10 per cent, there was no effect on the slope of the line. Nor was there any difference between the effects of radiation at dry ice temperatures and at the normal temperature of the cobalt source within the same limit of error. This is significant, in that it implies that indirect inactivation due to migrating radicals of short half-life must be at a very low value.

Data very similar to the results with leucine were obtained for arginine, isoleucine, cystine, and proline. The radiation-sensitive volumes calculated from these data are shown in Table I.

Bacterial cells were also irradiated in the Yale cyclotron with deuterons at two different energies and also with alpha particles. Subsequent to this treatment, the



**FIGURE 4** Incorporation of L-leucine as affected by various alpha particle bombardments.

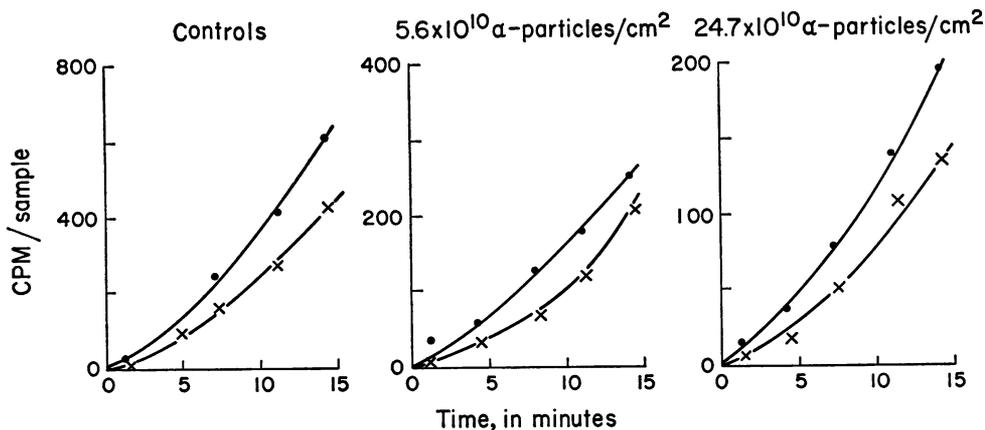


FIGURE 5 Incorporation of uracil as affected by various alpha particle bombardments.

incorporation of the labeled compounds was studied as in the case of gamma ray irradiation. Figs. 4 and 5 show the incorporation of leucine and uracil, respectively, after alpha particle bombardment of *E. coli*. The inhibition of cellular utilization appears to be similar to the results previously shown for gamma ray irradiations. However, the survival curve of the TCA-insoluble fraction, shown in Fig. 6, clearly indicates a distinct difference. The greater sensitivity to gamma rays of cellular incorporation of uracil over leucine is reversed, and the alpha particle radiation shows 37 per cent dose for leucine incorporation to be some 5 times smaller than for uracil. Other amino acids (arginine, isoleucine, and histidine) show the same sensitivity as leucine. Glucose incorporation into a TCA-precipitable form is extremely insensitive to alpha particle bombardment, with a  $D_{37}$  some 40 times greater than that of the amino acids.

#### ANALYSIS

An ionization within, or very near a macromolecule of protein or nucleic acid causes it to lose its function (Pollard, 1959). In material of the density of a bacterial cell (1.05), the number of primary ionizations per  $\text{cm}^3$  per roentgen is  $5.0 \times 10^{11}$ . Since ionization is an "all-or-none" process, one very simple basis for analysis is to inquire as to the probability that a macromolecule of volume  $V$  can wholly escape an ionization when these are distributed randomly such that there is a number of ionizations  $I$  per unit volume. Since  $VI$  is the average number per macromolecule, the application of Poisson's equation yields the probability of no ionization, by purely random occurrence, as  $e^{-VI}$ . Thus we can suggest that the fraction left active, which is an experimental measure of the probability of escape, can be equated to

$e^{-VI}$ . If we denote by  $n$  the number still active and by  $n_0$  the number initially, before radiation, we obtain

$$\frac{n}{n_0} = e^{-VI}$$

or equivalently,

$$\ln \frac{n}{n_0} = -VI$$

The fact that a plausible fit to this relation holds, makes it possible to calculate  $V$  within rather large limits of error. It will be seen that the limits of error are still not

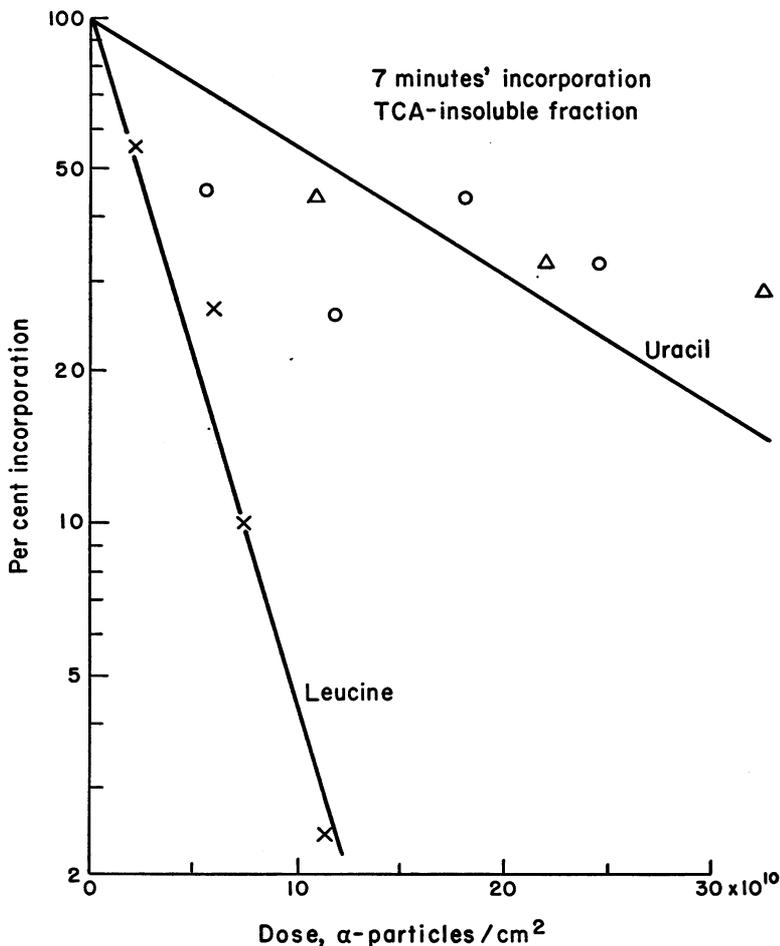


FIGURE 6 The percentage of uptake of L-leucine and uracil into the TCA-insoluble fraction at 7 minutes, as a function of alpha particle dose. Uracil data (o) from experiment shown in Fig. 5. Triangles from a duplicate experiment. The relative sensitivity is seen to be the reverse of that shown in Fig. 3 for gamma radiation.

so great as to preclude interesting deductions, and in fact, the power of the radiation analysis lies in the truth of this last statement.

Before calculating the values of  $V$  we can turn to the case of heavy particle radiation. The heavy charged particle cuts a narrow swath of ionization along its path. The swath is, however, accompanied by secondary ionization by ejected electrons, known as delta rays (Pollard *et al.*, 1955). If, for the moment, we ignore these delta rays, we can approach the "escape probability" by reasoning in terms of the idea that if one of densely ionizing tracks passes through the target, an inactivation will result. If we denote the sensitive area by  $S$  and the number of particles per unit area by  $D$ , then the average number passing through  $S$  is  $SD$ , and the same reasoning leads to the probability of there being a complete escape as  $e^{-SD}$ , so that we obtain

$$\frac{n}{n_0} = e^{-SD}$$

or equivalently,

$$\ln \frac{n}{n_0} = -SD$$

The same kind of logarithmic plot shows that this relation also plausibly holds. Thus a value of  $S$  can be calculated from the experimental data.

The value of  $S$  is found to vary with the ionization density. There are two major reasons for the variation. The first is the effect of delta rays; the second is the possibility of "straddling" a thin target, by which we mean that sometimes, even though a charged particle has gone through the target, the target is so thin that it may have failed to receive an ionization within it. The first can be corrected for by a simple method described by Pollard and Barrett (1959). Straddling effects have been discussed by Ore (1957) and his corrections have also been used in our analysis. After such corrections we can make an estimate of  $V$  from cobalt irradiation,  $S$  the area, and  $t$  the thickness, from heavy particle data. These estimates are only rough, but they are informative.

In Fig. 7 we show the results of plotting the experimentally found (uncorrected) values of  $S$ , which we call the cross-section, *versus* the rate of energy loss for the bombarding particles, for the uptake into the TCA-insoluble fraction of arginine, histidine, isoleucine, leucine, uracil, and glucose, as well as proline and methionine (Kempner and Pollard, 1958). The slopes of the lines near the origin are fixed by the values of  $V$  found from cobalt irradiation as described by Pollard *et al.* (1955). Even without any corrections it is quite apparent that there are three groupings. The cellular "targets" for arginine, histidine, isoleucine, leucine, and proline incorporation show a steady increase in radiation cross-section with the rate of energy loss, while the targets for methionine and uracil do not. The case of glucose is even more striking, in that a clear leveling off at a low cross-section can be seen.

In Table I we show the values of the sensitive volume and the values (corrected

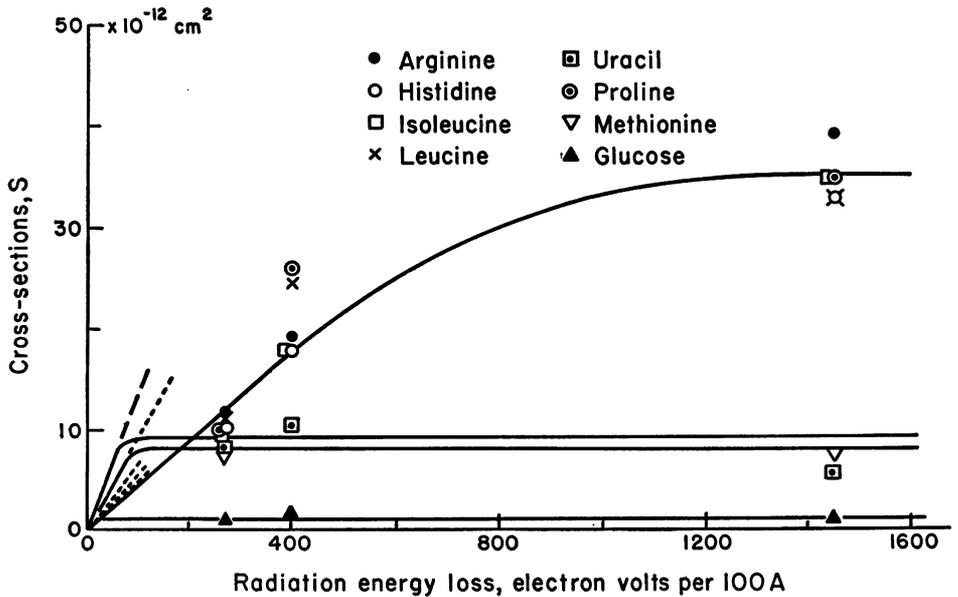


FIGURE 7 A plot of the sensitive cross-section for seven metabolites against the rate of energy loss. The initial slope is found from  $\text{Co}^{60}$  inactivation. Three groupings appear: arginine, histidine, leucine, isoleucine, and proline are all characterized by high sensitivity at high rates of energy loss; methionine and uracil have rather low sensitivities for such radiation and glucose is consistently low. Probably the first grouping are long thin objects, but the others are more nearly spherical.

for delta rays) of  $S_0$ , the maximum cross-section for heavily ionizing particles. In addition, we calculate the appropriate lengths and radii for long cylinders, or spheres according to which is the most suitable approximation. Since the calculation of radii involves  $V^{1/3}$  or  $A^{1/2}$ , a 20 per cent experimental error in the determination of the 37 per cent inhibition dose results in only a 10 per cent error in the linear dimensions of the target.

If we apply the statistical analysis previously used, we can consider the falling aspect of pool size. Roughly speaking, the relation

$$\ln \frac{n}{n_0} = -VI$$

can be held to apply. In most cases the dose necessary to reduce the survival ratio to 0.37 (for which the natural logarithm is  $-1$ ) is very roughly 500,000 r, giving a value of  $V$  of  $4 \times 10^{-18} \text{cm}^3$ , or a molecular weight of

$$4 \times 10^{-18} \times 1.3 \times 6.03 \times 10^{23} = 3.1 \times 10^6$$

assuming material of density 1.3. This is interesting in that it indicates that some rather large, organized molecular structures are responsible for the maintenance of a pool.

## DISCUSSION

The effects of radiation which we have roughly measured can be looked at in two ways. The first is essentially empirical and regards radiation as a kind of stress applied to the cell, which can perhaps produce differential effects on the structures that react with various metabolites. Thus one can look simply at any grouping of effects and consider whether they have any significance. Such grouping shows very clearly in the response to heavy particle irradiation. Data in Table I show that the radiation-sensitive elements associated with the uptake of the amino acids arginine, leucine, isoleucine, histidine, and proline fall into one class, characterized by behavior which radiation analysis associates with long, thin, sensitive units, whereas another amino acid, methionine, differs markedly. Methionine incorporation seems to require the intervention somewhere of a much shorter, thicker structure. Uracil seems to behave in the same way. Glucose, on the other hand, appears to be involved with a still smaller, but thick and roughly spherical object.

A second way of looking at the experiments is to consider the results of cell fractionation to see which of the known cellular structures could be involved with the various operations. Such a method is limited by our knowledge of cell components, which is admittedly imperfect, but it is still a useful viewpoint. An *E. coli* cell has a cell wall, a protoplast membrane, two or more "nuclear bodies," a rather organized complement of DNA within the nuclear bodies, and a large number of ribosomal particles with sedimentation constants ranging from 20 to 100 Svedberg units. These ribosomes contain RNA and protein in a tight bonding. There is in addition an amount of soluble RNA of smaller molecular weight, and a large number of enzymes.

The radiation data enable us to eliminate from this list the whole nucleus, as being too large a radiation target, and the enzymes or soluble RNA as being too small. Interest therefore centers on DNA, large specific RNA, and the ribosomes. The effect of radiation on the uptake of methionine and uracil fits rather remarkably well with the idea that ribosomal particles of sedimentation constant about 80 Svedberg units are involved. On the other hand, the sensitivity found for the five other amino acids studied is much more in agreement with that to be expected from a nucleic acid chain of molecular weight about  $4 \times 10^6$ . Whether this be DNA or RNA, we have no basis for telling. It is possible that a ribonucleoprotein particle, in action, is unrolled in some way, and could therefore result in the long, thin appearance of a radiation target.

Present concepts of protein synthesis postulate the existence of a protein-forming "template." In such a frame of reference, it would be expected that the incorporation of amino acids would be inhibited by destruction of a radiation target identical for all. Our results indicate that at least for five of the six amino acids studied, this indeed is the case. The results for methionine (Kempner and Pollard, 1958) therefore are quite paradoxical. It is extremely difficult to see how these re-

sults could be consistent with any simple model of protein synthesis. Further studies on the radiation inhibition of the incorporation of methionine and other amino acids might be very informative about the mechanism of such synthesis.

The ability of cells to utilize glucose after exposure to each type of radiation used was found to be a simple exponential function of dose. No evidence for a "multiple hit" requirement (Pollard *et al.*, 1955) or for targets of two or more different sizes was found. This implies that all exogenous glucose passes through a common structure which is the most radiation-sensitive element in its biochemical pathways. The target analysis of this unit is given in Table I. If it is assumed that the target is a single macromolecular structure, then a calculation of the expected sedimentation constant leads to a value of 20 to 30S.

We can mention briefly the radiation sensitivity found for the "pool." The fact that radiation does have an effect on the pool seems to dispose of the idea that no more is involved than an inert sieve-like membrane. It is of interest that the doses at which an effect on the pool becomes great are also those at which radioactive label begins to leak out of the cell. Whether the action of radiation is on large molecular units within the cell, or on large units comprising the protoplast membrane itself, we cannot say.

We wish to thank Dr. R. B. Roberts and Dr. E. T. Bolton of the Carnegie Institution of Washington for helpful advice with the technical problem of cell filtration and uptake studies, and Mr. J. Lowry and Miss N. Barrett for help in running the cyclotron.

This work is part of a dissertation presented to the faculty of Yale University in candidacy for the degree of Doctor of Philosophy.

Aided by grants from the John A. Hartford Foundation and the United States Atomic Energy Commission.

Received for publication, October 5, 1960.

## REFERENCES

- HUTCHINSON, F., 1957, The distance that a radical formed by ionizing radiation can diffuse in a yeast cell, *Radiation Research*, **7**, 473.
- HUTCHINSON, F. H., MOROWITZ, H. J., and KEMPNER, E. S., 1957, Evidence concerning the size of amino acid incorporation structures in *E. coli*, *Science*, **126**, 310.
- KEMPNER, E. S., and BISBEE, F. A., 1958, Simple, inexpensive, automatic sample changer and recorder, *Nucleonics*, **16**, 87.
- KEMPNER, E., and POLLARD, E. C., 1958, in *Microsomal particles and protein synthesis*, (R. B. Roberts, editor), Washington, D. C., Washington Academy of Sciences.
- MCQUILLEN, K., ROBERTS, R. B., and BRITTEN, R. J., 1959, Synthesis of nascent protein by ribosomes in *Escherichia coli*, *Proc. Nat. Acad. Sc.*, **45**, 1437.
- ORE, A., 1957, Interpretation of radiation results based on target theory, *Radiation Research*, **6**, 27.
- POLLARD, E. C., 1959, Radiation inactivation of enzymes, nucleic acids, and phage particles, *Rev. Mod. Physics*, **31**, 273.
- POLLARD, E. C., 1960, Theory of the action of ionizing radiation on bacteria, *Am. Naturalist*, **94**, 71.

- POLLARD, E. C., and BARRETT, N., 1959, Study of  $\beta$ -galactosidase using ionizing radiation, *Radiation Research* **11**, 781.
- POLLARD, E. C., GUILD, W. R., HUTCHINSON, F., and SETLOW, R. B., 1955, The direct action of ionizing radiation on enzymes and antigens, *Progr. Biophysics and Biophysic. Chem.*, **5**, 72.
- ROBERTS, R. B., COWIE, D. B., ABELSON, P. H., BOLTON, E. T., and BRITTEN, R. J., 1957, Studies of biosynthesis in *Escherichia coli*, *Carnegie Institution of Washington, Pub. No. 607*.

Magda Havas\*

# Radiation from wireless technology affects the blood, the heart, and the autonomic nervous system<sup>1)</sup>

**Abstract:** Exposure to electrosmog generated by electric, electronic, and wireless technology is accelerating to the point that a portion of the population is experiencing adverse reactions when they are exposed. The symptoms of electrohypersensitivity (EHS), best described as rapid aging syndrome, experienced by adults and children resemble symptoms experienced by radar operators in the 1940s to the 1960s and are well described in the literature. An increasingly common response includes clumping (rouleau formation) of the red blood cells, heart palpitations, pain or pressure in the chest accompanied by anxiety, and an upregulation of the sympathetic nervous system coincident with a downregulation of the parasympathetic nervous system typical of the “fight-or-flight” response. Provocation studies presented in this article demonstrate that the response to electrosmog is physiologic and not psychosomatic. Those who experience prolonged and severe EHS may develop psychologic problems as a consequence of their inability to work, their limited ability to travel in our highly technologic environment, and the social stigma that their symptoms are imagined rather than real.

**Keywords:** electrosmog; radio-frequency radiation; rouleau; tachycardia; WiFi; Wolff-Parkinson-White Syndrome.

---

<sup>1)</sup>Presented at the Corporate Interference with Science and Health: Fracking, Food, and Wireless, Scandinavia House, New York, NY, March 13 and 14, 2013.

\*Corresponding author: Magda Havas, PhD, Environmental and Resource Studies, Trent University, Peterborough, ON, K9J 7B8 Canada, E-mail: mhavas@trentu.ca; www.magdahavas.com

## Introduction

Our exposure to devices using electricity and emitting extremely low-frequency and radio-frequency electromagnetic fields has been increasing ever since Edison invented the incandescent light bulb and Tesla and

Marconi discovered that radio-frequency (RF) radiation can be transmitted without wires. Radio, television, computers, cell phones, and their accompanying cell phone antennas, cordless phones, wireless routers (WiFi), wireless baby monitors, wireless games, and smart meters are increasing our exposure to RF radiation and especially to microwave radiation (300 MHz–300 GHz).

As an example of the proliferation of this technology, access to WiFi was limited in 2002 but by 2012 access was virtually ubiquitous in the USA (Figure 1). We have city-wide WiFi in some communities, WiFi at work, at home, in school, universities, and hospitals, in restaurants and coffee shops, on public transit, at airports, and on an increasing number of airplanes. As a society, we seem to be insatiable for wireless technology and the connectivity it affords.

Although the downside to this technology, namely, the potentially harmful effects of nonionizing radiation, has received relatively little attention in North America and remains controversial, it is an area that deserves proper research funding based on the sheer number of users and people exposed worldwide to RF electromagnetic fields.

In this article, the relationship between electrosmog exposure and electrohypersensitivity (EHS), with a focus on the cardiovascular system, is presented, based on provocation studies and on reports of ill health among those living near cell phone base stations or exposed to WiFi in schools.

## Electrohypersensitivity

Just as some people have multiple chemical sensitivity or react to pollen, mold, and certain types of food, a growing population is becoming “sensitive” to electromagnetic radiation.

Khurana et al. (1) reviewed ten epidemiologic studies, three dealing with cancer and seven with neurobehavioral effects, that examined the putative effects of mobile phone base stations. All of the neurobehavioral studies reported more symptoms with proximity to base stations, and only

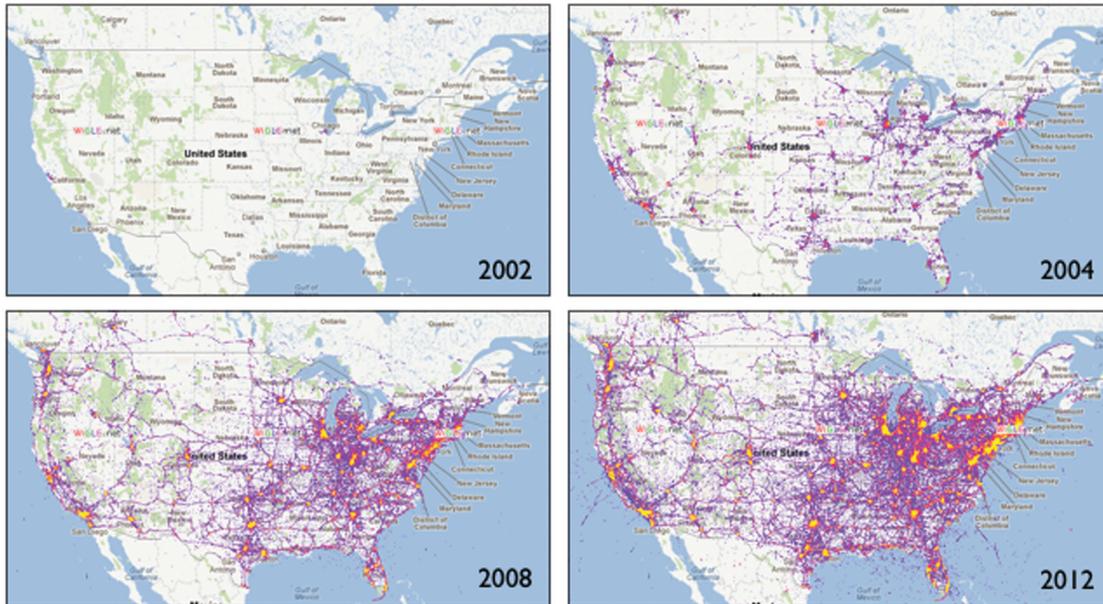


Figure 1 WiFi networks in the USA from 2002 to 2012 (source: wogle.net).

one attributed these health effects to stress rather than RF exposure.

The results from one of these studies are presented in Figure 2 (2). People who lived closest to the antennas experienced the following symptoms more often than those who lived further away: fatigue, sleep disturbance, headaches, feeling of discomfort, difficulty concentrating, depression, memory loss, visual disruptions, irritability,

hearing disruptions, skin problems, cardiovascular problems, dizziness, loss of appetite, movement difficulties, and nausea. Many of these symptoms are more common as we age, thus I prefer to call this rapid aging syndrome (RAS). The difference between real aging and RAS experienced by those who are electrically hypersensitive is that when these people go into an electromagnetically clean environment, many of their symptoms diminish

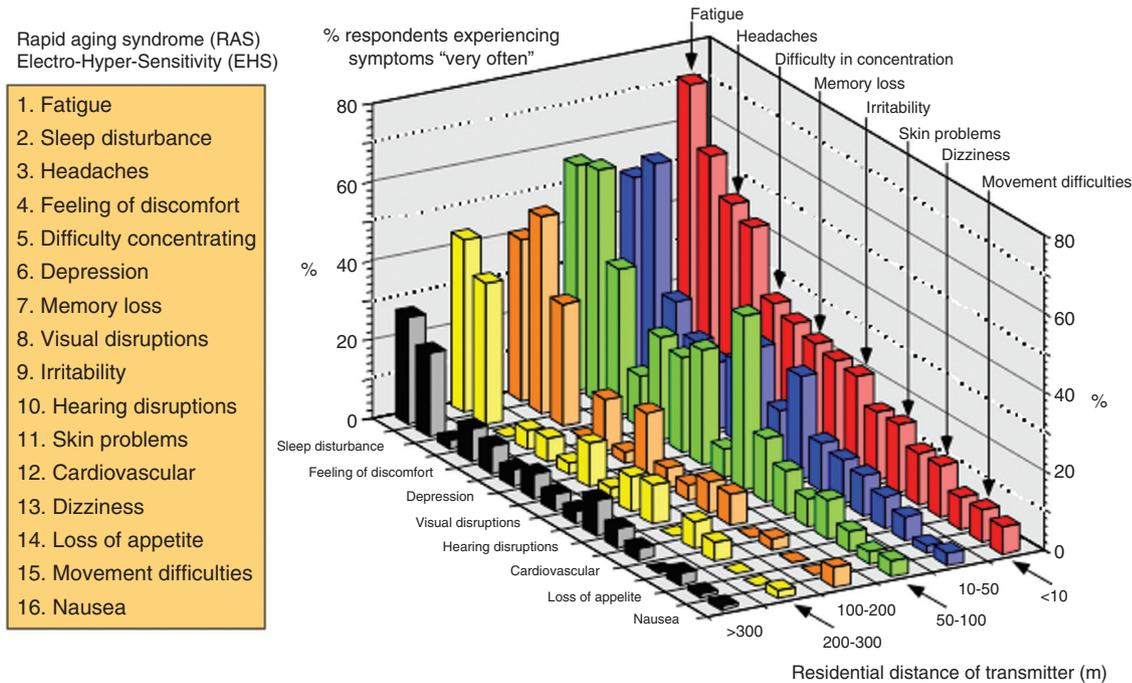


Figure 2 Symptoms experienced by people near cellular phone base stations [based on the work of Santini et al. (2)].

or disappear. Obviously, this does not happen with real aging.

Because cell towers are proliferating and difficult to avoid in both urban and rural communities and if the results of Santini et al. (2) represent what is happening to those who live near cell towers, then it is quite likely that we are going to experience (or are in the midst of experiencing) an emerging health crisis that is contributing to chronic ill health and is promoting the sale of pain medication, sleep medication, antidepressants and anti-anxiety medication, pills to moderate energy level and mood, and drugs for those with attention deficit hyperactivity disorder such as Ritalin® (methylphenidat).

In 2006, Hallberg and Oberfeld (3) documented the increasing prevalence of EHS. Figure 3 clearly shows that self-perceived EHS is on the rise. According to the authors, by 2017, 50% of the population is going to be complaining of this illness. Admittedly, this is a rough calculation but it demonstrates that symptoms of EHS are increasing.

It is difficult to estimate the percentage of the population that has EHS. I use a conservative estimate of 3% of the population for those who have severe symptoms, and this is based on the population in Sweden who have registered as being electrohypersensitive (4). Another 35% population may have mild to moderate symptoms of EHS when exposed to electrosmog (5). Based on these percentages, the cumulative number of people who may be adversely affected in Canada, the USA, and Europe is 25 million, for severe sensitivity (EHS), and another 300 million, for mild to moderate sensitivity (electrosensitivity). People in this latter group can function in an electrosmog environment but may develop headaches or have difficulty sleeping and are living a life compromised by increasingly poor health as a consequence of their exposure (Figure 2).

Historically, environmental contaminants have been presented as contentious issues due, in part, to the media’s need for “balanced reporting” and, in part, to the economic consequences of altering our behavior as consumers. This was certainly the case with asbestos, dichloro-diphenyl-trichloroethane (DDT), lead, mercury, acid rain, and tobacco smoke and is currently the case with climate change and EHS.

EHS may be viewed as a contentious issue, yet a growing number of international experts, scientists, and medical doctors have been asking governments and international agencies for decades to lower existing guidelines for RF radiation because the current guidelines do not protect public health. Table 1 provides a list of some of these resolutions and appeals.

Some governments have heeded the warnings and have exposure guidelines that are a fraction of those recommended by the World Health Organization (WHO) and accepted by the USA, UK, and Canada.

The WHO held an international workshop on electro-sensitivity in Prague in 2004 (6), and they defined EHS as follows:

“... a phenomenon where individuals experience adverse health effects while using or being in the vicinity of devices emanating electric, magnetic, or electromagnetic fields (EMFs).”

“Whatever its cause, EHS is a real and sometimes a debilitating problem for the affected persons.... Their exposures are generally several orders of magnitude under the limits in internationally accepted standards.”

What role should the WHO and other leading health authorities play in helping these sensitive individual? Some would advocate, at the very least, lower exposure

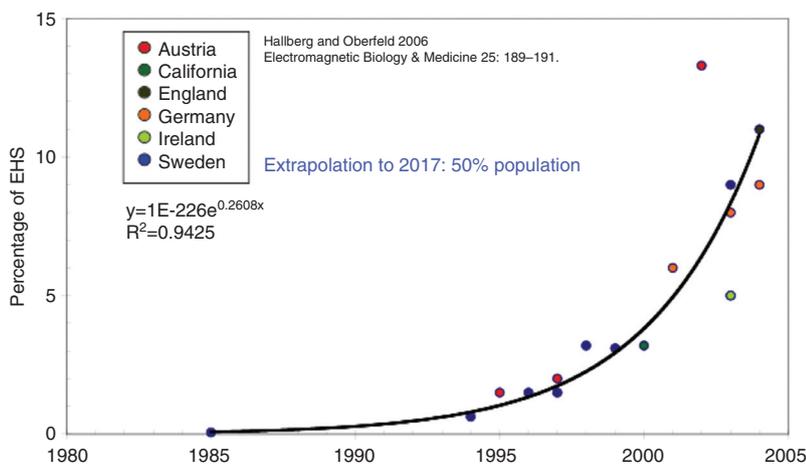


Figure 3 Estimated prevalence of self-proclaimed EHS in various countries [based on the work of Hallberg and Oberfeld (3)].

**Table 1** Appeals and resolutions from international groups of scientists and medical doctors.

Resolution/group	Country	Year	Link
Salzburg Resolution	Austria	2000	<a href="http://www.magdahavas.com/international-experts-perspective-on-the-health-effects-of-electromagnetic-fields-emf-and-electromagnetic-radiation-emr/">http://www.magdahavas.com/international-experts-perspective-on-the-health-effects-of-electromagnetic-fields-emf-and-electromagnetic-radiation-emr/</a>
Catania Resolution	Italy	2002	<a href="http://www.emrpolicy.org/faq/catania.pdf">www.emrpolicy.org/faq/catania.pdf</a>
Freiburger Appeal	Germany	2002	<a href="http://www.magdahavas.com/international-experts-perspective-on-the-health-effects-of-electromagnetic-fields-emf-and-electromagnetic-radiation-emr/">http://www.magdahavas.com/international-experts-perspective-on-the-health-effects-of-electromagnetic-fields-emf-and-electromagnetic-radiation-emr/</a>
World Health Organization	Czech Republic	2004	<a href="http://www.who.int/peh-emf/meetings/hypersensitivity_prague2004/en/">http://www.who.int/peh-emf/meetings/hypersensitivity_prague2004/en/</a>
Irish Doctors' Environmental Association	Ireland	2005	<a href="http://www.ideaireland.org">www.ideaireland.org</a>
Helsinki Appeal	Finland	2005	<a href="http://www.emrpolicy.org/headlines/helsinki_appeal_05.pdf">www.emrpolicy.org/headlines/helsinki_appeal_05.pdf</a>
Benevento Resolution	Italy	2006	<a href="http://www.icems.eu/docs/BeneventoResolution_REVISED_march2008.pdf">http://www.icems.eu/docs/BeneventoResolution_REVISED_march2008.pdf</a>
BioInitiative Report	USA	2007 and 2012	<a href="http://www.bioinitiative.org">www.bioinitiative.org</a>
Venice Appeal	Italy	2008	<a href="http://www.icems.eu/resolution.htm">http://www.icems.eu/resolution.htm</a>
Porto Alegre	Brazil	2009	<a href="http://www.icems.eu/docs/resolutions/Porto_Alegre_Resolution.pdf">http://www.icems.eu/docs/resolutions/Porto_Alegre_Resolution.pdf</a>
Seletun	Norway	2011	<a href="http://www.magdahavas.com/international-experts-perspective-on-the-health-effects-of-electromagnetic-fields-emf-and-electromagnetic-radiation-emr/">http://www.magdahavas.com/international-experts-perspective-on-the-health-effects-of-electromagnetic-fields-emf-and-electromagnetic-radiation-emr/</a>
International Doctors Appeal	Germany	2012	<a href="http://www.icems.eu/resolution.htm">http://www.icems.eu/resolution.htm</a>

limits and possibly places where the radiation is not allowed, similar to smoke-free environments. Instead, the WHO recommended that this illness be referred to as “idiopathic illness”, which basically means the cause is unknown. By refusing to acknowledge the cause, the WHO undermines the need for governing agencies to act.

In contrast to the WHO, the Austrian Medical Association (7) came out with guidelines to help doctors diagnose and treat those who experience EHS. In that document, they recognize that there is a rise in stress-related illness and that electrosmog may play a role. They even provide a temporary code (Z58.4, exposure to radiation) under the *International Classification of Diseases, 10th Edition* to be used for EMF syndrome, which is their term for EHS.

A group of psychologists considers EHS to be entirely a psychologic illness rather than a physiologic response to electrosmog (8, 9). A number of the articles reviewed by Rubin et al. are based on flawed assumptions about (1) who is truly experiencing EHS, (2) how people with EHS respond to exposure, (3) what frequencies and intensities they respond to, (3) how quickly they respond and recover following exposure, and (3) how the data should be analyzed. These flawed assumptions lead to flawed conclusions.

For example, not everyone who believes they have EHS actually have EHS. Thus, combing the results for the self-proclaimed “EHS group” is likely to dilute the results, producing no significant effect when analyzed statistically. The question that is being tested by this type of analysis is, “Do those who believe to be electrically sensitive all respond the same way to provocation testing?” and the answer is likely to be “no”.

In the study by Rea et al. (10) of 100 people who believed they were electrically hypersensitive, only 16 responded consistently to real exposure and not to sham exposure. Had the results been statistically analyzed for the entire 100 subjects tested, they would have shown no effect of EMF exposure. Objective testing is required, and people should be assessed as individuals rather than members of a group for analysis. An analogous situation is if there were 16 people with diabetes among a group of 100 people who all thought they were diabetic. Statistical analysis of blood sugar measurements before and after consuming a standard meal for the entire group would likely miss the 16 people with diabetes.

The proper way to test for EHS is to monitor and assess individual responses to electrosmog exposure in a double-blind study, as was done by Rea et al. (10).

However, it is clear that those who experience EHS and are no longer able to live a “normal” life and who are not supported by their family, friends, and physicians also experience stress leading to psychologic problems including depression and anxiety disorders. Where I disagree with Rea et al. (10) about EHS is that I believe the physiologic response precedes the psychologic problem.

In this article, examples of the effects of electrosmog on the blood, heart, and autonomic nervous system (ANS) are provided, indicating that EHS is a physiologic response to electromagnetic pollution. The only legitimate use of the term “idiopathic” (i.e., disease or disorder that has no known cause) is in reference to the trigger that initiated the electromagnetic sensitivity. In some cases, with good medical investigation, this also can be surmised.

## Electrosmog affects the blood

Healthy blood consists of erythrocytes (red blood cells), which are round and which float freely in the plasma. A live blood sample, consisting of a drop of blood from a finger prick, can be viewed under the microscope, as shown in Figure 4. Changes in the size, shape, and clumping of these erythrocytes can indicate impaired health.

Figure 4 shows live blood (blood without any chemicals added to it) in an electromagnetically clean environment (A) and the blood from the same person spoke on a cordless phone for 10 min (B) and after using a wired computer for 70 min (C). The erythrocytes are sticking together and resemble a stack of coins. This is known as rouleau formation and indicates unhealthy blood.

Usually rouleau is caused by an increased fibrinogen concentration or other changes in plasma proteins as in multiple myeloma or macroglobulinemia. An alternative explanation is that the rouleau may be due to a reduction in the electrical potential at the cell membrane, which would weaken the repellent forces between cells. A third possibility is that it is a microscopic artifact, which, in

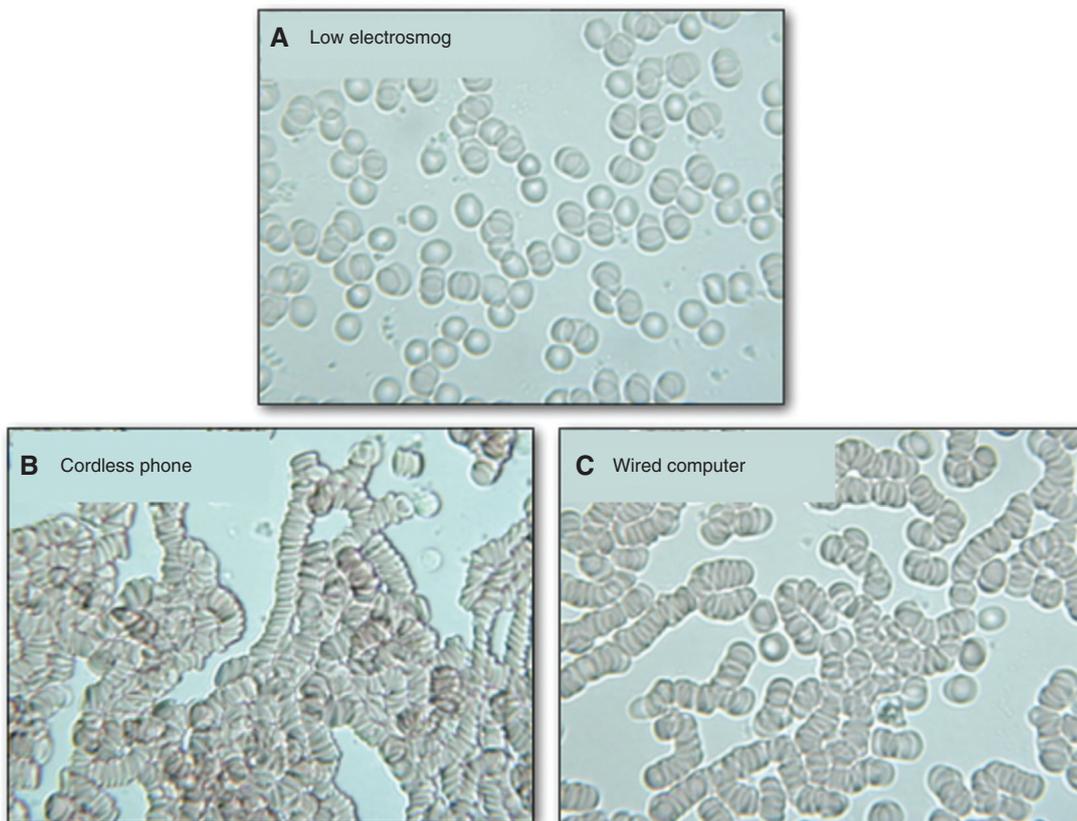
this case, is unlikely because the results are repeatable. Research on the mechanisms involved in the rouleau formation is needed.

With rouleau formation, the surface area of the red blood cells is significantly reduced, and the release of nutrients and the removal of waste products are compromised. Symptoms may include headaches, difficulty concentrating, dizziness, nausea, heart and blood pressure problems as well as cold, numbness, or tingling sensation in the extremities (hands and feet).

The good news is that live blood analysis may be a useful diagnostic for EHS. How quickly the blood clumps and how quickly it recovers following exposure may be a good indicator of the degree of sensitivity.

## Electrosmog affects the heart and the autonomic nervous system

Some people who are electrically hypersensitive complain of pain or pressure in the chest area, heart palpitations,



**Figure 4** Live blood cells in a low-electrosmog environment (A), after using a cordless phone for 10 min (B), and after using a wired computer for 70 min (C).

and/or an irregular heartbeat, accompanied by feelings of anxiety that develop rapidly. The symptoms resemble a heart attack and thus contribute to even more anxiety.

To test the effect of electromog on the heart, Havas et al. (11) designed a simple experiment where subjects were exposed to electromagnetic radiation generated by the base of a cordless phone. This was a double-blind study with randomized real and sham exposure. A cordless phone base station was selected as the source of exposure because the base emits a constant beacon signal when it is plugged into an electrical outlet. The beacon signal in this case was a pulsed frequency of 2.4 GHz, the same frequency used in WiFi.

In the original study (11), 25 subjects from Colorado were tested, and although most subjects did not react adversely to the radiation from the cordless phone base station (see Figure 5, subject A), a few did react with either tachycardia (rapid heart rate) or arrhythmia (irregular heart rate) (Figure 5, subject B). The reaction was often immediate and coincided with exposure to the radiation. When the radiation ceased, the heart returned to normal.

Two examples of responsive subjects are provided. The heart rate of subject B increased from a resting heart rate of 68 beats per minute (bpm) to a rapid 122 bpm during exposure, decreased to 66 bpm as soon as the radiation was stopped, and increased to 129 bpm when it was resumed. This reaction occurred while the subject was resting in a supine position and was unaware of when he or she was or was not exposed.

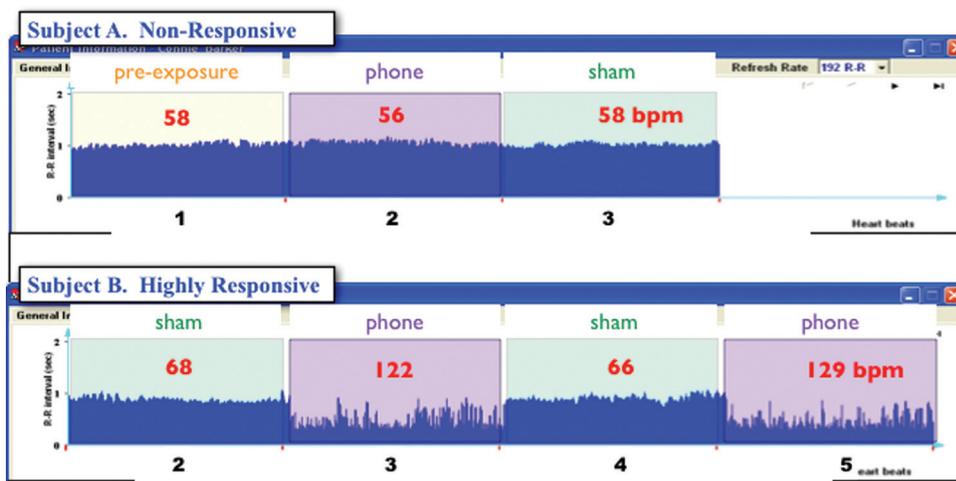
During the exposure to radiation from the cordless phone base station, subject C (Figure 6) experienced a slight increase in heart rate (from 65 to 86 bpm), an irregular heartbeat, and changes in the response of the

sympathetic and parasympathetic nervous system (SNS and PNS, respectively). This upregulation of the SNS and downregulation of the PNS is an example of the “fight-or-flight” response, indicating physiologic stress. During periods of this type of stress, the body redirects most of the blood and energy from the internal organs to the arms and legs to prepare the organism for fighting or fleeing a stressful situation. Intermittent exposure may not cause a problem but if the exposure is continuous and long-term, the immune system of the body will be compromised and the body will not be able to repair itself, resulting in symptoms that are commonly experienced by those who are electrically hypersensitive. This inability to heal is what then accelerates the symptoms of aging (i.e., RAS).

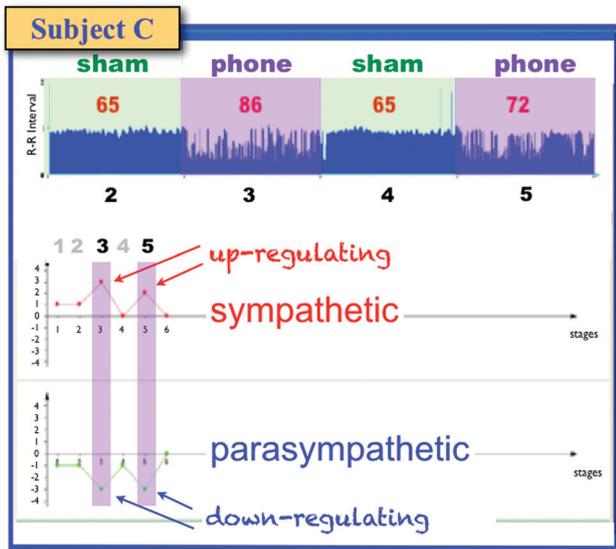
The level of radiation in this experiment was well below international guidelines. Subjects were exposed to  $3 \mu\text{W}/\text{cm}^2$ , or 0.3% of the guidelines recommended by International Centre for Non-Ionizing Radiation Protection (ICNIRP), the Federal Communication Commission (in US) (FCC), and Health Canada for 2.4-GHz frequencies. According to these organizations, harmful biologic effects do not occur below these thermal guidelines. Both blood and heart results from these provocation experiments indicate otherwise, i.e., that biologic effects that can have serious health implications do occur at levels well below current thermal guidelines.

The cordless phone provocation study has since been repeated for a larger group of subjects and shows similar results (12).

Some suggested that the radiation from the cordless phone was interfering with the technology rather than the heart. If this were the case, then 100% of the subjects would have had similar results because the



**Figure 5** Rhythmograph of HRV during provocation with a digital 2.4-GHz cordless phone and sham exposure. The x-axis unit is time, with each stage lasting approximately 3 min. The y-axis is the R-R interval (in seconds).



**Figure 6** Rhythmograph of HRV and functioning of the SNS and PNS during provocation with digital 2.4-GHz cordless phone and sham exposure.

electromagnetic interference (EMI) would have been consistent rather than highly variable and individualistic. Additional testing of higher levels of radiation at the sensor did not affect the heart rate variability (HRV) of a subject who was nonresponsive to the original levels. Had it been EMI, then higher levels of exposure should have had a greater response, but this was not the case (12).

One subject (52-year-old man) told us that he normally experiences a delayed reaction to electrosmog exposure, and thus we monitored him for 30 min postexposure and observed the delayed response during a period of no exposure. The response included periods of short-term and intermittent irregularity in the R-R interval (HRV) as well as episodic downregulation of both the SNS and the PNS, which were both low to begin with (12). The normally low heart rate, 53–55 bpm, began to increase slightly (61 bpm) 25 min postexposure.

## WiFi in schools affects student health

Students in schools with WiFi are complaining of headaches, difficulty concentrating, weakness, and heart palpitations, prompting their parents to take them to their family doctor and to their pediatric cardiologist to determine the nature of their problem.

In one Ontario school district, several students complained of heart problems. A 6-year-old girl had a “musical

heart”, and she experienced headaches and dizziness only at school. A 12-year-old boy had tachycardia (rapid heart rate). A 12-year-old girl experienced nausea, vomiting, no fever, insomnia, blurred vision, and tachycardia only at school. A 13-year-old boy had a pounding heart, insomnia, and headaches. His family moved to a different school district, and his symptoms disappeared.

In the same area, 4 students had sudden cardiac arrests (SCA) during exercise class within a 2-year period. Two of these students were resuscitated. The annual rate for SCA among young people in Canada is approximately 7 per year; hence, 4 in a small community is unusual.

According to Sinatra (13), a cardiologist, Wolff-Parkinson-White (WPW) syndrome, which is a disorder of the conduction system of the heart, is present in 1 out of 700 students. In a school district with 50,000 students, as many as 70 may have this generally undiagnosed condition. According to Sinatra (13), when students with WPW syndrome are exercising and are exposed to microwave radiation, the combined stress on the heart can lead to supraventricular tachycardia, thus creating the “perfect storm”.

Fortunately, due to the Defibrillator Access Act, schools and other public buildings are installing defibrillators. What they should also be doing is trying to determine what is causing SCA and why students are complaining of headaches and heart palpitations at school. A key question that needs to be asked is, “What role does RF radiation from a school’s WiFi system and from nearby cell phone base stations play in these symptoms?”

The effects of microwave radiation on the heart have been known for decades (14). In a 1969 symposium on the biological effects and health implications of microwave radiation, the authors clearly state that, “In the interest of occupational hygiene...researchers have recommended that cardiovascular abnormalities be used as screening criteria to exclude people from occupations involving radio-frequency exposures”. Perhaps students need to be screened at school to ensure that they do not have an underlying heart condition that may be exacerbated with WiFi microwave exposure.

According to Drezner et al. (15), out-of-hospital SCA among young people is on the rise in the USA, although doctors do not know the reason. The increasing exposure to electrosmog may be to blame for at least part of this increase. More research is urgently needed in this area.

Children are much more sensitive to environmental toxins than are adults, and as such, there should be stricter guidelines for exposure. To date, at least nine countries have issued warnings that children should limit their use of cell phones. These countries include the UK (2000), Germany

(2007), France (2008), Russia (2008), India (2008), Belgium (2008), Finland (2009), the USA (2009), and Canada (2012). The same warning should be issued for children exposed to wireless games and WiFi routers, depending on the amount of time students are exposed to these emitters.

WiFi routers emit a beacon signal that is continuous as long as the device is activated. In other words, you do not have to be connected to the Internet to be exposed to the radiation generated by the wireless router. When information is either uploaded or download, the radiation levels increase both at the router and at the computer. The same is true for cordless phones and wireless baby monitors. Voice-activated baby monitors and cordless phones that radiate only when in use are available in Europe but are not currently available in North America.

## Historic research on microwave illness resembles current research on electrohypersensitivity

The information provided in this article is not new. Reviews as far back as 1969 summarized the effects of microwave radiation and identified many of the same symptoms. Dodge (16) reviewed the Soviet and Eastern European literature and reported that microwave radiation affects the central nervous system, ANS (as shown here), neurohumoral systems, endocrine glands and functions, eye and ocular function, blood and hematopoietic system (as shown here), and miscellaneous organs.

Dodge (16) identified general subjective complaints resulting from exposure to electromagnetic radiation (Table 2) that are similar to the symptoms experienced by those who live near cell phone base stations (Figure 2). The major difference is that Dodge was reviewing symptoms for men who were occupationally exposed, whereas Santini et al. (2) was documenting symptoms for those who lived near cell phone antennas and were exposed to radiation in their own homes and as such were unable to avoid exposure.

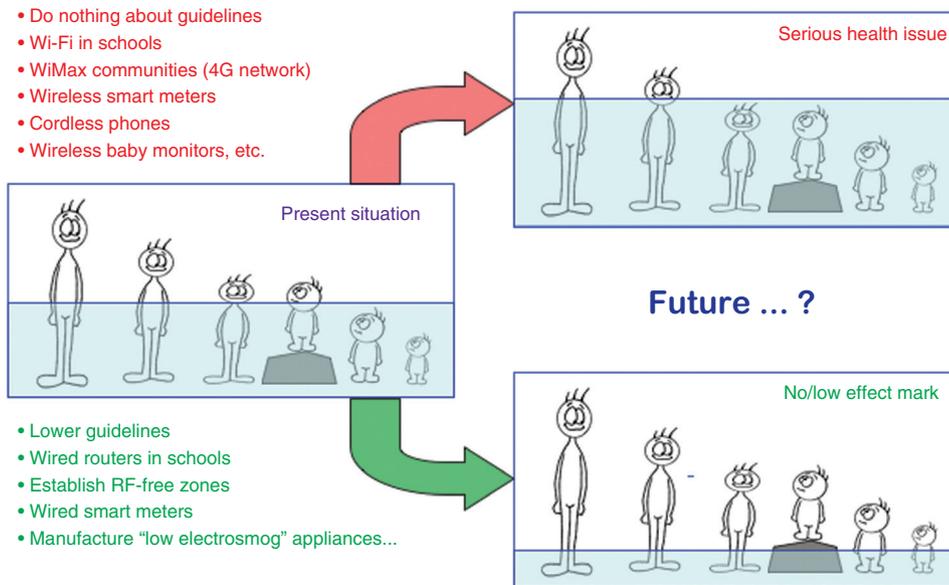
Glaser (17) reviewed the literature on the biologic effects of microwave radiation and provided more than 2000 references in 1972. Although many of these studies were conducted at levels above existing guidelines, we are getting similar results at levels of microwave radiation that are well below these guidelines.

Most revealing are the “psychophysiologic disorders” based on human behavioral studies. These disorders include the following and are similar to those reported by Santini et al. (2): neurasthenia (general “bad” feeling), depression, impotence, anxiety, lack of concentration, hypochondria, dizziness, hallucinations, sleepiness, insomnia, increased irritability, decreased appetite, loss of memory, scalp sensations, increased fatigability, chest pain, and tremor of the hands.

Both Glaser and Dodge worked for the US Navy and had access to information that was later declassified. In one limited-edition (only 15 copies were produced) document, Pollack and Healer (18) recommended that the power density guideline in the USA be reduced from 10,000  $\mu\text{W}/\text{cm}^2$  to the same level used in the Soviet Union (10  $\mu\text{W}/\text{cm}^2$ ), but little attention was paid to this recommendation.

**Table 2** Subjective symptoms associated with RF and microwave radiation.

General subjective complaints resulting from exposure to electromagnetic radiation (16)	Symptoms experienced “very often” by those who live within 300 m of a cell phone base station (2)
Similar symptoms	
Pain in head and eyes	Headaches and visual disruptions
Weakness, weariness, and dizziness	Dizziness and fatigue
Depression, antisocial tendencies, and general irritability	Depression and irritability
Impairment of memory and general mental function	Memory loss
Adenoma and inability to make decisions	Difficulty concentrating
Chest pain and heart palpitation	Cardiovascular
Dyspepsia, epigastric pain, and loss of appetite	Loss of appetite
Sensitivity of mechanical stimulation and dermagraphism	Skin problems
Different symptoms	
Lacrimation	Irritability
Hypochondria, sense of fear, and general tension	Nausea
Inhibition of sex life (male)	Movement difficulties
Scalp sensations and hair loss	Hearing disruption
Trembling of eyelids, tongue, and fingers	Sleep disturbance
Asthma	Feeling of discomfort
Brittle fingernails	



**Figure 7** Two future health scenarios based on the steps we take or fail to take to reduce electromagnetic exposure.

Years later, the power density guideline in the USA was reduced from 10,000 to 1000  $\mu\text{W}/\text{cm}^2$ , although this was still based on thermal effects.

## Where do we go from here?

If we do nothing about guidelines and allow WiFi to be installed in schools, if we allow WiMax to come into neighborhoods as part of the 4G network, if we allow wireless smart meters to be installed on homes, and if we fail to regulate the technology in a way that minimizes microwave exposure, then many more people are likely to become ill and some will die (Figure 7).

If we choose to minimize exposure by establishing biologically based guidelines rather than the current thermal guidelines, by encouraging wired Internet access in schools, universities, hospitals, workplaces, and homes, by installing wired smart meters, and by establishing RF-free zones for those who are highly sensitive, then we can reverse much of the damage that has been inflicted (Figure 7).

The choice is ours, and the real question is, "Do we have the foresight and courage to make the right decision or will we require a health tsunami before we act?"

Received April 23, 2013; accepted July 24, 2013

## References

1. Khurana V, Hardell L, Everaert J, Bortkiewicz A, Carlberg M, et al. Epidemiological evidence for a health risk from mobile phone base stations. *Int J Occup Environ Health* 2010;16:236–7.
2. Santini R, Santini P, Danze JM. Study of the health of people living in the vicinity of mobile phone base stations: 1. Influence of distance and sex. *Pathol Biol* 2002;50:S369–73.
3. Hallberg O, Oberfeld G. Letter to the editor: will we all become electrosensitive? *Electromagn Biol Med* 2006;25:189–91.
4. Johansson O. Electrohypersensitivity: state-of-the-art of a functional impairment. *Electromagn Biol Med* 2006;25:245–58.
5. Havas M, Olstad A. Power quality affects teacher wellbeing and student behavior in three Minnesota schools. *Sci Total Environ* 2008;402:157–62.
6. World Health Organization (WHO). Electromagnetic fields and public health. International Workshop on EMF Hypersensitivity, Prague, Czech Republic, October 25–27, 2004.
7. Austrian Medical Association. Guideline of the Austrian Medical Association for the diagnosis and treatment of EMF-related health problems and illnesses (EMF syndrome). Consensus paper of the Austrian Medical Association's EMF Working Group (AG-EMF). Meeting of environmental medicine officers

- of the Regional Medical Association's and the Austrian Medical Association, Vienna, Austria, March 3, 2012.
8. Rubin GJ, Das Munshi J, Wessely S. Electromagnetic hypersensitivity: a systematic review of provocation studies. *Psychosom Med* 2005;67:224–32.
  9. Rubin GJ, Hillert L, Nieto-Hernandez R, van Rongen E, Oftedal G. Do people with idiopathic environmental intolerance attributed to electromagnetic fields display physiological effects when exposed to electromagnetic fields? A systematic review of provocation studies. *Bioelectromagnetics* 2011;32:593–609.
  10. Rea WJ, Pan Y, Fenyves EJ, Sujisawa I, Samadi N, et al. Electromagnetic field sensitivity. *J Bioelectric* 1991;10:241–56.
  11. Havas M, Marrongelle J, Pollner B, Kelley E, Rees C, et al. Provocation study using heart rate variability shows microwave radiation from 2.4 GHz cordless phone affects autonomic nervous system. *Eur J Oncol* 2010;5:273–300.
  12. Havas M, Marrongelle J. Replication of heart rate variability (HRV) provocation study with 2.4 GHz cordless phone. *Electromagn Biol Med* 2013;32:1–14.
  13. Sinatra S. The negative health impact of wireless technologies and Wi-Fi. Talk at Total Health Show, MetroToronto Convention Centre, April 8–11, 2011.
  14. Cleary SF. Biological effects and health implications of microwave radiation. Symposium Proceedings, Richmond, VA, September 17–19, 1969.
  15. Drezner JA, Chun JSDY, Harmon KG, Derminer L. Survival trends in the United States following exercise-related sudden cardiac arrest in the youth: 2000–2006. *Heart Rhythm* 2008;5:794–9.
  16. Dodge CH. Clinical and hygienic aspects of exposure to electromagnetic fields. Biological effects and health implications of microwave radiation. A review of the Soviet and Eastern European literature. Symposium Proceedings, Richmond, VA, September 17–19, 1969.
  17. Glaser Z. Bibliography of reported biological phenomena ('effects') and clinical manifestations attributed to microwave and radio-frequency radiation. Research report no. 2, revised, AD750275. Bethesda, MD: Naval Medical Research Institute, National Naval Medical Center, 1972.
  18. Pollack H, Healer J. Review of information on hazards to personnel from high-frequency electromagnetic radiation. Internal note N-451, IDA/HQ 67-6211, series B. Arlington, VA: Institute for Defense Analysis, Research and Engineering Support Division, 1967.

# Radiation Sickness

NORD gratefully acknowledges Olivia Lanes, NORD Intern and David Cheng, MD, PhD, Associate Professor of Diagnostic Radiology, Yale University School of Medicine, Chief of Nuclear Medicine, Medical Director of Yale University PET Center, for assistance in the preparation of this report.

## Synonyms of Radiation Sickness

- Radiation Disease
- Radiation Effects
- Radiation Illness
- Radiation Injuries
- Radiation Reaction
- Radiation Syndrome

## Subdivisions of Radiation Sickness

- acute radiation sickness
- delayed radiation sickness

## General Discussion

### Summary

Radiation sickness describes the harmful effects--acute, delayed, or chronic--produced by exposure to ionizing radiation. An observable effect due to radiation exposure becomes quite certain after a single dose of several hundred rads. As a rule, large doses of radiation are of concern because of their immediate effects on the body (somatic), while low doses are of concern because of the potential for possible late somatic and long-term genetic effects. The effects of radiation exposure on an individual are cumulative. Although there is currently no treatment to repair cells that have already been damaged by radiation, the FDA has recently approved drugs that are very effective at removing radioactive elements from the body. Because the damage is irreversible, patients exposed to radiation that are experiencing symptoms should seek medical help immediately so that drugs can be administered.

### Introduction

The first observable cases of radiation sickness occurred after the nuclear bombing of Hiroshima and Nagasaki. Japanese doctors described an unknown disease with symptoms that "suddenly appeared in certain patients with no apparent injuries." It is now known that these first patients were suffering delayed effects of radiation exposure. Radiation sickness can result in patients with low exposure levels, such as cancer treatments, and leave them with symptoms similar to a case of the flu. However, in cases of extreme exposure caused from atomic weapons or a power plant meltdown, such as Chernobyl, the effects can be fatal. Total dose and dose rate determine somatic or genetic effects of radiation. The units of measurement commonly used in determining radiation exposure or dose are the roentgen, the rad, and the rem. The roentgen (R) is a measure of quantity of x or gamma ionizing radiation in air. The radiation absorbed dose (rad) is the amount of energy absorbed in any substance from exposure, and applies to all types of radiation. The R and the rad are nearly equivalent in energy for practical purposes. The rem is used to correct for the observation that some types of radiation, such as neutrons, may produce more biological effect for an equivalent amount of absorbed energy; thus the rem is equal to the rad multiplied by a constant called the "quality factor". For x and gamma radiation the rem is equal to the rad. The rad and the rem are currently being replaced in the scientific nomenclature by two units that are compatible with the International System of Units, namely the gray (Gy), equal to 100 rads and the Sievert (Sv), equal to 100 rem.

## Signs & Symptoms

Acute radiation sickness is characterized by nausea, vomiting, diarrhea, anorexia, headache, malaise and rapid heartbeat (tachycardia). With mild ARS, the discomfort subsides within a few hours or days. However, there are three different types of severe ARS, which can develop as a result of high doses (e.g., an atomic explosion) to small doses (e.g., repeated x-rays over a period of days or weeks):

The type of severe ARS depends on dose, dose rate, affected area of the body, and the period of time elapsing after exposure. The severe ARS is due to penetrating radiation to most or all of the body in a short period of time, usually a few minutes. A patient with any type of severe ARS usually goes through three stages: In the prodromal stage, the classic symptoms are nausea, diarrhea and vomiting. This stage can last for a few minutes up to a few days. In the next stage, called the latent stage, a patient seems to improve to the point where they are generally healthy for a few hours or even a few weeks. The last stage, called the overt or manifest illness stage is specific to each type. They are cardiovascular/central nervous system sickness, gastrointestinal sickness, and hematopoietic sickness.

Cardiovascular/central nervous system sickness is the type of ARS produced by extremely high total body doses of radiation (greater than 3000 rads). This type is the most severe and is always fatal. In addition to nausea and vomiting in the prodromal stage, patients with cerebral syndrome will also experience anxiety, confusion, and loss of consciousness within a few hours, the latent period will occur. 5 or 6 hours after the initial radiation exposure, tremors, and convulsions will begin, and eventually coma and death are inevitable within 3 days.

Gastrointestinal sickness is the type of ARS that can occur when the total dose of radiation is lower but still high (400 or more rads). It is characterized by intractable nausea, vomiting, imbalance of electrolytes, and diarrhea that lead to severe dehydration, diminished plasma volume, vascular collapse, infection and life-threatening complications.

Hematopoietic sickness (bone marrow sickness) is the type of ARS occurs at exposure of between 200 to 1000 rads. Initially it is characterized by lack of appetite (anorexia), fever, malaise, nausea and vomiting, which may be maximal within 6 to 12 hours after exposure. Symptoms then subside so that within 24 to 36 hours after exposure. During the latent period for this type, the lymph nodes, spleen and bone marrow begin to atrophy, leading to underproduction of all types of blood cells (pancytopenia). In the peripheral blood, lack of lymph cells (lymphopenia) commences immediately, reaching a peak within 24 to 36 hours. Lack of neutrophils, a type of white blood cell, develops more slowly. Lack of blood platelets (thrombocytopenia) may become prominent within 3 or 4 weeks. Increased susceptibility to infection develops due to a decrease in granulocytes and lymphocytes, impairment of antibody production and granulocyte migration, decreased ability to attack and kill bacteria, diminished resistance to diffusion in subcutaneous tissues, and bleeding (hemorrhagic) areas of the skin and bowel that encourage entrance and growth of bacteria. Hemorrhage occurs mainly due to the lack of blood platelets.

Delayed effects of radiation can lead to intermediate effects and late somatic and genetic effects. Intermediate effects from prolonged or repeated exposure to low radiation doses from a variety of sources may produce absence of menstruation (amenorrhea), decreased fertility in both sexes, decreased libido in the female, anemia, decreased white blood cells (leukopenia), decreased blood platelets (thrombocytopenia), skin redness (erythema), and cataracts. More severe or highly localized exposure causes loss of hair, skin atrophy and ulceration, thickening of the skin (keratosis), and vascular changes in the skin (telangiectasia). Ultimately it may cause a type of skin cancer called squamous cell carcinoma.

Kidney function changes include a decrease in renal plasma flow, glomerular filtration rate (GFR), and tubular function. Following a latent period of six months to one year after extremely high doses of radiation, protein in the urine, kidney insufficiency, anemia and high blood pressure may develop. When cumulative kidney exposure is greater than 2000 rads in less than 5 weeks, kidney failure with diminished urine output may occur in about 37% of cases.

Large accumulated doses of radiation to muscles may result in painful myopathy with atrophy and calcification.

Inflammation of the sac around the heart (pericarditis) and of the heart muscle (myocarditis) have been produced by extensive radiotherapy of the middle region between the lungs (mediastinum).

Myelopathy may develop after a segment of the spinal cord has received cumulative doses of greater than 4000 rads. Following vigorous therapy of abdominal lymph nodes for seminoma, lymphoma, ovarian carcinoma, or chronic ulceration, fibrosis and perforation of the bowel may develop.

Late somatic and genetic effects of radiation can alter the genes in proliferating cells of the body and germ cells. With body cells this may be manifested ultimately as somatic disease such as cancer (leukemia, thyroid, skin, bone), or cataracts. Another type of cancer, osteosarcoma, may appear years after swallowing radioactive bone-seeking nuclides such as radium salts. Injury to exposed organs may occur occasionally after extensive radiation therapy for treatment of cancer.

When cells are exposed to radiation, the number of mutations is increased. If mutations are passed down to children, this can cause genetic defects in the offspring.

## **Causes**

Harmful sources of ionizing radiation are limited primarily to high-energy x-rays used for diagnosis and therapy, and to radium and related radioactive materials. Present sources of potential radiation include nuclear reactors, cyclotrons, linear accelerators, alternating gradient synchrotrons, and sealed cobalt and cesium sources for cancer therapy. Numerous artificial radioactive materials have been produced for use in medicine and industry by neutron activation in reactors.

The accidental escape of moderate to large amounts of radiation from reactors has occurred several times. The radiation from the atomic bombs dropped in Hiroshima and Nagasaki caused hundred of cases of cancer, mutations, and genetic defects years after the explosion. Radiation exposure from reactor accidents like Chernobyl, for example, resulted in 134 illnesses and 28 deaths.

Very low doses of radiation such as unavoidable background radiation (about 0.1 rad/yr), produce no measureable effect. Mild symptoms have been observed with doses as low as 30 rad. The probability of measurable effects increases as the dose rate and/or total dose increases.

The area of the body exposed to radiation is also an important factor. The entire human body can probably absorb up to 200 rads acutely without fatality. However, as the whole-body dose approaches 450 rads the death rate will approximate 50%, and a total whole-body dose of greater than 600 rads received in a very short time will almost certainly be fatal. By contrast, many thousands of rads delivered over a long period of time (e.g. for cancer treatment), can be tolerated by the body when small volumes of tissue are irradiated. Distribution of the dose within the body is also important. For example, protection of bowel or bone marrow by appropriate shielding will permit survival of the exposed individual from what would be an otherwise fatal whole-body dose.

## **Affected Populations**

Radiation sickness can affect males and females in equal numbers.

## **Diagnosis**

Diagnosis is typically made based on a history of significant radiation exposure. The time between exposure and vomiting also can give good estimates of exposure levels in a patient.

## **Clinical Testing and Work-Up**

Monitoring of exposed patients is mandatory, using Geiger counters or sophisticated whole-body counters. Urine should be analyzed for non-gamma-emitting radionuclides if exposure to these agents is suspected. Radon breath analysis can be done in cases of suspected radium ingestion.

## Standard Therapies

### Treatment

Contamination of the skin by radioactive materials should be immediately removed by copious rinsing with water and special solutions containing an agent such as EDTA (ethylenediamine tetraacetic acid), a chelating agent which binds many radioactive isotopes. Small puncture wounds must be cleaned vigorously to remove contamination. Rinsing and removal of contaminated tissue are necessary until the wound is free of radioactivity. Ingested material should be removed promptly by induced vomiting or by washing out the stomach if exposure is recent.

If radioiodine is inhaled or ingested in large quantities, the patient should be given potassium iodide to block thyroid uptake for days to weeks, and diuresis should be promoted.

In 2015, Neupogen (filgrastim) was approved to treat adult and pediatric patients acutely exposed to myelosuppressive doses of radiation (hematopoietic syndrome of acute radiation syndrome, or radiation sickness). Neupogen is manufactured by Amgen, Inc.

Prussian blue is a pigment that has been used in industry for centuries and has also been approved by the FDA for the treatment of radioactive cesium and non-radioactive thallium exposure. Prussian blue traps these elements in the intestine so that they can be passed out of the body as stool instead of being absorbed.

Ca-DTPA and Zn-DTPA are also FDA approved drugs that speed up the excretion of elements such as plutonium, americium, and curium from the body. Ca-DTPA is given as a first dose, as it is more effective, but after the initial 24 hours, both are equally effective and Zn-DTPA becomes preferable because it removes less essential metals, such as zinc.

For the cardiovascular/central nervous system sickness, treatment is symptomatic and supportive. It is aimed at combating shock and lack of oxygen, relieving pain and anxiety and sedation for control of convulsions.

If the gastro-intestinal sickness develops after external whole-body irradiation, the type and degree of therapy will be dictated by the severity of the symptoms. After modest exposure, antiemetics and sedation may suffice. If oral feeding can be started, a bland diet is tolerated best. Fluid, electrolytes, and plasma may be required in huge volumes. The amount and type will be dictated by blood chemical studies (especially electrolytes and proteins), blood pressure, pulse, urine output, and skin turgor.

Management of the hematopoietic sickness, with its obvious potentially lethal factors of infection, hemorrhage and anemia, is similar to treatment of marrow hypoplasia and pancytopenia from any cause. Antibiotics, fresh blood, and platelet transfusions are the main therapeutic aids. However, a side effect of platelet transfusions may be development of an immune response to future platelet transfusions. Rigid germ-free conditions (asepsis) during all skin-puncturing procedures is mandatory as is strict isolation to prevent exposure to disease-causing germs.

Concurrent anticancer chemotherapy or use of other marrow-suppressing drugs, should be avoided.

Radiation ulcers and cancers require surgical removal and plastic repair. Radiation-induced leukemia is treated like any similar spontaneously occurring leukemia. Anemia is corrected by blood transfusion. Bleeding due to lack of platelets (thrombocytopenia) may be reduced by platelet transfusions.

No effective treatment for sterility, or for ovarian and testicular dysfunction (except for hormone supplementation in some cases), is currently available.

## Investigational Therapies

Bone marrow transplants have proven helpful in some cases. If a whole body radiation dose greater than 200 rads is suspected, and if granulocytes and platelets continue to decrease and fall to less than 500 and 20,000/ cu mm, respectively, compatible bone marrow transplantation should be made. With use of cyclosporin to prevent rejection of the graft, a marrow transplant will most likely increase the probability of survival. Thirteen people at Chernobyl who received estimated total body doses of radiation between 5.6 to 13.4, underwent bone marrow transplants after the Chernobyl accident. Two transplant recipients survived. Others died of various causes including burns, graft-vs-host disease, kidney failure, etc. Therefore, the success of bone marrow transplantation for radiation sickness was inconclusive.

Information on current clinical trials is posted on the Internet at [www.clinicaltrials.gov](http://www.clinicaltrials.gov). All studies receiving U.S. government funding, and some supported by private industry, are posted on this government web site.

For information about clinical trials being conducted at the NIH Clinical Center in Bethesda, MD, contact the NIH Patient Recruitment Office:

Tollfree: (800) 411-1222

TTY: (866) 411-1010

Email: [prpl@cc.nih.gov](mailto:prpl@cc.nih.gov)

For information about clinical trials sponsored by private sources, contact:

[www.centerwatch.com](http://www.centerwatch.com)

## Supporting Organizations

- [American Cancer Society, Inc.](#)
  - 250 Williams NW St
  - Ste 6000
  - Atlanta, GA 30303 USA
  - Phone: (404) 320-3333
  - Toll-free: (800) 227-2345
  - Website: <http://www.cancer.org>
- [Genetic and Rare Diseases \(GARD\) Information Center](#)
  - PO Box 8126
  - Gaithersburg, MD 20898-8126
  - Phone: (301) 251-4925
  - Toll-free: (888) 205-2311
  - Website: <http://rarediseases.info.nih.gov/GARD/>
- [Leukemia & Lymphoma Society](#)
  - 3 International Drive
  - Suite 200
  - Rye Brook, NY 10573
  - Phone: (914) 949-5213
  - Toll-free: (800) 955-4572
  - Email: [infocenter@LLS.org](mailto:infocenter@LLS.org)
  - Website: <http://www.LLS.org>
- [Radiation Sickness](#)

- [Rare Cancer Alliance](#)
  - 1649 North Pacana Way
  - Green Valley, AZ 85614 USA
  - Website: <http://www.rare-cancer.org>

## References

### TEXTBOOKS

Basic Radiation Protection Criteria; recommendations of the National Council on Radiation Protection and Measurements, National Council on Radiation Protection and Measurements (1984).

### REVIEW ARTICLES

Feldmeier JJ, Hampson NB. A systematic review of the literature reporting the application of hyperbaric oxygen prevention and treatment of delayed radiation injuries: an evidence based approach. *Undersea Hyperb Med.* 2002;29:4-30.

Lehmann AR. Replication of damaged DNA in mammalian cells: new solutions to an old problem. *Mutat Res.* 202;509:23-34.

Mendelsohn FA, Divino CM, Reis ED, et al. Wound care of radiation therapy. *Adv Skin Wound Care.* 2002;15:216-24.

Bismar MM, Sinicrope FA. Radiation enteritis. *Curr Gastroenterol Rep.* 2002;4:361-65.

Gandhi OP. Electromagnetic fields: human safety issues. *Annu Rev Biomed Eng.* 2002;4:211-34.

Moysich KB, Menezes RJ, Michalek AM. Chernobyl-related ionizing radiation exposure and cancer risk: an epidemiological review. *Lancet Oncol.* 2002;3:269-79.

Dainiak N. Hematologic consequences of exposure to ionizing radiation. *Exp Hematol.* 2002;30:513-28.

Kilpatrick JJ. Nuclear attacks. *RN.* 2002;65:46-51.

Winkelmann RA, Tretyakov FD, Startsev NV, et al. Cause-of-death registers in radiation contaminated areas of the Russian Federation and Kazakhstan. *Radiat Environ Biophys.* 2002;41:5-11.

Gilbert ES, Land CE, Simon SL. Health effects from fallout. *Health Phys.* 2002;82:726-35.

Murphy GM. Photoprotection: public campaigns in Ireland and the UK. *Br J Dermatol.* 2002;146 Suppl 61:31-33.

Brooks AL. Biomarkers of exposure and dose: state of the art. *Radiat Prot Dosimetry.* 2001;97:39-46.

Rydberg B. Radiation-induced DNA damage and chromatin structure. *Acta Oncol.* 2001;40:682-85.

### FROM THE INTERNET

Definition of Acute Radiation Syndrome. *MedicineNet.com.* Available at <http://www.medterms.com/script/main/art.asp?articlekey=26759>. Accessed 7/22/2011

U.S. Department of Health & Human Services. FDA, US Food and Drug Administration. <http://www.fda.gov/drugs/emergencypreparedness/BioterrorismandDrugpreparedness/default.htm> Accessed 7/22/11.

Centers for Disease Control. Radiation Emergencies, Prussian Blue.  
<http://emergency.cdc.gov/radiation/prussianblue.asp>. Accessed 7/22/2011

Mayo Clinic Staff. Mayo Clinic. Radiation sickness. <http://www.mayoclinic.com/health/radiation-sickness/DS00432> Accessed 7/22/2011

Heller, JL, Medline Plus. Radiation Sickness.

<http://www.nlm.nih.gov/medlineplus/ency/article/000026.htm> Accessed 7/22/2011

### **Years Published**

1986, 1987, 1988, 1989, 2003, 2011

The information in NORD's Rare Disease Database is for educational purposes only and is not intended to replace the advice of a physician or other qualified medical professional.

The content of the website and databases of the National Organization for Rare Disorders (NORD) is copyrighted and may not be reproduced, copied, downloaded or disseminated, in any way, for any commercial or public purpose, without prior written authorization and approval from NORD. Individuals may print one hard copy of an individual disease for personal use, provided that content is unmodified and includes NORD's copyright.

National Organization for Rare Disorders (NORD)  
55 Kenosia Ave., Danbury CT 06810 • (203)744-0100

**FOR MASS DISTRIBUTION**

# **WARNING**

---

To ALL Police, Fire,  
and First Responders:

**Your Wireless  
Communication  
Devices Use  
Pulsed Microwave  
Radiation and  
Effect the Brain**

**[www.StopTheCrime.net](http://www.StopTheCrime.net)**

# MICROWAVE RADIATION FREQUENCY AND W/FI SYMPTOMS

- Confusion
- Short term memory loss
- Inability to focus
- Brain fog/sluggish thinking
- Difficulty concentrating
- Headaches
- Migraines
- Vision disruption or eye problems
- Eye pain
- Cataracts
- Head or chest pressure
- Allergies
- Difficulty breathing
- Respiratory problems
- Slow reaction time
- Sleep disruption
- Insomnia
- Night sweats
- Nightmares
- Dizziness
- Disorientation
- Balance Problems
- Agitation
- Anxiety
- Depression
- Suicide
- Tension
- Irritability
- Tremors
- Nervousness
- Seizures
- Vertigo
- Nausea or vomiting
- Flu-like symptoms
- Digestive difficulty
- Nose bleeds
- Hair Loss
- Rapid Aging/oxidative damage
- Skin problems including rashes
- Skin irritation/dryness
- White Noise 24/7
- Ringing or buzzing in ears
- Ear pain
- Tinnitus
- Bed wetting
- Urinary problems

- Behavioral problems in children
- Pets get jumpy
- Mood disorders
- Lethargy
- Exhaustion
- Chronic fatigue
- Lost productivity/sick days
- Loss of employment
- Unusual family conflicts
- Disintegrating relationships

- organ and brain damage
- Psoriasis
- Autoimmune disease
- Lupus
- Damages mitochondria
- Free radical damage and aging
- Worsening existing poor health
- Demineralization of cells/tissue
- Impotence
- Infertility
- Birth defects
- Life span decreases by +/-8 years
- Heart Attack
- Pacemaker defibrillation
- Circulation problems
- Joint difficulty
- Muscle pain
- Fibromyalgia
- Dementia
- Personality changes
- Alzheimer's, Parkinson's, ALS  
Amyotrophic Lateral Sclerosis
- Childhood cancers increase
- Brain tumors
- Rare Deadly Brain Gliomas
- Leukemia
- Cancer
- Diabetes
- Heating beamed on humans that mimics a high fever
- Rhinitis (inflammation nasal membranes)
- Asthma
- Allergies such as hay fever
- Food allergy
- Atopic dermatitis (inflammation of the skin)
- Itching and chapped skin on the trunk
- Rheumatism (painful condition of the joints and muscles characterized pain and stiffness)
- Benign uterine fibroid tumors
- Bone loss/osteoporosis
- Dehydration
- Kidney damage



- Electronic Harassment-Stalking-Mind Control
  - Violent behavior
  - Autism
  - ADHD
  - Weakened immune system
  - Physical weakness or pain
  - High blood pressure
  - Leg cramps
  - Stiff neck or back
  - Shuts down the cells-cell death
  - Changes in genetic makeup
  - DNA breakage
  - EMF causes mercury dental filling vapor to leak causing

References:   
 \*Bio Initiative Report: Over 2,000 Scientific Studies [www.BioInitiative.org](http://www.BioInitiative.org)  
 \*AAEM-American Academy of Environmental Medicine - Position Paper "Electromagnetic and Radio Frequency Fields Effect on Human Health", including Wireless Technologies and Smart Meters  
 \*Department of the Army - Fort Mead "Bioeffects of Selected Nonlethal Weapons" Radiofrequency directed energy and Microwave (EMF/RF Radiation) on Targets  
 \*NASA: the Future of Warfare Document - Page 50 - Effects of Low Power Microwaves

**Confidential Report**

on

**TETRA**

Strictly for the

**Police Federation  
of  
England and Wales**

**B TROWER**

## INTRODUCTION

With respect to my fellow scientists I shall be writing this report in non-scientific speak for all of those readers who have not had the benefit of a scientific education.

## WHAT IS ALL THIS REALLY ABOUT?

Imagine the field around a magnet and imagine ordinary everyday static electricity. If you put the force field from the magnet with the force field from the static electricity you make a wave. This wave is called an electromagnetic wave. There are lots of different types of electromagnetic waves but they are all made of the same two things – magnetic and static. The only difference between the waves is their wavelength or the length of the wave and the number of waves that can be produced a second, i.e. the frequency. All of these waves are put into a table called the electromagnetic spectrum.

At one end of this electromagnetic spectrum you have the very short waves, namely gamma rays and x-rays and at the other end of the spectrum you have the very long waves, namely radio, TV and waves from overhead power cables. All of these waves have the same properties; that is to say they all behave the same. They can all be reflected, refracted, and they all travel at the same speed, which is the speed of light. For interest, if you were one wave of light you would be able to travel around the world nearly seven times every second; that is the speed of light. The electromagnetic spectrum is ordered so that at the short wave end you have the gamma rays, x-rays, ultra-violet, visible light, infra red, microwaves, radar, TV and radio in that order. The ultra-violet and above are known as ionising waves and there is no argument as to the damage they can cause when entering the body. Below ultraviolet is said to be non-ionising and this is where arguments occur between scientists as to whether damage can occur inside the human body through exposure to these waves. The microwaves

used in the TETRA system are in the non-ionising section of the electromagnetic spectrum and I will be discussing the arguments concerning microwaves and health in this report.

## SAFETY LEVELS

In this country, when somebody asks about whether a certain level of electromagnetic radiation is safe they are usually quoted a safety limit. This safety limit is laid down by the NRPB (National Radiological Protection Board). Usually when you ask about a dose of radiation you find that the amount that you were asking about is thousands of times below the safety limit and thereby reportedly safe. A safety limit is really a personal opinion. This personal opinion may be based on many factors by an individual or individuals from whatever data they have in their possession. To give you an example of some safety limits around the world, for one particular type of microwave transmitter, these read as follows:

Toronto Health Board	:	6 units
Italy	:	10 units
Russia	:	10 units
Poland	:	100 units
US Research Base	:	100 units
International Commission	:	450 units
The NRPB for Britain	:	3,300 units

There are other values for other transmitters but there is no need to list those in this document.

To look at this another way, supposing you took your car to a garage and one mechanic estimated a price of £6 and another mechanic estimated a price of £3,300 for the same job, you would feel justified about questioning the decisions. The reason that our safety limit is much higher than the rest of the world is that in other countries they base their safety limits on possible effects from the electric field, the magnetic field and the heat produced in the body. Our NRPB will only base the safety limit for this country on the heat produced in the body. I will comment on heat further in this report (Appendix 1, Reference 1).

## WHAT IS BELIEVED TO HAPPEN AS THESE WAVES ENTER OUR BODIES?

I will try to summarise the thousand or so research papers written over the last 20 or so years and explain or summarise what happens when the electric and magnetic part of the wave goes into our bodies.

We being water based animals act like aerials to these waves. As the waves go into our bodies an electric current is generated inside our bodies which is how aerials work; waves come in and electricity is generated. The electricity generated in our bodies like all electric currents goes to ground through our bodies and like all electric currents it takes the path of least resistance. Unfortunately the path of least resistance through our bodies, although only representing 10% of our pathways, carries 90% of our traffic rather like the M1 motorway. The traffic in our bodies, namely hormones, antibodies, neurotransmitters know where they are going because they also carry an electric charge. The hormones, antibodies and neurotransmitters know where to "get off" because there is a corresponding opposite charge at the site of delivery rather like the positive and negative ends of a battery. The problem is if you have an electric current passing through the body it can change this charge, either on the hormones, antibodies or neurotransmitters or the site of delivery.

An analogy to that would be - if you were in Paris on the Underground system and you could not speak a word of French, but you had a map with the station name of where to get off and somebody tippexed out one or two of the letters, you may get off or you may

not, and this can happen in the body. The hormones, antibodies or neurotransmitters may get off where they are meant to get off or they may carry on and miss their target. As a one-off this probably would not be very important but continuous interference over many years it is argued can lead to many illnesses.

A similar effect is that the destination for some of these hormones, neurotransmitters, antibodies is a surface of a cell where chemicals will pass through a membrane into a cell. If you think of a cell in our body, be it a brain cell, bone cell etc, as having a positive and negative charge on the outside and the inside similar to a battery the difference in these charges will draw the chemical into the cell or draw poisonous substances out of the cell. If the charge is changed on the outside of the cell, then necessary chemicals may not go in or poisonous chemicals may not go out. An analogy to that would be – think of your house as a cell in your body. Essential things like food, water and fuel come into the house and poisonous things like waste and gases leave the house. In fact a house is very similar in many ways to a cell in our body. Now, if we had a blockage and waste could not leave the house or sometimes food or electricity did not come into the house, over a short period of time we would survive this, but continual disruption over many years will probably have a knock-on effect on the health of the inhabitants particularly if they are young or frail. This is my explanation of how electromagnetic waves affect our cells.

A final description is possibly the accumulative effect of all the particles going through the body each second. Each particle and for TETRA we are talking about 400,000,000

particles a second carries a small amount of momentum with it. As an analogy, imagine you are driving down the M1 in the largest lorry you could possibly imagine and you are hit by the smallest dust particle you could ever imagine. Obviously the dust particle will not effect the speed or momentum of your lorry but if you have 400,000,000 dust particles a second for many years they could if something else was going wrong with your lorry exacerbate the effect and slow your lorry, and that is the crucial point. All of these effects I have described are believed to have one final conclusion. They all in their own way suppress the immune system. When you suppress the immune system as I will show in research papers, you tend to have more colds, more coughs, longer colds, longer coughs, longer illnesses, depression, anxiety leading to suicide or taken to its ultimate – leukaemia.

I will summarise just four of what I consider to be extremely well written research papers by arguably the worlds leading scientists in this field. There are other leading scientists of course but I cannot list them all in this report. I am using these as specimen papers.

When I refer to research papers I am not referring to something that somebody has sat down one Sunday afternoon and just written. These research papers have sometimes hundreds of references in the back and each reference on its own is usually 5-10 years work by a group of scientists where their work would have been peer reviewed, and in a lot of cases published. So for arguments sake, if a paper has say 100 references in the back that could well constitute 500-1,000 years accumulative work.

The first paper (Appendix 2, Reference 2) by Dr Neil Cherry was presented in May 2000 to the New Zealand Parliament, to Italy, Austria, Ireland and the European Parliament in Brussels. This paper has 122 references. I have photocopied the references to show that as well as being peer reviewed, many are published. I will do this with the other three papers (Appendix 3).

From this research paper some illnesses caused by long-term low level electromagnetic radiation are:

Heart problems;

Blood problems;

Interference with bone marrow;

Tumours;

Calcium interference;

46% reduction in night-time melatonin;

It is believed that during the daytime light going through our eyes passes a message to the pineal glands in the brain which slows down the production of melatonin. At night when no light goes through our eyes the production of melatonin is speeded up. Melatonin is believed to scavenge cancer cells and impurities in our bodies and boost the immune system. If an officer is sleeping in quarters within range of the TETRA transmitter, the microwave radiation is believed to act on the pineal gland and suppress the night-time melatonin to daytime levels; hence the good work of the melatonin at night will be restricted leading to suppression of the immune system.

Increased arthritis;

Skin problems;

Ear problems;

Risk to leukaemia;

Childhood cancer;

Sleep problems;

Depression;

Memory loss;

Difficulty in concentrating;

Mental conditions;

A very recent discovery shows that microwave radiation changes the permeability of the blood brain barrier. Our brain has its own immune system as does our body. The blood brain barrier keeps everything that is designed to be kept within the brain inside it and protects the brain from any unwanted diseases or chemicals which could harm it. Similarly it allows out of the brain anything dangerous to the brain. The blood brain barrier is rather like a sieve where only particles of a certain size may go through. Professor Salford at Lund University in Sweden has shown that such pulsing as from mobile phones can alter the permeability of the blood brain barrier (Appendix 4, Reference 3). I will argue as TETRA pulses, which is arguably more powerful than the average mobile phone, this situation could be worse with TETRA.

Also, it is shown that the electromagnetic radiation going into the body can change the size of the particles moving around the body (Reference 4). This is rather like an ice skater spinning on her skates. With her arms out she spins slowly, but if she pulls her arms in she spins faster. Microwaves can affect the particles in our body by changing their spin; hence their size. They can be made smaller or larger. With the changing of the permeability of the blood brain barrier and the changing in size of particles unwanted particles may enter the brain or necessary particles may leave the brain. The connection here with mental conditions is that Dr Hyland of Warwick

University has written that the uptake of drugs; in particular neurological drugs is inhibited because of changes in the blood brain barrier.

Neurological illnesses;

Headaches;

Dizziness;

Fatigue;

Miscarriage; and

Infertility.

I have listed all of the references on this particular research paper because all of these researches correspond to the above list.

The second paper I would like to comment on (Appendix 5, Reference 5) has 80 references and as well as a lot of the illnesses written in Dr Cherry's paper goes on to mention that with regard to mobile phone handsets you should avoid keeping the handset when switched on adjacent to the body, in particular in the vicinity of the waist or heart. There have been deaths due to colon cancer from the Royal Ulster Constabulary who wore radio or microwave transmitters in the small of their backs for extended periods of time. Dr Hyland recommends keeping the duration of calls to an absolute minimum and on his back page relating to pulse mobile phone radiation on alive humans and animals, the following may occur:

Epileptic activity;

Effects on human EEG;  
Effects on blood pressure;  
Depression of immune systems;  
Increased permeability of the blood brain barrier;  
Effects on brain electro-chemistry;  
DNA damage in rodent brain;  
Cancers in mice; and  
Synergistic effects with certain drugs.

Dr Hyland, in my opinion, is one of the world's leading authorities in this area and his advice is not to be dismissed lightly. Similarly, another very highly respected scientist is Dr Coghill. I would add that both Dr Hyland and Dr Coghill are members of the Stewart Committee.

Dr Coghill's paper which has 218 references (Appendix 6, Reference 6) agrees largely with the work by Dr Hyland and Dr Cherry. In this paper, Section 1.16, Dr Coghill writes "the ultimate question must be whether chronic exposure to say 1 V/m electric fields at the envisaged frequencies is likely to produce adverse health effects in the long term. At present the NRPB guidelines recommend an investigation level of 192 V/m while ICNIRP now offers much lower levels. However these are based on thermal effects: if non thermal evidence is accepted than 1 V/m is demonstrably able to induce biological effects, some of which may be adverse". I will show in a later paper that TETRA delivers a lot more than the 1 V/m recommended as a maximum by Dr Coghill.

Dr Coghill also, in his summary in the back, lists symptoms caused by mobile phone use. Again, I will argue that as TETRA is pulsed and pulsed radiation is arguably more aggressive than the continuous analogue wave and TETRA uses more power than the ordinary mobile the symptoms will be enhanced rather than be reduced for TETRA.

The symptoms listed by Dr Coghill are:

Fatigue;

Headache;

Warmth behind the ear;

Warmth on the ear; and

Burning skin.

My final paper by a very highly respected New Zealand doctor, Dr Eklund (Appendix 7, Reference 7) which has 37 references shows leukaemia clusters in and around ordinary radio and TV transmitters around the world. She says on page 13 that adult leukaemia within 2 kilometres of a transmitter is 83% above expected and significantly declines within increasing distance from the transmitter. Similarly skin and bladder cancers follow a similar pattern. As a scientist I could argue that if leukaemia's and cancers are known to exist from ordinary radio and TV transmitters which take many years to form and radio and TV waves are at the long end of the electromagnetic spectrum, and it is known that exposure to gamma rays or x-rays can cause death within a matter of weeks, a hypothetical line could be drawn from the long waves to the short waves to determine the length of time or exposure doses needed to cause such illnesses. Fitting

into this pattern would be several years exposure to sunlight causing skin cancer. There are obvious anomalies with this; namely personal health, hygiene and all sorts of other factors, but as a crude estimate I would argue that the further up the electromagnetic spectrum you go, the shorter the time for the serious illnesses to occur. The microwaves used by TETRA are above radio and television waves. Being water-based animals we are particularly sensitive to microwaves; this is why microwave ovens work. Microwave ovens resonate the water molecules in food and when molecules resonate they re-emit the energy they absorb as heat. This is why the food warms up and the plate does not, because it does not contain water.

The warmth on and behind the ear felt by users of mobile phones is one type of heat. Another type of heat unknown to the user, therefore not reported are hotspots within the body from microwaves. These hotspots are tiny areas in the body which warm up considerably when exposed to microwave radiation. The problem with warming up areas inside the body is that a very recent research paper has shown that heat shock proteins are produced to protect the cells in the body from damage. Heat shock proteins act rather like scaffolding around a building; they go around the cell and protect the DNA from damage from the heat. Heat shock proteins have been known to work when the temperature rises by just 2 degrees. Now the problem with heat shock proteins is as well as protecting the good cells they can also protect and save from destruction cancer cells. So, if you have a cell in your body which is turning cancerous and would normally be destroyed by the body's immune system, the heat shock proteins

will protect it and it will continue to grow. This work was carried out by Dr David de Pomerai, of Nottingham University (Appendix 8, Reference 8).

A report on mobile telephones and their transmitters by the French Health General Directorate, dated January 2001, states in its conclusion of the group of experts that "a variety of biological effects occur at energy levels that do not cause any rise in local temperature". The group ask "is it possible to state that there are no health risks?" and they reply "No". They go on to say "minimise the use of mobile telephones when reception is poor, use an earpiece kit and avoid carrying mobile phones close to potentially sensitive tissue, i.e. a pregnant woman's abdomen or adolescent gonads". They recommend hospitals, day-care centres and schools should not be directly in the path of the transmission beam. Also and very important, they say "the cumulative exposure over their lifetime will be higher ...". The word cumulative is also mentioned by Professor Sosskind and Dr Prausnitz in their paper (Reference 9) where they say "an accumulated cellular level damage mechanism is not necessarily related to the intensity but can relate to total dose ... Hence the averaging of weekly exposure is a meaningful adverse effect related level".

This accumulative factor puts a very different slant on doses of microwave radiation. In particular an accumulative level of radiation can build up very quickly when you receive 400,000,000 waves every single second. This is why scientists are concerned and warnings have been issued for people with pacemakers, hearing aids, insulin pumps in relation to interference of their apparatus from electromagnetic waves. Warnings are

also given to persons with metal implants in their bodies. These implants can a) warm up; and b) absorb the microwave radiation and re-emit it at a different wavelength. I have been around the world talking to scientists and we agree, although it cannot be proved, that the recent incidents in breast cancers in ladies could be due to the metal underwiring in bras absorbing microwave radiation and re-emitting it at a different wavelength into the mammary glands of the breast. The mammary glands are known to be particularly sensitive to radiation and they are known to be easily changed into cancer cells.

Following this line of thought, I would argue scientifically that using a TETRA handset, remembering that if you are using a TETRA handset you must also be receiving radiation from the main transmitter, i.e. you do not just have the radiation from the phone you would have the radiation from the transmitter as well, or the phone would not work, could enhance breast cancer in the lady police officers. A similar argument follows with the argument that the eyes receive 29% extra radiation because of their moist make-up. Metal-rimmed spectacles will absorb the microwave radiation and re-emit it onto the surface of the eye. Again, unproven, but I can follow the arguments that support the two recent research papers which have found increases in eye cancers in two separate areas of the eye. One cancer has been found in the side of the eye, one cancer has been found in the front of the eye (Appendix 9, Reference 10) (Appendix 10, Reference 11).

As a result of using pulsed mobile phones, again I will argue that as TETRA is more powerful than the average mobile there could be long-term damage to the eyes of the officers using TETRA.

A union document (Reference 12) printed 4 December 1979 for microwave transmitters up to 100,000 MHz warns its members of the following illnesses which may occur from accumulative exposure:

Menstrual problems;

Miscarriage; and

Problems of the eye, heart, central nervous system, reproductive organs.

They say "a false sense of safety may exist and non-thermal effects are much lower than have been recognised". The TETRA system of 380-400 MHz is within this range of this union paper. I emphasise that these effects are not new; they were being reported on as far back as 1979 and further on in this paper I will show documents that relate to exposure effects going way back to the early 1960s. A very important sentence in this research paper states "non-ionising radiation increases molecular vibration and rotational energies". I will refer to this further on in this document.

## INSURANCE

Two of the worlds largest insurance companies, Lloyds and Swiss Re, have recommended to other insurance companies on the advice of Dr Theodore Litivitz, Professor Emeritus of Physics at the Catholic University of America, to write in exclusion clauses against paying compensation for illnesses caused by continuous long-term low level radiation. My concern for the police force, although adequately insured, is that if in future years officers start claiming for spine or brain tumours the insurance company will terminate its contract with the police force and leave it uninsured.

## SURVEYS

Two recent surveys printed in Electromagnetic Hazard & Therapy 1998, Volume 9 and 2000, Volume 11; the first of a study of 11,000 mobile phone users, the second a study of 17,000 mobile users showed the symptoms already mentioned of fatigue, headache, warmth behind the ear, warmth on the ear and burning skin in various degrees, depending on the use and type of person. From the 17,000 persons studied, these symptoms varied from 31% to 78% of the users. If I take the lowest number of 31% as a purely hypothetical exercise which is easily dismissed as rubbish, but does give us a look at some of the numbers that could be involved; if we take 100,000 police officers then 31,000 of these officers could experience one symptom. Playing the numbers game, if these 31,000 that experienced one symptom were to progress to a more complicated level, let's argue 10% of them may develop a migraine or a headache or require one day's sick we would have 3,100 officers taking a day's sick. If 10% of those developed something more serious that required further sickness we would have 310 officers off sick. If we take 10% of those and suggest that something more serious may occur then we could be looking at 31 officers, or I would argue 31 families, per hundred thousand involved in something which may develop into a serious medical condition. I stress that this is hypothetical because it is very difficult to predict the future for a device that has not been tested and there are no long-term studies available.

As an aside it was noted last year that the Public & Commercial Services Union recommended to its 266,000 Civil Service members that they should not be forced to carry mobile phones.

## GROUND CURRENTS

A very little understood phenomena and reported by Dr D Dahlberg (Reference 13) is ground currents from living in the proximity of transmitters on animals. I mention this with a view to the police dogs and the police horses in their kennels or stables at a constabulary base which is bound to have a transmitter. All transmitters pass an electric current to the ground beneath them. If the ground is particularly wet this has an adverse static effect on the animals concerned and in farm animals can effect milk productions or food production. Huge static charges are built up in the animals and everytime they come across a metal object the charge is discharged through the head; the nose being wet. It has been shown that if animals are taken away from this environment they recover very quickly, yet in the environment of ground currents they also become very sick very quickly. I am particularly concerned for the acutely sensitive brains and organs of the highly trained police dogs.

Three years ago when a lot of research papers individually were being dismissed I decided to look at several of the main papers and show that there was a knock-on effect in the body. I drew two flow diagrams showing the knock-on effects from approximately 25 research papers to show that even if one symptom is dismissed there can be an accumulative effect throughout the body. The two flow charts - Appendix 11 relates to the body and Appendix 12 relates to the brain, show clearly that our body systems are very closely interlinked.

Taking TETRA's lowest operating power level of 2W I wrote a hypothetical equation, and being hypothetical it is very easily dismissed, which shows that at the 2W cell activity may be accelerated by a factor of 6 or slows down by a factor of 7.5.

There are experimental papers which do in fact show that mobile phones may speed up thought processes or may slow down cellular activity. I have tried to explain this using theoretical physics. I based my paper on the already previously mentioned accumulative doses and increased molecular vibration (please see previous references). I am fully prepared to be told that I am wrong or mistaken but I believe I can explain the process by which energy once inside the body affects the cell potential (charge on the outside of the cell), the signal transduction (movement from the outside to the inside of the cell) and the cell cycle timing (the process by which our cells operate). I have placed this calculation in Appendix 13.

Often overlooked are the electromagnetic waves from the cables and transformers of all electrical transmitters. These are usually in cabinets near the transmitters, hence near offices or sleeping quarters on constabulary bases or near kennels or stables. A research paper published in the Journal of Biological Chemistry in 1998 (Reference 14) describes the 50 cycles a second waves emitted by transformers and power cables, and how they may induce leukaemia. Although the NRPB and the National Grid have denied that these waves are dangerous both this paper and an article in the New Scientist dated 10 March 2001, page 7 which reads "Guilty as Charged. Powerful fields

from pylons and cables are linked to childhood cancer", demonstrates to me scientifically that these transformers and power cables should not be overlooked.

## THE CONCLUSIVE PROOF ARGUMENT

The Government's scientists will often ask for conclusive proof when they are challenged. It is a word often used when you wish to win your side of the argument. Scientifically conclusive proof is impossible to obtain – let me explain.

I was at a legal hearing in Torquay representing a community and the barrister representing the communications industry said "there is no conclusive proof that these microwaves will cause damage". I argued: if somebody stood up and shot me in this courtroom there would be three levels of proof. You would have everybody as a witness and that would be accepted in a Court of Law. A pathologist could perform a post mortem, decide that the bullet killed me and that would be a second level of proof. If, however you wanted conclusive proof that the bullet killed me, you would have to argue that at the split second the bullet went into my body every system in my body was working perfectly because there are thousands of reasons why I could drop dead on the spot before the bullet went in and you would have to prove conclusively that all of these systems were working perfectly before the bullet went in. Clearly, this is scientifically impossible; there is no such thing as conclusive proof, yet it is what is demanded by government scientists when challenging their decisions.

Conclusive proof has been demanded by scientists defending their decisions after they have said the following are safe:

Thalidomide;

Asbestos;

BSE;

Smoking;

Sheep dip;

Gulf War Syndrome;

GM Foods; and

Vitamin B6.

With the above list it will be recognised that evidence of damage from these comes only from counting the people who are injured. I am arguing scientifically that there is a blanket denial by some scientists and the only way to show them wrong is to present them with a certain number of bodies. When commercial interests are at stake there seems to be a denial of relevant scientific data. The problem with the microwave communications industry is that they do not have to prove it is safe; you have to prove it is not, and that is an entirely different ball game. As a scientist, if I develop a new pill I have to run a 5 or 10 year clinical trial and convince a Board of my peers that it is safe before I have permission to release the pill onto the market. With the telecommunications industry the tables are completely turned around. They do not have to show these instruments are safe; you have to show they are not.

## UNDERSTANDING RADIATION (MICROWAVE AS IN TETRA)

There are unknown phenomena concerning low level radiation that is not generally understood by the users of communication instruments. Following the Chernobyl incident it was found that long-term continuous low level radiation of all types was as dangerous as high level doses of radiation. With high level doses of radiation the anti-oxidants in the body (Vitamins A, C, E etc) rush to defend and repair the area of the body being damaged. However with low level radiation the anti-oxidants are not activated and because the dose is accumulative the problems can build up and are usually present before the body realises that there is trouble. So, low level does not necessarily mean safer. Also the smaller you are the more you tend to absorb. Wavelengths for TETRA and mobile phones are relatively short and the nearer the part of the body or the infant to the wavelength the more similarity they have to an aerial and the more they absorb. With ordinary mobiles the wavelength is around the size of a foetus and with TETRA you are looking at a 3-6 year old child. I mention this because TETRA may be used in areas where children are running around and there are very well known and documented cases of pulse radiation affecting epileptic children.

Pulse radiation from TETRA at 17.6 Hz (waves per second) is known to interfere with our natural brains rhythm. Our brains generate their own waves within our head. One of these waves, called beta waves is on a very similar frequency to the TETRA handsets. What happens is: If you could imagine yourself jumping on a trampoline and somebody larger and heavier jumps on and dances at a slightly different speed you will

bounce at their pace rather than yours. When they jump off you will still bounce at their speed. The jumping on of the person onto the trampoline is known as entrainment and this occurs when the TETRA is used in close proximity to an officer's brain. Because TETRA affects the beta rhythm of the brain it will affect what the beta rhythm is responsible for; namely sounds judgement in emergency situations. Entrainment is always followed by a phenomena called long-term potentiation. This is an analogous to the person getting off the trampoline leaving you dancing. Long-term potentiation has been known to last several weeks after the initial source has died down. The implications for this are that the officers' brain waves would continue to suffer entrainment even after the sets have been switched off, which would be reinforced everytime the sets are switched on again.

The first paper written on this subject was by a scientist called Ptolomy who was a Greek living in Egypt in 64BC. Ptolomy found that when he spun a wheel with holes in up against the sun at different rotational speeds he could induce different effects on the brains of his subjects. To get an idea of the complexity of the brain, if you imagine every single person in every single city in the world picking up their telephone and dialling everybody in their phonebooks, that is roughly how many connections we have in the brain. I will show later that even the Stewart Committee advised against using any communication instruments that pulsed above 16 waves per second. TETRA is of course 17.6 waves per second.

## MY SCIENTIFIC CONCERNS ABOUT THE NRPB

From a court case towards the end of 1998 Dr McKinlay was questioned in court about the use of mobile phones. Dr McKinlay is a senior scientist in the NRPB. It is known that roughly half of the NRPB's funding comes from the industries it represents, the other half of its funding comes from the Government. In court Dr McKinlay explained that data on tissue conductivity was supplied to the NRPB by Dr Camelia Gabriel of Microwave Consultants Limited. It transpired that virtually none of the NRPB documents on non-ionising radiation are peer reviewed and that Dr McKinlay himself had not authored any experimental studies. Dr McKinlay admitted he had no biological expertise. Dr Camelia Gabriel is Director of Microwave Consultants Limited and she reports to the Home Office and the Health & Safety Executive. She is also Chairman of the European Standardisation Body.

To summarise, the NRPB subcontract research on microwave radiation to Microwave Consultants Limited; namely Dr Camelia Gabriel. Dr Camelia Gabriel is also a senior consultant for Orange plc and has authored jointly with others the Orange Base Stations Health & Safety Manual (please see Appendices 14 and 15). Dr Gabriel's son, also of Microwave Consultants Limited, confirms the safety of transmitters for Orange plc in school playgrounds (Appendix 16). This dual interest between Dr Camelia Gabriel as representing the NRPB and Orange plc was picked up and reported on, on 19 April 1999, by The Observer where Sarah Ryle writes "concerns are increasing about industry's involvement in research. Some of the NRPB's conclusions have been based

on research by Dr Camelia Gabriel, a technical advisor to network operator Orange and Head of Private Consultancy, Microwave (Appendix 17).

The problem as I see it is that when it comes to asking about safety concerning TETRA or any other communication instrument there is not one single independent person to give an answer. Every single person who has a word to say about the safety of police officers is somehow in the "food chain" going back to the communications industry. The communications industry fund the NRPB and the Government who fund Microwave Consultants Limited so every single person has a financial interest in recommending the product.

## THE ABSOLUTE PARADOX

Since the early 1960s this country, America and Russia have had what is called the non-lethal weapons programme or synthetic telepathy programme. It is very well documented now that in the early 1960s in Moscow the Russians beamed continuous low level radiation (microwaves) down onto the American Embassy causing miscarriages, leukaemia's and other illnesses to the Embassy staff. Since then the non-lethal weapons programme has become very sophisticated indeed. It is used a) as a long-term low level radiation weapon to cause populations illness and b) at higher intensities to cause blindness, heart attacks or confusion. Details of all of the intensities are unknown to me but knowing that microwave radiation is accumulative, any effect can only be a matter of time. In quoting this research I refer to documents listed under Reference 15. So sophisticated is this research, and I refer to Operation Pandora Joint CIA/MI6 Operation since the 1960s, Operation Woodpecker USSR 1976, Operation HAARP still running in USA; they are able to define specific pulse frequencies to cause specific brain malfunctions or illnesses. For instance:

<u>Frequency</u>	<u>Illness Caused</u>
4.5	Paranoia
6.6	Depression/Suicide
11	Manic behaviour/Anger
25	Blindness if aimed at the head/Heart attack if aimed at the chest

Other consequences of frequencies used but not listed here are hysteria, trauma, lust, murder and cancer, and may all be induced.

The TETRA frequency is 17.6 Hz (waves per second) so as a scientist looking at this data which is well publicised I ask myself, if the illnesses moving up the frequency range are progressive and TETRA is between the frequency of 11 and 25 on this table, what will be the effect of TETRA's 17.6 waves per second on the brains of the police force? This phenomena cannot be denied by the NRPB; it is listed in their own document which I will refer to later in this paper, where on page 26 they have described how at 8 waves per second animals can be made to fall asleep and at different frequencies behave differently in various parts of their brains.

As this phenomena is written about by the NRPB for 8 waves per second I would like to know what other research they have for other frequencies in and around the TETRA range.

HAARP, which is being researched by a nun, Dr Rosalie Bertell, who is concerned about what it represents along with other scientists knows that HAARP is capable of bouncing low level continuous microwave radiation pulsed off the ionosphere to any community in the world and may cause cataracts, leukaemia, changes in blood brain chemistry, changes in blood sugar levels, blood pressure and heart rates.

The paradox of course is how can one system of pulsed microwaved radiation be used as a weapon to cause illness or death and at the same frequency and unless close range, a similar low intensity be used as a safe communications instrument. Following this research I fail to see how TETRA can possibly be safe for the officers which use it.

This argument is further reinforced by a Channel Four document (Reference 16) and I quote: "The telecoms industry has known about American research suggesting there may be brain effects from TETRA for at least a year". "The research suggests that TETRA radios may have a direct effect on the brain's bio chemistry". "The researchers found that balance changed when brain cells were exposed to pulsed radio signals".

On page 4 it is quoted "the Government was warned about the issue last year. The Stewart Report into mobile phones recommended research into pulsed signals and suggested the technology be avoided ... As a precautionary measure amplitude modulation (pulses) around 16 Hz should be avoided if possible". He continues "what the frequency of 17.6 Hz is doing is duplicating microwave weapons which you buy at arms fairs. So by holding one of these devices to their heads they are putting a small microwave weapon to their head everytime they use it". He finishes "but there is enough to warrant asking why the system is being rolled out before the proper research has been conducted into an effect which not only falls outside all the existing regulations but which the Government advises on mobile phones believes it important enough they recommend the technology not to be used and which the military authorities apparently

believe is so powerful that they can design non-lethal weapons to disrupt the minds of their targets".

In *Electromagnetic Hazard & Therapy* 2001, Volume 11, Numbers 2-4, Page 9, Simon Best says when writing about microwave crowd control weapons "after 20 years of rumours and speculation the Pentagon has finally confirmed that it has developed a device as part of its joint non-lethal weapons programme ..." He continues "in the UK many of the women protestors at Greenham Common in the 1980s experienced symptoms that they attributed to being zapped by microwave weapons from the US base".

Reported in *The Guardian*, Tuesday 8 May 2001 (Appendix 18) Stuart Millar and Stuart MacWilliam write "two independent experts on the biological effects of electromagnetic radiation have accused Ministers of using the police as guinea pigs by pressing on with the launch of the BT Airwave System in the absence of detailed research into potential health risks". They continue "last year Sir William Stewart's report on mobile phone safety concluded that systems modulating at frequencies around 16 Hz should be avoided if possible in future developments of signal coding". They conclude "low frequency electromagnetic radiation was identified as far back as the 1960s as a potential anti-personnel weapon when the superpowers began conducting experiments into non-lethal mind control devices".

Low level pulsed signals have even been tried in the oceans. It was reported (Reference 17) by Gibby Zobel that the whales and dolphins beached themselves because their delicate navigation systems were damaged by the low level pulses. This is not surprising as like us they are mammals. The comment from the Minister at the time was "it's their fault for being in that part of the ocean when they could have moved away".

Reporting in The Sunday Express, 4 February 2001, Nick Fleming writes "BT advise officers to turn off the handsets when they are near sensitive hospital, breathalyser and speed camera equipment ... Officers are also being advised to mount speed traps or breath tests only if the equipment is 35 ft from their handsets or 11 ft from radio sets in their cars". He concludes "someone using a TETRA handset will be receiving between 2 and 4 times as much power or energy as if they were using a mobile phone. The low frequency also means about double the penetration into the head".

Another document (Reference 18), Mr Stevens quoting from a US Defence document writes "if the more advanced nations of the West are strict in the enforcement of stringent exposure standards there could be unfavourable effects on industrial output and military functions". Listed in this document are all of the symptoms we now come to expect with long-term low level microwave radiation; for example "personnel exposed to microwave radiation below thermal levels experience more neurological cardio-vascular and haemodynamic disturbances than do their unexposed counterparts". Further down the document other symptoms include hypertension, changes in blood, headache,

fatigue, menstrual disorders, depression, anxiety and many of the other ailments previously listed.

## ADDING UP ALL OF THE WAVES THAT YOU ARE EXPOSED TO

An officer on duty may be exposed to his or her own handset, plus the handsets of officers around, plus the transmitter, plus anything else that happens to be on around them, i.e. vehicles. It may seem fairly easy for people to think that all you have to do is add up the radiation from each source, but in fact it can be very complicated and I would argue so complicated that scientists have yet to agree on a standard formula.

For example when measuring the magnetic part of the wave in Norwich it is known by some scientists that the maximum dose would be 0.4 units. When the arithmetic average was taken it came out at 0.46 above the danger level for the child. When the interested parties came and did their measurements they got the reading to be 0.26 units below the safety level; they calculated the geometric average. Clearly there is a difference between 0.26 and 0.46. When measurements are taken and quoted to you, you should always ask how the answer has been calculated and check the figures. Other ways of measuring waves may be time weighed average, constructive or destructive interference, the polarisation, the nearfield, the farfield, the root mean square, the peak to peak, the electric or the magnetic vectors; all of these are legitimate calculations and in my opinion could be used to make a reading look more acceptable if it was desired.

In Appendix 19 I enclose an e-mail conversation by three eminent scientists who are trying to agree on the best way to calculate multiple waves. The multiple wave

phenomena is of concern to me with regards the health of the police officers, simply because I have yet to find anybody who can say for sure the dose that each officer will be receiving. Arguably if the dose cannot be calculated therefore the health of the patients cannot be calculated.

Reporting in Engineering, February 2001 Matt Youson writes about the case where a man had a heart attack and in his journey to the hospital in an ambulance the ambulance crew using their TETRA sets, affected his heart monitoring devices which sadly resulted in the man's death. In an exclusive report in the Manchester News 11 May 2001 Dianne Bourne quoting the Head of Brain Surgery at NASA writes "the Head of Brain Surgery at NASA has even said he would not consider holding one of these to his head (with regards to TETRA). He said the net result is that the police are guinea pigs". Writing in Issue 51 of Caduceus magazine, in an article entitled 'Mobile Phones: The Pressure & Evidence Continues to Mount' by Simon Best, he writes "certainly if mobile phones had been a new drug they would never have got out of the laboratory". He continues commenting on TETRA "a 420 MHz signal producing a waveform that maximises radiation absorption for 3-6 year olds but also a pulse at 17 Hz right in the brains' beta rhythm – 17Hz is close to the peak frequency that triggers calcium e-flux in the brain which in turn affects apoptosis (programmed cell death) which can initiate cancer development. Despite this there is a complete lack of research on TETRA's possible health effects". He concludes "consider that you are talking about cumulative pulsed microwave radiation into your head, eyes and other organs possibly everyday for the rest of your life".

A Powerwatch comment dated 2 June 2001 reports in the first paragraph "as far as we can find out virtually no meaningful biological research on the effects of TETRA signals has been carried out. None of this is on humans nor is any on brain functions". In a late study published this month by The Independent entitled 'Mobile Phone Use Can Treble Risk of Brain Tumour', Charles Arthur writes that a research paper studying 1,600 people by a cancer specialist at the University of Sweden will be publishing his research paper on this data when it is finished.

In 1997 the Health Council of The Netherlands Radio Frequency Radiation Committee published their paper entitled 'Radio Frequency Electromagnetic Fields (300 Hz to 300 GHz) (this is within the TETRA range). They warn of interference to embryo development, hotspots inside the body, damage to eyes specifically infants, elderly and the sick. They also comment on interference to metallic implants and pacemakers. In Section 261 they write "the effects of electromagnetic fields occur at lower powered entities when the object is exposed to pulsed electromagnetic fields". I write this because TETRA is pulsed and most of the research which has been done has been done on continuous waves. The inference from these new research papers can only suggest that the symptoms will become more serious as pulsed radiation is arguably more aggressive.

In a recent paper (Reference 19) Dr Hyland who is also a member of the Stewart Committee and of the International Institute of Biophysics in Germany writes in Section

3 "the introduction of TETRA on the other hand gives rise to an increased level of both thermal and non-thermal concern". On page 14 Dr Hyland comments on the expression of calcium ions from brain cells and on page 15 writes a chapter on the magnetic field associated with current surges from the battery of the phone. Many people do not appreciate that batteries can produce magnetic fields that go into the body.

## THE NRPB DOCUMENT ON TETRA (Appendix 20)

The Governments' NRPB produced their own document (Reference 20) which is a report of an advisory group on non-ionising radiation and TETRA. Each page I quote from I will photocopy and place in the Appendix so that the reader may read the NRPB's research and the reader may compare my answer to that research.

On page 3 (Appendix 21) the picture shows the microwave signals labelled radio signals as a continuous not-pulsed signal. I would argue that this has been measured by the Cambridge researcher Alisdair Philips and has been shown to be pulsed leaving the transmitter going to the officer.

Page 4 (Appendix 22), Section 21 states "some radiation is also emitted from the case". It does not say which type of radiation – electric or magnetic or when the radiation is emitted, or the strength of the radiation or what part of the body will receive most of the exposure. In Section 22 "the main exposure to the body should be from the antenna and case of the hand portable". The question arises where is the rest of the exposure coming from and how much will there be? Section 24 refers to the earphone. If an earpiece is used and the smallest possible imaginable crack occurs in the earpiece radiation will have a direct path straight through the auditory canal to the brain. The officer will not even have the protection of the skull. In the rough and tumble world of a police officer where earpieces may be frequently knocked, what protection is there for the officer in checking that the earpieces do not leak?

I would recommend that earpieces should be checked with very accurate equipment for leaks at least on a weekly basis. The earpieces should be of the highest quality possible and definitely leakproof.

Page 5, Section 25 (Appendix 23) "the terminal is mounted inside the vehicle and connected to an antenna mounted on the outside". My concern is what sort of insulation is there inside the vehicle to protect the officers from the terminal inside the vehicle. If the terminal inside the vehicle is not sufficiently insulated from the officers they are effectively sitting inside a microwave oven, except for the windows.

Page 6, Section 26 (Appendix 24) shows that the useful range of a mobile terminal (car) to a transmitter is 56 km. 56 km is a fairly powerful transmitter and again I question if an officer is standing outside the vehicle or inside the vehicle, how much research has been done on the radiation levels being received by this officer?

Page 7, Section 28 (Appendix 25); this diagram shows a vehicle being used as a transmitting station to relay a message 56 km from a transmitter to 56 km to an officer. Again, I question how much insulation there is to protect the officers from the radiation if they are to be used as mobile transmitting stations?

Page 8, Section 37 (Appendix 26); this confirms that the pulses are 17.6 Hz and 35.2 Hz or waves per second. I emphasise that the Stewart Committee warned about using frequencies close to the brain above 16 Hz.

Page 9, Sections 39/40 (Appendix 27) refer to a top output in the table of 30 W and for hand terminals 3 W or 10 W for a vehicle mounted transmitter. My concern is that with ordinary mobile phone transmitters no sooner are they up when an engineer comes along and adds another section, then another section and within a few years the original transmitter is unrecognisable because of additional instruments. With TETRA when it expands to cover all of the emergency services; possibly traffic wardens, the new reserve police force, maybe even park keepers and security officers, I am wondering whether these outputs may be exceeded. In my own mind I find 3 W and 10 W outputs particularly high when in proximity to a living being. If we look at Professor Cherry's table (Appendix 27), it can be seen that in millionths of watts, the long-term exposure can lead to various ailments. On this graph I have drawn a line below which the TETRA power level applies. This is obviously an estimate because when the handset is switched on, there is a surge of power. If you are a long distance from a transmitter the power increases, or on standby the power drops down. Due to the lack of research in measuring TETRA in and around vehicles it is very difficult to place an accurate estimate on this graph at present. Suffice to say that the power on this table is in millionths of watts and Sections 39 and 40 are in watts. For the reader I have enclosed a three page guide of reported biological effects from low level radiation.

Page 10, Section 44 (Appendix 28); the table shows that the TETRA handsets are slightly more powerful than the ordinary GSM mobile phone systems. This is the basis of one of my arguments that if TETRA is pulsed, which is arguably more aggressive and

powerful than the ordinary mobile phone, the medical symptoms could arguably be more severe.

Page 14, Section 61 (Appendix 29) reads "hence with TETRA the energy is absorbed in a larger volume of tissue and so is less concentrated". Scientifically I cannot decide whether it is better to have the energy spread over a larger area or concentrated on a smaller area; I will have to discuss this with colleagues. Also in Section 61 the NRPB write "however, since the radiation from TETRA penetrates further into the head ...", that I am particularly concerned about because the most delicate parts of our brain are in its centre for maximum protection and if this is where TETRA is going to reach then I have grave concerns.

Page 15, Section 63 (Appendix 30) reads "VERY LITTLE INFORMATION EXISTS ON THE SAR'S PRODUCED BY TETRA AND PORTABLES. NO NUMERICAL MODELLING APPEARS TO HAVE BEEN CARRIED OUT". SAR means Specific Absorption Rate and refers to the heat generated inside that part of the body exposed to microwave radiation. I mentioned heat earlier with regard to heat shock proteins protecting cancer cells and to prevent damage to the DNA. I find it absolutely beyond belief that the NRPB can admit they have very little information on a system that is already being used and to say that no numerical modelling appears to have been carried out suggests to me as a scientist that no measurements have been taken to assess any medical damage which may occur to the officers. What experimentation has been done (Gabriel 2000), appears to have been carried out by Mr Gabriel of

Microwave Consultants Limited. As this research could possibly affect what may turn out to be brain tumours or spine cancers for the lady or gentlemen officers I would feel justified as a Police Federation in asking which totally independent scientists not connected in any way to the Government or communications industry peer reviewed this research paper and what were there comments?

Page 15, Section 65 (Appendix 30); this section explains that SARs could be up to 4 times larger than those in table 6 above. If the reader looks at the unit at the top of the table after SAR ( $Wkg^{-1}$ ), the reader can go to Appendix 27 'Reported Biological Effects', and the reader will observe one of the pages lists the medical symptoms expected from SAR doses. The reader will notice that for an SAR of 2 or 3 W/kg, cancer acceleration in the skin and breast tumours may be found. Coming back to the table it shows for the left ear an SAR of 2.88 but in the document below it explains that the SAR could be 4 times larger than this, i.e. you could be receiving an SAR above 8.

Page 11, Section 51 (Appendix 31) (NB: the NRPB bound document has pages 11-13 out of order and I cannot change this, and I apologise to the reader). This table shows that the power output may reach 40 W from a TETRA transmitter. My concern is that the officer will be receiving the radiation from the transmitter as well as the radiation from the handset.

Page 16, Section 66 (Appendix 32); "the main exposure to the body is expected to be at waist level from the antenna and base of the hand portable". My concern with this is the

reported cases of cancer of the spine from officers who have carried their hand portables on their belts. To my knowledge 4 deaths have occurred because of this.

"Although there could be some exposure from the earphone if RF current is induced in the cable ...". When the signal goes from the handset to the earpiece, electromagnetic waves are emitted from the cable, i.e. the cable actually becomes its own transmitter. These waves would obviously go through the neck and my concern is that they could affect the sensitive glands within the neck. Another concern, but unproven, came from a dentist who was concerned about the metal in peoples' fillings absorbing radiation and re-emitting it up into the centre of the brain where there is no protection from the skull. This is obviously a very complex research area to go into but nevertheless I feel that this dentist has a justifiable argument and one which should not be dismissed without thought.

Page 16, Section 67; "the situation is complicated by the metal body of the vehicle. It is not evident that this could be relied upon to provide shielding, since the non-conducting parts, e.g. windows of the vehicle are comparable to the wavelength of the radiation". Scientifically what this means to me is that there could be a considerable risk of electromagnetic radiation for the persons either inside or just outside of the vehicle. I find this incredible in so far as the risk is obviously appreciated by the NRPB and yet, as they stated earlier, no numerical modelling has been carried out. To me it appears that the risk in and around vehicles has been overlooked.

Page 16, Section 68; "the data in table 6 suggest that for both 3 W and 10 W vehicle mounted terminals the ICNIRP basic restrictions for the general public could be exceeded if a persons' head were within a few centimetres of a vehicle mounted transmission antenna for several minutes". The question I ask is what if the call is some big disaster emergency and the call may last longer than several minutes, or once the system is upgraded you are waiting for pictures to come through? Have calculations been done for say an accumulative 10 minute call?

NB: The Police Federation may wish to ask whether the dose levels in these tables are calculated as a geometric average or arithmetic average.

Page 16, Section 69; "at these power levels there will be regions in the immediate vicinity of the base station antenna where guidelines could be exceeded". My argument here is similar to the argument above. What if an officer has to remain through duty in the vicinity of a base station or transmitter where even the NRPB's high guidelines are exceeded or the International Commission's guidelines are exceeded? These guidelines, as shown in Appendix 1, are way above what the rest of the world recommends.

Page 18, Section 76 (Appendix 33); "no measurements appear to have been made of the exposures received inside or outside vehicles with externally mounted antennas". My simple question is, if officers are using what could be potentially dangerous

instruments, why have no measurements been taken to assess their risk? I find this beyond belief.

Page 26, Section 111 and 112 (Appendix 34). Here the NRPB agree that the phenomena of non-lethal weapons exists because they say that with a frequency of 8 waves per second into the brain, animals can be made to go to sleep, or be stimulated at higher frequencies. To me this simple statement by the NRPB verifies the non-lethal weapons programme as sound.

Page 29, Section 128 (Appendix 35); "HOWEVER THERE ARE LIMITATIONS TO THE REASSURANCE THAT THEY CAN PROVIDE. IN PARTICULAR THEY DO NOT EXCLUDE THE POSSIBILITY THAT RF RADIATION FROM CELLULAR PHONES MIGHT CARRY A RISK OF CANCER THAT BECOMES MANIFEST MANY YEARS AFTER FIRST EXPOSURE OR THAT RELATES TO INTENSE EXPOSURE OVER MANY YEARS. NOR DO THEY RULE OUT A HAZARD FROM RF RADIATION MODULATED SPECIFICALLY AT AROUND 16 Hz". Here, the NRPB are not ruling out that there may be a risk of cancer to the officers in several years time. Also there could be a risk because of TETRA's unique pulsing to the officers' brains.

Page 29, Section 129; "further research is needed using modern molecular and cellular biology techniques to assess the reliability of the positive findings and to determine the extent and significance of any effects that do occur". Scientifically to me, what the

NRPB are saying is that they need to do research to find out what effects TETRA will have on the officers.

Page 30, Section 133 (Appendix 36); "HOWEVER THEY DO NOT EXCLUDE THE POSSIBILITY OF A RISK OF CANCER THAT APPEARS ONLY AFTER MANY YEARS OF EXPOSURE, NOR OF A HAZARD FROM RF RADIATION MODULATED SPECIFICALLY AT AROUND 16 Hz". This suggests that cancer and brain damage has not been ruled out as a possibility of using TETRA. As an analogy, this seems to me like a situation where I could go to my GP and ask for some tablets and the GP can say, you can take these but there may be a risk of cancer in several years time, I don't know, or a risk of brain damage.

Page 31, Section 135 (Appendix 37); "A number of recommendations for further research are suggested by the Advisory Group". My observation is why wasn't this research was done before the system was introduced? This puts officers' health at risk unnecessarily.

"Proposals for experimental investigations of the possible biological effects of specific TETRA signals modulated at about 16Hz". Again, I suggest this should have been carried out before it was used on police officers.

"Further studies need to be carried out on effects of amplitude modulation or pulsing on neuronal activity and on signalling within and between nerve cells ... The likelihood of

epileptic seizures could be investigated ...". If the NRPB are suggesting this now, my question stands, why wasn't this research carried out before the officers began their trials with TETRA?

- Page 31, Section 135 - Section 5; "HUMAN VOLUNTEER STUDIES SHOULD BE CARRIED OUT TO MEASURE CHANGES IN COGNITIVE PERFORMANCE ARISING FROM EXPOSURE TO TETRA HANDSETS. THESE SHOULD INCLUDE EXAMINATION OF THE EFFECT OF VARYING PARAMETERS SUCH AS THE DURATION OF CALLS, THE EXTENT OF EXPOSURE, AS WELL AS SIGNAL CHARACTERISTICS".
- Page 31, Section 135 – Section 6; "THE TETRA SYSTEM IS EXPECTED TO BE DEPLOYED WIDELY FOR USE BY STAFF IN EMERGENCY SERVICES. THIS IS A RELATIVELY STABLE WORKFORCE WITH DEFINED PATTERNS OF WORK. IT WOULD BE WORTH CARRYING OUT STUDIES TO EXAMINE WORKING PRACTICES AND CONDITIONS OF EXPOSURE TO RF RADIATION FROM TETRA SYSTEMS. RECORDS OF USE SHOULD BE KEPT WHICH COULD BE OF VALUE IN ANY FUTURE EPIDEMIOLOGICAL STUDIES".  
Clearly this means that the police, although to my knowledge not volunteers, as a regular and stable workforce are absolutely ideal for a scientific study into the long-term effects of electromagnetic radiation from TETRA. The NRPB will use all of this data as an epidemiological study, as recorded in their own document.

- Page 31, Section 135 - Section 8; "ONLY LIMITED INFORMATION IS PRESENTLY AVAILABLE ON EXPOSURES FROM TETRA HAND PORTABLES. FURTHER WORK IS NEEDED TO PROVIDE MORE INFORMATION ON EXPOSURES FROM HAND PORTABLES AND FROM ANY OTHER TRANSMITTING EQUIPMENT DEPLOYED FOR USE". My simple observation to this statement is why? Why is only limited information presently available on exposures if the system is up and running? There has got to be a risk to the officers from unknown exposures.

## CONCLUSION

If you take a complete overview of this entire document, I would suggest that there is a lot of information which could suggest long-term low level exposure to microwave radiation is harmful. However, science is always about argument. I find it a very dangerous time when a scientist insists that he or she is right. Scientists that have insisted they are right (sometimes publicly) and have later to have been shown to be incorrect are those concerning thalidomide, asbestos, BSE, smoking, sheep dip, Gulf War Syndrome, GM foods, Vitamin B6, to mention just a few. So, let us assume that I am wrong and let us assume that every single scientist I have quoted in this report, which may involve thousands of years of work accumulatively, is also wrong, just for arguments sake. My argument is unchanged and my argument is simple. All I am suggesting is that the ladies and gentlemen of the police force have the opportunity to read both sides of this scientific debate with all of the literature at their disposal and they, be allowed to decide whether or not they would like to use the TETRA system. If every officer decides that they love the TETRA system so much they want to take it home to bed with them, I do not have a problem with that. All I ask is that the officers have the choice where their long-term future health could be at risk.

## RECOMMENDATIONS

- I would like to see a totally independent group of scientists, not connected with the communications industry or the NRPB, be able to represent the police force at their request.
- Should TETRA become widespread, a long-term full indemnity insurance policy should be guaranteed for the officers for any possible future long-term risks.
- That all major documents relating to TETRA safety be made available to the officers of the police force along with how the figures were calculated, i.e. which average was taken, which totally independent scientists peer reviewed the papers, the comments of those scientists and if necessary, the relative expertise of the scientist who carried out the experiments and wrote the paper.

I recommend this because when I applied to teach Advance Level Physics at College, all of my degrees are personally checked and when we go camping with College students, our mountain leadership certificates, life-saving certificates, updates to those certificates are all scrutinised by the parents. And I totally agree with this. I believe that if you are making decisions pertaining to persons' safety or health, your qualifications, background, experience should all be available for scrutiny. Also, anything that you write should be checked by totally independent persons, and their comments made available.

- My final recommendation with all of the information I have to hand is that the TETRA system be halted until further research on safety has been carried out. This research be made available to the ladies and gentlemen of the police force and not until they are satisfied with the safety of the system, should it be implemented. In other words, I am suggesting that the police have the final say in whether TETRA is introduced or not to their force. I believe the ladies and gentlemen of the police force should be credited with the intelligence they have to make decisions regarding their own safety. Further, any scientific document written for them to read should have full explanatory notes so that they can understand any complicated scientific terms.

NB: Before my lectures to the Police Federation and writing this report, I submitted my full CV for their scrutiny.

## QUESTIONS

- With all of the research written here showing dangers from electric, magnetic, pulsed microwave electromagnetic fields, why with the officers' safety at risk are we still sticking to our ridiculous safety limit, which only measures heat?
- Can more information be given to the officers on our Government's non-lethal weapons programme concerning pulses into the brain around 17.6 Hz, or stored information from other research papers?
- Can the signals from the transmitter to the officer be rechecked as they are listed in the manual as continuous waves, whereas they have been measured independently to be shown to be pulsed? This is important because pulsed radiation is arguably more aggressive than continuous.

NB: the following questions arise from the NRPB document on TETRA, Volume 12, Number 2, 2001, appended at the back of this document.

- Section 21 – How much radiation, and of which type is emitted from the case?
- Section 24 – What safeguards are in place to guarantee that the earphones are absolutely leakproof and with the rough and tumble world of the police officer, how

often are the earphones going to be checked for leaks? Who will do this, and which type of apparatus will be used?

- Section 25 – What experiments have been done to measure how the officers inside the vehicle are insulated from the transmitting device?
- Section 28 – If a police car is to be used as a relay transmitter, again, what measurements have been taken to ensure the officers are insulated from the electromagnetic waves?
- Section 37 – Why is a pulsed frequency of 17.6 Hz being used when it is known to interfere with the brains' beta rhythm and it was warned against by the Stewart Committee?
- Section 39/40 – If TETRA becomes widespread to all of the emergency services, reserve officers, traffic wardens, security officers, what is the expected output to be from handsets and the main transmitters? Transmitters generally increase their power to cope with additional calls. Will this be the case for TETRA?
- Section 61 – Has a neurosurgeon been consulted to comment on the effect of TETRA penetrating deep into the head?

- Section 63 – Why does very little information exist on the SAR produced by TETRA hand portables, why has no numerical modelling been carried out? Can this be done before TETRA is used nationally?
- Section 63 – Can all of the information relating to the experiments of measuring radiation inside the head (Gabriel 2000) be made available to the Police Federation for scrutiny, along with an independent peer review assessment from scientists, totally unconnected with the NRPB or communications industry?
- Section 65 – If the SAR's could be up to 4 times larger than those in table 6, what risk assessment has been carried out for officers receiving radiation with an SAR of over 8 W/kg? Can this information be made available to the Police Federation?
- Section 66 – With the main exposure expected to be at waist level, what research has been carried out relating this to the known deaths of officers from spine cancer from carrying transmitters on their belts? Could this research be made available to the Police Federation?
- Section 66 – Has an ear, nose and throat specialist been contacted for an opinion concerning radiation from the cable being transmitted into the glands of the neck? If not, could this be done?
- Section 67 – As vehicles cannot be relied upon to provide shielding for the officers, can further improvements to insulate the officers be recommended, then scientific

studies carried out to test this insulation and all data be made available to the Police Federation?

- Section 68 – If international guidelines could be exceeded, what risk assessment has been carried out for the officers and passers by who may be using pacemakers, insulin pumps, have metal plates in their bodies, or be epileptic? Could this risk assessment be made available to the Police Federation?

Similarly, for Section 69, concerning base station transmitters which will also exceed guidelines.

- Section 76 – Why have no measurements of exposures been made inside or outside vehicles? Could these be done and the data made available to the Police Federation along with how averages are calculated?
- Section 128 – As the possibility is not excluded that TETRA might carry a risk of cancer that becomes manifest many years after first exposure, or there may be a hazard from the pulses around 16 Hz, would it be a good idea to allow the ladies and gentlemen of the police force an opinion in the decision making processes which may concern their long-term health? Should these long-term health risks be published for the police force so that, like members of the armed forces, they may volunteer to expose themselves to possible danger?

- Section 129 – As further research is needed, should this not be done before TETRA becomes national, and can the results be made available to the Police Federation for their scrutiny?
- Section 133 – Again, the possibility of a risk of cancer after many years of exposure is commented on along with the hazard of pulsed radiation at 16 Hz. I repeat my observation that this risk assessment ought to be made available with full consultation with the officers concerned who will be using the system and that they should have the final decision concerning their future health risks. Is this a possibility?
- Section 135, Section 2 – Has a neurosurgeon been contacted to assess the risk of pulsing and its effect on the signalling mechanisms between nerve cells? Could this report please be made available to the Police Federation?
- Section 135, Section 5 – Shouldn't the human volunteers study on TETRA be carried out before its use becomes widespread?
- Section 135, Section 6 – As an epidemiological study is recommended to be carried out on the use of TETRA and its effects on "a relatively stable workforce with defined patterns of work", shouldn't the police officers be asked their permission if they are going to take part in what is a long-term medical study which

may result in a number of brain tumours, spine tumours, eye cancers, heart disorders and many other illnesses?

- Section 135, Section 8 – Why is TETRA being used by officers if "only limited information is presently available on exposures from TETRA hand portables and further work is needed to provide more information on exposures from hand portables and from any other transmitting equipment"?

## LEGAL IMPLICATIONS

Although I have legal documents in my possession I do not have the knowledge or confidence to even begin to try and explain legal words. I would recommend the Federation's solicitor contact Mr Alan Meyer who is in my opinion this country's leading authority on matters electromagnetic and all of its relevant implications. I would add I do not have shares in his firm nor do I receive "backhanders", in fact I have never met the gentleman. Mr Meyer will be able to advise on Government responsibilities, the human rights, civil rights and European Law. Mr Meyer may be contacted at:

Halsey Meyer Higgins Solicitors

56 Buckingham Gate

Westminster

London

SW1E 6AE

Tel: 020 7828 8772

Fax: 020 7828 8774

Researched and written by B Trower, September 2001

## REFERENCES

1. Electromagnetic Hazard & Therapy 2000, Volume 10, Numbers 3 & 4
2. Evidence that Electromagnetic Radiation is Genotoxic: The implications for the epidemiology of cancer and cardiac, neurological and reproductive effects. Dr Neil Cherry, June 2000
3. Electromagnetic Hazard & Therapy 2000, Volume 10, Numbers 3 & 4
4. Extremely Low Frequencies and living matter – a new biophysics by Dr Gilles Picard. Living matter and electronic devices
5. Potential Adverse Health Impacts of Mobile Telephony Memorandum, Dr Hyland, February 2000
6. Are Mobile Telephony Base Stations a Potential Health Hazard? A review of the present scientific literature, Roger Coghill MA (Cantab.) C. Biol. MI Biol. MA (Environ. Mgt.), August 1998
7. New Medical Evidence on Electromagnetic Fields and Health is Alarming: Do not Expose Local People to Mobile Phone Base Stations, Dr D A Eklund, BSc MBCHB MFPHM
8. Electromagnetic Hazard & Therapy 1999, Volume 10, Numbers 1 & 2
9. Effects of chronic microwave irradiation on mice, S Prausnitz & C Susskind, 1962
10. Scientists link eye cancer to mobile phones, Sunday Times, 14 January 2001
11. Electromagnetic Hazard & Therapy 2001, Volume 11, Numbers 2 to 4
12. DHHS (NIOSH) Publication No. 80-107, 4 December 1979
13. Understanding Ground Currents: An important factor in electromagnetic exposure, Dr D Dahlberg, Consultant, The Electromagnetics Research Foundation, Moorhead, MN56560/2118

14. Electromagnetic Field-induced Stimulation of Bruton's Tyrosine Kinase, Journal of Biological Chemistry, Volume 273, Number 20, 2 February 1998  
Stimulation of Src Family Protein-tyrosine Kinases as a Proximal and Mandatory Step for SYK Kinase-dependent Phospholipase Cy2 Activation in Lymphoma B Cells Exposed to Low Energy Electromagnetic Fields, Journal of Biological Chemistry, Volume 273, Number 7, 13 February 1998
15. Nexus: Military Use of Mind Control Weapons, Judy Wall, Volume 5, Number 6, November 1998  
The Encyclopaedia of Mind Control, Adventures Unlimited Press, 1997  
Secret & Suppressed, Jim Keith, Feral Press, 1993  
Planet Earth: The Latest Weapon of War, Dr Rosalie Bertell (Women's Press)  
Mind Control & the UK (Remote Viewing), Tim Rifat, ISBN 0712679081  
Neurophysiologic Effects of RF and MW Radiation, Ross Adey, Bulletin of the New York Academy of Medicine, Volume 55, Number 11, December 1979  
The Influences of Impressed Electrical Fields at EEG Frequencies on Brain and Behaviour, Burch & Altshuler, Plenum Press, 1975  
Effects of modulated very high frequency fields on specific brain rhythms in cats, Brain Research, Volume 58, 1973 (Also Volume 23, 1967) on low frequency re-brain (Hippocampus)  
Non-Lethality: John B Alexander, the Pentagon's Penguin, by Armen Victorian, Lobster June 1993
16. Channel Four News, Radio System Safety Fears, 5 February 2001, Julian Rush

17. The Big Issue Environment Correspondent Gibby Zobel, New Navy Death Risk to Dolphins & Whales, page 5, 12 March 2001
18. Extracts from US Defence Intelligence Agency documents from 1972 to 1983, Donald Stevens, November 2000
19. The Physiological & Environmental Effects of Non-ionising Electromagnetic Radiation, Dr G J Hyland, February 2001
20. NRPB Possible Health Affects from Terrestrial Trunked Radio (TETRA), Volume 12, Number 2, 2001

*Erratum Page 13 Hyland and Coghill (they sent evidence to IEGMP but were not actual members: JVM 28/9/2001)*

## APPENDICES



Review

# Radiation-Induced Organizing Pneumonia: A Characteristic Disease that Requires Symptom-Oriented Management

Keisuke Otani <sup>\*,†</sup>, Yuji Seo <sup>†</sup> and Kazuhiko Ogawa <sup>†</sup>

Department of Radiation Oncology, Graduate School of Medicine, Osaka University, Suita 565-0871, Japan; seo@radonc.med.osaka-u.ac.jp (Y.S.); kogawa@radonc.med.osaka-u.ac.jp (K.O.)

\* Correspondence: otani-keisuke@umin.org; Tel.: +81-6-6879-3482

† These authors contributed equally to this work.

Academic Editor: Susanna Esposito

Received: 30 November 2016; Accepted: 24 January 2017; Published: 27 January 2017

**Abstract:** Radiation-induced organizing pneumonia (RIOP) is an inflammatory lung disease that is occasionally observed after irradiation to the breast. It is a type of secondary organizing pneumonia that is characterized by infiltrates outside the irradiated volume that are sometimes migratory. Corticosteroids work acutely, but relapse of pneumonia is often experienced. Management of RIOP should simply be symptom-oriented, and the use of corticosteroids should be limited to severe symptoms from the perspective not only of cost-effectiveness but also of cancer treatment. Once steroid therapy is started, it takes a long time to stop it due to frequent relapses. We review RIOP from the perspective of its diagnosis, epidemiology, molecular pathogenesis, and patient management.

**Keywords:** organizing pneumonia; bronchiolitis obliterans organizing pneumonia; breast cancer; corticosteroid treatment; radiation-induced organizing pneumonia

## 1. Introduction

Pneumonia is one of the most common causes of death around the world, but various pathogeneses may be responsible. It is divided into alveolar and interstitial pneumonia, and interstitial pneumonia needs further classification [1]. Organizing pneumonia (OP) is a type of interstitial pneumonia and consists of cryptogenic organizing pneumonia (COP) and secondary organizing pneumonia (SOP) [2]. Radiation-induced organizing pneumonia (RIOP), which also used to be called radiation-induced bronchiolitis obliterans organizing pneumonia (BOOP) syndrome is one type of SOP. It was first reported by Crestani et al. and Bayle et al. in 1995 [3,4]. Since the term “bronchiolitis obliterans” does not reflect the actual pathophysiology, the name BOOP was replaced by organizing pneumonia. According to this, the name radiation-induced organizing pneumonia (RIOP) is considered better [5]. Several reports of RIOP were published, and its incidence was reported to be less than 3% [5–12] (1.7% in an extensive literature review [13]) after radiotherapy involving the breast. Although RIOP is classified as SOP, no actual fatal cases have been reported so far. However, the mortality of OP is estimated to be 5% [14], and SOP is reported to have a higher mortality than COP [15,16], so physicians need to pay attention in the management of RIOP.

## 2. Diagnosis

In the report of Crestani et al., the following four criteria were introduced [17]: (1) radiation therapy to the breast within 12 months; (2) general and/or respiratory symptoms lasting for at least two weeks; (3) lung infiltrates outside the radiation port; and (4) no specific cause. However, subsequent reports contained patients who did not fulfill all of these criteria, and the nature of RIOP was gradually revealed, which requires us to reconsider them.

### 2.1. Partial Irradiation Involving the Lung Occurring Approximately within 12 Months

Since most reports were based on the original criteria, most of the RIOP cases in the literature were diagnosed within 12 months after the completion of radiotherapy. Among them, up to 90% of the reported cases were diagnosed within six months after the completion of radiotherapy [5–9,11,18–20]. However, RIOP cases after more than 12 months were also reported; Arbetter et al. reported one case after 17 months, who was diagnosed by resection of an asymptomatic lung nodule [19]; Kubo reported a case after 23 months whose diagnosis was confirmed by bronchoscopy and whose onset was presumed to be delayed by immunosuppressive agents prescribed for coincident rheumatoid arthritis [9].

RIOP is not specific to irradiation of the breast or to women. Although reports are limited, RIOP has also been reported in lung cancer and thymoma patients, including male patients [21–25]. This fact supports the idea that the pathogenesis of RIOP is not related to breast cancer or sex, but to partial irradiation involving the lung. In addition, not only the conventional irradiation technique, which takes more than one month, but also ablative radiotherapy, which is completed within one or two weeks, can cause RIOP. Murai et al. and Ochiai et al. reported RIOP after stereotactic body radiotherapy (SBRT) for lung tumors [26,27]. Interestingly, the onset is longer after SBRT than after conventional radiotherapy; it has been reported to be at least 6 months after completion of radiotherapy and sometimes more than 12 months, in contrast to the short duration of treatment.

### 2.2. Lung Infiltrates Outside the High Irradiation Dose Area

After the completion of radiotherapy involving the lung, radiographic pulmonary changes on computed tomography (CT) are reported in 78% of cases at 3–9 months after radiotherapy and are thus common [28]. In the management of breast cancer patients, the volume of these changes is usually limited and seldom causes symptoms in this range. RIOP is noticed by the spreading of infiltrate outside the irradiated volume [3,4]. Chest radiographs show air-space opacities or diffuse infiltrative opacities, which are often detectable without CT scans. On CT scan images, peripheral air-space opacities with air bronchograms and ground-glass opacities are common, and multiple alveolar opacities on imaging represent the most frequent and typical imaging features of OP [29]. Migratory infiltrates are another feature of RIOP [4,5] and can be observed until corticosteroid therapy is initiated [17]. Ogo et al. classified the infiltrative pattern into four types: Type A, peripheral area in the radiation field and a continuous opacity that represents consolidation with or without an air-bronchogram, ground-glass attenuation, and/or nodular opacity; Type B, peripheral area in the radiation field and continuous alveolar infiltration in the zone of the middle lung; Type C, peripheral area in the radiation field and isolated consolidation on the back side of the radiation field; and Type D, peripheral area in the radiation field and consolidation or ground-glass attenuation (or both) in the contralateral side [8]. Among these patterns, Type A was the most common (65%), and multiple types were observed in 43% of patients. The clinical course of lung infiltrates was also classified into 3 types: Type 1, the ipsilateral side; Type 2, progressing on the ipsilateral side; and Type 3, moving from the ipsilateral side to the contralateral side [8]. Type 2 (13%) and Type 3 (22%) would correspond to migratory lesions in other reports [4], but their incidence varies from 17% to 100% [5,7,17,19,20].

### 2.3. No Other Specific Cause

Organizing pneumonia is known to occur from several triggers. The most important cause to be distinguished is infection, since subsequent corticosteroid treatment might worsen the condition. Bacterial pneumonia sometimes resembles OP on radiographic examination. Microbial culture of sputum or bronchoalveolar lavage (BAL) fluid would be helpful in ruling out bacterial infection. When BAL fluid is available, it shows an increase in lymphocytes, mast cells, CD3 cells, and CD8 cells, and a decrease in CD4 cells and the CD4/CD8 ratio [30], and this would support the diagnosis of RIOP.

Cottin et al. reported that chronic eosinophilic pneumonia (CEP) occurred after radiotherapy to the breast [31]. Interestingly, the clinical features of CEP after radiotherapy were almost the same as those of RIOP: CEP was observed 1–10 months after completion of radiotherapy; the migratory lung infiltrate was also similar to that of RIOP; and corticosteroids worked well. Considering these similarities, patients with CEP after radiotherapy might have been diagnosed as RIOP. Since all patients had a history of asthma or atopy [31], patients with allergy seemed to be predisposed to CEP. Eosinophilia may be a key finding to discriminate it from RIOP, and an increased number of eosinophils in the BAL fluid may support the diagnosis. However, considering that corticosteroid works effectively, as in RIOP, as mentioned above, definite discrimination of these two would not be critical in managing patients.

General and/or respiratory symptoms lasting for at least two weeks were another diagnostic criterion. Clinical manifestations include fever, nonproductive cough, dyspnea, malaise, fatigue, chest pain, and weight loss [8,13,17]. However, several reports included asymptomatic patients [5,10,19] who manifested similar radiographic features or histopathologic observations. RIOP has gradually gained attention, and the diagnosis of RIOP can often be made within two weeks. Despite the impressive lung imaging findings, symptoms are not always serious and can be relieved by antitussives or non-steroidal anti-inflammatory drugs within two weeks. Indeed, the symptoms are important when considering the management of RIOP, but the diagnosis of the massive lung infiltrates does not require the presence of symptoms.

Although these criteria describe the features of RIOP, RIOP is ultimately COP with a history of irradiation. In the current criteria, RIOP includes genuine COP after radiotherapy by chance. It is not very important to discriminate them because their general management is similar [14], but we should carefully diagnose RIOP as much as COP if the patient's general condition is unfavorable. If the treatment response is poor, or the clinical course or chest imaging findings are not typical for RIOP, a video-assisted thoracoscopic lung biopsy should be considered to confirm a definitive diagnosis of OP [13].

### 3. Pathogenesis and Epidemiology

OP is known as an inflammatory response to acute lung injuries. Development of OP has been reported to go through three stages [32]. The first stage is the injury phase: local epithelial injury induces the death of pneumocytes and the formation of gaps in the basal lamina [29,33]. The second stage is the proliferating phase: fibroblasts and inflammatory cells, such as lymphocytes, neutrophils, and eosinophils, infiltrate the alveolar interstitium and form fibroinflammatory buds. Activated fibroblasts proliferate, differentiate into myofibroblasts, and form cell clusters within the distal airspaces. The third phase is the mature phase: mature fibrotic buds occupy the lumens of bronchioles, alveolar ducts, and adjacent peribronchiolar alveoli [29,33,34]. Recently, transgenic mice overexpressing human C-C motif chemokine ligand 2 (hCCL2) under control of the surfactant protein C promoter in type II alveolar epithelial cells were reported to work as an animal model for OP [35]. This animal model showed pathogenomic, molecular, and morphological features of human OP and exhibited a similar inflammatory profile, which is a key feature in interpreting human OP. In this model, the generation of OP was completed in 7 days. As for RIOP, the epithelial injury would be irradiation-induced. The most lethal effect in the irradiated cells is DNA double-strand breaks, and the cells in the thorax develop apoptosis if they fail to recover from the DNA damage. Interestingly,

cell death after irradiation can start within 10 h [36], but the onset of RIOP is delayed by about 6 months after the completion of radiotherapy. Furthermore, RIOP after SBRT, which delivers a higher dose to the cancer and circumscribed lung tissue than does conventional radiotherapy to the breast, is delayed even more [26,27]. In COP cases, the time to onset is known to be less than three months [32]. Additional insights are necessary to understand what is going on during this long gap. When we look into other secondary OPs, drug-related OP can occur months to years after drug administration [14]. The first step to treating drug-related OP is to discontinue the suspected agents. In contrast, most cases of RIOP occur after completion of radiotherapy. The trigger had already been disseminated and already finished several months before the onset of RIOP.

As another explanation of the pathogenesis of RIOP, mutations in the ATM (ataxia telangiectasia mutated) gene were proposed [37]. The ATM gene is a key molecule to repair DNA double-strand breaks whose mutation brings hypersensitivity to irradiation [38] and predisposes to cancer [39]. A patient with RIOP who was also diagnosed to have monoallelic germline ATM mutation was reported [37]. Interestingly, the frequency of ATM mutation carriers among women affected with breast cancer has been estimated to be 2.04% [40], similar to that with RIOP. This might be the explanation of the long time between radiotherapy and RIOP. Further epidemiologic evidence and analysis of causal molecular background are expected.

Several risk factors have been identified for RIOP: age [11,41], irradiated lung volume [9], concurrent endocrinology [11], and smoking [13,41]. Kubo et al. reported that a central lung distance of more than 1.8 cm, which means the extent of irradiated lung volume is a risk for RIOP [9]. Considering the pathogenesis, it is reasonable that some extent of irradiated lung volume is required to prime the consequent immune-responses that lead to RIOP. However, a central lung distance of below 1.8 cm is too strict a limit to require for every breast-irradiation treatment. Since the incidence of RIOP is below 3.0% [13] and its prognosis is generally good, the radiation field should not be minimized too much for fear of RIOP.

As another risk factor for RIOP, concurrent endocrine therapy is controversial. Katayama et al. reported that endocrine therapy, including both tamoxifen and anastrozole, was a risk factor [11], but Kubo did not find it to be significant [9]. Tamoxifen is known to induce transforming growth factor- $\beta$  (TGF- $\beta$ ) secretion, which causes lung fibrosis [42,43]. Epidemiologic observations reported that tamoxifen was a risk for lung fibrosis on multivariate analysis [44]. However, epidemiologic data showed that concurrent usage of tamoxifen does not increase the incidence of pneumonitis compared to the sequential usage of tamoxifen [45,46]. Today, the concurrent usage of tamoxifen is considered tolerable. As for aromatase inhibitors, a randomized controlled trial showed that the incidence of lung fibrosis was similar between concurrent and sequential administration of aromatase inhibitors [47]. Although these data did not refer to RIOP as a specific disorder, concurrent endocrine treatment is considered tolerable. Because of the rarity of RIOP, it is difficult to assess the actual risk of concurrent endocrine therapy, but it seems that endocrine therapy need not be interrupted at the initiation of radiotherapy.

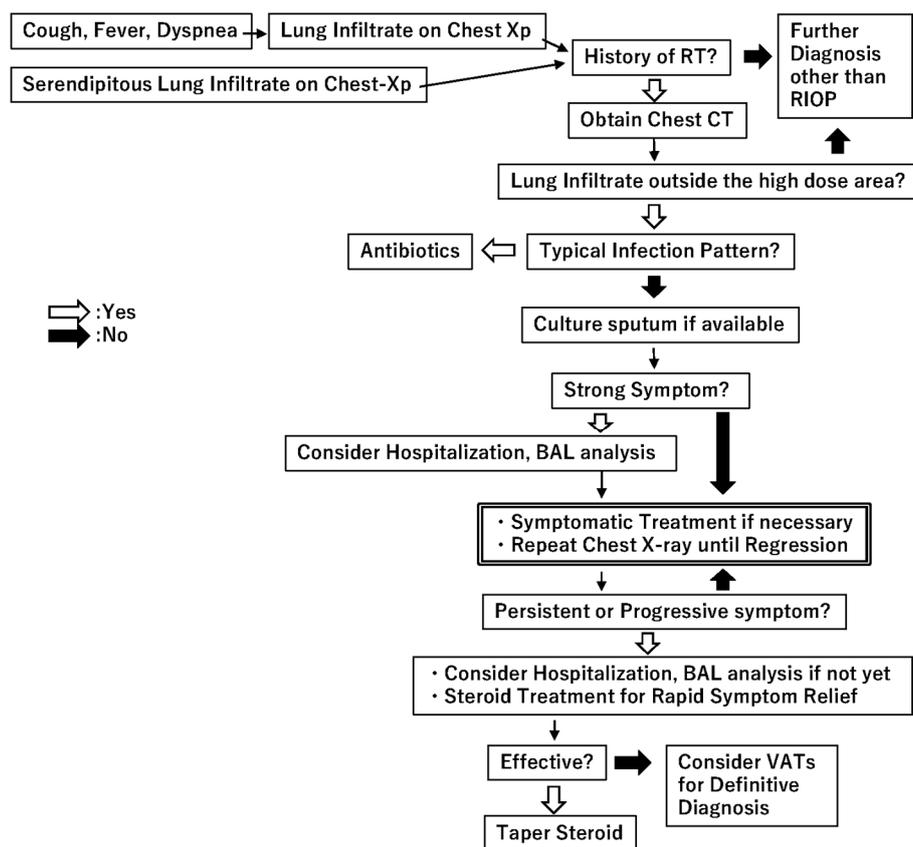
#### 4. Patient Management

RIOP is generally a complication with a good prognosis due to the acute effectiveness of corticosteroids [17]. However, relapse of RIOP is common when steroids are administered [13,17]. Okada et al. reported that relapse after steroid therapy was associated with higher C-reactive protein levels at RIOP diagnosis [12]. We previously reported that steroid-treated patients relapsed at a significantly higher rate [5]. Since no new lesion was recognized during steroid administration, we assumed that steroid therapy effectively suppresses the development of new lesions (migratory infiltrate). However, this suppressive effect seemed to decline with steroid tapering; therefore, new lesions (relapses) appeared particularly in patients in the steroid group. We hypothesized two reasons: steroids can postpone the development of new lesions by suppressing tissue responses to inflammation; and they can cause the relapse of tissue-damaging responses.

We also showed that patients in the steroid group took less than half a month to achieve symptom relief after the administration of steroids. Other reports also indicate that steroid therapy has a strong role in the rapid relief of initial RIOP symptoms [6,17]. In contrast, some patients in the nonsteroid group experienced persistent symptoms for up to three months [5]. Since nonsteroidal treatment of RIOP was reported to result in almost normal lung function without severe sequelae [5,10], steroids can be saved as a last resort in managing RIOP. If RIOP is relieved without steroid therapy, the overall time to become free of symptoms, steroids, and other medications would be shorter than with steroid treatment [5]. Adverse effects of systemic steroid therapy include infection, adrenal insufficiency, osteoporosis, peptic ulcer disease, cataract formation, dermal thinning, hypertension, diabetes, psychosis, and hyperadrenocorticism [48], and additional management is necessary once steroid is initiated. Steroid is routinely used in several situations during cancer treatment, such as controlling nausea and vomiting and improving symptoms caused by advanced disease [49]. However, patients who undergo chemotherapy are predisposed to lung infections [50], and steroid therapy shares this risk. In addition, use of corticosteroids in patients with solid tumors could induce resistance to treatment in cancer cells in some patients [49,51,52]. Thus, nonsteroidal treatment is favored in terms not only of short treatment time, requiring less care and medicine, and therefore cost-effectiveness, but also of treatment effectiveness for cancer.

RIOP is often noticed during the follow-up after completion of radiotherapy. RIOP patients may come to clinics with flu-like symptoms or massive lung infiltrates. For the physicians who are not engaged in their cancer treatment, getting the history of radiotherapy is the first step to diagnosing RIOP. The next step is to evaluate the chest X-ray. As for breast cancer patients, lung infiltrates of RIOP are obvious, in contrast to radiation pneumonitis. If the chest X-ray is abnormal, CT is necessary. These steps are similar to common pneumonias. If there is a history of radiotherapy within one year or more, and infiltrates outside the high-dose irradiated area are confirmed, the diagnosis of RIOP takes just one more step, but it is the most difficult one. On the radiographic appearance, if typical imaging features of OP are seen, most experienced clinicians may make the diagnosis [29]. COP had the highest rate of correct diagnosis among the interstitial pneumonias, in 79% of cases [53], suggesting that the CT imaging features are characteristic. However, it is not always easy to rule out infection. Sputum culture is recommended if available. Empiric antibiotic therapy is permitted for ambiguous cases because it does no harm to RIOP, but it makes the diagnosis unclear. BAL is indicated in all cases where COP is suspected [29]. Since RIOP includes various general conditions, patients with no or mild symptoms should undergo repeated chest imaging instead of BAL [13]. Patients with severe symptoms and/or considerable steroid therapy will benefit from BAL fluid analysis.

Treatment of RIOP should simply be symptom-oriented (Figure 1); no medication is necessary for asymptomatic patients, and antitussives and non-steroidal anti-inflammatory drugs can be prescribed for patients with cough and/or fever. If the patient develops shortness of breath, evaluation of hypoxemia is necessary, and hospitalization should be considered depending on the degree. Steroid treatment can be used whenever rapid symptom relief is required, but it should be restricted to patients who have already undergone BAL fluid analysis and the diagnosis of RIOP is supported. If steroid treatment response is poor, or the clinical course or chest imaging findings are not typical for RIOP, a video-assisted thoracoscopic lung biopsy should be considered to confirm a definitive diagnosis of OP [13]. Relapse of RIOP is common once tapering of steroid therapy begins. The optimal tapering schedule to avoid RIOP relapse is not yet known.



**Figure 1.** Diagnostic and treatment decision tree of radiation-induced organizing pneumonia. Abbreviations: RT: Radiotherapy; RIOP: radiation-induced organizing pneumonia; CT: computed tomography; BAL: bronchoalveolar lavage; VATs: video-assisted thoracoscopic lung biopsy.

### 5. Conclusions

In summary, RIOP is an OP observed after radiotherapy involving a limited volume of lung. It is relatively rare, but its prognosis is good. Steroid treatment works well, but is related to relapses. Patient management should be symptom-oriented, and use of steroid should be limited to those who require rapid symptom relief.

**Conflicts of Interest:** The authors declare no conflict of interest.

### Abbreviations

RIOP	Radiation-induced organizing pneumonia
OP	Organizing pneumonia
COP	Cryptogenic organizing pneumonia
SOP	Secondary organizing pneumonia
BOOP	Bronchiolitis obliterans organizing pneumonia
SBRT	Stereotactic body radiotherapy
CT	Computed tomography
BAL	Bronchoalveolar lavage
CEP	Chronic eosinophilic pneumonia
ATM	Ataxia telangiectasia mutated
TGF-β	Transforming growth factor-β

## References

1. American Thoracic Society/European Respiratory Society International Multidisciplinary Consensus Classification of the Idiopathic Interstitial Pneumonias. This joint statement of the American Thoracic Society (ATS), and the European Respiratory Society (ERS) was adopted by the ATS board of directors, June 2001 and by the ERS Executive Committee, June 2001. *Am. J. Respir. Crit. Care Med.* **2002**, *165*, 277–304.
2. Vasu, T.S.; Cavallazzi, R.; Hirani, A.; Sharma, D.; Weibel, S.B.; Kane, G.C. Clinical and radiologic distinctions between secondary bronchiolitis obliterans organizing pneumonia and cryptogenic organizing pneumonia. *Respir. Care* **2009**, *54*, 1028–1032. [[PubMed](#)]
3. Crestani, B.; Kambouchner, M.; Soler, P.; Crequit, J.; Brauner, M.; Battesti, J.P.; Valeyre, D. Migratory bronchiolitis obliterans organizing pneumonia after unilateral radiation therapy for breast carcinoma. *Eur. Respir. J.* **1995**, *8*, 318–321. [[CrossRef](#)] [[PubMed](#)]
4. Bayle, J.Y.; Nesme, P.; Bejui-Thivolet, F.; Loire, R.; Guerin, J.C.; Cordier, J.F. Migratory organizing pneumonitis “primed” by radiation therapy. *Eur. Respir. J.* **1995**, *8*, 322–326. [[CrossRef](#)] [[PubMed](#)]
5. Otani, K.; Nishiyama, K.; Ito, Y.; Kawaguchi, Y.; Inaji, H. Steroid treatment increases the recurrence of radiation-induced organizing pneumonia after breast-conserving therapy. *Cancer Med.* **2014**, *3*, 947–953. [[CrossRef](#)] [[PubMed](#)]
6. Takigawa, N.; Segawa, Y.; Saeki, T.; Kataoka, M.; Ida, M.; Kishino, D.; Fujiwara, K.; Ohsumi, S.; Eguchi, K.; Takashima, S. Bronchiolitis obliterans organizing pneumonia syndrome in breast-conserving therapy for early breast cancer: Radiation-induced lung toxicity. *Int. J. Radiat. Oncol. Biol. Phys.* **2000**, *48*, 751–755. [[CrossRef](#)]
7. Miwa, S.; Morita, S.; Suda, T.; Suzuki, K.; Hayakawa, H.; Chida, K.; Nakamura, H. The incidence and clinical characteristics of bronchiolitis obliterans organizing pneumonia syndrome after radiation therapy for breast cancer. *Sarcoidosis Vasc. Diffuse Lung Dis.* **2004**, *21*, 212–218. [[PubMed](#)]
8. Ogo, E.; Komaki, R.; Fujimoto, K.; Uchida, M.; Abe, T.; Nakamura, K.; Mitsumori, M.; Sekiguchi, K.; Kaneyasu, Y.; Hayabuchi, N. A survey of radiation-induced bronchiolitis obliterans organizing pneumonia syndrome after breast-conserving therapy in Japan. *Int. J. Radiat. Oncol. Biol. Phys.* **2008**, *71*, 123–131. [[CrossRef](#)] [[PubMed](#)]
9. Kubo, A.; Osaki, K.; Kawanaka, T.; Furutani, S.; Ikushima, H.; Nishitani, H. Risk factors for radiation pneumonitis caused by whole breast irradiation following breast-conserving surgery. *J. Med. Investig.* **2009**, *56*, 99–110. [[CrossRef](#)]
10. Ogo, E.; Komaki, R.; Abe, T.; Uchida, M.; Fujimoto, K.; Suzuki, G.; Tsuji, C.; Suefuji, H.; Etou, H.; Hattori, C.; et al. The clinical characteristics and non-steroidal treatment for radiation-induced bronchiolitis obliterans organizing pneumonia syndrome after breast-conserving therapy. *Radiother. Oncol.* **2010**, *97*, 95–100. [[CrossRef](#)] [[PubMed](#)]
11. Katayama, N.; Sato, S.; Katsui, K.; Takemoto, M.; Tsuda, T.; Yoshida, A.; Morito, T.; Nakagawa, T.; Mizuta, A.; Waki, T.; et al. Analysis of factors associated with radiation-induced bronchiolitis obliterans organizing pneumonia syndrome after breast-conserving therapy. *Int. J. Radiat. Oncol. Biol. Phys.* **2009**, *73*, 1049–1054. [[CrossRef](#)] [[PubMed](#)]
12. Okada, Y.; Sakamoto, S.; Abe, T.; Shinozaki, M.; Gomi, H.; Kanemaki, Y.; Matsuoka, S.; Nakajima, Y. Factors Predicting the Relapse of Radiation-Induced Organizing Pneumonia after Breast-Conserving Therapy. *Open J. Radiol.* **2015**, *5*, 159–169. [[CrossRef](#)]
13. Epler, G.R.; Kelly, E.M. Systematic review of postradiotherapy bronchiolitis obliterans organizing pneumonia in women with breast cancer. *Oncologist* **2014**, *19*, 1216–1226. [[CrossRef](#)] [[PubMed](#)]
14. Epler, G.R. Bronchiolitis obliterans organizing pneumonia, 25 years: A variety of causes, but what are the treatment options? *Expert Rev. Respir. Med.* **2011**, *5*, 353–361. [[CrossRef](#)] [[PubMed](#)]
15. Cohen, A.J.; King, T.E., Jr.; Downey, G.P. Rapidly progressive bronchiolitis obliterans with organizing pneumonia. *Am. J. Respir. Crit. Care Med.* **1994**, *149*, 1670–1675. [[CrossRef](#)] [[PubMed](#)]
16. Lohr, R.H.; Boland, B.J.; Douglas, W.W.; Dockrell, D.H.; Colby, T.V.; Swensen, S.J.; Wollan, P.C.; Silverstein, M.D. Organizing pneumonia: Features and prognosis of cryptogenic, secondary, and focal variants. *Arch. Intern. Med.* **1997**, *157*, 1323–1329. [[CrossRef](#)] [[PubMed](#)]

17. Crestani, B.; Valeyre, D.; Roden, S.; Wallaert, B.; Dalphin, J.C.; Cordier, J.F. Bronchiolitis obliterans organizing pneumonia syndrome primed by radiation therapy to the breast. The Groupe d'Etudes et de Recherche sur les Maladies Orphelines Pulmonaires (GERM"O"P). *Am. J. Respir. Crit. Care Med.* **1998**, *158*, 1929–1935. [[CrossRef](#)] [[PubMed](#)]
18. Stover, D.E.; Milite, F.; Zakowski, M. A newly recognized syndrome—Radiation-related bronchiolitis obliterans and organizing pneumonia. A case report and literature review. *Respiration* **2001**, *68*, 540–544. [[CrossRef](#)] [[PubMed](#)]
19. Arbetter, K.R.; Prakash, U.B.; Tazelaar, H.D.; Douglas, W.W. Radiation-induced pneumonitis in the “nonirradiated” lung. *Mayo Clin. Proc.* **1999**, *74*, 27–36. [[CrossRef](#)] [[PubMed](#)]
20. Van Laar, J.M.; Holscher, H.C.; van Krieken, J.H.; Stolk, J. Bronchiolitis obliterans organizing pneumonia after adjuvant radiotherapy for breast carcinoma. *Respir. Med.* **1997**, *91*, 241–244. [[CrossRef](#)]
21. Hamanishi, T.; Morimatu, T.; Oida, K.; Kori, Y.; Taguchi, Y.; Tanaka, E.; Inoue, T.; Kato, T.; Maniwa, K.; Kobashi, Y. Occurrence of BOOP outside radiation field after radiation therapy for small cell lung cancer. *Nihon Kokyuki Gakkai Zasshi* **2001**, *39*, 683–688. [[PubMed](#)]
22. Iijima, M.; Sakahara, H. Radiation pneumonitis resembling bronchiolitis obliterans organizing pneumonia after postoperative irradiation for lung cancer: A case report. *Nihon Igaku Hoshasen Gakkai Zasshi* **2003**, *63*, 332–333. [[PubMed](#)]
23. Kwok, E.; Chan, C.K. Corticosteroids and azathioprine do not prevent radiation-induced lung injury. *Can. Respir. J.* **1998**, *5*, 211–214. [[CrossRef](#)] [[PubMed](#)]
24. Nogi, S.; Nakayama, H.; Tajima, Y.; Okubo, M.; Mikami, R.; Sugahara, S.; Akata, S.; Tokuyue, K. Cryptogenic organizing pneumonia associated with radiation: A report of two cases. *Oncol. Lett.* **2014**, *7*, 321–324. [[PubMed](#)]
25. Falcinelli, L.; Bellavita, R.; Rebonato, A.; Chiari, R.; Vannucci, J.; Puma, F.; Aristei, C. Bronchiolitis obliterans organizing pneumonia after radiation therapy for lung cancer: A case report. *Tumori* **2015**, *101*, e88–e91. [[CrossRef](#)] [[PubMed](#)]
26. Murai, T.; Shibamoto, Y.; Nishiyama, T.; Baba, F.; Miyakawa, A.; Ayakawa, S.; Ogino, H.; Otsuka, S.; Iwata, H. Organizing pneumonia after stereotactic ablative radiotherapy of the lung. *Radiat. Oncol.* **2012**, *7*, 123. [[CrossRef](#)] [[PubMed](#)]
27. Ochiai, S.; Nomoto, Y.; Yamashita, Y.; Murashima, S.; Hasegawa, D.; Kurobe, Y.; Toyomasu, Y.; Kawamura, T.; Takada, A.; Noriko, I. Radiation-induced organizing pneumonia after stereotactic body radiotherapy for lung tumor. *J. Radiat. Res.* **2015**, *56*, 904–911. [[CrossRef](#)] [[PubMed](#)]
28. Krengli, M.; Sacco, M.; Loi, G.; Masini, L.; Ferrante, D.; Gambaro, G.; Ronco, M.; Magnani, C.; Carriero, A. Pulmonary changes after radiotherapy for conservative treatment of breast cancer: A prospective study. *Int. J. Radiat. Oncol. Biol. Phys.* **2008**, *70*, 1460–1467. [[CrossRef](#)] [[PubMed](#)]
29. Cordier, J.-F. Cryptogenic organising pneumonia. *Eur. Respir. J.* **2006**, *28*, 422–446. [[CrossRef](#)] [[PubMed](#)]
30. Majori, M.; Poletti, V.; Curti, A.; Corradi, M.; Falcone, F.; Pesci, A. Bronchoalveolar lavage in bronchiolitis obliterans organizing pneumonia primed by radiation therapy to the breast. *J. Allergy Clin. Immunol.* **2000**, *105*, 239–244. [[CrossRef](#)]
31. Cottin, V.; Frogner, R.; Monnot, H.; Levy, A.; DeVuyst, P.; Cordier, J.F. Chronic eosinophilic pneumonia after radiation therapy for breast cancer. *Eur. Respir. J.* **2004**, *23*, 9–13. [[CrossRef](#)] [[PubMed](#)]
32. Cottin, V.; Cordier, J.-F. Cryptogenic organizing pneumonia. *Semin. Respir. Crit. Care Med.* **2012**, *33*, 462–475. [[PubMed](#)]
33. Robertson, B.J.; Hansell, D.M. Organizing pneumonia: A kaleidoscope of concepts and morphologies. *Eur. Radiol.* **2011**, *21*, 2244–2254. [[CrossRef](#)] [[PubMed](#)]
34. Beardsley, B.; Rassl, D. Fibrosing organising pneumonia. *J. Clin. Path.* **2013**, *66*, 875–881. [[CrossRef](#)] [[PubMed](#)]
35. Izykowski, N.; Kuehnel, M.; Hussein, K.; Mitschke, K.; Gunn, M.; Janciauskiene, S.; Haverich, A.; Warnecke, G.; Laenger, F.; Maus, U. Organizing pneumonia in mice and men. *J. Transl. Med.* **2016**, *14*, 169. [[CrossRef](#)] [[PubMed](#)]
36. Endlich, B.; Radford, I.R.; Forrester, H.B.; Dewey, W.C. Computerized video time-lapse microscopy studies of ionizing radiation-induced rapid-interphase and mitosis-related apoptosis in lymphoid cells. *Radiat. Res.* **2000**, *153*, 36–48. [[CrossRef](#)]

37. Cordier, J.-F.; Cottin, V.; Lazor, R.; Stoppa-Lyonnet, D. Monoallelic germline ATM mutation and organising pneumonia induced by radiation therapy to the breast. *Eur. Respir. J.* **2016**, *47*, 997–1000. [[CrossRef](#)] [[PubMed](#)]
38. Lee, J.; Paull, T. Activation and regulation of ATM kinase activity in response to DNA double-strand breaks. *Oncogene* **2007**, *26*, 7741–7748. [[CrossRef](#)] [[PubMed](#)]
39. Thompson, D.; Duedal, S.; Kirner, J.; McGuffog, L.; Last, J.; Reiman, A.; Byrd, P.; Taylor, M.; Easton, D.F. Cancer risks and mortality in heterozygous ATM mutation carriers. *J. Natl. Cancer Inst.* **2005**, *97*, 813–822. [[CrossRef](#)] [[PubMed](#)]
40. Renwick, A.; Thompson, D.; Seal, S.; Kelly, P.; Chagtai, T.; Ahmed, M.; North, B.; Jayatilake, H.; Barfoot, R.; Spanova, K. ATM mutations that cause ataxia-telangiectasia are breast cancer susceptibility alleles. *Nat. Genet.* **2006**, *38*, 873–875. [[CrossRef](#)] [[PubMed](#)]
41. Murofushi, K.N.; Oguchi, M.; Goshio, M.; Kozuka, T.; Sakurai, H. Radiation-induced bronchiolitis obliterans organizing pneumonia (BOOP) syndrome in breast cancer patients is associated with age. *Radiat. Oncol.* **2015**, *10*, 103. [[CrossRef](#)] [[PubMed](#)]
42. Colletta, A.; Wakefield, L.; Howell, F.; Van Roozendaal, K.; Danielpour, D.; Ebbs, S.; Sporn, M.; Baum, M. Anti-oestrogens induce the secretion of active transforming growth factor  $\beta$  from human fetal fibroblasts. *Br. J. Cancer* **1990**, *62*, 405–409. [[CrossRef](#)] [[PubMed](#)]
43. Bentzen, S.M.; Skoczylas, J.Z.; Overgaard, M.; Overgaard, J. Radiotherapy-related lung fibrosis enhanced by tamoxifen. *J. Natl. Cancer Inst.* **1996**, *88*, 918–922. [[CrossRef](#)] [[PubMed](#)]
44. Huang, E.-Y.; Wang, C.-J.; Chen, H.-C.; Sun, L.-M.; Fang, F.-M.; Yeh, S.-A.; Hsu, H.-C.; Hsiung, C.-Y.; Wu, J.-M. Multivariate analysis of pulmonary fibrosis after electron beam irradiation for postmastectomy chest wall and regional lymphatics: Evidence for non-dosimetric factors. *Radiother. Oncol.* **2000**, *57*, 91–96. [[CrossRef](#)]
45. Harris, E.E.; Christensen, V.J.; Hwang, W.-T.; Fox, K.; Solin, L.J. Impact of concurrent versus sequential tamoxifen with radiation therapy in early-stage breast cancer patients undergoing breast conservation treatment. *J. Clin. Oncol.* **2005**, *23*, 11–16. [[CrossRef](#)] [[PubMed](#)]
46. Pierce, L.J.; Hutchins, L.F.; Green, S.R.; Lew, D.L.; Gralow, J.R.; Livingston, R.B.; Osborne, C.K.; Albain, K.S. Sequencing of tamoxifen and radiotherapy after breast-conserving surgery in early-stage breast cancer. *J. Clin. Oncol.* **2005**, *23*, 24–29. [[CrossRef](#)] [[PubMed](#)]
47. Azria, D.; Belkacemi, Y.; Romieu, G.; Gourgou, S.; Gutowski, M.; Zaman, K.; Moscardo, C.L.; Lemanski, C.; Coelho, M.; Rosenstein, B. Concurrent or sequential adjuvant letrozole and radiotherapy after conservative surgery for early-stage breast cancer (CO-HO-RT): A phase 2 randomised trial. *Lancet Oncol.* **2010**, *11*, 258–265. [[CrossRef](#)]
48. McEvoy, C.E.; Niewoehner, D.E. Adverse effects of corticosteroid therapy for COPD: A critical review. *Chest* **1997**, *111*, 732–743. [[CrossRef](#)] [[PubMed](#)]
49. Rutz, H.P. Effects of corticosteroid use on treatment of solid tumours. *Lancet* **2002**, *360*, 1969–1970. [[CrossRef](#)]
50. Vento, S.; Cainelli, F.; Temesgen, Z. Lung infections after cancer chemotherapy. *Lancet Oncol.* **2008**, *9*, 982–992. [[CrossRef](#)]
51. Herr, I.; Pfitzenmaier, J. Glucocorticoid use in prostate cancer and other solid tumours: Implications for effectiveness of cytotoxic treatment and metastases. *Lancet Oncol.* **2006**, *7*, 425–430. [[CrossRef](#)]
52. Zhang, C.; Kolb, A.; Mattern, J.; Gassler, N.; Wenger, T.; Herzer, K.; Debatin, K.; Büchler, M.; Friess, H.; Rittgen, W. Dexamethasone desensitizes hepatocellular and colorectal tumours toward cytotoxic therapy. *Cancer Lett.* **2006**, *242*, 104–111. [[CrossRef](#)] [[PubMed](#)]
53. Johkoh, T.; Muller, N.L.; Cartier, Y.; Kavanagh, P.V.; Hartman, T.E.; Akira, M.; Ichikado, K.; Ando, M.; Nakamura, H. Idiopathic Interstitial Pneumonias: Diagnostic Accuracy of Thin-Section CT in 129 Patients. *Radiology* **1999**, *211*, 555–560. [[CrossRef](#)] [[PubMed](#)]



# Radio Frequency Technology damages Plant DNA in 48hrs and is carcinogenic, new research reveals

By [Sara Vincent](#)

2017-02-21 03:29

Scientists revealed in a new [study](#), the damaging effects of [Radio Frequency](#) exposure through the use of cell phones and laptops. In this experiment, researchers exposed 150 healthy dry seeds of chickpea, which were distributed in two petri plates, and each plate was placed at distances of 1 inch to cell phone and laptop for 24 and 48 h. This simple experiment revealed that all radio frequency exposure inhibits seed germination percentage.

A decrease was observed in [mitotic index \(M.I\)](#) and increase in [abnormality index \(A.I\)](#) with the increase in exposure duration and frequency in (Hz).

Cell phone Radio frequency at 900MHz had less inhibitory effect in the germination process, than the laptop at 3.31 GHz. Nevertheless, the damage to the germination process of the chickpea seed was evident, with a negative effect of 17% germination only. The researchers suggested that in order to avoid reported DNA damages, cell phones should always be used either for short duration or with hands free for long duration and they should not be kept in pockets or near body. Laptops should not be used unnecessarily for enjoyment purpose. It must be placed on desk top rather lap to minimize their exposure to the human body.

Another revealing finding was the damage that Radio Frequency does on the DNA of the plant, as cell membrane degradation was observed. There was also maximum nuclear membrane damage and [ghost cells](#), which is a clear indication that such Radio Frequency induces the formation of cancerigenous cells.

The effects of Radio Frequency in humans and animals are well documented. Recently an [in vitro study](#), evaluated the induction of DNA and chromosomal damage in human blood leukocytes and lymphocytes by cells phone signals of 837 MHz and 1909.8 MHz. This research demonstrates that, under extended exposure conditions, Radio Frequency signals at an average Specific [Absorption Rate](#) of at least 5.0 W/kg are capable of inducing chromosomal damage in human lymphocytes.

[An analysis](#) of 100 peer-reviewed studies about the oxidative effects of low-intensity (RFR) Radio Frequency Radiation, revealed that 93 studies confirmed that RFR induces oxidative effects in biological systems. The conclusion was low- intensity RFR is in fact expressive oxidative agent for living cells.

According to the American Cancer Society "If RF radiation is absorbed in large enough amounts by materials containing water, such as food, fluids, and body tissues, it can produce heat. This can lead to burns and tissue damage."

**What are the technologies that emit Radio Frequency?**

There are many ways you can be exposed to man made radiation. The most common are through: microwaving food, television and radio signals, wi - fi and blue tooth, cordless phones, cell-phones and cell phone towers, laptops, satellite phones, 2-way radios, Radar, Millimeter wave scanners, microchip implants and more.

### **The recent applications of RFID technology and moving forward**

At the fast pace technology is developing, and the way in which society's infra - structure seems to be leaning towards a dependence in technology to operate. There are many ideas being put forward by the scientific community. Some of these ideas are bellow:

- 1) implantable RFID device to track the elderly or [brain implant device for patients with Alzheimers](#)
- 2) [implantable drug to deliver medicine](#)
- 3) Some are using to [buy and sell](#) and identify themselves



King Saud University  
Saudi Journal of Biological Sciences

www.ksu.edu.sa  
www.sciencedirect.com



## ORIGINAL ARTICLE

# Radiofrequency radiations induced genotoxic and carcinogenic effects on chickpea (*Cicer arietinum* L.) root tip cells

Sadaf Tabasum Qureshi <sup>a,\*</sup>, Sajjad Ahmed Memon <sup>b</sup>, Abdul Rasool Abassi <sup>a</sup>, Mahboob Ali Sial <sup>c</sup>, Farooque Ali Bughio <sup>a</sup>

<sup>a</sup> Institute of Plant Sciences, University of Sindh, Jamshoro, Pakistan

<sup>b</sup> Nuclear Institute of Medicine and Radiotherapy Jamshoro, Pakistan

<sup>c</sup> Nuclear Institute of Agriculture, Tando Jam, Pakistan

Received 7 September 2015; revised 21 January 2016; accepted 7 February 2016

## KEYWORDS

Radio frequency radiation;  
Genotoxicity;  
Carcinogenicity;  
Chromosomal aberrations

**Abstract** Present study was under taken to predict the possible DNA damages (genotoxicity) and carcinogenicity caused by radiofrequency radiations (RF) to living tissue. Dry seeds of chickpea were treated with GSM cell phone (900 MHz) and laptop (3.31 GHz) as RF source for 24 and 48 h. Untreated seeds were used as (0 h) negative control and Gamma rays (250 Gray) as positive control. Plant chromosomal aberration assay was used as genotoxicity marker. All the treatment of RF inhibits seed germination percentage. 48 h laptop treatment has the most negative effect as compared to untreated control. A decrease was observed in mitotic index (M.I) and increase in abnormality index (A.I) with the increase in exposure duration and frequency in (Hz). Cell membrane damages were also observed only in 48 h exposure of cell phone and laptop (RF). Maximum nuclear membrane damages and ghost cells were again recorded in 48 h exposure of cell phone and laptop. The radiofrequency radiations (900 MHz and 3.31 GHz) are only genotoxic as they induce micronuclei, bi-nuclei, multi-nuclei and scattered nuclei but could be carcinogenic as 48 h incubation of RF induced fragmentation and ghost cells. Therefore cell phones and laptop should not be used unnecessarily to avoid possible genotoxic and carcinogenic effects.

© 2016 The Authors. Production and hosting by Elsevier B.V. on behalf of King Saud University. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## 1. Introduction

Electromagnetic radiation (EMR) can be classified into two types: Ionizing radiation and Non-ionizing radiation. Non-ionizing radiation refers to any type of electromagnetic radiation that doesn't carry enough energy per quantum to ionize atoms or molecules. ([www.wikipedia.com](http://www.wikipedia.com)). Non-ionizing radiation includes Ultra Violet (UV), Microwave and

\* Corresponding author.

Peer review under responsibility of King Saud University.



Production and hosting by Elsevier

<http://dx.doi.org/10.1016/j.sjbs.2016.02.011>

1319-562X © 2016 The Authors. Production and hosting by Elsevier B.V. on behalf of King Saud University.

This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Please cite this article in press as: Qureshi, S.T. et al., Radiofrequency radiations induced genotoxic and carcinogenic effects on chickpea (*Cicer arietinum* L.) root tip cells. Saudi Journal of Biological Sciences (2016), <http://dx.doi.org/10.1016/j.sjbs.2016.02.011>

radiofrequency radiation. Probably the most important use of radiofrequency (RF) energy is in providing telecommunication services. Radio and television broadcasting, cellular telephones, laptops, radio communication for police and fire departments, amateur radio, microwave point-to-point links, and satellite communication. Besides being so useful these radiofrequency radiations have many biological effects on living tissues. Recent studies link exposure to health problem that includes lower sperm counts (Avendano et al., 2012), memory loss (Koivisto et al., 2000; Cech et al., 2008), sleep disruption (Loughran et al., 2005), decreased immune function, dizziness, headaches, higher blood pressure and reduced DNA repair capacity (Braune et al., 1998; Trimmel and Bachmann, 2004; James, 2008; Tyagi et al., 2011).

Genotoxicity is the property possessed by some substances that make them harmful to the genetic information contained in organism. Physical and chemical agents having ability to damage deoxyribonucleic acid (DNA) are called genotoxic (Galloway, 1994). Segment breaks in DNA molecule are called chromosomal aberrations. These are only visible in cell divisions. Mitosis is widely used for the study of genotoxic compounds using chromosomal aberration assay.

The damage of DNA or genotoxicity is an important consideration, because it has a potential to cause irreversible changes to genes and even cancer (M-boh, 2003). Mainly *Allium cepa* chromosomal aberration assay was used as bioassay plant since 1938 (Levan, 1938) for investigating environmental pollution factors, toxicity of chemical compounds, and evaluating potential anticancer properties (Bakare et al., 2000; Majewska et al., 2003; Babatunde and Bakare, 2006; Kuraš et al., 2007) but now researchers are also using *Vicia Faba*, *Vigna mungo* and *Cicer arietinum* L. (Rank and Nielsen, 1993; Unyaya et al., 2006; Chahal et al., 2012; Siddiqui, 2012; Arain and Maqbool, 2011).

Non-thermal level of radiofrequency exposure has genotoxic effects in the form of chromosomal instability, altered gene expression, gene mutation, DNA fragmentation and DNA structure break. Some other genotoxic effects are documented to occur on neurons, blood lymphocytes, sperms, Red Blood Cell (RBC), epithelial cells, hematopoietic tissues, lung cells and bone marrow (Mashevich et al., 2003). Microwave frequencies ranging between 375 and 36.64 GHz can increase cell membrane permeability to staining dye used to study cytological aspects in living human buccal epithelium cells (Shckorbatov et al., 2002, 2011). EMFs can change secondary structure of cell membrane proteins by causing reversible changes to peptide linkage (Ikehara et al., 2003). EMFs have

ability to influence usual oxidation and reduction inside a cell (Kovacic and Somanath, 2010) and their long time exposure can alter cellular balance resulting in oxidative stress (Scaiano et al., 1994; Repacholi and Greenebaum, 1999; Jajte et al., 2002; Akdag et al., 2007; Simkó, 2007).

Chromosomal aberrations have been used as a measure of reproductive success in plants for many years but now they are also used as measure of co-relation between reduction in fertility, mutagenesis and carcinogenesis (Kostoff, 1934). Cytogenetic abnormalities are a characteristic attribute of cancer cells. To date, chromosome aberrations have been found in all major tumor types of cancer. Translocations and double stranded breaks (deletions) are more commonly found chromosomal aberration in tumor cells (Hindus and Weinberg, 1994; Knudson, 2001; Keen-Kim et al., 2008; Stratton et al., 2009).

Chromosomal aberrations in plants serve as excellent monitoring system for the detection of environmental chemicals that may pose a genetic hazard. The plant systems have proven most useful for this purpose (Nilan and Vig, 1976; Gustavino et al., 2015). Use of *C. arietinum* L. as assay plant is reported by many workers (Arain and Maqbool, 2011; Qureshi et al., 2014; Parihar and Mawal, 2015).

The usage of GSM cell phone and laptop has increased many folds over the last few years. It is therefore a matter of great concern. Prolonged use of GSM cell phones due to free call packages and use of laptops on our laps during travel and leisure expose humans to more intense radiation. More portable devices with RF are to be expected in future that may be operated near the body. This will further increase the exposure of people to high frequency electromagnetic fields. Many researchers worked on effects of far field RF on plants but no study is carried out on near field effects. Therefore present study is first attempt to predict possible radiofrequency radiation induced genotoxic and carcinogenic effects.

## 2. Material and methods

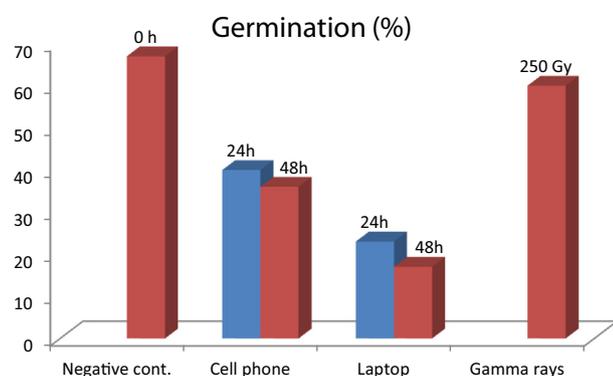
Plant chromosomal aberration assay was used as genotoxicity marker as suggested by (Grant, 1978). Kabuli chickpea genotype NCS 0530 was obtained from National Agriculture Research Center, Islamabad (NARC) was used in assay.

### 2.1. RF source and treatment plan

In order to predict possible cytotoxic and genotoxic effects by near field RF, Nokia GSM set, model N0# X2-00 (900 MHz)



Figure 1 RF treatment of chickpea seeds.



**Figure 2** Effect of radiofrequency radiations on germination of chickpea (h = hours; Gy = Gray).

and HP laptop, model N0# 430 core i5 (3.31 GHz) were used as RF sources. 150 healthy dry seeds of chickpea were distributed in two petri plates. Each petri plate was placed at distances of 1 inch to cell phone and laptop for 24 and 48 h (Fig. 1). Untreated seeds were used as (0 h) negative control and Gamma rays 250 (Gray) as positive control.

## 2.2. Seed germination

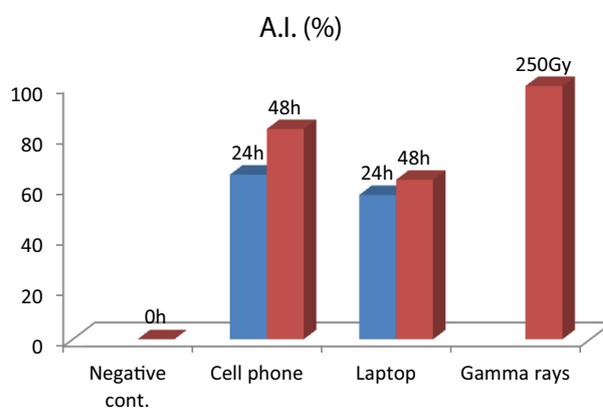
Seeds were soaked in distilled water for 2 h before sowing in the sand pots. The number of roots recovered was expressed in percentage.

## 2.3. Root fixation and slide preparation

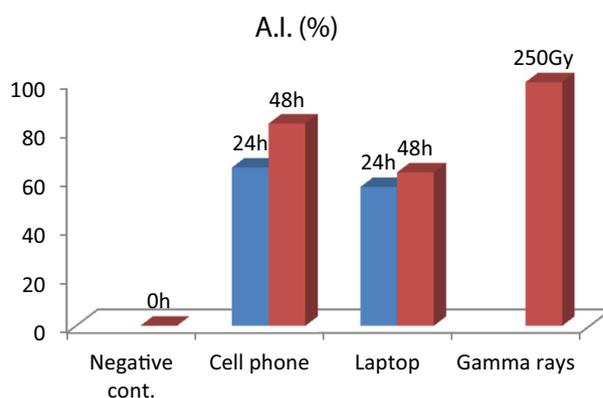
2 cm root samples were collected and fixed in Carnoy solution (3:1 alcohol and glaciated acetic acid) for 24 h. Roots were then transferred to 70% alcohol until used. Root tips were spread using the squash technique (Dille and King, 1983; Dille et al., 1986) and stained with 2% Acetocarmine (2% in 45% glacial acetic acid).

## 2.4. Microscopy of mitotic slide

Slides were studied and photographed with Olympus 1X51 Microscope at 100 × magnification. Five slides per treatment were used to score number of cells for each chromosomal aberration (DNA damages).



**Figure 3** Effect of radiofrequency radiations on abnormality index (%) (h = hours; Gy = Gray).



**Figure 4** Effect of radiofrequency radiations on mitotic index (%) (h = hours; Gy = Gray).

## 2.5. Data analysis

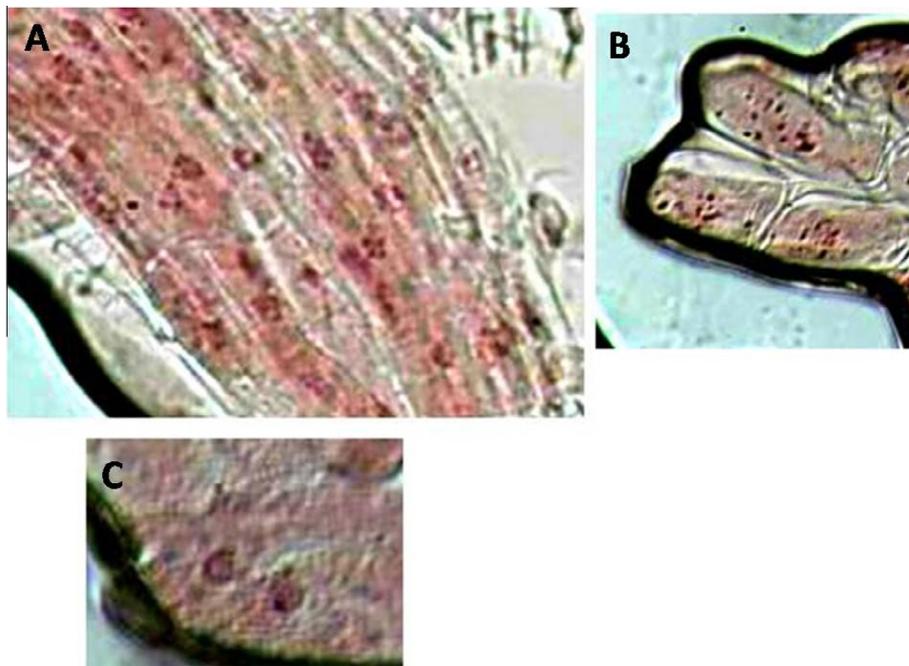
### 2.5.1. Mitotic Index (M.I.)

Mitotic index was calculated as described by Racuciu (2009). It was calculated by the following formula:

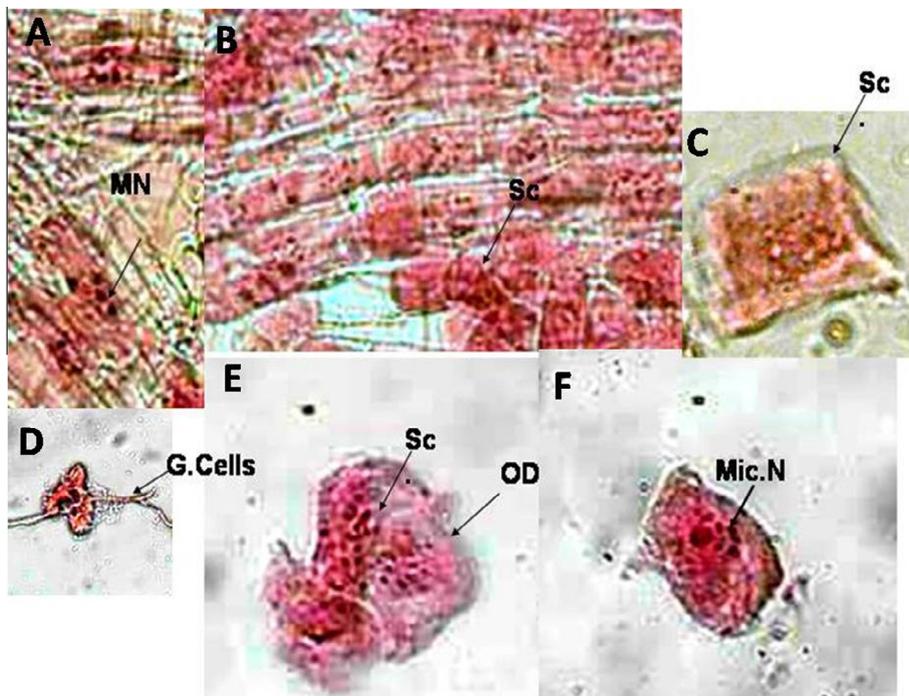
$$\text{M.I.} = \frac{\text{Total dividing cells}}{\text{Total cells analyzed}} \times 100$$

**Table 1** Effect of radiofrequency on abnormality index (A.I.) and mitotic index (M.I.) in chickpea root tip cells.

Treatments	Hours	Number of cells				No. of abnormal cells in stages of mitosis			A.I. (%)	M.I. (%)
		Dividing	Abnormal	Normal	Non-dividing	Metaphase	Anaphase	Telophase		
Negative control	0	500	0	500	0	75	0	141	0	100
Cell phone (900 MHz)	24	419	276	143	81	42	143	92	65	84
	48	316	263	56	184	27	117	116	83	63
Laptop (3.31 GHz)	24	450	260	140	50	169	76	0	57	90
	48	397	318	78	103	243	75	0	63	79
Positive control	250	211	211	0	189	128	37	0	100	52
Gamma ray (Gy)										



**Figure 5** Negative control showing normal mitotic cells (A and B = pro-metaphase; C = prophase).



**Figure 6** Positive control Gamma rays (250 Gy) induced chromosomal aberrations (A) Multinuclei (MN); (B, C and E) sticky metaphase (Sc) and oxidative cell membrane damage (OD); (D) ghost cell with pilus; (F) micro-nuclei (Mic. N).

### 2.5.2. Abnormal index (A.I.)

Abnormal index was calculated by the method of (Racuciu, 2009) according to the following formula.

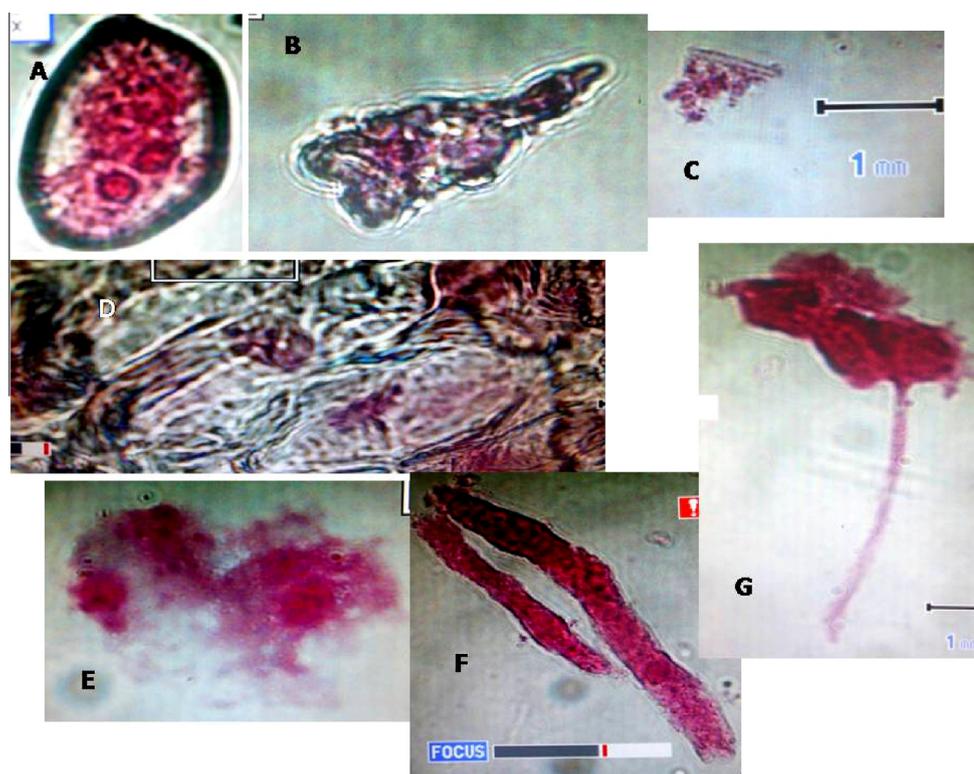
$$A.I. = \frac{\text{Total abnormal dividing cells}}{\text{Total dividing cells}} \times 100$$

### 3. Results

The effect of radiofrequency radiations on the germination percentage of chickpea is presented in (Fig. 2). All the treatment of RF inhibits seed germination percentage. Cell phone RF (900 MHz) has less inhibitory effect than laptop

**Table 2** Types of chromosomal aberrations induced by radiofrequency radiations.

Mitosis stage	S. No	Abnormalities	Control (%)		Cell phone (900 MHz)		Laptop (3.31 GHz)	
			Negative control (0 H)	Positive control Gamma rays (250 Gy)	24 (H)	48 (H)	24 (H)	48 (H)
Metaphase	1	Sticky metaphase	0	31	0	27	33	0
	2	Translocations	0	0	42	0	0	0
	3	Distributed metaphase	0	15	0	0	0	0
Anaphase	4	Scattered nuclei	0	34	118	0	130	60
	5	Laggard	0	43	0	2	0	0
Interphase	6	Fragmentation	0	36	25	117	39	183
	7	Micronuclei	0	0	25	43	16	25
	8	Multinuclei	0	37	0	0	33	0
	9	Dinuclei	0	0	67	73	27	50

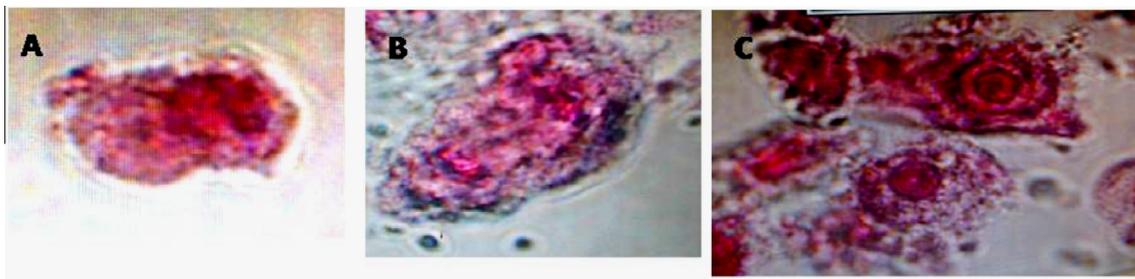


**Figure 7** Cell phone 24 h treatment induced chromosomal aberrations (Showing (A and E) Di-nuclei; (D) sticky metaphase; (B and C) ghost cells; (G) ghost cell with proliferation pilus); (F) fragmentation.

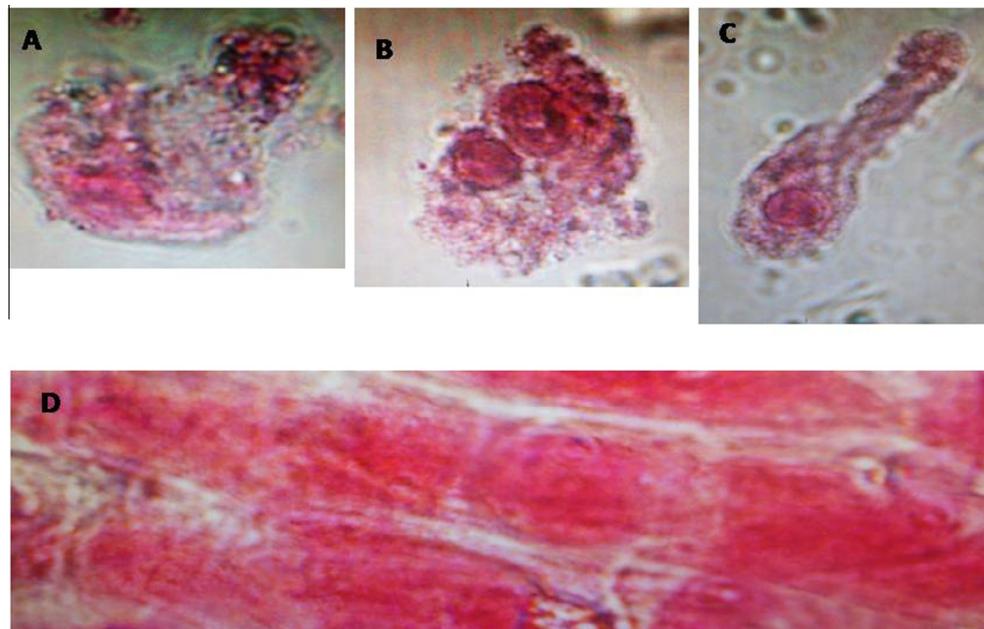
(3.31 GHz). 48 h laptop exposure has the most negative effect with 17% germination as compared to negative control with 67% germination. Present results are consistent with Racuciu et al. (2015) and Kumar et al. (2015) who reported electromagnetic radiation of mobile phone induced root and coleoptiles growth inhibition in *Zea mays* and Cammaerts and Johansson (2015) in *Lepidium sativum*. Possible reasons for reduced growth observed by these researchers were retarded in chlorophyll pigments and nucleic acid content, interference in starch and sucrose metabolism and lack of imbibitions by germinal cells. Parihar and Mawal (2015) working with

radiations emitted by 2G and 3G mobile phones also observed growth retardation and diminished fresh and dry weight of roots in pulses. On the contrary Brozouei et al. (2010) reported that only high dose of ionization radiation can depress germination percentage.

The results indicate negative association between radiation exposure duration and germination percentage except 24 h cell phone exposure (40%). This may be due to random mutation induced by RF. A slight mutation in genes responsible for cell division may cause germination inhibition. The possible reason behind decline in germination, growth and survival are



**Figure 8** Cell phone 48 h treatment induced chromosomal aberrations (A and B) Laggard; (C) micronuclei.



**Figure 9** Laptop 24 h treatment induced chromosomal aberrations (A and C) abnormal telophase with nuclear membrane damage (B) Di-nuclei with cell membrane damage and (D) chromosomal fragmentation.

generally metabolic disorders of which cytokinin breakdown or lack of synthesis is most common (Gandhi et al., 2014; Gustavino et al., 2014).

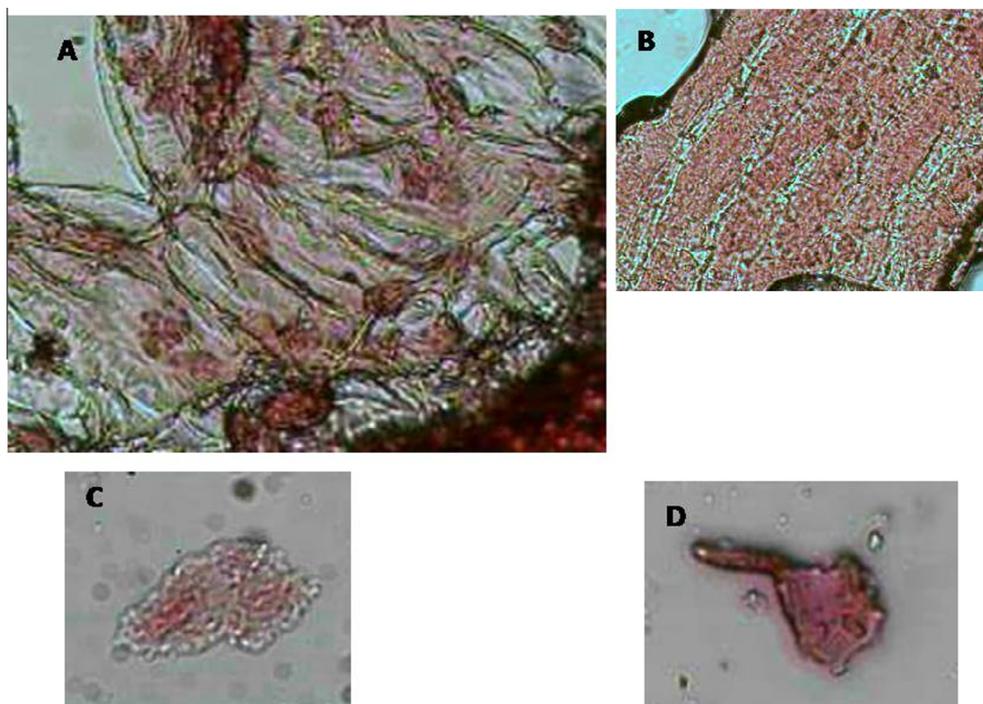
The results of effect of radiofrequency on abnormality index and mitotic index on chickpea root tip cells are compiled in Table 1. The abnormality index showed a linear increase with exposure and frequency in Hz (Fig. 3). Whereas mitotic index (%) exhibited a linear decrease with increased RF exposure (Fig. 4). Similar trends were observed by Lamsal et al. (2010) in *Allium cepa* root tip cells treated with agricultural insecticide. Results showed that mitotic index decreases as abnormality index increased. The altered mitotic rate of the plant subjected to EMR is mostly attributed to interference in normal steps of mitosis and spindle formation (Moisescu et al., 2008; Tkalec et al., 2009), failure of DNA replication and proteins synthesis (Lia and Singh, 2004), enzyme production, function and regulation and low level of ATP generation due to decreased oxidative photophosphorylation (Hao et al., 2015) (see Figs. 5 and 6).

The types of chromosomal aberrations induced by radiofrequency are compiled in (Table 2). During 24 h with cell phone treatment most frequent abnormality was scattered nuclei (118

cells) while least frequent abnormality was micronuclei (25 cells) (Fig. 7).

In 48 h cell phone treatment fragmentation (117 cells) was the most frequent abnormality, while least frequent abnormality was sticky metaphase (27 cells) (Fig. 8). In 24 h laptop exposure most frequent abnormality was scattered nuclei (130 cells) while the least frequent abnormality was micronuclei (16 cells) (Fig. 9). In 48 h laptop exposure, the most frequent abnormality was fragmentation (183 cells) while the least frequent abnormality was micronuclei (25 cells) (Fig. 10).

Present research reveals increased DNA damages with increasing duration of RF exposure. Chavdoula et al. (2010) reported mobile phone radiations (900 MHz–1800 MHz) induced DNA fragmentation in the egg chamber cells resulting in decreased fertility and apoptosis in *Drosophila melanogaster*. Gustavino et al. (2015) evaluated mutagenic potential of radiofrequency radiation of 915 MHz continuous wave radiation for 72 h on secondary root tips of *Vicia faba* and recorded dose dependent increase in micronucleus frequency. Similarly Zotti-Martelli et al. (2005) assess the micronucleus (MN) induction capability of microwaves (1800 MHz), on peripheral blood lymphocytes of humans and found statistically



**Figure 10** Laptop 48 h treatment induced chromosomal aberrations (A and C) normal prophase (B) fragmentation (C) scattered nuclei and (D) ghost cells with pilus.

**Table 3** Oxidative damages induced by radiofrequency radiations in chickpea root tip cells.

Treatments	Hours	Type of oxidative damage (No. of cells)		
		C.M. damage	N. M. damage	Ghost cells
Negative control	0	0	0	0
Cell phone (900 MHz)	24	0	164	60
	48	100	342	132
Laptop (3.31 GHz)	24	0	200	200
	48	20	254	250
Gamma ray 250 Gy		17	32	255
Grand mean		137	992	897

(C.M. = Cell membrane; N.M. = Nuclear membrane).

significant increase of MN, in exposure time and applied power density dependent manner. Presence of pilus like tube in some cells treated with cell phone 24 and laptop 48 h is evidence of cellular connection that may lead to proliferation of apoptotic cells and nuclear aggregation commonly found in cancerous cells. This may be due to error of repair machinery and high level of fragmentation that leads to defected chimeric gene (Shaffer and Pandolfi, 2006; Meyerson, 2007) expressing pilus like tubular out growth. Therefore it is suggested to carry out PCR amplifications with all type of pilin promoters in such cells (see Fig. 8).

The results of oxidative damages induced by radiofrequency are presented in Table 3. Maximum cell membrane damages were observed in 48 h exposure with cell phone (100 cells) and laptop (20 cells). Maximum nuclear membrane damages were again recorded in 48 h exposure with cell phone (342 cells) and laptop (254 cells).

Maximum numbers of ghost cells were found in 48 h cell phone (432 cells) and laptop (255 cells) RF. It can be inferred from the results that increase in exposure duration and frequency (Hz) of RF increased the number of cells with oxidative damages. Overall cell membrane damage (137 cells) was the least frequent oxidative damage while nuclear membrane damage (992 cells) was most frequent. All the treatments with RF induced more oxidative stress than positive control (250 Gy). The disruption of membrane integrity may be due to interference of RF with membrane permeability or membrane proteins leading to oxidative stress (Livingstone, 2003). Afzal and Mansoor (2012) reported mobile phone emitted radiofrequency radiation induced oxidative stress in mung bean and wheat crops. Burlaka et al. (2013) observed significant overproduction of free radicals/reactive oxygen species and oxidative damage of DNA in quail embryo cells exposed to GSM 900 MHz for one hundred and fifty-eight

hours. They relate oxidative changes to health effects up to oncogenesis.

Similar findings are reported by Xu et al. (2010) working with cultured neurons irradiated with 1800 MHz RF radiation. They reported that RF is capable of causing oxidative damage to mtDNA that leads to the neurotoxicity of RF radiation in the brain. In another study with 1.8 GHz Global system for mobile communication (GSM) Avci et al. (2012) concluded that RF exposure can enhance protein oxidation in rat brain cells as compared to control group ( $p < 0.001$ ).

#### 4. Conclusion

It is concluded that radiofrequency radiations are genotoxic as they induced chromosomal aberrations in chickpea mitotic cells and the presence of ghost cells is clear indication of their carcinogenic potential. To avoid reported DNA damages in this work cell phones should always be used either for short duration or with handsfree for long duration and they should not be kept in pockets or near body. Laptops should not be used unnecessarily for enjoyment purpose. It must be placed on desk top rather lap to minimize their exposure to human body. Further assay of carcinogenicity are recommended on mouse and human cell lines.

#### References

- Afzal, M., Mansoor, S., 2012. Effect of mobile phone radiation on morphological and biochemical parameters of mung bean (*Vigna radiata*) and wheat (*Triticum aestivum*). *Asian J. Agric. Sci.* 4 (2), 149–152.
- Akdag, M.Z., Bilgin, M.H., Dasdag, S., Tumer, C., 2007. Alteration of nitric oxide production in rat exposed to a prolonged, extremely low-frequency magnetic field. *Electromagn. Biol. Med.* 26 (2), 99–106.
- Arain, A., Maqbool F., 2011. Gross mutations and oxidative stress induced by high doses of Gamma rays on Chickpea (*Cicer arietinum* L.) root tip cells (M.Sc.Thesis). Submitted to the University of Sindh, Jamshoro.
- Avci, B., Akar, A., Bilgici, B., Tunçel, Ö.K., 2012. Oxidative stress induced by 1.8 GHz radio frequency electromagnetic radiation and effects of garlic extract in rats. *Int. J. Radiat. Biol.* 88 (11), 799–805. <http://dx.doi.org/10.3109/09553002.2012.711504>.
- Avendano, C., Mata, A., Sarmient, C.A.S., Doncel, G.F., 2012. Use of laptop computer connected to internet through wi-fi decrease human sperm motility and increase sperm DNA fragmentation. *Fertil. Steril.* 97 (1), 39–45.
- Babatunde, B.B., Bakare, A.A., 2006. Genotoxicity screening of wastewaters from Agbara industrial estate, Nigeria evaluated with the *Allium* test. *Pollut. Res.* 25 (2), 227–234.
- Bakare, A.A., Mosuro, A.A., Osibanjo, O., 2000. Effect of simulated leachate on Chromosomes and mitosis in roots of *Allium cepa* (L). *J. Environ. Biol.* 21 (3), 263–271.
- Braune, S., Wrocklage, C., Raczed, J., Gailus, T., Lucking, C.H., 1998. Resting blood pressure increase during exposure to radio frequency electromagnetic field. *Lancet* 351, 1857.
- Brozouei, A., Kafi, M., Khazaei, H., Naseriyan, B., Majdabadi, A., 2010. Effect of Gamma radiation on germination and physiological aspects of wheat (*Triticum aestivum* L.) seedlings. *Pak. J. Bot.* 42 (4), 2281–2290.
- Burlaka, A., Tsybulin, O., Sidorik, E., Lukin, S., Polishuk, V., Tsehmistrenko, S., Yakymenko, I., 2013. Overproduction of free radicals species in embryonal cells exposed to low intensity radiofrequency radiation. *Exp. Oncol.* 5, 219–225.
- Cammaerts, M.C., Johansson, O., 2015. Effect of man-made electromagnetic fields on common Brassicaceae *Lepidium sativum* (cress d' Illinois) seed germination: a preliminary replication study. *Int. J. Exp. Bot.* 84, 132–137.
- Cech, R., Leitgeb, N., Pediadiaditis, M., 2008. Current densities in a pregnant women model induced by simultaneous ELF electric and magnetic field exposure. *Phys. Med. Biol.* 53 (1), 177–186.
- Chahal, V., Nagpal, A., Katnoria, J.K., 2012. Genotoxicity evaluation of soil sample from agricultural field under wheat cultivation. *Bot. Res. Int.* 5 (1), 01–03.
- Chavdoula, E.D., Panagopoulos, D.J., Margaritis, L.H., 2010. Comparison of biological effects between continuous and intermittent exposure to GSM-900- MHz mobile phone radiation: detection of apoptotic cell-death features. *Mutat. Res.* 700, 51–61.
- Dille, J., King, N., 1983. Changes in mitotic indexes in roots of cereal exposed to di-methyl sulphide (DMJO). *Cytologica* 48, 659–662.
- Dille, J., King, N., Brigh, M., 1986. Morphological, cytological and cytogenetic effect of 50 to  $\times$  25 seed treater (f) (lindane and captan) on roots and chromosomes of rye (*S.cereal* L.). *Cytologia* 5, 489–492.
- Galloway, S.M., 1994. Genotoxicity testing. *Mutat. Res.* 312, 195–322.
- Gandhi, G., Kaur, G., Nisar, U., 2014. A cross-sectional case control study on genetic damage in individuals residing in the vicinity of a mobile phone base station. *Electromagn. Biol. Med.* 9, 1–11.
- Grant, W.F., 1978. Chromosome aberrations in plants as a monitoring system. *Environ. Health Perspect.* 27, 4–7.
- Gustavino, B., Carboni, G., Petrillo, R., Santovetti, E., Rizzoni, M., 2014. Micronucleus induction by 915 MHz Radiofrequency radiation in Vicia Faba root tips. *Mutagenesis*, 1409–1431, arXiv.
- Gustavino, B., Carboni, G., Petrillo, R., Paoluzzi, G., Santovetti, E., Rizzoni, M., 2015. Exposure to 915 MHz radiation induces micronuclei in vicia faba root tips. *Mutagenesis*, gev071.
- Hao, Y., Zhao, L., Peng, R., 2015. Effect of Microwaver ralliation on brain energy metabolism and related mechanisms. *Military Med. Res.* 2 (4). <http://dx.doi.org/10.1186/s40779-015-0033-6>.
- Hindus, P.W., Weinberg, R.A., 1994. Tumor suppressor gens. *Curr. Opin. Genet. Dev.* 4, 15–141.
- Ikehara, T., Yamaguchi, H., Hosokawa, K., Miyamoto, H., Aizawa, K., 2003. Effect of ELF magnetic field on membrane protein structure of living HeLa cells studied by Fourier transform infrared spectroscopy. *Bioelectromagnetics* 24, 457–464.
- Jajte, J., Grzegorzczak, M., Zmysacute, Rajkowska, E., 2002. Effect of 7 mT static magnetic field and iron ions on rat lymphocytes: apoptosis, necrosis and free radical processes. *Bioelectrochemistry* 57 (2), 107–111.
- James, R.J., 2008. Effect of low level radio frequency (3 KHz to 30 GHz) energy on human cardiovascular reproductive immune and other system a review of the recent literature. *Int. J. Hyg. Environ. Health* 211 (1–2), 1–29.
- Keen-Kim, D., Nooraie, F., Rao, P.N., 2008. Cytogenetic biomarkers for human cancer. *Front. Biosci.* 1, 5928–5949.
- Knudson, A.G., 2001. Two genetic hits (more or less) to cancer. *Nat. Rev. Cancer* 1, 157–162.
- Koivisto, M., Kravese, C.M., Revonsvo, A., Laine, M., Hamaalain, H., 2000. The effect of electromagnetic field emitted by GSM phone on working memory. *Neuroreport. Cognit. Neurosci.* 11 (8), 1641–1643.
- Kostoff, D., 1934. Heteroploidy in *Nicotiana tobaccum* and *Solanum melongena* caused by fumigation with nicotine sulphate. *Bull. Soc. Bulg.* 87 (8), 10.
- Kovacic, P., Somanath, R., 2010. Electromagnetic fields: mechanism, cell signaling, other bioprocesses, toxicity, radicals, antioxidants and beneficial effects. *J. Recept. Signal Transduction* 30 (4), 214–226.
- Kumar, A., Singh, H.P., Batish, D.R., Kaur, S., 2015. EMF radiations (1800 MHz) inhibited early seedling growth of maize (*Zea mays*) involves alterations in starch and sucrose. *Protoplasma*. <http://dx.doi.org/10.1007/S00709-015-0863-9>, Online Publication.

- Kuraś, M., Augustynowicz, J., Śliwińska, E., Pilarski, R., Ilasz, R., Tykarska, T., Zobel, A., Gulewicz, K., 2007. Changes in chromosome structure, mitotic activity and nuclear DNA content from cells of *Allium test* induced by bark water extract of *Uncaria tomentosa* (willd.). *J. Ethnopharmacol.* 107 (2), 211–221.
- Lamsal, K., Ghimire, B.K., Sharma, P., Ghimiray, A.K., Kim, S.W., Yu, C.Y., Chung, I.M., Lee, Y.S., Kim, J., Shaky, S.R., 2010. Genotoxicity evaluation of the insecticide ethion root of *Allium cepa*. *Afr. J. Biotechnol.* 9 (27), 4204–4210.
- Levan, A., 1938. The effect of colchicine on root mitoses in *Allium*. *Hereditas* 24, 471–486.
- Lia, H., Singh, N.P., 2004. Magnetic-field induced DNA strand breaks in rain cells of the rat. *Environ. Health Perspect.* 112 (6), 687–694.
- Livingstone, D.R., 2003. Oxidative stress in aquatic organisms in relation to pollution and aquaculture. *Revue de Médecine Vétérinaire* 154, 427–430.
- Loughran, S.P., Wood, A.W., Barton, T.M., Croft, R.J., Thompson, B., Stough, C., 2005. The effect of electromagnetic field emitted by mobile phone on human sleep. *Neuroreport* 16 (17), 1973–1976.
- Majewska, A., Wolska, E., Śliwińska, E., Furmanowa, M., Urbańska, N., Pietrosiuk, A., Zobel, A., Kuraś, M., 2003. Anti-mitotic effect, G2/M accumulation, chromosomal and ultra structure changes in meristematic cells of *Allium cepa* L. root tips treated with the extract from *Rhodiola rosea* roots. *Caryologia* 56, 337–351.
- Mashevich, M., Folkman, D., Kesar, A., 2003. Exposure of human peripheral blood lymphocyte to electromagnetic field associated with cellular phones lead to chromosomal instability. *Bioelectromagnetics* 24, 82–90.
- M-boh, 2003. Genotoxicity: there should or not, introduction of cases of industries chemicals. *Toxicol. Lett.* 140–141.
- Meyerson, M., 2007. Cancer broken genes in solid tumors. *Nature* 448, 545–546.
- Moisescu, M.G., Leveque, P., Bertrand, J.R., Kovacs, E., Mir, L.M., 2008. Microscopic observation of living cells during their exposure to modulated electromagnetic fields. *Bioelectrochemistry* 74 (1), 9.
- Nilan, R.A., Vig, B.K., 1976. Plant test system for detection of chemical mutagen. In: Alexander, Hollander (Ed.), *Chemical Mutagens*, 4. Plenum Publishing Corp., New York, pp. 147–170.
- Parihar, L., Mawal, P., 2015. Effect of 2G and 3G mobile phones radiations on germination and growth of seedlings of pulses. *J. Pharm. Res.* 7 (3), 268–271.
- Qureshi, S.T., Soomro, A.G., Bux, H., Yasmeen, A., 2014. Genotoxic and carcinogenic effects of house hold detergents using chromosomal aberration assay in Chickpea (*Cicer arietinum* L.) root tip cells. *World Appl. Sci. J.* 32 (7), 1381–1387.
- Racuciu, M., 2009. Effect of radiofrequency radiation on root tip cells of *Zea mays*. *Roum. Biotechnol. Lett.* 14 (3), 4365–4369.
- Racuciu, M., Iftode, C., Mićlaus, S., 2015. Inhibitory effects of low thermal radiofrequency radiation on physiological parameters of *Zea mays* seedlings growth. *Rom. J. Phys.* 60 (3–4), 603–612.
- Rank, J., Nielsen, M.H., 1997. *Allium Cepa* anaphase-telophase root tip chromosome aberration assay on N-methyl-n-nitrosourea, maleic hydrazide sodium a zide, and ethyl methanerul fonate. *Mutat. Res.* 390, 1212–1227.
- Repacholi, M.H., Greenebaum, B., 1999. Interaction of static and extremely low frequency electric and magnetic fields with living systems: health effects and research needs. *Bioelectromagnetics* 20 (3), 133–160.
- Scaiano, J.C., Mohtat, N., Cozen, F.L., McLean, J., Thansandote, A., 1994. Application of the radical pair mechanism to free radicals in organized systems: can the effect of 60 Hz be predicted from the studies under static fields? *Bioelectromagnetics*.
- Shaffer, D.R., Pandolfi, P.P., 2006. Breaking the rules of cancer. *Nat. Med.* 12, 14–15.
- Shckorbatov, Y.G., Shakhbazov, V.G., Navrotskaya, V.V., Grabina, V.A., Sirenko, S.P., Fisun, A.I., Gorobets, N.N., Kiyko, V.I., 2002. Application of intracellular microelectrophoresis to analysis of the influence of the low-level microwave radiation on electrokinetic properties of nuclei in human epithelial cells. *Electrophoresis* 23, 2074–2079.
- Shckorbatov, Y.G., Pasiuga, V.N., Kolhigin, N.N., Grabina, V.A., Ivanchenko, D., Victor Bykov, V., Dumin, O., 2011. Cell nucleus and membrane recovery after exposure to microwaves. *Proc. Latv. Acad. Sci.* 65, 1–20.
- Siddiqui, S., 2012. Lead induced genotoxicity in *Vigna mungo* var. HD-94. *J. Saudi Soc. Agr. Sci.* 11, 107–112.
- Simkó, M., 2007. Cell type specific redox status is responsible for diverse electromagnetic field effects. *Curr. Med. Chem.* 14 (10), 1141–1152.
- Stratton, M.R., Campbell, P.J., Futreal, P.A., 2009. The cancer genome. *Nature* 458, 719–724.
- Tkalec, M., Malaric, K., Pavlica, M., Pevallekkozlina, B., Vidakovic-clerek, Z., 2009. Effects of radiofrequency electromagnetic field on seed germination and root meristematic cells of *Allium cepa* L. *Mutat. Res. Genet. Toxicol. Environ. Mutagen.* 672 (2), 76.
- Trimmel, M., Bachmann, J., 2004. Cognitive social motivational and health aspect of student in laptop classroom. *J. Comp. Assisted Learn.* 20 (2), 151–158.
- Tyagi, A., Duhan Bhatia, D., 2011. Effect of mobile phone radiation on brain activity GSM Vs CDMA. *Int. J. Sci. Technol. Manage.* 2 (2), 1–5.
- Unyayar, S., Celik, A., Cekic, F.O.Z., Gözel, A., 2006. Cadmium-induced genotoxicity, cytotoxicity and lipid peroxidation in *Allium sativum* and *Vicia faba*. *Mutagenesis* 21 (1), 77–81.
- Xu, S., Zhou, Z., Zhang, L., Yu, Z., Zhang, W., Wang, Y., Wang, X., Li, M., Chen, Y., Chen, C., He, M., Zhang, G., Zhong, M., 2010. Exposure to 1800 MHz radiofrequency radiation induces oxidative damage to mitochondrial DNA in primary cultured neurons. *Brain Res.* 22 (1311), 189–196. <http://dx.doi.org/10.1016/j.brainres.2009.10.062>.
- Zotti-Martelli, L., Peccatori, M., Maggini, V., Ballardini, M., Barale, R., 2005. Individual responsiveness to induction of micronuclei in human lymphocytes after exposure in vitro to 1800-MHz microwave radiation. *Mutat. Res.* 582, 42–52.

# Power-Frequency EMFs Promote Cancer in Massive Animal Study

## Italians Call for a “Reevaluation of the Safety of Non-Ionizing Radiation”

February 27, 2016

Last updated

May 24, 2016

Once again, power-frequency magnetic fields have been found to act as a cancer promoter.

Eighteen months ago an international team led by [Elisabeth Cardis](#) in Spain showed cancer promotion in workers exposed to chemicals and extremely low frequency (ELF) EMFs. Now an Italian team has found essentially the same promotional effect in animals exposed to ionizing radiation and ELF EMFs.

Rats, which received a single low-dose of gamma radiation early in life and were exposed to magnetic fields for their entire lifetime, developed higher than expected rates of three different types of cancer: Breast cancer and leukemia/lymphoma, as well as an extremely rare and obscure tumor, called malignant schwannoma of the heart.

The [new study](#), which was carried out at the [Ramazzini Institute](#) in Bologna, Italy, is part of the most ambitious EMF–animal project ever attempted. Future reports from the same group will describe the action of EMFs combined with a number of other cancer agents, specifically formaldehyde and aflatoxin, in addition to EMFs alone. Together, all these experiments involve more than 10,000 rats at a cost in excess of 5 million euros (\$5-6 million). The EMF–gamma radiation study had more than 650 exposed rats and 1,001 controls.

“We have confirmed the old epidemiological observations of Milham, Wertheimer and Matanoski regarding the increased risk of lymphoma/leukemia and mammary cancers, as well as the more recent study by Cardis,” said [Morando Soffritti](#), the director of the project, in an interview with *Microwave News*. Soffritti was referring to the pioneering work of [Sam Milham](#), [Nancy Wertheimer](#) and [Geneveive Matanoski](#) from 1979 through the 1990’s.

Magnetic fields can “enhance the effects of a well-known carcinogen,” said [Fiorella Belpoggi](#), the scientific director of the Institute, in an e-mail exchange. Soffritti, the former scientific director, is now the honorary president of the Institute and continues to work on this and other projects. [Their paper](#) will appear in an upcoming issue of the *International Journal of Radiation Biology* and is now posted on the journal’s Web site.

The Ramazzini researchers did not mince words about the implications of the new findings. In the “Conclusions” section of their abstract, they wrote just one sentence: “These results call for a reevaluation of the safety of non-ionizing radiation.”

The new animal results “lend support to [our recent findings](#) on ELF and brain tumor risk,” said Cardis of the Center for Research in Environmental Epidemiology ([CREAL](#)) in Barcelona. Her project, known as the [INTEROCC study](#), investigated brain cancer among workers exposed to chemicals and EMFs (see our report: [“EMF Cancer Promotion: An Old Idea Makes a Strong Comeback”](#)).

Soffritti declined to describe the findings of the EMF–formaldehyde animal experiment, saying only that they have found some “very interesting results regarding public health” and that a paper has been submitted to a peer-reviewed journal. A number of other publications, including a commentary, are also in the pipeline. [May 24, 2016 update: The formaldehyde paper has been published. [Details here.](#)]

### **The Ramazzini Experiment**

The Ramazzini team followed what is commonly known as an [initiation-promotion protocol](#). Male and female Sprague-Dawley rats were exposed in their mothers’ wombs and then for the rest of their lives to 50 Hz magnetic fields at an intensity of either 20 $\mu$ T or 1,000 $\mu$ T (200 mG or 10 G). At the age of six weeks, they each received a single 0.1Gy dose of gamma radiation, a known cancer agent. (They say that such a human exposure to ionizing radiation, from a set of CT scans for example, “cannot be called unusual.”)

Here are the key findings in the researchers’ own words:

- (a) A significant dose-related increased incidence of mammary adenocarcinomas [breast cancer] in males and females in particular in males exposed to 20 $\mu$ T plus 0.1Gy and in females exposed to 1,000 $\mu$ T plus 0.1 Gy;
- (b) In males a significant dose-related increased incidence of heart malignant schwannomas with a significant increase among males exposed to 20 $\mu$ T plus 0.1Gy [statistically significant] and to 1,000 $\mu$ T plus 0.1 Gy; and
- (c) A significant increased incidence of hematopoietic neoplasias [leukemia and lymphoma] in males treated at 1,000 $\mu$ T plus 0.1 Gy.

The Italian team expressed surprise at the observed excess of breast tumors in male rats. “In our historical controls, mammary cancer in male rats is a very rare tumor,” they wrote.

The link between EMFs and breast cancer in men was [first described](#) by Matanoski of Johns Hopkins University more than 25 years ago. Others later reported similar findings (see [MWN, J/A90](#), p.1 and [MWN, M/A91](#), p.5). A recent [meta-analysis](#) of ten studies of male breast cancer and EMFs found support for the association.

Yet, members of the EMF establishment have contested the hypothesis that there may be a link between EMFs and breast cancer, male or female. One notable critic is [Maria Feychting](#) of the Karolinska Institute who serves as the vice chair of [ICNIRP](#). She has called for an end of all such studies (see our [“The Shrill Cry To Stop EMF Research”](#)). ICNIRP has never accepted the possibility that there may be any type of cancer risk—to the breast, brain or blood—from EMFs or RF radiation.

### **Some Sordid History on EMFs and the NIEHS**

The new support for the hypothesis that EMFs can promote breast cancer in animals is the latest chapter in a long-running drama that pitted the National Institute of Environmental Health Sciences ([NIEHS](#)) against a research group at the School of Veterinary Medicine in Hannover, Germany. The German team, led by [Wolfgang Löscher](#) and [Meike Mevissen](#), ran a series of animal experiments in the 1990’s which showed that EMFs could promote breast cancer in animals that had been initiated by [DMBA](#), a chemical carcinogen (see, for instance, “Löscher Again Finds EMFs can Promote Breast Cancer,” [MWN, S/O99](#), p.4). When an NIEHS-funded team was unable to replicate that work, a senior NIEHS official, Gary Boorman, waged a dirty tricks campaign to discredit the German researchers. Boorman was later disciplined and the NIEHS offered Löscher a formal apology (for more on this fiasco, see our [“It’s Genetics, Stupid”](#)). Nevertheless, NIEHS, like ICNIRP, has declined to acknowledge an EMF–cancer risk.

After reviewing the Ramazzini results, we contacted Mevissen, who is now a professor of veterinary pharmacology and toxicology at the University of Bern in Switzerland, for a comment. “The new study indicates that ELF EMFs can promote breast cancer,” she told us. “This and the leukemia findings contribute new pieces of the puzzle supporting the IARC decision of 2001 that ELF EMFs is a possible carcinogen.” Mevissen was a member of the [IARC](#) panel that designated [power-frequency magnetic fields as a 2B \(possible\) carcinogen](#) (see [MWN, J/A01](#), p.1). Soffritti attended the meeting in Lyon as an observer.

### **No Cancer Seen with EMFs Alone**

In an interview, Belpoggi said that they are planning to publish the results of a concurrent experiment in which rats were exposed to power-frequency EMFs, without any other treatment. “In our preliminary data, ELF EMFs alone didn’t appear to show an increase of cancer in experimental animals so far,” she disclosed. “The main result of our experiment,” she said, is that “ELF EMFs have a synergistic effect: They are able to enhance the effects of a well-known carcinogen at low doses that was negative at those doses in the same experimental model.”

Belpoggi said that, for the present, she prefers the term “enhancement” to “promotion” because, “we don’t know the mechanism of action.” She added that, “We are open to give our frozen material and paraffin blocks to qualified laboratories for studies of these synergistic effects.”

### **Lifetime vs. Two-Year Exposures**

We asked Belpoggi why the Ramazzini animal studies had found an EMF effect on cancer development while a similar effort that had been coordinated by NIEHS’ Boorman during the 1990’s had not. “A basic difference,” she replied is that the Ramazzini team had used lifetime exposures while NIEHS had limited them to two years. (Note that the Boorman [EMF–DMBA experiments](#) were even shorter, lasting only 13 or 26 weeks.)

“We forgot something very simple,” Belpoggi explained, and continued:

“When we started in the 1970s, experimental carcinogenesis was the main tool to study *occupational exposures*, and exposures started in adulthood and lasted until two-thirds of the natural life, about 60 years in humans, corresponding to 104 weeks in animals. The rationale for industrial carcinogenesis in laboratory animals is very different from ‘environmental carcinogenesis,’ which often means low doses for the whole lifespan, starting from gestation. This is crucial and this is the reason we used long-lasting exposures.”

We posed the same question to Sam Milham: He too favors extended exposure durations. “Due to the long latencies for most cancers, lifetime animal and human EMF exposure studies show most of their mortality and morbidity after midlife. This makes lifetime studies superior to short-term, follow-up studies,” he said.

Back in 1998 when the first results of the Boorman–NTP EMF animal study emerged, Soffritti and his mentor, [Cesar Maltoni](#), wrote to the NTP arguing that its experiment had ended too early and questioned whether the study had been misdesigned. “It is our belief,” they said, “that the NTP bioassay was planned and conducted with a protocol that could only allow negative conclusions on 60 Hz [EMF] carcinogenesis.” (See [MWN, M/A98](#), p.4.)

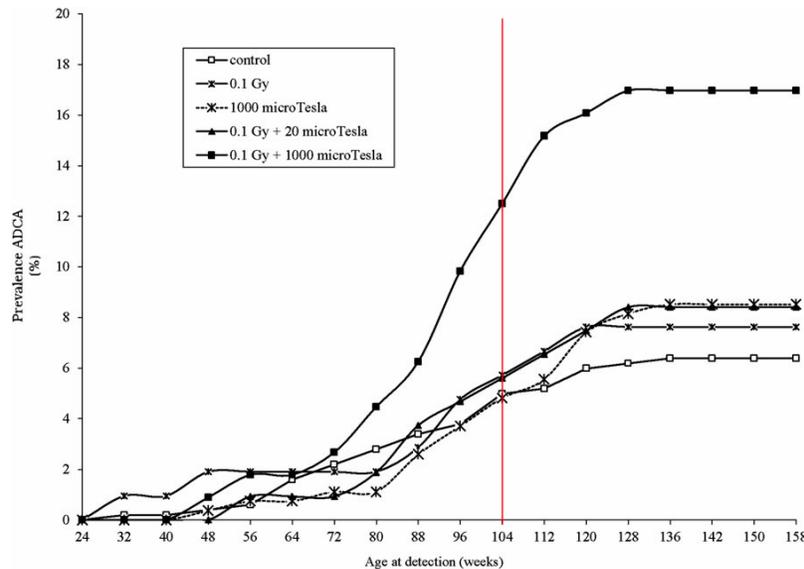
### **Should NTP’s \$25 million RF–Animal Studies Have Used Lifetime Exposures?**

The Ramazzini group is running a similar project with RF radiation. Here again, these are lifetime exposure studies. Soffritti said the exposures have been completed and the experimental data are under analysis. The results should be available sometime next year. The Ramazzini studies are using far-field RF signals to mimic exposures from cell towers rather than from phones.

The National Toxicology Program (NTP) has its own ongoing, and long delayed, project on cell phone radiation — with a \$25 million price tag. Here again, the NTP ended exposures after two years, even though Ron Melnick, who designed the protocol, had wanted to run lifetime exposures. He was overruled at the last minute.

We turned to Chris Portier, who made the initial decision to stop the RF exposures after two years: Do you have any regrets after reading the new Ramazzini paper, we asked. “No misgivings,” he replied. “This study actually supports that decision, it does not refute it.” (Portier noted that [John Bucher](#), who replaced him at the helm of NTP, had made the final decision to limit the RF study to two years.)

We pointed to a graph in the Ramazzini paper showing that the prevalence of breast cancer in female rats continues to increase after two years (104 weeks, marked by our vertical red line, see below).



Cumulative incidence of breast tumors among female rats over time (in weeks); Figure 7 from the [Ramazzini paper](#) with our addition of the red line at 104 weeks

Portier countered that those later tumors would likely have been found had the study ended at two years and the animals been sacrificed and their organs examined.

### History Repeats at NTP/NIEHS

There is another, disquieting parallel between the NTP’s EMF and RF animal projects. In 1995, when the NTP EMF animal studies had only just got underway and no results were yet on the horizon, Boorman gave a press interview in which he stated that it had become “obvious” to him that “there’s really nothing there,” that is, EMFs have no effects on the development of cancer (see [MWN, J/A95](#), p.6).

In 2010, when the NTP RF animal studies were still in their very early stages, Bucher, the NIEHS senior manager in charge, told a local newspaper that he did not believe that cell phones can cause cancer —the very question his agency was spending \$25 million to answer (see [“Will NIEHS Ever ‘Get’ EMFs?”](#)).

For more on the NTP RF study and NIEHS’ peculiar modus operandi, see our [recent report](#).

## **Exhibit C: Reference List for Important Fertility and Reproduction Papers**

- Agarwal A, Tamer M, Said TM. Role of sperm chromatin abnormalities and DNA damage in male infertility Human Reproduction Update 2003;9:331-345.
- Agarwal A, Deepinder F, Sharma RK, Ranga G, Li J. Effect of cell phone usage on semen analysis in men attending infertility clinic: an observational study. Fertil Steril. 2008;89(1):124-8.
- Agarwal A, Desai NR, Makker K, Varghese A, Mouradi R, Sabanegh E, et al. Effect of radiofrequency electromagnetic waves (RF-EMF) from cellular phones on human ejaculated semen: an in vitro study. Fertility Sterility 2009;92(4):1318-1325.
- Aitken RJ, Bennetts LE, Sawyer D, Wiklendt AM, King BV. Impact of radio frequency electromagnetic radiation on DNA integrity in the male germline. Int J Androl. 2005 Jun;28(3):171-9.
- Aitken RJ, Roman SD. Antioxidant systems and oxidant stress in the testes. Review. Oxidative Med. Cell Longevity. 2008;1:15-24
- Akdag MZ, Dasdag S, Aksen F, Isik B, Yilmaz F. Effect of ELF magnetic fields on lipid peroxidation, sperm count, p53, and trace elements. Med Sci Monit. 2006;12 (11):BR366-71.
- Al-Akhras MA, Darmani H, Elbetieha A. Influence of 50 Hz magnetic field on sex hormones and other fertility parameters of adult male rats. Bioelectromagnetics 2006; 27(2):127-131.
- Amara S, Abdelmelek H, Garrel C, Guiraud P, Douki Travant JL, et al. Effects of subchronic exposure to static magnetic field on testicular function in rats. Arch Med Res. 2006;37(8):947-52.
- Avendano C, Mata A, Sanchez Sarmiento CA, Doncel GF. Use of laptop computers connected to internet through Wi-Fi decreases human sperm motility and increases sperm DNA fragmentation. Fertility Sterility 2012;97(1):39-45.
- Bawin S, Adey W, Sabbot I. Ionic factors in release of  $^{45}\text{Ca}^{2+}$  from chicken cerebral tissues by electromagnetic fields, In Proc. Natl. Acad. Sci. 1978;75(12):6314-6318.
- Behari J, Kesari KK. Effects of microwave radiations on reproductive system of male rats. Embryo Talk 2006;1 (Suppl.1):81-5.
- Bellieni CV, Pinto I, Bogi A, Zoppetti N, Andreuccetti D, Buonocore G. Exposure to electromagnetic fields from laptop use of “laptop” computers, Arch Environ Occup Health, 2012;67:1:31-36
- Bernabo N, Tettamant E, Pistilli MG, Nardinocchi D, Beradinelli P, Mattioli M, Barboni B. Effects of 50 Hz extremely low frequency magnetic field on the morphology and function of boar spermatozoa capacitated in vitro. Theriogenology. 2007;67(4):801-815.
- Bernabo N, Tettamant E, Pistilli MG, Nardinocchi D, Beradinelli P, Mattioli M, et al. Extremely low frequency electromagnetic field exposure affects fertilization outcome in swine animal model. Theriogenology. 2010;73(9):1293-1305.
- Blackman CF, Benane SG, Elder JA, House DE, Lampe JA, Faulk JM. Induction of calcium-ion influx from tissue by radiofrequency radiation : Effect of sample number and modulation frequency on the power-density window. Bioelectromagnetics 1980;1:35-43.
- Blackman CF, Kinney LS, House DE, Joines WT. Multiple power density windows and their origin. Bioelectromagnetics 1989;10(2):115-128.
- Blank M, Goodman R. DNA is a fractal antenna in electromagnetic fields. Int J Radiation Biol 2011;87:409-415.
- Cao XW, Zhao TD, Wang CH, Zhou Q, Li LQ, Yao HG, Zhang SQ, Tang, JT, Wei W. Alternating magnetic field damages the reproductive function of murine testes. Zhonghua Nan Ke Xue. 2009;15(6):530-533.
- Capri M, Scarcella E, Fumelli C, Bianchi E, Salvioli S, Mesirca P. et al. In vitro exposure of human lymphocytes to 900 MHz CW and GSM modulated radiofrequency: studies of proliferation, apoptosis and mitochondrial membrane potential. Radiat Res. 2004a;162, 211-218.

Capri M, Scarcella E, Bianchi E, Fumelli C, Mesirca P, Agostini C, et al. 1800 MHz radiofrequency (mobile phones, different Global System for Mobile communication modulations) does not affect apoptosis and heat shock protein 70 level in peripheral blood mononuclear cells from young and old donors. *Int J Radiat Biol.* 2004b;80:389-397.

Caraglia M, Marra M, Mancinelli F, D'Ambrosio G, Massa R, Giordano A. et al. Electromagnetic fields at mobile phone frequency induce apoptosis and inactivation of the multi-chaperone complex in human epidermoid cancer cells. *J Cell Physiol.* 2005; 204:539-548.

Roychoudhury S, Massanyi P, Slamecka J, Chlebec I, Trandzik J, et al. In vitro gossypol induced spermatozoa motility alterations in rabbits. *J Environ Sci Health B.* 2009 Sep;44(7):730-41.

Chung MK, Lee SJ, Kim YB, Park SC, Shin DH, Kim SH, Kim JC. Evaluation of spermatogenesis and fertility in F1 male rats after in utero and neonatal exposure to extremely low frequency electromagnetic fields. *Asian J Androl.* 2005, 7(2):189-94.

Cotgreave IA. Biological stress responses to radio frequency electromagnetic radiation: are mobile phones really so (heat) shocking?, *Arch Biochem Biophys.* 2005;435:227-240.

Dasdag S, Akdag MZ, Aksen F, Yilmaz F, Bashan M, Dasdag M, Salih Celik M. Whole body exposure of rats to microwaves emitted from a cell phone does not affect the testes, *Bioelectromagnetics* 2003;24(3):182-188.

Dasdag S, Akdag MZ, Ulukaya E, Uzunlar AK, Yegin D. Mobile phone exposure does not induce apoptosis on spermatogenesis in rats. *Arch Med Res.* 2008 Jan;39(1):40-4.

Delgado JMR, Leal J, Monteagudo JL, Gracia MG. Embryological changes induced by weak, extremely low frequency electromagnetic fields. *J Anat (Lond)* 1982;134:533-552.

DeLullis GN, Newey RJ, King BV, Aitken RJ. Mobile phone radiation induces reactive oxygen species production and DNA damage in human spermatozoa in vitro. *PLoS One* 2009;4(7):e6446.

Deno DW, Zaffanella LE. Field effects of overhead transmission lines and stations, In *Transmission Line Reference Book. 345 kV and above, 2nd edition*, J J Ed. Project UHV, Technical Resource Operations. Large Transformer Division. General Electric Company, Pinstfield Mass. 1982;329/625.

Derias EM, Stefanis P, Drakeley, A, Gazvani R, Lewis\_Jones DI. Growing concern over the safety of using mobile phones and male fertility. *Arch. Androl.* 2006;521:9-14.

Drozdov KA, Khlistun OA, Drozdov AL. The influence of ultrasound and constant magnetic field on gametes, zygotes, and embryos of the sea urchin. *Biofizika.* 2008; 53(3):513-518.

Eberhardt JL, Persson BR, Brun AE, Salford LG, Malmgren LO. Blood-brain barrier permeability and nerve cell damage in rat brain 14 and 28 days after exposure to microwaves from GSM mobile phones. *Electromagn Biol Med.* 2008;27(3):215-29.

Edwards MJ, Mulley R, Ring S, Warmer RA. Mitotic cell death and delay of mitotic activity in guinea pig embryos following brief material hyperthermia. *J Embryol Exp Morphol* 1974;32:593-602.

Erogul O, Oztas E, Yildirim I, Kir T, Aydur E, Komesli G, Irkilata HC, IrmakMK, Peker AF. Effects of electromagnetic radiation from a cellular phone on human sperm motility:an vitro study. *Arch Med Res* 2006;37(7):840-3.

Falzone N, Huyser C, Franken DR, Leszezynski D. Mobile phone radiation does not induce proapoptosis effects in human spermatozoa. *Radiation Res* 2010;174(2):169-76.

Falzone N, Huyser C, Becker P, Leszezynski DR, Franken DR. The effect of pulsed 900 MHz GSM mobile phone radiation on the acrosome reaction, head morphometry and zona binding of human spermatozoa. *Int J Androl* 2011;34(1):20-6.

Farrell JM Litovitz TL, Penafiel M, Montrose CJ, Doinov P, Barber M, et al. The effect of pulsed and sinusoidal magnetic fields on the morphology. *Bioelectromagnetics.* 1997;18:431-438.

Fraser FC, Skelton J (1978) Possible tetragenicity of maternal fever. *Lancet* 2:634.

Fejes I, Zavacki Z, Szollosi J, Koloszar Daru J, Kovacs L, Pal A. Is there a relationship between cell phone use and semen quality ? *Arch Androl.* 2005;51, 385-393.

Forgács Z, Kubinyi G, Sinay G, Bakos J, Hudák A, Surján A, Révész C, Thuróczy G. Effects of 1800 MHz GSM-like exposure on the gonadal function and hematological parameters of male mice. *Magy Onkol.* 2005;49(2):149-51. [Article in Hungarian]

Forgács Z, Somosy Z, Kubinyi G, Bakos J, Hudák A, Surján A, Thuróczy G. Effect of whole-body 1800 MHz GSM-like microwave exposure on testicular steroidogenesis and histology in mice. *Reprod Toxicol.* 2006; Jul;22(1):111-7.

French PW, PennyR, Laurence JA, McKenzie DR. Mobile phones, heat shock proteins and cancer. *Differentiation* 2001;67, 93-97.

García AM, Sisternas A, Hoyos SP. Occupational exposure to extremely low frequency electric and magnetic fields and Alzheimer disease: a meta-analysis. *Int J Epidemiol.* 2008;37(2):329-40

Gharagozloo P, Aitken RJ. The role of sperm oxidative stress in male infertility and the significance of oral antioxidant therapy. *Hum Reprod* 2011 Jul;26(7):1628-40. Epub 2011 May 5.

Gotoh T, Terada K, Mori M. hsp70-DnaJ chaperone pairs prevent nitric oxide-mediated apoptosis in RAW 264. 7 macrophages. *Cell Death Differ.* 2001; 8, 357-366.

Gul A, Celebi H, Ugras S. The effects of microwaves emitted by cellular phones on ovarian follicles in rats. *Archives of Gynecology and Obstetrics* 2009;280(5): 729-33.

Gutschi T, Al-Ali BM, Shamloul R, Pummer K, Trummer H. Impact of cell phone use on men's semen parameters. *Andrologia.* 2011;43, 5, 312–316.

Heredia-Rojas JA, Caballero-Hernandez DE, Rodriguez-de la Fuente AO, Ramos-Alfano G, Rodriguez-Flores LE. Lack of alterations on meiotic chromosomes and morphological characteristics of male germ cells in mice exposed to a 60 Hz and 2. 0 mT magnetic field. *Bioelectromagnetics.* 2004;25(1):63-8.

Hardell L, Sage C. Biological effects from electromagnetic field exposure and public exposure standards. *Biomed Pharmacother.* 2008;62(2):104-9.

Higashikubo R, Ragouzis M, Moros EG, Straube WL, Roti Roti JL. Radiofrequency electromagnetic fields do not alter the cell cycle progression of C3H 10T and U87MG cells. *Radiat Res.* 2001; 786–795.

Hong R, Liu Y, Yu YM, Hu K, Weng EQ. Effects of extremely low frequency electro magnetic fields on male reproduction in mice. *Zhonghua Lao dong Wei Sheng, Zhi Ye Bing Za Zhi.* 2003;21(5):342-345.

Hong R, Zhang V, Liu Y, Weng EQ. Effects of extremely low frequency electromagnetic fields on DNA of testicular cells and sperm chromatin structure in mice. *Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi.* 2005;23(6):414-417.

Hook GJ, Zhang P, Lagroye I, Li L, Higashikubo R, Moros EG, et al. Measurement of DNA damage and apoptosis in Molt-4 cells after in vitro exposure to radiofrequency radiation. *Radiat Res.* 2004; 161:193-200.

Hughes CM, Lewis SE, Mckelvey-Martin VJ, Thompson W. A comparison of baseline and induced DNA damage in human spermatozoa from fertile and infertile men, using a modified comet assay. *Mol Hum Reprod.* 1996; 13, 1240-1247.

Huss A, Spoerri A, Egger M, Rössli M and for the Swiss National Cohort Study. Residence near power lines and mortality from neurodegenerative diseases: longitudinal study of the Swiss Population. *Am J Epidemiol.* 2008;15, 169, 167-175.

ICNIRP. Guidelines for limiting exposure to time varying electric, magnetic, and electromagnetic fields (upto 300 GHz) 1998. *Health Phys.* 1998;74:494-522.

Imai N, Kawabe M, Hikage T, Nojima T, Takahashi S, Shirai T. Effects on rat testis of 1. 95-GHz W-CDMA for IMT-2000 cellular phones. *Syst Biol Reprod Med.* 2011; Aug;57(4):204-9.

Inoue Y, Sato Y, Nishimura M, Seguchi M, Zaitzu Y, Yamada K. et al. Heat-induced drug resistance is associated with increased expression of Bcl-2 in HL60. *Anticancer Res.* 1999;19:3989-3992.

Iwasaki A, Gagon C. Formation of reactive oxygen species in spermatozoa of infertile patients. *Fertil Steril.* 1992; 57:409-416.

Jajte J, Grzegorzczak J, Zmyslony M, Rajkowska E. Effect of 7 mT static magnetic field and iron ions on rat lymphocytes: apoptosis, necrosis and free radical processes. *Bioelectrochemistry*. 2002;57:107-111.

Yan JG, Agresti M, Bruce T, Yan YH, Granlund A, Matloub HS. Effects of cellular phone emissions on sperm motility in rats. *Fertility Sterility*, 2007;88(4):957-964.

Jolly C, Morimoto RI. Role of the heat shock response and molecular chaperones in oncogenesis and cell death. *J Natl Cancer Inst*. 2000;92:1564 -1572.

Juutilainen J, Matilainen P, Saarikoski S, Läärä E, Suonio S. et al. Early pregnancy loss and exposure to 50 Hz magnetic fields. *Bioelectromagnetics* 1993;14:220-236.

Kesari KK, Behari J. Comparative study of 900MHz and 2.45 GHz radiation effect on reproductive system of male rats. In: *Recent Advances and Challenges in Reproductive Health Research*. (RS Sharma, A Rajanna, M Rajalakshmi. Proceedings of the conference on "Recent Advances and Challenges in Reproductive Health Research (Feb 19-21, 2007 New Delhi) ICMR Publication, 2008.

Kesari KK, Behari J. Fifty gigahertz microwave exposure effect of radiation on rat brain. *Appl Biochem Biotechnol* 2009;158:126-139.

Kesari KK, Behari J. Microwave exposure affecting reproductive system in male rats. *Appl Biochem Biotechnol*. 2010;31(6):495-498.

Kesari KK, Behari J. Evidence for mobile phone radiation exposure effects on reproductive pattern of male rats: Role of ROS. *Electromagnetics Biology Medicine*. 2012;31(3):213-222.

Kesari KK, Kumar S, Nirala J, Siddiqui MH, Behari J. Biophysical evaluation of radiofrequency electromagnetic field effects on male reproductive pattern. *Cell Biochem Biophys* 2012;Aug 29;DOI 10. 1007/s12013-012-9414-6

Kesari KK, Kumar S, Behari J. Effects of radiofrequency electromagnetic wave exposure from cellular phones on the reproductive pattern in male Wistar rats. *Appl Biochem Biotechnol* 2011;164(4):546-59.

Kim YW, Kim HS, Lee JS, Kim YJ, Lee SK, Seo JN, Jung KC, Kim N, Gimm YM. Effects of 60 Hz 14  $\mu$ T magnetic field on the apoptosis of testicular cell in mice. *Bioelectromagnetics* 2009;30(1):66-72.

Kilgallon SJ, Simmons LW. Image content influences men's semen quality. *Biol Lett*. 2005; 1, 385-393.

Kodama H, Yamaguchi R, Fukada J, Kasai H, Tanaka T. Increased oxidative deoxyribonucleic acid damage in the spermatozoa of infertile male patients. *Fertil Steril*. 1997;68, 519-524.

Kumar S, Kesari KK, Behari J. Evaluation of genotoxic effect in male wistar rats following microwave exposure. *Ind J. Exp Biology* 2010;48, 586-592.

Kumar S, Kesari KK, Behari J. The therapeutic effect of a pulsed electromagnetic field on the reproductive pattern of male wistar rats exposed to a 2.45 GHz microwave field. *Clinics* 2011;66(7)1237-1245.

Kumar S, Kesari KK, Behari J. The influence of microwave exposure on male fertility. *fertility and sterility*. 2011a;95 (4); 1500-1502.

Kwee S, Raskmark P, Velizarov S. Changes in cellular proteins due to environmental nonionizing radiation. 1. Heat shock proteins. *Electro- and Magnetobiol*. 2001;20, 141-152.

Lacy KK, DeSesso JM, Lary JM. Early histological changes observed in the neural folds of day 9 rat embryos subsequent to radio frequency radiation or water bath induced hyperthermia. *Teratology* 1981;23:48A.

Lantow M, Viergutz T, Weiss DG, Simkó M. Comparative study of cell cycle kinetics and induction of apoptosis or necrosis after exposure to radiofrequency radiation in human Mono Mac 6 cells. *Radiat Res*. 2006c;166, 539-543.

Lee GM, Neutra RR, Hristova L, Yost M, Hatt RA. A nested case-control study of residential and personal magnetic field measures and miscarriages. *Epidemiology* 2001;13:21-31.

Leszczynski D, Joenväärä S, Reivinen J, Kuokka R. Non-thermal activation of the hsp27/p38MAPK stress pathway by mobile phone radiation in human endothelial cells: molecular mechanism for cancer and blood-brain barrier-related effects. *Differentiation* 2002;2–3:120.

Li De-Kun, Checkoway H, Muller A. Electric blanket use during pregnancy in relation to the risk of congenital urinary tract anomalies among women with a history of subfertility. *Epidemiology*. 1995;6(5):485-489.

Lorio R, Scrimaglio R, Rantucci E, Delle Monache S, Di Gateano A, Finetti N, et al. A preliminary study of oscillating electromagnetic field effects on human spermatozoon motility. *Bioelectromagnetics* 2007;28(1): 72-75.

Lorio R, Delle Monache S, Bennato F, Di Bartolomeo C, Scrimaglio R, Cinque B, et al. Involvement of mitochondrial activity in mediating ELF-EMF stimulatory effect on human sperm motility. *Bioelectromagnetics* 2011;32 (1):15-27

Milan PB, Nejad DM, Ghanbari AA, Rad JS, Nasrabadi HT, Roudkenar MH, et al. Effects of Polygonum aviculare herbal extract on sperm parameters after EMF exposure in mouse. *Pak J Biol Sci*. 2011;1;14(13):720-4.

Marinelli F, La Sala D, Ciccotti G, Cattini L, Trimarchi C, Putti S, et al. Exposure to 900 MHz electromagnetic field induces an unbalance between pro-apoptotic and pro-survival signals in T-lymphoblastoid leukaemia CCRF-CEM cells. *J Cell Physiol*. 2004;198, 324-332.

Marx JL. Electric currents may guide development. *Science* 1981;211:1147-1149.

Miller P, Smith DW, Shepard TH. Material Hyperthermia as a possible cause of anencephaly. *Lancet* 1978;i:519-520.

Miyakoshi J, Takemasa K, Takashima Y, Ding GR, Hirose H, Koyama S. Effects of exposure to a 1950 MHz radio frequency field on expression of Hsp70 and Hsp27 in human glioma cells. *Bioelectromagnetics* 2005;26:251-257.

Nakamura H, Nagase H, Ogino K, Hatta K, Matsuzaki I. Uteroplacental circulatory disturbance mediated by prostaglandin f2alpha in rats exposed to microwaves. *Reprod Toxicol*. 2000;14(3):235-40.

Nikolova T, Czyz J, Rolletschek A, Blyszczuk P, Fuchs J, Jovtchev G, et al. Electromagnetic fields affect transcript levels of apoptosis-related genes in embryonic stem cell-derived neural progenitor cells. *FASEB J*. 2005;19:1686-1688.

O'Carroll MJ, Henshaw DL. Aggregating disparate epidemiological evidence: comparing two seminal EMF reviews. *Risk Anal*. 2008;28(1):225-34.

Otitoloju AA, Obe IA, Adewale OA, Otubanjo OA, Osunkalu VO. Preliminary study on the reduction of sperm head abnormalities in mice, *Mus musculus*, exposed to radiofrequency radiations from global system for mobile communication base stations. *Bull Environ Contamin Toxicol* 2010;84(1):51-4.

Pacini S, Ruggiero M, Sardi I, Aterini S, Gulisano F, Gulisano M. Exposure to global system for mobile communication (GSM) cellular phone radiofrequency alters gene expression, proliferation, and morphology of human skin fibroblasts. *Oncol Res*. 2002; 1, 19–24.

Panagopoulos DJ, Karabarbounis A, Margaritis LH. Effect of GSM 900 MHz mobile phone radiation on the reproductive capacity of *Drosophila melanogaster*. *Electromagnetic Biology and Medicine*. 2004;23(1):29-43.

Panagopoulos DJ, Margaritis LH. Mobile Telephony radiation Effects on Living Organisms. In Harper A C and Bures R V (Eds) "Mobile Telephones Networks, Applications and Performance". Nova Science Publishers. 2008;107-149.

Panagopoulos DJ, Margaritis LH. Mobile telephony radiations. *International Journal of Medical and Biological Frontiers*. 2009;15(1-2), 33-76.

Panagopoulos DJ, Margaritis LH. The effects of exposure duration on the biological activity of mobile telephony radiation. *International Journal of Radiation Biology*. 2010;86(5):358-366.

Panagopoulos D J (2011) Analyzing the Health Impacts of Modern Telecommunications Microwaves. *Advances in Medicine and Biology*. 17:1-54.

Phillips JL, Singh NP, Lai H. Electromagnetic fields and DNA damage. *Pathophysiology*. 2009;16(23):79-88.

Polk C. Introduction. In: CRC Handbook of Biological Effects of Electromagnetic Fields (Polk C and Postow E) CRC Press, Inc Boca Raton, Florida. 1986;1-24.

Portier CJ, Wolfe MS, eds. EMF Science Review Symposium Breakout Group Reports for Theoretical Mechanisms and In Vitro Research Findings. Research Triangle Park: National Institute of Environmental Health Sciences, 1997.

Rajaei F, Borhani N, Sabbagh-Ziarani F, Mashayekhi F. Effects of extremely low-frequency electromagnetic field on fertility and heights of epithelial cells in pre-implantation stage endometrium and fallopian tube in mice. *Zhong Xi Yi Jie He Xue Bao*. 2010;8(1):56-60.

Remondini D, Nylund R, Reivinen J, Poullietier de Gannes F, Veyret B, et al. Gene expression changes in human cells after exposure to mobile phone microwaves. 2006; *Proteomics*, 6(17), 4745-4754.

Ribeiro EP, Rhoden EL, Horn MM, Rhoden C, Lima LP, Toniolo L. Effects of subchronic exposure to radiofrequency frequency from a conventional cellular telephone on testicular function in adult rats. *J Urol* 2007;177(1):395-9.

Roychoudhury S, Jedicka S, Parkanyl V, Rafay J, Ondruska L, Massanyl P, et al. Influence of a 50 Hz extremely low frequency electromagnetic field on spermatozoa motility and fertilization rats in rabbits. *J Environ Sci Health A Tox Hazard subst Environ Eng*. 2009;44(10):1041-1047.

Sage C, Johansson O, Sage SA. Personal digital assistant (PDA) cell phone units produce elevated extremely-low frequency electromagnetic field emissions. *Bioelectromagnetics*. 2007;28(5):386-392.

Salama N, Kishimoto T, Kanayama HO. Effects of exposure to a mobile phone on testicular function and structure in adult rabbit. *International Journal of Andrology* 2010;33(1):88-94.

Singh NP, Stephens RE. X-ray induced DNA double strand breaks in human sperm. *Mutagenesis* 1998;13:75-79.

Smith R, Vantman D, Ponce J, Escobar J, Lissi E. Total antioxidant capacity of human seminal plasma. *Hum Reprod* 1996;11:1655-60.

Sommer AM, Grote K, Reinhardt T, Streckert J, Hansen V, Lerchl A. Effects of radiofrequency electromagnetic fields (UMTS) on reproduction and development of mice: a multi-generation study. *Radiation Research* 2009;171(1):89-95.

Sun YL, Zhou WJ, Wu JQ, Gao ES. Does exposure to computers affect the routine parameters of semen quality? *Asian J Androl* 2005;; 7:263-266.

VanDemark NL, Free MJ. Temperature effects. IN Johnson AD, Gomes WR, VanDemark NL(eds): "The Testis," Vol III. New York: Academic, 1970;233-312.

Vijayalaxmi, Bisht KS, Pickard WF, Meltz ML, Roti JL, Moros EG. Chromosome damage and micronucleus formation in human blood lymphocytes exposed in vitro to radiofrequency radiation at a cellular telephone frequency 1847-74 MHz CDMA. *radiation Research*. 2001;156:430-432.

Wang XW, Ding GR, Shi CH, Zeng, LH, Liu JY, Li J, et al. Mechanism involved in the blood-testis barrier increased permeability induced by EMP. *Toxicology* 2010;276:58-63.

Wdowiak A, Wdowiak L, Wiktor H. Evaluation of the effect of using mobile phones on male fertility. *Annals Agriculture Environmental Medicine: AAEM* 2007;14(1):169-72.

Wertheimer N, Leeper E. Possible effects of electric blankets and heated waterbeds on fetal development. *Bioelectromagnetics* 1986;7:13-22.

Yan JG, Agresti M, Bruce T, Yan YH, Granlund A, Metaloub HS. Effects of cellular phone emissions on sperm motility in rats. *Fertility Sterility* 2007;88(4): 957-64.

Zeni O, Chiavoni AS, Sannino A, Antolini A, Forigo D, Bersani F, et al. Lack of genotoxic effects (micronucleus induction) in human lymphocytes exposed in vitro to 900 electromagnetic fields. *Radiat Res*. 2003;160:152-158.

**Exhibit B-1**  
**RF Color Charts for Fertility and Reproduction Studies with Exposures**

**PUBLISHED STUDIES RELEVANT TO SCENIHR REVIEW OF EMF –  
FERTILITY AND REPRODUCTION**

C. SAGE, BIOINITIATIVE WORKING GROUP, APRIL 2014

Agarwal A, Deepinder F, Sharma RK, Ranga G, Li J. 2008. Effect of cell phone usage on semen analysis in men attending infertility clinic: an observational study. *Fertil Steril.* 89(1):124-8.

oti it , per ount, per orpho o , and iabi it redu ed in ar a ,  
a ti e e phone u er hu an a e in do e dependent anner

Agarwal A, Desai NR, Makker K, Varghese A, Mouradi R, Sabanegh E, Sharma R. 2009. Effects of radiofrequency electromagnetic waves (RF-EMW) from cellular phones on human ejaculated semen: an in vitro pilot study. *Fertil Steril.* 92(4) 1318-1325.

oti it , per ount, per orpho o , and iabi it redu ed in ar a ,  
a ti e e phone u er hu an a e in do e dependent anner

Aitken RJ, Bennetts LE, Sawyer D, Wiklendt AM, King BV. 2005 Impact of radio frequency electromagnetic radiation on DNA integrity in the male germline *28:171-179.*

tud of i e for da , hr per da ho e bod it en,  
re u ted in i nifi ant effe t on ito hondria and eno e tabi it

Aldad TS Gan G Gao XB Taylor HS. 2012. Fetal radiofrequency radiation exposure from 800-1900 MHz rated cellular telephones affects neurodevelopment and behavior in mice. *Sci. Rep.* 2, 312. DOI: 10.1038/srep00312

eurobeha iora di order in off prin of pre nant i e  
e po ed in utero to e phone do e re pon e i paired  
uta ater i napti tran i ion onto a er dad,  
p ra ida neuron of the prefronta orste  
pera ti it and i paired e or fun tion in off prin  
tered brain de e op ent

Atasoy HI, Gunal MY, Atasoy P, Elgun S, Bugdayci G. 2012 Immunohistopathologic demonstration of deleterious effects on growing rat testes of radiofrequency waves emitted from conventional Wi-Fi devices. *J Pediatr Urol.* [Epub ahead of print]

ire e internet , hr per da ee  
in rea ed da a e and redu ed repair e e  
be o uthor a findin rai e ue tion  
about afet of radiofre uen e po ure fro i i ta o ,  
internet a e de i e for ro in or ani of  
reprodu ti e a e, ith a potentia effe t on ferti it and  
inte rit of er e a e er e are the  
reprodu ti e e per

Avendano C, Mata A, Sanchez Sarmiento CA, Doncei GF. 2012. Use of laptop computers connected to internet through Wi-Fi decreases human sperm motility and increases sperm DNA fragmentation. *Fertility and Sterility.* American Society for Reproductive Medicine, Published by Elsevier Inc. doi:10.1016/j.fertnstert.2011.10.012.

u i e e aptop e po ure for hr re u ted in de rea e in  
per iabi it , fra entation ith per a pe pa ed endano,  
in petri di he under a aptop onne ted ia to the  
internet

Behari J, Kesari KK 2006. Effects of microwave radiations on reproductive system of male rats. Embryo Talk 1 (Suppl.1):81-5.

u hroni e po ure to obi e phone pu ed i nifi ant ehari,  
redu ed per ount,

Dasdag, S et al, 1999. Whole-body microwave exposure emitted by cellular phones and testicular function of rats. Urological Research 27(3):219-223.

tru tura han e in te a er dia eter of e iniferou a da ,

De Iuliis GN, Newey RJ, King BV, Aitken RJ. 2009. Mobile phone radiation induces reactive oxygen species production and DNA damage in human spermatozoa in vitro. PLoS One 4(7):e6446.

ne hr e po ure to e phone radiation in hu an  
per e au ed a i nifi ant do e re pon e and redu ed  
per oti it and iabi it rea ti e o en pe ie e e ere  
i nifi ant in rea ed after e po ure to tud  
onfir detri enta effe t of to hu an per he e u ii ,  
author on ude he e findin ha e ear i pi ation for  
the afet of e ten i e obi e phone u e b a e of  
reprodu ti e a e, potentia affe tin both their ferti it and the  
hea th and e bein of their off prin

De Iuliis GN, Newey RJ, King BV, Aitken RJ. 2009. Mobile phone radiation induces reactive oxygen species production and DNA damage in human spermatozoa in vitro. PLoS One 4(7):e6446.

u an e en de raded b e po ure to e phone fre uen e u ii ,  
in rea ed free radi a da a e

Forgács Z, Somosy Z, Kubinyi G, Bakos J, Hudák A, Surján A, Thuróczy G. Effect of whole-body 1800 MHz GSM-like microwave exposure on testicular steroidogenesis and histology in mice. Reprod Toxicol. 2006; Jul;22(1):111-7.

u u ed affe ted eru te to terone e e in i e or a ,

A.F. Fragopoulou, et al., Cranial and postcranial skeletal variations induced in mouse embryos by mobile phone radiation, Pathophysiology (2009), doi:10.1016/j.pathophys.2009.10.002

ou e e br o de e op fra i e rania bone fro in  
utero he author a ur re ut ear  
ho that e en ode te po ure e , in dai for ra opou ou,  
da i ufficient to interfere ith the nor a ou e  
de e op enta pro e

Gul A, Celebi H, Ugras S. The effects of microwaves emitted by cellular phones on ovarian follicles in rats. Archives of Gynecology

at e po ed to obi e phone radiation on for hr  
in pu in ode ti e per da for da  
ho ed de rea ed nu ber of o arian fo i e in pup born to the e u,  
pre nant rat he author on ude the de rea ed nu ber of fo i e  
in pup e po ed to obi e phone i ro a e u e t that intrauterine  
e po ure ha to i effe t on o arie

Kumar S Behari J Sisodia R. 2012. Impact of Microwave at X-Band in the aetiology of male infertility. *Electromagnetic Biology and Medicine*, 31(3): 223–232. online DOI: 10.3109/15368378.2012.700293.

per da a e fro o idati e tre and o ered e atonin u ar,  
e e re u ted fro hr per da da e po ure to

!

Magras, IN & Zenos, TD, 1997. RF Radiation-induced changes in the prenatal development of mice. *Bioelectromagnetics* 18:455-461.!

u rre er ib e inferti it in i e after  
eneration of e po ure to fro an a ra eno ,  
antenna par

!

Navakatikian, MA & Tomashevskaya, LA, 1994 Phasic behavioral and endocrine effects of microwaves of nonthermal intensity. In: *Biological Effects of Electric and Magnetic Fields*, Volume 1, Carpenter, DO, (Ed.) Academic Press, Inc., San Diego, CA., pp. 333-342.!

u drop in te to terone after hour of a a ati ian,  
e po ure

!

Otutolu AA, Obe IA, Adewale OA, Otubanjo OA, Osunkalu VO. 2010. Preliminary study on the induction of sperm head abnormalities in mice, *Mus musculus*, exposed to radiofrequency radiations from global system for mobile communication base stations. *Bulletin of Environmental Contamination and Toxicology* 84(1):51-4.!

u per head abnor aitie in i e e po ed for  
onth to ba e tation e e per head  
abnor aitie o urred in to e po ed i e  
on in ontro abnor aitie a a o found to  
be do e dependent he i pi ation of the pin head tito o u,  
and banana haped per head he o urren e of  
per head ob er ed in rea e o urren e of  
head abnor aitie on the reprodu ti e hea th of  
hu an i in in o e pro i it to ba e tation  
ere di u ed

!

Panagopoulos DJ. 2012. Effect of microwave exposure on the ovarian development of *Drosophila melanogaster*. *Cell Biochem Biophys*. 63(2):121-132.

, i nifi ant de rea e o arian  
de e op ent and i e of o arie , due to da a e and ana opou ou ,  
pre ature e death of nur e e and fo i e in o arie  
that nour i h e e

Salama N, Kishimoto T, Kanayama HO. Effects of exposure to a mobile phone on testicular function and structure in adult rabbit. *International Journal of Andrology* 2010;33(1):88-94.

i nifi ant de rea e in per obi it drop in per  
on entration and de rea e in e iniferou tubue at , a a a,  
hr da , ee , ith obi e phone radiation e e on  
in rabbit

Somosy, Z et al, 1993. Effects of modulated and continuous microwave irradiation on pyroantimonate precipitable calcium content junctional complex of mouse small intestine. *Scanning Microsc* 7(4): 1255-1261

u au ed tru tura han e in e of ou e e br o o o ,

!

!

## Chart References

!

Agarwal A, Desai NR, Makker K, Varghese A, Mouradi R, Sabanegh E, Sharma R (2009). Effects of radiofrequency electromagnetic waves (RF-EMW) from cellular phones on human ejaculated semen: an in vitro pilot study. *Fertil Steril*, 92(4), 1318-25.

Al-Damegh MA (2012). Rat testicular impairment induced by electromagnetic radiation from a conventional cellular telephone and the protective effects of the antioxidants vitamins C and E. *Clinics (Sao Paulo)*, 67(7), 785-92.

Kesari KK, Behari J (2102). Evidence for mobile phone radiation exposure effects on reproductive pattern of male rats: role of ROS. *Electromagn Biol Med*, 31(3), 213-22.  
Kesari KK, Kumar S, Behari J (2010). Mobile phone usage and male infertility in Wistar rats. *Indian J Exp Biol*, 48 (10), 987-92.

Kesari KK, Kumar S, Behari J (2011). Effects of radiofrequency electromagnetic wave exposure from cellular phones on the reproductive pattern in male Wistar rats. *Appl Biochem Biotechnol*, 164(4), 546-59. Health effects of EMF – 2013-11-29 218

Otitoloju AA, Obe IA, Adewale OA, Otubanjo OA, Osunkalu VO (2010). Preliminary study on the induction of sperm head abnormalities in mice, *Mus musculus*, exposed to radiofrequency radiations from global system for mobile communication base stations. *Bull Environ Contam Toxicol*. 84(1), 51-4.

Ribeiro EP, Rhoden EL, Horn MM, Rhoden C, Lima LP, Toniolo L (2007). Effects of subchronic exposure to radio frequency from a conventional cellular telephone on testicular function in adult rats. *J Urol*, 177(1), 395-9.

Salama N, Kishimoto T and Kanayama HO (2010a). Effects of exposure to a mobile phone on testicular function and structure in adult rabbit. *Int J Androl*, 33(1), 88-94.

Salama N, Kishimoto T, Kanayama HO and Kagawa S (2009). The mobile phone decreases fructose but not citrate in rabbit semen: a longitudinal study. *Syst Biol Reprod Med*, 55(5-6), 181-7.

Salama N, Kishimoto T, Kanayama HO and Kagawa S (2010b). Effects of exposure to a mobile phone on sexual behavior in adult male rabbit: an observational study. *Int J Impot Res*, 22(2), 127-33.

!

# Peer-reviewed scientific studies on EMF related subjects

Science index » [Overview](#) | [Article library](#) | List of studies | [Basic guide to EMFs](#) | [International guidance levels](#) | [Unit conversion](#) | [Frequently asked questions](#) | [Other resources](#)

---

When it comes to EMF issues, one of the most frequently heard phrases is "There is no evidence to support EMFs having health effects" or simply "There is no conclusive evidence".

This is completely wrong; there is an enormous body of evidence out there, but public and even academic awareness seems to be very poor. Therefore, we will be presenting a list of papers and odds ratios which either show serious effects or are considered important papers on the subject which we have collected over the years. This page will be updated regularly.

P This study has found effects from the exposure or radiation category

N This study has found no effects from the exposure or radiation category

- This study has offered important insights or findings but is neither a positive or null finding

---

## Contents (click on subjects to be taken to that section of the page)

[\[Mobile Phones\]](#) [\[Phone Masts\]](#) [\[Radio Transmitters\]](#) [\[Powerlines and Substations\]](#) [\[WiFi\]](#)  
[\[Electromagnetic Sensitivity\]](#) [\[EEG and Brain Responses\]](#) [\[RF Mechanisms\]](#) [\[ELF Mechanisms\]](#)

*(click on subjects to be taken to that section of the page)*

---

## Mobile and Cordless Phones

[\[Back to the top\]](#)

- **Lahham A et al**, (August 2015) *Public Exposure from Indoor Radiofrequency Radiation in the City of Hebron, West Bank-Palestine*, Health Phys. 2015 Aug;109(2):117-21. doi: 10.1097/HP.0000000000000296 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

- **Redmayne M**, (June 2015) *International policy and advisory response regarding children's exposure to radio frequency electromagnetic fields (RF-EMF)*, *Electromagn Biol Med*. 2015 Jun 19:1-9. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Balmori A**, (June 2015) *Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation*, *Sci Total Environ*. 2015 Jun 15;518-519:58-60. doi: 10.1016/j.scitotenv.2015.02.077. Epub 2015 Mar 4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Hareuveny R et al**, (June 2015) *Occupational exposures to radiofrequency fields: results of an Israeli national survey*, *J Radiol Prot*. 2015 Jun;35(2):429-45. doi: 10.1088/0952-4746/35/2/429. Epub 2015 May 15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Jeong YJ et al**, (2015) *1950 MHz Electromagnetic Fields Ameliorate AB Pathology in Alzheimer's Disease Mice*, *Curr Alzheimer Res*. 2015;12(5):481-92 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Osei S et al**, (May 2015) *Assessment of levels of occupational exposure to workers in radiofrequency fields of two television stations in Accra, Ghana*, *Radiat Prot Dosimetry*. 2015 May 15. pii: ncv326. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Roggeveen S et al**, (May 2015) *Does the Brain Detect 3G Mobile Phone Radiation Peaks? An Explorative In-Depth Analysis of an Experimental Study*, *PLoS One*. 2015 May 11;10(5):e0125390. doi: 10.1371/journal.pone.0125390. eCollection 2015 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Masuda H et al**, (May 2015) *No Dynamic Changes in Blood-brain Barrier Permeability Occur in Developing Rats During Local Cortex Exposure to Microwaves*, *In Vivo*. 2015 05-06;29(3):351-357 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Morgan LL et al**, (May 2015) *Mobile phone radiation causes brain tumors and should be classified as a probable human carcinogen (2A) (Review)*, *Int J Oncol*. 2015 May;46(5):1865-71. doi: 10.3892/ijo.2015.2908. Epub 2015 Feb 25 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Lerchl A et al**, (April 2015) *Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans*, *Biochem Biophys Res Commun*. 2015 Apr 17;459(4):585-90. doi: 10.1016/j.bbrc.2015.02.151. Epub 2015 Mar 6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Aydogan F et al**, (April 2015) *The effects of 2100-MHz radiofrequency radiation on nasal mucosa and mucociliary clearance in rats*, *Int Forum Allergy Rhinol*. 2015 Apr 16. doi: 10.1002/alr.21509. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Dasdag S et al**, (April 2015) *Long term and excessive use of 900 MHz radiofrequency radiation alter microRNA expression in brain*, *Int J Radiat Biol*. 2015 Apr;91(4):306-11. doi: 10.3109/09553002.2015.997896. Epub 2015 Jan 2 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Zalata A et al**, (April 2015) *In vitro effect of cell phone radiation on motility, DNA fragmentation and clusterin gene expression in human sperm*, *Int J Fertil Steril*. 2015 Apr-Jun;9(1):129-36. Epub 2015 Apr 21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Gryz K et al**, (March 2015) *The Role of the Location of Personal Exposimeters on the Human Body in Their Use for Assessing Exposure to the Electromagnetic Field in the Radiofrequency Range 98-2450 MHz and*

*Compliance Analysis: Evaluation by Virtual Measurements*, Biomed Res Int. 2015;2015:272460. doi: 10.1155/2015/272460. Epub 2015 Mar 24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Boga A et al**, (March 2015) *The effect of 900 and 1800 MHz GSM-like radiofrequency irradiation and nicotine sulfate administration on the embryonic development of Xenopus laevis*, Ecotoxicol Environ Saf. 2015 Mar;113:378-90. doi: 10.1016/j.ecoenv.2014.12.020. Epub 2014 Dec 20. [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Masuda H et al**, (March 2015) *No Changes in Cerebral Microcirculatory Parameters in Rat During Local Cortex Exposure to Microwaves*, In Vivo. 2015 03-04;29(2):207-215 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Zong C et al**, (March 2015) *Adaptive response in mice exposed to 900 MHz radiofrequency fields: Bleomycin-induced DNA and oxidative damage/repair*, Int J Radiat Biol. 2015 Mar;91(3):270-6. doi: 10.3109/09553002.2014.980465. Epub 2015 Jan 27 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Aerts S et al**, (February 2015) *Impact of a small cell on the RF-EMF exposure in a train*, Int J Environ Res Public Health. 2015 Feb 27;12(3):2639-52. doi: 10.3390/ijerph120302639. [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Ghosn R et al**, (February 2015) *Radiofrequency signal affects alpha band in resting electroencephalogram*, J Neurophysiol. 2015 Feb 18;jn.00765.2014. doi: 10.1152/jn.00765.2014. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Cao H et al**, (February 2015) *Circadian rhythmicity of antioxidant markers in rats exposed to 1.8 GHz radiofrequency fields*, Int J Environ Res Public Health. 2015 Feb 12;12(2):2071-87. doi: 10.3390/ijerph120202071. [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Eltiti S et al**, (February 2015) *Aggregated data from two double-blind base station provocation studies comparing individuals with idiopathic environmental intolerance with attribution to electromagnetic fields and controls*, Bioelectromagnetics. 2015 Feb;36(2):96-107. doi: 10.1002/bem.21892. Epub 2015 Jan 30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Paul B et al**, (February 2015) *Mobile phones: Time to rethink and limit usage*, Indian J Public Health. 2015 Jan-Mar;59(1):37-41. doi: 10.4103/0019-557X.152856 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Freudenstein F et al**, (January 2015) *Exposure Knowledge and Risk Perception of RF EMF*, Front Public Health. 2015 Jan 13;2:289. doi: 10.3389/fpubh.2014.00289. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Adibzadeh F et al**, (January 2015) *Impact of head morphology on local brain specific absorption rate from exposure to mobile phone radiation*, Bioelectromagnetics. 2015 Jan;36(1):66-76. doi: 10.1002/bem.21885. Epub 2014 Nov 15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Aydogan F et al**, (January 2015) *The effect of 2100 MHz radiofrequency radiation of a 3G mobile phone on the parotid gland of rats*, Am J Otolaryngol. 2015 Jan-Feb;36(1):39-46. doi: 10.1016/j.amjoto.2014.10.001. Epub 2014 Oct 5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Li C et al**, (January 2015) *Generation of infant anatomical models for evaluating electromagnetic field exposures*, Bioelectromagnetics. 2015 Jan;36(1):10-26. doi: 10.1002/bem.21868. Epub 2014 Oct 18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Pettersson D et al**, (January 2015) *Validation of self-reported start year of mobile phone use in a Swedish case-control study on radiofrequency fields and acoustic neuroma risk*, J Expo Sci Environ Epidemiol. 2015 Jan;25(1):72-9. doi: 10.1038/jes.2014.76. Epub 2014 Nov 5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Tomitsch J, Dechant E et al**, (January 2015) *Exposure to electromagnetic fields in households--trends from 2006 to 2012*, Bioelectromagnetics. 2015 Jan;36(1):77-85. doi: 10.1002/bem.21887. Epub 2014 Nov 24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Agarwal A, Durairajanayagam D**, (November 2014) *Are men talking their reproductive health away?*, Asian J Androl. 2014 Nov 18. doi: 10.4103/1008-682X.140963. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Geronikolou S et al**, (November 2014) *Diverse radiofrequency sensitivity and radiofrequency effects of mobile or cordless phone near fields exposure in Drosophila melanogaster*, PLoS One. 2014 Nov 17;9(11):e112139. doi: 10.1371/journal.pone.0112139. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Carpenter DO**, (November 2014) *Excessive exposure to radiofrequency electromagnetic fields may cause the development of electrohypersensitivity*, Altern Ther Health Med. 2014 Nov-Dec;20(6):40-2 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Carlberg M, Hardell L**, (October 2014) *Decreased Survival of Glioma Patients with Astrocytoma Grade IV (Glioblastoma Multiforme) Associated with Long-Term Use of Mobile and Cordless Phones*, Int J Environ Res Public Health. 2014 Oct 16;11(10):10790-10805 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Klose M et al**, (October 2014) *Effects of Early-Onset Radiofrequency Electromagnetic Field Exposure (GSM 900 MHz) on Behavior and Memory in Rats*, Radiat Res. 2014 Oct;182(4):435-47. doi: 10.1667/RR13695.1. Epub 2014 Sep 24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Bamiou DE et al**, (September 2014) *Mobile telephone use effects on perception of verticality.*, Bioelectromagnetics. 2014 Sep 26. doi: 10.1002/bem.21877. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Rosado MM et al**, (September 2014) *Effects of GSM-modulated 900 MHz radiofrequency electromagnetic fields on the hematopoietic potential of mouse bone marrow cells*, Bioelectromagnetics. 2014 Sep 25. doi: 10.1002/bem.21880. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Sadetzki S et al**, (September 2014) *The MOBI-Kids Study Protocol: Challenges in Assessing Childhood and Adolescent Exposure to Electromagnetic Fields from Wireless Telecommunication Technologies and Possible Association with Brain Tumor Risk*, Front Public Health. 2014 Sep 23;2:124. doi: 10.3389/fpubh.2014.00124. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Vijayalaxmi, Scarfi MR**, (September 2014) *International and national expert group evaluations: biological/health effects of radiofrequency fields*, Int J Environ Res Public Health. 2014 Sep 10;11(9):9376-408.

doi: 10.3390/ijerph110909376 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Kim BC et al**, (September 2014) *Evaluation of radiofrequency exposure levels from multiple wireless installations in population dense areas in Korea*, Bioelectromagnetics. 2014 Sep 4. doi: 10.1002/bem.21874. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Dasdag S et al**, (September 2014) *Effect of Long Term 900 MHz Radiofrequency Radiation on Enamel Microhardness of Rat's Teeth*, Oral Health Dent Manag. 2014 Sep;13(3):749-52 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Mortazavi S et al**, (September 2014) *Electromagnetic Radiofrequency Radiation Emitted from GSM Mobile Phones Decreases the Accuracy of Home Blood Glucose Monitors*, J Biomed Phys Eng. 2014 Sep 1;4(3):111-6. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Chiu CT et al**, (August 2014) *Mobile phone use and health symptoms in children*, J Formos Med Assoc. 2014 Aug 9. pii: S0929-6646(14)00207-1. doi: 10.1016/j.jfma.2014.07.002. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Marjanovic AM et al**, (August 2014) *Cell oxidation-reduction imbalance after modulated radiofrequency radiation*, Electromagn Biol Med. 2014 Aug 13:1-6. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Maskey D et al**, (August 2014) *Alteration of glycine receptor immunoreactivity in the auditory brainstem of mice following three months of exposure to radiofrequency radiation at SAR 4.0 W/kg*, Int J Mol Med. 2014 Aug;34(2):409-19. doi: 10.3892/ijmm.2014.1784. Epub 2014 May 22 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Coureau G et al**, (July 2014) *Mobile phone use and brain tumours in the CERENAT case-control study*, Occup Environ Med. 2014 Jul;71(7):514-22. doi: 10.1136/oemed-2013-101754. Epub 2014 May 9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Vila J et al**, (June 2014) *Development of a source-based approach to assessing occupational exposure to electromagnetic fields in the INTEROCC study* Development of a source-based approach to assessing occupational exposure to electromagnetic fields in the INTEROCC study, Occup Environ Med. 2014 Jun;71 Suppl 1:A35-6. doi: 10.1136/oemed-2014-102362.110 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Chen C et al**, (May 2014) *Exposure to 1800 MHz radiofrequency radiation impairs neurite outgrowth of embryonic neural stem cells*, Sci Rep. 2014 May 29;4:5103. doi: 10.1038/srep05103. [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Saikhedkar N et al**, (May 2014) *Effects of mobile phone radiation (900 MHz radiofrequency) on structure and functions of rat brain*, Neurol Res. 2014 May 26:1743132814Y0000000392. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Ozgur E et al**, (May 2014) *Mobile Phone Radiation Alters Proliferation of Hepatocarcinoma Cells*, Cell Biochem Biophys. 2014 May 11. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Liu K et al**, (May 2014) *The protective effect of autophagy on mouse spermatocyte derived cells exposure to 1800MHz radiofrequency electromagnetic radiation*, Toxicol Lett. 2014 May 9;228(3):216-224. doi:

10.1016/j.toxlet.2014.05.004. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Movvahedi MM et al**, (May 2014) *Does exposure to GSM 900 MHz mobile phone radiation affect short-term memory of elementary school students?*, J Pediatr Neurosci. 2014 May;9(2):121-4. doi: 10.4103/1817-1745.139300 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Seckin E et al**, (May 2014) *The effect of radiofrequency radiation generated by a Global System for Mobile Communications source on cochlear development in a rat model*, J Laryngol Otol. 2014 May;128(5):400-5. doi: 10.1017/S0022215114000723. Epub 2014 May 1 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Vijayalaxmi, Prihoda TJ**, (April 2014) *Mobile phones, non-ionizing radiofrequency fields and brain cancer: is there an adaptive response?*, Dose Response. 2014 Apr 22;12(3):509-14. doi: 10.2203/dose-response.14-012.Vijayalaxmi. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Gorpinchenko I et al**, (2014) *The influence of direct mobile phone radiation on sperm quality*, Cent European J Urol. 2014;67(1):65-71. doi: 10.5173/cej.2014.01.art14. Epub 2014 Apr 17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Lustenberger C et al**, (April 2015) *Inter-individual and intra-individual variation of the effects of pulsed RF EMF exposure on the human sleep EEG*, Bioelectromagnetics. 2015 Apr;36(3):169-77. doi: 10.1002/bem.21893. Epub 2015 Feb 17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Qin F et al**, (January 2014) *Effects of nano-selenium on cognition performance of mice exposed in 1800 MHz radiofrequency fields*, Wei Sheng Yan Jiu. 2014 Jan;43(1):16-21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Mohammed HS et al**, (March 2013) *Non-thermal continuous and modulated electromagnetic radiation fields effects on sleep EEG of rats*, J Adv Res. 2013 Mar;4(2):181-7. doi: 10.1016/j.jare.2012.05.005. Epub 2012 Jun 25 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Ingole IV, Ghosh SK**, (December 2012) *Effect of exposure to radio frequency radiation emitted by cell phone on the developing dorsal root ganglion of chick embryo: a light microscopic study*, Nepal Med Coll J. 2012 Dec;14(4):337-41 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Bolte JF, Eikelboom T**, (November 2012) *Personal radiofrequency electromagnetic field measurements in the Netherlands: Exposure level and variability for everyday activities, times of day and types of area*, Environ Int. 2012 Nov 1;48:133-42. Epub 2012 Aug 18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Pilla AA**, (September 2012) *Electromagnetic fields instantaneously modulate nitric oxide signaling in challenged biological systems*, Biochem Biophys Res Commun. 2012 Sep 28;426(3):330-3. doi: 10.1016/j.bbrc.2012.08.078. Epub 2012 Aug 24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Vijayalaxmi, Prihoda TJ**, (September 2012) *Genetic Damage in Human Cells Exposed to Non-ionizing Radiofrequency Fields: A Meta-Analysis of the Data from 88 Publications (1990-2011)*, Mutat Res. 2012 Sep 27. pii: S1383-5718(12)00286-0. doi: 10.1016/j.mrgentox.2012.09.007. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Redmayne M et al**, (September 2012) *Patterns in wireless phone estimation data from a cross-sectional survey: what are the implications for epidemiology?*, BMJ Open. 2012 Sep 4;2(5). pii: e000887. doi: 10.1136/bmjopen-

2012-000887. Print 2012 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Kesari KK, Behari J**, (September 2012) *Evidence for mobile phone radiation exposure effects on reproductive pattern of male rats: Role of ROS*, Electromagn Biol Med. 2012 Sep;31(3):213-22 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Kesari KK et al**, (August 2012) *Biophysical Evaluation of Radiofrequency Electromagnetic Field Effects on Male Reproductive Pattern*, Cell Biochem Biophys. 2012 Aug 29. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Hamzany Y et al**, (August 2012) *Is human saliva an indicator of the adverse health effects of using mobile phones?*, Antioxid Redox Signal. 2012 Aug 15. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Bhargava S et al**, (August 2012) *Effect of handheld mobile phone use on parotid gland salivary flow rate and volume*, Oral Surg Oral Med Oral Pathol Oral Radiol. 2012 Aug;114(2):200-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Leitgeb N**, (August 2012) *Improved classification of evidence for EMF health risks*, Health Phys. 2012 Aug;103(2):195-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Avci B et al**, (July 2012) *Oxidative stress induced by 1.8 Ghz radio frequency electromagnetic radiation and effects of the garlic extract in rats*, Int J Radiat Biol. 2012 Jul 12. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Jin YB et al**, (July 2012) *Effects of Simultaneous Combined Exposure to CDMA and WCDMA Electromagnetic Field on Immune Functions in Rats*, Int J Radiat Biol. 2012 Jul 12. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Bourthoumieu S et al**, (July 2012) *Study of p53 expression and post-transcriptional modifications after GSM-900 radiofrequency exposure of human amniotic cells*, Bioelectromagnetics. 2012 Jul 5. doi: 10.1002/bem.21744. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Repacholi M et al**, (July 2012) *Scientific basis for the Soviet and Russian radiofrequency standards for the general public*, Bioelectromagnetics. 2012 Jul 2. doi: 10.1002/bem.21742. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Schmid MR et al**, (June 2012) *Sleep EEG alterations: effects of pulsed magnetic fields versus pulse-modulated radio frequency electromagnetic fields*, J Sleep Res. 2012 Jun 22. doi: 10.1111/j.1365-2869.2012.01025.x. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Blank M, Goodman RM**, (June 2012) *Electromagnetic fields and health: DNA-based dosimetry*, Electromagn Biol Med. 2012 Jun 7. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Lu YS et al**, (2012) *Reactive Oxygen Species Formation and Apoptosis in Human Peripheral Blood Mononuclear Cell Induced by 900 MHz Mobile Phone Radiation*, Oxid Med Cell Longev. 2012;2012:740280. Epub 2012 Jun 14 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Soderqvist F et al**, (2012) *Review of four publications on the Danish cohort study on mobile phone subscribers and risk of brain tumors*, Rev Environ Health. 2012;27(1):51-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Arendash GW et al**, (2012) *Electromagnetic treatment to old Alzheimer's mice reverses beta-amyloid deposition, modifies cerebral blood flow, and provides selected cognitive benefit*, PLoS One. 2012;7(4):e35751. Epub 2012 Apr 25 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Chen G et al**, (April 2012) *Using model organism Saccharomyces cerevisiae to evaluate the effects of ELF-MF and RF-EMF exposure on global gene expression*, Bioelectromagnetics. 2012 Apr 9. doi: 10.1002/bem.21724. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Aldad TS et al**, (March 2012) *Fetal radiofrequency radiation exposure from 800-1900 mhz-rated cellular telephones affects neurodevelopment and behavior in mice*, Sci Rep. 2012;2:312. Epub 2012 Mar 15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Soderqvist F et al**, (March 2012) *Use of wireless phones and the risk of salivary gland tumours: a case-control study*, Eur J Cancer Prev. 2012 Mar 17. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Little MP et al**, (March 2012) *Mobile phone use and glioma risk: comparison of epidemiological study results with incidence trends in the United States*, BMJ. 2012 Mar 8;344:e1147. doi: 10.1136/bmj.e1147 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Jing J et al**, (March 2012) *The influence of microwave radiation from cellular phone on fetal rat brain*, Electromagn Biol Med. 2012 Mar;31(1):57-66. Epub 2012 Jan 23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Trivino Pardo JC et al**, (March 2012) *Microwave electromagnetic field regulates gene expression in T-lymphoblastoid leukemia CCRF-CEM cell line exposed to 900 MHz*, Electromagn Biol Med. 2012 Mar;31(1):1-18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Xu XR et al**, (March 2012) *The effects of extremely low frequency electromagnetic field exposure on the pH of the adult male semen and the motoricity parameters of spermatozoa in vitro*, Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi. 2012 Mar;30(3):178-80 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Zada G et al**, (March 2012) *Incidence trends in the anatomic location of primary malignant brain tumors in the United States: 1992-2006*, World Neurosurg. 2012 Mar;77(3-4):518-24. Epub 2011 Nov 7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Jiang B et al**, (2012) *Adaptive Response in Mice Exposed to 900 MHz Radiofrequency Fields: Primary DNA Damage*, PLoS One. 2012;7(2):e32040. Epub 2012 Feb 28 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Calabro E et al**, (February 2012) *Modulation of heat shock protein response in SH-SY5Y by mobile phone microwaves*, World J Biol Chem. 2012 Feb 26;3(2):34-40 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P Cam ST, Seyhan N**, (February 2012) *Single-strand DNA breaks in human hair root cells exposed to mobile phone radiation*, Int J Radiat Biol. 2012 Feb 21. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Vecchio F et al**, (February 2012) *Mobile phone emission increases inter-hemispheric functional coupling of electroencephalographic alpha rhythms in epileptic patients*, Int J Psychophysiol. 2012 Feb 16. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Murbach M et al**, (February 2012) *Exposure system to study hypotheses of ELF and RF electromagnetic field interactions of mobile phones with the central nervous system*, Bioelectromagnetics. 2012 Feb 13. doi: 10.1002/bem.21710. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Miller G et al**, (February 2012) *The heritability and genetic correlates of mobile phone use: a twin study of consumer behavior*, Twin Res Hum Genet. 2012 Feb;15(1):97-106 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Cammaerts MC et al**, (January 2012) *GSM 900 MHz radiation inhibits ants' association between food sites and encountered cues*, Electromagn Biol Med. 2012 Jan 23. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Dasdag S et al**, (January 2012) *Effect of 900 MHz Radio Frequency Radiation on Beta Amyloid Protein, Protein Carbonyl, and Malondialdehyde in the Brain*, Electromagn Biol Med. 2012 Jan 23. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Hansson Mild K et al**, (January 2012) *Is there any exposure from a mobile phone in stand-by mode?*, Electromagn Biol Med. 2012 Jan 23. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Fragopoulou AF et al**, (January 2012) *Brain proteome response following whole body exposure of mice to mobile phone or wireless DECT base radiation*, Electromagn Biol Med. 2012 Jan 20. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Deatanyah P et al**, (January 2012) *Assessment of radiofrequency radiation within the vicinity of some gsm base stations in ghana*, Radiat Prot Dosimetry. 2012 Jan 18. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Deltour I et al**, (January 2012) *Mobile Phone Use and Incidence of Glioma in the Nordic Countries 1979-2008: Consistency Check*, Epidemiology. 2012 Jan 13. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Maskey D et al**, (January 2012) *Calcium-binding proteins and GFAP immunoreactivity alterations in murine hippocampus after 1 month of exposure to 835MHz radiofrequency at SAR values of 1.6 and 4.0W/kg*, Neurosci Lett. 2012 Jan 11;506(2):292-6. Epub 2011 Nov 25 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Soderqvist F et al**, (December 2011) *Childhood brain tumour risk and its association with wireless phones: a commentary*, Environ Health. 2011 Dec 19;10(1):106. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Guler G** *et al*, (December 2011) *The effect of radiofrequency radiation on DNA and lipid damage in female and male infant rabbits*, Int J Radiat Biol. 2011 Dec 7. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Esmekaya MA** *et al*, (December 2011) *Mutagenic and morphologic impacts of 1.8GHz radiofrequency radiation on human peripheral blood lymphocytes (hPBLs) and possible protective role of pre-treatment with Ginkgo biloba (EGb 761)*, Sci Total Environ. 2011 Dec 1;410-411:59-64. Epub 2011 Oct 19 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Feychting M**, (December 2011) *Mobile phones, radiofrequency fields, and health effects in children - Epidemiological studies*, Prog Biophys Mol Biol. 2011 Dec;107(3):343-8. Epub 2011 Sep 21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Kesari KK** *et al*, (December 2011) *900-MHz microwave radiation promotes oxidation in rat brain*, Electromagn Biol Med. 2011 Dec;30(4):219-34 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Lindholm H** *et al*, (December 2011) *Thermal effects of mobile phone RF fields on children: A provocation study*, Prog Biophys Mol Biol. 2011 Dec;107(3):399-403. Epub 2011 Sep 10 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Marino C** *et al*, (December 2011) *Are the young more sensitive than adults to the effects of radiofrequency fields? An examination of relevant data from cellular and animal studies*, Prog Biophys Mol Biol. 2011 Dec;107(3):374-85. Epub 2011 Sep 8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Sirav B, Seyhan N**, (December 2011) *Effects of radiofrequency radiation exposure on blood-brain barrier permeability in male and female rats*, Electromagn Biol Med. 2011 Dec;30(4):253-60 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Trosic I** *et al*, (December 2011) *Effect of electromagnetic radiofrequency radiation on the rats' brain, liver and kidney cells measured by comet assay*, Coll Antropol. 2011 Dec;35(4):1259-64 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Eskander EF** *et al*, (November 2011) *How does long term exposure to base stations and mobile phones affect human hormone profiles?*, Clin Biochem. 2011 Nov 27. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Sun W** *et al*, (November 2011) *A 1.8-GHz radiofrequency radiation induces EGF receptor clustering and phosphorylation in cultured human amniotic (FL) cells*, Int J Radiat Biol. 2011 Nov 18. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Ballardin M** *et al*, (November 2011) *Non-thermal effects of 2.45 GHz microwaves on spindle assembly, mitotic cells and viability of Chinese hamster V-79 cells*, Mutat Res. 2011 Nov 1;716(1-2):1-9. Epub 2011 Jul 30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Swerdlow AJ** *et al*, (November 2011) *Mobile phones, brain tumors, and the interphone study: where are we now?*, Environ Health Perspect. 2011 Nov;119(11):1534-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Repacholi MH et al**, (October 2011) *Systematic review of wireless phone use and brain cancer and other head tumors*, Bioelectromagnetics. 2011 Oct 21. doi: 10.1002/bem.20716. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Lee HJ et al**, (October 2011) *The effects of simultaneous combined exposure to CDMA and WCDMA electromagnetic fields on rat testicular function*, Bioelectromagnetics. 2011 Oct 19. doi: 10.1002/bem.20715. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Gandhi OP et al**, (October 2011) *Exposure Limits: The underestimation of absorbed cell phone radiation, especially in children*, Electromagn Biol Med. 2011 Oct 14. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Gandhi OP et al**, (October 2011) *Exposure Limits: The underestimation of absorbed cell phone radiation, especially in children*, Electromagn Biol Med. 2011 Oct 14. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Boursianis A et al**, (October 2011) *Measurements for assessing the exposure from 3G femtocells*, Radiat Prot Dosimetry. 2011 Oct 13. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Colak C et al**, (October 2011) *Effects of electromagnetic radiation from 3G mobile phone on heart rate, blood pressure and ECG parameters in rats*, Toxicol Ind Health. 2011 Oct 13. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Breckenkamp J et al**, (October 2011) *Residential characteristics and radiofrequency electromagnetic field exposures from bedroom measurements in Germany*, Radiat Environ Biophys. 2011 Oct 1. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Cardis E et al**, (October 2011) *Acoustic neuroma risk in relation to mobile telephone use: results of the INTERPHONE international case-control study*, Cancer Epidemiol. 2011 Oct;35(5):453-64. Epub 2011 Aug 23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Hareuveny R et al**, (October 2011) *Cognitive effects of cellular phones: a possible role of non-radiofrequency radiation factors*, Bioelectromagnetics 2011 Oct;32(7):585-8. doi: 10.1002/bem.20671. Epub 2011 Apr 12 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Lukac N et al**, (October 2011) *In vitro effects of radiofrequency electromagnetic waves on bovine spermatozoa motility*, J Environ Sci Health A Tox Hazard Subst Environ Eng. 2011 Oct;46(12):1417-23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Cardis E et al**, (September 2011) *Risk of brain tumours in relation to estimated RF dose from mobile phones: results from five Interphone countries*, Occup Environ Med. 2011 Sep;68(9):631-40. Epub 2011 Jun 9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Cardis E et al**, (September 2011) *Estimation of RF energy absorbed in the brain from mobile phones in the Interphone Study*, Occup Environ Med. 2011 Sep;68(9):686-93. Epub 2011 Jun 9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Aydin D et al**, (August 2011) *Mobile phone use and brain tumors in children and adolescents: a multicenter case-control study*, J Natl Cancer Inst. 2011 Aug 17;103(16):1264-76. Epub 2011 Jul 27 [[View Author's abstract](#)]

[conclusions](#)] [[View on Pubmed](#)]

N **Schuz J** *et al*, (August 2011) *Long-term mobile phone use and the risk of vestibular schwannoma: a danish nationwide cohort study*, Am J Epidemiol. 2011 Aug 15;174(4):416-22. Epub 2011 Jun 28 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Tomitsch J, Dechant E**, (August 2011) *Trends in residential exposure to electromagnetic fields from 2006 to 2009*, Radiat Prot Dosimetry. 2011 Aug 8. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Jorge-Mora T** *et al*, (August 2011) *The Effects of Single and Repeated Exposure to 2.45 GHz Radiofrequency Fields on c-Fos Protein Expression in the Paraventricular Nucleus of Rat Hypothalamus*, Neurochem Res. 2011 Aug 5. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Loughran SP** *et al*, (August 2011) *Individual differences in the effects of mobile phone exposure on human sleep: Rethinking the problem*, Bioelectromagnetics. 2011 Aug 3. doi: 10.1002/bem.20691. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Sarapultseva EI, Igolkina JV**, (August 2011) *Experimental Study of Relationship between Biological Hazards of Low-Dose Radiofrequency Exposure and Energy Flow Density in Spirostomum Ambiguum Infusoria Exposed at a Mobile Connection Frequency (1 GHz)*, Bull Exp Biol Med. 2011 Aug;151(4):477-80 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Neskovic N** *et al*, (July 2011) *Improving the efficiency of measurement procedures for assessing human exposure in the vicinity of mobile phone (gsm/dcs/umts) base stations.*, Radiat Prot Dosimetry. 2011 Jul 20. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Curcio G** *et al*, (July 2011) *Effects of mobile phone signals over BOLD response while performing a cognitive task*, Clin Neurophysiol. 2011 Jul 6. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Karaca E** *et al*, (July 2011) *The genotoxic effect of radiofrequency waves on mouse brain*, J Neurooncol. 2011 Jul 6. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Baan R** *et al*, (July 2011) *Carcinogenicity of radiofrequency electromagnetic fields*, Lancet Oncol. 2011 Jul;12(7):624-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Larjavaara S** *et al*, (July 2011) *Location of gliomas in relation to mobile telephone use: a case-case and case-specular analysis*, Am J Epidemiol. 2011 Jul 1;174(1):2-11. Epub 2011 May 24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **van Deventer E** *et al*, (July 2011) *WHO research agenda for radiofrequency fields*, Bioelectromagnetics. 2011 Jul;32(5):417-21. doi: 10.1002/bem.20660. Epub 2011 Mar 14 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Deltour I** *et al*, (June 2011) *Analysis of three-dimensional SAR distributions emitted by mobile phones in an epidemiological perspective*, Bioelectromagnetics. 2011 Jun 21. doi: 10.1002/bem.20684. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P Levis AG et al**, (June 2011) *Mobile phones and head tumours. The discrepancies in cause-effect relationships in the epidemiological studies - how do they arise?*, Environ Health. 2011 Jun 17;10:59 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Kumar S et al**, (2011) *The therapeutic effect of a pulsed electromagnetic field on the reproductive patterns of male Wistar rats exposed to a 2.45-GHz microwave field*, Clinics (Sao Paulo). 2011;66(7):1237-45 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Yoon SY et al**, (2011) *Induction of Hair Growth by Insulin-Like Growth Factor-1 in 1,763 MHz Radiofrequency-Irradiated Hair Follicle Cells*, PLoS One. 2011;6(12):e28474. Epub 2011 Dec 2 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Bornkessel C**, (May 2011) *Assessment of exposure to mobile telecommunication electromagnetic fields*, Wien Med Wochenschr. 2011 May;161(9-10):233-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Hardell L et al**, (May 2011) *Pooled analysis of case-control studies on malignant brain tumours and the use of mobile and cordless phones including living and deceased subjects*, Int J Oncol. 2011 May;38(5):1465-74. doi: 10.3892/ijo.2011.947. Epub 2011 Feb 17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Roosli M, Hug K**, (May 2011) *Wireless communication fields and non-specific symptoms of ill health: a literature review*, Wien Med Wochenschr. 2011 May;161(9-10):240-50 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Viel JF et al**, (May 2011) *Variability of radiofrequency exposure across days of the week: a population-based study*, Environ Res. 2011 May;111(4):510-3. Epub 2011 Mar 15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Blank M, Goodman R**, (April 2011) *DNA is a fractal antenna in electromagnetic fields*, Int J Radiat Biol. 2011 Apr;87(4):409-15. Epub 2011 Feb 28 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Esmekaya MA et al**, (March 2011) *900 MHz pulse-modulated radiofrequency radiation induces oxidative stress on heart, lung, testis and liver tissues*, Gen Physiol Biophys. 2011 Mar;30(1):84-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Volkow ND et al**, (February 2011) *Effects of cell phone radiofrequency signal exposure on brain glucose metabolism*, JAMA. 2011 Feb 23;305(8):808-13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Cao Y et al**, (February 2011) *Induction of adaptive response: Pre-exposure of mice to 900 MHz radiofrequency fields reduces hematopoietic damage caused by subsequent exposure to ionising radiation*, Int J Radiat Biol. 2011 Feb 7. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Liu ML et al**, (February 2011) *Potential Protection of Green Tea Polyphenols Against 1800 MHz Electromagnetic Radiation-Induced Injury on Rat Cortical Neurons*, Neurotox Res. 2011 Feb 4. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Kumar G et al**, (February 2011) *Evaluation of hematopoietic system effects after in vitro radiofrequency radiation exposure in rats*, Int J Radiat Biol. 2011 Feb;87(2):231-40. Epub 2010 Nov 4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Olsen J**, (February 2011) *The interphone study: brain cancer and beyond*, Bioelectromagnetics. 2011 Feb;32(2):164-7. doi: 10.1002/bem.20628. Epub 2010 Nov 30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Paulraj R, Behari J**, (February 2011) *Effects of low level microwave radiation on carcinogenesis in Swiss Albino mice*, Mol Cell Biochem. 2011 Feb;348(1-2):191-7. Epub 2010 Nov 18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N de Vocht F et al**, (January 2011) *Time trends (1998-2007) in brain cancer incidence rates in relation to mobile phone use in England*, Bioelectromagnetics. 2011 Jan 28. doi: 10.1002/bem.20648. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Trillo MA et al**, (January 2011) *Cytostatic response of NB69 cells to weak pulse-modulated 2.2 GHz radar-like signals*, Bioelectromagnetics. 2011 Jan 28. doi: 10.1002/bem.20643. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Kesari KK et al**, (January 2011) *Effects of Radiofrequency Electromagnetic Wave Exposure from Cellular Phones on the Reproductive Pattern in Male Wistar Rats*, Appl Biochem Biotechnol. 2011 Jan 15. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Clouston SA**, (January 2011) *Social and economic patterning in the Interphone study*, Int J Epidemiol. 2011 Jan 6. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Kumar NR et al**, (January 2011) *Exposure to cell phone radiations produces biochemical changes in worker honey bees*, Toxicol Int. 2011 Jan;18(1):70-2 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Lowden A et al**, (January 2011) *Sleep after mobile phone exposure in subjects with mobile phone-related symptoms*, Bioelectromagnetics. 2011 Jan;32(1):4-14 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Lowden A et al**, (January 2011) *Sleep after mobile phone exposure in subjects with mobile phone-related symptoms*, Bioelectromagnetics. 2011 Jan;32(1):4-14 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Jin YB et al**, (December 2010) *One-year, simultaneous combined exposure of CDMA and WCDMA radiofrequency electromagnetic fields to rats*, Int J Radiat Biol. 2010 Dec 21. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Hardell L et al**, (December 2010) *Re-analysis of risk for glioma in relation to mobile telephone use: comparison with the results of the Interphone international case-control study*, Int J Epidemiol. 2010 Dec 17. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Repacholi M et al**, (December 2010) *An international project to confirm soviet-era results on immunological and teratological effects of RF field exposure in wistar rats and comments on Grigoriev et al. [2010]*, Bioelectromagnetics. 2010 Dec 15. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Divan H et al**, (December 2010) *Cell phone use and behavioural problems in young children*, J Epidemiol Community Health (2010). doi:10.1136/jech.2010.115402 [[View Author's abstract conclusions](#)]

- N **Bourthoumieu S et al**, (December 2010) *Cytogenetic studies in human cells exposed in vitro to GSM-900 MHz radiofrequency radiation using R-banded karyotyping*, Radiat Res. 2010 Dec;174(6):712-8. Epub 2010 Sep 20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Esmekaya MA et al**, (December 2010) *Pulse modulated 900 MHz radiation induces hypothyroidism and apoptosis in thyroid cells: a light, electron microscopy and immunohistochemical study*, Int J Radiat Biol. 2010 Dec;86(12):1106-16. Epub 2010 Sep 1 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Grigoriev YG et al**, (December 2010) *Confirmation studies of Soviet research on immunological effects of microwaves: Russian immunology results*, Bioelectromagnetics. 2010 Dec;31(8):589-602. doi: 10.1002/bem.20605. Epub 2010 Sep 20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Pacey AA et al**, (December 2010) *Environmental and lifestyle factors associated with sperm DNA damage*, Hum Fertil (Camb). 2010 Dec;13(4):189-93 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Thomas S et al**, (December 2010) *Use of mobile phones and changes in cognitive function in adolescents*, Occup Environ Med. 2010 Dec;67(12):861-6. Epub 2010 Aug 25 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Olsen J**, (November 2010) *The interphone study: Brain cancer and beyond*, Bioelectromagnetics. 2010 Nov 30. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Heinrich S et al**, (November 2010) *Association between exposure to radiofrequency electromagnetic fields assessed by dosimetry and acute symptoms in children and adolescents: a population based cross-sectional study*, Environ Health. 2010 Nov 25;9:75 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Cooke R et al**, (November 2010) *A case-control study of risk of leukaemia in relation to mobile phone use*, Br J Cancer. 2010 Nov 23;103(11):1729-35. Epub 2010 Oct 12 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **de Gannes FP et al**, (November 2010) *Effect of Exposure to the Edge Signal on Oxidative Stress in Brain Cell Models*, Radiat Res. 2010 Nov 22. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Pouletier de Gannes F et al**, (February 2011) *Effect of exposure to the edge signal on oxidative stress in brain cell models*, Radiat Res. 2011 Feb;175(2):225-30. Epub 2010 Nov 22 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Damvik M, Johansson O**, (November 2010) *Health risk assessment of electromagnetic fields: a conflict between the precautionary principle and environmental medicine methodology*, Rev Environ Health. 2010 Oct-Dec;25(4):325-33 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Dubey RB et al**, (November 2010) *Risk of brain tumors from wireless phone use*, J Comput Assist Tomogr. 2010 Nov-Dec;34(6):799-807 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Inskip PD et al**, (November 2010) *Brain cancer incidence trends in relation to cellular telephone use in the United States*, Neuro Oncol. 2010 Nov;12(11):1147-51. Epub 2010 Jul 16 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P Ozgur E et al**, (November 2010) *Mobile phone radiation-induced free radical damage in the liver is inhibited by the antioxidants N-acetyl cysteine and epigallocatechin-gallate*, *Int J Radiat Biol.* 2010 Nov;86(11):935-45. Epub 2010 Sep 1 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Lee KY et al**, (October 2010) *Effects of combined radiofrequency radiation exposure on the cell cycle and its regulatory proteins*, *Bioelectromagnetics.* 2010 Oct 28. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Behari J**, (October 2010) *Biological responses of mobile phone frequency exposure*, *Indian J Exp Biol.* 2010 Oct;48(10):959-81 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Joseph W et al**, (October 2010) *Comparison of personal radio frequency electromagnetic field exposure in different urban areas across Europe*, *Environ Res.* 2010 Oct;110(7):658-63 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Kheifets L et al**, (October 2010) *Risk governance for mobile phones, power lines, and other EMF technologies*, *Risk Anal.* 2010 Oct;30(10):1481-94 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Kowalczyk C et al**, (October 2010) *Absence of nonlinear responses in cells and tissues exposed to RF energy at mobile phone frequencies using a doubly resonant cavity*, *Bioelectromagnetics.* 2010 Oct;31(7):556-65 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Lee HJ et al**, (October 2010) *The lack of histological changes of CDMA cellular phone-based radio frequency on rat testis*, *Bioelectromagnetics.* 2010 Oct;31(7):528-34 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Bourthoumieu S et al**, (September 2010) *Cytogenetic Studies in Human Cells Exposed In Vitro to GSM-900 MHz Radiofrequency Radiation Using R-Banded Karyotyping*, *Radiat Res.* 2010 Sep 20. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **McIntosh RL, Anderson V**, (September 2010) *SAR versus S(inc): What is the appropriate RF exposure metric in the range 1-10 GHz? Part II: Using complex human body models*, *Bioelectromagnetics.* 2010 Sep;31(6):467-78 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Schuz J et al**, (August 2010) *An international prospective cohort study of mobile phone users and health (Cosmos): Design considerations and enrolment*, *Cancer Epidemiol.* 2010 Aug 30. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Hardell L et al**, (August 2010) *Mobile phone use and the risk for malignant brain tumors: a case-control study on deceased cases and controls*, *Neuroepidemiology.* 2010 Aug;35(2):109-14. Epub 2010 Jun 15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N O'Connor RP et al**, (July 2010) *Exposure to GSM RF fields does not affect calcium homeostasis in human endothelial cells, rat pheochromocytoma cells or rat hippocampal neurons*, *PLoS One.* 2010 Jul 27;5(7):e11828 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Khurana VG et al**, (July 2010) *Epidemiological evidence for a health risk from mobile phone base stations*, *Int J Occup Environ Health.* 2010 Jul-Sep;16(3):263-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P **Ragbetli MC et al**, (July 2010) *The effect of mobile phone on the number of Purkinje cells: a stereological study*, Int J Radiat Biol. 2010 Jul;86(7):548-54 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Yakymenko I, Sidorik E**, (July 2010) *Risks of carcinogenesis from electromagnetic radiation of mobile telephony devices*, Exp Oncol. 2010 Jul;32(2):54-60 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Hutter HP et al**, (December 2010) *Tinnitus and mobile phone use*, Occup Environ Med. 2010 Dec;67(12):804-8. Epub 2010 Jun 23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Maskey D et al**, (July 2010) *Chronic 835-MHz radiofrequency exposure to mice hippocampus alters the distribution of calbindin and GFAP immunoreactivity*, Brain Res. 2010 Jul 30;1346:237-46. Epub 2010 Jun 17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Kelsh MA et al**, (July 2011) *Measured radiofrequency exposure during various mobile-phone use scenarios*, J Expo Sci Environ Epidemiol. 2010 Jun 16. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Stam R**, (October 2010) *Electromagnetic fields and the blood-brain barrier*, Brain Res Rev. 2010 Oct 5;65(1):80-97. Epub 2010 Jun 13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Dimida A et al**, (June 2010) *Electric and magnetic fields do not modify the biochemical properties of frtl-5 cells*, J Endocrinol Invest. 2010 Jun 11. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Lehrer S et al**, (June 2010) *Association between number of cell phone contracts and brain tumor incidence in nineteen U.S. States*, J Neurooncol. 2010 Jun 30. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Bartsch H et al**, (2010) *Effect of chronic exposure to a GSM-like signal (mobile phone) on survival of female Sprague-Dawley rats: modulatory effects by month of birth and possibly stage of the solar cycle*, Neuro Endocrinol Lett. 2010;31(4):457-73 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Bartsch H et al**, (2010) *Effect of chronic exposure to a GSM-like signal (mobile phone) on survival of female Sprague-Dawley rats: modulatory effects by month of birth and possibly stage of the solar cycle*, Neuro Endocrinol Lett. 2010;31(4):457-73 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Cardis E et al**, (June 2010) *Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study*, Int J Epidemiol. 2010 Jun;39(3):675-94. Epub 2010 May 17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Saracci R, Samet J**, (June 2010) *Commentary: Call me on my mobile phone...or better not?--a look at the INTERPHONE study results*, Int J Epidemiol. 2010 Jun;39(3):695-8. Epub 2010 May 17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Soderqvist F et al**, (2010) *Radiofrequency fields, transthyretin, and Alzheimer's disease*, J Alzheimers Dis. 2010;20(2):599-606 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **van Kleef E et al**, (June 2010) *Risk and benefit perceptions of mobile phone and base station technology in Bangladesh*, Risk Anal. 2010 Jun;30(6):1002-15. Epub 2010 Apr 8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

[on Pubmed\]](#)

N **Yildirim MS** *et al*, (2010) *Effect of mobile phone station on micronucleus frequency and chromosomal aberrations in human blood cells*, Genet Couns. 2010;21(2):243-51 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Joseph W** *et al*, (May 2010) *Estimation of whole-body SAR from electromagnetic fields using personal exposure meters*, Bioelectromagnetics. 2010 May;31(4):286-95 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Narayanan SN** *et al*, (May 2010) *Effect of radio-frequency electromagnetic radiations (RF-EMR) on passive avoidance behaviour and hippocampal morphology in Wistar rats*, Ups J Med Sci. 2010 May;115(2):91-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Panagopoulos DJ, Margaritis LH**, (May 2010) *The identification of an intensity 'window' on the bioeffects of mobile telephony radiation*, Int J Radiat Biol. 2010 May;86(5):358-66 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Vorobyov V** *et al*, (May 2010) *Repeated exposure to low-level extremely low frequency-modulated microwaves affects cortex-hypothalamus interplay in freely moving rats: EEG study*, Int J Radiat Biol. 2010 May;86(5):376-83 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Yu Y, Yao K**, (May 2010) *Non-thermal cellular effects of lowpower microwave radiation on the lens and lens epithelial cells*, J Int Med Res. 2010 May-Jun;38(3):729-36 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Redmayne M** *et al*, (April 2010) *Cordless telephone use: implications for mobile phone research*, J Environ Monit. 2010 Apr 9;12(4):809-12. Epub 2010 Feb 2 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Tomitsch J** *et al*, (April 2010) *Survey of electromagnetic field exposure in bedrooms of residences in lower Austria*, Bioelectromagnetics. 2010 Apr;31(3):200-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Campisi A** *et al*, (March 2010) *Reactive oxygen species levels and DNA fragmentation on astrocytes in primary culture after acute exposure to low intensity microwave electromagnetic field*, Neurosci Lett. 2010 Mar 31;473(1):52-5. Epub 2010 Feb 13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Sekijima M** *et al*, (March 2010) *2-GHz band CW and W-CDMA modulated radiofrequency fields have no significant effect on cell proliferation and gene expression profile in human cells*, J Radiat Res (Tokyo). 2010;51(3):277-84. Epub 2010 Mar 9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Falzone N** *et al*, (March 2010) *The effect of pulsed 900-MHz GSM mobile phone radiation on the acrosome reaction, head morphometry and zona binding of human spermatozoa*, Int J Androl. 2010 Mar 7. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Christ A** *et al*, (April 2010) *Age-dependent tissue-specific exposure of cell phone users*, Phys Med Biol. 2010 Apr 7;55(7):1767-83. Epub 2010 Mar 5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Guler G** *et al*, (March 2010) *The effect of radiofrequency radiation on DNA and lipid damage in non-pregnant and pregnant rabbits and their newborns*, Gen Physiol Biophys. 2010 Mar;29(1):59-66 [[View Author's abstract](#)]

[conclusions](#)] [[View on Pubmed](#)]

P **Carpenter DO** *et al*, (January 2010) *Electromagnetic fields and cancer: the cost of doing nothing*, Rev Environ Health. 2010 Jan-Mar;25(1):75-80 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Panda NK** *et al*, (February 2010) *Audiologic disturbances in long-term mobile phone users*, J Otolaryngol Head Neck Surg. 2010 Feb 1;39(1):5-11 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Salama N** *et al*, (February 2010) *Effects of exposure to a mobile phone on testicular function and structure in adult rabbit*, Int J Androl. 2010 Feb;33(1):88-94. Epub 2009 Dec 2 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Carrubba S** *et al*, (January 2010) *Mobile-phone pulse triggers evoked potentials*, Neurosci Lett. 2010 Jan 18;469(1):164-8. Epub 2009 Dec 4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Arendash GW** *et al*, (January 2010) *Electromagnetic field treatment protects against and reverses cognitive impairment in Alzheimer's disease mice*, J Alzheimers Dis. 2010 Jan;19(1):191-210 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Johansson A** *et al*, (January 2010) *Symptoms, personality traits, and stress in people with mobile phone-related symptoms and electromagnetic hypersensitivity*, J Psychosom Res. 2010 Jan;68(1):37-45 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Deltour I** *et al*, (December 2009) *Time trends in brain tumor incidence rates in Denmark, Finland, Norway, and Sweden, 1974-2003*, J Natl Cancer Inst. 2009 Dec 16;101(24):1721-4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Maskey D** *et al*, (February 2010) *Effect of 835 MHz radiofrequency radiation exposure on calcium binding proteins in the hippocampus of the mouse brain*, Brain Res. 2010 Feb 8;1313:232-41. Epub 2009 Dec 5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Thomas S** *et al*, (February 2010) *Exposure to radio-frequency electromagnetic fields and behavioural problems in Bavarian children and adolescents*, Eur J Epidemiol. 2010 Feb;25(2):135-41. Epub 2009 Dec 4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Inyang I** *et al*, (December 2009) *A new method to determine laterality of mobile telephone use in adolescents*, Occup Environ Med. 2009 Dec 2. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Fragopoulou AF** *et al*, (June 2010) *Whole body exposure with GSM 900MHz affects spatial memory in mice*, Pathophysiology. 2010 Jun;17(3):179-187. Epub 2009 Dec 1 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Perez-Castejon C** *et al*, (December 2009) *Exposure to ELF-pulse modulated X band microwaves increases in vitro human astrocytoma cell proliferation*, Histol Histopathol. 2009 Dec;24(12):1551-61 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Salama N** *et al*, (December 2009) *The mobile phone decreases fructose but not citrate in rabbit semen: a longitudinal study*, Syst Biol Reprod Med. 2009 Dec;55(5-6):181-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

[on Pubmed\]](#)

**P Salama N et al**, (March 2010) *Effects of exposure to a mobile phone on sexual behavior in adult male rabbit: an observational study*, Int J Impot Res. 2010 Mar;22(2):127-33. Epub 2009 Nov 26 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N de Gannes FP et al**, (November 2009) *A confirmation study of Russian and Ukrainian data on effects of 2450 MHz microwave exposure on immunological processes and teratology in rats*, Radiat Res. 2009 Nov;172(5):617-24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Hansteen IL et al**, (November 2009) *Cytogenetic effects of exposure to 2.3 GHz radiofrequency radiation on human lymphocytes in vitro*, Anticancer Res. 2009 Nov;29(11):4323-30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Kaufman DW et al**, (November 2009) *Risk factors for leukemia in Thailand*, Ann Hematol. 2009 Nov;88(11):1079-88. Epub 2009 Mar 18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Lee HJ et al**, (November 2009) *Lack of teratogenicity after combined exposure of pregnant mice to CDMA and WCDMA radiofrequency electromagnetic fields*, Radiat Res. 2009 Nov;172(5):648-52 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Xu S et al**, (October 2009) *Exposure to 1800 MHz radiofrequency radiation induces oxidative damage to mitochondrial DNA in primary cultured neurons*, Brain Res. 2010 Jan 22;1311:189-96. Epub 2009 Oct 30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P de Tommaso M et al**, (October 2009) *Mobile phones exposure induces changes of contingent negative variation in humans*, Neurosci Lett. 2009 Oct 23;464(2):79-83. Epub 2009 Aug 21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Belyaev I et al**, (October 2009) *Microwaves from Mobile Phones Inhibit 53BP1 Focus Formation in Human Stem Cells Stronger than in Differentiated Cells: Possible Mechanistic Link to Cancer Risk*, Environ Health Perspect. 2009 Oct 22. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Myung SK et al**, (November 2009) *Mobile phone use and risk of tumors: a meta-analysis*, J Clin Oncol. 2009 Nov 20;27(33):5565-72. Epub 2009 Oct 13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Zhijian C et al**, (January 2010) *Impact of 1.8-GHz radiofrequency radiation (RFR) on DNA damage and repair induced by doxorubicin in human B-cell lymphoblastoid cells*, Mutat Res. 2010 Jan;695(1-2):16-21. Epub 2009 Oct 13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Otitoloju AA et al**, (October 2009) *Preliminary study on the induction of sperm head abnormalities in mice, Mus musculus, exposed to radiofrequency radiations from global system for mobile communication base stations*, Bull Environ Contam Toxicol. 2010 Jan;84(1):51-4. Epub 2009 Oct 9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Wake K et al**, (October 2009) *The estimation of 3D SAR distributions in the human head from mobile phone compliance testing data for epidemiological studies*, Phys Med Biol. 2009 Oct 7;54(19):5695-706. Epub 2009 Sep 1 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- N Brescia F et al**, (October 2009) *Reactive oxygen species formation is not enhanced by exposure to UMTS 1950 MHz radiation and co-exposure to ferrous ions in Jurkat cells*, *Bioelectromagnetics*. 2009 Oct;30(7):525-35 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Del Vecchio G et al**, (October 2009) *Effect of radiofrequency electromagnetic field exposure on in vitro models of neurodegenerative disease*, *Bioelectromagnetics*. 2009 Oct;30(7):564-72 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Desai NR et al**, (October 2009) *Pathophysiology of cell phone radiation: oxidative stress and carcinogenesis with focus on male reproductive system*, *Reprod Biol Endocrinol*. 2009 Oct 22;7:114 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N van Rongen E et al**, (October 2009) *Effects of radiofrequency electromagnetic fields on the human nervous system*, *J Toxicol Environ Health B Crit Rev*. 2009 Oct;12(8):572-97 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Goldwein O, Aframian DJ**, (September 2009) *The influence of handheld mobile phones on human parotid gland secretion*, *Oral Dis*. 2009 Sep 8. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Ahlbom A et al**, (September 2009) *Epidemiologic evidence on mobile phones and tumor risk: a review*, *Epidemiology*. 2009 Sep;20(5):639-52 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **McNamee JP, Chauhan V.**, (September 2009) *Radiofrequency radiation and gene/protein expression: a review*, *Radiat Res*. 2009 Sep;172(3):265-87 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Soderqvist F et al**, (August 2009) *Exposure to an 890-MHz mobile phone-like signal and serum levels of S100B and transthyretin in volunteers*, *Toxicol Lett*. 2009 Aug 25;189(1):63-6. Epub 2009 May 7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Sharma VP et al**, (October 2009) *Mobile phone radiation inhibits Vigna radiata (mung bean) root growth by inducing oxidative stress*, *Sci Total Environ*. 2009 Oct 15;407(21):5543-7. Epub 2009 Aug 13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Viel JF et al**, (August 2009) *Radiofrequency exposure in the French general population: band, time, location and activity variability*, *Environ Int*. 2009 Nov;35(8):1150-4. Epub 2009 Aug 4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Contalbrigo L et al**, (August 2009) *Effects of different electromagnetic fields on circadian rhythms of some haematochemical parameters in rats*, *Biomed Environ Sci*. 2009 Aug;22(4):348-53 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Frei P et al**, (August 2009) *Temporal and spatial variability of personal exposure to radio frequency electromagnetic fields*, *Environ Res*. 2009 Aug;109(6):779-85. Epub 2009 May 23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P De Iuliis GN et al**, (July 2009) *Mobile phone radiation induces reactive oxygen species production and DNA damage in human spermatozoa in vitro*, *PLoS One*. 2009 Jul 31;4(7):e6446 [[View Author's abstract conclusions](#)]

[\[View on Pubmed\]](#)

**N Hirose H et al**, (July 2009) *1950 MHz IMT-2000 field does not activate microglial cells in vitro*, Bioelectromagnetics. 2009 Jul 31. [Epub ahead of print] [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

**P Abramson MJ et al**, (July 2009) *Mobile telephone use is associated with changes in cognitive function in young adolescents*, Bioelectromagnetics. 2009 Jul 30. [Epub ahead of print] [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

**P Hardell L, Carlberg M**, (July 2009) *Mobile phones, cordless phones and the risk for brain tumours*, Int J Oncol. 2009 Jul;35(1):5-17. [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

**N Masuda H et al**, (July 2009) *Effects of 915 MHz electromagnetic-field radiation in TEM cell on the blood-brain barrier and neurons in the rat brain*, Radiat Res. 2009 Jul;172(1):66-73 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

**P Cao Y et al**, (2009) *900-MHz Microwave Radiation Enhances gamma-Ray Adverse Effects on SHG44 Cells*, J Toxicol Environ Health A. 2009;72(11-12):727-32 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

**P Mailankot M et al**, (2009) *Radio frequency electromagnetic radiation (RF-EMR) from GSM (0.9/1.8GHz) mobile phones induces oxidative stress and reduces sperm motility in rats*, Clinics (Sao Paulo). 2009;64(6):561-5 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

**N Sannino A et al**, (June 2009) *Human fibroblasts and 900 MHz radiofrequency radiation: evaluation of DNA damage after exposure and co-exposure to 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5h)-furanone (MX)*, Radiat Res. 2009 Jun;171(6):743-51 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

**P Sannino A et al**, (June 2009) *Induction of adaptive response in human blood lymphocytes exposed to radiofrequency radiation*, Radiat Res. 2009 Jun;171(6):735-42 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

**P Sirav B, Seyhan N**, (2009) *Blood-brain barrier disruption by continuous-wave radio frequency radiation*, Electromagn Biol Med. 2009;28(2):215-22 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

- **Breckenkamp J et al**, (May 2009) *Feasibility of a cohort study on health risks caused by occupational exposure to radiofrequency electromagnetic fields*, Environ Health. 2009 May 29;8:23 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

**P Del Vecchio G et al**, (May 2009) *Continuous exposure to 900MHz GSM-modulated EMF alters morphological maturation of neural cells*, Neurosci Lett. 2009 May 22;455(3):173-7. Epub 2009 Mar 24 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

- **Milham S**, (November 2009) *Most cancer in firefighters is due to radio-frequency radiation exposure not inhaled carcinogens*, Med Hypotheses. 2009 Nov;73(5):788-9. Epub 2009 May 22 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

- **Vrijheid M et al**, (May 2009) *Determinants of mobile phone output power in a multinational study - implications for exposure assessment*, Occup Environ Med. 2009 May 21. [Epub ahead of print] [\[View Author's abstract conclusions\]](#)

[abstract conclusions](#)] [[View on Pubmed](#)]

N **Billaudel B** *et al*, (May 2009) *Effects of exposure to DAMPS and GSM signals on Ornithine Decarboxylase (ODC) activity: II- SH-SY5Y human neuroblastoma cells*, Int J Radiat Biol. 2009 May 12;1-4. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Lopez-Martin E** *et al*, (May 2009) *The action of pulse-modulated GSM radiation increases regional changes in brain activity and c-Fos expression in cortical and subcortical areas in a rat model of picrotoxin-induced seizure proneness*, J Neurosci Res. 2009 May 1;87(6):1484-99 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **McQuade JM** *et al*, (May 2009) *Radiofrequency-radiation exposure does not induce detectable leakage of albumin across the blood-brain barrier*, Radiat Res. 2009 May;171(5):615-21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Soderqvist F** *et al*, (April 2009) *Mobile and cordless telephones, serum transthyretin and the blood-cerebrospinal fluid barrier: a cross-sectional study*, Environ Health. 2009 Apr 21;8:19 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Morgan LL**, (April 2009) *Estimating the risk of brain tumors from cellphone use: Published case-control studies*, Pathophysiology. 2009 Apr 6. [Epub ahead of print]Click here to read [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Nittby H** *et al*, (August 2009) *Increased blood-brain barrier permeability in mammalian brain 7 days after exposure to the radiation from a GSM-900 mobile phone*, Pathophysiology. 2009 Aug;16(2-3):103-12. Epub 2009 Apr 2 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Budak GG** *et al*, (April 2009) *Effects of GSM-like radiofrequency on distortion product otoacoustic emissions in pregnant adult rabbits*, Clin Invest Med. 2009 Apr 1;32(2):E112-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Finnie JW** *et al*, (April 2009) *Heat shock protein induction in fetal mouse brain as a measure of stress after whole of gestation exposure to mobile telephony radiofrequency fields*, Pathology. 2009 Apr;41(3):276-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Habash RW** *et al*, (April 2009) *Recent advances in research on radiofrequency fields and health: 2004-2007*, J Toxicol Environ Health B Crit Rev. 2009 Apr;12(4):250-88 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Hartikka H** *et al*, (April 2009) *Mobile phone use and location of glioma: a case-case analysis*, Bioelectromagnetics. 2009 Apr;30(3):176-82 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Mousavy SJ** *et al*, (April 2009) *Effects of mobile phone radiofrequency on the structure and function of the normal human hemoglobin*, Int J Biol Macromol. 2009 Apr 1;44(3):278-85 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Han YY** *et al*, (March 2009) *Cell phone use and acoustic neuroma: the need for standardized questionnaires and access to industry data*, 2009 Mar 26. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on](#)

[Pubmed](#)]

**P Orendacova J et al**, (March 2009) *Immunohistochemical Study of Postnatal Neurogenesis After Whole-body Exposure to Electromagnetic Fields: Evaluation of Age- and Dose-Related Changes in Rats*, Cell Mol Neurobiol. 2009 Mar 21. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Ruediger HW**, (March 2009) *Genotoxic effects of radiofrequency electromagnetic fields*, Pathophysiology. 2009 Mar 12. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Pourlis AF**, (March 2009) *Reproductive and developmental effects of EMF in vertebrate animal models*, Pathophysiology. 2009 Mar 7. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Blank M, Goodman R**, (March 2009) *Electromagnetic fields stress living cells*, Pathophysiology. 2009 Mar 4. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Hardell L et al**, (March 2009) *Epidemiological evidence for an association between use of wireless phones and tumor diseases*, Pathophysiology. 2009 Mar 4. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Blackman C**, (March 2009) *Cell phone radiation: Evidence from ELF and RF studies supporting more inclusive risk identification and assessment*, Pathophysiology. 2009 Aug;16(2-3):205-16. Epub 2009 Mar 4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Phillips JL et al**, (March 2009) *Electromagnetic fields and DNA damage*, Pathophysiology. 2009 Mar 3. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Budak GG et al**, (March 2009) *Effects of intrauterine and extrauterine exposure to GSM-like radiofrequency on distortion product otoacoustic emissions in infant male rabbits*, Int J Pediatr Otorhinolaryngol. 2009 Mar;73(3):391-9. Epub 2008 Dec 23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Gajski G et al**, (March 2009) *Radioprotective effects of honeybee venom (Apis mellifera) against 915-MHz microwave radiation-induced DNA damage in wistar rat lymphocytes: in vitro study*, Int J Toxicol. 2009 Mar-Apr;28(2):88-98 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Kundi M**, (March 2009) *The controversy about a possible relationship between mobile phone use and cancer*, Environ Health Perspect. 2009 Mar;117(3):316-24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Prihoda TJ**, (March 2009) *Genetic damage in mammalian somatic cells exposed to extremely low frequency electro-magnetic fields: A meta-analysis of data from 87 publications (1990-2007)*, Int J Radiat Biol. 2009 Mar;85(3):196-213 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Zareen N et al**, (March 2009) *Derangement of chick embryo retinal differentiation caused by radiofrequency electromagnetic fields*, Congenit Anom (Kyoto). 2009 Mar;49(1):15-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Gul A et al**, (February 2009) *The effects of microwave emitted by cellular phones on ovarian follicles in rats*, Arch Gynecol Obstet. 2009 Feb 25. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Bas O et al**, (February 2009) *900 MHz electromagnetic field exposure affects qualitative and quantitative features of hippocampal pyramidal cells in the adult female rat*, Brain Res. 2009 Feb 20. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Schuz J et al**, (2009) *Risks for central nervous system diseases among mobile phone subscribers: a Danish retrospective cohort study*, PLoS ONE. 2009;4(2):e4389. Epub 2009 Feb 5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Stang A et al**, (January 2009) *Mobile phone use and risk of uveal melanoma: results of the risk factors for uveal melanoma case-control study*, J Natl Cancer Inst. 2009 Jan 21;101(2):120-3. Epub 2009 Jan 13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Sommer AM et al**, (January 2009) *Effects of Radiofrequency Electromagnetic Fields (UMTS) on Reproduction and Development of Mice: A Multi-generation Study*, Radiat Res. 2009 Jan;171(1):89-95 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Luukkonen J et al**, (December 2008) *Enhancement of chemically induced reactive oxygen species production and DNA damage in human SH-SY5Y neuroblastoma cells by 872MHz radiofrequency radiation*, Mutat Res. 2008 Dec 24. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Croft RJ et al**, (December 2008) *Mobile phones and brain tumours: a review of epidemiological research*, Australas Phys Eng Sci Med. 2008 Dec;31(4):255-67 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Prisco MG et al**, (December 2008) *Effects of GSM-modulated radiofrequency electromagnetic fields on mouse bone marrow cells*, Radiat Res. 2008 Dec;170(6):803-10 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Verschaeve L**, (November 2008) *Genetic damage in subjects exposed to radiofrequency radiation*, Mutat Res. 2008 Nov 27. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Luria R et al**, (November 2008) *Cognitive effects of radiation emitted by cellular phones: The influence of exposure side and time*, Bioelectromagnetics. 2008 Nov 17;30(3):198-204. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Tkalec M et al**, (November 2008) *Effects of radiofrequency electromagnetic fields on seed germination and root meristematic cells of Allium cepa L*, Mutat Res. 2008 Nov 5. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Nieto-Hernandez R et al**, (November 2008) *Can evidence change belief? Reported mobile phone sensitivity following individual feedback of an inability to discriminate active from sham signals*, J Psychosom Res. 2008 Nov;65(5):453-60 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Belyaev IY et al**, (October 2008) *Microwaves from UMTS/GSM mobile phones induce long-lasting inhibition of 53BP1/gamma-H2AX DNA repair foci in human lymphocytes*, Bioelectromagnetics. 2008 Oct 6. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Franzellitti S et al**, (October 2008) *HSP70 Expression in Human Trophoblast Cells Exposed to Different 1.8 GHz Mobile Phone Signals*, Rad. Res. 2008 Oct;170(4): 488-497 [[View Author's abstract conclusions](#)]

**P Sokolovic D et al**, (September 2008) *Melatonin Reduces Oxidative Stress Induced by Chronic Exposure of Microwave Radiation from Mobile Phones in Rat Brain*, J Radiat Res (Tokyo). 2008 Sep 29. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Agarwal A et al**, (September 2008) *Effects of radiofrequency electromagnetic waves (RF-EMW) from cellular phones on human ejaculated semen: an in vitro pilot study*, Fertil Steril. 2008 Sep 18. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Wiholm C et al**, (September 2008) *Mobile phone exposure and spatial memory*, Bioelectromagnetics. 2008 Sep 15. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Hoyto A et al**, (September 2008) *Radiofrequency radiation does not significantly affect ornithine decarboxylase activity, proliferation, or caspase-3 activity of fibroblasts in different physiological conditions*, Int J Radiat Biol. 2008 Sep;84(9):727-33 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Huang TQ et al**, (September 2008) *Molecular responses of Jurkat T-cells to 1763 MHz radiofrequency radiation*, Int J Radiat Biol. 2008 Sep;84(9):734-41 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Palumbo R et al**, (September 2008) *Exposure to 900 MHz Radiofrequency Radiation Induces Caspase 3 Activation in Proliferating Human Lymphocytes*, Radiat Res. 2008 Sep;170(3):327-34 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Vanderstraeten J, Verschaeve L**, (September 2008) *Gene and protein expression following exposure to radiofrequency fields from mobile phones*, Environ Health Perspect. 2008 Sep;116(9):1131-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Odaci E et al**, (August 2008) *Effects of prenatal exposure to a 900 Mhz electromagnetic field on the dentate gyrus of rats: a stereological and histopathological study*, Brain Res. 2008 Aug 16. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Lahkola A et al**, (August 2008) *Meningioma and mobile phone use--a collaborative case-control study in five North European countries*, Int J Epidemiol. 2008 Aug 2. [Epub ahead of print]Click here to read [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Andrzejak R et al**, (August 2008) *The influence of the call with a mobile phone on heart rate variability parameters in healthy volunteers*, Ind Health. 2008 Aug;46(4):409-17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Pavicic I, Trosic I**, (August 2008) *In vitro testing of cellular response to ultra high frequency electromagnetic field radiation*, Toxicol In Vitro. 2008 Aug;22(5):1344-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Zhang SZ et al**, (August 2008) *Effect of 1.8 GHz radiofrequency electromagnetic fields on gene expression of rat neurons*, Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi. 2008 Aug;26(8):449-52 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Wiert J et al**, (July 2008) *Analysis of RF exposure in the head tissues of children and adults*, Phys Med Biol. 2008 Jul 7;53(13):3681-95 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- N **Kim TH** *et al*, (June 2008) *Local exposure of 849 MHz and 1763 MHz radiofrequency radiation to mouse heads does not induce cell death or cell proliferation in brain*, *Exp Mol Med*. 2008 Jun 30;40(3):294-303 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Cardis E** *et al*, (June 2008) *Distribution of RF energy emitted by mobile phones in anatomical structures of the brain*, *Phys Med Biol*. 2008 Jun 7;53(11):2771-83. Epub 2008 May 1 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Abdus-salam A** *et al*, (June 2008) *Mobile phone radiation and the risk of cancer; a review*, *Afr J Med Med Sci*. 2008 Jun;37(2):107-18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Eberhardt JL** *et al*, (2008) *Blood-brain barrier permeability and nerve cell damage in rat brain 14 and 28 days after exposure to microwaves from GSM mobile phones*, *Electromagn Biol Med*. 2008;27(3):215-29 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Kim DW** *et al*, (2008) *Physiological effects of RF exposure on hypersensitive people by a cell phone*, *Conf Proc IEEE Eng Med Biol Soc*. 2008;2008:2322-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Mathur R**, (2008) *Effect of chronic intermittent exposure to AM radiofrequency field on responses to various types of noxious stimuli in growing rats*, *Electromagn Biol Med*. 2008;27(3):266-76 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Matronchik AY, Belyaev IY** *et al*, (2008) *Mechanism for combined action of microwaves and static magnetic field: slow non uniform rotation of charged nucleoid*, *Electromagn Biol Med*. 2008;27(4):340-54 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Nitby H** *et al*, (2008) *Radiofrequency and extremely low-frequency electromagnetic field effects on the blood-brain barrier*, *Electromagn Biol Med*. 2008;27(2):103-26 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Perentos N** *et al*, (2008) *The effect of GSM-like ELF radiation on the alpha band of the human resting EEG*, *Conf Proc IEEE Eng Med Biol Soc*. 2008;2008:5680-3 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Stovner LJ** *et al*, (2008) *Nocebo as headache trigger: evidence from a sham-controlled provocation study with RF fields*, *Acta Neurol Scand Suppl*. 2008;188:67-71 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Yan JG** *et al*, (2008) *Upregulation of specific mRNA levels in rat brain after cell phone exposure*, *Electromagn Biol Med*. 2008;27(2):147-54 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Vrijheid M** *et al*, (May 2008) *Recall bias in the assessment of exposure to mobile phones*, *J Expo Sci Environ Epidemiol*. 2008 May 21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Yao K** *et al*, (May 2008) *Electromagnetic noise inhibits radiofrequency radiation-induced DNA damage and reactive oxygen species increase in human lens epithelial cells*, *Mol Vis*. 2008 May 19;14:964-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Divan H** *et al*, (May 2008) *Prenatal and Postnatal Exposure to Cell Phone Use*, *Epidemiology*. 2008 May 7 [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P George DF et al**, (May 2008) *Non-thermal effects in the microwave induced unfolding of proteins observed by chaperone binding*, Bioelectromagnetics. 2008 May;29(4):324-30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Hardell L et al**, (May 2008) *Meta-analysis of long-term mobile phone use and the association with brain tumours*, Int J Oncol. 2008 May;32(5):1097-103 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Manti L et al**, (May 2008) *Effects of Modulated Microwave Radiation at Cellular Telephone Frequency (1.95 GHz) on X-Ray-Induced Chromosome Aberrations in Human Lymphocytes In Vitro*, Radiat Res. 2008 May;169(5):575-83 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Paglialonga A et al**, (May 2008) *Analysis of time-frequency fine structure of transiently evoked otoacoustic emissions to study the effects of exposure to GSM radiofrequency fields*, J Acoust Soc Am. 2008 May;123(5):3855 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Schwarz C et al**, (May 2008) *Radiofrequency electromagnetic fields (UMTS, 1,950 MHz) induce genotoxic effects in vitro in human fibroblasts but not in lymphocytes*, Int Arch Occup Environ Health. 2008 May;81(6):755-67 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Yao K et al**, (May 2008) *Effect of superposed electromagnetic noise on DNA damage of lens epithelial cells induced by microwave radiation*, Invest Ophthalmol Vis Sci. 2008 May;49(5):2009-15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Baste V et al**, (April 2008) *Radiofrequency electromagnetic fields; male infertility and sex ratio of offspring*, Eur J Epidemiol. 2008 Apr 16 [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Lerchl A et al**, (April 2008) *Effects of mobile phone electromagnetic fields at nonthermal SAR values on melatonin and body weight of Djungarian hamsters (Phodopus sungorus)*, J Pineal Res. 2008 Apr;44(3):267-72 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Cinel C et al**, (March 2008) *Exposure to Mobile Phone Electromagnetic Fields and Subjective Symptoms: A Double-Blind Study*, Psychosom Med. 2008 Mar 31 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Roosli M**, (March 2008) *Radiofrequency electromagnetic field exposure and non-specific symptoms of ill health: A systematic review*, Environ Res. 2008 Mar 20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Djeridane Y et al**, (March 2008) *Influence of Electromagnetic Fields Emitted by GSM-900 Cellular Telephones on the Circadian Patterns of Gonadal, Adrenal and Pituitary Hormones in Men*, Radiat Res. 2008 Mar;169(3):337-43 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Li M et al**, (March 2008) *Elevation of plasma corticosterone levels and hippocampal glucocorticoid receptor translocation in rats: a potential mechanism for cognition impairment following chronic low-power-density microwave exposure*, J Radiat Res (Tokyo). 2008 Mar;49(2):163-70 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Rao VS et al**, (March 2008) *Nonthermal effects of radiofrequency-field exposure on calcium dynamics in stem cell-derived neuronal cells: elucidation of calcium pathways*, Radiat Res. 2008 Mar;169(3):319-29 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- N Valbonesi P et al**, (March 2008) *Evaluation of HSP70 Expression and DNA Damage in Cells of a Human Trophoblast Cell Line Exposed to 1.8 GHz Amplitude-Modulated Radiofrequency Fields*, Radiat Res. 2008 Mar;169(3):270-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Sadetzki S et al**, (February 2008) *Cellular Phone Use and Risk of Benign and Malignant Parotid Gland Tumors A Nationwide Case-Control Study*, Am J Epidemiol. 2007 Dec 6 [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Takebayashi T et al**, (February 2008) *Mobile phone use, exposure to radiofrequency electromagnetic field, and brain tumour: a case-control study*, Br J Cancer. 2008 Feb 12;98(3):652-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Aly AA et al**, (February 2008) *Effects of 900-MHz radio frequencies on the chemotaxis of human neutrophils in vitro*, IEEE Trans Biomed Eng. 2008 Feb;55(2):795-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Hardell L, Sage C**, (February 2008) *Biological effects from electromagnetic field exposure and public exposure standards*, Biomed Pharmacother. 2008 Feb;62(2):104-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Karinen A et al**, (February 2008) *Mobile phone radiation might alter protein expression in human skin*, BMC Genomics. 2008 Feb 11;9:77 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Rezk AY et al**, (February 2008) *Fetal and neonatal responses following maternal exposure to mobile phones*, Saudi Med J. 2008 Feb;29(2):218-23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Kim JY et al**, (January 2008) *In vitro assessment of clastogenicity of mobile-phone radiation (835 MHz) using the alkaline comet assay and chromosomal aberration test*, Environ Toxicol. 2008 Jan 23 [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Garaj-Vrhovac V, Orescanin V**, (January 2008) *Assessment of DNA sensitivity in peripheral blood leukocytes after occupational exposure to microwave radiation: the alkaline comet assay and chromatid breakage assay*, Cell Biol Toxicol. 2008 Jan 23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Agarwal A et al**, (January 2008) *Effect of cell phone usage on semen analysis in men attending infertility clinic*, Fertil Steril. 2008 Jan;89(1):124-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Joubert V et al**, (January 2008) *Apoptosis is Induced by Radiofrequency Fields through the Caspase-Independent Mitochondrial Pathway in Cortical Neurons*, Radiat Res. 2008 Jan;169(1):38-45 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Kan P et al**, (January 2008) *Cellular phone use and brain tumor: a meta-analysis*, J Neurooncol. 2008 Jan;86(1):71-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Mazor R et al**, (January 2008) *Increased levels of numerical chromosome aberrations after in vitro exposure of human peripheral blood lymphocytes to radiofrequency electromagnetic fields for 72 hours*, Radiat Res. 2008 Jan;169(1):28-37 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Nitthy H et al**, (November 2007) *Cognitive impairment in rats after long-term exposure to GSM-900 mobile phone radiation*, Bioelectromagnetics. 2007 Nov 28 [Epub ahead of print] [[View Author's abstract conclusions](#)]

[\[View on Pubmed\]](#)

P **Roux D** et al, (November 2007) *High frequency (900 MHz) low amplitude (5 V m(-1)) electromagnetic field: a genuine environmental stimulus that affects transcription, translation, calcium and energy charge in tomato.*, *Planta*. 2007 Nov 20 [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Arnetz BB** et al, (2007) *The Effects of 884 MHz GSM Wireless Communication Signals on Self-reported Symptom and Sleep (EEG)- An Experimental Provocation Study*, *PIERS Online* Vol. 3 No. 7 2007 pp: 1148-1150 [[View Author's abstract conclusions](#)]

- **Hours M** et al, (October 2007) *Cell Phones and Risk of brain and acoustic nerve tumours: the French INTERPHONE case-control study*, *Rev Epidemiol Sante Publique*. 2007 Oct;55(5):321-32 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Yan JG** et al, (October 2007) *Effects of cellular phone emissions on sperm motility in rats*, *Fertil Steril*. 2007 Oct;88(4):957-64. Epub 2007 Jul 12 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Meral I** et al, (September 2007) *Effects of 900-MHz electromagnetic field emitted from cellular phone on brain oxidative stress and some vitamin levels of guinea pigs*, *Brain Res*. 2007 Sep 12;1169:120-4. Epub 2007 Jul 17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Hardell L** et al, (September 2007) *Long-term use of cellular phones and brain tumours - increased risk associated with use for > 10 years*, *Occup Environ Med*. 2007 Sep;64(9):626-32 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Oberto G** et al, (September 2007) *Carcinogenicity study of 217 Hz pulsed 900 MHz electromagnetic fields in Pim1 transgenic mice*, *Radiat Res*. 2007 Sep;168(3):316-26 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Friedman J** et al, (August 2007) *Mechanism of a short-term ERK activation by electromagnetic fields at mobile phone frequency*, *Biochem J*. 2007 Aug 1;405(3):559-68 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Guney M** et al, (August 2007) *900 MHz radiofrequency-induced histopathologic changes and oxidative stress in rat endometrium: protection by vitamins E and C*, *Toxicol Ind Health*. 2007 Aug;23(7):411-20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Hung CS** et al, (June 2007) *Mobile phone 'talk-mode' signal delays EEG-determined sleep onset*, *Neurosci Lett*. 2007 Jun 21;421(1):82-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Hoyto A** et al, (June 2007) *Ornithine decarboxylase activity is affected in primary astrocytes but not in secondary cell lines exposed to 872 MHz RF radiation*, *Int J Radiat Biol*. 2007 Jun;83(6):367-74 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Mild KH** et al, (2007) *Pooled analysis of two Swedish case-control studies on the use of mobile and cordless telephones and the risk of brain tumours diagnosed during 1997-2003*, *Int J Occup Saf Ergon*. 2007;13(1):63-71 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- N Fritzer G et al**, (May 2007) *Effects of short- and long-term pulsed radiofrequency electromagnetic fields on night sleep and cognitive functions in healthy subject*, *Bioelectromagnetics*. 2007 May;28(4):316-25 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Haarala C et al**, (May 2007) *Pulsed and continuous wave mobile phone exposure over left versus right hemisphere: Effects on human cognitive function*, *Bioelectromagnetics* 2007 May;28(4):289-95 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Krause CM et al**, (May 2007) *Effects of pulsed and continuous wave 902 MHz mobile phone exposure on brain oscillatory activity during cognitive processing*, *Bioelectromagnetics* 2007 May;28(4):296-308 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Mortazavi SM et al**, (May 2007) *Prevalence of subjective poor health symptoms associated with exposure to electromagnetic fields among university students*, *Bioelectromagnetics*. 2007 May;28(4):326-30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Oftedal G et al**, (May 2007) *Mobile phone headache: a double blind, sham-controlled provocation study*, *Cephalalgia*. 2007 May;27(5):447-55 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Lahkola A et al**, (April 2007) *Mobile phone use and risk of glioma in 5 North European countries*, *Int J Cancer*. 2007 Apr 15;120(8):1769-75 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Hardell L et al**, (April 2007) *Use of cellular and cordless telephones and risk of testicular cancer*, *Int J Androl*. 2007 Apr;30(2):115-22 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Klæboe L et al**, (April 2007) *Use of mobile phones in Norway and risk of intracranial tumours*, *Eur J Cancer Prev*. 2007 Apr;16(2):158-64 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Panagopoulos D et al**, (January 2007) *Cell death induced by GSM 900-MHz and DCS 1800-MHz mobile telephony radiation*, *Mutat Res*. 2007 Jan 10;626(1-2):69-78 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Huss A et al**, (January 2007) *Source of funding and results of studies of health effects of mobile phone use: systematic review of experimental studies*, *Environ Health Perspect*. 2007 Jan;115(1):1-4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Ribeiroa E et al**, (January 2007) *Effects of subchronic exposure to radio frequency from a conventional cellular telephone on testicular function in adult rats*, *J Urol* 177(1): 395-399 [[View Author's abstract conclusions](#)]
- N Schuz J et al**, (December 2006) *Cellular telephone use and cancer risk: update of a nationwide Danish cohort*, *J Natl Cancer Inst*. 2006 Dec 6;98(23):1707-13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Ferreira A et al**, (December 2006) *Ultra high frequency-electromagnetic field irradiation during pregnancy leads to an increase in erythrocytes micronuclei incidence in rat offspring*, *Life Sci* 2006 Dec 3;80(1):43-50 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Takebayashi T et al**, (December 2006) *Mobile phone use and acoustic neuroma risk in Japan*, *Occup Environ Med*. 2006 Dec;63(12):802-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Oral B et al**, (November 2006) *Endometrial apoptosis induced by a 900-MHz mobile phone: preventive effects of vitamins E and C*, *Adv Ther.* 2006 Nov-Dec;23(6):957-73 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Hardell L et al**, (October 2006) *Tumour risk associated with use of cellular telephones or cordless desktop telephones*, *World J Surg Oncol* 2006 Oct 11;4:74 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Eroglu O et al**, (October 2006) *Effects of electromagnetic radiation from a cellular phone on human sperm motility: an in vitro study*, *Arch Med Res* 37(7):840-3 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Lonn S et al**, (October 2006) *Mobile phone use and risk of parotid gland tumor*, *Am J Epidemiol.* 2006 Oct 1;164(7):637-43. Epub 2006 Jul 3 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Hardell L et al**, (September 2006) *Pooled analysis of two case-control studies on use of cellular and cordless telephones and the risk for malignant brain tumours diagnosed in 1997-2003*, *Int Arch Occup Environ Health.* 2006 Sep;79(8):630-9. Epub 2006 Mar 16 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Lantow M et al**, (September 2006) *Comparative study of cell cycle kinetics and induction of apoptosis or necrosis after exposure of human mono mac 6 cells to radiofrequency radiation*, *Radiat Res.* 2006 Sep;166(3):539-43 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Nylund R, Leszczynski D**, (September 2006) *Mobile phone radiation causes changes in gene and protein expression in human endothelial cell lines and the response seems to be genome- and proteome-dependent*, *Proteomics* 2006 Sep;6(17):4769-80 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Remondini D et al**, (September 2006) *Gene expression changes in human cells after exposure to mobile phone microwaves*, *Proteomics* 2006 Sep;6(17):4745-54 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Aalto S et al**, (July 2006) *Mobile phone affects cerebral blood flow in humans*, *J Cereb Blood Flow Metab.* 2006 Jul;26(7):885-90 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Kuhn S, Kuster N**, (July 2006) *Development of Procedures for the EMF Exposure Evaluation of Wireless Devices in Home and Office Environments Supplement 1: Close-to-Body and Base Station Wireless Data Communication Devices*, Foundation for Research on Information Technologies in Society, ETH Zurich, Switzerland [[View Author's abstract conclusions](#)]

**N Schuz J et al**, (July 2006) *Radiofrequency electromagnetic fields emitted from base stations of DECT cordless phones and the risk of glioma and meningioma (Interphone Study Group, Germany)*, *Radiat Res.* 2006 Jul;166(1 Pt 1):116-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Bachmann M et al**, (2006) *Integration of differences in EEG Analysis Reveals Changes in Human EEG Caused by Microwave*, *Conf Proc IEEE Eng Med Biol Soc.* 2006;1:1597-600 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**- de Salles AA et al**, (2006) *Electromagnetic absorption in the head of adults and children due to mobile phone operation close to the head*, *Electromagn Biol Med.* 2006;25(4):349-60 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Hondou T et al**, (2006) *Passive Exposure to Mobile Phones: Enhancement of Intensity by Reflection*, J. Phys. Soc. Jpn. 75 (2006) 084801 [[View Author's abstract conclusions](#)]
- P **Koylu H et al**, (June 2006) *Melatonin modulates 900 Mhz microwave-induced lipid peroxidation changes in rat brain*, Toxicol Ind Health 2006 Jun;22(5):211-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Krause CM et al**, (June 2006) *Mobile phone effects on children's event-related oscillatory EEG during an auditory memory task*, Int J Radiat Biol 2006 Jun;82(6):443-50 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Oktay MF, Dasdag S**, (2006) *Effects of intensive and moderate cellular phone use on hearing function*, Electromagn Biol Med. 2006;25(1):13-21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Belyaev IY et al**, (May 2006) *Exposure of rat brain to 915 MHz GSM microwaves induces changes in gene expression but not double stranded DNA breaks or effects on chromatin conformation*, Bioelectromagnetics. 2006 May;27(4):295-306 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Hepworth SJ et al**, (April 2006) *Mobile phone use and risk of glioma in adults: case-control study*, BMJ. 2006 Apr 15;332(7546):883-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Rubin GJ et al**, (April 2006) *Are some people sensitive to mobile phone signals? Within participants double blind randomised provocation study*, BMJ. 2006 Apr 15;332(7546):886-91 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Papageorgiou CC et al**, (April 2006) *Acute mobile phone effects on pre-attentive operation*, Neurosci Lett. 2006 Apr 10-17;397(1-2):99-103 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Vrijheid M et al**, (April 2006) *Validation of short term recall of mobile phone use for the Interphone study*, Occup Environ Med. 2006 Apr;63(4):237-43 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Wilen J et al**, (April 2006) *Psychophysiological tests and provocation of subjects with mobile phone related symptoms*, Bioelectromagnetics 2006 Apr;27(3):204-14 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Schuz J et al**, (March 2006) *Cellular phones, cordless phones, and the risks of glioma and meningioma (Interphone Study Group, Germany)*, Am J Epidemiol. 2006 Mar 15;163(6):512-20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Esen F, Esen H**, (March 2006) *Effect of electromagnetic fields emitted by cellular phones on the latency of evoked electrodermal activity*, Int J Neurosci. 2006 Mar;116(3):321-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Hardell L et al**, (February 2006) *Case-control study of the association between the use of cellular and cordless telephones and malignant brain tumors diagnosed during 2000-2003*, Environ Res. 2006 Feb;100(2):232-41 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Schoemaker MJ et al**, (October 2005) *Mobile phone use and risk of acoustic neuroma: results of the Interphone case-control study in five North European countries*, Br J Cancer. 2005 Oct 3;93(7):842-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Nikolova T et al**, (October 2005) *Electromagnetic fields affect transcript levels of apoptosis-related genes in embryonic stem cell-derived neural progenitor cells*, FASEB J. 2005 Oct;19(12):1686-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Fejes I et al**, (September 2005) *Is there a relationship between cell phone use and semen quality?*, Arch Androl. 2005 Sep-Oct;51(5):385-93 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Hardell L et al**, (September 2005) *Use of cellular or cordless telephones and the risk for non-Hodgkin's lymphoma*, Int Arch Occup Environ Health. 2005 Sep;78(8):625-32 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Markova E et al**, (September 2005) *Microwaves from GSM mobile telephones affect 53BP1 and gamma-H2AX foci in human lymphocytes from hypersensitive and healthy persons*, Environ Health Perspect. 2005 Sep;113(9):1172-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Wang Q et al**, (September 2005) *Effect of 900 MHz electromagnetic fields on the expression of GABA receptor of cerebral cortical neurons in postnatal rats*, Wei Sheng Yan Jiu. 2005 Sep;34(5):546-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Ozguner F et al**, (August 2005) *Comparative analysis of the protective effects of melatonin and caffeic acid phenethyl ester (CAPE) on mobile phone-induced renal impairment in rat*, Mol Cell Biochem. 2005 Aug;276(1-2):31-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Preece AW et al**, (2005) *Effect of 902 MHz mobile phone transmission on cognitive function in children*, Bioelectromagnetics Suppl 7 S138-43 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Fernandez C et al**, (July 2005) *Comparison of Electromagnetic Absorption Characteristics in the Head of Adult and a Children for 1800 MHz Mobile Phones*, Conference Proceeding from the 2005 SBMO/IEEE MTT-S International Conference on Microwave and Optoelectronics [[View Author's abstract conclusions](#)]

P **Oktem F et al**, (July 2005) *Oxidative damage in the kidney induced by 900-MHz-emitted mobile phone: protection by melatonin*, Arch Med Res. 2005 Jul-Aug;36(4):350-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Hardell L et al**, (2005) *Case-control study on cellular and cordless telephones and the risk for acoustic neuroma or meningioma in patients diagnosed 2000-2003*, Neuroepidemiology. 2005;25(3):120-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Diem E et al**, (June 2005) *Non-thermal DNA breakage by mobile-phone radiation (1800 MHz) in human fibroblasts and in transformed GFSH-R17 rat granulosa cells in vitro*, Mutat Res. 2005 Jun 6;583(2):178-83 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Christ A, Kuster N**, (2005) *Differences in RF energy absorption in the heads of adults and children*, Bioelectromagnetics. 2005;Suppl 7:S31-44 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Hardell L et al**, (June 2005) *Use of cellular telephones and brain tumour risk in urban and rural areas*, Occup Environ Med. 2005 Jun;62(6):390-4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Meo SA, Al-Drees AM**, (2005) *Mobile phone related-hazards and subjective hearing and vision symptoms in the Saudi population*, Int J Occup Med Environ Health. 2005;18(1):53-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Garcia Callejo FJ et al**, (May 2005) *Hearing level and intensive use of mobile phones*, Acta Otorrinolaringol Esp. 2005 May;56(5):187-91 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Lahkola A et al**, (May 2005) *Selection bias due to differential participation in a case-control study of mobile phone use and brain tumors*, Ann Epidemiol. 2005 May;15(5):321-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Christensen HC et al**, (April 2005) *Cellular telephones and risk for brain tumors: a population-based, incident case-control study*, Neurology. 2005 Apr 12;64(7):1189-95 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Belyaev IY et al**, (April 2005) *915 MHz microwaves and 50 Hz magnetic field affect chromatin conformation and 53BP1 foci in human lymphocytes from hypersensitive and healthy persons*, Bioelectromagnetics. 2005 Apr;26(3):173-84 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Lonn S et al**, (March 2005) *Long-term mobile phone use and brain tumor risk*, Am J Epidemiol. 2005 Mar 15;161(6):526-35 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Balik HH et al**, (March 2005) *Some ocular symptoms and sensations experienced by long term users of mobile phones*, Pathol Biol (Paris). 2005 Mar;53(2):88-91 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Wang Q et al**, (March 2005) *Effect of 900Mhz electromagnetic fields on energy metabolism in postnatal rat cerebral cortical neurons*, Wei Sheng Yan Jiu. 2005 Mar;34(2):155-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Bianchi A, Phillips JG**, (February 2005) *Psychological predictors of problem mobile phone use*, Cyberpsychol Behav. 2005 Feb;8(1):39-51 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Huber R et al**, (February 2005) *Exposure to pulse-modulated radio frequency electromagnetic fields affects regional cerebral blood flow*, Eur J Neurosci. 2005 Feb;21(4):1000-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Leena K et al**, (February 2005) *Intensity of mobile phone use and health compromising behaviours--how is information and communication technology connected to health-related lifestyle in adolescence?*, J Adolesc. 2005 Feb;28(1):35-47 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Lonn S et al**, (November 2004) *Mobile phone use and the risk of acoustic neuroma*, Epidemiology. 2004 Nov;15(6):653-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Lai H**, (October 2004) *Interaction of microwaves and a temporally incoherent magnetic field on spatial learning in the rat*, Physiol Behav. 2004 Oct 15;82(5):785-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P Panagopoulos D et al**, (2004) *Effect of GSM 900-MHz Mobile Phone radiation on the reproductive capacity of Drosophila melanogaster*, Electromagn Biol Med 23(1): 29-43 [[View Author's abstract conclusions](#)]
- P Ozguner F et al**, (September 2004) *Prevention of mobile phone induced skin tissue changes by melatonin in rat: an experimental study*, Toxicol Ind Health. 2004 Sep;20(6-10):133-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Hardell L et al**, (August 2004) *No association between the use of cellular or cordless telephones and salivary gland tumours*, Occup Environ Med. 2004 Aug;61(8):675-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Wang Q et al**, (July 2004) *Effect of 900MHz electromagnetic fields on energy metabolism of cerebral cortical neurons in postnatal rat*, Wei Sheng Yan Jiu. 2004 Jul;33(4):428-9, 432 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Al-Khlaiwi T, Meo SA**, (June 2004) *Association of mobile phone radiation with fatigue, headache, dizziness, tension and sleep disturbance in Saudi population*, Saudi Med J. 2004 Jun;25(6):732-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Hutter HP et al**, (2004) *Public perception of risk concerning celltowers and mobile phones*, Soz Praventivmed. 2004;49(1):62-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Czyz J et al**, (May 2004) *High frequency electromagnetic fields (GSM signals) affect gene expression levels in tumor suppressor p53-deficient embryonic stem cells*, Bioelectromagnetics. 2004 May;25(4):296-307 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Samkange-Zeeb F et al**, (May 2004) *Validation of self-reported cellular phone use*, J Expo Anal Environ Epidemiol. 2004 May;14(3):245-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Sarimov R et al**, (2004) *Nonthermal GSM Microwaves Affect Chromatin Conformation in Human Lymphocytes Similar to Heat Shock*, IEEE Trans Plasma Sci 2004; 32 (4): 1600 - 1608 [[View Author's abstract conclusions](#)]
- N Christensen HC et al**, (February 2004) *Cellular telephone use and risk of acoustic neuroma*, Am J Epidemiol. 2004 Feb 1;159(3):277-83 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Lonn S et al**, (January 2004) *Incidence trends of adult primary intracerebral tumors in four Nordic countries*, Int J Cancer. 2004 Jan 20;108(3):450-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Johansen C**, (2004) *Electromagnetic fields and health effects--epidemiologic studies of cancer, diseases of the central nervous system and arrhythmia-related heart disease*, Scand J Work Environ Health. 2004;30 Suppl 1:1-30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P D'Costa H et al**, (December 2003) *Human brain wave activity during exposure to radiofrequency field emissions from mobile phones*, Australas Phys Eng Sci Med. 2003 Dec;26(4):162-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Grigor'ev IuG**, (September 2003) *Biological effects of mobile phone electromagnetic field on chick embryo (risk assessment using the mortality rate)*, Radiats Biol Radioecol. 2003 Sep-Oct;43(5):541-3 [[View Author's](#)]

[abstract conclusions](#)] [[View on Pubmed](#)]

**P Kramarenko AV, Tan U**, (July 2003) *Effects of high-frequency electromagnetic fields on human EEG: a brain mapping study*, Int J Neurosci. 2003 Jul;113(7):1007-19 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Cook A et al**, (June 2003) *Cellular telephone use and time trends for brain, head and neck tumours*, N Z Med J. 2003 Jun 6;116(1175):U457 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Salford L et al**, (June 2003) *Nerve cell damage in mammalian brain after exposure to microwaves from GSM mobile phones*, Environ Health Perspect 2003 Jun;111(7):881-3; discussion A408 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P de Pomerai DI et al**, (May 2003) *Microwave radiation can alter protein conformation without bulk heating*, FEBS Lett. 2003 May 22;543(1-3):93-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Huber R et al**, (May 2003) *Radio frequency electromagnetic field exposure in humans: Estimation of SAR distribution in the brain, effects on sleep and heart rate*, Bioelectromagnetics. 2003 May;24(4):262-76 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Warren HG et al**, (April 2003) *Cellular telephone use and risk of intratemporal facial nerve tumor*, Laryngoscope. 2003 Apr;113(4):663-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Wilen J et al**, (April 2003) *Subjective symptoms among mobile phone users--a consequence of absorption of radiofrequency fields?*, Bioelectromagnetics. 2003 Apr;24(3):152-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Hardell L et al**, (March 2003) *Vestibular schwannoma, tinnitus and cellular telephones*, Neuroepidemiology 2003 Mar-Apr;22(2):124-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Hocking B, Westerman R**, (March 2003) *Neurological effects of radiofrequency radiation*, Occup Med 2003 Mar;53(2):123-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Strayer D et al**, (March 2003) *Cell phone-induced failures of visual attention during simulated driving*, J Exp Psychol Appl Mar;9(1):23-32 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Hardell L et al**, (February 2003) *Further aspects on cellular and cordless telephones and brain tumours*, Int J Oncol. 2003 Feb;22(2):399-407 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Huber R et al**, (December 2002) *Electromagnetic fields, such as those from mobile phones, alter regional cerebral blood flow and sleep and waking EEG*, J Sleep Res 2002 Dec;11(4):289-95 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Beason R, Semm P**, (November 2002) *Responses of neurons to an amplitude modulated microwave stimulus*, Neurosci Lett 2002 Nov 29;333(3):175-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Burch JB et al**, (November 2002) *Melatonin metabolite excretion among cellular telephone users*, Int J Radiat Biol. 2002 Nov;78(11):1029-36 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P Hocking B, Westerman R**, (October 2002) *Neurological changes induced by a mobile phone*, *Occup Med (Lond)*. 2002 Oct;52(7):413-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Hardell L et al**, (August 2002) *Cellular and cordless telephones and the risk for brain tumours*, *Eur J Cancer Prev*. 2002 Aug;11(4):377-86 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Ghandi O, Kang G**, (May 2002) *Some present problems and a proposed experimental phantom for SAR compliance testing of cellular telephones at 835 and 1900 MHz*, *Phys. Med. Biol.* 47 1501 18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Auvinen A et al**, (May 2002) *Brain tumors and salivary gland cancers among cellular telephone users*, *Epidemiology*. 2002 May;13(3):356-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Leszczynski D et al**, (May 2002) *Non-thermal activation of the hsp27/p38MAPK stress pathway by mobile phone radiation in human endothelial cells: molecular mechanism for cancer- and blood-brain barrier-related effects*, *Differentiation*. 2002 May;70(2-3):120-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Muscat JE et al**, (April 2002) *Handheld cellular telephones and risk of acoustic neuroma*, *Neurology*. 2002 Apr 23;58(8):1304-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Johansen C et al**, (February 2002) *Mobile phones and malignant melanoma of the eye*, *Br J Cancer*. 2002 Feb 1;86(3):348-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Edelstyn N, Oldershaw A**, (January 2002) *The acute effects of exposure to the electromagnetic field emitted by mobile phones on human attention*, *Neuroreport*. 2002 Jan 21;13(1):119-21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P D'Ambrosio G et al**, (January 2002) *Cytogenetic damage in human lymphocytes following GSM phase modulated microwave exposure*, *Bioelectromagnetics*. 2002 Jan;23(1):7-13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Hardell L et al**, (December 2001) *Ionizing radiation, cellular telephones and the risk for brain tumours*, *Eur J Cancer Prev*. 2001 Dec;10(6):523-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Hocking B, Westerman R**, (September 2001) *Neurological abnormalities associated with CDMA exposure*, *Occup Med (Lond)*. 2001 Sep;51(6):410-3 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Tattersall JE et al**, (June 2001) *Effects of low intensity radiofrequency electromagnetic fields on electrical activity in rat hippocampal slices*, *Brain Res*. 2001 Jun 15;904(1):43-53 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Johansen C et al**, (February 2001) *Cellular telephones and cancer--a nationwide cohort study in Denmark*, *J Natl Cancer Inst*. 2001 Feb 7;93(3):203-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Sandstrom M et al**, (February 2001) *Mobile phone use and subjective symptoms. Comparison of symptoms experienced by users of analogue and digital mobile phones*, *Occup Med (Lond)*. 2001 Feb;51(1):25-35 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- N Inskip PD et al**, (January 2001) *Cellular-telephone use and brain tumors*, N Engl J Med. 2001 Jan 11;344(2):79-86 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Stang A et al**, (January 2001) *The possible role of radiofrequency radiation in the development of uveal melanoma*, Epidemiology. 2001 Jan;12(1):7-12 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Muscat JE et al**, (December 2000) *Handheld cellular telephone use and risk of brain cancer*, JAMA. 2000 Dec 20;284(23):3001-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Krause CM et al**, (December 2000) *Effects of electromagnetic fields emitted by cellular phones on the electroencephalogram during a visual working memory task*, Int J Radiat Biol. 2000 Dec;76(12):1659-67 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Chia SE et al**, (November 2000) *Prevalence of headache among handheld cellular telephone users in Singapore: a community study*, Environ Health Perspect. 2000 Nov;108(11):1059-62 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Huber R et al**, (October 2000) *Exposure to pulsed high-frequency electromagnetic field during waking affects human sleep EEG*, Neuroreport. 2000 Oct 20;11(15):3321-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Grajewski B et al**, (October 2000) *Semen quality and hormone levels among radiofrequency heater operators*, J Occup Environ Med. 2000 Oct;42(10):993-1005 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Richter E et al**, (July 2000) *Cancer in radar technicians exposed to radiofrequency/microwave radiation: sentinel episodes*, Int J Occup Environ Health. 2000 Jul-Sep;6(3):187-93 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Koivisto M et al**, (June 2000) *The effects of electromagnetic field emitted by GSM phones on working memory*, Neuroreport. 2000 Jun 5;11(8):1641-3 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Hardell L et al**, (May 2000) *Case-control study on radiology work, medical x-ray investigations, and use of cellular telephones as risk factors for brain tumors*, MedGenMed. 2000 May 4;2(2):E2 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Oftedal G et al**, (May 2000) *Symptoms experienced in connection with mobile phone use*, Occup Med (Lond). 2000 May;50(4):237-45 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Cao Z et al**, (March 2000) *Effects of electromagnetic radiation from handsets of cellular telephone on neurobehavioral function*, Wei Sheng Yan Jiu. 2000 Mar 30;29(2):102-3 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Krause CM et al**, (March 2000) *Effects of electromagnetic field emitted by cellular phones on the EEG during a memory task*, Neuroreport. 2000 Mar 20;11(4):761-4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Morgan RW et al**, (March 2000) *Radiofrequency exposure and mortality from cancer of the brain and lymphatic/hematopoietic systems*, Epidemiology. 2000 Mar;11(2):118-27 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P Koivisto M et al**, (February 2000) *Effects of 902 MHz electromagnetic field emitted by cellular telephones on response times in humans*, Neuroreport. 2000 Feb 7;11(2):413-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Wang B, Lai H**, (January 2000) *Acute exposure to pulsed 2450-MHz microwaves affects water-maze performance of rats*, Bioelectromagnetics. 2000 Jan;21(1):52-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Borbely AA et al**, (November 1999) *Pulsed high-frequency electromagnetic field affects human sleep and sleep electroencephalogram*, Neurosci Lett. 1999 Nov 19;275(3):207-10 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Hardell L et al**, (July 1999) *Use of cellular telephones and the risk for brain tumours: A case-control study*, Int J Oncol. 1999 Jul;15(1):113-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Velizarov S et al**, (February 1999) *The effects of radiofrequency fields on cell proliferation are non-thermal*, Bioelectrochem Bioenerg. 1999 Feb;48(1):177-80 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Hardell L et al**, (December 1998) *Case-control study on risk factors for testicular cancer*, Int J Oncol. 1998 Dec;13(6):1299-303 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Eulitz C et al**, (October 1998) *Mobile phones modulate response patterns of human brain activity*, Neuroreport. 1998 Oct 5;9(14):3229-32 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Freude G et al**, (1998) *Effects of microwaves emitted by cellular phones on human slow brain potentials*, Bioelectromagnetics. 1998;19(6):384-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Haugsdal B et al**, (1998) *Comparison of symptoms experienced by users of analogue and digital mobile phones: a Swedish-Norwegian epidemiological study*, Arbetslivsrapport 23: 1998 [[View Author's abstract conclusions](#)]
- **Hocking B et al**, (1988) *Health aspects of radio-frequency radiation accidents. Part I: Assessment of health after a radio-frequency radiation accident*, J Microw Power Electromagn Energy. 1988;23(2):67-74 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Duan L et al**, (March 1998) *Observations of changes in neurobehavioral functions in workers exposed to high-frequency radiation*, Zhonghua Yu Fang Yi Xue Za Zhi. 1998 Mar;32(2):109-11 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Frey AH**, (March 1998) *Headaches from cellular telephones: are they real and what are the implications?*, Environ Health Perspect. 1998 Mar;106(3):101-3 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Donnellan M et al**, (July 1997) *Effects of exposure to electromagnetic radiation at 835 MHz on growth, morphology and secretory characteristics of a mast cell analogue, RBL-2H3*, Cell Biol Int. 1997 Jul;21(7):427-39 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P French PW et al**, (June 1997) *Electromagnetic radiation at 835 MHz changes the morphology and inhibits proliferation of a human astrocytoma cell line*, Bioelectrochemistry and Bioenergetics, June 1997;43(1):13-18

[\[View Author's abstract conclusions\]](#)

- **Jauchem JR**, (1997) *Exposure to extremely-low-frequency electromagnetic fields and radiofrequency radiation: cardiovascular effects in humans*, Int Arch Occup Environ Health. 1997;70(1):9-21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Singh B, Bate LA**, (November 1996) *Responses of pulmonary intravascular macrophages to 915-MHz microwave radiation: ultrastructural and cytochemical study*, Anat Rec. 1996 Nov;246(3):343-55 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Dobson J, St. Pierre T**, (October 1996) *Application of the ferromagnetic transduction model to D.C. and pulsed magnetic fields: effects on epileptogenic tissue and implications for cellular phone safety*, Biochem Biophys Res Commun 1996 Oct 23;227(3):718-23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Ghandi O, Kang G**, (1996) *Effect of the head size on SAR for mobile telephones at 835 and 1900MHz*, Bioelectromagnetics Society 23rd Annual Meeting. St. Paul, Minnesota, USA, June 10-14, 2001, p. 52 [[View Author's abstract conclusions](#)]

- **Funch DP et al**, (May 1996) *Utility of telephone company records for epidemiologic studies of cellular telephones*, Epidemiology. 1996 May;7(3):299-302 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Rothman KJ et al**, (May 1996) *Overall mortality of cellular telephone customers*, Epidemiology. 1996 May;7(3):303-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Szmigielski S**, (February 1996) *Cancer morbidity in subjects occupationally exposed to high frequency (radiofrequency and microwave) electromagnetic radiation*, Sci Total Environ. 1996 Feb 2;180(1):9-17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Reiser H et al**, (October 1995) *The influence of electromagnetic fields on human brain activity*, Eur J Med Res. 1995 Oct 16;1(1):27-32 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Goldsmith JR**, (January 1995) *Epidemiologic Evidence of Radiofrequency Radiation (Microwave) Effects on Health in Military, Broadcasting, and Occupational Studies*, Int J Occup Environ Health. 1995 Jan;1(1):47-57 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Zhao Z et al**, (July 1994) *The effects of radiofrequency (< 30 MHz) radiation in humans*, Rev Environ Health. 1994 Jul-Dec;10(3-4):213-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Lai H et al**, (1994) *Microwave irradiation affects radial-arm maze performance in the rat*, Bioelectromagnetics. 1994;15(2):95-104 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Ouellet-Hellstrom R, Stewart WF**, (November 1993) *Miscarriages among female physical therapists who report using radio- and microwave-frequency electromagnetic radiation*, Am J Epidemiol. 1993 Nov 15;138(10):775-86 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Lai H et al**, (May 1989) *Low-level microwave irradiation and central cholinergic systems*, Pharmacol Biochem Behav. 1989 May;33(1):131-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Szyjkowska A et al**, (October 2005) *Subjective symptoms related to mobile phone use--a pilot study*, Pol Merkur Lekarski. 2005 Oct;19(112):529-32 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

## Mobile Phone Masts

[[Back to the top](#)]

- **Lahham A et al**, (August 2015) *Public Exposure from Indoor Radiofrequency Radiation in the City of Hebron, West Bank-Palestine*, Health Phys. 2015 Aug;109(2):117-21. doi: 10.1097/HP.0000000000000296 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Redmayne M**, (June 2015) *International policy and advisory response regarding children's exposure to radio frequency electromagnetic fields (RF-EMF)*, Electromagn Biol Med. 2015 Jun 19:1-9. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Balmori A**, (June 2015) *Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation*, Sci Total Environ. 2015 Jun 15;518-519:58-60. doi: 10.1016/j.scitotenv.2015.02.077. Epub 2015 Mar 4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Hareuveny R et al**, (June 2015) *Occupational exposures to radiofrequency fields: results of an Israeli national survey*, J Radiol Prot. 2015 Jun;35(2):429-45. doi: 10.1088/0952-4746/35/2/429. Epub 2015 May 15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Osei S et al**, (May 2015) *Assessment of levels of occupational exposure to workers in radiofrequency fields of two television stations in Accra, Ghana*, Radiat Prot Dosimetry. 2015 May 15. pii: ncv326. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Zhou LY et al**, (April 2014) *Epidemiological investigation of risk factors of the pregnant women with early spontaneous abortion in Beijing*, Chin J Integr Med. 2015 Apr 14. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Gryz K et al**, (March 2015) *The Role of the Location of Personal Exposimeters on the Human Body in Their Use for Assessing Exposure to the Electromagnetic Field in the Radiofrequency Range 98-2450 MHz and Compliance Analysis: Evaluation by Virtual Measurements*, Biomed Res Int. 2015;2015:272460. doi: 10.1155/2015/272460. Epub 2015 Mar 24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Tomitsch J, Dechant E et al**, (January 2015) *Exposure to electromagnetic fields in households--trends from 2006 to 2012*, Bioelectromagnetics. 2015 Jan;36(1):77-85. doi: 10.1002/bem.21887. Epub 2014 Nov 24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Kim BC et al**, (September 2014) *Evaluation of radiofrequency exposure levels from multiple wireless installations in population dense areas in Korea*, Bioelectromagnetics. 2014 Sep 4. doi: 10.1002/bem.21874. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Gandhi G et al**, (July 2014) *A cross-sectional case control study on genetic damage in individuals residing in the vicinity of a mobile phone base station*, Electromagn Biol Med. 2014 Jul 9:1-11. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Pelletier A et al**, (June 2014) *Does exposure to a radiofrequency electromagnetic field modify thermal preference in juvenile rats?*, PLoS One. 2014 Jun 6;9(6):e99007. doi: 10.1371/journal.pone.0099007. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Bolte JF, Eikelboom T**, (November 2012) *Personal radiofrequency electromagnetic field measurements in the Netherlands: Exposure level and variability for everyday activities, times of day and types of area*, Environ Int. 2012 Nov 1;48:133-42. Epub 2012 Aug 18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Li CY et al**, (October 2012) *A population-based case-control study of radiofrequency exposure in relation to childhood neoplasm*, Sci Total Environ. 2012 Oct 1;435-436:472-8. Epub 2012 Aug 9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Pilla AA**, (September 2012) *Electromagnetic fields instantaneously modulate nitric oxide signaling in challenged biological systems*, Biochem Biophys Res Commun. 2012 Sep 28;426(3):330-3. doi: 10.1016/j.bbrc.2012.08.078. Epub 2012 Aug 24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Vijayalaxmi, Prihoda TJ**, (September 2012) *Genetic Damage in Human Cells Exposed to Non-ionizing Radiofrequency Fields: A Meta-Analysis of the Data from 88 Publications (1990-2011)*, Mutat Res. 2012 Sep 27. pii: S1383-5718(12)00286-0. doi: 10.1016/j.mrgentox.2012.09.007. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Repacholi M et al**, (July 2012) *Scientific basis for the Soviet and Russian radiofrequency standards for the general public*, Bioelectromagnetics. 2012 Jul 2. doi: 10.1002/bem.21742. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Bortkiewicz A et al**, (March 2012) *Subjective complaints of people living near mobile phone base stations in Poland*, Int J Occup Med Environ Health. 2012 Mar;25(1):31-40. Epub 2012 Jan 5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Hassig M et al**, (February 2012) *Increased occurrence of nuclear cataract in the calf after erection of a mobile phone base station*, Schweiz Arch Tierheilkd. 2012 Feb;154(2):82-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Deatanyah P et al**, (January 2012) *Assessment of radiofrequency radiation within the vicinity of some gsm base stations in ghana*, Radiat Prot Dosimetry. 2012 Jan 18. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Wallace D et al**, (January 2012) *Cognitive and physiological responses in humans exposed to a TETRA base station signal in relation to perceived electromagnetic hypersensitivity*, Bioelectromagnetics. 2012 Jan;33(1):23-39. doi: 10.1002/bem.20681. Epub 2011 Jun 6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Rufo MM et al**, (December 2011) *Exposure to high-frequency electromagnetic fields (100 kHz-2 GHz) in Extremadura (Spain)*, Health Phys. 2011 Dec;101(6):739-45 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Sirav B, Seyhan N**, (December 2011) *Effects of radiofrequency radiation exposure on blood-brain barrier permeability in male and female rats*, Electromagn Biol Med. 2011 Dec;30(4):253-60 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Eskander EF** *et al*, (November 2011) *How does long term exposure to base stations and mobile phones affect human hormone profiles?*, Clin Biochem. 2011 Nov 27. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Boursianis A** *et al*, (October 2011) *Measurements for assessing the exposure from 3G femtocells*, Radiat Prot Dosimetry. 2011 Oct 13. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Breckenkamp J** *et al*, (October 2011) *Residential characteristics and radiofrequency electromagnetic field exposures from bedroom measurements in Germany*, Radiat Environ Biophys. 2011 Oct 1. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Tomitsch J, Dechant E**, (August 2011) *Trends in residential exposure to electromagnetic fields from 2006 to 2009*, Radiat Prot Dosimetry. 2011 Aug 8. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Dode AC** *et al*, (July 2011) *Mortality by neoplasia and cellular telephone base stations in the Belo Horizonte municipality, Minas Gerais state, Brazil*, Sci Total Environ. 2011 Jul 7. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **van Deventer E** *et al*, (July 2011) *WHO research agenda for radiofrequency fields*, Bioelectromagnetics. 2011 Jul;32(5):417-21. doi: 10.1002/bem.20660. Epub 2011 Mar 14 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **van Rhoon GC** *et al*, (2011) *Health Council of The Netherlands: no need to change from SAR to time-temperature relation in electromagnetic fields exposure limits*, Int J Hyperthermia. 2011;27(4):399-404 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Bornkessel C**, (May 2011) *Assessment of exposure to mobile telecommunication electromagnetic fields*, Wien Med Wochenschr. 2011 May;161(9-10):233-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Roosli M, Hug K**, (May 2011) *Wireless communication fields and non-specific symptoms of ill health: a literature review*, Wien Med Wochenschr. 2011 May;161(9-10):240-50 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Viel JF** *et al*, (May 2011) *Variability of radiofrequency exposure across days of the week: a population-based study*, Environ Res. 2011 May;111(4):510-3. Epub 2011 Mar 15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Blank M, Goodman R**, (April 2011) *DNA is a fractal antenna in electromagnetic fields*, Int J Radiat Biol. 2011 Apr;87(4):409-15. Epub 2011 Feb 28 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Ibitoye ZA, Aweda AM**, (February 2011) *Assessment of radiofrequency power density distribution around GSM and broadcast antenna masts in Lagos City, Nigeria*, Nig Q J Hosp Med. 2011 Jan-Mar;21(1):35-40 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Trillo MA** *et al*, (January 2011) *Cytostatic response of NB69 cells to weak pulse-modulated 2.2 GHz radar-like signals*, Bioelectromagnetics. 2011 Jan 28. doi: 10.1002/bem.20643. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Vulevic B, Osmokrovic P**, (January 2011) *Survey of elf magnetic field levels in households near overhead power lines in serbia*, Radiat Prot Dosimetry. 2011 Jan 26. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Kos B et al**, (December 2010) *Exposure assessment in front of a multi-band base station antenna*, Bioelectromagnetics. 2010 Dec 22. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Roosli M et al**, (December 2010) *Systematic review on the health effects of exposure to radiofrequency electromagnetic fields from mobile phone base stations*, Bull World Health Organ. 2010 Dec 1;88(12):887-896F. Epub 2010 Oct 5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Heinrich S et al**, (November 2010) *Association between exposure to radiofrequency electromagnetic fields assessed by dosimetry and acute symptoms in children and adolescents: a population based cross-sectional study*, Environ Health. 2010 Nov 25;9:75 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Damvik M, Johansson O**, (November 2010) *Health risk assessment of electromagnetic fields: a conflict between the precautionary principle and environmental medicine methodology*, Rev Environ Health. 2010 Oct-Dec;25(4):325-33 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Joseph W, Verloock L**, (November 2010) *Influence of mobile phone traffic on base station exposure of the general public*, Health Phys. 2010 Nov;99(5):631-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Joseph W et al**, (October 2010) *Comparison of personal radio frequency electromagnetic field exposure in different urban areas across Europe*, Environ Res. 2010 Oct;110(7):658-63 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Joseph W et al**, (October 2010) *Assessment of general public exposure to LTE and RF sources present in an urban environment*, Bioelectromagnetics. 2010 Oct;31(7):576-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Kheifets L et al**, (October 2010) *Risk governance for mobile phones, power lines, and other EMF technologies*, Risk Anal. 2010 Oct;30(10):1481-94 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Vermeeren G et al**, (September 2010) *The influence of the reflective environment on the absorption of a human male exposed to representative base station antennas from 300 MHz to 5 GHz*, Phys Med Biol. 2010 Sep 21;55(18):5541-55. Epub 2010 Aug 31 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Danker-Hopfe H et al**, (September 2010) *Do mobile phone base stations affect sleep of residents? Results from an experimental double-blind sham-controlled field study*, Am J Hum Biol. 2010 Sep-Oct;22(5):613-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Kim BC, Park SO**, (September 2010) *Evaluation of RF electromagnetic field exposure levels from cellular base stations in Korea*, Bioelectromagnetics. 2010 Sep;31(6):495-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **McIntosh RL, Anderson V**, (September 2010) *SAR versus S(inc): What is the appropriate RF exposure metric in the range 1-10 GHz? Part II: Using complex human body models*, Bioelectromagnetics. 2010 Sep;31(6):467-

78 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Russo P et al**, (August 2010) *A numerical coefficient for evaluation of the environmental impact of electromagnetic fields radiated by base stations for mobile communications*, *Bioelectromagnetics*. 2010 Aug 5. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Elliott P et al**, (June 2010) *Mobile phone base stations and early childhood cancers: case-control study*, *BMJ*. 2010 Jun 22;340:c3077. doi: 10.1136/bmj.c3077 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Stam R**, (October 2010) *Electromagnetic fields and the blood-brain barrier*, *Brain Res Rev*. 2010 Oct 5;65(1):80-97. Epub 2010 Jun 13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Augner C et al**, (June 2010) *Effects of exposure to GSM mobile phone base station signals on salivary cortisol, alpha-amylase, and immunoglobulin A*, *Biomed Environ Sci*. 2010 Jun;23(3):199-207. [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **van Kleef E et al**, (June 2010) *Risk and benefit perceptions of mobile phone and base station technology in Bangladesh*, *Risk Anal*. 2010 Jun;30(6):1002-15. Epub 2010 Apr 8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Panagopoulos DJ, Margaritis LH**, (May 2010) *The identification of an intensity 'window' on the bioeffects of mobile telephony radiation*, *Int J Radiat Biol*. 2010 May;86(5):358-66 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Vorobyov V et al**, (May 2010) *Repeated exposure to low-level extremely low frequency-modulated microwaves affects cortex-hypothalamus interplay in freely moving rats: EEG study*, *Int J Radiat Biol*. 2010 May;86(5):376-83 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Tomitsch J et al**, (April 2010) *Survey of electromagnetic field exposure in bedrooms of residences in lower Austria*, *Bioelectromagnetics*. 2010 Apr;31(3):200-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Takahashi S et al**, (March 2010) *Lack of adverse effects of whole-body exposure to a mobile telecommunication electromagnetic field on the rat fetus*, *Radiat Res*. 2010 Mar;173(3):362-72 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Carpenter DO et al**, (January 2010) *Electromagnetic fields and cancer: the cost of doing nothing*, *Rev Environ Health*. 2010 Jan-Mar;25(1):75-80 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Wallace D et al**, (January 2010) *Do TETRA (Airwave) Base Station Signals Have a Short-Term Impact on Health and Well-Being? A Randomized Double-Blind Provocation Study*, *Environ Health Perspect*. 2010 Jan 14. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Hu J et al**, (November 2009) *Level of microwave radiation from mobile phone base stations built in residential districts*, *Wei Sheng Yan Jiu*. 2009 Nov;38(6):712-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **McNamee JP, Chauhan V.**, (September 2009) *Radiofrequency radiation and gene/protein expression: a review*, *Radiat Res*. 2009 Sep;172(3):265-87 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Sirav B** et al, (2009) *Radio frequency radiation (RFR) from TV and radio transmitters at a pilot region in Turkey*, Radiat Prot Dosimetry. 2009;136(2):114-7. Epub 2009 Aug 11 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Viel JF** et al, (August 2009) *Radiofrequency exposure in the French general population: band, time, location and activity variability*, Environ Int. 2009 Nov;35(8):1150-4. Epub 2009 Aug 4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Frei P** et al, (August 2009) *Temporal and spatial variability of personal exposure to radio frequency electromagnetic fields*, Environ Res. 2009 Aug;109(6):779-85. Epub 2009 May 23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Eltiti S** et al, (May 2009) *Short-term exposure to mobile phone base station signals does not affect cognitive functioning or physiological measures in individuals who report sensitivity to electromagnetic fields and controls*, Bioelectromagnetics. 2009 May 27. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Viel JF** et al, (March 2009) *Residential exposure to radiofrequency fields from mobile-phone base stations, and broadcast transmitters: a population-based survey with personal meter*, Occup Environ Med. 2009 Mar 30. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Balmori A**, (March 2009) *Electromagnetic pollution from phone masts. Effects on wildlife*, Pathophysiology. 2009 Mar 3. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Kundi M, Hutter HP**, (March 2009) *Mobile phone base stations-Effects on wellbeing and health*, Pathophysiology. 2009 Mar 2. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Berg-Beckhoff G** et al, (February 2009) *Mobile phone base stations and adverse health effects: phase 2 of a cross-sectional study with measured radio frequency electromagnetic fields*, Occup Environ Med. 2009 Feb;66(2):124-30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Blettner M** et al, (November 2008) *Mobile phone base stations and adverse health effects: Phase 1: A population-based cross-sectional study in Germany*, Occup Environ Med. 2008 Nov 18. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Augner C** et al, (September 2008) *GSM base stations: Short-term effects on well-being*, Bioelectromagnetics. 2008 Sep 19. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Pavicic I, Trosic I**, (August 2008) *In vitro testing of cellular response to ultra high frequency electromagnetic field radiation*, Toxicol In Vitro. 2008 Aug;22(5):1344-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Eberhardt JL** et al, (2008) *Blood-brain barrier permeability and nerve cell damage in rat brain 14 and 28 days after exposure to microwaves from GSM mobile phones*, Electromagn Biol Med. 2008;27(3):215-29 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Aly AA** et al, (February 2008) *Effects of 900-MHz radio frequencies on the chemotaxis of human neutrophils in vitro*, IEEE Trans Biomed Eng. 2008 Feb;55(2):795-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Hardell L, Sage C**, (February 2008) *Biological effects from electromagnetic field exposure and public exposure standards*, Biomed Pharmacother. 2008 Feb;62(2):104-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Everaert J, Bauwens D**, (2007) *A possible effect of electromagnetic radiation from mobile phone base stations on the number of breeding house sparrows (Passer domesticus)*, Electromagn Biol Med. 2007;26(1):63-72 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Preece AW et al**, (June 2007) *Health response of two communities to military antennae in Cyprus*, Occup Environ Med. 2007 Jun;64(6):402-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Abdel-Rassoul G et al**, (March 2007) *Neurobehavioral effects among inhabitants around mobile phone base stations*, Neurotoxicology. 2007 Mar;28(2):434-40 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Yurekli A et al**, (2006) *GSM base station electromagnetic radiation and oxidative stress in rats*, Electromagn Biol Med 25(3):177-88 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Hutter HP et al**, (May 2006) *Subjective symptoms, sleeping problems, and cognitive performance in subjects living near mobile phone base stations*, Occup Environ Med. 2006 May;63(5):307-13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Balmori A**, (October 2005) *Possible Effects of Electromagnetic Fields from Phone Masts on a Population of White Stork (Ciconia ciconia)*, Electromagn Biol Med 24: 109-119, 2005 [[View Author's abstract conclusions](#)]
- P Reif JS et al**, (August 2005) *Human responses to Residential RF exposure*, 2 RO1 ES0008117-04 [[View Author's abstract conclusions](#)]
- N Degraeve E et al**, (2005) *All-cause mortality among Belgian military radar operators: a 40-year controlled longitudinal study*, Eur J Epidemiol. 2005;20(8):677-81 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P REFLEX Report**, (December 2004) *Risk Evaluation of Potential Environmental Hazards From Low Frequency Electromagnetic Field Exposure Using Sensitive in vitro Methods*, A project funded by the European Union under the programme "Quality of Life and Management of Living Resources" [[View Author's abstract conclusions](#)]
- P Eger H et al**, (November 2004) *The Influence of Being Physically Near to a Cell Phone Transmission Mast on the Incidence of Cancer*, Umwelt Medizin Gesellschaft 17,4 2004 [[View Author's abstract conclusions](#)]
- P Bortkiewicz A et al**, (2004) *Subjective symptoms reported by people living in the vicinity of cellular phone base stations: review*, Med Pr. 2004;55(4):345-51 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Oberfeld G et al**, (October 2004) *The Microwave Syndrome - Further Aspects of a Spanish Study*, Conference Proceedings [[View Author's abstract conclusions](#)]
- P Wolf R, Wolf D**, (April 2004) *Increased incidence of cancer near a cell-phone transmitter station*, International Journal of Cancer Prevention, 1(2) April 2004 [[View Author's abstract conclusions](#)]
- **Roosli M et al**, (February 2004) *Symptoms of ill health ascribed to electromagnetic field exposure--a questionnaire survey*, Int J Hyg Environ Health. 2004 Feb;207(2):141-50 [[View Author's abstract conclusions](#)]

[\[View on Pubmed\]](#)

P Navarro EA *et al*, (December 2003) *The Microwave Syndrome: A Preliminary Study in Spain*, Electromagn Biol Med 22(2-3): 161-169 [\[View Author's abstract conclusions\]](#)

P Santini R *et al*, (September 2003) *Symptoms experienced by people in vicinity of base stations: II/ Incidences of age, duration of exposure, location of subjects in relation to the antennas and other electromagnetic factors*, Pathol Biol (Paris). 2003 Sep;51(7):412-5 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

P Santini R *et al*, (July 2002) *Investigation on the health of people living near mobile telephone relay stations: I/Incidence according to distance and sex*, Pathol Biol (Paris) 2002 Jul;50(6):369-73 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

## Radio Transmitters

[\[Back to the top\]](#)

- Baste V *et al*, (January 2010) *Radiofrequency exposure on fast patrol boats in the Royal Norwegian Navy-an approach to a dose assessment*, Bioelectromagnetics. 2010 Jan 6. [Epub ahead of print] [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

P Sirav B *et al*, (2009) *Radio frequency radiation (RFR) from TV and radio transmitters at a pilot region in Turkey*, Radiat Prot Dosimetry. 2009;136(2):114-7. Epub 2009 Aug 11 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

P Viel JF *et al*, (August 2009) *Radiofrequency exposure in the French general population: band, time, location and activity variability*, Environ Int. 2009 Nov;35(8):1150-4. Epub 2009 Aug 4 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

P Huttunen P *et al*, (March 2009) *FM-radio and TV tower signals can cause spontaneous hand movements near moving RF reflector*, Pathophysiology. 2009 Mar 4. [Epub ahead of print] [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

N Merzenich H *et al*, (October 2008) *Childhood Leukemia in Relation to Radio Frequency Electromagnetic Fields in the Vicinity of TV and Radio Broadcast Transmitters*, Am J Epidemiol. 2008 Oct 3. [Epub ahead of print] [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

P Baste V *et al*, (April 2008) *Radiofrequency electromagnetic fields; male infertility and sex ratio of offspring*, Eur J Epidemiol. 2008 Apr 16 [Epub ahead of print] [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

P Clark ML *et al*, (October 2007) *Biomonitoring of estrogen and melatonin metabolites among women residing near radio and television broadcasting transmitters*, J Occup Environ Med. 2007 Oct;49(10):1149-56 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

P Ha M *et al*, (August 2007) *Radio-frequency radiation exposure from AM radio transmitters and childhood leukemia and brain cancer*, Am J Epidemiol. 2007 Aug 1;166(3):270-9 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

- P **Reif JS et al**, (August 2005) *Human responses to Residential RF exposure*, 2 RO1 ES0008117-04 [[View Author's abstract conclusions](#)]
- P **Hallberg O, Johansson O**, (2005) *FM broadcasting exposure time and malignant melanoma incidence*, *Electromagnetic Biology and Medicine* 24; 1-8 [[View Author's abstract conclusions](#)]
- P **Park SK et al**, (August 2004) *Ecological study on residences in the vicinity of AM radio broadcasting towers and cancer death: preliminary observations in Korea*, *Int Arch Occup Environ Health*. 2004 Aug;77(6):387-94 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Hallberg O, Johansson O**, (July 2004) *Malignant melanoma of the skin - not a sunshine story!*, *Med Sci Monit*. 2004 Jul;10(7):CR336-40 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Ha M et al**, (December 2003) *Incidence of cancer in the vicinity of Korean AM radio transmitters*, *Arch Environ Health*. 2003 Dec;58(12):756-62 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Hocking B, Gordon I**, (September 2003) *Decreased survival for childhood leukemia in proximity to television towers*, *Arch Environ Health*. 2003 Sep;58(9):560-4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Michelozzi P et al**, (June 2002) *Adult and childhood leukemia near a high-power radio station in Rome, Italy*, *Am J Epidemiol*. 2002 Jun 15;155(12):1096-103 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Hallberg O, Johansson O**, (January 2002) *Melanoma incidence and frequency modulation (FM) broadcasting*, *Arch Environ Health*. 2002 Jan-Feb;57(1):32-40 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Michelozzi P et al**, (November 2001) *Leukemia mortality and incidence of infantile leukemia near the Vatican Radio Station of Rome*, *Epidemiol Prev*. 2001 Nov-Dec;25(6):249-55 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Lalic H et al**, (April 2001) *Comparison of chromosome aberrations in peripheral blood lymphocytes from people occupationally exposed to ionizing and radiofrequency radiation*, *Acta Med Okayama*. 2001 Apr;55(2):117-27 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Stang A et al**, (January 2001) *The possible role of radiofrequency radiation in the development of uveal melanoma*, *Epidemiology*. 2001 Jan;12(1):7-12 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Richter E et al**, (July 2000) *Cancer in radar technicians exposed to radiofrequency/microwave radiation: sentinel episodes*, *Int J Occup Environ Health*. 2000 Jul-Sep;6(3):187-93 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Reeves GI**, (March 2000) *Review of extensive workups of 34 patients overexposed to radiofrequency radiation*, *Aviat Space Environ Med*. 2000 Mar;71(3):206-15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Moszczyński P et al**, (1999) *The effect of various occupational exposures to microwave radiation on the concentrations of immunoglobulins and T lymphocyte subsets*, *Wiad Lek*. 1999;52(1-2):30-4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Dmoch A, Moszczyński P**, (1998) *Levels of immunoglobulin and subpopulations of T lymphocytes and NK cells in men occupationally exposed to microwave radiation in frequencies of 6-12 GHz*, *Med Pr*. 1998;49(1):45-9

[\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

P **Szmigielski S et al**, (1998) *Alteration of diurnal rhythms of blood pressure and heart rate to workers exposed to radiofrequency electromagnetic fields*, Blood Press Monit. 1998;3(6):323-30 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

P **Duan L et al**, (March 1998) *Observations of changes in neurobehavioral functions in workers exposed to high-frequency radiation*, Zhonghua Yu Fang Yi Xue Za Zhi. 1998 Mar;32(2):109-11 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

P **Hjollund NH et al**, (November 1997) *Semen analysis of personnel operating military radar equipment*, Reprod Toxicol. 1997 Nov-Dec;11(6):897 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

- **Lagorio S et al**, (1997) *Mortality of plastic-ware workers exposed to radiofrequencies*, Bioelectromagnetics. 1997;18(6):418-21 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

P **Schilling CJ**, (April 1997) *Effects of acute exposure to ultrahigh radiofrequency radiation on three antenna engineers*, Occup Environ Med. 1997 Apr;54(4):281-4 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

P **Bortkiewicz A et al**, (March 1997) *Ambulatory ECG monitoring in workers exposed to electromagnetic fields*, J Med Eng Technol. 1997 Mar-Apr;21(2):41-6 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

- **Dolk H et al**, (January 1997) *Cancer incidence near radio and television transmitters in Great Britain. II. All high power transmitters*, Am J Epidemiol. 1997 Jan 1;145(1):10-7. [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

P **Dolk H et al**, (January 1997) *Cancer incidence near radio and television transmitters in Great Britain. I. Sutton Coldfield transmitter*, Am J Epidemiol. 1997 Jan 1;145(1):1-9 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

P **Hocking B et al**, (December 1996) *Cancer incidence and mortality and proximity to TV towers*, Med J Aust. 1996 Dec 2-16;165(11-12):601-5 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

P **Weyandt TB et al**, (November 1996) *Semen analysis of military personnel associated with military duty assignments*, Reprod Toxicol. 1996 Nov-Dec;10(6):521-8 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

P **Bortkiewicz A et al**, (July 1996) *Heart rate variability in workers exposed to medium-frequency electromagnetic fields*, J Auton Nerv Syst. 1996 Jul 5;59(3):91-7 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

P **Grayson JK**, (March 1996) *Radiation exposure, socioeconomic status, and brain tumor risk in the US Air Force: a nested case-control study*, Am J Epidemiol. 1996 Mar 1;143(5):480-6 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

P **Tynes T et al**, (March 1996) *Incidence of breast cancer in Norwegian female radio and telegraph operators*, Cancer Causes Control. 1996 Mar;7(2):197-204 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

P **Kolodynski AA, Kolodynska VV**, (February 1996) *Motor and psychological functions of school children living in the area of the Skrunda Radio Location Station in Latvia*, Sci Total Environ. 1996 Feb 2;180(1):87-93 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Holly EA et al**, (January 1996) *Intraocular melanoma linked to occupations and chemical exposures*, Epidemiology. 1996 Jan;7(1):55-61 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Guberan E et al**, (October 1994) *Gender ratio of offspring and exposure to shortwave radiation among female physiotherapists*, Scand J Work Environ Health. 1994 Oct;20(5):345-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Maskarinec G et al**, (1994) *Investigation of increased incidence in childhood leukemia near radio towers in Hawaii: preliminary observations*, J Environ Pathol Toxicol Oncol. 1994;13(1):33-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Goldoni J et al**, (September 1993) *Health status of personnel occupationally exposed to radiowaves*, Arh Hig Rada Toksikol. 1993 Sep;44(3):223-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Davis RL, Mostofi FK**, (August 1993) *Cluster of testicular cancer in police officers exposed to hand-held radar*, Am J Ind Med. 1993 Aug;24(2):231-3 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Holt JA**, (June 1980) *Changing epidemiology of malignant melanoma in Queensland*, Med J Aust. 1980 Jun 14;1(12):619-20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

## Powerlines and Substations, and other Powerfrequency EMF exposure

[\[Back to the top\]](#)

- **Vanderstraeten J et al**, (July 2015) *Could Magnetic Fields Affect the Circadian Clock Function of Cryptochromes? Testing the Basic Premise of the Cryptochrome Hypothesis (ELF Magnetic Fields)*, Health Phys. 2015 Jul;109(1):84-9. doi: 10.1097/HP.0000000000000292 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Koeman T et al**, (June 2015) *Occupational exposures and risk of dementia-related mortality in the prospective Netherlands Cohort Study*, Am J Ind Med. 2015 Jun;58(6):625-35. doi: 10.1002/ajim.22462. Epub 2015 May 5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Kottou S et al**, (May 2015) *Preliminary background indoor EMF measurements in Greece*, Phys Med. 2015 May 21. pii: S1120-1797(15)00112-X. doi: 10.1016/j.ejmp.2015.05.002. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Talibov M et al**, (May 2015) *Occupational exposure to extremely low-frequency magnetic fields and electrical shocks and acute myeloid leukemia in four Nordic countries*, Cancer Causes Control. 2015 May 14. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Prato FS**, (May 2015) *Non-thermal extremely low frequency magnetic field effects on opioid related behaviors: Snails to humans, mechanisms to therapy*, Bioelectromagnetics. 2015 May 11. doi: 10.1002/bem.21918. [Epub

ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Hosseini M et al**, (May 2015) *Hazard zoning around electric substations of petrochemical industries by stimulation of extremely low-frequency magnetic fields*, Environ Monit Assess. 2015 May;187(5):4449. doi: 10.1007/s10661-015-4449-y. Epub 2015 Apr 16 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Tell RA et al**, (May 2015) *Electromagnetic Fields Associated with Commercial Solar Photovoltaic Electric Power Generating Facilities*, J Occup Environ Hyg. 2015 May 29:0. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Nofouzi K et al**, (April 2015) *Influence of extremely low frequency electromagnetic fields on growth performance, innate immune response, biochemical parameters and disease resistance in rainbow trout, Oncorhynchus mykiss*, Fish Physiol Biochem. 2015 Apr 14. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Porsius JT et al**, (April 2015) *Symptom reporting after the introduction of a new high-voltage power line: A prospective field study*, Environ Res. 2015 Apr;138:112-7. doi: 10.1016/j.envres.2015.02.009. Epub 2015 Feb 20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Brouwer M et al**, (February 2015) *Occupational exposures and Parkinson's disease mortality in a prospective Dutch cohort*, Occup Environ Med. 2015 Feb 23. pii: oemed-2014-102209. doi: 10.1136/oemed-2014-102209. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Bolte JF et al**, (January 2015) *Everyday exposure to power frequency magnetic fields and associations with non-specific physical symptoms*, Environ Pollut. 2015 Jan;196:224-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **D'Angelo C et al**, (January 2015) *Experimental model for ELF-EMF exposure: Concern for human health*, Saudi J Biol Sci. 2015 Jan;22(1):75-84. doi: 10.1016/j.sjbs.2014.07.006. Epub 2014 Aug 6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Tomitsch J, Dechant E et al**, (January 2015) *Exposure to electromagnetic fields in households--trends from 2006 to 2012*, Bioelectromagnetics. 2015 Jan;36(1):77-85. doi: 10.1002/bem.21887. Epub 2014 Nov 24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Baek S et al**, (October 2014) *Electromagnetic Fields Mediate Efficient Cell Reprogramming into a Pluripotent State*, ACS Nano. 2014 Oct 1. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Liorni I et al**, (September 2014) *Dosimetric study of fetal exposure to uniform magnetic fields at 50 Hz*, Bioelectromagnetics. 2014 Sep 29. doi: 10.1002/bem.21878. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Calvente I et al**, (September 2014) *Characterization of Indoor Extremely Low Frequency and Low Frequency Electromagnetic Fields in the INMA-Granada Cohort*, PLoS One. 2014 Sep 5;9(9):e106666. doi: 10.1371/journal.pone.0106666. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Lee SK et al**, (September 2014) *Extremely low frequency magnetic fields induce spermatogenic germ cell apoptosis: possible mechanism*, Biomed Res Int. 2014;2014:567183. doi: 10.1155/2014/567183. Epub 2014 Jun

15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Sorahan T, Mohammed N**, (September 2014) *Neurodegenerative disease and magnetic field exposure in UK electricity supply workers*, *Occup Med (Lond)*. 2014 Sep;64(6):454-60. doi: 10.1093/occmed/kqu105. Epub 2014 Aug 7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Turner MC et al**, (September 2014) *Occupational exposure to extremely low-frequency magnetic fields and brain tumor risks in the INTEROCC study*, *Cancer Epidemiol Biomarkers Prev*. 2014 Sep;23(9):1863-72. doi: 10.1158/1055-9965.EPI-14-0102. Epub 2014 Jun 16 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Zhao G et al**, (September 2014) *Relationship between exposure to extremely low-frequency electromagnetic fields and breast cancer risk: a meta-analysis*, *Eur J Gynaecol Oncol*. 2014;35(3):264-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P de Vocht F, Lee B**, (August 2014) *Residential proximity to electromagnetic field sources and birth weight: Minimizing residual confounding using multiple imputation and propensity score matching*, *Environ Int*. 2014 Aug;69:51-7. doi: 10.1016/j.envint.2014.04.012. Epub 2014 May 7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N van der Mark M et al**, (June 2014) *Extremely low-frequency magnetic field exposure, electrical shocks and risk of Parkinson's disease*, *Int Arch Occup Environ Health*. 2014 Jun 18. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Monazzam MR et al**, (April 2014) *Sleep quality and general health status of employees exposed to extremely low frequency magnetic fields in a petrochemical complex*, *J Environ Health Sci Eng*. 2014 Apr 29;12:78. doi: 10.1186/2052-336X-12-78. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Consales C et al**, (September 2012) *Electromagnetic fields, oxidative stress, and neurodegeneration*, *Int J Cell Biol*. 2012;2012:683897. Epub 2012 Sep 9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Kirschenlohr H et al**, (September 2012) *Gene expression profiles in white blood cells of volunteers exposed to a 50 Hz electromagnetic field*, *Radiat Res*. 2012 Sep;178(3):138-49. Epub 2012 Aug 1 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Mattsson MO, Simko M**, (June 2012) *Is there a relation between extremely low frequency magnetic field exposure, inflammation and neurodegenerative diseases? A review of in vivo and in vitro experimental evidence.*, *Toxicology*. 2012 Jun 29. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Balamuralikrishnan B et al**, (2012) *Evaluation of Chromosomal Alteration in Electrical Workers Occupationally Exposed to Low Frequency of Electro Magnetic Field (EMFs) in Coimbatore Population, India*, *Asian Pac J Cancer Prev*. 2012;13(6):2961-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Teepeen JC, van Dijck JA**, (March 2012) *Impact of high electromagnetic field levels on childhood leukaemia incidence*, *Int J Cancer*. 2012 Mar 21. doi: 10.1002/ijc.27542. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Bellieni CV et al**, (March 2012) *Is newborn melatonin production influenced by magnetic fields produced by incubators?*, *Early Hum Dev*. 2012 Mar 13. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

[Pubmed](#)]

P **Zhao LY** et al, (March 2012) *Effects of extremely low frequency electromagnetic radiation on cardiovascular system of workers*, Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi. 2012 Mar;30(3):194-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Narinyan L** et al, (January 2012) *Age-dependent magnetosensitivity of heart muscle hydration*, Bioelectromagnetics. 2012 Jan 17. doi: 10.1002/bem.21704. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Touitou Y** et al, (January 2012) *Long-term (up to 20years) effects of 50-Hz magnetic field exposure on blood chemistry parameters in healthy men*, Clin Biochem. 2012 Jan 9. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Lagroye I** et al, (December 2011) *ELF magnetic fields: Animal studies, mechanisms of action*, Prog Biophys Mol Biol. 2011 Dec;107(3):369-73. Epub 2011 Sep 8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Pilla A** et al, (December 2011) *Electromagnetic fields as first messenger in biological signaling: Application to calmodulin-dependent signaling in tissue repair*, Biochim Biophys Acta. 2011 Dec;1810(12):1236-45. Epub 2011 Oct 8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Schuz J**, (December 2011) *Exposure to extremely low-frequency magnetic fields and the risk of childhood cancer: Update of the epidemiological evidence*, Prog Biophys Mol Biol. 2011 Dec;107(3):339-42. Epub 2011 Sep 19 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Reid A** et al, (October 2011) *Risk of childhood acute lymphoblastic leukaemia following parental occupational exposure to extremely low frequency electromagnetic fields*, Br J Cancer. 2011 Oct 25;105(9):1409-13. doi: 10.1038/bjc.2011.365. Epub 2011 Sep 13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Gandhi OP** et al, (October 2011) *Exposure Limits: The underestimation of absorbed cell phone radiation, especially in children*, Electromagn Biol Med. 2011 Oct 14. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Roosli M** et al, (August 2011) *Extremely low frequency magnetic field measurements in buildings with transformer stations in Switzerland*, Sci Total Environ. 2011 Aug 15;409(18):3364-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Wunsch-Filho V** et al, (August 2011) *Exposure to magnetic fields and childhood acute lymphocytic leukemia in Sao Paulo, Brazil*, Cancer Epidemiol. 2011 Aug 12. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Tomitsch J, Dechant E**, (August 2011) *Trends in residential exposure to electromagnetic fields from 2006 to 2009*, Radiat Prot Dosimetry. 2011 Aug 8. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Li DK** et al, (August 2011) *Maternal Exposure to Magnetic Fields During Pregnancy in Relation to the Risk of Asthma in Offspring*, Arch Pediatr Adolesc Med. 2011 Aug 1. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Wang X et al**, (August 2011) *Occupational and residential exposure to electric and magnetic field and its relationship on acute myeloid leukemia in adults - A Meta-analysis*, Zhonghua Liu Xing Bing Xue Za Zhi. 2011 Aug;32(8):821-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Auger N et al**, (July 2011) *Stillbirth and residential proximity to extremely low frequency power transmission lines: a retrospective cohort study*, Occup Environ Med. 2011 Jul 8. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Cam ST et al**, (June 2011) *Occupational exposure to magnetic fields from transformer stations and electric enclosures in Turkey*, Electromagn Biol Med. 2011 Jun;30(2):74-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Huang SM et al**, (April 2011) *Occupational Exposure of Dentists to Extremely-low-frequency Magnetic Field*, J Occup Health. 2011 Apr 20;53(2):130-6. Epub 2011 Feb 17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Gobba F et al**, (April 2011) *Occupational and environmental exposure to extremely low frequency-magnetic fields: a personal monitoring study in a large group of workers in Italy*, J Expo Sci Environ Epidemiol. 2011 Apr 6. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Blank M, Goodman R**, (April 2011) *DNA is a fractal antenna in electromagnetic fields*, Int J Radiat Biol. 2011 Apr;87(4):409-15. Epub 2011 Feb 28 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Vulevic B, Osmokrovic P**, (January 2011) *Survey of elf magnetic field levels in households near overhead power lines in serbia*, Radiat Prot Dosimetry. 2011 Jan 26. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Contessa GM et al**, (December 2010) *Exposure to magnetic fields of railway engine drivers: a case study in Italy*, Radiat Prot Dosimetry. 2010 Dec;142(2-4):160-7. Epub 2010 Nov 11 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Coskun O, Comlekci S**, (November 2010) *Effect of ELF electric field on some on biochemistry characters in the rat serum*, Toxicol Ind Health. 2010 Nov 18. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Baldi I et al**, (November 2010) *Occupational and residential exposure to electromagnetic fields and risk of brain tumors in adults: A case-control study in Gironde, France*, Int J Cancer. 2010 Nov 12. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Maslanyj M et al**, (November 2010) *A precautionary public health protection strategy for the possible risk of childhood leukaemia from exposure to power frequency magnetic fields*, BMC Public Health. 2010 Nov 5;10:673 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Andel R et al**, (November 2010) *Work-related exposure to extremely low-frequency magnetic fields and dementia: results from the population-based study of dementia in Swedish twins*, J Gerontol A Biol Sci Med Sci. 2010 Nov;65(11):1220-7. Epub 2010 Jul 9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Andel R et al**, (November 2010) *Work-related exposure to extremely low-frequency magnetic fields and dementia: results from the population-based study of dementia in Swedish twins*, J Gerontol A Biol Sci Med Sci.

2010 Nov;65(11):1220-7. Epub 2010 Jul 9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Damvik M, Johansson O**, (November 2010) *Health risk assessment of electromagnetic fields: a conflict between the precautionary principle and environmental medicine methodology*, Rev Environ Health. 2010 Oct-Dec;25(4):325-33 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Dubey RB et al**, (November 2010) *Risk of brain tumors from wireless phone use*, J Comput Assist Tomogr. 2010 Nov-Dec;34(6):799-807 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Kheifets L et al**, (October 2010) *A pooled analysis of extremely low-frequency magnetic fields and childhood brain tumors*, Am J Epidemiol. 2010 Oct 1;172(7):752-61. Epub 2010 Aug 9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Kheifets L et al**, (October 2010) *Risk governance for mobile phones, power lines, and other EMF technologies*, Risk Anal. 2010 Oct;30(10):1481-94 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Kheifets L et al**, (September 2010) *Pooled analysis of recent studies on magnetic fields and childhood leukaemia*, Br J Cancer. 2010 Sep 28;103(7):1128-35 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Kroll ME et al**, (September 2010) *Childhood cancer and magnetic fields from high-voltage power lines in England and Wales: a case-control study*, Br J Cancer. 2010 Sep 28;103(7):1122-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Schmiedel S, Blettner M**, (September 2010) *The association between extremely low-frequency electromagnetic fields and childhood leukaemia in epidemiology: enough is enough?*, Br J Cancer. 2010 Sep 28;103(7):931-2 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **El-Helaly M, Abu-Hashem E**, (September 2010) *Oxidative stress, melatonin level, and sleep insufficiency among electronic equipment repairers*, Bioelectromagnetics. 2011 May;32(4):325-30. doi: 10.1002/bem.20638. Epub 2010 Dec 15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Rajkovic V et al**, (August 2010) *Studies on the synergistic effects of extremely low-frequency magnetic fields and the endocrine-disrupting compound atrazine on the thyroid gland*, Int J Radiat Biol. 2010 Aug 10. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Mild KH, Mattsson MO**, (August 2010) *ELF noise fields: a review*, Electromagn Biol Med. 2010 Aug;29(3):72-97 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Calvente I et al**, (July 2010) *Exposure to electromagnetic fields (non-ionizing radiation) and its relationship with childhood leukemia: a systematic review*, Sci Total Environ. 2010 Jul 15;408(16):3062-9. Epub 2010 May 7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Auger N et al**, (July 2010) *The relationship between residential proximity to extremely low frequency power transmission lines and adverse birth outcomes*, J Epidemiol Community Health. 2010 Jul 13. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Kheifets L et al**, (July 2010) *Exploring exposure-response for magnetic fields and childhood leukemia*, J Expo Sci Environ Epidemiol. 2010 Jul 7. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on](#)

[Pubmed\]](#)

**P de Bruyn L, de Jager L**, (June 2010) *Effect of long-term exposure to a randomly varied 50 Hz power frequency magnetic field on the fertility of the mouse*, Electromagn Biol Med. 2010 Jun;29(1-2):52-61 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Miller AB, Green LM**, (2010) *Electric and magnetic fields at power frequencies*, Chronic Dis Can. 2010;29 Suppl 1:69-83 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Okudan N et al**, (2010) *Effects of long-term 50 Hz magnetic field exposure on the micro nucleated polychromatic erythrocyte and blood lymphocyte frequency and argyrophilic nucleolar organizer regions in lymphocytes of mice*, Neuro Endocrinol Lett. 2010;31(2):208-14 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Sohrabi MR et al**, (2010) *Living near overhead high voltage transmission power lines as a risk factor for childhood acute lymphoblastic leukemia: a case-control study*, Asian Pac J Cancer Prev. 2010;11(2):423-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Barth A et al**, (April 2010) *Effects of extremely low-frequency magnetic field exposure on cognitive functions: results of a meta-analysis*, Bioelectromagnetics. 2010 Apr;31(3):173-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Girgert R et al**, (April 2010) *Signal transduction of the melatonin receptor MT1 is disrupted in breast cancer cells by electromagnetic fields*, Bioelectromagnetics. 2010 Apr;31(3):237-45 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Tomitsch J et al**, (April 2010) *Survey of electromagnetic field exposure in bedrooms of residences in lower Austria*, Bioelectromagnetics. 2010 Apr;31(3):200-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Malagoli C et al**, (March 2010) *Risk of hematological malignancies associated with magnetic fields exposure from power lines: a case-control study in two municipalities of northern Italy*, Environ Health. 2010 Mar 30;9:16 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Reyes-Guerrero G et al**, (March 2010) *Extremely low-frequency electromagnetic fields differentially regulate estrogen receptor-alpha and -beta expression in the rat olfactory bulb*, Neurosci Lett. 2010 Mar 3;471(2):109-13. Epub 2010 Jan 18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Chen C et al**, (February 2010) *Extremely low-frequency electromagnetic fields exposure and female breast cancer risk: a meta-analysis based on 24,338 cases and 60,628 controls*, Breast Cancer Res Treat. 2010 Feb 10. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Carpenter DO et al**, (January 2010) *Electromagnetic fields and cancer: the cost of doing nothing*, Rev Environ Health. 2010 Jan-Mar;25(1):75-80 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Focke F et al**, (January 2010) *DNA fragmentation in human fibroblasts under extremely low frequency electromagnetic field exposure*, Mutat Res. 2010 Jan 5;683(1-2):74-83 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Li DK et al**, (January 2010) *Exposure to magnetic fields and the risk of poor sperm quality*, *Reprod Toxicol*. 2010 Jan;29(1):86-92. Epub 2009 Nov 6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Celikler S et al**, (December 2009) *A biomonitoring study of genotoxic risk to workers of transformers and distribution line stations*, *Int J Environ Health Res*. 2009 Dec;19(6):421-30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Hug K et al**, (January 2010) *Parental occupational exposure to extremely low frequency magnetic fields and childhood cancer: a German case-control study*, *Am J Epidemiol*. 2010 Jan 1;171(1):27-35. Epub 2009 Nov 25 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Hirata A et al**, (2010) *Intercomparison of induced fields in Japanese male model for ELF magnetic field exposures: effect of different computational methods and codes*, *Radiat Prot Dosimetry*. 2010;138(3):237-44. Epub 2009 Nov 22 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Saito T et al**, (2010) *Power-frequency magnetic fields and childhood brain tumors: a case-control study in Japan*, *J Epidemiol*. 2010;20(1):54-61. Epub 2009 Nov 14 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Kaufman DW et al**, (November 2009) *Risk factors for leukemia in Thailand*, *Ann Hematol*. 2009 Nov;88(11):1079-88. Epub 2009 Mar 18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Cvetkovic D, Cosic I**, (October 2009) *Alterations of human electroencephalographic activity caused by multiple extremely low frequency magnetic field exposures*, *Med Biol Eng Comput*. 2009 Oct;47(10):1063-73. Epub 2009 Aug 26 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Gobba F et al**, (October 2009) *Natural killer cell activity decreases in workers occupationally exposed to extremely low frequency magnetic fields exceeding 1 microT*, *Int J Immunopathol Pharmacol*. 2009 Oct-Dec;22(4):1059-66 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Albanese A et al**, (2009) *Alterations in adenylate kinase activity in human PBMCs after in vitro exposure to electromagnetic field: comparison between extremely low frequency electromagnetic field (ELF) and therapeutic application of a musically modulated electromagnetic field*, *J Biomed Biotechnol*. 2009;2009:717941. Epub 2009 Sep 16 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Eleuteri AM et al**, (2009) *50 Hz extremely low frequency electromagnetic fields enhance protein carbonyl groups content in cancer cells: effects on proteasomal systems*, *J Biomed Biotechnol*. 2009;2009:834239. Epub 2009 Aug 5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Robertson JA et al**, (August 2009) *Low-frequency pulsed electromagnetic field exposure can alter neuroprocessing in humans*, *J R Soc Interface*. 2009 Aug 5. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Contalbrigo L et al**, (August 2009) *Effects of different electromagnetic fields on circadian rhythms of some haematochemical parameters in rats*, *Biomed Environ Sci*. 2009 Aug;22(4):348-53 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Li P et al**, (August 2009) *Maternal occupational exposure to extremely low frequency magnetic fields and the risk of brain cancer in the offspring*, *Cancer Causes Control*. 2009 Aug;20(6):945-55. Epub 2009 Feb 18 [[View](#)]

[Author's abstract conclusions](#) [[View on Pubmed](#)]

N **Kheifets L et al**, (July 2009) *Extremely low frequency electric fields and cancer: Assessing the evidence*, Bioelectromagnetics. 2009 Jul 31. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Gonet B et al**, (July 2009) *Effects of extremely low-frequency magnetic fields on the oviposition of Drosophila melanogaster over three generations*, Bioelectromagnetics. 2009 Jul 23. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Goodman R et al**, (July 2009) *Extremely low frequency electromagnetic fields activate the ERK cascade, increase hsp70 protein levels and promote regeneration in Planaria*, Int J Radiat Biol. 2009 Jul 9:1-9. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Comba P, Fazzo L**, (2009) *Health effects of magnetic fields generated from power lines: new clues for an old puzzle*, Ann Ist Super Sanita. 2009;45(3):233-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Ruiz-Gomez MJ, Martinez-Morillo M**, (2009) *Electromagnetic fields and the induction of DNA strand breaks*, Electromagn Biol Med. 2009;28(2):201-14 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Mee T et al**, (April 2009) *Occupational exposure of UK adults to ELF magnetic fields*, Occup Environ Med. 2009 Apr 20. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Burda H et al**, (April 2009) *Extremely low-frequency electromagnetic fields disrupt magnetic alignment of ruminants*, Proc Natl Acad Sci U S A. 2009 Apr 7;106(14):5708-13. Epub 2009 Mar 19 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Fazzo L et al**, (April 2009) *Morbidity experience in populations residentially exposed to 50 hz magnetic fields: methodology and preliminary findings of a cohort study*, Int J Occup Environ Health. 2009 Apr-Jun;15(2):133-42 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Girgert R et al**, (April 2009) *Exposure of mcf-7 breast cancer cells to electromagnetic fields up-regulates the plasminogen activator system*, Int J Gynecol Cancer. 2009 Apr;19(3):334-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Davanipour Z, Sobel E**, (March 2009) *Long-term exposure to magnetic fields and the risks of Alzheimer's disease and breast cancer: Further biological research*, Pathophysiology. 2009 Mar 9. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Novikov VV et al**, (March 2009) *Effect of weak combined static and extremely low-frequency alternating magnetic fields on tumor growth in mice inoculated with the Ehrlich ascites carcinoma*, Bioelectromagnetics. 2009 Mar 6. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **McNamee DA et al**, (February 2009) *A literature review: the cardiovascular effects of exposure to extremely low frequency electromagnetic fields*, Int Arch Occup Environ Health. 2009 Feb 17. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Yang Y et al**, (December 2008) *Case-only study of interactions between DNA repair genes (hMLH1, APEX1, MGMT, XRCC1 and XPD) and low-frequency electromagnetic fields in childhood acute leukemia*, Leuk

Lymphoma. 2008 Dec;49(12):2344-50 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Burdak-Rothkamm S** et al, (November 2008) *DNA and chromosomal damage in response to intermittent extremely low-frequency magnetic fields*, Mutat Res. 2008 Nov 13. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Schuz J, Ahlbom A**, (October 2008) *Exposure to electromagnetic fields and the risk of childhood leukaemia: a review*, Radiat Prot Dosimetry. 2008 Oct 16. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Kim YW** et al, (October 2008) *Effects of 60 Hz 14 microT magnetic field on the apoptosis of testicular germ cell in mice*, Bioelectromagnetics. 2008 Oct 6. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Huss A** et al, (November 2008) *Residence Near Power Lines and Mortality From Neurodegenerative Diseases: Longitudinal Study of the Swiss Population*, Am J Epidemiol. 2008 Nov 5. [Epub ahead of print]Click here to read [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Bernard N** et al, (October 2008) *Assessing the Potential Leukemogenic Effects of 50 Hz and their Harmonics Using an Animal Leukemia Model*, J Radiat Res (Tokyo). 2008 Oct 4. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Kheifets L** et al, (September 2008) *Future needs of occupational epidemiology of extremely low frequency (ELF) electric and magnetic fields (EMF): review and recommendations*, Occup Environ Med. 2008 Sep 19. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Gobba F** et al, (September 2008) *Extremely Low Frequency-Magnetic Fields (ELF-EMF) occupational exposure and natural killer activity in peripheral blood lymphocytes*, Sci Total Environ. 2008 Sep 18. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Poullietier de Gannes F** et al, (September 2008) *Amyotrophic Lateral Sclerosis (ALS) and extremely-low frequency (ELF) magnetic fields: a study in the SOD-1 transgenic mouse model*, Amyotroph Lateral Scler. 2008 Sep 1:1-4. [Epub ahead of print]Click here to read [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Falone S** et al, (June 2008) *Chronic exposure to 50Hz magnetic fields causes a significant weakening of antioxidant defence systems in aged rat brain*, Int J Biochem Cell Biol. 2008 Jun 10. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Al-Akhras MA** et al, (2008) *Influence of 50 Hz magnetic field on sex hormones and body, uterine, and ovarian weights of adult female rats*, Electromagn Biol Med. 2008;27(2):155-63 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Blank M**, (2008) *Protein and DNA reactions stimulated by electromagnetic fields*, Electromagn Biol Med. 2008;27(1):3-23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Kheifets L** et al, (June 2008) *Occupational electromagnetic fields and leukemia and brain cancer: an update to two meta-analyses*, J Occup Environ Med. 2008 Jun;50(6):677-88 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Thuroczy G et al**, (2008) *Exposure to 50 Hz magnetic field in apartment buildings with built-in transformer stations in Hungary*, Radiat Prot Dosimetry. 2008;131(4):469-73. Epub 2008 Jul 30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Milham S, Morgan LL**, (May 2008) *A new electromagnetic exposure metric: High frequency voltage transients associated with increased cancer incidence in teachers in a california school*, Am J Ind Med. 2008 May 29. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Sharifian A et al**, (May 2008) *Effect of extremely low frequency magnetic field on antioxidant activity in plasma and red blood cells in spot welders.*, Int Arch Occup Environ Health. 2008 May 27 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Keklikci U et al**, (May 2008) *The effect of extremely low frequency magnetic field on the conjunctiva and goblet cells*, Curr Eye Res. 2008 May;33(5):441-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Mezei G et al**, (May 2008) *Residential magnetic field exposure and childhood brain cancer: a meta-analysis*, Epidemiology. 2008 May;19(3):424-30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Garcia AM et al**, (April 2008) *Occupational exposure to extremely low frequency electric and magnetic fields and Alzheimer disease: a meta-analysis*, Int J Epidemiol. 2008 Feb 2 [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Henshaw DL et al**, (April 2008) *Can disturbances in the atmospheric electric field created by powerline corona ions disrupt melatonin production in the pineal gland?*, J Pineal Res. 2008 Apr 1. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Ilonen K et al**, (April 2008) *Indoor transformer stations as predictors of residential ELF magnetic field exposure*, Bioelectromagnetics. 2008 Apr;29(3):213-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P St-Pierre LS et al**, (April 2008) *Altered blood chemistry and hippocampal histomorphology in adult rats following prenatal exposure to physiologically-patterned, weak (50-500 nanoTesla range) magnetic fields*, Int J Radiat Biol. 2008 Apr;84(4):325-35 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Liu T et al**, (March 2008) *Chronic exposure to low-intensity magnetic field improves acquisition and maintenance of memory*, Neuroreport. 2008 Mar 25;19(5):549-52 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Erdal N et al**, (March 2008) *Effects of Long-term Exposure of Extremely Low Frequency Magnetic Field on Oxidative/Nitrosative Stress in Rat Liver*, J Radiat Res (Tokyo). 2008 Mar;49(2):181-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Hardell L, Sage C**, (February 2008) *Biological effects from electromagnetic field exposure and public exposure standards*, Biomed Pharmacother. 2008 Feb;62(2):104-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Clapp RW et al**, (January 2008) *Environmental and occupational causes of cancer: new evidence 2005-2007*, Rev Environ Health. 2008 Jan-Mar;23(1):1-37 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Fedrowitz M, Loscher W**, (January 2008) *Exposure of Fischer 344 rats to a weak power frequency magnetic field facilitates mammary tumorigenesis in the DMBA model of breast cancer*, Carcinogenesis. 2008

Jan;29(1):186-93 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Lowenthal RM et al**, (September 2007) *Residential exposure to electric power transmission lines and risk of lymphoproliferative and myeloproliferative disorders: a case-control study*, Intern Med J. 2007 Sep;37(9):614-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Pearce MS et al**, (September 2007) *Paternal occupational exposure to electro-magnetic fields as a risk factor for cancer in children and young adults: a case-control study from the North of England*, Pediatr Blood Cancer. 2007 Sep;49(3):280-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Scaringi M et al**, (September 2007) *Evaluation of the genotoxicity of the extremely low frequency-magnetic fields (ELF-MF) in workers exposed for professional reasons*, G Ital Med Lav Ergon. 2007 Jul-Sep;29(3 Suppl):420-1 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Einstein AJ et al**, (July 2007) *Estimating risk of cancer associated with radiation exposure from 64-slice computed tomography coronary angiography*, JAMA. 2007 Jul 18;298(3):317-23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Budi A et al**, (May 2007) *Effect of frequency on insulin response to electric field stress*, J Phys Chem B. 2007 May 24;111(20):5748-56 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **SAGE**, (April 2007) *SAGE first interim assessment: Power Lines and Property, Wiring in Homes, and Electrical Equipment in Homes*, [[View Author's abstract conclusions](#)]

- **Maslanyj MP et al**, (March 2007) *Investigation of the sources of residential power frequency magnetic field exposure in the UK Childhood Cancer Study*, J Radiol Prot. 2007 Mar;27(1):41-58 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Cech R et al**, (February 2007) *Fetal exposure to low frequency electric and magnetic fields*, Phys Med Biol. 2007 Feb 21;52(4):879-88 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Feizi AA, Arabi MA**, (January 2007) *Acute childhood leukemias and exposure to magnetic fields generated by high voltage overhead power lines - a risk factor in Iran*, Asian Pac J Cancer Prev. 2007 Jan-Mar;8(1):69-72 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Ravindra T et al**, (December 2006) *Melatonin in pathogenesis and therapy of cancer*, Indian J Med Sci. 2006 Dec;60(12):523-35 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Havas M**, (2006) *Electromagnetic hypersensitivity: biological effects of dirty electricity with emphasis on diabetes and multiple sclerosis*, Electromagn Biol Med. 2006;25(4):259-68 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Kheifets L et al**, (October 2006) *Public Health Impact of Extremely Low-Frequency Electromagnetic Fields*, Environ Health Perspect 114:1532-1537 [[View Author's abstract conclusions](#)]

- **Kheifets L et al**, (October 2006) *Childhood leukemia, electric and magnetic fields, and temporal trends*, Bioelectromagnetics. 2006 Oct;27(7):545-52 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Rajkovic V** et al, (September 2006) *Light and electron microscopic study of the thyroid gland in rats exposed to power-frequency electromagnetic fields*, J Exp Biol. 2006 Sep;209(Pt 17):3322-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Swanson J** et al, (September 2006) *Power-frequency electric and magnetic fields in the light of Draper et al. 2005*, Ann N Y Acad Sci. 2006 Sep;1076:318-30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Cao YN** et al, (August 2006) *Effects of exposure to extremely low frequency electromagnetic fields on reproduction of female mice and development of offsprings*, Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi. 2006 Aug;24(8):468-70 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Kabuto M** et al, (August 2006) *Childhood leukemia and magnetic fields in Japan: a case-control study of childhood leukemia and residential power-frequency magnetic fields in Japan*, Int J Cancer. 2006 Aug 1;119(3):643-50 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Espinosa JM** et al, (July 2006) *Exposure to AC and DC magnetic fields induces changes in 5-HT1B receptor binding parameters in rat brain membranes*, Bioelectromagnetics. 2006 Jul;27(5):414-22 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Juutilainen J, Kumlin T**, (July 2006) *Occupational magnetic field exposure and melatonin: interaction with light-at-night*, Bioelectromagnetics. 2006 Jul;27(5):423-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Blackman CF**, (2006) *Can EMF exposure during development leave an imprint later in life?*, Electromagn Biol Med. 2006;25(4):217-25 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Fadel RA** et al, (June 2006) *Growth assessment of children exposed to low frequency electromagnetic fields at the Abu Sultan area in Ismailia (Egypt)*, Anthropol Anz. 2006 Jun;64(2):211-26 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Persinger MA**, (2006) *A potential multiple resonance mechanism by which weak magnetic fields affect molecules and medical problems: the example of melatonin and experimental "multiple sclerosis"*, Med Hypotheses. 2006;66(4):811-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Feychting M, Forssen U**, (May 2006) *Electromagnetic fields and female breast cancer*, Cancer Causes Control. 2006 May;17(4):553-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Altpeter ES** et al, (February 2006) *Effect of short-wave (6-22 MHz) magnetic fields on sleep quality and melatonin cycle in humans: the Schwarzenburg shut-down study*, Bioelectromagnetics. 2006 Feb;27(2):142-50 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Bediz CS** et al, (February 2006) *Zinc supplementation ameliorates electromagnetic field-induced lipid peroxidation in the rat brain*, Tohoku J Exp Med. 2006 Feb;208(2):133-40 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Elwood JM**, (February 2006) *Childhood leukemia and residential magnetic fields: are pooled analyses more valid than the original studies?*, Bioelectromagnetics. 2006 Feb;27(2):112-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P **Juutilainen J** *et al*, (January 2006) *Do extremely low frequency magnetic fields enhance the effects of environmental carcinogens? A meta-analysis of experimental studies*, Int J Radiat Biol. 2006 Jan;82(1):1-12 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Blask DE** *et al*, (December 2005) *Melatonin-depleted blood from premenopausal women exposed to light at night stimulates growth of human breast cancer xenografts in nude rats*, Cancer Res. 2005 Dec 1;65(23):11174-84 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Budi A** *et al*, (December 2005) *Electric field effects on insulin chain-B conformation*, J Phys Chem B. 2005 Dec 1;109(47):22641-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Li L** *et al*, (December 2005) *Pulsed electric field exposure of insulin induces anti-proliferative effects on human hepatocytes*, Bioelectromagnetics. 2005 Dec;26(8):639-47 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Girgert R** *et al*, (November 2005) *Induction of tamoxifen resistance in breast cancer cells by ELF electromagnetic fields*, Biochem Biophys Res Commun. 2005 Nov 4;336(4):1144-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Rajkovic V** *et al*, (November 2005) *The effect of extremely low-frequency electromagnetic fields on skin and thyroid amine- and peptide-containing cells in rats: an immunohistochemical and morphometrical study*, Environ Res. 2005 Nov;99(3):369-77 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Maslanyj MP** *et al*, (August 2005) *Investigation and Identification of Sources of Residential Magnetic Field Exposures in the United Kingdom Childhood Cancer Study (UKCCS)*, HPA-RPD-005 - ISBN 0 85951 564 8 [[View Author's abstract conclusions](#)]
- P **Winker R** *et al*, (August 2005) *Chromosomal damage in human diploid fibroblasts by intermittent exposure to extremely low-frequency electromagnetic fields*, Mutat Res. 2005 Aug 1;585(1-2):43-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Rajkovic V** *et al*, (July 2005) *Histological characteristics of cutaneous and thyroid mast cell populations in male rats exposed to power-frequency electromagnetic fields*, Int J Radiat Biol. 2005 Jul;81(7):491-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Vijayalaxmi , Obe G**, (July 2005) *Controversial cytogenetic observations in mammalian somatic cells exposed to extremely low frequency electromagnetic radiation: a review and future research recommendations*, Bioelectromagnetics. 2005 Jul;26(5):412-30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Crumpton MJ**, (June 2005) *The Bernal Lecture 2004 Are low-frequency electromagnetic fields a health hazard?*, Philos Trans R Soc Lond B Biol Sci. 2005 Jun 29;360(1458):1223-30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Ivancsits S** *et al*, (June 2005) *Cell type-specific genotoxic effects of intermittent extremely low-frequency electromagnetic fields*, Mutat Res. 2005 Jun 6;583(2):184-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Draper G** *et al*, (June 2005) *Childhood cancer in relation to distance from high voltage power lines in England and Wales: a case-control study*, BMJ. 2005 Jun 4;330(7503):1290 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

[on Pubmed\]](#)

P **Chiu RS, Stuchly MA**, (June 2005) *Electric fields in bone marrow substructures at power-line frequencies*, IEEE Trans Biomed Eng. 2005 Jun;52(6):1103-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Henshaw DL, Reiter RJ**, (2005) *Do magnetic fields cause increased risk of childhood leukemia via melatonin disruption?*, Bioelectromagnetics. 2005;Suppl 7:S86-97 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Sims S, Dent P**, (2005) *High-voltage Overhead Power Lines and Property Values: A Residential Study in the UK*, Urban Studies, Vol. 42, No. 4, 665-694 (2005) [[View Author's abstract conclusions](#)]

- **Klaeboe L et al**, (May 2005) *Residential and occupational exposure to 50-Hz magnetic fields and brain tumours in Norway: a population-based study*, Int J Cancer. 2005 May 20;115(1):137-41 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Carrillo-Vico A et al**, (February 2005) *Human lymphocyte-synthesized melatonin is involved in the regulation of the interleukin-2/interleukin-2 receptor system*, J Clin Endocrinol Metab. 2005 Feb;90(2):992-1000 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Leszczynski D**, (February 2005) *Rapporteur report: cellular, animal and epidemiological studies of the effects of static magnetic fields relevant to human health*, Prog Biophys Mol Biol. 2005 Feb-Apr;87(2-3):247-53 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Miyakoshi J**, (February 2005) *Effects of static magnetic fields at the cellular level*, Prog Biophys Mol Biol. 2005 Feb-Apr;87(2-3):213-23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Kleinerman RA et al**, (January 2005) *Self-reported electrical appliance use and risk of adult brain tumors*, Am J Epidemiol. 2005 Jan 15;161(2):136-46 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Liu Y et al**, (January 2005) *Magnetic field effect on singlet oxygen production in a biochemical system*, Chem Commun (Camb). 2005 Jan 14;(2):174-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Crumpton MJ, Collins AR**, (October 2004) *Are environmental electromagnetic fields genotoxic?*, DNA Repair (Amst). 2004 Oct 5;3(10):1385-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Lupke M et al**, (September 2004) *Cell activating capacity of 50 Hz magnetic fields to release reactive oxygen intermediates in human umbilical cord blood-derived monocytes and in Mono Mac 6 cells*, Free Radic Res. 2004 Sep;38(9):985-93 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Simko M, Mattsson MO**, (September 2004) *Extremely low frequency electromagnetic fields as effectors of cellular responses in vitro: possible immune cell activation*, J Cell Biochem. 2004 Sep 1;93(1):83-92 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Wakeford R**, (August 2004) *The cancer epidemiology of radiation*, Oncogene. 2004 Aug 23;23(38):6404-28 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Kliukiene J et al**, (May 2004) *Residential and occupational exposures to 50-Hz magnetic fields and breast cancer in women: a population-based study*, Am J Epidemiol. 2004 May 1;159(9):852-61 [[View Author's abstract](#)]

[conclusions](#)] [[View on Pubmed](#)]

**P Lai H, Singh NP**, (May 2004) *Magnetic-field-induced DNA strand breaks in brain cells of the rat*, Environ Health Perspect. 2004 May;112(6):687-94 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Lee BC et al**, (January 2004) *Effects of extremely low frequency magnetic field on the antioxidant defense system in mouse brain: a chemiluminescence study*, J Photochem Photobiol B. 2004 Jan 23;73(1-2):43-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Fedrowitz M et al**, (January 2004) *Significant differences in the effects of magnetic field exposure on 7,12-dimethylbenz(a)anthracene-induced mammary carcinogenesis in two substrains of Sprague-Dawley rats*, Cancer Res. 2004 Jan 1;64(1):243-51 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Johansen C**, (2004) *Electromagnetic fields and health effects--epidemiologic studies of cancer, diseases of the central nervous system and arrhythmia-related heart disease*, Scand J Work Environ Health. 2004;30 Suppl 1:1-30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Rodriguez C et al**, (January 2004) *Regulation of antioxidant enzymes: a significant role for melatonin*, J Pineal Res. 2004 Jan;36(1):1-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Tynes T, Haldorsen T**, (October 2003) *Residential and occupational exposure to 50 Hz magnetic fields and hematological cancers in Norway*, Cancer Causes Control. 2003 Oct;14(8):715-20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Hakansson N et al**, (September 2003) *Occupational exposure to extremely low frequency magnetic fields and mortality from cardiovascular disease*, Am J Epidemiol. 2003 Sep 15;158(6):534-42 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Tikhonova GI et al**, (September 2003) *Remote effects of occupational and non-occupational exposure to electromagnetic fields of power-line frequency. Epidemiological studies*, Radiats Biol Radioecol. 2003 Sep-Oct;43(5):555-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Feychting M et al**, (July 2003) *Occupational magnetic field exposure and neurodegenerative disease*, Epidemiology. 2003 Jul;14(4):413-9; discussion 427-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Hakansson N et al**, (July 2003) *Neurodegenerative diseases in welders and other workers exposed to high levels of magnetic fields*, Epidemiology. 2003 Jul;14(4):420-6; discussion 427-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Infante-Rivard C, Deadman JE**, (July 2003) *Maternal occupational exposure to extremely low frequency magnetic fields during pregnancy and childhood leukemia*, Epidemiology. 2003 Jul;14(4):437-41 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Ivancsits S et al**, (July 2003) *Intermittent extremely low frequency electromagnetic fields cause DNA damage in a dose-dependent way*, Int Arch Occup Environ Health. 2003 Jul;76(6):431-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Ivancsits S et al**, (July 2003) *Age-related effects on induction of DNA strand breaks by intermittent exposure to electromagnetic fields*, Mech Ageing Dev. 2003 Jul;124(7):847-50 [[View Author's abstract conclusions](#)] [[View](#)

[on Pubmed\]](#)

P **Cho YH, Chung HW**, (June 2003) *The effect of extremely low frequency electromagnetic fields (ELF-EMF) on the frequency of micronuclei and sister chromatid exchange in human lymphocytes induced by benzo(a)pyrene*, Toxicol Lett. 2003 Jun 5;143(1):37-44 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Habash RW et al**, (2003) *Health risks of electromagnetic fields. Part I: Evaluation and assessment of electric and magnetic fields*, Crit Rev Biomed Eng. 2003;31(3):141-95 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Lewy H et al**, (June 2003) *Magnetic field (50 Hz) increases N-acetyltransferase, hydroxy-indole-O-methyltransferase activity and melatonin release through an indirect pathway*, Int J Radiat Biol. 2003 Jun;79(6):431-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Touitou Y et al**, (June 2003) *Magnetic fields and the melatonin hypothesis: a study of workers chronically exposed to 50-Hz magnetic fields*, Am J Physiol Regul Integr Comp Physiol. 2003 Jun;284(6):R1529-35 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Tynes T et al**, (May 2003) *Residential and occupational exposure to 50 Hz magnetic fields and malignant melanoma: a population based study*, Occup Environ Med. 2003 May;60(5):343-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Charles LE et al**, (April 2003) *Electromagnetic fields, polychlorinated biphenyls, and prostate cancer mortality in electric utility workers*, Am J Epidemiol. 2003 Apr 15;157(8):683-91 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **van Wijngaarden E**, (January 2003) *An exploratory investigation of suicide and occupational exposure*, J Occup Environ Med. 2003 Jan;45(1):96-101 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Kaune WT**, (December 2002) *Thermal noise limit on the sensitivity of cellular membranes to power frequency electric and magnetic fields*, Bioelectromagnetics. 2002 Dec;23(8):622-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Navas-Acien A et al**, (December 2002) *Interactive effect of chemical substances and occupational electromagnetic field exposure on the risk of gliomas and meningiomas in Swedish men*, Cancer Epidemiol Biomarkers Prev. 2002 Dec;11(12):1678-83 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Kavet R, Zaffanella LE**, (September 2002) *Contact voltage measured in residences: implications to the association between magnetic fields and childhood leukemia*, Bioelectromagnetics. 2002 Sep;23(6):464-74 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Ivancsits S et al**, (August 2002) *Induction of DNA strand breaks by intermittent exposure to extremely-low-frequency electromagnetic fields in human diploid fibroblasts*, Mutat Res. 2002 Aug 26;519(1-2):1-13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Henshaw DL**, (July 2002) *Does our electricity distribution system pose a serious risk to public health?*, Med Hypotheses. 2002 Jul;59(1):39-51 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P California EMF Program**, (June 2002) *An Evaluation of the Possible Risks From Electric and Magnetic Fields (EMFs) From Power Lines, Internal Wiring, Electrical Occupations and Appliances*, [[View Author's abstract conclusions](#)]

**P Fedrowitz M et al**, (March 2002) *Magnetic field exposure increases cell proliferation but does not affect melatonin levels in the mammary gland of female Sprague Dawley rats*, *Cancer Res.* 2002 Mar 1;62(5):1356-63 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Noonan CW et al**, (February 2002) *Occupational exposure to magnetic fields in case-referent studies of neurodegenerative diseases*, *Scand J Work Environ Health.* 2002 Feb;28(1):42-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Villeneuve PJ et al**, (February 2002) *Brain cancer and occupational exposure to magnetic fields among men: results from a Canadian population-based case-control study*, *Int J Epidemiol.* 2002 Feb;31(1):210-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Lee GM et al**, (January 2002) *A nested case-control study of residential and personal magnetic field measures and miscarriages*, *Epidemiology.* 2002 Jan;13(1):21-31 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Li DK et al**, (January 2002) *A population-based prospective cohort study of personal exposure to magnetic fields during pregnancy and the risk of miscarriage*, *Epidemiology.* 2002 Jan;13(1):9-20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Ahlbom A et al**, (December 2001) *Review of the epidemiologic literature on EMF and Health*, *Environ Health Perspect.* 2001 Dec;109 Suppl 6:911-33 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Johansson O et al**, (November 2001) *Cutaneous mast cells are altered in normal healthy volunteers sitting in front of ordinary TVs/PCs--results from open-field provocation experiments*, *J Cutan Pathol.* 2001 Nov;28(10):513-9. [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Davis S et al**, (October 2001) *Residential magnetic fields, light-at-night, and nocturnal urinary 6-sulfatoxymelatonin concentration in women*, *Am J Epidemiol.* 2001 Oct 1;154(7):591-600 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Levallois P et al**, (October 2001) *Effects of electric and magnetic fields from high-power lines on female urinary excretion of 6-sulfatoxymelatonin*, *Am J Epidemiol.* 2001 Oct 1;154(7):601-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**- De Roos AJ et al**, (September 2001) *Parental occupational exposures to electromagnetic fields and radiation and the incidence of neuroblastoma in offspring*, *Epidemiology.* 2001 Sep;12(5):508-17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Simko M et al**, (August 2001) *Micronucleus induction in Syrian hamster embryo cells following exposure to 50 Hz magnetic fields, benzo(a)pyrene, and TPA in vitro*, *Mutat Res.* 2001 Aug 22;495(1-2):43-50 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Beale IL et al**, (August 2001) *Association Of Health Problems With 50 -Hz Magnetic Fields In Human Adults Living Near Power Transmission Lines*, *Journal of the Australasian College of Nutritional & Environmental*

Medicine, 20(2) August 2001 [[View Author's abstract conclusions](#)]

**P Cano MI, Pollan M**, (August 2001) *Non-Hodgkin's lymphomas and occupation in Sweden*, Int Arch Occup Environ Health. 2001 Aug;74(6):443-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Ishido M et al**, (July 2001) *Magnetic fields (MF) of 50 Hz at 1.2 microT as well as 100 microT cause uncoupling of inhibitory pathways of adenylyl cyclase mediated by melatonin 1a receptor in MF-sensitive MCF-7 cells*, Carcinogenesis. 2001 Jul;22(7):1043-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P van Wijngaarden E et al**, (July 2001) *Population-based case-control study of occupational exposure to electromagnetic fields and breast cancer*, Ann Epidemiol. 2001 Jul;11(5):297-303 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Ahlbom A**, (2001) *Neurodegenerative diseases, suicide and depressive symptoms in relation to EMF*, Bioelectromagnetics. 2001;Suppl 5:S132-43 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Erren TC**, (2001) *A meta-analysis of epidemiologic studies of electric and magnetic fields and breast cancer in women and men*, Bioelectromagnetics. 2001;Suppl 5:S105-19 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Keetley V et al**, (June 2001) *Neuropsychological sequelae of 50 Hz magnetic fields*, Int J Radiat Biol. 2001 Jun;77(6):735-42 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Li X et al**, (June 2001) *Effects of low frequency pulsed electric field on insulin studied by fluorescent spectrum*, Guang Pu Xue Yu Guang Pu Fen Xi. 2001 Jun;21(3):406-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Wartenberg D**, (2001) *Residential EMF exposure and childhood leukemia: meta-analysis and population attributable risk*, Bioelectromagnetics. 2001;Suppl 5:S86-104 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Fabbro-Peray P et al**, (April 2001) *Environmental risk factors for non-Hodgkin's lymphoma: a population-based case-control study in Languedoc-Roussillon, France*, Cancer Causes Control. 2001 Apr;12(3):201-12 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Milham S, Ossiander EM**, (March 2001) *Historical evidence that residential electrification caused the emergence of the childhood leukemia peak*, Med Hypotheses. 2001 Mar;56(3):290-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Pollan M et al**, (March 2001) *Breast cancer, occupation, and exposure to electromagnetic fields among Swedish men*, Am J Ind Med. 2001 Mar;39(3):276-85 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Schuz J et al**, (March 2001) *Residential magnetic fields as a risk factor for childhood acute leukaemia: results from a German population-based case-control study*, Int J Cancer. 2001 Mar 1;91(5):728-35 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Blackman CF et al**, (February 2001) *The influence of 1.2 microT, 60 Hz magnetic fields on melatonin- and tamoxifen-induced inhibition of MCF-7 cell growth*, Bioelectromagnetics. 2001 Feb;22(2):122-8 [[View Author's](#)

[abstract conclusions](#)] [[View on Pubmed](#)]

**P Hansen J**, (January 2001) *Increased breast cancer risk among women who work predominantly at night*, Epidemiology. 2001 Jan;12(1):74-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Cecconi S et al**, (November 2000) *Evaluation of the effects of extremely low frequency electromagnetic fields on mammalian follicle development*, Hum Reprod. 2000 Nov;15(11):2319-25 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Greenland S et al**, (November 2000) *A pooled analysis of magnetic fields, wire codes, and childhood leukemia. Childhood Leukemia-EMF Study Group*, Epidemiology. 2000 Nov;11(6):624-34 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Savitz DA et al**, (October 2000) *Case-cohort analysis of brain cancer and leukemia in electric utility workers using a refined magnetic field job-exposure matrix*, Am J Ind Med. 2000 Oct;38(4):417-25 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Ahlbom A et al**, (September 2000) *A pooled analysis of magnetic fields and childhood leukaemia*, Br J Cancer. 2000 Sep;83(5):692-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Anderson LE et al**, (September 2000) *Effects of 50- or 60-hertz, 100 microT magnetic field exposure in the DMBA mammary cancer model in Sprague-Dawley rats: possible explanations for different results from two laboratories*, Environ Health Perspect. 2000 Sep;108(9):797-802 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Johansen C**, (September 2000) *Exposure to electromagnetic fields and risk of central nervous system disease in utility workers*, Epidemiology. 2000 Sep;11(5):539-43 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Boorman GA et al**, (May 2000) *Leukemia and lymphoma incidence in rodents exposed to low-frequency magnetic fields*, Radiat Res. 2000 May;153(5 Pt 2):627-36 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Loberg LI et al**, (May 2000) *Expression of cancer-related genes in human cells exposed to 60 Hz magnetic fields*, Radiat Res. 2000 May;153(5 Pt 2):679-84 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P van Wijngaarden E et al**, (April 2000) *Exposure to electromagnetic fields and suicide among electric utility workers: a nested case-control study*, Occup Environ Med. 2000 Apr;57(4):258-63 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Hatch EE et al**, (March 2000) *Do confounding or selection factors of residential wiring codes and magnetic fields distort findings of electromagnetic fields studies?*, Epidemiology. 2000 Mar;11(2):189-98 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Miyakoshi J et al**, (February 2000) *Suppression of heat-induced HSP-70 by simultaneous exposure to 50 mT magnetic field*, Life Sci. 2000 Feb 18;66(13):1187-96 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Burch JB et al**, (February 2000) *Melatonin metabolite levels in workers exposed to 60-Hz magnetic fields: work in substations and with 3-phase conductors*, J Occup Environ Med. 2000 Feb;42(2):136-42 [[View Author's](#)

[abstract conclusions](#)] [[View on Pubmed](#)]

P **Wei M** *et al*, (February 2000) *Exposure to 60-Hz magnetic fields and proliferation of human astrocytoma cells in vitro*, Toxicol Appl Pharmacol. 2000 Feb 1;162(3):166-76 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Forssen UM** *et al*, (January 2000) *Occupational and residential magnetic field exposure and breast cancer in females*, Epidemiology. 2000 Jan;11(1):24-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **UKCCS**, (December 1999) *Exposure to power-frequency magnetic fields and the risk of childhood cancer. UK Childhood Cancer Study Investigators*, Lancet. 1999 Dec 4;354(9194):1925-31 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Fews AP** *et al*, (December 1999) *Increased exposure to pollutant aerosols under high voltage power lines*, Int J Radiat Biol. 1999 Dec;75(12):1505-21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Fews AP** *et al*, (December 1999) *Corona ions from powerlines and increased exposure to pollutant aerosols*, Int J Radiat Biol. 1999 Dec;75(12):1523-31 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Irgens A** *et al*, (December 1999) *The effect of male occupational exposure in infertile couples in Norway*, J Occup Environ Med. 1999 Dec;41(12):1116-20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Pipkin JL** *et al*, (September 1999) *Induction of stress proteins by electromagnetic fields in cultured HL-60 cells*, Bioelectromagnetics. 1999 Sep;20(6):347-57 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Anderson LE** *et al*, (August 1999) *Effect of 13 week magnetic field exposures on DMBA-initiated mammary gland carcinomas in female Sprague-Dawley rats*, Carcinogenesis. 1999 Aug;20(8):1615-20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Loberg LI** *et al*, (August 1999) *Gene expression in human breast epithelial cells exposed to 60 Hz magnetic fields*, Carcinogenesis. 1999 Aug;20(8):1633-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Thun-Battersby S** *et al*, (August 1999) *Exposure of Sprague-Dawley rats to a 50-Hertz, 100-microTesla magnetic field for 27 weeks facilitates mammary tumorigenesis in the 7,12-dimethylbenz[a]-anthracene model of breast cancer*, Cancer Res. 1999 Aug 1;59(15):3627-33 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Green LM** *et al*, (July 1999) *A case-control study of childhood leukemia in southern Ontario, Canada, and exposure to magnetic fields in residences*, Int J Cancer. 1999 Jul 19;82(2):161-70 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Burch JB** *et al*, (July 1999) *Reduced excretion of a melatonin metabolite in workers exposed to 60 Hz magnetic fields*, Am J Epidemiol. 1999 Jul 1;150(1):27-36 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Galvanovskis J** *et al*, (1999) *Cytoplasmic Ca<sup>2+</sup> oscillations in human leukemia T-cells are reduced by 50 Hz magnetic fields*, Bioelectromagnetics. 1999;20(5):269-76 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P Graham C, Cook MR**, (1999) *Human sleep in 60 Hz magnetic fields*, Bioelectromagnetics. 1999;20(5):277-83 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Boorman GA et al**, (May 1999) *Effect of 26 week magnetic field exposures in a DMBA initiation-promotion mammary gland model in Sprague-Dawley rats*, Carcinogenesis. 1999 May;20(5):899-904 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N McBride ML et al**, (May 1999) *Power-frequency electric and magnetic fields and risk of childhood leukemia in Canada*, Am J Epidemiol. 1999 May 1;149(9):831-42 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Jahreis GP et al**, (December 1998) *Absence of 60-Hz, 0.1-mT magnetic field-induced changes in oncogene transcription rates or levels in CEM-CM3 cells*, Biochim Biophys Acta. 1998 Dec 22;1443(3):334-42 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Johansen C, Olsen JH**, (August 1998) *Mortality from amyotrophic lateral sclerosis, other chronic disorders, and electric shocks among utility workers*, Am J Epidemiol. 1998 Aug 15;148(4):362-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **McCann J et al**, (August 1998) *The genotoxic potential of electric and magnetic fields: an update*, Mutat Res. 1998 Aug;411(1):45-86 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Feychting M et al**, (July 1998) *Magnetic fields and breast cancer in Swedish adults residing near high-voltage power lines*, Epidemiology. 1998 Jul;9(4):392-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Burch JB et al**, (June 1998) *Nocturnal excretion of a urinary melatonin metabolite among electric utility workers*, Scand J Work Environ Health. 1998 Jun;24(3):183-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Lagroye I, Poncy JL**, (1998) *Influences of 50-Hz magnetic fields and ionizing radiation on c-jun and c-fos oncoproteins*, Bioelectromagnetics. 1998;19(2):112-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Lai H et al**, (1998) *Acute exposure to a 60 Hz magnetic field affects rats' water-maze performance*, Bioelectromagnetics. 1998;19(2):117-22 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Moulder JE**, (1998) *Power-frequency fields and cancer*, Crit Rev Biomed Eng. 1998;26(1-2):1-116 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Tuinstra R et al**, (1998) *Protein kinase C activity following exposure to magnetic field and phorbol ester*, Bioelectromagnetics. 1998;19(8):469-76 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Zecca L et al**, (1998) *Biological effects of prolonged exposure to ELF electromagnetic fields in rats: III. 50 Hz electromagnetic fields*, Bioelectromagnetics. 1998;19(1):57-66 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Cohen B et al**, (May 1998) *Deposition of charged particles on lung airways*, Health Phys 74(5):554-60 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Michaelis J et al**, (January 1998) *Combined risk estimates for two German population-based case-control studies on residential magnetic fields and childhood acute leukemia*, Epidemiology. 1998 Jan;9(1):92-4. [[View](#)]

[Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Verkasalo PK** *et al*, (December 1997) *Magnetic fields of transmission lines and depression*, Am J Epidemiol. 1997 Dec 15;146(12):1037-45 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Eriksson N** *et al*, (December 1997) *The psychosocial work environment and skin symptoms among visual display terminal workers: a case referent study*, Int J Epidemiol. 1997 Dec;26(6):1250-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Petridou E** *et al*, (November 1997) *Electrical power lines and childhood leukemia: a study from Greece*, Int J Cancer. 1997 Nov 4;73(3):345-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Theriault G, Li CY**, (September 1997) *Risks of leukaemia among residents close to high voltage transmission electric lines*, Occup Environ Med. 1997 Sep;54(9):625-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Linnet MS** *et al*, (July 1997) *Residential exposure to magnetic fields and acute lymphoblastic leukemia in children*, N Engl J Med. 1997 Jul 3;337(1):1-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Valberg PA** *et al*, (July 1997) *Can low-level 50/60 Hz electric and magnetic fields cause biological effects?*, Radiat Res. 1997 Jul;148(1):2-21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Beale IL** *et al*, (1997) *Psychological effects of chronic exposure to 50 Hz magnetic fields in humans living near extra-high-voltage transmission lines*, Bioelectromagnetics. 1997;18(8):584-94 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Jauchem JR**, (1997) *Exposure to extremely-low-frequency electromagnetic fields and radiofrequency radiation: cardiovascular effects in humans*, Int Arch Occup Environ Health. 1997;70(1):9-21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Vignati M, Giuliani L**, (December 1997) *Radiofrequency exposure near high-voltage lines*, Environ Health Perspect. 1997 Dec;105 Suppl 6:1569-73 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Kelsh MA, Sahl JD**, (May 1997) *Mortality among a cohort of electric utility workers, 1960-1991*, Am J Ind Med. 1997 May;31(5):534-44 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Michaelis J** *et al*, (March 1997) *Childhood leukemia and electromagnetic fields: results of a population-based case-control study in Germany*, Cancer Causes Control. 1997 Mar;8(2):167-74 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Tynes T, Haldorsen T**, (February 1997) *Electromagnetic fields and cancer in children residing near Norwegian high-voltage power lines*, Am J Epidemiol. 1997 Feb 1;145(3):219-26 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Li CY** *et al*, (January 1997) *Residential exposure to 60-Hertz magnetic fields and adult cancers in Taiwan*, Epidemiology. 1997 Jan;8(1):25-30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- N **Dees C** *et al*, (October 1996) *Effects of 60-Hz fields, estradiol and xenoestrogens on human breast cancer cells*, Radiat Res. 1996 Oct;146(4):444-52 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Lai H**, (1996) *Spatial learning deficit in the rat after exposure to a 60 Hz magnetic field*, Bioelectromagnetics. 1996;17(6):494-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Reipert BM** *et al*, (1996) *Exposure to extremely low frequency magnetic fields has no effect on growth rate or clonogenic potential of multipotential haemopoietic progenitor cells*, Growth Factors. 1996;13(3-4):205-17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Baris D** *et al*, (January 1996) *A case cohort study of suicide in relation to exposure to electric and magnetic fields among electrical utility workers*, Occup Environ Med. 1996 Jan;53(1):17-24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Heath CW Jr**, (January 1996) *Electromagnetic field exposure and cancer: a review of epidemiologic evidence*, CA Cancer J Clin. 1996 Jan-Feb;46(1):29-44 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Lacy-Hulbert A** *et al*, (October 1995) *No effect of 60 Hz electromagnetic fields on MYC or beta-actin expression in human leukemic cells*, Radiat Res. 1995 Oct;144(1):9-17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Saffer JD, Thurston SJ**, (October 1995) *Short exposures to 60 Hz magnetic fields do not alter MYC expression in HL60 or Daudi cells*, Radiat Res. 1995 Oct;144(1):18-25 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Desjobert H** *et al*, (1995) *Effects of 50 Hz magnetic fields on C-myc transcript levels in nonsynchronized and synchronized human cells*, Bioelectromagnetics. 1995;16(5):277-83 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Wertheimer N** *et al*, (1995) *Childhood cancer in relation to indicators of magnetic fields from ground current sources*, Bioelectromagnetics. 1995;16(2):86-96 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Reif JS** *et al*, (February 1995) *Residential exposure to magnetic fields and risk of canine lymphoma*, Am J Epidemiol. 1995 Feb 15;141(4):352-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Feychting M, Ahlbom A**, (September 1994) *Magnetic fields, leukemia, and central nervous system tumors in Swedish adults residing near high-voltage power lines*, Epidemiology. 1994 Sep;5(5):501-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Gold S** *et al*, (1994) *Exposure of simian virus-40-transformed human cells to magnetic fields results in increased levels of T-antigen mRNA and protein*, Bioelectromagnetics. 1994;15(4):329-36 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Goodman EM** *et al*, (1994) *Magnetic fields after translation in Escherichia coli*, Bioelectromagnetics. 1994;15(1):77-83 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Ubeda A** *et al*, (1994) *Chick embryo development can be irreversibly altered by early exposure to weak extremely-low-frequency magnetic fields*, Bioelectromagnetics. 1994;15(5):385-98 [[View Author's abstract](#)]

[conclusions](#)] [[View on Pubmed](#)]

- **Savitz DA et al**, (February 1994) *Prevalence of depression among electrical workers*, Am J Ind Med. 1994 Feb;25(2):165-76 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **McMahan S et al**, (January 1994) *Depressive symptomatology in women and residential proximity to high-voltage transmission lines*, Am J Epidemiol. 1994 Jan 1;139(1):58-63 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Liburdy RP et al**, (November 1993) *Experimental evidence for 60 Hz magnetic fields operating through the signal transduction cascade. Effects on calcium influx and c-MYC mRNA induction*, FEBS Lett. 1993 Nov 22;334(3):301-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Olsen JH et al**, (October 1993) *Residence near high voltage facilities and risk of cancer in children*, BMJ. 1993 Oct 9;307(6909):891-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Verkasalo PK et al**, (October 1993) *Risk of cancer in Finnish children living close to power lines*, BMJ. 1993 Oct 9;307(6909):895-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Feychting M, Ahlbom A**, (October 1993) *Magnetic fields and cancer in children residing near Swedish high-voltage power lines*, Am J Epidemiol. 1993 Oct 1;138(7):467-81 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Lindstrom E et al**, (August 1993) *Intracellular calcium oscillations induced in a T-cell line by a weak 50 Hz magnetic field*, J Cell Physiol. 1993 Aug;156(2):395-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Loscher W et al**, (July 1993) *Tumor promotion in a breast cancer model by exposure to a weak alternating magnetic field*, Cancer Lett. 1993 Jul 30;71(1-3):75-81 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **McCann J et al**, (July 1993) *A critical review of the genotoxic potential of electric and magnetic fields*, Mutat Res. 1993 Jul;297(1):61-95 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Greene JJ et al**, (May 1993) *Gene-specific modulation of RNA synthesis and degradation by extremely low frequency electromagnetic fields*, Cell Mol Biol (Noisy-le-grand). 1993 May;39(3):261-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Murphy JC et al**, (March 1993) *International Commission for Protection Against Environmental Mutagens and Carcinogens. Power frequency electric and magnetic fields: a review of genetic toxicology*, Mutat Res. 1993 Mar;296(3):221-40 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Poole C et al**, (February 1993) *Depressive symptoms and headaches in relation to proximity of residence to an alternating-current transmission line right-of-way*, Am J Epidemiol. 1993 Feb 1;137(3):318-30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Walleczek J**, (October 1992) *Electromagnetic field effects on cells of the immune system: the role of calcium signaling*, FASEB J. 1992 Oct;6(13):3177-85 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P **Phillips JL** *et al*, (September 1992) *Magnetic field-induced changes in specific gene transcription*, *Biochim Biophys Acta*. 1992 Sep 24;1132(2):140-4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **London SJ** *et al*, (November 1991) *Exposure to residential electric and magnetic fields and risk of childhood leukemia*, *Am J Epidemiol*. 1991 Nov 1;134(9):923-37 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Myers A** *et al*, (December 1990) *Childhood cancer and overhead powerlines: a case-control study*, *Br J Cancer*. 1990 Dec;62(6):1008-14 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Coleman MP** *et al*, (November 1989) *Leukaemia and residence near electricity transmission equipment: a case-control study*, *Br J Cancer*. 1989 Nov;60(5):793-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Perry S** *et al*, (May 1989) *Power frequency magnetic field; depressive illness and myocardial infarction*, *Public Health*. 1989 May;103(3):177-80 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Savitz DA** *et al*, (July 1988) *Case-control study of childhood cancer and exposure to 60-Hz magnetic fields*, *Am J Epidemiol*. 1988 Jul;128(1):21-38 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Wilson BW**, (1988) *Chronic exposure to ELF fields may induce depression*, *Bioelectromagnetics*. 1988;9(2):195-205 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Tomenius L**, (1986) *50-Hz electromagnetic environment and the incidence of childhood tumors in Stockholm County*, *Bioelectromagnetics*. 1986;7(2):191-207 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Lawrence AF, Adey WR**, (1982) *Nonlinear wave mechanisms in interactions between excitable tissue and electromagnetic fields*, *Neurol Res*. 1982;4(1-2):115-53 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Tamarkin L** *et al*, (May 1982) *Decreased nocturnal plasma melatonin peak in patients with estrogen receptor positive breast cancer*, *Science*. 1982 May 28;216(4549):1003-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Tamarkin L** *et al*, (November 1981) *Melatonin inhibition and pinealectomy enhancement of 7,12-dimethylbenz(a)anthracene-induced mammary tumors in the rat*, *Cancer Res*. 1981 Nov;41(11 Pt 1):4432-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Wertheimer N, Leeper E**, (March 1979) *Electrical wiring configurations and childhood cancer*, *Am J Epidemiol*. 1979 Mar;109(3):273-84 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Reichmanis M** *et al*, (1979) *Relation between suicide and the electromagnetic field of overhead power lines*, *Physiol Chem Phys*. 1979;11(5):395-403 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

## Wi-Fi

[\[Back to the top\]](#)

- **Lahham A** *et al*, (August 2015) *Public Exposure from Indoor Radiofrequency Radiation in the City of Hebron, West Bank-Palestine*, *Health Phys*. 2015 Aug;109(2):117-21. doi: 10.1097/HP.0000000000000296 [[View](#)]

[Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Redmayne M**, (June 2015) *International policy and advisory response regarding children's exposure to radio frequency electromagnetic fields (RF-EMF)*, *Electromagn Biol Med*. 2015 Jun 19;1-9. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Balmori A**, (June 2015) *Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation*, *Sci Total Environ*. 2015 Jun 15;518-519:58-60. doi: 10.1016/j.scitotenv.2015.02.077. Epub 2015 Mar 4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Hareuveny R et al**, (June 2015) *Occupational exposures to radiofrequency fields: results of an Israeli national survey*, *J Radiol Prot*. 2015 Jun;35(2):429-45. doi: 10.1088/0952-4746/35/2/429. Epub 2015 May 15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Osei S et al**, (May 2015) *Assessment of levels of occupational exposure to workers in radiofrequency fields of two television stations in Accra, Ghana*, *Radiat Prot Dosimetry*. 2015 May 15. pii: ncv326. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Gryz K et al**, (March 2015) *The Role of the Location of Personal Exposimeters on the Human Body in Their Use for Assessing Exposure to the Electromagnetic Field in the Radiofrequency Range 98-2450 MHz and Compliance Analysis: Evaluation by Virtual Measurements*, *Biomed Res Int*. 2015;2015:272460. doi: 10.1155/2015/272460. Epub 2015 Mar 24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Dasdag S et al**, (March 2015) *Effects of 2.4 GHz radiofrequency radiation emitted from WiFi equipment on microRNA expression in brain tissue*, *Int J Radiat Biol*. 2015 Mar 16:1-26. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Tomitsch J, Dechant E et al**, (January 2015) *Exposure to electromagnetic fields in households--trends from 2006 to 2012*, *Bioelectromagnetics*. 2015 Jan;36(1):77-85. doi: 10.1002/bem.21887. Epub 2014 Nov 24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Carpenter DO**, (November 2014) *Excessive exposure to radiofrequency electromagnetic fields may cause the development of electrohypersensitivity*, *Altern Ther Health Med*. 2014 Nov-Dec;20(6):40-2 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Sadetzki S et al**, (September 2014) *The MOBI-Kids Study Protocol: Challenges in Assessing Childhood and Adolescent Exposure to Electromagnetic Fields from Wireless Telecommunication Technologies and Possible Association with Brain Tumor Risk*, *Front Public Health*. 2014 Sep 23;2:124. doi: 10.3389/fpubh.2014.00124. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Bolte JF, Eikelboom T**, (November 2012) *Personal radiofrequency electromagnetic field measurements in the Netherlands: Exposure level and variability for everyday activities, times of day and types of area*, *Environ Int*. 2012 Nov 1;48:133-42. Epub 2012 Aug 18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Pilla AA**, (September 2012) *Electromagnetic fields instantaneously modulate nitric oxide signaling in challenged biological systems*, *Biochem Biophys Res Commun*. 2012 Sep 28;426(3):330-3. doi: 10.1016/j.bbrc.2012.08.078. Epub 2012 Aug 24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Vijayalaxmi, Prihoda TJ**, (September 2012) *Genetic Damage in Human Cells Exposed to Non-ionizing Radiofrequency Fields: A Meta-Analysis of the Data from 88 Publications (1990-2011)*, *Mutat Res.* 2012 Sep 27. pii: S1383-5718(12)00286-0. doi: 10.1016/j.mrgentox.2012.09.007. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Repacholi M et al**, (July 2012) *Scientific basis for the Soviet and Russian radiofrequency standards for the general public*, *Bioelectromagnetics.* 2012 Jul 2. doi: 10.1002/bem.21742. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Bellieni CV et al**, (2012) *Exposure to electromagnetic fields from laptop use of "laptop" computers*, *Arch Environ Occup Health.* 2012;67(1):31-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Atasoy HI et al**, (March 2012) *Immunohistopathologic demonstration of deleterious effects on growing rat testes of radiofrequency waves emitted from conventional Wi-Fi devices*, *J Pediatr Urol.* 2012 Mar 30. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Poullietier de Gannes F et al**, (February 2012) *Effect of In Utero Wi-Fi Exposure on the Pre- and Postnatal Development of Rats*, *Birth Defects Res B Dev Reprod Toxicol.* 2012 Feb 6. doi: 10.1002/bdrb.20346. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Avendano C et al**, (January 2012) *Use of laptop computers connected to internet through Wi-Fi decreases human sperm motility and increases sperm DNA fragmentation*, *Fertil Steril.* 2012 Jan;97(1):39-45.e2. Epub 2011 Nov 23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Sambucci M et al**, (December 2011) *Early life exposure to 2.45GHz Wi-Fi-like signals: Effects on development and maturation of the immune system*, *Prog Biophys Mol Biol.* 2011 Dec;107(3):393-8. Epub 2011 Sep 9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Breckenkamp J et al**, (October 2011) *Residential characteristics and radiofrequency electromagnetic field exposures from bedroom measurements in Germany*, *Radiat Environ Biophys.* 2011 Oct 1. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Kumar S et al**, (2011) *The therapeutic effect of a pulsed electromagnetic field on the reproductive patterns of male Wistar rats exposed to a 2.45-GHz microwave field*, *Clinics (Sao Paulo).* 2011;66(7):1237-45 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Papageorgiou CC et al**, (June 2011) *Effects of wi-fi signals on the p300 component of event-related potentials during an auditory listening task*, *J Integr Neurosci.* 2011 Jun;10(2):189-202. doi: 10.1142/S0219635211002695 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Peyman A et al**, (June 2011) *Assessment of exposure to electromagnetic fields from wireless computer networks (wi-fi) in schools; results of laboratory measurements*, *Health Phys.* 2011 Jun;100(6):594-612. [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Viel JF et al**, (May 2011) *Variability of radiofrequency exposure across days of the week: a population-based study*, *Environ Res.* 2011 May;111(4):510-3. Epub 2011 Mar 15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Blank M, Goodman R**, (April 2011) *DNA is a fractal antenna in electromagnetic fields*, Int J Radiat Biol. 2011 Apr;87(4):409-15. Epub 2011 Feb 28 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **McIntosh RL, Anderson V**, (September 2010) *SAR versus S(inc): What is the appropriate RF exposure metric in the range 1-10 GHz? Part II: Using complex human body models*, Bioelectromagnetics. 2010 Sep;31(6):467-78 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Joseph W et al**, (May 2010) *Estimation of whole-body SAR from electromagnetic fields using personal exposure meters*, Bioelectromagnetics. 2010 May;31(4):286-95 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Fang M, Malone D**, (April 2010) *Experimental verification of a radiofrequency power model for Wi-Fi technology*, Health Phys. 2010 Apr;98(4):574-83 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Verloock L et al**, (April 2010) *Procedure for assessment of general public exposure from WLAN in offices and in wireless sensor network testbed*, Health Phys. 2010 Apr;98(4):628-38 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Carpenter DO et al**, (January 2010) *Electromagnetic fields and cancer: the cost of doing nothing*, Rev Environ Health. 2010 Jan-Mar;25(1):75-80 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Viel JF et al**, (August 2009) *Radiofrequency exposure in the French general population: band, time, location and activity variability*, Environ Int. 2009 Nov;35(8):1150-4. Epub 2009 Aug 4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Frei P et al**, (August 2009) *Temporal and spatial variability of personal exposure to radio frequency electromagnetic fields*, Environ Res. 2009 Aug;109(6):779-85. Epub 2009 May 23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Peyman A et al**, (June 2009) *Evaluation Of Exposure Of School Children To Electromagnetic Fields From Wireless Computer Networks (Wi-Fi): Phase I Laboratory Measurements*, [[View Author's abstract conclusions](#)]
- **Kuhn S et al**, (August 2007) *Assessment Methods for Demonstrating Compliance With Safety Limits of Wireless Devices Used in Home and Office Environments*, Electromagnetic Compatibility, 2007 August;49(3):519-525 [[View Author's abstract conclusions](#)]
- **Foster KR**, (March 2007) *Radiofrequency exposure from wireless LANs utilizing Wi-Fi technology*, Health Phys. 2007 Mar;92(3):280-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Kuhn S, Kuster N**, (July 2006) *Development of Procedures for the EMF Exposure Evaluation of Wireless Devices in Home and Office Environments Supplement 1: Close-to-Body and Base Station Wireless Data Communication Devices*, Foundation for Research on Information Technologies in Society, ETH Zurich, Switzerland [[View Author's abstract conclusions](#)]

## Electrical Sensitivity

[\[Back to the top\]](#)

**N Eltiti S et al**, (February 2015) *Aggregated data from two double-blind base station provocation studies comparing individuals with idiopathic environmental intolerance with attribution to electromagnetic fields and controls*, *Bioelectromagnetics*. 2015 Feb;36(2):96-107. doi: 10.1002/bem.21892. Epub 2015 Jan 30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Carpenter DO**, (November 2014) *Excessive exposure to radiofrequency electromagnetic fields may cause the development of electrohypersensitivity*, *Altern Ther Health Med*. 2014 Nov-Dec;20(6):40-2 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Lamech F**, (November 2014) *Self-reporting of symptom development from exposure to radiofrequency fields of wireless smart meters in victoria, australia: a case series*, *Altern Ther Health Med*. 2014 Nov-Dec;20(6):28-39 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Redmayne M, Johansson O**, (September 2014) *Could myelin damage from radiofrequency electromagnetic field exposure help explain the functional impairment electrohypersensitivity? A review of the evidence*, *J Toxicol Environ Health B Crit Rev*. 2014;17(5):247-58. doi: 10.1080/10937404.2014.923356 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Baliatsas C et al**, (August 2012) *Idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF): A systematic review of identifying criteria*, *BMC Public Health*. 2012 Aug 11;12(1):643. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Augner C et al**, (March 2012) *Acute effects of electromagnetic fields emitted by GSM mobile phones on subjective well-being and physiological reactions: A meta-analysis*, *Sci Total Environ*. 2012 Mar 13. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Frei P et al**, (January 2012) *Cohort study on the effects of everyday life radio frequency electromagnetic field exposure on non-specific symptoms and tinnitus*, *Environ Int*. 2012 Jan;38(1):29-36. doi: 10.1016/j.envint.2011.08.002. Epub 2011 Sep 10 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Wallace D et al**, (January 2012) *Cognitive and physiological responses in humans exposed to a TETRA base station signal in relation to perceived electromagnetic hypersensitivity*, *Bioelectromagnetics*. 2012 Jan;33(1):23-39. doi: 10.1002/bem.20681. Epub 2011 Jun 6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Genuis SJ, Lipp CT**, (December 2011) *Electromagnetic hypersensitivity: Fact or fiction?*, *Sci Total Environ*. 2011 Dec 5. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P McCarty DE et al**, (December 2011) *Electromagnetic hypersensitivity: evidence for a novel neurological syndrome*, *Int J Neurosci*. 2011 Dec;121(12):670-6. Epub 2011 Sep 5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Rubin GJ et al**, (December 2011) *Do people with idiopathic environmental intolerance attributed to electromagnetic fields display physiological effects when exposed to electromagnetic fields? A systematic review of provocation studies*, *Bioelectromagnetics*. 2011 Dec;32(8):593-609. doi: 10.1002/bem.20690. Epub 2011 Jul 18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Nijs J et al**, (July 2011) *In the mind or in the brain? Scientific evidence for central sensitisation in chronic fatigue syndrome*, *Eur J Clin Invest*. 2011 Jul 2. doi: 10.1111/j.1365-2362.2011.02575.x. [Epub ahead of print]

[\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

**N Roosli M, Hug K**, (May 2011) *Wireless communication fields and non-specific symptoms of ill health: a literature review*, Wien Med Wochenschr. 2011 May;161(9-10):240-50 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

- **Blank M, Goodman R**, (April 2011) *DNA is a fractal antenna in electromagnetic fields*, Int J Radiat Biol. 2011 Apr;87(4):409-15. Epub 2011 Feb 28 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

**P Nishimura T et al**, (March 2011) *A 1-uT extremely low-frequency electromagnetic field vs. sham control for mild-to-moderate hypertension: a double-blind, randomized study*, Hypertens Res. 2011 Mar;34(3):372-7. Epub 2011 Jan 20 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

**P Lowden A et al**, (January 2011) *Sleep after mobile phone exposure in subjects with mobile phone-related symptoms*, Bioelectromagnetics. 2011 Jan;32(1):4-14 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

**P Grigoriev YG et al**, (December 2010) *Confirmation studies of Soviet research on immunological effects of microwaves: Russian immunology results*, Bioelectromagnetics. 2010 Dec;31(8):589-602. doi: 10.1002/bem.20605. Epub 2010 Sep 20 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

**N Kowalczyk C et al**, (October 2010) *Absence of nonlinear responses in cells and tissues exposed to RF energy at mobile phone frequencies using a doubly resonant cavity*, Bioelectromagnetics. 2010 Oct;31(7):556-65 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

**N Nieto-Hernandez R et al**, (September 2010) *Can exposure to a terrestrial trunked radio (TETRA)-like signal cause symptoms? A randomised double-blind provocation study*, Occup Environ Med. 2010 Sep 23. [Epub ahead of print] [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

- **Danker-Hopfe H et al**, (September 2010) *Do mobile phone base stations affect sleep of residents? Results from an experimental double-blind sham-controlled field study*, Am J Hum Biol. 2010 Sep-Oct;22(5):613-8 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

**N Mohler E et al**, (September 2010) *Effects of everyday radiofrequency electromagnetic-field exposure on sleep quality: a cross-sectional study*, Radiat Res. 2010 Sep;174(3):347-56 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

**N Wallace D et al**, (January 2010) *Do TETRA (Airwave) Base Station Signals Have a Short-Term Impact on Health and Well-Being? A Randomized Double-Blind Provocation Study*, Environ Health Perspect. 2010 Jan 14. [Epub ahead of print] [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

- **Johansson A et al**, (January 2010) *Symptoms, personality traits, and stress in people with mobile phone-related symptoms and electromagnetic hypersensitivity*, J Psychosom Res. 2010 Jan;68(1):37-45 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

**N Rubin GJ et al**, (January 2010) *Idiopathic environmental intolerance attributed to electromagnetic fields (formerly 'electromagnetic hypersensitivity'): An updated systematic review of provocation studies*, Bioelectromagnetics. 2010 Jan;31(1):1-11 [\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

N **Eltiti S et al**, (May 2009) *Short-term exposure to mobile phone base station signals does not affect cognitive functioning or physiological measures in individuals who report sensitivity to electromagnetic fields and controls*, Bioelectromagnetics. 2009 May 27. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Dahmen N et al**, (March 2009) *Blood laboratory findings in patients suffering from self-perceived electromagnetic hypersensitivity (EHS)*, Bioelectromagnetics. 2009 Mar 3;30(4):299-306. [Epub ahead of print] Click here to read [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Hallberg O, Johansson O**, (March 2009) *Apparent decreases in Swedish public health indicators after 1997- Are they due to improved diagnostics or to environmental factors?*, Pathophysiology. 2009 Jun;16(1):43-6. Epub 2009 Feb 10 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Berg-Beckhoff G et al**, (February 2009) *Mobile phone base stations and adverse health effects: phase 2 of a cross-sectional study with measured radio frequency electromagnetic fields*, Occup Environ Med. 2009 Feb;66(2):124-30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Blettner M et al**, (November 2008) *Mobile phone base stations and adverse health effects: Phase 1: A population-based cross-sectional study in Germany*, Occup Environ Med. 2008 Nov 18. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Nieto-Hernandez R et al**, (November 2008) *Can evidence change belief? Reported mobile phone sensitivity following individual feedback of an inability to discriminate active from sham signals*, J Psychosom Res. 2008 Nov;65(5):453-60 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Wiholm C et al**, (September 2008) *Mobile phone exposure and spatial memory*, Bioelectromagnetics. 2008 Sep 15. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Furubayashi T et al**, (September 2008) *Effects of short-term W-CDMA mobile phone base station exposure on women with or without mobile phone related symptoms*, Bioelectromagnetics. 2008 Sep 8. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Landgrebe M et al**, (July 2008) *Neuronal correlates of symptom formation in functional somatic syndromes: a fMRI study*, Neuroimage. 2008 Jul 15;41(4):1336-44 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Kim DW et al**, (2008) *Physiological effects of RF exposure on hypersensitive people by a cell phone*, Conf Proc IEEE Eng Med Biol Soc. 2008;2008:2322-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Cinel C et al**, (March 2008) *Exposure to Mobile Phone Electromagnetic Fields and Subjective Symptoms: A Double-Blind Study*, Psychosom Med. 2008 Mar 31 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Landgrebe M et al**, (March 2008) *Cognitive and neurobiological alterations in electromagnetic hypersensitive patients: results of a case-control study*, Psychol Med. 2008 Mar 26;:1-11 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Roosli M**, (March 2008) *Radiofrequency electromagnetic field exposure and non-specific symptoms of ill health: A systematic review*, Environ Res. 2008 Mar 20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Kwon MS** *et al*, (November 2007) *Perception of the electromagnetic field emitted by a mobile phone*, *Bioelectromagnetics*. 2007 Nov 20;29(2):154-159 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Eltiti S** *et al*, (November 2007) *Does short-term exposure to mobile phone base station signals increase symptoms in individuals who report sensitivity to electromagnetic fields? A double-blind randomized provocation study.*, *Environ Health Perspect*. 2007 Nov;115(11):1603-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Lin JC, Wang Z**, (June 2007) *Hearing of microwave pulses by humans and animals: effects, mechanism, and thresholds*, *Health Phys*. 2007 Jun;92(6):621-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Mortazavi SM** *et al*, (May 2007) *Prevalence of subjective poor health symptoms associated with exposure to electromagnetic fields among university students*, *Bioelectromagnetics*. 2007 May;28(4):326-30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Oftedal G** *et al*, (May 2007) *Mobile phone headache: a double blind, sham-controlled provocation study*, *Cephalalgia*. 2007 May;27(5):447-55 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Schrottner J** *et al*, (April 2007) *Investigation of electric current perception thresholds of different EHS groups*, *Bioelectromagnetics*. 2007 Apr;28(3):208-13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Abdel-Rassoul G** *et al*, (March 2007) *Neurobehavioral effects among inhabitants around mobile phone base stations*, *Neurotoxicology*. 2007 Mar;28(2):434-40 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Landgrebe M** *et al*, (March 2007) *Altered cortical excitability in subjectively electrosensitive patients: results of a pilot study*, *J Psychosom Res*. 2007 Mar;62(3):283-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Eltiti S** *et al*, (February 2007) *Development and evaluation of the electromagnetic hypersensitivity questionnaire*, *Bioelectromagnetics*. 2007 Feb;28(2):137-51 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Schreier N** *et al*, (2006) *The prevalence of symptoms attributed to electromagnetic field exposure: a cross-sectional representative survey in Switzerland*, *Soz Praventivmed*. 2006;51(4):202-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Havas M**, (2006) *Electromagnetic hypersensitivity: biological effects of dirty electricity with emphasis on diabetes and multiple sclerosis*, *Electromagn Biol Med*. 2006;25(4):259-68 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Johansson O**, (2006) *Electrohypersensitivity: state-of-the-art of a functional impairment*, *Electromagn Biol Med*. 2006;25(4):245-58 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Huss A, Roosli M**, (October 2006) *Consultations in primary care for symptoms attributed to electromagnetic fields--a survey among general practitioners*, *BMC Public Health*. 2006 Oct 30;6:267 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Persinger MA**, (2006) *A potential multiple resonance mechanism by which weak magnetic fields affect molecules and medical problems: the example of melatonin and experimental "multiple sclerosis"*, *Med*

Hypotheses. 2006;66(4):811-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Hutter HP et al**, (May 2006) *Subjective symptoms, sleeping problems, and cognitive performance in subjects living near mobile phone base stations*, *Occup Environ Med*. 2006 May;63(5):307-13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Rubin GJ et al**, (April 2006) *Are some people sensitive to mobile phone signals? Within participants double blind randomised provocation study*, *BMJ*. 2006 Apr 15;332(7546):886-91 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Papageorgiou CC et al**, (April 2006) *Acute mobile phone effects on pre-attentive operation*, *Neurosci Lett*. 2006 Apr 10-17;397(1-2):99-103 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Wilen J et al**, (April 2006) *Psychophysiological tests and provocation of subjects with mobile phone related symptoms*, *Bioelectromagnetics* 2006 Apr;27(3):204-14 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Irvine N et al**, (November 2005) *Definition, Epidemiology and Management of Electrical Sensitivity*, HPA-RPD-010 [[View Author's abstract conclusions](#)]

**N Seitz H et al**, (October 2005) *Electromagnetic hypersensitivity (EHS) and subjective health complaints associated with electromagnetic fields of mobile phone communication--a literature review published between 2000 and 2004*, *Sci Total Environ*. 2005 Oct 15;349(1-3):45-55 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Rajkovic V et al**, (July 2005) *Histological characteristics of cutaneous and thyroid mast cell populations in male rats exposed to power-frequency electromagnetic fields*, *Int J Radiat Biol*. 2005 Jul;81(7):491-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Meo SA, Al-Drees AM**, (2005) *Mobile phone related-hazards and subjective hearing and vision symptoms in the Saudi population*, *Int J Occup Med Environ Health*. 2005;18(1):53-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Leitgeb N et al**, (May 2005) *Does "electromagnetic pollution" cause illness? An inquiry among Austrian general practitioners*, *Wien Med Wochenschr*. 2005 May;155(9-10):237-41 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Rubin GJ et al**, (March 2005) *Electromagnetic hypersensitivity: a systematic review of provocation studies*, *Psychosom Med*. 2005 Mar-Apr;67(2):224-32 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Bortkiewicz A et al**, (2004) *Subjective symptoms reported by people living in the vicinity of cellular phone base stations: review*, *Med Pr*. 2004;55(4):345-51 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Oberfeld G et al**, (October 2004) *The Microwave Syndrome - Further Aspects of a Spanish Study*, *Conference Proceedings* [[View Author's abstract conclusions](#)]

**P Al-Khlaiwi T, Meo SA**, (June 2004) *Association of mobile phone radiation with fatigue, headache, dizziness, tension and sleep disturbance in Saudi population*, *Saudi Med J*. 2004 Jun;25(6):732-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Westerman R, Hocking B**, (May 2004) *Diseases of modern living: neurological changes associated with mobile phones and radiofrequency radiation in humans*, Neurosci Lett. 2004 May 6;361(1-3):13-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Roosli M et al**, (February 2004) *Symptoms of ill health ascribed to electromagnetic field exposure--a questionnaire survey*, Int J Hyg Environ Health. 2004 Feb;207(2):141-50 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Navarro EA et al**, (December 2003) *The Microwave Syndrome: A Preliminary Study in Spain*, Electromagn Biol Med 22(2-3): 161-169 [[View Author's abstract conclusions](#)]

- **Leitgeb N, Schrottner J**, (September 2003) *Electrosensibility and electromagnetic hypersensitivity*, Bioelectromagnetics. 2003 Sep;24(6):387-94 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Santini R et al**, (September 2003) *Symptoms experienced by people in vicinity of base stations: II/ Incidences of age, duration of exposure, location of subjects in relation to the antennas and other electromagnetic factors*, Pathol Biol (Paris). 2003 Sep;51(7):412-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Hocking B, Westerman R**, (October 2002) *Neurological changes induced by a mobile phone*, Occup Med (Lond). 2002 Oct;52(7):413-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Stenberg B et al**, (October 2002) *Medical and social prognosis for patients with perceived hypersensitivity to electricity and skin symptoms related to the use of visual display terminals*, Scand J Work Environ Health. 2002 Oct;28(5):349-57 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Levallois P et al**, (August 2002) *Study of self-reported hypersensitivity to electromagnetic fields in California*, Environ Health Perspect. 2002 Aug;110 Suppl 4:619-23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Levallois P**, (August 2002) *Hypersensitivity of human subjects to environmental electric and magnetic field exposure: a review of the literature*, Environ Health Perspect. 2002 Aug;110 Suppl 4:613-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Santini R et al**, (July 2002) *Investigation on the health of people living near mobile telephone relay stations: I/Incidence according to distance and sex*, Pathol Biol (Paris) 2002 Jul;50(6):369-73 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Hillert L et al**, (February 2002) *Prevalence of self-reported hypersensitivity to electric or magnetic fields in a population-based questionnaire survey*, Scand J Work Environ Health. 2002 Feb;28(1):33-41 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Edelstyn N, Oldershaw A**, (January 2002) *The acute effects of exposure to the electromagnetic field emitted by mobile phones on human attention*, Neuroreport. 2002 Jan 21;13(1):119-21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Johansson O et al**, (November 2001) *Cutaneous mast cells are altered in normal healthy volunteers sitting in front of ordinary TVs/PCs--results from open-field provocation experiments*, J Cutan Pathol. 2001 Nov;28(10):513-9. [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P **Lyskov E et al**, (November 2001) *Int J Psychophysiol.* 2001 Nov;42(3):233-41, *Int J Psychophysiol.* 2001 Nov;42(3):233-41 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Lyskov E et al**, (October 2001) *Provocation study of persons with perceived electrical hypersensitivity and controls using magnetic field exposure and recording of electrophysiological characteristics*, *Bioelectromagnetics.* 2001 Oct;22(7):457-62 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Hillert L et al**, (March 2001) *Environmental illness: fatigue and cholinesterase activity in patients reporting hypersensitivity to electricity*, *Environ Res.* 2001 Mar;85(3):200-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Oftedal G et al**, (May 2000) *Symptoms experienced in connection with mobile phone use*, *Occup Med (Lond).* 2000 May;50(4):237-45 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Gangi S, Johansson O**, (April 2000) *A theoretical model based upon mast cells and histamine to explain the recently proclaimed sensitivity to electric and/or magnetic fields in humans*, *Med Hypotheses.* 2000 Apr;54(4):663-71 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Freude G et al**, (January 2000) *Microwaves emitted by cellular telephones affect human slow brain potentials*, *Eur J Appl Physiol.* 2000 Jan;81(1-2):18-27 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Hillert L et al**, (November 1999) *Hypersensitivity to electricity: working definition and additional characterization of the syndrome*, *J Psychosom Res.* 1999 Nov;47(5):429-38 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Bergdahl J et al**, (October 1998) *Odontologic survey of referred patients with symptoms allegedly caused by electricity or visual display units*, *Acta Odontol Scand.* 1998 Oct;56(5):303-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Haugsdal B et al**, (1998) *Comparison of symptoms experienced by users of analogue and digital mobile phones: a Swedish-Norwegian epidemiological study*, *Arbetslivsrapport 23:* 1998 [[View Author's abstract conclusions](#)]
- P **Eriksson N et al**, (December 1997) *The psychosocial work environment and skin symptoms among visual display terminal workers: a case referent study*, *Int J Epidemiol.* 1997 Dec;26(6):1250-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Gangi S, Johansson O**, (December 1997) *Skin changes in "screen dermatitis" versus classical UV- and ionizing irradiation-related damage--similarities and differences*, *Exp Dermatol.* 1997 Dec;6(6):283-91 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Sandstrom M et al**, (January 1997) *Neurophysiological effects of flickering light in patients with perceived electrical hypersensitivity*, *J Occup Environ Med.* 1997 Jan;39(1):15-22 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Forman SA et al**, (October 1995) *Psychological symptoms and intermittent hypertension following acute microwave exposure*, *J Occup Med.* 1982 Nov;24(11):932-4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Johansson O** et al, (October 1994) *Skin changes in patients claiming to suffer from "screen dermatitis": a two-case open-field provocation study*, *Exp Dermatol*. 1994 Oct;3(5):234-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Szyjkowska A** et al, (October 2005) *Subjective symptoms related to mobile phone use--a pilot study*, *Pol Merkur Lekarski*. 2005 Oct;19(112):529-32 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

## EEG and Brain Responses

[[Back to the top](#)]

P **Schmid MR** et al, (June 2012) *Sleep EEG alterations: effects of pulsed magnetic fields versus pulse-modulated radio frequency electromagnetic fields*, *J Sleep Res*. 2012 Jun 22. doi: 10.1111/j.1365-2869.2012.01025.x. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Loughran SP** et al, (August 2011) *Individual differences in the effects of mobile phone exposure on human sleep: Rethinking the problem*, *Bioelectromagnetics*. 2011 Aug 3. doi: 10.1002/bem.20691. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Vorobyov V** et al, (May 2010) *Repeated exposure to low-level extremely low frequency-modulated microwaves affects cortex-hypothalamus interplay in freely moving rats: EEG study*, *Int J Radiat Biol*. 2010 May;86(5):376-83 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Barth A** et al, (April 2010) *Effects of extremely low-frequency magnetic field exposure on cognitive functions: results of a meta-analysis*, *Bioelectromagnetics*. 2010 Apr;31(3):173-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Fragopoulou AF** et al, (June 2010) *Whole body exposure with GSM 900MHz affects spatial memory in mice*, *Pathophysiology*. 2010 Jun;17(3):179-187. Epub 2009 Dec 1 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Cvetkovic D, Cosic I**, (October 2009) *Alterations of human electroencephalographic activity caused by multiple extremely low frequency magnetic field exposures*, *Med Biol Eng Comput*. 2009 Oct;47(10):1063-73. Epub 2009 Aug 26 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Robertson JA** et al, (August 2009) *Low-frequency pulsed electromagnetic field exposure can alter neuroprocessing in humans*, *J R Soc Interface*. 2009 Aug 5. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Abramson MJ** et al, (July 2009) *Mobile telephone use is associated with changes in cognitive function in young adolescents*, *Bioelectromagnetics*. 2009 Jul 30. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Lopez-Martin E** et al, (May 2009) *The action of pulse-modulated GSM radiation increases regional changes in brain activity and c-Fos expression in cortical and subcortical areas in a rat model of picrotoxin-induced seizure proneness*, *J Neurosci Res*. 2009 May 1;87(6):1484-99 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **McNamee DA et al**, (February 2009) *A literature review: the cardiovascular effects of exposure to extremely low frequency electromagnetic fields*, Int Arch Occup Environ Health. 2009 Feb 17. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Luria R et al**, (November 2008) *Cognitive effects of radiation emitted by cellular phones: The influence of exposure side and time*, Bioelectromagnetics. 2008 Nov 17;30(3):198-204. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Wiholm C et al**, (September 2008) *Mobile phone exposure and spatial memory*, Bioelectromagnetics. 2008 Sep 15. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Andrzejak R et al**, (August 2008) *The influence of the call with a mobile phone on heart rate variability parameters in healthy volunteers*, Ind Health. 2008 Aug;46(4):409-17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Cook CM et al**, (July 2008) *Changes in human EEG alpha activity following exposure to two different pulsed magnetic field sequences*, Bioelectromagnetics. 2008 Jul 28 [Epub] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Perentos N et al**, (2008) *The effect of GSM-like ELF radiation on the alpha band of the human resting EEG*, Conf Proc IEEE Eng Med Biol Soc. 2008;2008:5680-3 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Liu T et al**, (March 2008) *Chronic exposure to low-intensity magnetic field improves acquisition and maintenance of memory*, Neuroreport. 2008 Mar 25;19(5):549-52 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Hardell L, Sage C**, (February 2008) *Biological effects from electromagnetic field exposure and public exposure standards*, Biomed Pharmacother. 2008 Feb;62(2):104-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Arnetz BB et al**, (2007) *The Effects of 884 MHz GSM Wireless Communication Signals on Self-reported Symptom and Sleep (EEG)- An Experimental Provocation Study*, PIERS Online Vol. 3 No. 7 2007 pp: 1148-1150 [[View Author's abstract conclusions](#)]

**P Abdel-Rassoul G et al**, (March 2007) *Neurobehavioral effects among inhabitants around mobile phone base stations*, Neurotoxicology. 2007 Mar;28(2):434-40 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Landgrebe M et al**, (March 2007) *Altered cortical excitability in subjectively electrosensitive patients: results of a pilot study*, J Psychosom Res. 2007 Mar;62(3):283-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Bachmann M et al**, (2006) *Integration of differences in EEG Analysis Reveals Changes in Human EEG Caused by Microwave*, Conf Proc IEEE Eng Med Biol Soc. 2006;1:1597-600 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Papageorgiou CC et al**, (April 2006) *Acute mobile phone effects on pre-attentive operation*, Neurosci Lett. 2006 Apr 10-17;397(1-2):99-103 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P **Preece AW et al**, (2005) *Effect of 902 MHz mobile phone transmission on cognitive function in children*, Bioelectromagnetics Suppl 7 S138-43 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Wang Q et al**, (March 2005) *Effect of 900Mhz electromagnetic fields on energy metabolism in postnatal rat cerebral cortical neurons*, Wei Sheng Yan Jiu. 2005 Mar;34(2):155-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Huber R et al**, (February 2005) *Exposure to pulse-modulated radio frequency electromagnetic fields affects regional cerebral blood flow*, Eur J Neurosci. 2005 Feb;21(4):1000-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Lai H**, (October 2004) *Interaction of microwaves and a temporally incoherent magnetic field on spatial learning in the rat*, Physiol Behav. 2004 Oct 15;82(5):785-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Wang Q et al**, (July 2004) *Effect of 900MHz electromagnetic fields on energy metabolism of cerebral cortical neurons in postnatal rat*, Wei Sheng Yan Jiu. 2004 Jul;33(4):428-9, 432 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **D'Costa H et al**, (December 2003) *Human brain wave activity during exposure to radiofrequency field emissions from mobile phones*, Australas Phys Eng Sci Med. 2003 Dec;26(4):162-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Kramarenko AV, Tan U**, (July 2003) *Effects of high-frequency electromagnetic fields on human EEG: a brain mapping study*, Int J Neurosci. 2003 Jul;113(7):1007-19 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Huber R et al**, (May 2003) *Radio frequency electromagnetic field exposure in humans: Estimation of SAR distribution in the brain, effects on sleep and heart rate*, Bioelectromagnetics. 2003 May;24(4):262-76 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Hocking B, Westerman R**, (March 2003) *Neurological effects of radiofrequency radiation*, Occup Med 2003 Mar;53(2):123-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Huber R et al**, (December 2002) *Electromagnetic fields, such as those from mobile phones, alter regional cerebral blood flow and sleep and waking EEG*, J Sleep Res 2002 Dec;11(4):289-95 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Hocking B, Westerman R**, (October 2002) *Neurological changes induced by a mobile phone*, Occup Med (Lond). 2002 Oct;52(7):413-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Keetley V et al**, (June 2001) *Neuropsychological sequelae of 50 Hz magnetic fields*, Int J Radiat Biol. 2001 Jun;77(6):735-42 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Krause CM et al**, (December 2000) *Effects of electromagnetic fields emitted by cellular phones on the electroencephalogram during a visual working memory task*, Int J Radiat Biol. 2000 Dec;76(12):1659-67 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Huber R et al**, (October 2000) *Exposure to pulsed high-frequency electromagnetic field during waking affects human sleep EEG*, Neuroreport. 2000 Oct 20;11(15):3321-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

[Pubmed](#)]

P **Koivisto M** *et al*, (June 2000) *The effects of electromagnetic field emitted by GSM phones on working memory*, Neuroreport. 2000 Jun 5;11(8):1641-3 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **van Wijngaarden E** *et al*, (April 2000) *Exposure to electromagnetic fields and suicide among electric utility workers: a nested case-control study*, Occup Environ Med. 2000 Apr;57(4):258-63 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Cao Z** *et al*, (March 2000) *Effects of electromagnetic radiation from handsets of cellular telephone on neurobehavioral function*, Wei Sheng Yan Jiu. 2000 Mar 30;29(2):102-3 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Krause CM** *et al*, (March 2000) *Effects of electromagnetic field emitted by cellular phones on the EEG during a memory task*, Neuroreport. 2000 Mar 20;11(4):761-4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Koivisto M** *et al*, (February 2000) *Effects of 902 MHz electromagnetic field emitted by cellular telephones on response times in humans*, Neuroreport. 2000 Feb 7;11(2):413-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Freude G** *et al*, (January 2000) *Microwaves emitted by cellular telephones affect human slow brain potentials*, Eur J Appl Physiol. 2000 Jan;81(1-2):18-27 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Wang B, Lai H**, (January 2000) *Acute exposure to pulsed 2450-MHz microwaves affects water-maze performance of rats*, Bioelectromagnetics. 2000 Jan;21(1):52-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Borbely AA** *et al*, (November 1999) *Pulsed high-frequency electromagnetic field affects human sleep and sleep electroencephalogram*, Neurosci Lett. 1999 Nov 19;275(3):207-10 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Eulitz C** *et al*, (October 1998) *Mobile phones modulate response patterns of human brain activity*, Neuroreport. 1998 Oct 5;9(14):3229-32 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Freude G** *et al*, (1998) *Effects of microwaves emitted by cellular phones on human slow brain potentials*, Bioelectromagnetics. 1998;19(6):384-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Lai H** *et al*, (1998) *Acute exposure to a 60 Hz magnetic field affects rats' water-maze performance*, Bioelectromagnetics. 1998;19(2):117-22 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Lai H**, (1996) *Spatial learning deficit in the rat after exposure to a 60 Hz magnetic field*, Bioelectromagnetics. 1996;17(6):494-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Reiser H** *et al*, (October 1995) *The influence of electromagnetic fields on human brain activity*, Eur J Med Res. 1995 Oct 16;1(1):27-32 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Zhao Z** *et al*, (July 1994) *The effects of radiofrequency (< 30 MHz) radiation in humans*, Rev Environ Health. 1994 Jul-Dec;10(3-4):213-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Lai H** *et al*, (1994) *Microwave irradiation affects radial-arm maze performance in the rat*, *Bioelectromagnetics*. 1994;15(2):95-104 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Lai H** *et al*, (May 1989) *Low-level microwave irradiation and central cholinergic systems*, *Pharmacol Biochem Behav*. 1989 May;33(1):131-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Reichmanis M** *et al*, (1979) *Relation between suicide and the electromagnetic field of overhead power lines*, *Physiol Chem Phys*. 1979;11(5):395-403 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

## Radiofrequency EMF Mechanisms

[\[Back to the top\]](#)

P **Balmori A**, (June 2015) *Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation*, *Sci Total Environ*. 2015 Jun 15;518-519:58-60. doi: 10.1016/j.scitotenv.2015.02.077. Epub 2015 Mar 4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Jeong YJ** *et al*, (2015) *1950 MHz Electromagnetic Fields Ameliorate AB Pathology in Alzheimer's Disease Mice*, *Curr Alzheimer Res*. 2015;12(5):481-92 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Roggeveen S** *et al*, (May 2015) *Does the Brain Detect 3G Mobile Phone Radiation Peaks? An Explorative In-Depth Analysis of an Experimental Study*, *PLoS One*. 2015 May 11;10(5):e0125390. doi: 10.1371/journal.pone.0125390. eCollection 2015 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Masuda H** *et al*, (May 2015) *No Dynamic Changes in Blood-brain Barrier Permeability Occur in Developing Rats During Local Cortex Exposure to Microwaves*, *In Vivo*. 2015 05-06;29(3):351-357 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Aydogan F** *et al*, (April 2015) *The effects of 2100-MHz radiofrequency radiation on nasal mucosa and mucociliary clearance in rats*, *Int Forum Allergy Rhinol*. 2015 Apr 16. doi: 10.1002/alr.21509. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Court-Kowalski S** *et al*, (April 2015) *Effect of long-term (2 years) exposure of mouse brains to global system for mobile communication (GSM) radiofrequency fields on astrocytic immunoreactivity.*, *Bioelectromagnetics*. 2015 Apr;36(3):245-50. doi: 10.1002/bem.21891. Epub 2015 Feb 20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Dasdag S** *et al*, (April 2015) *Long term and excessive use of 900 MHz radiofrequency radiation alter microRNA expression in brain*, *Int J Radiat Biol*. 2015 Apr;91(4):306-11. doi: 10.3109/09553002.2015.997896. Epub 2015 Jan 2 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Zalata A** *et al*, (April 2015) *In vitro effect of cell phone radiation on motility, DNA fragmentation and clusterin gene expression in human sperm*, *Int J Fertil Steril*. 2015 Apr-Jun;9(1):129-36. Epub 2015 Apr 21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Dasdag S** *et al*, (March 2015) *Effects of 2.4 GHz radiofrequency radiation emitted from WiFi equipment on microRNA expression in brain tissue*, *Int J Radiat Biol*. 2015 Mar 16:1-26. [Epub ahead of print] [[View Author's](#)

[abstract conclusions](#)] [[View on Pubmed](#)]

P **Duan W** *et al*, (March 2015) *Comparison of the Genotoxic Effects Induced by 50 Hz Extremely Low-Frequency Electromagnetic Fields and 1800 MHz Radiofrequency Electromagnetic Fields in GC-2 Cells*, *Radiat Res*. 2015 Mar;183(3):305-14. doi: 10.1667/RR13851.1. Epub 2015 Feb 17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Masuda H** *et al*, (March 2015) *No Changes in Cerebral Microcirculatory Parameters in Rat During Local Cortex Exposure to Microwaves, In Vivo*. 2015 03-04;29(2):207-215 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Zong C** *et al*, (March 2015) *Adaptive response in mice exposed to 900 MHz radiofrequency fields: Bleomycin-induced DNA and oxidative damage/repair*, *Int J Radiat Biol*. 2015 Mar;91(3):270-6. doi: 10.3109/09553002.2014.980465. Epub 2015 Jan 27 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Ghosn R** *et al*, (February 2015) *Radiofrequency signal affects alpha band in resting electroencephalogram*, *J Neurophysiol*. 2015 Feb 18;jn.00765.2014. doi: 10.1152/jn.00765.2014. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Cao H** *et al*, (February 2015) *Circadian rhythmicity of antioxidant markers in rats exposed to 1.8 GHz radiofrequency fields*, *Int J Environ Res Public Health*. 2015 Feb 12;12(2):2071-87. doi: 10.3390/ijerph120202071. [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Halgamuge MN** *et al*, (February 2015) *Reduced growth of soybean seedlings after exposure to weak microwave radiation from GSM 900 mobile phone and base station*, *Bioelectromagnetics*. 2015 Feb;36(2):87-95. doi: 10.1002/BEM.21890. Epub 2015 Jan 21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Aydogan F** *et al*, (January 2015) *The effect of 2100 MHz radiofrequency radiation of a 3G mobile phone on the parotid gland of rats*, *Am J Otolaryngol*. 2015 Jan-Feb;36(1):39-46. doi: 10.1016/j.amjoto.2014.10.001. Epub 2014 Oct 5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Li C** *et al*, (January 2015) *Generation of infant anatomical models for evaluating electromagnetic field exposures*, *Bioelectromagnetics*. 2015 Jan;36(1):10-26. doi: 10.1002/bem.21868. Epub 2014 Oct 18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Ayrapetyan S, De J**, (2014) *Cell hydration as a biomarker for estimation of biological effects of nonionizing radiation on cells and organisms*, *ScientificWorldJournal*. 2014;2014:890518. doi: 10.1155/2014/890518. Epub 2014 Dec 18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Geronikolou S** *et al*, (November 2014) *Diverse radiofrequency sensitivity and radiofrequency effects of mobile or cordless phone near fields exposure in Drosophila melanogaster*, *PLoS One*. 2014 Nov 17;9(11):e112139. doi: 10.1371/journal.pone.0112139. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Klose M** *et al*, (October 2014) *Effects of Early-Onset Radiofrequency Electromagnetic Field Exposure (GSM 900 MHz) on Behavior and Memory in Rats*, *Radiat Res*. 2014 Oct;182(4):435-47. doi: 10.1667/RR13695.1. Epub 2014 Sep 24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Rosado MM** *et al*, (September 2014) *Effects of GSM-modulated 900 MHz radiofrequency electromagnetic fields on the hematopoietic potential of mouse bone marrow cells*, *Bioelectromagnetics*. 2014 Sep 25. doi:

10.1002/bem.21880. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Mortazavi S** et al, (September 2014) *Electromagnetic Radiofrequency Radiation Emitted from GSM Mobile Phones Decreases the Accuracy of Home Blood Glucose Monitors*, J Biomed Phys Eng. 2014 Sep 1;4(3):111-6. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Redmayne M, Johansson O**, (September 2014) *Could myelin damage from radiofrequency electromagnetic field exposure help explain the functional impairment electrohypersensitivity? A review of the evidence*, J Toxicol Environ Health B Crit Rev. 2014;17(5):247-58. doi: 10.1080/10937404.2014.923356 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Marjanovic AM** et al, (August 2014) *Cell oxidation-reduction imbalance after modulated radiofrequency radiation*, Electromagn Biol Med. 2014 Aug 13:1-6. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Maskey D** et al, (August 2014) *Alteration of glycine receptor immunoreactivity in the auditory brainstem of mice following three months of exposure to radiofrequency radiation at SAR 4.0 W/kg*, Int J Mol Med. 2014 Aug;34(2):409-19. doi: 10.3892/ijmm.2014.1784. Epub 2014 May 22 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Gandhi G** et al, (July 2014) *A cross-sectional case control study on genetic damage in individuals residing in the vicinity of a mobile phone base station*, Electromagn Biol Med. 2014 Jul 9:1-11. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Pelletier A** et al, (June 2014) *Does exposure to a radiofrequency electromagnetic field modify thermal preference in juvenile rats?*, PLoS One. 2014 Jun 6;9(6):e99007. doi: 10.1371/journal.pone.0099007. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Chen C** et al, (May 2014) *Exposure to 1800 MHz radiofrequency radiation impairs neurite outgrowth of embryonic neural stem cells*, Sci Rep. 2014 May 29;4:5103. doi: 10.1038/srep05103. [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Saikhedkar N** et al, (May 2014) *Effects of mobile phone radiation (900 MHz radiofrequency) on structure and functions of rat brain*, Neurol Res. 2014 May 26:1743132814Y0000000392. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Ozgun E** et al, (May 2014) *Mobile Phone Radiation Alters Proliferation of Hepatocarcinoma Cells*, Cell Biochem Biophys. 2014 May 11. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Liu K** et al, (May 2014) *The protective effect of autophagy on mouse spermatocyte derived cells exposure to 1800MHz radiofrequency electromagnetic radiation*, Toxicol Lett. 2014 May 9;228(3):216-224. doi: 10.1016/j.toxlet.2014.05.004. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Seckin E** et al, (May 2014) *The effect of radiofrequency radiation generated by a Global System for Mobile Communications source on cochlear development in a rat model*, J Laryngol Otol. 2014 May;128(5):400-5. doi: 10.1017/S0022215114000723. Epub 2014 May 1 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Vijayalaxmi, Prihoda TJ**, (April 2014) *Mobile phones, non-ionizing radiofrequency fields and brain cancer: is there an adaptive response?*, Dose Response. 2014 Apr 22;12(3):509-14. doi: 10.2203/dose-response.14-

012.Vijayalaxmi. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Gorpichenko I et al**, (2014) *The influence of direct mobile phone radiation on sperm quality*, Cent European J Urol. 2014;67(1):65-71. doi: 10.5173/ceju.2014.01.art14. Epub 2014 Apr 17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Lustenberger C et al**, (April 2015) *Inter-individual and intra-individual variation of the effects of pulsed RF EMF exposure on the human sleep EEG*, Bioelectromagnetics. 2015 Apr;36(3):169-77. doi: 10.1002/bem.21893. Epub 2015 Feb 17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Gherardini L et al**, (March 2014) *Searching for the perfect wave: the effect of radiofrequency electromagnetic fields on cells*, Int J Mol Sci. 2014 Mar 27;15(4):5366-87. doi: 10.3390/ijms15045366 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Qin F et al**, (January 2014) *Effects of nano-selenium on cognition performance of mice exposed in 1800 MHz radiofrequency fields*, Wei Sheng Yan Jiu. 2014 Jan;43(1):16-21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Ingole IV, Ghosh SK**, (December 2012) *Effect of exposure to radio frequency radiation emitted by cell phone on the developing dorsal root ganglion of chick embryo: a light microscopic study*, Nepal Med Coll J. 2012 Dec;14(4):337-41 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Li CY et al**, (October 2012) *A population-based case-control study of radiofrequency exposure in relation to childhood neoplasm*, Sci Total Environ. 2012 Oct 1;435-436:472-8. Epub 2012 Aug 9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Pilla AA**, (September 2012) *Electromagnetic fields instantaneously modulate nitric oxide signaling in challenged biological systems*, Biochem Biophys Res Commun. 2012 Sep 28;426(3):330-3. doi: 10.1016/j.bbrc.2012.08.078. Epub 2012 Aug 24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Vijayalaxmi, Prihoda TJ**, (September 2012) *Genetic Damage in Human Cells Exposed to Non-ionizing Radiofrequency Fields: A Meta-Analysis of the Data from 88 Publications (1990-2011)*, Mutat Res. 2012 Sep 27. pii: S1383-5718(12)00286-0. doi: 10.1016/j.mrgentox.2012.09.007. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Kesari KK, Behari J**, (September 2012) *Evidence for mobile phone radiation exposure effects on reproductive pattern of male rats: Role of ROS*, Electromagn Biol Med. 2012 Sep;31(3):213-22 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Kesari KK et al**, (August 2012) *Biophysical Evaluation of Radiofrequency Electromagnetic Field Effects on Male Reproductive Pattern*, Cell Biochem Biophys. 2012 Aug 29. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Hamzany Y et al**, (August 2012) *Is human saliva an indicator of the adverse health effects of using mobile phones?*, Antioxid Redox Signal. 2012 Aug 15. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Avci B et al**, (July 2012) *Oxidative stress induced by 1.8 Ghz radio frequency electromagnetic radiation and effects of the garlic extract in rats*, Int J Radiat Biol. 2012 Jul 12. [Epub ahead of print] [[View Author's abstract](#)]

[conclusions](#)] [[View on Pubmed](#)]

N **Jin YB** *et al*, (July 2012) *Effects of Simultaneous Combined Exposure to CDMA and WCDMA Electromagnetic Field on Immune Functions in Rats*, Int J Radiat Biol. 2012 Jul 12. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Bourthoumieu S** *et al*, (July 2012) *Study of p53 expression and post-transcriptional modifications after GSM-900 radiofrequency exposure of human amniotic cells*, Bioelectromagnetics. 2012 Jul 5. doi: 10.1002/bem.21744. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Schmid MR** *et al*, (June 2012) *Sleep EEG alterations: effects of pulsed magnetic fields versus pulse-modulated radio frequency electromagnetic fields*, J Sleep Res. 2012 Jun 22. doi: 10.1111/j.1365-2869.2012.01025.x. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Blank M, Goodman RM**, (June 2012) *Electromagnetic fields and health: DNA-based dosimetry*, Electromagn Biol Med. 2012 Jun 7. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Lu YS** *et al*, (2012) *Reactive Oxygen Species Formation and Apoptosis in Human Peripheral Blood Mononuclear Cell Induced by 900 MHz Mobile Phone Radiation*, Oxid Med Cell Longev. 2012;2012:740280. Epub 2012 Jun 14 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Chen G** *et al*, (April 2012) *Using model organism Saccharomyces cerevisiae to evaluate the effects of ELF-MF and RF-EMF exposure on global gene expression*, Bioelectromagnetics. 2012 Apr 9. doi: 10.1002/bem.21724. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Atasoy HI** *et al*, (March 2012) *Immunohistopathologic demonstration of deleterious effects on growing rat testes of radiofrequency waves emitted from conventional Wi-Fi devices*, J Pediatr Urol. 2012 Mar 30. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Jing J** *et al*, (March 2012) *The influence of microwave radiation from cellular phone on fetal rat brain*, Electromagn Biol Med. 2012 Mar;31(1):57-66. Epub 2012 Jan 23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Trivino Pardo JC** *et al*, (March 2012) *Microwave electromagnetic field regulates gene expression in T-lymphoblastoid leukemia CCRF-CEM cell line exposed to 900 MHz*, Electromagn Biol Med. 2012 Mar;31(1):1-18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Xu XR** *et al*, (March 2012) *The effects of extremely low frequency electromagnetic field exposure on the pH of the adult male semen and the motoricity parameters of spermatozoa in vitro*, Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi. 2012 Mar;30(3):178-80 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Jiang B** *et al*, (2012) *Adaptive Response in Mice Exposed to 900 MHz Radiofrequency Fields: Primary DNA Damage*, PLoS One. 2012;7(2):e32040. Epub 2012 Feb 28 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Calabro E** *et al*, (February 2012) *Modulation of heat shock protein response in SH-SY5Y by mobile phone microwaves*, World J Biol Chem. 2012 Feb 26;3(2):34-40 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P **Cam ST, Seyhan N**, (February 2012) *Single-strand DNA breaks in human hair root cells exposed to mobile phone radiation*, Int J Radiat Biol. 2012 Feb 21. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Cammaerts MC et al**, (January 2012) *GSM 900 MHz radiation inhibits ants' association between food sites and encountered cues*, Electromagn Biol Med. 2012 Jan 23. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Dasdag S et al**, (January 2012) *Effect of 900 MHz Radio Frequency Radiation on Beta Amyloid Protein, Protein Carbonyl, and Malondialdehyde in the Brain*, Electromagn Biol Med. 2012 Jan 23. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Fragopoulou AF et al**, (January 2012) *Brain proteome response following whole body exposure of mice to mobile phone or wireless DECT base radiation*, Electromagn Biol Med. 2012 Jan 20. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Blackman C**, (January 2012) *Treating cancer with amplitude-modulated electromagnetic fields: a potential paradigm shift, again?*, Br J Cancer. 2012 Jan 17;106(2):241-2. doi: 10.1038/bjc.2011.576 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Maskey D et al**, (January 2012) *Calcium-binding proteins and GFAP immunoreactivity alterations in murine hippocampus after 1 month of exposure to 835MHz radiofrequency at SAR values of 1.6 and 4.0W/kg*, Neurosci Lett. 2012 Jan 11;506(2):292-6. Epub 2011 Nov 25 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Avendano C et al**, (January 2012) *Use of laptop computers connected to internet through Wi-Fi decreases human sperm motility and increases sperm DNA fragmentation*, Fertil Steril. 2012 Jan;97(1):39-45.e2. Epub 2011 Nov 23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Guler G et al**, (December 2011) *The effect of radiofrequency radiation on DNA and lipid damage in female and male infant rabbits*, Int J Radiat Biol. 2011 Dec 7. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Esmekaya MA et al**, (December 2011) *Mutagenic and morphologic impacts of 1.8GHz radiofrequency radiation on human peripheral blood lymphocytes (hPBLs) and possible protective role of pre-treatment with Ginkgo biloba (EGb 761)*, Sci Total Environ. 2011 Dec 1;410-411:59-64. Epub 2011 Oct 19 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Kesari KK et al**, (December 2011) *900-MHz microwave radiation promotes oxidation in rat brain*, Electromagn Biol Med. 2011 Dec;30(4):219-34 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Marino C et al**, (December 2011) *Are the young more sensitive than adults to the effects of radiofrequency fields? An examination of relevant data from cellular and animal studies*, Prog Biophys Mol Biol. 2011 Dec;107(3):374-85. Epub 2011 Sep 8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Sirav B, Seyhan N**, (December 2011) *Effects of radiofrequency radiation exposure on blood-brain barrier permeability in male and female rats*, Electromagn Biol Med. 2011 Dec;30(4):253-60 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P Trosic I et al**, (December 2011) *Effect of electromagnetic radiofrequency radiation on the rats' brain, liver and kidney cells measured by comet assay*, Coll Antropol. 2011 Dec;35(4):1259-64 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Zimmerman JW et al**, (December 2011) *Cancer cell proliferation is inhibited by specific modulation frequencies*, Br J Cancer. 2011 Dec 1. doi: 10.1038/bjc.2011.523. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Eskander EF et al**, (November 2011) *How does long term exposure to base stations and mobile phones affect human hormone profiles?*, Clin Biochem. 2011 Nov 27. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Sun W et al**, (November 2011) *A 1.8-GHz radiofrequency radiation induces EGF receptor clustering and phosphorylation in cultured human amniotic (FL) cells*, Int J Radiat Biol. 2011 Nov 18. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Ballardin M et al**, (November 2011) *Non-thermal effects of 2.45 GHz microwaves on spindle assembly, mitotic cells and viability of Chinese hamster V-79 cells*, Mutat Res. 2011 Nov 1;716(1-2):1-9. Epub 2011 Jul 30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Lee HJ et al**, (October 2011) *The effects of simultaneous combined exposure to CDMA and WCDMA electromagnetic fields on rat testicular function*, Bioelectromagnetics. 2011 Oct 19. doi: 10.1002/bem.20715. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Colak C et al**, (October 2011) *Effects of electromagnetic radiation from 3G mobile phone on heart rate, blood pressure and ECG parameters in rats*, Toxicol Ind Health. 2011 Oct 13. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- Hareuveny R et al**, (October 2011) *Cognitive effects of cellular phones: a possible role of non-radiofrequency radiation factors*, Bioelectromagnetics 2011 Oct;32(7):585-8. doi: 10.1002/bem.20671. Epub 2011 Apr 12 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Lukac N et al**, (October 2011) *In vitro effects of radiofrequency electromagnetic waves on bovine spermatozoa motility*, J Environ Sci Health A Tox Hazard Subst Environ Eng. 2011 Oct;46(12):1417-23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Jorge-Mora T et al**, (August 2011) *The Effects of Single and Repeated Exposure to 2.45 GHz Radiofrequency Fields on c-Fos Protein Expression in the Paraventricular Nucleus of Rat Hypothalamus*, Neurochem Res. 2011 Aug 5. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Le Quement C et al**, (August 2011) *Whole-genome expression analysis in primary human keratinocyte cell cultures exposed to 60 GHz radiation*, Bioelectromagnetics. 2011 Aug 3. doi: 10.1002/bem.20693. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Loughran SP et al**, (August 2011) *Individual differences in the effects of mobile phone exposure on human sleep: Rethinking the problem*, Bioelectromagnetics. 2011 Aug 3. doi: 10.1002/bem.20691. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Sarapultseva EI, Igolkina JV**, (August 2011) *Experimental Study of Relationship between Biological Hazards of Low-Dose Radiofrequency Exposure and Energy Flow Density in Spirostomum Ambiguum Infusoria Exposed at a Mobile Connection Frequency (1 GHz)*, Bull Exp Biol Med. 2011 Aug;151(4):477-80 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Karaca E et al**, (July 2011) *The genotoxic effect of radiofrequency waves on mouse brain*, J Neurooncol. 2011 Jul 6. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Kumar S et al**, (2011) *The therapeutic effect of a pulsed electromagnetic field on the reproductive patterns of male Wistar rats exposed to a 2.45-GHz microwave field*, Clinics (Sao Paulo). 2011;66(7):1237-45 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Papageorgiou CC et al**, (June 2011) *Effects of wi-fi signals on the p300 component of event-related potentials during an auditory hayling task*, J Integr Neurosci. 2011 Jun;10(2):189-202. doi: 10.1142/S0219635211002695 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Rossi C et al**, (June 2011) *New perspectives in cell communication: Bioelectromagnetic interactions*, Semin Cancer Biol. 2011 Jun;21(3):207-14. Epub 2011 May 6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **van Rhoon GC et al**, (2011) *Health Council of The Netherlands: no need to change from SAR to time-temperature relation in electromagnetic fields exposure limits*, Int J Hyperthermia. 2011;27(4):399-404 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Yoon SY et al**, (2011) *Induction of Hair Growth by Insulin-Like Growth Factor-1 in 1,763 MHz Radiofrequency-Irradiated Hair Follicle Cells*, PLoS One. 2011;6(12):e28474. Epub 2011 Dec 2 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Ziskin MC, Morrissey J**, (2011) *Thermal thresholds for teratogenicity, reproduction, and development*, Int J Hyperthermia. 2011;27(4):374-87 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Juutilainen J et al**, (April 2011) *Review of possible modulation-dependent biological effects of radiofrequency fields*, Bioelectromagnetics. 2011 Apr 7. doi: 10.1002/bem.20652. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Blank M, Goodman R**, (April 2011) *DNA is a fractal antenna in electromagnetic fields*, Int J Radiat Biol. 2011 Apr;87(4):409-15. Epub 2011 Feb 28 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Esmekaya MA et al**, (March 2011) *900 MHz pulse-modulated radiofrequency radiation induces oxidative stress on heart, lung, testis and liver tissues*, Gen Physiol Biophys. 2011 Mar;30(1):84-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Sakurai T et al**, (February 2011) *Analysis of Gene Expression in a Human-derived Glial Cell Line Exposed to 2.45 GHz Continuous Radiofrequency Electromagnetic Fields*, J Radiat Res (Tokyo). 2011;52(2):185-92. Epub 2011 Feb 19 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Cao Y et al**, (February 2011) *Induction of adaptive response: Pre-exposure of mice to 900 MHz radiofrequency fields reduces hematopoietic damage caused by subsequent exposure to ionising radiation*, Int J Radiat Biol. 2011 Feb 7. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Liu ML** *et al*, (February 2011) *Potential Protection of Green Tea Polyphenols Against 1800 MHz Electromagnetic Radiation-Induced Injury on Rat Cortical Neurons*, Neurotox Res. 2011 Feb 4. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Kumar G** *et al*, (February 2011) *Evaluation of hematopoietic system effects after in vitro radiofrequency radiation exposure in rats*, Int J Radiat Biol. 2011 Feb;87(2):231-40. Epub 2010 Nov 4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Trillo MA** *et al*, (January 2011) *Cytostatic response of NB69 cells to weak pulse-modulated 2.2 GHz radar-like signals*, Bioelectromagnetics. 2011 Jan 28. doi: 10.1002/bem.20643. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Kesari KK** *et al*, (January 2011) *Effects of Radiofrequency Electromagnetic Wave Exposure from Cellular Phones on the Reproductive Pattern in Male Wistar Rats*, Appl Biochem Biotechnol. 2011 Jan 15. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Lowden A** *et al*, (January 2011) *Sleep after mobile phone exposure in subjects with mobile phone-related symptoms*, Bioelectromagnetics. 2011 Jan;32(1):4-14 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Masuda H** *et al*, (January 2011) *Local exposure of the rat cortex to radiofrequency electromagnetic fields increases local cerebral blood flow along with temperature*, J Appl Physiol. 2011 Jan;110(1):142-8. Epub 2010 Oct 28 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Repacholi M** *et al*, (December 2010) *An international project to confirm soviet-era results on immunological and teratological effects of RF field exposure in wistar rats and comments on Grigoriev et al. [2010]*, Bioelectromagnetics. 2010 Dec 15. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Bourthoumieu S** *et al*, (December 2010) *Cytogenetic studies in human cells exposed in vitro to GSM-900 MHz radiofrequency radiation using R-banded karyotyping*, Radiat Res. 2010 Dec;174(6):712-8. Epub 2010 Sep 20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Esmekaya MA** *et al*, (December 2010) *Pulse modulated 900 MHz radiation induces hypothyroidism and apoptosis in thyroid cells: a light, electron microscopy and immunohistochemical study*, Int J Radiat Biol. 2010 Dec;86(12):1106-16. Epub 2010 Sep 1 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Grigoriev YG** *et al*, (December 2010) *Confirmation studies of Soviet research on immunological effects of microwaves: Russian immunology results*, Bioelectromagnetics. 2010 Dec;31(8):589-602. doi: 10.1002/bem.20605. Epub 2010 Sep 20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Verschaeve L** *et al*, (December 2010) *In vitro and in vivo genotoxicity of radiofrequency fields*, Mutat Res. 2010 Dec;705(3):252-68. Epub 2010 Oct 16 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **de Gannes FP** *et al*, (November 2010) *Effect of Exposure to the Edge Signal on Oxidative Stress in Brain Cell Models*, Radiat Res. 2010 Nov 22. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Poullietier de Gannes F** *et al*, (February 2011) *Effect of exposure to the edge signal on oxidative stress in brain cell models*, Radiat Res. 2011 Feb;175(2):225-30. Epub 2010 Nov 22 [[View Author's abstract conclusions](#)] [[View](#)

[on Pubmed\]](#)

**P Ozgur E et al**, (November 2010) *Mobile phone radiation-induced free radical damage in the liver is inhibited by the antioxidants N-acetyl cysteine and epigallocatechin-gallate*, Int J Radiat Biol. 2010 Nov;86(11):935-45. Epub 2010 Sep 1 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Lee KY et al**, (October 2010) *Effects of combined radiofrequency radiation exposure on the cell cycle and its regulatory proteins*, Bioelectromagnetics. 2010 Oct 28. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Kowalczyk C et al**, (October 2010) *Absence of nonlinear responses in cells and tissues exposed to RF energy at mobile phone frequencies using a doubly resonant cavity*, Bioelectromagnetics. 2010 Oct;31(7):556-65 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Bourthoumieu S et al**, (September 2010) *Cytogenetic Studies in Human Cells Exposed In Vitro to GSM-900 MHz Radiofrequency Radiation Using R-Banded Karyotyping*, Radiat Res. 2010 Sep 20. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **McIntosh RL, Anderson V**, (September 2010) *SAR versus S(inc): What is the appropriate RF exposure metric in the range 1-10 GHz? Part II: Using complex human body models*, Bioelectromagnetics. 2010 Sep;31(6):467-78 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N O'Connor RP et al**, (July 2010) *Exposure to GSM RF fields does not affect calcium homeostasis in human endothelial cells, rat pheochromocytoma cells or rat hippocampal neurons*, PLoS One. 2010 Jul 27;5(7):e11828 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Ragbetli MC et al**, (July 2010) *The effect of mobile phone on the number of Purkinje cells: a stereological study*, Int J Radiat Biol. 2010 Jul;86(7):548-54 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Yakymenko I, Sidorik E**, (July 2010) *Risks of carcinogenesis from electromagnetic radiation of mobile telephony devices*, Exp Oncol. 2010 Jul;32(2):54-60 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Maskey D et al**, (July 2010) *Chronic 835-MHz radiofrequency exposure to mice hippocampus alters the distribution of calbindin and GFAP immunoreactivity*, Brain Res. 2010 Jul 30;1346:237-46. Epub 2010 Jun 17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Stam R**, (October 2010) *Electromagnetic fields and the blood-brain barrier*, Brain Res Rev. 2010 Oct 5;65(1):80-97. Epub 2010 Jun 13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Dimida A et al**, (June 2010) *Electric and magnetic fields do not modify the biochemical properties of frtl-5 cells*, J Endocrinol Invest. 2010 Jun 11. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Bartsch H et al**, (2010) *Effect of chronic exposure to a GSM-like signal (mobile phone) on survival of female Sprague-Dawley rats: modulatory effects by month of birth and possibly stage of the solar cycle*, Neuro Endocrinol Lett. 2010;31(4):457-73 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Soderqvist F** et al, (2010) *Radiofrequency fields, transthyretin, and Alzheimer's disease*, J Alzheimers Dis. 2010;20(2):599-606 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Yildirim MS** et al, (2010) *Effect of mobile phone station on micronucleus frequency and chromosomal aberrations in human blood cells*, Genet Couns. 2010;21(2):243-51 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Yu Y, Yao K**, (May 2010) *Non-thermal cellular effects of lowpower microwave radiation on the lens and lens epithelial cells*, J Int Med Res. 2010 May-Jun;38(3):729-36 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Campisi A** et al, (March 2010) *Reactive oxygen species levels and DNA fragmentation on astrocytes in primary culture after acute exposure to low intensity microwave electromagnetic field*, Neurosci Lett. 2010 Mar 31;473(1):52-5. Epub 2010 Feb 13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Sekijima M** et al, (March 2010) *2-GHz band CW and W-CDMA modulated radiofrequency fields have no significant effect on cell proliferation and gene expression profile in human cells*, J Radiat Res (Tokyo). 2010;51(3):277-84. Epub 2010 Mar 9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Falzone N** et al, (March 2010) *The effect of pulsed 900-MHz GSM mobile phone radiation on the acrosome reaction, head morphometry and zona binding of human spermatozoa*, Int J Androl. 2010 Mar 7. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Christ A** et al, (April 2010) *Age-dependent tissue-specific exposure of cell phone users*, Phys Med Biol. 2010 Apr 7;55(7):1767-83. Epub 2010 Mar 5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Takahashi S** et al, (March 2010) *Lack of adverse effects of whole-body exposure to a mobile telecommunication electromagnetic field on the rat fetus*, Radiat Res. 2010 Mar;173(3):362-72 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Panda NK** et al, (February 2010) *Audiologic disturbances in long-term mobile phone users*, J Otolaryngol Head Neck Surg. 2010 Feb 1;39(1):5-11 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Salama N** et al, (February 2010) *Effects of exposure to a mobile phone on testicular function and structure in adult rabbit*, Int J Androl. 2010 Feb;33(1):88-94. Epub 2009 Dec 2 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Carrubba S** et al, (January 2010) *Mobile-phone pulse triggers evoked potentials*, Neurosci Lett. 2010 Jan 18;469(1):164-8. Epub 2009 Dec 4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Maskey D** et al, (February 2010) *Effect of 835 MHz radiofrequency radiation exposure on calcium binding proteins in the hippocampus of the mouse brain*, Brain Res. 2010 Feb 8;1313:232-41. Epub 2009 Dec 5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Perez-Castejon C** et al, (December 2009) *Exposure to ELF-pulse modulated X band microwaves increases in vitro human astrocytoma cell proliferation*, Histol Histopathol. 2009 Dec;24(12):1551-61 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N de Gannes FP et al**, (November 2009) *A confirmation study of Russian and Ukrainian data on effects of 2450 MHz microwave exposure on immunological processes and teratology in rats*, Radiat Res. 2009 Nov;172(5):617-24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Hansteen IL et al**, (November 2009) *Cytogenetic effects of exposure to 2.3 GHz radiofrequency radiation on human lymphocytes in vitro*, Anticancer Res. 2009 Nov;29(11):4323-30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Lee HJ et al**, (November 2009) *Lack of teratogenicity after combined exposure of pregnant mice to CDMA and WCDMA radiofrequency electromagnetic fields*, Radiat Res. 2009 Nov;172(5):648-52 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Xu S et al**, (October 2009) *Exposure to 1800 MHz radiofrequency radiation induces oxidative damage to mitochondrial DNA in primary cultured neurons*, Brain Res. 2010 Jan 22;1311:189-96. Epub 2009 Oct 30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P de Tommaso M et al**, (October 2009) *Mobile phones exposure induces changes of contingent negative variation in humans*, Neurosci Lett. 2009 Oct 23;464(2):79-83. Epub 2009 Aug 21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Belyaev I et al**, (October 2009) *Microwaves from Mobile Phones Inhibit 53BP1 Focus Formation in Human Stem Cells Stronger than in Differentiated Cells: Possible Mechanistic Link to Cancer Risk*, Environ Health Perspect. 2009 Oct 22. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Zhijian C et al**, (January 2010) *Impact of 1.8-GHz radiofrequency radiation (RFR) on DNA damage and repair induced by doxorubicin in human B-cell lymphoblastoid cells*, Mutat Res. 2010 Jan;695(1-2):16-21. Epub 2009 Oct 13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Otitoloju AA et al**, (October 2009) *Preliminary study on the induction of sperm head abnormalities in mice, Mus musculus, exposed to radiofrequency radiations from global system for mobile communication base stations*, Bull Environ Contam Toxicol. 2010 Jan;84(1):51-4. Epub 2009 Oct 9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Brescia F et al**, (October 2009) *Reactive oxygen species formation is not enhanced by exposure to UMTS 1950 MHz radiation and co-exposure to ferrous ions in Jurkat cells*, Bioelectromagnetics. 2009 Oct;30(7):525-35 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Del Vecchio G et al**, (October 2009) *Effect of radiofrequency electromagnetic field exposure on in vitro models of neurodegenerative disease*, Bioelectromagnetics. 2009 Oct;30(7):564-72 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Desai NR et al**, (October 2009) *Pathophysiology of cell phone radiation: oxidative stress and carcinogenesis with focus on male reproductive system*, Reprod Biol Endocrinol. 2009 Oct 22;7:114 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **McNamee JP, Chauhan V.**, (September 2009) *Radiofrequency radiation and gene/protein expression: a review*, Radiat Res. 2009 Sep;172(3):265-87 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P Soderqvist F et al**, (August 2009) *Exposure to an 890-MHz mobile phone-like signal and serum levels of S100B and transthyretin in volunteers*, *Toxicol Lett.* 2009 Aug 25;189(1):63-6. Epub 2009 May 7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Sharma VP et al**, (October 2009) *Mobile phone radiation inhibits Vigna radiata (mung bean) root growth by inducing oxidative stress*, *Sci Total Environ.* 2009 Oct 15;407(21):5543-7. Epub 2009 Aug 13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Contalbrigo L et al**, (August 2009) *Effects of different electromagnetic fields on circadian rhythms of some haematochemical parameters in rats*, *Biomed Environ Sci.* 2009 Aug;22(4):348-53 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Roychoudhury S et al**, (August 2009) *Influence of a 50 hz extra low frequency electromagnetic field on spermatozoa motility and fertilization rates in rabbits*, *J Environ Sci Health A Tox Hazard Subst Environ Eng.* 2009 Aug;44(10):1041-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Hirose H et al**, (July 2009) *1950 MHz IMT-2000 field does not activate microglial cells in vitro*, *Bioelectromagnetics.* 2009 Jul 31. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Masuda H et al**, (July 2009) *Effects of 915 MHz electromagnetic-field radiation in TEM cell on the blood-brain barrier and neurons in the rat brain*, *Radiat Res.* 2009 Jul;172(1):66-73 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Cao Y et al**, (2009) *900-MHz Microwave Radiation Enhances gamma-Ray Adverse Effects on SHG44 Cells*, *J Toxicol Environ Health A.* 2009;72(11-12):727-32 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Funk RH et al**, (2009) *Electromagnetic effects - From cell biology to medicine*, *Prog Histochem Cytochem.* 2009;43(4):177-264. Epub 2008 Sep 18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Sannino A et al**, (June 2009) *Human fibroblasts and 900 MHz radiofrequency radiation: evaluation of DNA damage after exposure and co-exposure to 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5h)-furanone (MX)*, *Radiat Res.* 2009 Jun;171(6):743-51 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Sannino A et al**, (June 2009) *Induction of adaptive response in human blood lymphocytes exposed to radiofrequency radiation*, *Radiat Res.* 2009 Jun;171(6):735-42 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Sirav B, Seyhan N**, (2009) *Blood-brain barrier disruption by continuous-wave radio frequency radiation*, *Electromagn Biol Med.* 2009;28(2):215-22 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Del Vecchio G et al**, (May 2009) *Continuous exposure to 900MHz GSM-modulated EMF alters morphological maturation of neural cells*, *Neurosci Lett.* 2009 May 22;455(3):173-7. Epub 2009 Mar 24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Billaudel B et al**, (May 2009) *Effects of exposure to DAMPS and GSM signals on Ornithine Decarboxylase (ODC) activity: II- SH-SY5Y human neuroblastoma cells*, *Int J Radiat Biol.* 2009 May 12:1-4. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Lopez-Martin E et al**, (May 2009) *The action of pulse-modulated GSM radiation increases regional changes in brain activity and c-Fos expression in cortical and subcortical areas in a rat model of picrotoxin-induced seizure proneness*, J Neurosci Res. 2009 May 1;87(6):1484-99 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N McQuade JM et al**, (May 2009) *Radiofrequency-radiation exposure does not induce detectable leakage of albumin across the blood-brain barrier*, Radiat Res. 2009 May;171(5):615-21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Soderqvist F et al**, (April 2009) *Mobile and cordless telephones, serum transthyretin and the blood-cerebrospinal fluid barrier: a cross-sectional study*, Environ Health. 2009 Apr 21;8:19 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Nittby H et al**, (August 2009) *Increased blood-brain barrier permeability in mammalian brain 7 days after exposure to the radiation from a GSM-900 mobile phone*, Pathophysiology. 2009 Aug;16(2-3):103-12. Epub 2009 Apr 2 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Budak GG et al**, (April 2009) *Effects of GSM-like radiofrequency on distortion product otoacoustic emissions in pregnant adult rabbits*, Clin Invest Med. 2009 Apr 1;32(2):E112-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Orendacova J et al**, (March 2009) *Immunohistochemical Study of Postnatal Neurogenesis After Whole-body Exposure to Electromagnetic Fields: Evaluation of Age- and Dose-Related Changes in Rats*, Cell Mol Neurobiol. 2009 Mar 21. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Ruediger HW**, (March 2009) *Genotoxic effects of radiofrequency electromagnetic fields*, Pathophysiology. 2009 Mar 12. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Pourlis AF**, (March 2009) *Reproductive and developmental effects of EMF in vertebrate animal models*, Pathophysiology. 2009 Mar 7. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Blank M, Goodman R**, (March 2009) *Electromagnetic fields stress living cells*, Pathophysiology. 2009 Mar 4. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Blackman C**, (March 2009) *Cell phone radiation: Evidence from ELF and RF studies supporting more inclusive risk identification and assessment*, Pathophysiology. 2009 Aug;16(2-3):205-16. Epub 2009 Mar 4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Phillips JL et al**, (March 2009) *Electromagnetic fields and DNA damage*, Pathophysiology. 2009 Mar 3. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Gajski G et al**, (March 2009) *Radioprotective effects of honeybee venom (Apis mellifera) against 915-MHz microwave radiation-induced DNA damage in wistar rat lymphocytes: in vitro study*, Int J Toxicol. 2009 Mar-Apr;28(2):88-98 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Gul A et al**, (February 2009) *The effects of microwave emitted by cellular phones on ovarian follicles in rats*, Arch Gynecol Obstet. 2009 Feb 25. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Bas O et al**, (February 2009) *900 MHz electromagnetic field exposure affects qualitative and quantitative features of hippocampal pyramidal cells in the adult female rat*, Brain Res. 2009 Feb 20. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Luukkonen J et al**, (December 2008) *Enhancement of chemically induced reactive oxygen species production and DNA damage in human SH-SY5Y neuroblastoma cells by 872MHz radiofrequency radiation*, Mutat Res. 2008 Dec 24. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Prisco MG et al**, (December 2008) *Effects of GSM-modulated radiofrequency electromagnetic fields on mouse bone marrow cells*, Radiat Res. 2008 Dec;170(6):803-10 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Verschaeve L**, (November 2008) *Genetic damage in subjects exposed to radiofrequency radiation*, Mutat Res. 2008 Nov 27. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Belyaev IY et al**, (October 2008) *Microwaves from UMTS/GSM mobile phones induce long-lasting inhibition of 53BP1/gamma-H2AX DNA repair foci in human lymphocytes*, Bioelectromagnetics. 2008 Oct 6. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Franzellitti S et al**, (October 2008) *HSP70 Expression in Human Trophoblast Cells Exposed to Different 1.8 GHz Mobile Phone Signals*, Rad. Res. 2008 Oct;170(4): 488-497 [[View Author's abstract conclusions](#)]

- **Sheppard AR et al**, (October 2008) *Quantitative evaluations of mechanisms of radiofrequency interactions with biological molecules and processes*, Health Phys. 2008 Oct;95(4):365-96 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Sokolovic D et al**, (September 2008) *Melatonin Reduces Oxidative Stress Induced by Chronic Exposure of Microwave Radiation from Mobile Phones in Rat Brain*, J Radiat Res (Tokyo). 2008 Sep 29. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Hoyto A et al**, (September 2008) *Radiofrequency radiation does not significantly affect ornithine decarboxylase activity, proliferation, or caspase-3 activity of fibroblasts in different physiological conditions*, Int J Radiat Biol. 2008 Sep;84(9):727-33 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Huang TQ et al**, (September 2008) *Molecular responses of Jurkat T-cells to 1763 MHz radiofrequency radiation*, Int J Radiat Biol. 2008 Sep;84(9):734-41 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Vanderstraeten J, Verschaeve L**, (September 2008) *Gene and protein expression following exposure to radiofrequency fields from mobile phones*, Environ Health Perspect. 2008 Sep;116(9):1131-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Odaci E et al**, (August 2008) *Effects of prenatal exposure to a 900 Mhz electromagnetic field on the dentate gyrus of rats: a stereological and histopathological study*, Brain Res. 2008 Aug 16. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Andrzejak R et al**, (August 2008) *The influence of the call with a mobile phone on heart rate variability parameters in healthy volunteers*, Ind Health. 2008 Aug;46(4):409-17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Pavicic I, Trosic I**, (August 2008) *In vitro testing of cellular response to ultra high frequency electromagnetic field radiation*, Toxicol In Vitro. 2008 Aug;22(5):1344-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Zhang SZ et al**, (August 2008) *Effect of 1.8 GHz radiofrequency electromagnetic fields on gene expression of rat neurons*, Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi. 2008 Aug;26(8):449-52 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Kim TH et al**, (June 2008) *Local exposure of 849 MHz and 1763 MHz radiofrequency radiation to mouse heads does not induce cell death or cell proliferation in brain*, Exp Mol Med. 2008 Jun 30;40(3):294-303 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Eberhardt JL et al**, (2008) *Blood-brain barrier permeability and nerve cell damage in rat brain 14 and 28 days after exposure to microwaves from GSM mobile phones*, Electromagn Biol Med. 2008;27(3):215-29 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Mathur R**, (2008) *Effect of chronic intermittent exposure to AM radiofrequency field on responses to various types of noxious stimuli in growing rats*, Electromagn Biol Med. 2008;27(3):266-76 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Matronchik AY, Belyaev IY et al**, (2008) *Mechanism for combined action of microwaves and static magnetic field: slow non uniform rotation of charged nucleoid*, Electromagn Biol Med. 2008;27(4):340-54 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Nittby H et al**, (2008) *Radiofrequency and extremely low-frequency electromagnetic field effects on the blood-brain barrier*, Electromagn Biol Med. 2008;27(2):103-26 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Yan JG et al**, (2008) *Upregulation of specific mRNA levels in rat brain after cell phone exposure*, Electromagn Biol Med. 2008;27(2):147-54 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P George DF et al**, (May 2008) *Non-thermal effects in the microwave induced unfolding of proteins observed by chaperone binding*, Bioelectromagnetics. 2008 May;29(4):324-30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Manti L et al**, (May 2008) *Effects of Modulated Microwave Radiation at Cellular Telephone Frequency (1.95 GHz) on X-Ray-Induced Chromosome Aberrations in Human Lymphocytes In Vitro*, Radiat Res. 2008 May;169(5):575-83 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Pokorny J et al**, (May 2008) *Biophysical aspects of cancer--electromagnetic mechanism*, Indian J Exp Biol. 2008 May;46(5):310-21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Schwarz C et al**, (May 2008) *Radiofrequency electromagnetic fields (UMTS, 1,950 MHz) induce genotoxic effects in vitro in human fibroblasts but not in lymphocytes*, Int Arch Occup Environ Health. 2008 May;81(6):755-67 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Vijayalaxmi , Prihoda TJ**, (May 2008) *Genetic damage in mammalian somatic cells exposed to radiofrequency radiation: a meta-analysis of data from 63 publications (1990-2005)*, Radiat Res. 2008 May;169(5):561-74 [[View](#)]

[Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Yao K** *et al*, (May 2008) *Effect of superposed electromagnetic noise on DNA damage of lens epithelial cells induced by microwave radiation*, Invest Ophthalmol Vis Sci. 2008 May;49(5):2009-15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Lerchl A** *et al*, (April 2008) *Effects of mobile phone electromagnetic fields at nonthermal SAR values on melatonin and body weight of Djungarian hamsters (Phodopus sungorus)*, J Pineal Res. 2008 Apr;44(3):267-72 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Perez FP** *et al*, (April 2008) *Electromagnetic field therapy delays cellular senescence and death by enhancement of the heat shock response*, Exp Gerontol. 2008 Apr;43(4):307-16 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Li M** *et al*, (March 2008) *Elevation of plasma corticosterone levels and hippocampal glucocorticoid receptor translocation in rats: a potential mechanism for cognition impairment following chronic low-power-density microwave exposure*, J Radiat Res (Tokyo). 2008 Mar;49(2):163-70 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Rao VS** *et al*, (March 2008) *Nonthermal effects of radiofrequency-field exposure on calcium dynamics in stem cell-derived neuronal cells: elucidation of calcium pathways*, Radiat Res. 2008 Mar;169(3):319-29 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Valbonesi P** *et al*, (March 2008) *Evaluation of HSP70 Expression and DNA Damage in Cells of a Human Trophoblast Cell Line Exposed to 1.8 GHz Amplitude-Modulated Radiofrequency Fields*, Radiat Res. 2008 Mar;169(3):270-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Aly AA** *et al*, (February 2008) *Effects of 900-MHz radio frequencies on the chemotaxis of human neutrophils in vitro*, IEEE Trans Biomed Eng. 2008 Feb;55(2):795-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Hardell L, Sage C**, (February 2008) *Biological effects from electromagnetic field exposure and public exposure standards*, Biomed Pharmacother. 2008 Feb;62(2):104-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Karinen A** *et al*, (February 2008) *Mobile phone radiation might alter protein expression in human skin*, BMC Genomics. 2008 Feb 11;9:77 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Kim JY** *et al*, (January 2008) *In vitro assessment of clastogenicity of mobile-phone radiation (835 MHz) using the alkaline comet assay and chromosomal aberration test*, Environ Toxicol. 2008 Jan 23 [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Garaj-Vrhovac V, Orescanin V**, (January 2008) *Assessment of DNA sensitivity in peripheral blood leukocytes after occupational exposure to microwave radiation: the alkaline comet assay and chromatid breakage assay*, Cell Biol Toxicol. 2008 Jan 23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Lopez-Berenguer C** *et al*, (November 2007) *Effects of microwave cooking conditions on bioactive compounds present in broccoli inflorescences*, J Agric Food Chem. 2007 Nov 28;55(24):10001-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Roux D et al**, (November 2007) *High frequency (900 MHz) low amplitude (5 V m(-1)) electromagnetic field: a genuine environmental stimulus that affects transcription, translation, calcium and energy charge in tomato.*, *Planta*. 2007 Nov 20 [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Meral I et al**, (September 2007) *Effects of 900-MHz electromagnetic field emitted from cellular phone on brain oxidative stress and some vitamin levels of guinea pigs*, *Brain Res*. 2007 Sep 12;1169:120-4. Epub 2007 Jul 17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Friedman J et al**, (August 2007) *Mechanism of a short-term ERK activation by electromagnetic fields at mobile phone frequency*, *Biochem J*. 2007 Aug 1;405(3):559-68 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Guney M et al**, (August 2007) *900 MHz radiofrequency-induced histopathologic changes and oxidative stress in rat endometrium: protection by vitamins E and C*, *Toxicol Ind Health*. 2007 Aug;23(7):411-20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Hoyto A et al**, (June 2007) *Ornithine decarboxylase activity is affected in primary astrocytes but not in secondary cell lines exposed to 872 MHz RF radiation*, *Int J Radiat Biol*. 2007 Jun;83(6):367-74 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Lin JC, Wang Z**, (June 2007) *Hearing of microwave pulses by humans and animals: effects, mechanism, and thresholds*, *Health Phys*. 2007 Jun;92(6):621-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Oral B et al**, (November 2006) *Endometrial apoptosis induced by a 900-MHz mobile phone: preventive effects of vitamins E and C*, *Adv Ther*. 2006 Nov-Dec;23(6):957-73 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Nylund R, Leszczynski D**, (September 2006) *Mobile phone radiation causes changes in gene and protein expression in human endothelial cell lines and the response seems to be genome- and proteome-dependent*, *Proteomics* 2006 Sep;6(17):4769-80 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Belyaev IY et al**, (May 2006) *Exposure of rat brain to 915 MHz GSM microwaves induces changes in gene expression but not double stranded DNA breaks or effects on chromatin conformation*, *Bioelectromagnetics*. 2006 May;27(4):295-306 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Nikolova T et al**, (October 2005) *Electromagnetic fields affect transcript levels of apoptosis-related genes in embryonic stem cell-derived neural progenitor cells*, *FASEB J*. 2005 Oct;19(12):1686-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Markova E et al**, (September 2005) *Microwaves from GSM mobile telephones affect 53BP1 and gamma-H2AX foci in human lymphocytes from hypersensitive and healthy persons*, *Environ Health Perspect*. 2005 Sep;113(9):1172-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Wang Q et al**, (September 2005) *Effect of 900 MHz electromagnetic fields on the expression of GABA receptor of cerebral cortical neurons in postnatal rats*, *Wei Sheng Yan Jiu*. 2005 Sep;34(5):546-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P **Reif JS et al**, (August 2005) *Human responses to Residential RF exposure*, 2 RO1 ES0008117-04 [[View Author's abstract conclusions](#)]
- P **Caraglia M et al**, (August 2005) *Electromagnetic fields at mobile phone frequency induce apoptosis and inactivation of the multi-chaperone complex in human epidermoid cancer cells*, J Cell Physiol. 2005 Aug;204(2):539-48 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Ozguner F et al**, (August 2005) *Comparative analysis of the protective effects of melatonin and caffeic acid phenethyl ester (CAPE) on mobile phone-induced renal impairment in rat*, Mol Cell Biochem. 2005 Aug;276(1-2):31-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Oktem F et al**, (July 2005) *Oxidative damage in the kidney induced by 900-MHz-emitted mobile phone: protection by melatonin*, Arch Med Res. 2005 Jul-Aug;36(4):350-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Diem E et al**, (June 2005) *Non-thermal DNA breakage by mobile-phone radiation (1800 MHz) in human fibroblasts and in transformed GFSH-R17 rat granulosa cells in vitro*, Mutat Res. 2005 Jun 6;583(2):178-83 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Hallberg O, Johansson O**, (2005) *FM broadcasting exposure time and malignant melanoma incidence*, Electromagnetic Biology and Medicine 24; 1-8 [[View Author's abstract conclusions](#)]
- P **Belyaev IY et al**, (April 2005) *915 MHz microwaves and 50 Hz magnetic field affect chromatin conformation and 53BP1 foci in human lymphocytes from hypersensitive and healthy persons*, Bioelectromagnetics. 2005 Apr;26(3):173-84 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Wang Q et al**, (March 2005) *Effect of 900Mhz electromagnetic fields on energy metabolism in postnatal rat cerebral cortical neurons*, Wei Sheng Yan Jiu. 2005 Mar;34(2):155-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Lai H**, (October 2004) *Interaction of microwaves and a temporally incoherent magnetic field on spatial learning in the rat*, Physiol Behav. 2004 Oct 15;82(5):785-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Ozguner F et al**, (September 2004) *Prevention of mobile phone induced skin tissue changes by melatonin in rat: an experimental study*, Toxicol Ind Health. 2004 Sep;20(6-10):133-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Wang Q et al**, (July 2004) *Effect of 900MHz electromagnetic fields on energy metabolism of cerebral cortical neurons in postnatal rat*, Wei Sheng Yan Jiu. 2004 Jul;33(4):428-9, 432 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Czyz J et al**, (May 2004) *High frequency electromagnetic fields (GSM signals) affect gene expression levels in tumor suppressor p53-deficient embryonic stem cells*, Bioelectromagnetics. 2004 May;25(4):296-307 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Sarimov R et al**, (2004) *Nonthermal GSM Microwaves Affect Chromatin Conformation in Human Lymphocytes Similar to Heat Shock*, IEEE Trans Plasma Sci 2004; 32 (4): 1600 - 1608 [[View Author's abstract conclusions](#)]

- P de Pomerai DI et al**, (May 2003) *Microwave radiation can alter protein conformation without bulk heating*, FEBS Lett. 2003 May 22;543(1-3):93-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Burch JB et al**, (November 2002) *Melatonin metabolite excretion among cellular telephone users*, Int J Radiat Biol. 2002 Nov;78(11):1029-36 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Leszczynski D et al**, (May 2002) *Non-thermal activation of the hsp27/p38MAPK stress pathway by mobile phone radiation in human endothelial cells: molecular mechanism for cancer- and blood-brain barrier-related effects*, Differentiation. 2002 May;70(2-3):120-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P D'Ambrosio G et al**, (January 2002) *Cytogenetic damage in human lymphocytes following GMSK phase modulated microwave exposure*, Bioelectromagnetics. 2002 Jan;23(1):7-13 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Tattersall JE et al**, (June 2001) *Effects of low intensity radiofrequency electromagnetic fields on electrical activity in rat hippocampal slices*, Brain Res. 2001 Jun 15;904(1):43-53 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Wang B, Lai H**, (January 2000) *Acute exposure to pulsed 2450-MHz microwaves affects water-maze performance of rats*, Bioelectromagnetics. 2000 Jan;21(1):52-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Velizarov S et al**, (February 1999) *The effects of radiofrequency fields on cell proliferation are non-thermal*, Bioelectrochem Bioenerg. 1999 Feb;48(1):177-80 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Daniells C et al**, (March 1998) *Transgenic nematodes as biomonitors of microwave-induced stress*, Mutat Res. 1998 Mar 13;399(1):55-64 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Donnellan M et al**, (July 1997) *Effects of exposure to electromagnetic radiation at 835 MHz on growth, morphology and secretory characteristics of a mast cell analogue, RBL-2H3*, Cell Biol Int. 1997 Jul;21(7):427-39 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P French PW et al**, (June 1997) *Electromagnetic radiation at 835 MHz changes the morphology and inhibits proliferation of a human astrocytoma cell line*, Bioelectrochemistry and Bioenergetics, June 1997;43(1):13-18 [[View Author's abstract conclusions](#)]
- P Singh B, Bate LA**, (November 1996) *Responses of pulmonary intravascular macrophages to 915-MHz microwave radiation: ultrastructural and cytochemical study*, Anat Rec. 1996 Nov;246(3):343-55 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Dobson J, St. Pierre T**, (October 1996) *Application of the ferromagnetic transduction model to D.C. and pulsed magnetic fields: effects on epileptogenic tissue and implications for cellular phone safety*, Biochem Biophys Res Commun 1996 Oct 23;227(3):718-23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Lai H et al**, (1994) *Microwave irradiation affects radial-arm maze performance in the rat*, Bioelectromagnetics. 1994;15(2):95-104 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Lai H** *et al*, (May 1989) *Low-level microwave irradiation and central cholinergic systems*, Pharmacol Biochem Behav. 1989 May;33(1):131-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Holt JA**, (June 1980) *Changing epidemiology of malignant melanoma in Queensland*, Med J Aust. 1980 Jun 14;1(12):619-20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

## Powerfrequency EMF Mechanisms

[\[Back to the top\]](#)

- **Vanderstraeten J** *et al*, (July 2015) *Could Magnetic Fields Affect the Circadian Clock Function of Cryptochromes? Testing the Basic Premise of the Cryptochrome Hypothesis (ELF Magnetic Fields)*, Health Phys. 2015 Jul;109(1):84-9. doi: 10.1097/HP.0000000000000292 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Prato FS**, (May 2015) *Non-thermal extremely low frequency magnetic field effects on opioid related behaviors: Snails to humans, mechanisms to therapy*, Bioelectromagnetics. 2015 May 11. doi: 10.1002/bem.21918. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Qi G** *et al*, (May 2015) *Effects of extremely low-frequency electromagnetic fields (ELF-EMF) exposure on B6C3F1 mice*, Environ Health Prev Med. 2015 May 5. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Nofouzi K** *et al*, (April 2015) *Influence of extremely low frequency electromagnetic fields on growth performance, innate immune response, biochemical parameters and disease resistance in rainbow trout, Oncorhynchus mykiss*, Fish Physiol Biochem. 2015 Apr 14. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Percherancier Y** *et al*, (April 2015) *Effects of 50 Hz magnetic fields on gap junctional intercellular communication in NIH3T3 cells*, Bioelectromagnetics. 2015 Apr 3. doi: 10.1002/bem.21908. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Fiocchi S** *et al*, (Aprli 2015) *Assessment of foetal exposure to the homogeneous magnetic field harmonic spectrum generated by electricity transmission and distribution networks*, Int J Environ Res Public Health. 2015 Apr 1;12(4):3667-90. doi: 10.3390/ijerph120403667 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Hori T** *et al*, (March 2015) *Exposure to 50 Hz electric fields reduces stress-induced glucocorticoid levels in BALB/c mice in a kV/m- and duration-dependent manner*, Bioelectromagnetics. 2015 Mar 27. doi: 10.1002/bem.21914. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Manzella N** *et al*, (March 2015) *Circadian gene expression and extremely low-frequency magnetic fields: An in vitro study*, Bioelectromagnetics. 2015 Mar 22. doi: 10.1002/bem.21915. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Duan W** *et al*, (March 2015) *Comparison of the Genotoxic Effects Induced by 50 Hz Extremely Low-Frequency Electromagnetic Fields and 1800 MHz Radiofrequency Electromagnetic Fields in GC-2 Cells*, Radiat Res. 2015 Mar;183(3):305-14. doi: 10.1667/RR13851.1. Epub 2015 Feb 17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

[Pubmed](#)]

N **Jin H** *et al*, (March 2015) *Effects on g2/m phase cell cycle distribution and aneuploidy formation of exposure to a 60 Hz electromagnetic field in combination with ionizing radiation or hydrogen peroxide in I132 nontumorigenic human lung epithelial cells*, Korean J Physiol Pharmacol. 2015 Mar;19(2):119-24. doi: 10.4196/kjpp.2015.19.2.119. Epub 2015 Feb 25 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Tessaro LW** *et al*, (March 2015) *Bacterial growth rates are influenced by cellular characteristics of individual species when immersed in electromagnetic fields*, Microbiol Res. 2015 Mar;172:26-33. doi: 10.1016/j.micres.2014.12.008. Epub 2015 Jan 19 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Wilson JW** *et al*, (March 2015) *The effects of extremely low frequency magnetic fields on mutation induction in mice*, Mutat Res. 2015 Mar;773:22-6. doi: 10.1016/j.mrfmmm.2015.01.014. Epub 2015 Jan 30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Todorovic D** *et al*, (February 2015) *Effects of two different waveforms of ELF MF on bioelectrical activity of antennal lobe neurons of Morimus funereus (Insecta, Coleoptera)*, Int J Radiat Biol. 2015 Feb 10:1-8. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Li L** *et al*, (February 2015) *A cross-sectional study on oxidative stress in workers exposed to extremely low frequency electromagnetic fields*, Int J Radiat Biol. 2015 Feb 4:1-23. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Chung YH** *et al*, (January 2015) *Extremely low frequency magnetic field modulates the level of neurotransmitters*, Korean J Physiol Pharmacol. 2015 Jan;19(1):15-20. doi: 10.4196/kjpp.2015.19.1.15. Epub 2014 Dec 31 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **D'Angelo C** *et al*, (January 2015) *Experimental model for ELF-EMF exposure: Concern for human health*, Saudi J Biol Sci. 2015 Jan;22(1):75-84. doi: 10.1016/j.sjbs.2014.07.006. Epub 2014 Aug 6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Patrino A** *et al*, (January 2015) *Effects of extremely low frequency electromagnetic field (ELF-EMF) on catalase, cytochrome P450 and nitric oxide synthase in erythro-leukemic cells*, Life Sci. 2015 Jan 15;121:117-23. doi: 10.1016/j.lfs.2014.12.003. Epub 2014 Dec 11 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Gok DK** *et al*, (December 2014) *The developmental effects of extremely low frequency electric fields on visual and somatosensory evoked potentials in adult rats*, Electromagn Biol Med. 2014 Dec 11:1-10. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Grant DN** *et al*, (December 2014) *In vitro electromagnetic stimulation to enhance cell proliferation in extracellular matrix constructs with and without metallic nanoparticles*, J Biomed Mater Res B Appl Biomater. 2014 Dec 2. doi: 10.1002/jbm.b.33338. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Giorgi G** *et al*, (December 2014) *An evaluation of genotoxicity in human neuronal-type cells subjected to oxidative stress under an extremely low frequency pulsed magnetic field*, Mutat Res Genet Toxicol Environ Mutagen. 2014 Dec;775-776:31-7. doi: 10.1016/j.mrgentox.2014.10.003. Epub 2014 Oct 22 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Huang CY et al**, (November 2014) *Distinct epidermal keratinocytes respond to extremely low-frequency electromagnetic fields differently*, PLoS One. 2014 Nov 19;9(11):e113424. doi: 10.1371/journal.pone.0113424. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Saha S et al**, (November 2014) *Increased apoptosis and DNA double-strand breaks in the embryonic mouse brain in response to very low-dose X-rays but not 50 Hz magnetic fields*, J R Soc Interface. 2014 Nov 6;11(100):20140783. doi: 10.1098/rsif.2014.0783 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Raus Balind et al**, (October 2014) *Short- and long-term exposure to alternating magnetic field (50 Hz, 0.5 mT) affects rat pituitary ACTH cells: Stereological study*, Environ Toxicol. 2014 Oct 27. doi: 10.1002/tox.22059. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Korr H et al**, (October 2014) *No Evidence of Persisting Unrepaired Nuclear DNA Single Strand Breaks in Distinct Types of Cells in the Brain, Kidney, and Liver of Adult Mice after Continuous Eight-Week 50 Hz Magnetic Field Exposure with Flux Density of 0.1 mT or 1.0 mT*, PLoS One. 2014 Oct 10;9(10):e109774. doi: 10.1371/journal.pone.0109774. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Alsaeed I et al**, (October 2014) *Autism-relevant social abnormalities in mice exposed perinatally to extremely low frequency electromagnetic fields*, Int J Dev Neurosci. 2014 Oct;37:58-64. doi: 10.1016/j.ijdevneu.2014.06.010. Epub 2014 Jun 23. [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Baek S et al**, (October 2014) *Electromagnetic Fields Mediate Efficient Cell Reprogramming into a Pluripotent State*, ACS Nano. 2014 Oct 1. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Hasanzadeh H et al**, (October 2014) *Effect of ELF-EMF Exposure on Human Neuroblastoma Cell Line: a Proteomics Analysis*, Iran J Cancer Prev. 2014 Winter;7(1):22-7. [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Jung IS et al**, (October 2014) *Effects of extremely low frequency magnetic fields on NGF induced neuronal differentiation of PC12 cells*, Bioelectromagnetics. 2014 Oct;35(7):459-69. doi: 10.1002/bem.21861. Epub 2014 Aug 26 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Liorni I et al**, (September 2014) *Dosimetric study of fetal exposure to uniform magnetic fields at 50 Hz*, Bioelectromagnetics. 2014 Sep 29. doi: 10.1002/bem.21878. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Stormer FC et al**, (September 2014) *Is magnetite a universal memory molecule?*, Med Hypotheses. 2014 Sep 6. pii: S0306-9877(14)00312-0. doi: 10.1016/j.mehy.2014.08.028. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N de Groot MW et al**, (September 2014) *Assessment of the neurotoxic potential of exposure to 50Hz extremely low frequency electromagnetic fields (ELF-EMF) in naive and chemically stressed PC12 cells*, Neurotoxicology. 2014 Sep;44:358-64. doi: 10.1016/j.neuro.2014.07.009. Epub 2014 Aug 8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Isaac Aleman E et al**, (September 2014) *Effects of 60 Hz sinusoidal magnetic field on in vitro establishment, multiplication, and acclimatization phases of Coffee arabica seedlings*, Bioelectromagnetics. 2014 Sep;35(6):414-25. doi: 10.1002/bem.21859. Epub 2014 Jul 17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P Lee SK *et al*, (September 2014) *Extremely low frequency magnetic fields induce spermatogenic germ cell apoptosis: possible mechanism*, Biomed Res Int. 2014;2014:567183. doi: 10.1155/2014/567183. Epub 2014 Jun 15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Zhao G *et al*, (September 2014) *Relationship between exposure to extremely low-frequency electromagnetic fields and breast cancer risk: a meta-analysis*, Eur J Gynaecol Oncol. 2014;35(3):264-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Zhu H *et al*, (August 2014) *Effects of extremely low frequency electromagnetic fields on human fetal scleral fibroblasts*, Toxicol Ind Health. 2014 Aug 21. pii: 0748233714545837. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Reale M *et al*, (August 2014) *Neuronal cellular responses to extremely low frequency electromagnetic field exposure: implications regarding oxidative stress and neurodegeneration*, PLoS One. 2014 Aug 15;9(8):e104973. doi: 10.1371/journal.pone.0104973. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Seifirad S *et al*, (August 2014) *Effects of extremely low frequency electromagnetic fields on paraoxonase serum activity and lipid peroxidation metabolites in rat*, J Diabetes Metab Disord. 2014 Aug 13;13(1):85. doi: 10.1186/s40200-014-0085-2. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Zhang Y *et al*, (August 2014) *Short term effects of extremely low frequency electromagnetic fields exposure on Alzheimer's disease in rats*, Int J Radiat Biol. 2014 Aug 13:1-35. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Li C *et al*, (July 2014) *The extremely low-frequency magnetic field exposure differently affects the AMPAR and NMDAR subunit expressions in the hippocampus, entorhinal cortex and prefrontal cortex without effects on the rat spatial learning and memory*, Environ Res. 2014 Jul 18;134C:74-80. doi: 10.1016/j.envres.2014.06.025. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Kantar Gok D *et al*, (July 2014) *Effects of extremely low-frequency electric fields at different intensities and exposure durations on mismatch negativity*, Neuroscience. 2014 Jul 11;272:154-66. doi: 10.1016/j.neuroscience.2014.04.056. Epub 2014 May 6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Liu DD *et al*, (June 2014) *Melatonin protects rat cerebellar granule cells against electromagnetic field-induced increases in Na(+) currents through intracellular Ca(2+) release*, J Cell Mol Med. 2014 Jun;18(6):1060-70. doi: 10.1111/jcmm.12250. Epub 2014 Feb 18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Shafiei SA *et al*, (May 2014) *Investigation of EEG changes during exposure to extremely low-frequency magnetic field to conduct brain signals*, Neurol Sci. 2014 May 27. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Ma Q *et al*, (March 2014) *Extremely low-frequency electromagnetic fields affect transcript levels of neuronal differentiation-related genes in embryonic neural stem cells*, PLoS One. 2014 Mar 3;9(3):e90041. doi: 10.1371/journal.pone.0090041. eCollection 2014 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Seong Y *et al*, (March 2014) *Egr1 mediated the neuronal differentiation induced by extremely low-frequency electromagnetic fields*, Life Sci. 2014 Mar 3. pii: S0024-3205(14)00278-1. doi: 10.1016/j.lfs.2014.02.022. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Leone L et al**, (February 2014) *Epigenetic Modulation of Adult Hippocampal Neurogenesis by Extremely Low-Frequency Electromagnetic Fields*, Mol Neurobiol. 2014 Feb 16. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Jia HL et al**, (February 2014) *Combined effects of 50 Hz magnetic field and magnetic nanoparticles on the proliferation and apoptosis of PC12 cells*, Biomed Environ Sci. 2014 Feb;27(2):97-105. doi: 10.3967/bes2014.022 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Zhu H et al**, (October 2013) *Effect of puerarin on matrix metalloproteinase-2 in human fetal scleral fibroblasts treated with low frequency electromagnetic fields*, J Tradit Chin Med. 2013 Oct;33(5):664-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Bayat PD et al**, (November 2012) *Effects of prenatal exposure to extremely low electro-magnetic field on in vivo derived blastocysts of mice*, Iran J Reprod Med. 2012 Nov;10(6):555-60 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Potenza L et al**, (September 2012) *Effect of 300 mT static and 50 Hz 0.1 mT extremely low frequency magnetic fields on Tuber borchii mycelium*, Can J Microbiol. 2012 Sep 25. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Consales C et al**, (September 2012) *Electromagnetic fields, oxidative stress, and neurodegeneration*, Int J Cell Biol. 2012;2012:683897. Epub 2012 Sep 9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Del Re B et al**, (September 2012) *Assessing LINE-1 retrotransposition activity in neuroblastoma cells exposed to extremely low-frequency pulsed magnetic fields*, Mutat Res. 2012 Sep 7. pii: S1383-5718(12)00276-8. doi: 10.1016/j.mrgentox.2012.07.004. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Das S et al**, (September 2012) *Exposure to ELF- magnetic field promotes restoration of sensori-motor functions in adult rats with hemisection of thoracic spinal cord*, Electromagn Biol Med. 2012 Sep;31(3):180-94 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Kirschenlohr H et al**, (September 2012) *Gene expression profiles in white blood cells of volunteers exposed to a 50 Hz electromagnetic field*, Radiat Res. 2012 Sep;178(3):138-49. Epub 2012 Aug 1 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Cho H et al**, (July 2012) *Neural stimulation on human bone marrow-derived mesenchymal stem cells by extremely low frequency electromagnetic fields*, Biotechnol Prog. 2012 Jul 31. doi: 10.1002/btpr.1607. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Kitaoka K et al**, (July 2012) *Chronic exposure to an extremely low-frequency magnetic field induces depression-like behavior and corticosterone secretion without enhancement of the hypothalamic-pituitary-adrenal axis in mice*, Bioelectromagnetics. 2012 Jul 2. doi: 10.1002/bem.21743. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Balamuralikrishnan B et al**, (2012) *Evaluation of Chromosomal Alteration in Electrical Workers Occupationally Exposed to Low Frequency of Electro Magnetic Field (EMFs) in Coimbatore Population, India*, Asian Pac J Cancer Prev. 2012;13(6):2961-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Ince B** *et al*, (June 2012) *Can exposure to manganese and extremely low frequency magnetic fields affect some important elements in the rat teeth?*, Eur Rev Med Pharmacol Sci. 2012 Jun;16(6):763-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Korpinar MA** *et al*, (2012) *The 50 Hz (10 mT) sinusoidal magnetic field: effects on stress-related behavior of rats*, Bratisl Lek Listy. 2012;113(9):521-4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Fedrowitz M, Loscher W**, (May 2012) *Gene expression in the mammary gland tissue of female Fischer 344 and Lewis rats after magnetic field exposure (50 Hz, 100 uT) for 2 weeks*, Int J Radiat Biol. 2012 May;88(5):425-9. Epub 2012 Feb 28 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Chen G** *et al*, (April 2012) *Using model organism Saccharomyces cerevisiae to evaluate the effects of ELF-MF and RF-EMF exposure on global gene expression*, Bioelectromagnetics. 2012 Apr 9. doi: 10.1002/bem.21724. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Foroozandeh E** *et al*, (March 2012) *Toxic effects of 50 Hz electromagnetic field on memory consolidation in male and female mice*, Toxicol Ind Health. 2012 Mar 7. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Huwiler SG** *et al*, (February 2012) *Genome-wide transcription analysis of Escherichia coli in response to extremely low-frequency magnetic fields*, Bioelectromagnetics. 2012 Feb 13. doi: 10.1002/bem.21709. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Narinyan L** *et al*, (January 2012) *Age-dependent magnetosensitivity of heart muscle hydration*, Bioelectromagnetics. 2012 Jan 17. doi: 10.1002/bem.21704. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Patrino A** *et al*, (January 2012) *Kinetic Study on the Effects of Extremely Low Frequency Electromagnetic Field on Catalase, Cytochrome P450 and Inducible Nitric Oxide Synthase in Human HaCaT and THP-1 Cell Lines*, CNS Neurol Disord Drug Targets. 2012 Jan 10. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Touitou Y** *et al*, (January 2012) *Long-term (up to 20years) effects of 50-Hz magnetic field exposure on blood chemistry parameters in healthy men*, Clin Biochem. 2012 Jan 9. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Janac B** *et al*, (January 2012) *Temporal patterns of extremely low frequency magnetic field-induced motor behaviour changes in Mongolian gerbils of different age*, Int J Radiat Biol. 2012 Jan 6. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Borhani N** *et al*, (December 2011) *Analysis of DNA fragmentation in mouse embryos exposed to an extremely low-frequency electromagnetic field*, Electromagn Biol Med. 2011 Dec;30(4):246-52 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Chu LY** *et al*, (December 2011) *Extremely low frequency magnetic field induces oxidative stress in mouse cerebellum*, Gen Physiol Biophys. 2011 Dec;30(4):415-21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P **Ciejka E** *et al*, (December 2011) *Effects of extremely low frequency magnetic field on oxidative balance in brain of rats*, J Physiol Pharmacol. 2011 Dec;62(6):657-61 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Dominici L** *et al*, (December 2011) *Genotoxic hazard evaluation in welders occupationally exposed to extremely low-frequency magnetic fields (ELF-MF)*, Int J Hyg Environ Health. 2011 Dec;215(1):68-75. Epub 2011 Aug 20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Lagroye I** *et al*, (December 2011) *ELF magnetic fields: Animal studies, mechanisms of action*, Prog Biophys Mol Biol. 2011 Dec;107(3):369-73. Epub 2011 Sep 8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Pilla A** *et al*, (December 2011) *Electromagnetic fields as first messenger in biological signaling: Application to calmodulin-dependent signaling in tissue repair*, Biochim Biophys Acta. 2011 Dec;1810(12):1236-45. Epub 2011 Oct 8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Costin GE** *et al*, (October 2011) *Trends in Wound Repair: Cellular and Molecular Basis of Regenerative Therapy Using Electromagnetic Fields*, Curr Mol Med. 2011 Oct 27. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Gandhi OP** *et al*, (October 2011) *Exposure Limits: The underestimation of absorbed cell phone radiation, especially in children*, Electromagn Biol Med. 2011 Oct 14. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Hwang YH** *et al*, (October 2011) *Intracellular Ca Mobilization and Beta-hexosaminidase Release Are Not Influenced by 60 Hz-electromagnetic Fields (EMF) in RBL 2H3 Cells*, Korean J Physiol Pharmacol. 2011 Oct;15(5):313-7. Epub 2011 Oct 31 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Verschaeve L** *et al*, (October 2011) *Genotoxicity investigation of ELF-magnetic fields in Salmonella typhimurium with the sensitive SOS-based VITOTOX test*, Bioelectromagnetics 2011 Oct;32(7):580-4. doi: 10.1002/bem.20672. Epub 2011 Apr 12 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Lee HJ** *et al*, (September 2011) *Combined effects of 60 Hz electromagnetic field exposure with various stress factors on cellular transformation in NIH3T3 cells*, Bioelectromagnetics. 2011 Sep 6. doi: 10.1002/bem.20700. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Legros A** *et al*, (September 2011) *Neurophysiological and behavioral effects of a 60 Hz, 1,800 uT magnetic field in humans*, Eur J Appl Physiol. 2011 Sep 6. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Shin EJ** *et al*, (September 2011) *Exposure to extremely low frequency magnetic fields induces fos-related antigen-immunoreactivity via activation of dopaminergic d1 receptor*, Exp Neurobiol. 2011 Sep;20(3):130-6. Epub 2011 Sep 20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Sulpizio M** *et al*, (August 2011) *Molecular basis underlying the biological effects elicited by extremely low-frequency magnetic field (ELF-MF) on neuroblastoma cells*, J Cell Biochem. 2011 Aug 8. doi: 10.1002/jcb.23310. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Selmaoui B** *et al*, (June 2011) *Acute Exposure to 50-Hz Magnetic Fields Increases Interleukin-6 in Young Healthy Men*, J Clin Immunol. 2011 Jun 28. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

[Pubmed](#)]

**P Giorgi G et al**, (June 2011) *Effect of extremely low frequency magnetic field exposure on DNA transposition in relation to frequency, wave shape and exposure time*, Int J Radiat Biol. 2011 Jun;87(6):601-8. Epub 2011 Apr 19 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Hong ME et al**, (June 2011) *Influence of exposure to extremely low frequency magnetic field on neuroendocrine cells and hormones in stomach of rats*, Korean J Physiol Pharmacol. 2011 Jun;15(3):137-42. Epub 2011 Jun 30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Ravera S et al**, (June 2011) *Extremely low-frequency electromagnetic fields affect lipid-linked Carbonic anhydrase*, Electromagn Biol Med. 2011 Jun;30(2):67-73 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Rossi C et al**, (June 2011) *New perspectives in cell communication: Bioelectromagnetic interactions*, Semin Cancer Biol. 2011 Jun;21(3):207-14. Epub 2011 May 6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Belyaev I et al**, (May 2011) *Toxicity and SOS response to ELF magnetic field and nalidixic acid in E. coli cells*, Mutat Res. 2011 May 18;722(1):84-8. Epub 2011 Mar 29 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Blank M, Goodman R**, (April 2011) *DNA is a fractal antenna in electromagnetic fields*, Int J Radiat Biol. 2011 Apr;87(4):409-15. Epub 2011 Feb 28 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Luukkonen J et al**, (March 2011) *Pre-exposure to 50 Hz magnetic fields modifies menadione-induced genotoxic effects in human SH-SY5Y neuroblastoma cells*, PLoS One. 2011 Mar 23;6(3):e18021 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Sert C et al**, (March 2011) *Intracellular Ca(2+) levels in rat ventricle cells exposed to extremely low frequency magnetic field*, Electromagn Biol Med. 2011 Mar;30(1):14-20. doi: 10.3109/15368378.2011.566773 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Moghadam MK et al**, (March 2011) *Effects of weak environmental magnetic fields on the spontaneous bioelectrical activity of snail neurons*, J Membr Biol. 2011 Mar;240(2):63-71. Epub 2011 Jan 20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Kleijn S et al**, (January 2011) *Extremely low frequency electromagnetic field exposure does not modulate toll-like receptor signaling in human peripheral blood mononuclear cells*, Cytokine. 2011 Apr;54(1):43-50. Epub 2011 Jan 15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Masuda H et al**, (January 2011) *Lack of effect of 50-Hz magnetic field exposure on the binding affinity of serotonin for the 5-HT 1B receptor subtype*, Brain Res. 2011 Jan 12;1368:44-51. Epub 2010 Nov 1 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Morabito C et al**, (January 2011) *Effects of acute and chronic low frequency electromagnetic field exposure on PC12 cells during neuronal differentiation*, Cell Physiol Biochem. 2010;26(6):947-58. Epub 2011 Jan 4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Song HS** *et al*, (December 2010) *Effect of Extremely Low Frequency Electromagnetic Fields (EMF) on Phospholipase Activity in the Cultured Cells*, Korean J Physiol Pharmacol. 2010 Dec;14(6):427-33. Epub 2010 Dec 31 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Mayer-Wagner S** *et al*, (December 2010) *Effects of low frequency electromagnetic fields on the chondrogenic differentiation of human mesenchymal stem cells*, Bioelectromagnetics. 2010 Dec 22. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Akan Z** *et al*, (December 2010) *Extremely low-frequency electromagnetic fields affect the immune response of monocyte-derived macrophages to pathogens*, Bioelectromagnetics. 2010 Dec;31(8):603-12. doi: 10.1002/bem.20607. Epub 2010 Aug 31 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Berg H** *et al*, (December 2010) *Bioelectromagnetic field effects on cancer cells and mice tumors*, Electromagn Biol Med. 2010 Dec;29(4):132-43 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Martinez-Samano J** *et al*, (December 2010) *Effects of acute electromagnetic field exposure and movement restraint on antioxidant system in liver, heart, kidney and plasma of Wistar rats: a preliminary report*, Int J Radiat Biol. 2010 Dec;86(12):1088-94. Epub 2010 Aug 11 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Yan J** *et al*, (December 2010) *Effects of extremely low-frequency magnetic field on growth and differentiation of human mesenchymal stem cells*, Electromagn Biol Med. 2010 Dec;29(4):165-76. Epub 2010 Oct 5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Coskun O, Comlekci S**, (November 2010) *Effect of ELF electric field on some on biochemistry characters in the rat serum*, Toxicol Ind Health. 2010 Nov 18. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Andel R** *et al*, (November 2010) *Work-related exposure to extremely low-frequency magnetic fields and dementia: results from the population-based study of dementia in Swedish twins*, J Gerontol A Biol Sci Med Sci. 2010 Nov;65(11):1220-7. Epub 2010 Jul 9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Cuccurazzu B** *et al*, (November 2010) *Exposure to extremely low-frequency (50 Hz) electromagnetic fields enhances adult hippocampal neurogenesis in C57BL/6 mice*, Exp Neurol. 2010 Nov;226(1):173-82. Epub 2010 Sep 15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Tenorio BM** *et al*, (October 2010) *Testicular development evaluation in rats exposed to 60 Hz and 1 mT electromagnetic field*, J Appl Toxicol. 2010 Oct 8. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Kheifets L** *et al*, (October 2010) *A pooled analysis of extremely low-frequency magnetic fields and childhood brain tumors*, Am J Epidemiol. 2010 Oct 1;172(7):752-61. Epub 2010 Aug 9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Kim J** *et al*, (October 2010) *Repetitive exposure to a 60-Hz time-varying magnetic field induces DNA double-strand breaks and apoptosis in human cells*, Biochem Biophys Res Commun. 2010 Oct 1;400(4):739-44. Epub 2010 Sep 15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P Sun W *et al*, (October 2010) *Effects of 50-Hz magnetic field exposure on hormone secretion and apoptosis-related gene expression in human first trimester villous trophoblasts in vitro*, *Bioelectromagnetics*. 2010 Oct;31(7):566-72 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P Ulku R *et al*, (September 2010) *Extremely Low-Frequency Magnetic Field Decreased Calcium, Zinc and Magnesium Levels in Costa of Rat*, *Biol Trace Elem Res*. 2010 Sep 25. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P Emre M *et al*, (September 2010) *Oxidative Stress and Apoptosis in Relation to Exposure to Magnetic Field*, *Cell Biochem Biophys*. 2010 Sep 8. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P El-Helaly M, Abu-Hashem E, (September 2010) *Oxidative stress, melatonin level, and sleep insufficiency among electronic equipment repairers*, *Bioelectromagnetics*. 2011 May;32(4):325-30. doi: 10.1002/bem.20638. Epub 2010 Dec 15 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N Rajkovic V *et al*, (August 2010) *Studies on the synergistic effects of extremely low-frequency magnetic fields and the endocrine-disrupting compound atrazine on the thyroid gland*, *Int J Radiat Biol*. 2010 Aug 10. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P Iorio R *et al*, (August 2010) *Involvement of mitochondrial activity in mediating ELF-EMF stimulatory effect on human sperm motility*, *Bioelectromagnetics*. 2010 Aug 5. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P Mariucci G *et al*, (August 2010) *Brain DNA damage and 70-kDa heat shock protein expression in CD1 mice exposed to extremely low frequency magnetic fields*, *Int J Radiat Biol*. 2010 Aug;86(8):701-10 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- Mild KH, Mattsson MO, (August 2010) *ELF noise fields: a review*, *Electromagn Biol Med*. 2010 Aug;29(3):72-97 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P Rajkovic V *et al*, (August 2010) *Combined exposure of peripubertal male rats to the endocrine-disrupting compound atrazine and power-frequency electromagnetic fields causes degranulation of cutaneous mast cells: a new toxic environmental hazard?*, *Arch Environ Contam Toxicol*. 2010 Aug;59(2):334-41. Epub 2010 Feb 11 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P Akdag MZ *et al*, (June 2010) *The effect of long-term extremely low-frequency magnetic field on geometric and biomechanical properties of rats' bone*, *Electromagn Biol Med*. 2010 Jun;29(1-2):9-18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P Bernabo N *et al*, (June 2010) *Extremely low frequency electromagnetic field exposure affects fertilization outcome in swine animal model*, *Theriogenology*. 2010 Jun;73(9):1293-305. Epub 2010 Feb 21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P de Bruyn L, de Jager L, (June 2010) *Effect of long-term exposure to a randomly varied 50 Hz power frequency magnetic field on the fertility of the mouse*, *Electromagn Biol Med*. 2010 Jun;29(1-2):52-61 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Garip AI, Akan Z**, (June 2010) *Effect of ELF-EMF on number of apoptotic cells; correlation with reactive oxygen species and HSP*, Acta Biol Hung. 2010 Jun;61(2):158-67 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Goraca A et al**, (June 2010) *Effects of extremely low frequency magnetic field on the parameters of oxidative stress in heart*, J Physiol Pharmacol. 2010 Jun;61(3):333-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Kolodziejczyk L et al**, (2010) *Extremely low frequency magnetic field and the hatching rate of Fasciola hepatica eggs, the fecundity and survival of liver fluke-infected snail, Lymnaea truncatula*, Folia Biol (Krakow). 2010;58(3-4):157-61 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Okudan N et al**, (2010) *Effects of long-term 50 Hz magnetic field exposure on the micro nucleated polychromatic erythrocyte and blood lymphocyte frequency and argyrophilic nucleolar organizer regions in lymphocytes of mice*, Neuro Endocrinol Lett. 2010;31(2):208-14 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Goudarzi I et al**, (May 2010) *Pulsed electromagnetic fields accelerate wound healing in the skin of diabetic rats*, Bioelectromagnetics. 2010 May;31(4):318-23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Girgert R et al**, (April 2010) *Signal transduction of the melatonin receptor MT1 is disrupted in breast cancer cells by electromagnetic fields*, Bioelectromagnetics. 2010 Apr;31(3):237-45 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Reyes-Guerrero G et al**, (March 2010) *Extremely low-frequency electromagnetic fields differentially regulate estrogen receptor-alpha and -beta expression in the rat olfactory bulb*, Neurosci Lett. 2010 Mar 3;471(2):109-13. Epub 2010 Jan 18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**N Akdag MZ et al**, (February 2010) *Effects of Extremely Low-Frequency Magnetic Field on Caspase Activities and Oxidative Stress Values in Rat Brain*, Biol Trace Elem Res. 2010 Feb 23. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Jahandideh S et al**, (February 2010) *Comparing performances of logistic regression and neural networks for predicting melatonin excretion patterns in the rat exposed to ELF magnetic fields*, Bioelectromagnetics. 2010 Feb;31(2):164-71 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Focke F et al**, (January 2010) *DNA fragmentation in human fibroblasts under extremely low frequency electromagnetic field exposure*, Mutat Res. 2010 Jan 5;683(1-2):74-83 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Rajaei F et al**, (January 2010) *Effects of extremely low-frequency electromagnetic field on fertility and heights of epithelial cells in pre-implantation stage endometrium and fallopian tube in mice*, Zhong Xi Yi Jie He Xue Bao. 2010 Jan;8(1):56-60 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

**P Severini M et al**, (January 2010) *Metamorphosis delay in Xenopus laevis (Daudin) tadpoles exposed to a 50 Hz weak magnetic field*, Int J Radiat Biol. 2010 Jan;86(1):37-46 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P Di Campi E et al**, (June 2010) *Effects of extremely low-frequency electromagnetic fields on Helicobacter pylori biofilm*, *Curr Microbiol.* 2010 Jun;60(6):412-8. Epub 2009 Dec 24 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Morabito C et al**, (February 2010) *Modulation of redox status and calcium handling by extremely low frequency electromagnetic fields in C2C12 muscle cells: A real-time, single-cell approach*, *Free Radic Biol Med.* 2010 Feb 15;48(4):579-89. Epub 2009 Dec 11 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Celikler S et al**, (December 2009) *A biomonitoring study of genotoxic risk to workers of transformers and distribution line stations*, *Int J Environ Health Res.* 2009 Dec;19(6):421-30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Del Re B et al**, (December 2009) *Extremely low frequency magnetic field exposure affects DnaK and GroEL expression in E. coli cells with impaired heat shock response*, *Gen Physiol Biophys.* 2009 Dec;28(4):420-4 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Perez-Castejon C et al**, (December 2009) *Exposure to ELF-pulse modulated X band microwaves increases in vitro human astrocytoma cell proliferation*, *Histol Histopathol.* 2009 Dec;24(12):1551-61 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N de Gannes FP et al**, (October 2009) *Amyotrophic lateral sclerosis (ALS) and extremely-low frequency (ELF) magnetic fields: a study in the SOD-1 transgenic mouse model*, *Amyotroph Lateral Scler.* 2009 Oct-Dec;10(5-6):370-3 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Patruno A et al**, (October 2009) *Extremely low frequency electromagnetic fields modulate expression of inducible nitric oxide synthase, endothelial nitric oxide synthase and cyclooxygenase-2 in the human keratinocyte cell line HaCat: potential therapeutic effects in wound healing*, *Br J Dermatol.* 2010 Feb 1;162(2):258-66. Epub 2009 Oct 3 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Gobba F et al**, (October 2009) *Natural killer cell activity decreases in workers occupationally exposed to extremely low frequency magnetic fields exceeding 1 microT*, *Int J Immunopathol Pharmacol.* 2009 Oct-Dec;22(4):1059-66 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Albanese A et al**, (2009) *Alterations in adenylate kinase activity in human PBMCs after in vitro exposure to electromagnetic field: comparison between extremely low frequency electromagnetic field (ELF) and therapeutic application of a musically modulated electromagnetic field*, *J Biomed Biotechnol.* 2009;2009:717941. Epub 2009 Sep 16 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Eleuteri AM et al**, (2009) *50 Hz extremely low frequency electromagnetic fields enhance protein carbonyl groups content in cancer cells: effects on proteasomal systems*, *J Biomed Biotechnol.* 2009;2009:834239. Epub 2009 Aug 5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Robertson JA et al**, (August 2009) *Low-frequency pulsed electromagnetic field exposure can alter neuroprocessing in humans*, *J R Soc Interface.* 2009 Aug 5. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Contalbrigo L et al**, (August 2009) *Effects of different electromagnetic fields on circadian rhythms of some haematochemical parameters in rats*, *Biomed Environ Sci.* 2009 Aug;22(4):348-53 [[View Author's abstract](#)]

[conclusions](#)] [[View on Pubmed](#)]

P **Dundar B** *et al*, (August 2009) *The effect of the prenatal and post-natal long-term exposure to 50 Hz electric field on growth, pubertal development and IGF-1 levels in female Wistar rats*, Toxicol Ind Health. 2009 Aug;25(7):479-87 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Gonet B** *et al*, (July 2009) *Effects of extremely low-frequency magnetic fields on the oviposition of Drosophila melanogaster over three generations*, Bioelectromagnetics. 2009 Jul 23. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Goodman R** *et al*, (July 2009) *Extremely low frequency electromagnetic fields activate the ERK cascade, increase hsp70 protein levels and promote regeneration in Planaria*, Int J Radiat Biol. 2009 Jul 9:1-9. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Funk RH** *et al*, (2009) *Electromagnetic effects - From cell biology to medicine*, Prog Histochem Cytochem. 2009;43(4):177-264. Epub 2008 Sep 18 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Ruiz-Gomez MJ, Martinez-Morillo M**, (2009) *Electromagnetic fields and the induction of DNA strand breaks*, Electromagn Biol Med. 2009;28(2):201-14 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Mild KH** *et al*, (April 2009) *Background ELF magnetic fields in incubators: A factor of importance in cell culture work*, Cell Biol Int. 2009 Apr 23. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Burda H** *et al*, (April 2009) *Extremely low-frequency electromagnetic fields disrupt magnetic alignment of ruminants*, Proc Natl Acad Sci U S A. 2009 Apr 7;106(14):5708-13. Epub 2009 Mar 19 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Girgert R** *et al*, (April 2009) *Exposure of mcf-7 breast cancer cells to electromagnetic fields up-regulates the plasminogen activator system*, Int J Gynecol Cancer. 2009 Apr;19(3):334-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Santini MT** *et al*, (April 2009) *Cellular effects of extremely low frequency (ELF) electromagnetic fields*, Int J Radiat Biol. 2009 Apr;85(4):294-313 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Novikov VV** *et al*, (March 2009) *Effect of weak combined static and extremely low-frequency alternating magnetic fields on tumor growth in mice inoculated with the Ehrlich ascites carcinoma*, Bioelectromagnetics. 2009 Mar 6. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Prihoda TJ**, (March 2009) *Genetic damage in mammalian somatic cells exposed to extremely low frequency electro-magnetic fields: A meta-analysis of data from 87 publications (1990-2007)*, Int J Radiat Biol. 2009 Mar;85(3):196-213 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Harris SR** *et al*, (February 2009) *Effect of magnetic fields on cryptochrome-dependent responses in Arabidopsis thaliana*, 2009 Feb 25. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Yang Y** *et al*, (December 2008) *Case-only study of interactions between DNA repair genes (hMLH1, APEX1, MGMT, XRCC1 and XPD) and low-frequency electromagnetic fields in childhood acute leukemia*, Leuk

Lymphoma. 2008 Dec;49(12):2344-50 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Burdak-Rothkamm S et al**, (November 2008) *DNA and chromosomal damage in response to intermittent extremely low-frequency magnetic fields*, Mutat Res. 2008 Nov 13. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Kim YW et al**, (October 2008) *Effects of 60 Hz 14 microT magnetic field on the apoptosis of testicular germ cell in mice*, Bioelectromagnetics. 2008 Oct 6. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

N **Bernard N et al**, (October 2008) *Assessing the Potential Leukemogenic Effects of 50 Hz and their Harmonics Using an Animal Leukemia Model*, J Radiat Res (Tokyo). 2008 Oct 4. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Yokus B et al**, (October 2008) *Extremely low frequency magnetic fields cause oxidative DNA damage in rats*, Int J Radiat Biol. 2008 Oct;84(10):789-95 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Palumbo R et al**, (September 2008) *Exposure to 900 MHz Radiofrequency Radiation Induces Caspase 3 Activation in Proliferating Human Lymphocytes*, Radiat Res. 2008 Sep;170(3):327-34 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Soda A et al**, (August 2008) *Effect of exposure to an extremely low frequency-electromagnetic field on the cellular collagen with respect to signaling pathways in osteoblast-like cells*, J Med Invest. 2008 Aug;55(3-4):267-78 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Binhi V**, (July 2008) *Do naturally occurring magnetic nanoparticles in the human body mediate increased risk of childhood leukaemia with EMF exposure?*, Int J Radiat Biol. 2008 Jul;84(7):569-79 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Falone S et al**, (June 2008) *Chronic exposure to 50Hz magnetic fields causes a significant weakening of antioxidant defence systems in aged rat brain*, Int J Biochem Cell Biol. 2008 Jun 10. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Blank M**, (2008) *Protein and DNA reactions stimulated by electromagnetic fields*, Electromagn Biol Med. 2008;27(1):3-23 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Juutilainen J**, (2008) *Do electromagnetic fields enhance the effects of environmental carcinogens?*, Radiat Prot Dosimetry. 2008;132(2):228-31 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Sharifian A et al**, (May 2008) *Effect of extremely low frequency magnetic field on antioxidant activity in plasma and red blood cells in spot welders.*, Int Arch Occup Environ Health. 2008 May 27 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Cellini L et al**, (May 2008) *Bacterial response to the exposure of 50 Hz electromagnetic fields*, Bioelectromagnetics. 2008 May;29(4):302-11 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Pokorny J et al**, (May 2008) *Biophysical aspects of cancer--electromagnetic mechanism*, Indian J Exp Biol. 2008 May;46(5):310-21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P Vianale G et al**, (April 2008) *Extremely low frequency electromagnetic field enhances human keratinocyte cell growth and decreases proinflammatory chemokine production*, Br J Dermatol. 2008 Apr 10 [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Henshaw DL et al**, (April 2008) *Can disturbances in the atmospheric electric field created by powerline corona ions disrupt melatonin production in the pineal gland?*, J Pineal Res. 2008 Apr 1. [Epub ahead of print] [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P St-Pierre LS et al**, (April 2008) *Altered blood chemistry and hippocampal histomorphology in adult rats following prenatal exposure to physiologically-patterned, weak (50-500 nanoTesla range) magnetic fields*, Int J Radiat Biol. 2008 Apr;84(4):325-35 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Liu T et al**, (March 2008) *Anxiogenic effect of chronic exposure to extremely low frequency magnetic field in adult rats*, Neurosci Lett. 2008 Mar 21;434(1):12-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Hardell L, Sage C**, (February 2008) *Biological effects from electromagnetic field exposure and public exposure standards*, Biomed Pharmacother. 2008 Feb;62(2):104-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Fedrowitz M, Loscher W**, (January 2008) *Exposure of Fischer 344 rats to a weak power frequency magnetic field facilitates mammary tumorigenesis in the DMBA model of breast cancer*, Carcinogenesis. 2008 Jan;29(1):186-93 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Binhi V**, (January 2007) *A mathematical model of DNA degradation: possible role of magnetic nanoparticles*, arXiv.org - 0701202v1 [[View Author's abstract conclusions](#)]
- **Ravindra T et al**, (December 2006) *Melatonin in pathogenesis and therapy of cancer*, Indian J Med Sci. 2006 Dec;60(12):523-35 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Swanson J et al**, (September 2006) *Power-frequency electric and magnetic fields in the light of Draper et al. 2005*, Ann N Y Acad Sci. 2006 Sep;1076:318-30 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Davis S et al**, (August 2006) *Effects of 60-Hz magnetic field exposure on nocturnal 6-sulfatoxymelatonin, estrogens, luteinizing hormone, and follicle-stimulating hormone in healthy reproductive-age women: results of a crossover trial*, Ann Epidemiol. 2006 Aug;16(8):622-31 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Espinosa JM et al**, (July 2006) *Exposure to AC and DC magnetic fields induces changes in 5-HT1B receptor binding parameters in rat brain membranes*, Bioelectromagnetics. 2006 Jul;27(5):414-22 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Juutilainen J, Kumlin T**, (July 2006) *Occupational magnetic field exposure and melatonin: interaction with light-at-night*, Bioelectromagnetics. 2006 Jul;27(5):423-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Blackman CF**, (2006) *Can EMF exposure during development leave an imprint later in life?*, Electromagn Biol Med. 2006;25(4):217-25 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Persinger MA**, (2006) *A potential multiple resonance mechanism by which weak magnetic fields affect molecules and medical problems: the example of melatonin and experimental "multiple sclerosis"*, Med

Hypotheses. 2006;66(4):811-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Altpeter ES et al**, (February 2006) *Effect of short-wave (6-22 MHz) magnetic fields on sleep quality and melatonin cycle in humans: the Schwarzenburg shut-down study*, Bioelectromagnetics. 2006 Feb;27(2):142-50 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Koziak AM et al**, (January 2006) *Light alters nociceptive effects of magnetic field shielding*, Bioelectromagnetics. 2006 Jan;27(1):10-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Blask DE et al**, (December 2005) *Melatonin-depleted blood from premenopausal women exposed to light at night stimulates growth of human breast cancer xenografts in nude rats*, Cancer Res. 2005 Dec 1;65(23):11174-84 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Li L et al**, (December 2005) *Pulsed electric field exposure of insulin induces anti-proliferative effects on human hepatocytes*, Bioelectromagnetics. 2005 Dec;26(8):639-47 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Girgert R et al**, (November 2005) *Induction of tamoxifen resistance in breast cancer cells by ELF electromagnetic fields*, Biochem Biophys Res Commun. 2005 Nov 4;336(4):1144-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Winker R et al**, (August 2005) *Chromosomal damage in human diploid fibroblasts by intermittent exposure to extremely low-frequency electromagnetic fields*, Mutat Res. 2005 Aug 1;585(1-2):43-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Ainsbury EA et al**, (July 2005) *An investigation into the vector ellipticity of extremely low frequency magnetic fields from appliances in UK homes*, Phys Med Biol. 2005 Jul 7;50(13):3197-209 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Chiu RS, Stuchly MA**, (June 2005) *Electric fields in bone marrow substructures at power-line frequencies*, IEEE Trans Biomed Eng. 2005 Jun;52(6):1103-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Henshaw DL, Reiter RJ**, (2005) *Do magnetic fields cause increased risk of childhood leukemia via melatonin disruption?*, Bioelectromagnetics. 2005;Suppl 7:S86-97 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- **Binhi V, Chernavskh D**, (2005) *Stochastic dynamics of magnetosomes in cytoskeleton*, Europhysics Letters - 70 (6), pp. 850-856 (2005) [[View Author's abstract conclusions](#)]

- **Carrillo-Vico A et al**, (February 2005) *Human lymphocyte-synthesized melatonin is involved in the regulation of the interleukin-2/interleukin-2 receptor system*, J Clin Endocrinol Metab. 2005 Feb;90(2):992-1000 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Simko M, Mattsson MO**, (September 2004) *Extremely low frequency electromagnetic fields as effectors of cellular responses in vitro: possible immune cell activation*, J Cell Biochem. 2004 Sep 1;93(1):83-92 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

P **Lai H, Singh NP**, (May 2004) *Magnetic-field-induced DNA strand breaks in brain cells of the rat*, Environ Health Perspect. 2004 May;112(6):687-94 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P Lee BC *et al*, (January 2004) *Effects of extremely low frequency magnetic field on the antioxidant defense system in mouse brain: a chemiluminescence study*, J Photochem Photobiol B. 2004 Jan 23;73(1-2):43-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Fedrowitz M *et al*, (January 2004) *Significant differences in the effects of magnetic field exposure on 7,12-dimethylbenz(a)anthracene-induced mammary carcinogenesis in two substrains of Sprague-Dawley rats*, Cancer Res. 2004 Jan 1;64(1):243-51 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- Rodriguez C *et al*, (January 2004) *Regulation of antioxidant enzymes: a significant role for melatonin*, J Pineal Res. 2004 Jan;36(1):1-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Ivancsits S *et al*, (July 2003) *Intermittent extremely low frequency electromagnetic fields cause DNA damage in a dose-dependent way*, Int Arch Occup Environ Health. 2003 Jul;76(6):431-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Cho YH, Chung HW, (June 2003) *The effect of extremely low frequency electromagnetic fields (ELF-EMF) on the frequency of micronuclei and sister chromatid exchange in human lymphocytes induced by benzo(a)pyrene*, Toxicol Lett. 2003 Jun 5;143(1):37-44 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Lewy H *et al*, (June 2003) *Magnetic field (50 Hz) increases N-acetyltransferase, hydroxy-indole-O-methyltransferase activity and melatonin release through an indirect pathway*, Int J Radiat Biol. 2003 Jun;79(6):431-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Touitou Y *et al*, (June 2003) *Magnetic fields and the melatonin hypothesis: a study of workers chronically exposed to 50-Hz magnetic fields*, Am J Physiol Regul Integr Comp Physiol. 2003 Jun;284(6):R1529-35 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Kaune WT, (December 2002) *Thermal noise limit on the sensitivity of cellular membranes to power frequency electric and magnetic fields*, Bioelectromagnetics. 2002 Dec;23(8):622-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Burch JB *et al*, (November 2002) *Melatonin metabolite excretion among cellular telephone users*, Int J Radiat Biol. 2002 Nov;78(11):1029-36 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Kavet R, Zaffanella LE, (September 2002) *Contact voltage measured in residences: implications to the association between magnetic fields and childhood leukemia*, Bioelectromagnetics. 2002 Sep;23(6):464-74 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Fedrowitz M *et al*, (March 2002) *Magnetic field exposure increases cell proliferation but does not affect melatonin levels in the mammary gland of female Sprague Dawley rats*, Cancer Res. 2002 Mar 1;62(5):1356-63 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Ishido M *et al*, (February 2002) *The mechanism of biological magnetic field effects on oncostatic actions of melatonin*, RIKEN review - No. 44 (February, 2002) [[View Author's abstract conclusions](#)]
- P Tonini R *et al*, (November 2001) *Calcium protects differentiating neuroblastoma cells during 50 Hz electromagnetic radiation*, Biophys J. 2001 Nov;81(5):2580-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- P Davis S et al**, (October 2001) *Residential magnetic fields, light-at-night, and nocturnal urinary 6-sulfatoxymelatonin concentration in women*, Am J Epidemiol. 2001 Oct 1;154(7):591-600 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Levallois P et al**, (October 2001) *Effects of electric and magnetic fields from high-power lines on female urinary excretion of 6-sulfatoxymelatonin*, Am J Epidemiol. 2001 Oct 1;154(7):601-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Simko M et al**, (August 2001) *Micronucleus induction in Syrian hamster embryo cells following exposure to 50 Hz magnetic fields, benzo(a)pyrene, and TPA in vitro*, Mutat Res. 2001 Aug 22;495(1-2):43-50 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Ishido M et al**, (July 2001) *Magnetic fields (MF) of 50 Hz at 1.2 microT as well as 100 microT cause uncoupling of inhibitory pathways of adenylyl cyclase mediated by melatonin 1a receptor in MF-sensitive MCF-7 cells*, Carcinogenesis. 2001 Jul;22(7):1043-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Blackman CF et al**, (February 2001) *The influence of 1.2 microT, 60 Hz magnetic fields on melatonin- and tamoxifen-induced inhibition of MCF-7 cell growth*, Bioelectromagnetics. 2001 Feb;22(2):122-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Cecconi S et al**, (November 2000) *Evaluation of the effects of extremely low frequency electromagnetic fields on mammalian follicle development*, Hum Reprod. 2000 Nov;15(11):2319-25 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Woods M et al**, (November 2000) *Lyn and syk tyrosine kinases are not activated in B-lineage lymphoid cells exposed to low-energy electromagnetic fields*, FASEB J. 2000 Nov;14(14):2284-90 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Anderson LE et al**, (September 2000) *Effects of 50- or 60-hertz, 100 microT magnetic field exposure in the DMBA mammary cancer model in Sprague-Dawley rats: possible explanations for different results from two laboratories*, Environ Health Perspect. 2000 Sep;108(9):797-802 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Loberg LI et al**, (May 2000) *Expression of cancer-related genes in human cells exposed to 60 Hz magnetic fields*, Radiat Res. 2000 May;153(5 Pt 2):679-84 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P van Wijngaarden E et al**, (April 2000) *Exposure to electromagnetic fields and suicide among electric utility workers: a nested case-control study*, Occup Environ Med. 2000 Apr;57(4):258-63 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Burch JB et al**, (February 2000) *Melatonin metabolite levels in workers exposed to 60-Hz magnetic fields: work in substations and with 3-phase conductors*, J Occup Environ Med. 2000 Feb;42(2):136-42 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Wei M et al**, (February 2000) *Exposure to 60-Hz magnetic fields and proliferation of human astrocytoma cells in vitro*, Toxicol Appl Pharmacol. 2000 Feb 1;162(3):166-76 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- N **Wey HE et al**, (February 2000) *50-Hertz magnetic field and calcium transients in Jurkat cells: results of a research and public information dissemination (RAPID) program study*, Environ Health Perspect. 2000 Feb;108(2):135-40 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Fews AP et al**, (December 1999) *Increased exposure to pollutant aerosols under high voltage power lines*, Int J Radiat Biol. 1999 Dec;75(12):1505-21 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Fews AP et al**, (December 1999) *Corona ions from powerlines and increased exposure to pollutant aerosols*, Int J Radiat Biol. 1999 Dec;75(12):1523-31 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Loberg LI et al**, (August 1999) *Gene expression in human breast epithelial cells exposed to 60 Hz magnetic fields*, Carcinogenesis. 1999 Aug;20(8):1633-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Burch JB et al**, (July 1999) *Reduced excretion of a melatonin metabolite in workers exposed to 60 Hz magnetic fields*, Am J Epidemiol. 1999 Jul 1;150(1):27-36 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Galvanovskis J et al**, (1999) *Cytoplasmic Ca<sup>2+</sup> oscillations in human leukemia T-cells are reduced by 50 Hz magnetic fields*, Bioelectromagnetics. 1999;20(5):269-76 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Miller SC, Furniss MJ**, (December 1998) *Bruton's tyrosine kinase activity and inositol 1,4,5-trisphosphate production are not altered in DT40 lymphoma B cells exposed to power line frequency magnetic fields*, J Biol Chem. 1998 Dec 4;273(49):32618-26 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Burch JB et al**, (June 1998) *Nocturnal excretion of a urinary melatonin metabolite among electric utility workers*, Scand J Work Environ Health. 1998 Jun;24(3):183-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Lai H et al**, (1998) *Acute exposure to a 60 Hz magnetic field affects rats' water-maze performance*, Bioelectromagnetics. 1998;19(2):117-22 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Tuinstra R et al**, (1998) *Protein kinase C activity following exposure to magnetic field and phorbol ester*, Bioelectromagnetics. 1998;19(8):469-76 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Kristupaitis D et al**, (May 1998) *Electromagnetic field-induced stimulation of Bruton's tyrosine kinase*, J Biol Chem. 1998 May 15;273(20):12397-401 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Cohen B et al**, (May 1998) *Deposition of charged particles on lung airways*, Health Phys 74(5):554-60 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P **Dibirdik I et al**, (February 1998) *Stimulation of Src family protein-tyrosine kinases as a proximal and mandatory step for SYK kinase-dependent phospholipase Cgamma2 activation in lymphoma B cells exposed to low energy electromagnetic fields*, J Biol Chem. 1998 Feb 13;273(7):4035-9 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N **Lyle DB et al**, (1997) *Intracellular calcium signaling by Jurkat T-lymphocytes exposed to a 60 Hz magnetic field*, Bioelectromagnetics. 1997;18(6):439-45 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- N Dees C et al**, (October 1996) *Effects of 60-Hz fields, estradiol and xenoestrogens on human breast cancer cells*, Radiat Res. 1996 Oct;146(4):444-52 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Lai H**, (1996) *Spatial learning deficit in the rat after exposure to a 60 Hz magnetic field*, Bioelectromagnetics. 1996;17(6):494-6 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Reipert BM et al**, (1996) *Exposure to extremely low frequency magnetic fields has no effect on growth rate or clonogenic potential of multipotential haemopoietic progenitor cells*, Growth Factors. 1996;13(3-4):205-17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Uckun FM et al**, (November 1995) *Exposure of B-lineage lymphoid cells to low energy electromagnetic fields stimulates Lyn kinase*, J Biol Chem. 1995 Nov 17;270(46):27666-70 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Lacy-Hulbert A et al**, (October 1995) *No effect of 60 Hz electromagnetic fields on MYC or beta-actin expression in human leukemic cells*, Radiat Res. 1995 Oct;144(1):9-17 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Kato M et al**, (January 1994) *Circularly polarized 50-Hz magnetic field exposure reduces pineal gland and blood melatonin concentrations of Long-Evans rats*, Neurosci Lett. 1994 Jan 17;166(1):59-62 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Liburdy RP et al**, (November 1993) *Experimental evidence for 60 Hz magnetic fields operating through the signal transduction cascade. Effects on calcium influx and c-MYC mRNA induction*, FEBS Lett. 1993 Nov 22;334(3):301-8 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- N Coulton LA, Barker AT**, (March 2003) *Magnetic fields and intracellular calcium: effects on lymphocytes exposed to conditions for 'cyclotron resonance'*, Phys Med Biol. 1993 Mar;38(3):347-60 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- P Walleczek J**, (October 1992) *Electromagnetic field effects on cells of the immune system: the role of calcium signaling*, FASEB J. 1992 Oct;6(13):3177-85 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Kirschvink JL et al**, (August 1992) *Magnetite biomineralization in the human brain*, Proc Natl Acad Sci U S A. 1992 Aug 15;89(16):7683-7 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **van Zwieten MJ et al**, (September 1984) *Differences in DMBA-induced mammary neoplastic responses in two lines of Sprague-Dawley rats*, Eur J Cancer Clin Oncol. 1984 Sep;20(9):1199-204 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Lawrence AF, Adey WR**, (1982) *Nonlinear wave mechanisms in interactions between excitable tissue and electromagnetic fields*, Neurol Res. 1982;4(1-2):115-53 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Tamarkin L et al**, (May 1982) *Decreased nocturnal plasma melatonin peak in patients with estrogen receptor positive breast cancer*, Science. 1982 May 28;216(4549):1003-5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- **Tamarkin L et al**, (November 1981) *Melatonin inhibition and pinealectomy enhancement of 7,12-dimethylbenz(a)anthracene-induced mammary tumors in the rat*, Cancer Res. 1981 Nov;41(11 Pt 1):4432-6

[\[View Author's abstract conclusions\]](#) [\[View on Pubmed\]](#)

## WHITE PAPER

---

# mRNA Vaccines: Disruptive Innovation in Vaccination

May 2017

Corporate Headquarters | 320 Bent Street | Cambridge, MA 02141

p: 617.714.6500 f: 617.583.1998

[modernatx.com](http://modernatx.com)

Moderna Therapeutics | May 2017

Evan Rachlin, MD

Michael Watson, MB ChB, MRCP, AFPM

## INTRODUCTION

Vaccines to prevent infectious diseases are the greatest medical innovation of all time. The CDC estimates that U.S. childhood vaccinations given in the past two decades will prevent Americans from 322 million illnesses, 21 million hospitalizations, 732,000 deaths, \$295 billion of direct costs, and \$1.3 trillion in social costs. For example, before the advent of the measles vaccine in 1963, the virus infected 500,000 Americans annually, causing 480,000 hospitalizations. Today, we see only 60 measles cases a year, primarily from foreign travelers. Smallpox, polio, diphtheria, pertussis, measles, mumps, and many other vaccines have also had an enormous impact on public health. (Figure 1)

However, despite these remarkable successes, there is significant room for innovation in vaccine research, development, manufacturing and delivery.

## EXISTING VACCINE PARADIGM

Immunization against disease has been practiced for a thousand years, from variolation (deliberately exposing a healthy person to small amounts of infected material) to vaccination in all of its forms today. The goal of vaccination is to safely pre-expose our immune system to a small, harmless dose of all or a piece of a pathogen (called an antigen) so that, if and/or when we encounter the actual pathogen in the future, our immune system is already prepared to fight it and prevent disease.

Today we have vaccines against more than 25 different diseases<sup>1</sup>, using at least half a dozen different approaches. These include weakened or killed versions of pathogens, inactivated toxins, partial subunits of the pathogen, and conjugates (combinations of strong and weak antigens). All of these traditional approaches involve long, complex, and costly development and production.

Traditional vaccines face a number of challenges (Figure 2):

1. The target pathogens/antigens are grown in dedicated cell-culture and/or fermentation-based production before being extracted, killed, separated and purified. This involves a long, complex and costly process.
2. They often demonstrate efficacy empirically (i.e., without knowing why they work). The exact mechanism of protection may only be fully elucidated after the vaccine has been licensed and used and in some cases, such as pertussis (whooping cough), we still do not understand the mechanism of efficacy.
3. They require bespoke vaccine-specific production processes, production facilities and operators. Moreover, these capital investments must be made years in advance of vaccine approval, with all of the attendant risks that the vaccine could ultimately fail and waste this capital. This, in turn, limits the vaccine targets that developers are able or willing to sustainably pursue.
4. Existing vaccines are only just learning to adjust the kind of immune response they induce, using adjuvants.

## NUCLEIC ACID VACCINES

Nucleic acid vaccines, DNA and messenger RNA (mRNA), deliver the nucleotide sequence (eg, "AAAGGCC...") that codes for the proteins that pathogens use to cause disease. The idea is that those proteins will act as antigens that the immune system will recognize. In other words, these vaccines enable the body to innately mimic a native infection to elicit an immune response, but without the ability to cause disease or spread.

<sup>1</sup><https://www.fda.gov/BiologicsBloodVaccines/Vaccines/ApprovedProducts/UCM093833>

This approach has three main advantages over traditional vaccines (Figure 3):

1. The discovery stage can be exceedingly rapid because many of these antigens are already identified. Discovery also benefits from significant *in silico* (computer-based) antigen design and rapid testing of vaccines in small animal models.
2. Production is standardized. It does not involve either pathogens or the development of target specific cell culture or fermentation. There is no need to grow the vaccine. As a result, a single facility can produce *all* mRNA vaccines, with efficient utilization of a single set of processes, capital equipment, and labor.
3. The vaccine mimics natural viral infections in a way that the immune system recognizes. It's delivered to the muscle and immune cells, which process the nucleotide sequence just as they would do during an infection using viral DNA/mRNA inside the body's own cells (but safely).

Moreover, because the vaccine is DNA or mRNA, it can be sequenced and produced in a standardized process with fewer, more precisely controlled steps. This renders production faster, cheaper, and less vulnerable to unnecessary batch losses due to batch-to-batch variability. mRNA and DNA vaccines offer extraordinary improvements over traditional vaccines in both modularity and standardization.

In addition, nucleic acid vaccines offer the potential to adjust the balance between humoral protection and cellular protection based on the ability to precisely adjust the antigens being delivered. Because of this, nucleic acid vaccines can be designed to address pathogens that are exceptionally difficult to address using traditional vaccines approaches. (Figure 4)

## DNA VACCINES

DNA vaccine work began thirty years ago, but as yet there are no licensed DNA vaccines and most remain in Phase 1 testing. (Figure 5)

The key challenge associated with DNA vaccines is that they must penetrate the cell nucleus (crossing two membranes; the cytoplasm and the nucleus). The DNA must then be transcribed in the nucleus into mRNA before moving to the cytoplasm to stimulate antigen production. This core complex pathway often requires both larger doses and special, often painful delivery devices using electric shocks or gold microspheres into person's skin to deliver the DNA vaccine. Once inside the nucleus, DNA vaccines have a risk of permanently changing a person's DNA.

## mRNA VACCINES

There are now six prophylactic mRNA vaccines in clinical trials, four of which are being conducted by Moderna Therapeutics. These vaccines combine the advantages of DNA vaccines (natural antigen expression and production that is faster and standardized) while addressing many of the disadvantages. Unlike DNA vaccines, mRNA vaccines do not need to enter the nucleus, nor do they risk being integrated into our DNA, and they are directly translated into protein antigens. As a result, mRNA vaccines require only 1/1000 the dose of DNA vaccines and do not need special delivery devices. (Figure 6)

The first-ever published data demonstrating a prophylactic mRNA vaccine's ability to elicit robust immunity in humans was published in *Molecular Therapy* in April 2017. (Bahl *et al.*, 2017)<sup>2</sup> As with all new vaccines, time is needed to establish the level and duration of immunogenicity and the safety profile of mRNA vaccines in larger, more diverse populations. However, the innovation of mRNA vaccines offers the opportunity to improve upon DNA vaccines. These vaccines work seamlessly with the body to mimic the natural sequence of exposure and protection, without the dangers of a real infection. The precision and standardization of the antigen design and delivery offer public health and commercial advantages in terms of the speed and cost of discovery, the speed of development, the probability of success for many targets and the speed, cost and adaptability of production. mRNA offers us a new paradigm in vaccinations' hundred-year history.

	DNA Vaccine	mRNA Vaccine
Risk of DNA Integration	Yes	No
Dose	mg	µg (1000x lower)
Special Delivery Device	Yes	No
Factory Size	Large	Small
Membrane Penetration	Cytoplasm & Nucleus	Cytoplasm

<sup>2</sup>Bahl *et al.*, Preclinical and Clinical Demonstration of Immunogenicity by mRNA Vaccines against H10N8 and H7N9 Influenza Viruses, *Molecular Therapy* (2017), <http://dx.doi.org/10.1016/j.ymthe.2017.03.035>

Figure 1: Impact of Vaccines on Disease in U.S.

	Baseline U.S. 20th Century Morbidity (annual)	1998 Morbidity	% Decrease
Measles	503,282	89	99.98%
Diphtheria	175,885	1	99.999%
Mumps	152,209	606	99.6%
Pertussis	147,271	6,279	95.7%
Smallpox	48,164	0	100.0%
Rubella	47,745	345	99.3%
Hemophilus influenzae type b	20,000	54	99.7%
Poliomyelitis	16,316	0	100.0%
Tetanus	1,314	34	97.4%

Average annual reported or estimated cases in years before vaccine licensure.  
<https://www.cdc.gov/mmwr/preview/mmwrhtml/00056803.htm#00003753.htm>

Figure 2: Comparison of Production Processes for Traditional, mRNA and DNA vaccines

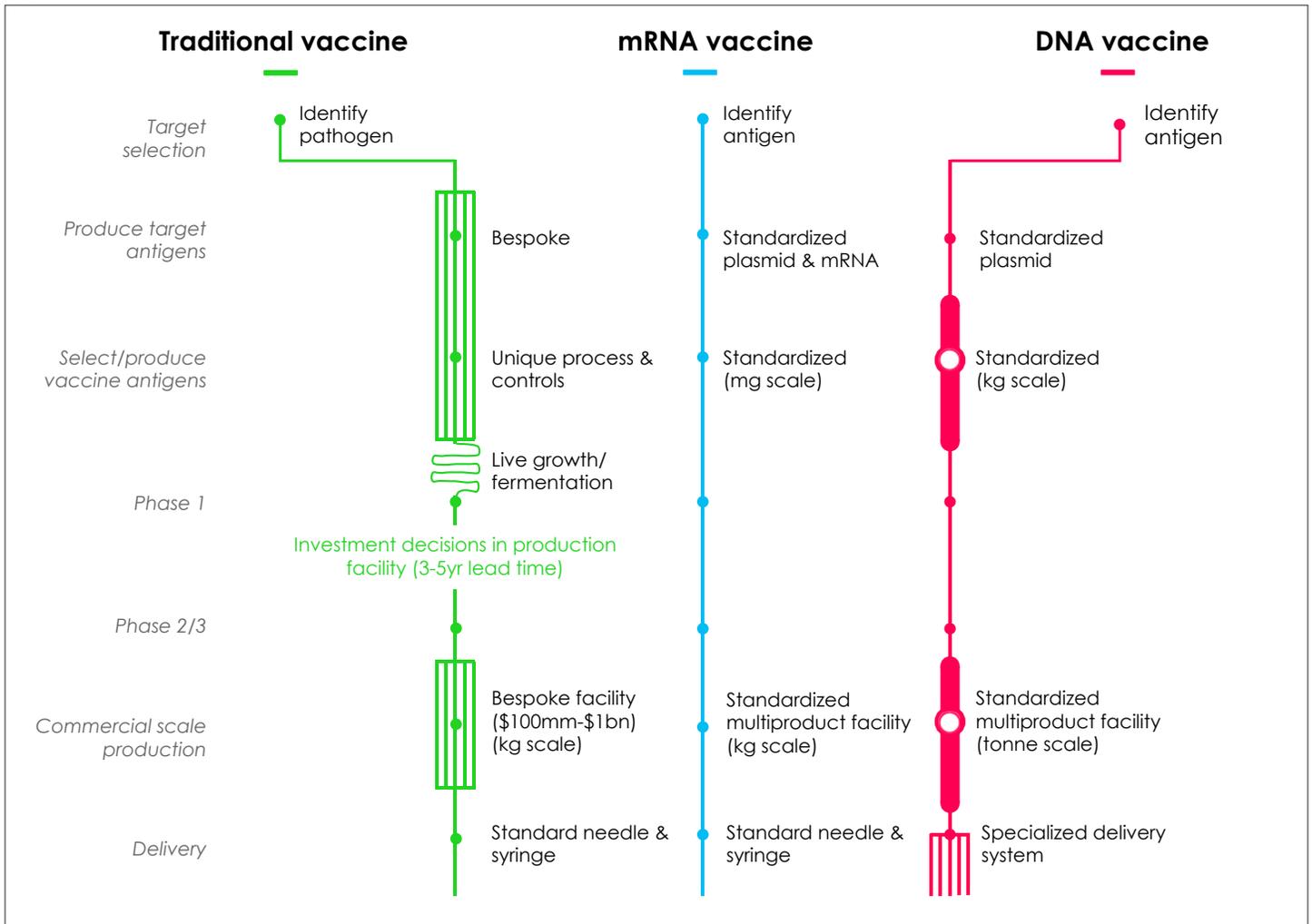
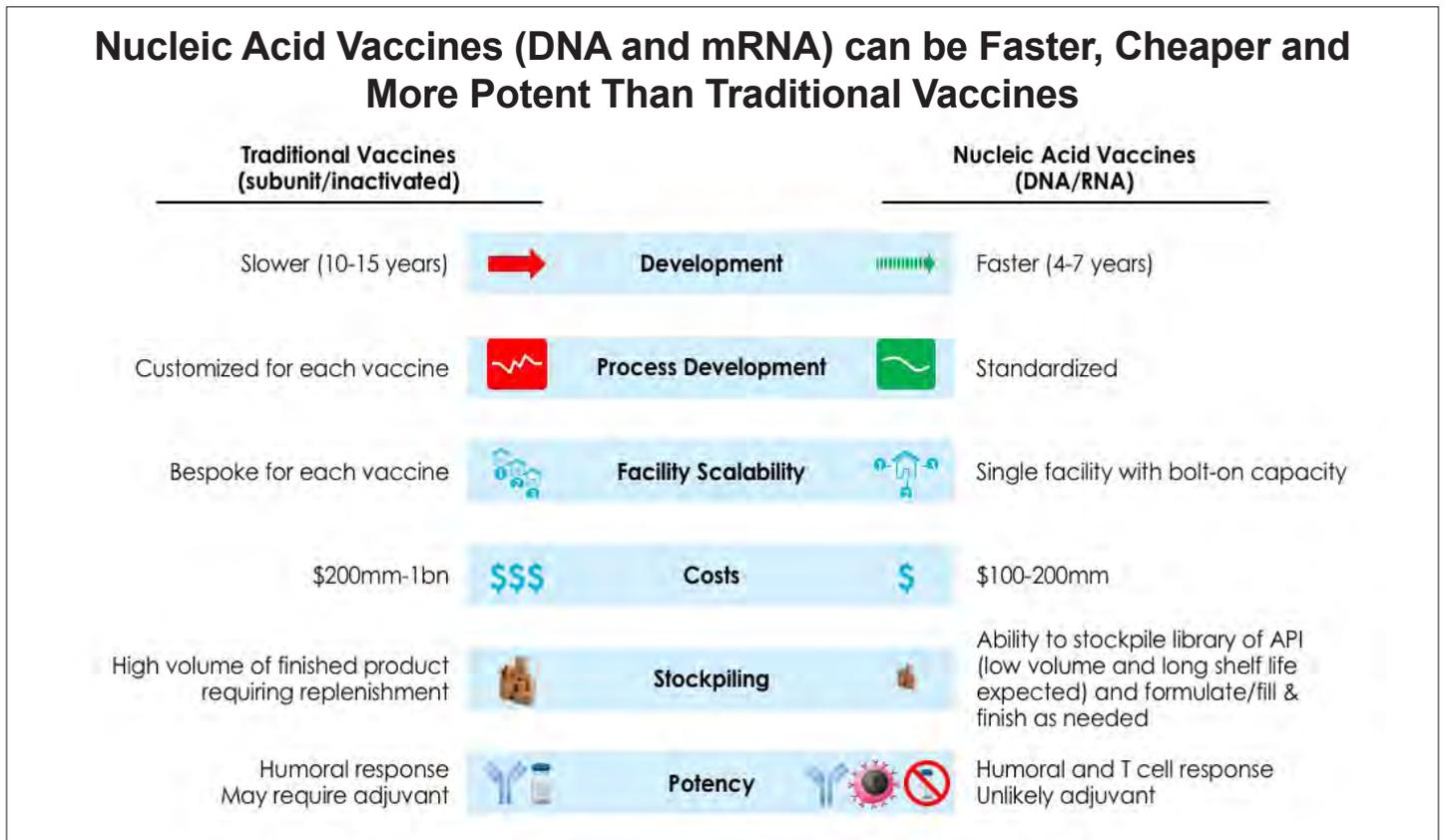


Figure 3: Key Differences between Traditional, mRNA and DNA vaccines



<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1551949/pdf/0961554.pdf>

<http://www.ipha.ie/alist/vaccine-development-cycle.aspx>

# THE WALL STREET JOURNAL.

DECEMBER 15, 2016

## *America's Next Defense Against Zika and Other Foreign Invaders; Experimental DNA vaccines could shield against infectious-disease outbreaks that now spread around the world with alarming speed*

By Betsy McKay and Peter Loftus

**PHILADELPHIA**—Dr. Keith Hamilton took his turn in the patient chair and braced for the sting of an experimental Zika vaccine.

The injection was the easy part. Next, a nurse jabbed three tiny needles in his upper arm with a device that delivered two electrical jolts strong enough to flex muscle. He said it felt like a needle piercing his arm, again and again.

Dr. Hamilton, an infectious-diseases doctor, was on a break from his rounds to volunteer in a landmark trial of a next-generation vaccine at the University of Pennsylvania's medical school.

The Zika epidemic is accelerating work on this and other experimental DNA vaccines, which could turn out to be America's best defense against infectious-disease outbreaks that now spread around the world with alarming speed, fueled by rising populations and global travel. These vaccines, made with synthetic DNA, can be developed and manufactured quickly.

Researchers in the U.S. and Canada have injected dozens of volunteers in the past few months with two competing DNA vaccines intended to provide immunity to the Zika virus. The mosquito-borne virus has caused hundreds of birth defects, including brain damage, and fetal deaths, mostly in Brazil.

Inovio Pharmaceuticals Inc., which makes the vaccine in the trial here, is in a race to market its vaccine and accompanying "electroporation device," a tool the size of an electric toothbrush that uses a jolt of electricity to help usher the firm's DNA vaccine

into human cells.

One of the National Institutes of Health is pursuing its own DNA vaccine for Zika in a trial that began this summer.

While there are significant hurdles, some researchers believe DNA vaccines could provide faster, more effective ways to combat Zika, as well as Ebola, Middle East respiratory syndrome and other deadly viruses and bacteria that have sickened millions.

Scientists can develop DNA vaccines in weeks and begin human trials within months. DNA vaccines also may provide longer-lasting immunity compared with conventional vaccines and, in some cases, even cure the malady they are intended to protect against.

Conventional vaccines take years to develop and test. They often cost more than pharmaceutical companies are likely to recoup from sales in the mostly poor tropical countries where the diseases originate. The economics discourage many firms from producing them for new, emerging diseases.

Yet the stakes are high, concluded a report this year from health experts convened by the U.S. National Academy of Medicine: "A pandemic could kill as many people as a devastating war."

Preparedness against most of the emerging infectious diseases that threaten the world is hobbled by a lack of vaccines and drugs, experts say.

More than 41 million people have died around the world over the past decade from AIDS, malaria, tuberculosis, Ebola and other tropical diseases, according to a tally by the Institute for Health Metrics and Evaluation at the University of Washington.

The World Health Organization

declared last month that Zika was no longer a global public health emergency, but public-health leaders said it would remain a long-term crisis until a vaccine is developed to prevent its spread.

Zika has infected more than 170,000 people in the Americas, according to the Pan American Health Organization, with hundreds of thousands more suspected cases. Brazil is girding for a resurgence of the virus as summer arrives in the southern hemisphere.

DNA vaccines are made with so-called platform technologies, building blocks that shave years off development time. Ideally, they could deliver protection while an epidemic was still spreading instead of years later. Ebola, which struck West Africa in 2014, still has no licensed vaccine.

Traditional vaccines are developed by growing batches of viruses and bacteria, a slow, labor-intensive process. DNA vaccines are made by inserting a gene related to a particular virus or bacterium into pieces of synthetic DNA called DNA plasmids, an all-purpose platform.

Last fall, as it became apparent that Zika was taking a toll, researchers at the National Institute of Allergy and Infectious Diseases, or NIAID, retrieved an experimental DNA vaccine the agency had developed about a decade ago for West Nile virus. The vaccine had shown promise in human tests, but no company agreed to finish development and produce it.

The health agency retooled the shelved West Nile vaccine by substituting a gene for Zika in the platform DNA, providing "a big head start on Zika," said Anthony Fauci, the NIAID director. "That's where the field of vaccinology is going—having a series of readily interchangeable platforms."

THE PUBLISHER'S SALE OF THIS REPRINT DOES NOT CONSTITUTE OR IMPLY ANY ENDORSEMENT OR SPONSORSHIP OF ANY PRODUCT, SERVICE, COMPANY OR ORGANIZATION  
CUSTOM REPRINTS (609) 520-4331 P.O. BOX 300 PRINCETON, NJ 08543-0300. DO NOT EDIT OR ALTER REPRINTS, REPRODUCTIONS NOT PERMITTED

D | DOW JONES

NIAID took less than four months from the time it settled on a vaccine design to begin a human trial, said Barney Graham, deputy director of the agency's Vaccine Research Center. The trial to assess its safety, and see if it generates an immune response, began in August. Initial results are expected by year's end. A second DNA vaccine is also being tested.

The DNA vaccines by Inovio and NIAID were the first two administered to human volunteers among nearly 30 Zika vaccines in development, according to the World Health Organization.

Even if Inovio's and NIAID's vaccines work in human trials, they aren't likely to be on the market for a couple of years, the approximate time needed to satisfy regulatory requirements for effectiveness and safety.

From a business perspective, the market may be small if public-health authorities determine that a Zika vaccine need only be stockpiled for emergencies rather than administered routinely to the general population.

Companies pursuing Zika vaccines are hoping public demand for widespread immunization will create a commercial market similar to the vaccine for rubella, another disease that causes birth defects. Any Zika vaccine wouldn't likely be aimed at pregnant women because of potential risks, but instead administered more broadly to young people.

Hundreds of millions of people are at risk, said Thomas Monath, chief operations officer of the infectious-disease division at NewLink Genetics Corp., which is developing two Zika vaccines.

Zika, he said, "is the biggest opportunity for a new vaccine that's come along in my career, and I've been in vaccines for 40 years."

#### Electric shocks

Scientists have been working on DNA vaccines for a quarter-century, including ones for the flu and severe acute respiratory syndrome, known as SARS, an infectious virus that sprang from China in 2002 and killed 774 people out of more than 8,000 infected on several continents. None of the DNA vaccines have made it to market for human use. The main problem has been that human cells don't easily absorb them.

Inovio's electroporation device is

intended to be a solution. After the vaccine shot, the device delivers a mild electrical current to the same spot on the arm, temporarily opening cell membranes to allow the DNA inside. "That's the fire that cooks the meal," said J. Joseph Kim, Inovio's chief executive.

In late summer 2015, Dr. Kim read about the spread of Zika in South America and began work on a DNA vaccine to fight the virus. It only took about two weeks to design the DNA sequences on a computer and make a small batch of the vaccine. By December 2015, it was being tested on mice.

In June, the Food and Drug Administration approved a human study, based on animal tests that showed the vaccine triggered immunity to the Zika virus.

Inovio and GeneOne Life Science Inc., which are codeveloping the vaccine with academic collaborators at the University of Pennsylvania and the nearby Wistar Institute, a medical-research center, began their trial in July, around the same time as NIAID.

Dr. Hamilton, one of about 40 people who have volunteered to receive the experimental vaccine, said electroporation "felt more like putting a needle in multiple times rather than an electrical shock."

Helping science was worth the discomfort, he said: "This is a small piece in a larger puzzle to come up with an effective vaccine for the people who need it the most."

The Inovio trial is expected to be completed this month. Researchers are monitoring the volunteers for any side effects, as well as taking blood tests to see if the vaccine induces the expected immune response.

Inovio, based in Plymouth Meeting, Pa., also began a 10-month trial this summer with 160 participants in Puerto Rico, where Zika spread rapidly.

Dr. Kim, the company's 47-year-old chief executive, got his Ph.D. in biochemical engineering at the University of Pennsylvania, where he met David Weiner, a biologist and now a director at Inovio.

After working in vaccine manufacturing and research at Merck & Co., Dr. Kim co-founded a company called Viral Genomix in 2000. The company later acquired a San Diego-based company called Inovio and took

its name.

Inovio explored experimental DNA vaccines for HIV, among other technologies. At the time, the vaccines showed promise in animal studies, but failed in humans when given via standard vaccine injections.

Drs. Kim and Weiner turned to electroporation—first tried in the 1980s to boost the effectiveness of chemotherapy. In 2006, they tested an electroporation device, developed by a Texas company called Advisys, to immunize monkeys against a form of HIV.

One evening, close to midnight, Dr. Kim's home phone rang. It was Dr. Weiner calling to say the HIV vaccine, assisted by the electroporation device, had kick-started an immune response in the monkeys.

"That really triggered the path we're on now," Dr. Kim said. His company acquired Advisys in 2007.

The company reported positive results for its DNA vaccine against Ebola; 64 of 69 subjects mounted a strong antibody response after three doses. Inovio's vaccine for Middle East respiratory syndrome—a virus that can cause fatal respiratory illness—was developed with GeneOne in partnership with the Walter Reed Army Institute of Research. It is in an early clinical trial.

Inovio has had to delay a new trial of its vaccine against human papillomavirus vaccine until next year after the FDA in October asked the company for more information about the stability and sterility of the disposable parts in its electroporation device, which is used to both inject vaccine and deliver an electrical jolt. Its device in the Zika trial delivers only the shock.

Not everyone has embraced DNA vaccines. Merck & Co. explored a DNA vaccine for HIV several years ago, but dropped it after a study in 2007 found it didn't work.

Merck is now exploring synthetic RNA-based vaccines, a spokeswoman said. In theory, the approach is easier because RNA needs only to get into a cell's cytoplasm—the material between its outer surface and the core nucleus. DNA vaccines must penetrate the nucleus to work, said W. Ripley Ballou, head of Glaxo's U.S. vaccine research center in Rockville, Md.

GlaxoSmithKline also is exploring an RNA-based vaccine for

Zika, in collaboration with NIAID. It is being tested in animals and could move to human studies next year, Dr. Ballou said.

Using the method for different vaccines is a relatively simple process, he said, "once you figure out how to do it."

#### Health frontier

NIAID has pioneered DNA vaccines over the past several years for HIV, Ebola and other diseases.

Dr. Graham at the agency's Vaccine Research Center began thinking about a Zika vaccine after learning about the spread of the virus from a Brazilian researcher who approached him at a conference in July 2015.

NIAID researchers started work on the vaccine in November and accelerated their efforts after the World Health Organization declared in February that the complications of Zika posed a global public health emergency. By June, the agency had an experimental vaccine for the human trial.

NIAID's Zika vaccine doesn't use an electroporation device and it may not be necessary, according to Julie Ledgerwood, chief of the clinical trials program for the Vaccine Research Center.

Data from NIAID's trials of the DNA Zika vaccine in monkeys, and evidence from its progenitor West Nile vaccine in humans, "makes us think this vaccine is highly immunogenic and it should work well even delivered by traditional needle," Dr. Ledgerwood said.

A few studies conducted by other scientists have found little difference in the immune response generated by experimental DNA vaccines for HIV and the H5N1 flu that were given with and without electroporation.

NIAID has used electroporation in animal tests. "In our opinion, the device development probably still has a way to go," Dr. Graham said. "But the technology itself, I think, is promising."

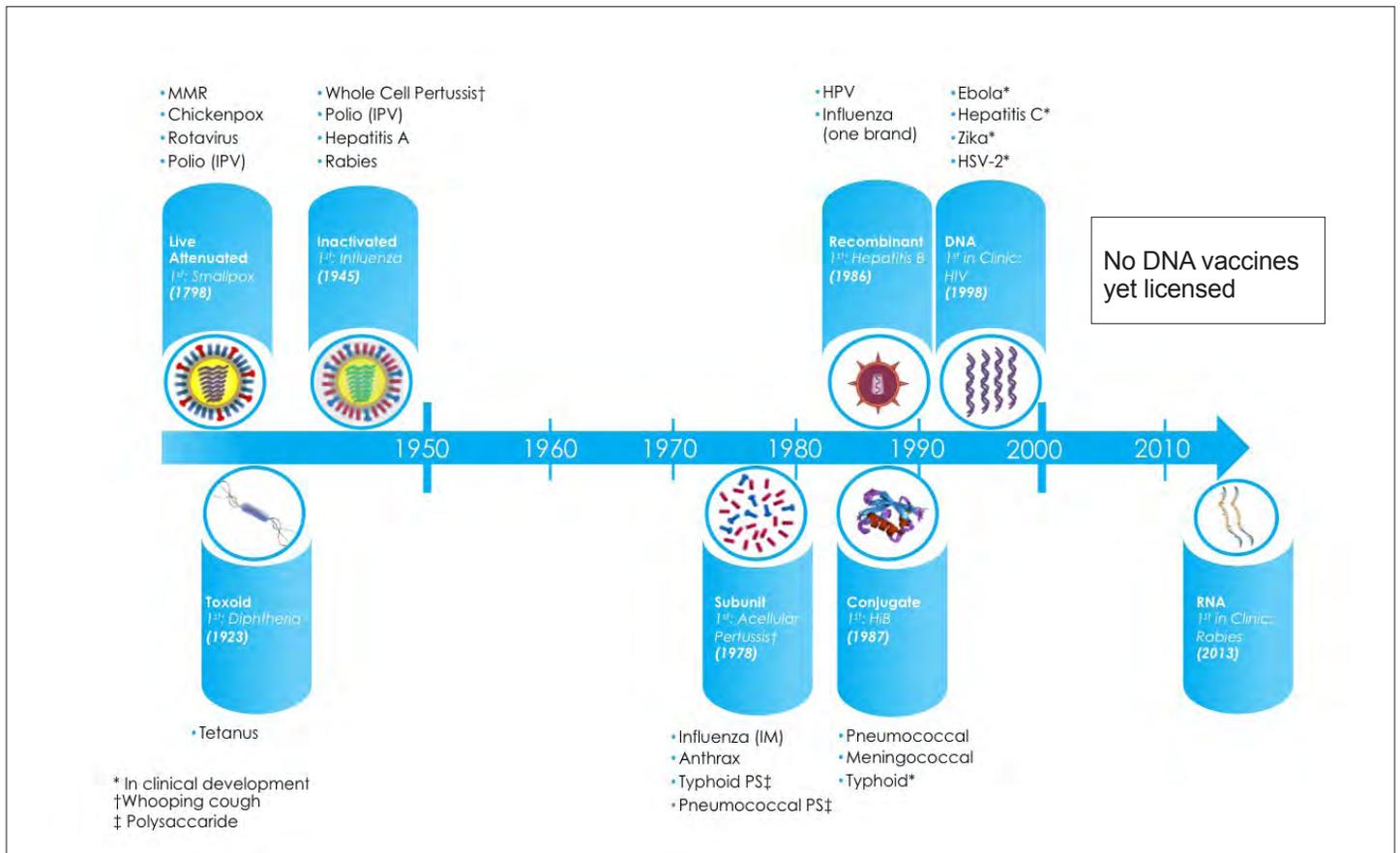
Whether with or without an electrical shock, a successful DNA vaccine would accelerate the exploration of new technologies against Zika and other outbreaks, said Kayvon Modjarrad, associate director for emerging infectious disease threats at the Walter Reed Army Institute of Research.

Dr. Modjarrad is the principal investigator of the DNA vaccine trial for Middle East respiratory syndrome that uses electroporation.

"The way we make vaccines now and what's on the horizon," he said, "is very, very different from the way we've been making vaccines for the past 100 years."

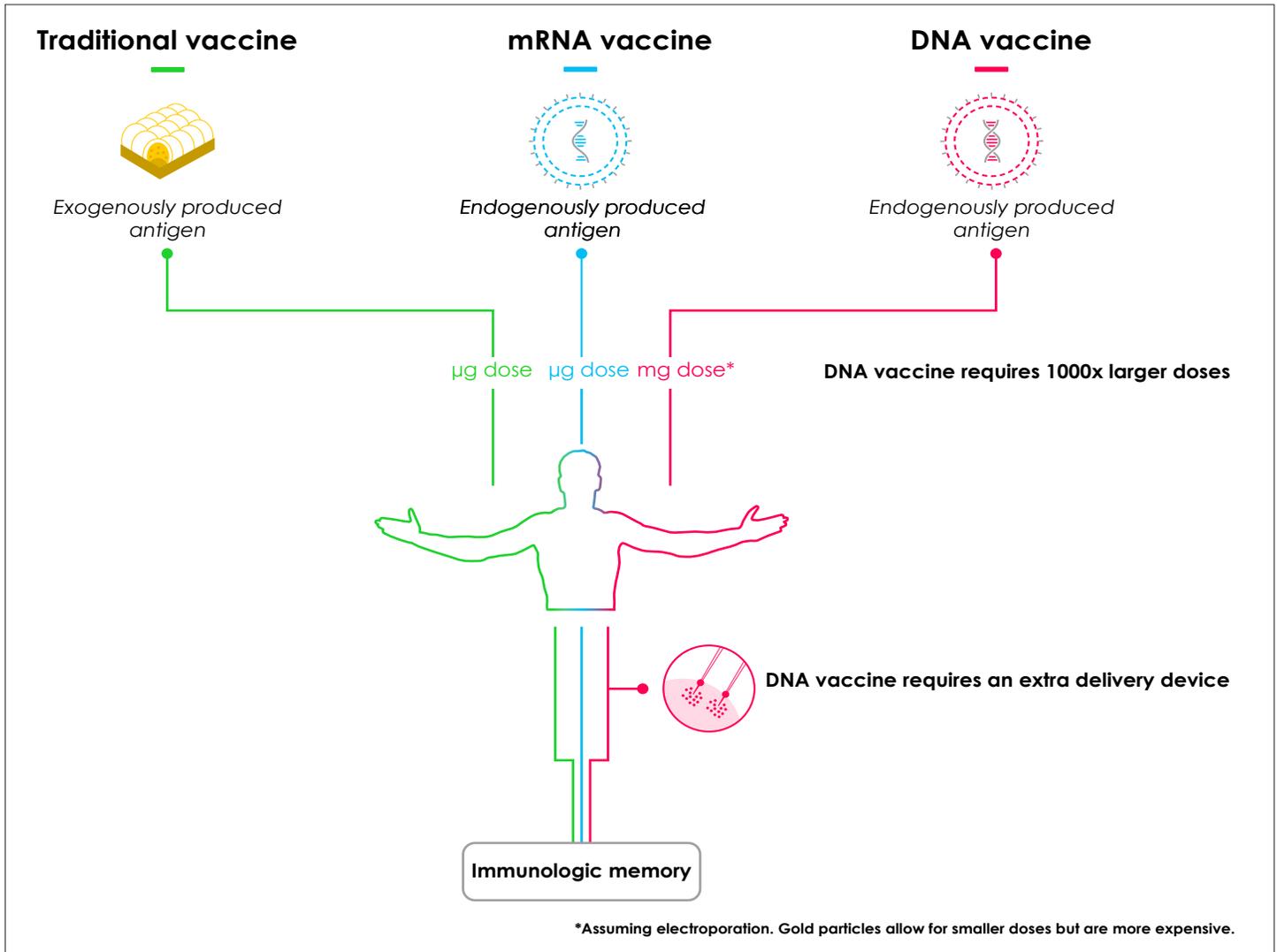
Write to Betsy McKay at [betsy.mckay@wsj.com](mailto:betsy.mckay@wsj.com) and Peter Loftus at [peter.loftus@wsj.com](mailto:peter.loftus@wsj.com)

Figure 5: History of Vaccine Development



<http://www.immunize.org/timeline/>  
<https://www.cdc.gov/vaccines/pubs/pinkbook/downloads/prinvac.pdf>  
<https://www.vaccines.gov/basics/types/index.html#conjugate>  
<http://www.who.int/biologicals/vaccines/pertussis/en/>  
<http://www.inovio.com/company/revolutionizing-vaccines/history/>  
<https://www.ncbi.nlm.nih.gov/pubmed/9652427>

Figure 6: Differences between Traditional, mRNA and DNA vaccines (Delivery)



About the Authors

**Evan Rachlin, M.D.**

*Senior Director of Strategic Planning*

Dr. Rachlin leads Strategy across Moderna’s portfolio of mRNA medicines. Prior to joining Moderna, Dr. Rachlin was a principal at Bain Capital Ventures, an engagement manager at McKinsey & Company, and an associate in the Portfolio and Decision Analysis Group at Pfizer. He received his M.D./M.B.A. from Harvard University.

**Michael Watson, MB ChB, MRCP, AFPM**

*President, Valera, a Moderna venture*

Dr. Watson is a UK-trained physician in internal medicine and infectious disease, bringing his twenty-year career in vaccine work to his role as President of Valera, Moderna’s infectious disease-focused venture. Previously, Dr. Watson was Global Head of Vaccination Policy and Advocacy at Sanofi Pasteur. He has also held positions including Head of R&D for Acambis, UK Medical Director of Aventis Pasteur MSD, as well as Head of Clinical and Epidemiology for SPMSD in France.

Martin L. Pall\*

# Scientific evidence contradicts findings and assumptions of Canadian Safety Panel 6: microwaves act through voltage-gated calcium channel activation to induce biological impacts at non-thermal levels, supporting a paradigm shift for microwave/lower frequency electromagnetic field action

**Abstract:** This review considers a paradigm shift on microwave electromagnetic field (EMF) action from only thermal effects to action via voltage-gated calcium channel (VGCC) activation. Microwave/lower frequency EMFs were shown in two dozen studies to act via VGCC activation because all effects studied were blocked by calcium channel blockers. This mode of action was further supported by hundreds of studies showing microwave changes in calcium fluxes and intracellular calcium  $[Ca^{2+}]_i$  signaling. The biophysical properties of VGCCs/similar channels make them particularly sensitive to low intensity, non-thermal EMF exposures. Non-thermal studies have shown that in most cases pulsed fields are more active than are non-pulsed fields and that exposures within certain intensity windows have much larger biological effects than do either lower or higher intensity exposures; these are both consistent with a VGCC role but inconsistent with only a heating/thermal role. Downstream effects of VGCC activation include calcium signaling, elevated nitric oxide (NO), NO signaling, peroxynitrite, free radical formation, and oxidative stress. Downstream effects explain repeatedly reported biological responses to non-thermal exposures: oxidative stress; single and double strand breaks in cellular DNA; cancer; male and female infertility; lowered melatonin/sleep disruption; cardiac changes including tachycardia, arrhythmia, and sudden cardiac death; diverse neuropsychiatric effects including depression; and therapeutic effects. Non-VGCC non-thermal mechanisms may occur,

but none have been shown to have effects in mammals. Biologically relevant safety standards can be developed through studies of cell lines/cell cultures with high levels of different VGCCs, measuring their responses to different EMF exposures. The 2014 Canadian Report by a panel of experts only recognizes thermal effects regarding safety standards for non-ionizing radiation exposures. Its position is therefore contradicted by each of the observations above. The Report is assessed here in several ways including through Karl Popper's assessment of strength of evidence. Popper argues that the strongest type of evidence is evidence that falsifies a theory; second strongest is a test of "risky prediction"; the weakest confirms a prediction that the theory could be correct but in no way rules out alternative theories. All of the evidence supporting the Report's conclusion that only thermal effects need be considered are of the weakest type, confirming prediction but not ruling out alternatives. In contrast, there are thousands of studies apparently falsifying their position. The Report argues that there are no biophysically viable mechanisms for non-thermal effects (shown to be false, see above). It claims that there are many "inconsistencies" in the literature causing them to throw out large numbers of studies; however, the one area where it apparently documents this claim, that of genotoxicity, shows no inconsistencies; rather it shows that various cell types, fields and end points produce different responses, as should be expected. The Report claims that cataract formation is produced by thermal effects but ignores studies falsifying this claim and also studies showing  $[Ca^{2+}]_i$  and VGCC roles. It is time for a paradigm shift away from only thermal effects toward VGCC activation and consequent downstream effects.

\*Corresponding author: Martin L. Pall, Washington State University, 638 NE 41st Ave., Portland, OR 97232-3312, USA, E-mail: martin\_pall@wsu.edu

**Keywords:** calcium and nitric oxide signaling; calcium channel blockers; low level microwave/radiofrequency radiation; oxidative and nitrosative stress; peroxynitrite.

DOI 10.1515/reveh-2015-0001

Received January 8, 2015; accepted March 10, 2015

## Introduction

There has been a literature reporting various non-thermal effects of microwave/radiofrequency radiation exposures starting with the Soviet literature in the 1950s. Subsequently, there have been thousands of international published studies reporting non-thermal or what are sometimes called micro-thermal effects producing therapeutic responses, changes in calcium fluxes and signaling, increased oxidative stress, and a wide variety other health-related responses in humans and animal models.

Nevertheless, there has been a series of medical reports, arguing that only thermal effects need be considered when setting guidelines or safety standards for microwave electromagnetic field (EMF) exposures. These have been based mainly on two types of arguments:

- That there cannot be any biophysically viable mechanism for any such non-thermal effects and therefore that reports of such effects should be viewed with great skepticism.
- That there are many “conflicts” or “inconsistencies” in the literature which according to these reports, justify rejection of the various thousands of publications showing apparent non-thermal effects.

The focus of this review is to consider whether it is time for a “paradigm shift” away from strictly thermal effects toward non-thermal effects. Specifically, it is focused on the recent finding that most, possibly all non-thermal effects can be produced by microwave activation of voltage-gated calcium channels (VGCCs). It is also focused on the 2014 Report of the Canadian Panel of Experts on Safety Code 6 as the most recent and therefore up-to-date summary of the evidence supporting the strictly thermal point of view.

## EMFs act via stimulation of voltage-gated calcium channels (VGCCs)

Calcium provides an essential role in cell function, being normally maintained at very low, circa  $10^{-7}$  M

intracellular levels, but also with transient intracellular calcium ( $[Ca^{2+}]_i$ ) increases being used for widespread and important regulatory signaling. A recent review (1), noted that in two dozen studies, calcium channel blocking drugs block a wide range of electromagnetic field (EMF) effects on cells and organisms by blocking voltage-gated calcium channels (VGCCs which are also known as voltage-operated, voltage-dependent or voltage-regulated calcium channels). In most but not all cases, L-type VGCCs were studied, but T-type, N-type and P/Q-type channels can also have roles, as shown by channel blockers specific for these other channels (1). In each of these studies, calcium channel blockers blocked or greatly lowered each of the responses studied, showing that VGCC activation is required for low intensity fields to produce a wide range of responses (1). Each of these channel blockers is thought to be highly specific, such that with two different types of L-type blockers being used that act at different sites on the L-type VGCCs and also one each of the T-type, N-type and P/Q type blockers being used, with each showing activity in blocking or greatly lowering EMF responses, it is highly unlikely that a non-VGCC mechanism is involved here.

VGCC activation is thought to act mainly by increasing  $[Ca^{2+}]_i$ . Other considerations also support VGCCs as a major EMF target, accounting for numerous biological impacts of microwave exposures (1–3) at levels not producing substantial changes in temperature.

Pilla published a very important paper, suggesting in retrospect that these low-level fields directly activate the VGCCs (4, see also 1–3). He showed that cells in culture when exposed to a low intensity pulsed microwave field, produce an almost instantaneous  $Ca^{2+}$ /calmodulin-dependent increase in nitric oxide (NO), occurring in  $<5$  s. The NO increase is produced by the  $[Ca^{2+}]_i$  activating the two  $Ca^{2+}$ /calmodulin-dependent NO synthases, which can occur almost instantaneously. These results show that the  $[Ca^{2+}]_i$  increases must also occur almost instantaneously, providing strong evidence that the VGCCs are directly activated by the low intensity field in this study. The known properties of the VGCCs are discussed below, properties that are expected to make them particularly susceptible to activation by such low intensity fields.

In addition to calcium channel blocker studies, the important role of VGCC activation for the biological effects of microwave radiation at levels that do not produce measured changes in temperature is also supported by a large number of studies, some of which were reviewed earlier (5, 6), showing that low level microwave EMF exposures lead to measured changes in calcium signaling and/or calcium fluxes consistent with VGCC activation. There are

also hundreds of studies of oxidative stress responses to low intensity field exposures, which can also be produced by downstream effects of increased  $[Ca^{2+}]_i$  (1–3). The mode of microwave action via VGCC activation also confirms earlier predictions of Panagopoulos et al. (7, 8) that EMFs may act via voltage-gated ion channel activation. The whole issue of the biophysics of VGCCs and other voltage-gated ion channels is discussed in some detail below.

Various frequencies, intensities and pulse patterns of EMFs act via VGCC activation (1), including extremely low frequency fields of 50 or 60 Hz electrical wiring, microwave frequency EMFs also referred to as radiofrequency (RF), very short “nanosecond” pulses, and even static electric or magnetic fields. Given recent global increases in exposures to microwave/RF EMFs, the findings for microwave EMFs create the most concerns for both human and environmental health.

We are therefore in a situation where the paradigm of EMF action focused solely on heating (9–13), should be replaced by one based on VGCC activation of microwave and other EMFs (1–3).

In addition to impacts of EMFs directly involving VGCCs, there are a number of other related mechanisms which should be explored. For instance, Pilla reviewed 2 studies in which microwave EMFs increased apparent calmodulin activation (14). Calmodulin is regulated by  $[Ca^{2+}]_i$  such that calmodulin activation may act along with VGCC activation in two related pathways of action discussed below.

## Three other types of observations that contradict the assumptions of current safety standards

Current safety standards are based on the assumption that all important biological effects of microwave and lower frequency EMFs are due to tissue heating (thermal effects) and that specific absorption rates (SARs) of EMFs are therefore a measure of their ability to produce all important biological effects. While the VGCC studies, discussed above clearly invalidate that assumption, there are three other distinct types of observations that also contradict that assumption. As discussed below, an extensive scientific literature reports biological microwave EMF effects at exposure levels well within safety standards and that therefore should not occur according to current safety standards. Two other types of falsifying evidence are the findings that pulsed fields are often much more biologically active than non-pulsed fields and that certain intensity windows of exposure are more biologically active than

are exposures of both lower and higher intensities. These two are each discussed in some detail immediately below.

It has been known for well over 30 years that pulsed microwave fields are often much more biologically active than are continuous non-pulsed fields. This was shown, for example, by Seaman and Wachtel in studies of microwave exposures of *Aplysia* pacemaker cells (15). Pacemaker cells have a very high density of VGCCs, suggesting that the pulsed microwave exposures may in this study act via VGCC activation. This was shown by Bassett et al. (16) and by Pilla (17) both in 1974 studies of augmentation of bone repair, that pulsed field microwaves were much more active than continuous field microwave exposures. Both Baranski (18) and Czerski (19) showed that microwave pulsed field exposures were more active than non-pulsed fields in terms of their impact on blood forming cells. Micro pulsed field exposures were also more effective than non-pulsed continuous wave (CW) fields in producing a breakdown of the blood-brain barrier (20). Adey’s review (21) stated that “There is evidence of interactions with radio and microwave fields pulse-modulated at higher frequencies from 500 to 1500 Hz and an absence of similar effects with CW fields of the same average power density at the same carrier frequency.” Several other studies are cited in the Adey (21) review documenting higher biological activity of pulsed fields than non-pulsed CW fields at identical power levels. A recent study showing that pulsed microwave EMFs acted via activation of L-type VGCCs (22) suggests that all these inconsistencies of the pulsed field findings with any heating mechanism may be due to their action in VGCC activation.

More than four decades ago, the biological impact of non-thermal levels of pulsed fields was sufficiently well documented that it became the basis for a number of therapeutic applications of microwave pulses. Therapies currently employed include a wide range of bone growth and orthopedic rehabilitation regimens as well as some applications to enhance the uptake of chemotherapeutic agents (14). These numerous therapeutic effects are well established to be non-thermal and operate through increased levels of  $[Ca^{2+}]_i$  and nitric oxide (NO) signaling (2, 14). The medical use of these pulsed fields provides therefore prima facie evidence that such fields are often more active in VGCC activation than are non-pulsed fields.

The greater biological activity of pulsed field exposures were sufficiently well documented 30–48 years ago, such that it influenced safety standards of the 1960s and 1970s. For example, the Canadian Standards Association 48 years ago in 1966, adopted lower standards [see Table 2 in ref. (23)] for occupational exposure to pulsed field exposures (1 mWhr/cm<sup>2</sup>, limited to 6 min exposure) in contrast to those for continuous, that is non-pulsed exposures

(10 mW/cm<sup>2</sup>, for which there was no time limitation). In 1974, in the United States, the American National Standards Institute (ANSI) adopted essentially identical standards as had Canada for occupational pulsed field and non-pulsed field exposure (23). In 1970, the Czechoslovakian government adopted more stringent occupational and general public standards for pulsed field exposures vs non-pulsed field exposures (23). Pulsed fields are, of course, produced by any type of wireless communication device since it is the pattern of pulsations that conveys the information. Different devices often use different types of pulsation patterns. However, we do not know how biologically active the different pulsation patterns are, because this has not been systematically studied. As a result, we cannot rationally compare the dangers of one device vs another.

Furthermore, Barrie Trower, a retired military intelligence expert from the United Kingdom, has stated that classified research indicates that different wavelengths vary in their biological activities as well. He reports that the specific details about the biological impacts of variations in pulsed electromagnetic fields are classified by multiple countries because of “national security”. Thus much of what research appears to have been done in this field remains unavailable to decision makers charged with setting standards on such devices that emit pulsed electromagnetic fields.

It has been shown that there can be intensity “windows” where biological activity is greater than at intensities both higher and lower than the window intensity (24–32). This again argues against a heating mechanism as there are no known thermal dose-response curves with similar windows. In addition, these window effects are also found at levels where there is extremely low heating. For example, Blackman et al. (28) state that “Because of the extremely small increments of temperature associated with positive findings [less than  $4 \times 10^{-4}$  degrees C], and the existence of more than one productive absorption rate (“window”), a solely thermal explanation appears extremely unlikely”. It is (31) stated that “Since there was no detectable temperature increase during exposures, the recorded effects are considered non-thermal”. The suggested mechanism (31) may involve a role of voltage-gated ion channels such that “the action of external EMF on cells is dependent on irregular gating of membrane electro-sensitive ion channels whenever a force on the channel sensors exceeds the force exerted on them by a change in the membrane potential of about 30 mV which is necessary to gate the channel normally. If in some kind of cells there is an upper limit for this value of membrane potential change, then the channel would be gated

whenever the force exerted on its sensors is within this ‘window’”. Five of these studies show effects on [Ca<sup>2+</sup>]<sub>i</sub> fluxes (24–28), consistent with possible roles of VGCCs. These studies provide strong evidence that these window effects occur at levels where there is either no measured change in temperature or extremely low heating.

Perhaps the strongest evidence for non-thermal effects of EMFs comes from studies on animal female and human male reproduction. This literature indicates that sperm exposed to microwave radiation emitted by approved mobile phones die three times faster and develop significantly more damage to their mitochondrial DNA (33). Studies of pregnant mice, rats and rabbits report that prenatally exposed offspring develop significantly more damage to their eyes, skin and liver (33) with hippocampus and pyramidal cell formation are impaired as well.

In summary, four distinct types of evidence provide contradictory information about the basic assumption underlying current US, Canadian and International Commission on Non-Ionizing Radiation Protection (ICNIRP) safety standards that non-thermal effects do not exist: Microwave and other lower frequency EMFs act via VGCC activation rather than by heating; there are numerous papers in the scientific literature reporting biological effects with exposures well within safety standards where substantial heating cannot occur. Moreover, pulsed fields are, in most cases, more biologically active than non-pulsed fields that produce equal heating; windows of exposure intensities occur which are more active than both higher and lower exposures of the same fields. While, in general, lower intensities are safer than higher intensities, this “window” effect shows that there are some major, biologically and medically important exceptions to this pattern. The pulsed field effects and the window effects make it impossible to currently predict biological activity without doing actual measurements of biological activity of specific devices at specific exposure intensities. The question of how to best approach and evaluate such biological effects is discussed below.

## **The properties of VGCCs and other voltage-gated ion channels may make them uniquely susceptible to low intensity MF activation**

There has been an argument repeatedly put forth that there cannot be a biophysically viable mechanism for low intensity, apparently non-thermal effects. This claim

is argued as follows [see Sheppard et al., ref. (34)]: While they acknowledge that EMFs can exert forces on charged groups, they argue that weak EMFs produce only weak forces that are less than are exerted by thermal motion produced at normal body temperature. They argue therefore that the only effects that can be produced by weak EMFs would be dwarfed by a high background noise created by random thermal motion. One of the problems with the Sheppard argument comes from a consideration of the structure of the voltage-gated ion channels and how these channels detect electrical changes, which may lead to opening the channel. The structure of the alpha-1 subunit containing the channel has been modeled and discussed (35–38).

What can be seen is that there are four similar domains in this protein, with each domain containing six transmembrane alpha helices in it. These four domains are thought to have been produced evolutionarily by two tandem duplications, starting with a gene encoding a protein with one such domain. The fourth helix in each domain contains five positively charged amino acid side chains which collectively make up the voltage sensor (37, 38). It is thought that 20 (4×5) charges make up the voltage sensor, each of which must be pushed in approximately the same direction (and the right direction) at the same time in order for the channel to open. Changes in the membrane potential across the plasma membrane can do this, as can EMFs, because the fields will produce forces on these different charged groups in the same direction at a particular time. Random thermal motion, in contrast, is random in three dimensions and will only extraordinarily rarely produce forces on 20 groups in approximately the same direction at the same time. So you can see the thermal motion argument is clearly at best highly questionable when it is applied to voltage-gated ion channels including VGCCs.

There are other issues that come into play, both influencing the effects of fields on the VGCC voltage sensor. One is that the plasma membrane has high electrical resistance whereas both the aqueous extracellular fluid and the aqueous cytoplasm, with their dissolved salts are good electrical conductors. EMFs only traverse plasma membranes with great difficulty (39, 40). Therefore, fields will produce rapid movement of charges in the intracellular and extracellular aqueous phases which will be blocked by the plasma membrane such that voltage sensor will be influenced by greatly amplified electrical forces, in a direction perpendicular to the plane of the plasma membrane. That circa 3000-fold amplification is recognized by Sheppard et al. (34) immediately before their Conclusion section. The only example of an integral membrane that may be influenced in this way, that they give (34) is that

of bacteriorhodopsin, where light exposure leads to the pumping of a proton across the plasma membrane. They attempt to estimate the effects of voltages on the proton pumping, by looking at the effects of voltages on the absorption changes that occur in bacteriorhodopsin (34); however, the cycling of bacteriorhodopsin is a complex process (41) where the proton pumping is not rate-limiting and therefore these studies give little insight into the actual effects on proton pumping.

Bacteriorhodopsin differs from the voltage-sensor in the VGCCs in several important ways:

- The voltage sensor has evolved to respond to voltage changes across the plasma membrane, whereas bacteriorhodopsin has evolved to respond to light exposure.
- There are 20 charged groups in the VGCC voltage sensor (37, 38), whereas there is one charge involved in the bacteriorhodopsin mechanism.
- Whereas the bacteriorhodopsin has considerable water in the center of its structure, water seems to be excluded near the helix 4 structures that constitute the voltage sensor.

The third way, above, is important because the force on charged groups, as shown by Coulomb's law, is inversely proportional to the dielectric constant of the surrounding material. The charged groups of the voltage sensor are found in the lipid region of the plasma membrane. The dielectric constant of the lipid section of the membrane is similar to the dielectric constant of hydrocarbon solvents (41), whereas the water dielectric constant is about 40 times higher than that of hydrocarbon solvents (41). The dielectric constant of the extracellular fluid is 2.5–3.5 times that of water, because of the dissolved salts (42, 43) and the measured dielectric constant of cytoplasm is quite similar to the dielectric constant of extracellular fluid. It follows from this that the aqueous phase where most charges exist in cells has about 120 times the dielectric constant of the membrane where the voltage sensor resides. Therefore, the forces on the voltage sensor charges are on the order of 120 times higher than the forces on most charges in the cell.

It follows from this that if one wants to compare the forces on the voltage sensor with that produced by EMFs on most other charged groups in the cell, the voltage sensor forces are approximately  $3000 \times 120 \times 20 = 7.2$  million times greater. [Please note again that the 3000 figure is recognized by Sheppard et al. (34); 120 is the effect of the dielectric constant and 20, the number of charges in the voltage sensor.]

The above considerations in this section, clearly show that Sheppard et al. (34) provide no evidence arguing for biophysical implausibility of the VGCC voltage sensor as

a target of low-intensity EMFs, such that when we have compelling empirical evidence that it is the main target, that evidence should be taken at face value. Furthermore, the VGCC voltage sensor is likely to be many orders of magnitude more sensitive to EMF effects than are any non-plasma membrane localized target. Because heating is produced by the joggling of charged/partially charged groups almost all of which are outside the plasma membrane, the much greater forces on the VGCC voltage sensors show that fields 6–7 orders of magnitude lower than produce heating may activate the VGCC voltage sensors.

Have others been influenced by somewhat similar considerations? I believe it is likely that W.R. Adey was influenced by the plasma membrane properties when in the 1980s he proposed that a plasma membrane protein was the likely target of weak EMFs. Panagopoulos et al. (7, 8) may have been influenced by these plasma membrane and voltage sensor considerations when they decided to do biophysical modeling on voltage gated ion channels. The two reviewers of this paper each had some criticisms of the Panagopoulos et al. (7, 8) modeling, and some of the things in their papers go beyond my biophysics understanding, so I am unable to judge. What I would say is that the modeling studies came to three important predictions: That voltage-gated ion channels may be targets of low-intensity EMFs, that the VGCCs may be particularly activated because of the mechanism of the actual calcium flux through the channel and that pulsed fields may be more active than non-pulsed fields. Biophysical modeling of such complex membrane proteins as the voltage-gated ion channels is, at best a work in progress, given their complexity.

At this point, there is much evidence implicating VGCC activation but no apparent evidence implicating other voltage-gated ion channels in low intensity EMF responses (1–3). Possible reasons for this should be assessed elsewhere.

What is most needed at this point is not more biophysical modeling, although that would be useful, but extensive detailed information on the effects of various fields on VGCC activation. Such information can be obtained via the types of studies advocated below for biologically-based safety standards.

## Canadian Royal Society Expert Panel Report on radiofrequency fields

This Royal Society Expert Panel was charged with reviewing Safety Code 6 (2013) safety limits for exposure to radiofrequency (primarily microwave frequency) fields,

following the charge to “advance knowledge, encourage integrated interdisciplinary understanding and address issues that are critical to Canadians”. The Expert Panel Report (44) can be judged based on these charges and also the requirements that apply to authors of all purportedly scientific documents:

- The need to provide documentation that it has given as objective an assessment of the science as possible;
- The need for clarity of thought and clarity of expression, such that it will be clear to the reader what the Report is trying to say;
- The need to provide the reader of the Report with sufficient information in the Report and in the citations provided in the Report such that the reader can make an independent assessment of the quality of the science;
- And perhaps most importantly, the need to follow widely accepted principles for assessing scientific evidence.

This paper considers both the charges to the panel and these more generally applicable scientific principles to judge the scientific merit of the Report.

## What is in the report?

The Report is, in the author’s view, stronger on opinion than on evidence (44). Let us consider some specifics.

The Report states that “The Panel considered an ‘established adverse health effect’ as an adverse effect that is observed consistently in several studies with strong methodology. With this definition in mind, the Panel reviewed the evidence for a wide variety of negative health impacts from exposure to RF energy, including cancer, cognitive and neurologic effects, male and female reproductive effects, developmental effects, cardiac function and heart rate variability, electromagnetic hypersensitivity, and adverse health effects in susceptible regions of the eye.” Despite this claim to have reviewed a broad array of biological impacts, in fact the Report does not provide a comprehensive review. Rather it engages, as documented below, in what can be referred to as “cherry-picking” – selecting studies consistent with its assumptions. Moreover, it often ignores studies that are not consistent with its assumption that there are no biological effects excepting those that, in their view, may be tied to heating. Thus the Report completely excludes many different studies on prenatally exposed animals and those on spermatogenesis, on oxidative stress, changes of calcium fluxes and

thousands of studies on therapeutic effects, all at non-thermal levels of exposure.

The Report uses the existence of what it calls “inconsistent,” and others have called “conflicting” studies to argue that conflict *per se* indicates a lack of established health impact. This paper considers below whether there are any genuine “inconsistencies” in this literature. Henry Lai and Devra Davis have documented that “conflicting” scientific evidence in the field of bioelectromagnetics relating to mobile phones has been carefully cultivated (45), an inference that may also explain the data of Huss et al. (46). Huss et al. stated “We found that the studies funded exclusively by industry were indeed substantially less likely to report statistically significant effects on a range of end points that may be relevant to health. Our findings add to the existing evidence that single-source sponsorship is associated with outcomes that favor sponsors’ products.” The panel ignores these findings and considers that conflicting evidence about effects of exposure to RF energy on cancer or other end points means that effects are possible but are not ‘established’ in accordance with its definition of ‘established health effects’. Similarly, while the Report notes that effects of exposure to RF energy on aspects of male reproductive function have been found, it concludes that “the evidence has not been established to indicate that these translate into fertility or health effects” even when such aspects are used clinically to assess male fertility.

The Panel reviewed “inconsistent” evidence about effects of exposure to RF energy on cancer, concluding that effects are possible but are not ‘established in accordance with its definition of ‘established health effects’. The Report states that the Panel’s conclusion on cancer is in agreement with a recent report from the International Agency for Research on Cancer (47). In fact, the Report’s characterization of the IARC (47) position does not agree with the IARC actual position. IARC states that “In the text, the Working Group provides comments on those findings that are of greatest relevance to the evaluation, e.g., risk in the overall exposed group, patterns of change in risk with increasing exposure (such as a monotonic increase in risk with increasing exposure), and changes in risk with duration of exposure or latency.” Furthermore, the Report ignores the fact that WHO considers microwave radiation to be a Class 2B carcinogen, and the Report also ignores the fact that four prominent reviews on this topic (48–51) all come to the conclusion that microwave exposures can cause cancer. It is apparent therefore that the Panel of Experts on Safety Code 6 has allowed its assumptions to greatly influence its assessment here, rather than providing an objective assessment of the literature.

There are complexities here that the Expert Panel fails to consider. For example, oxidative stress produced by microwave EMF exposure is likely to have a role in causation of cancer. For decades, it has been established that low level oxidative stress can lower oxidative stress markers below initial, pre-stress levels and protect the body from subsequent higher level oxidative stress, a phenomenon known as hormesis that has been recently shown to act by raising the activity of a transcriptional regulator, Nrf2; it has been suggested that this may explain some observations that low level cell phone use may lower cancer incidence via this mechanism, whereas higher level, long-term cell phone use may produce major elevation of cancer incidence. However, the Expert Panel apparently considers these studies to be conflicting, when to the contrary, these studies may raise the issue of biological complexity and a possible U- or J-shaped dose-response curve.

Another even clearer example where inferences of “inconsistencies” or “conflicts” in the literature have been misconstrued regarding the induction of single strand breaks in cellular DNA, measured by what are known as alkaline comet assays, a well-documented method for such studies (1). This literature was reviewed by the author (1), who found 19 different studies where greatly elevated levels of such single strand breaks were found following exposure as well as eight studies where they were not found. However, in examining these studies in detail, it is clear that the differences can be easily explained. For instance, regarding *in vitro* studies of DNA damage, some of the studies have used different cell types and studied different microwave source EMFs. Thus adult lymphocytes appear relatively resistant to EMF, while neural stem cells are much more susceptible. Different cell types differ from one another in how many and what types of VGCCs may be present and they may differ as well in how the VGCCs are regulated and so may be expected to differ widely in terms of response. All of these studies were done using exposures that were well within current safety standards. Consequently, each of these 19 positive findings contradict the assumptions behind the current safety standards, assumptions that are being defended by the Expert Panel Report, but the Report ignores all of these studies. Moreover, in two of the 19 positive studies, results were positive in some cell types but not others (1), clearly showing that in measurements using identical methodologies, the properties of the cells being studied are critical in determining the biological response found.

Thus the Panel has failed to take into account important nuances regarding scientific research in this field. It has limited considerations to what the Panel calls

“established health effects” defined in terms of consistent responses of various cell and tissue types (44). Where apparent conflict exists, the Panel uses its existence as proof that an effect is not established. In doing so, the Panel fails to take into account scientific details that account for many “inconsistent” results. Such details are likely to include, in addition to the factors discussed above in this section, such factors as the role of different pulsation patterns in different types of exposures, the presence of “window effects” providing very complex dose-response relationships and the role of field frequencies in determining biological response. In effect, the panel dismisses science that does not comport with their underlying assumptions that only thermal effects are relevant.

## Genotoxicity of non-thermal microwave exposures: examples of inconsistency?

This inconsistency issue is central to the Report’s consideration of genotoxicity of non-thermal microwave exposures. This is one of the two areas (pp. 80–82) where the Report cites substantial numbers of primary citations (22 in this case). It lists 13 citations where studies found genotoxicity following exposure levels, well within safety standards. It also lists nine citations where the Report states that no genotoxic effect was found. The Report only cites a small fraction of the overall literature on genotoxicity. For example, it only cites one of the 19 studies reviewed earlier by the author (1) on induction of single strand DNA breaks in microwave frequency exposed cells [that of Kesari et al. (52)]. In overall outline, the literature cited in the Report on this topic reflects fairly well this overall much larger literature. There are, however, a number of ways in which the Report is problematic in dealing with this subject. The author has looked up all 22 of these studies to determine from the original papers what the original authors stated.

Scientists often look at genotoxicity because of its importance in carcinogenesis and this section of the Report is part of a larger section on carcinogenesis. However, the Panel of Experts nowhere considers that many of the authors of these studies discuss their own work as strengthening the case that such fields are carcinogenic. A second connection, to male infertility, is also hidden in the report. Two of the positive studies (53, 54) are falsely stated in the Report as being on blood formation but what was actually being studied

in both of these studies was testicular sperm formation. The positive study Liu et al. (55) which shows genotoxicity in a spermatocyte cell line may also have implications regarding male infertility, because of the cell type being studied. There is also a connection with male infertility of one of the negative studies (56). This study of effects of mobile phones, found no genotoxic effects on human sperm, but the same group published two earlier studies showing that other EMFs had substantial effects that suggested lowered fertility as a consequence of exposure. The Report cited the Falzone et al. (56) study but not the two earlier studies. Perhaps this is an overreaction, but the Report seems to be hiding studies providing substantial support for the view that these EMFs can substantially impact male fertility and also hiding the implications of many of these studies on carcinogenesis.

There are other aspects of this section that are problematic. The Report listed the Franzellitti et al. (57) study as a negative one but it is not; it reports increased single strand DNA breaks as measured by alkaline comet assays following exposure. The Report accurately lists the Bourthoumieu et al. (58) study as being negative, but that study cites other studies by the same research group using other cell types as being positive; these positive studies are not cited or discussed in the Report. Similarly, the Report correctly lists two studies by Zeni, Sannino and their colleagues as being negative for apparent genotoxicity; however, this same research group published 6 additional studies, with three showing positive effects, depending on the cell type being studied. The Xu et al. (59) study found genotoxicity in two cell types but not in four other cell types. These studies clearly show that different types of cells respond differently to low level microwave exposures, but for some reason, the Panel of Experts seems unable to draw this very important conclusion. The cell type differences are discussed above in relation to the role of VGCCs in producing single strand breaks in cellular DNA (1). Another problematic aspect of this part of the Report, is that it lists seven of the 13 positive studies as studies providing evidence for “genotoxic or epigenetic” changes but none of those seven have anything to do with epigenetics.

We have here 13 (14 actually when the Franzellitti study is added) studies each of which provide clear evidence for genotoxic activity of non-thermal microwave fields and each of which therefore falsify the heating/thermal hypothesis underlying the Report and also falsify current safety standards. Therefore, based on widely accepted scientific standards, the heating/thermal hypothesis and the safety standards should be rejected.

What conclusion does the Panel draw? It concludes that “Extensive in vitro studies have generated inconsistent evidence that RF energy has genotoxic or epigenetic potential”. There is, however, no inconsistent evidence whatsoever. When one studies different cell types, different fields with different pulsation patterns, and different end points, even an elementary understanding of biology argues that different results are likely to be obtained. This section of the Report makes very clear on what basis the Panel is inferring “inconsistency”. The authors of the Report are simply looking at superficial similarities of studies and falsely inferring that differences should be interpreted as “inconsistencies” or “conflicts”, when they are not inconsistent or conflicting at all. The only type of studies that can produce clear evidence of inconsistency are identical studies that produce different results. Neither the Report nor, to my knowledge, its predecessors have provided any examples of such identical studies. Because this inconsistency argument underlies so much of the Report, one can see that this argument and the Report and also the current safety standards are each deeply flawed.

## Karl popper and how to assess scientific evidence

What is the responsibility of the Expert Panel as a group of scientists attempting to produce a scientifically defensible Report? Probably the most influential work on this topic comes from the famous philosopher of science Karl Popper. In his work, *Conjectures and refutations*, Popper argues that scientific hypotheses cannot be proven, but they can be falsified (60). Thus science is to be regarded as tentative information that can always be advanced through further research. Falsifying information, information that apparently falsifies a theory, is the most important type of scientific information and needs therefore to be considered very carefully. The next more important type of evidence is what he calls “risky predictions” where one makes a prediction based on a hypothesis, a prediction that is not likely to be made based on any other unrelated hypothesis. Confirmation of such a risky prediction provides substantial support whereas lack of confirmation can again lead to falsifying the hypothesis. Finally, there are confirmatory evidence studies where multiple hypotheses may explain any confirmation and consequently such confirmation is of low scientific significance.

When considered against the Popperian framework, all of the evidence supporting the heating/thermal

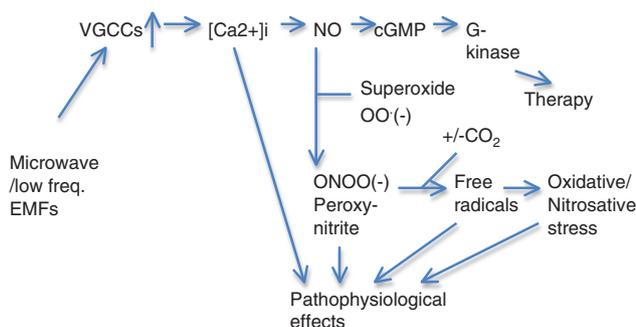
hypothesis, favored by the Expert Panel (44) is of the third type. It is widely established therefore that a scientific assessment of this area needs to consider in detail each apparently falsifying study and unless each of them can clearly be shown to be deeply flawed, the inference that should be drawn is that the heating hypothesis should be rejected. This rejection is the one aspect of this that may need to be modified in biology, given the inherent complexity of biology. It is possible that rather than rejection, the hypothesis needs instead to be modified in such a way that the information no longer falsifies the new hypothesis. However, in this situation where perhaps thousands of such modifications may be needed because of thousands of apparent falsifying studies, the difference in practice from outright falsification by each study may be trivial. It is clear, in any case that the Expert Panel has completely avoided doing its scientific duty here, failing to assess each of the thousands of apparent falsifying studies, and opting instead, as seen above, to make specious arguments. That is tragic, in my view, failing to protect the health of many Canadians, and indeed others around the world.

## Some other aspects

Most of the Report is focused on their heating/thermal interpretation of microwave radiofrequency effects (44). That is, perhaps, not surprising. What is however very surprising, is that having made such a fetish out of the “inconsistencies” in dealing with various topics, nowhere does the Expert Panel consider in this very large section of the Report, the thousands of findings that clearly conflict with their own favorite hypothesis. What sections of data should be thrown out that may be relevant to this section? The Panel of Experts seem to be completely oblivious that if in its view “inconsistencies” are sufficient to throw out many studies in one area, it should have at least a little consistency in dealing with “inconsistencies” in the heart of their own Report.

In the first paragraph in the conclusion section, the Panel of Experts state that (44) “No viable biophysical mechanism has been proposed for carcinogenic effects for exposure below the levels of SC6 that are supported by results in experimental systems,” citing three earlier studies but neglecting to consider the VGCC mechanism of microwave EMF action. The VGCC mechanism is clearly a viable biophysical mechanism, because of the properties of the voltage sensor located in the plasma membrane. VGCC activation produces downstream effects including [Ca<sup>2+</sup>]<sub>i</sub> elevation, NO elevation and peroxynitrite/oxidative stress/

free radical elevation (1–3), see Figure 1. It has been shown that NO and peroxynitrite/oxidative stress/free radical elevation are central to the mechanism of inflammatory carcinogenesis (61–64), the type of carcinogenesis that occurs in chronically inflamed tissues and therefore causes cancer in such tissues. It follows that it is biophysically and physiologically plausible, that microwave caused VGCC activation may cause cancer via the same mechanisms shown to cause cancer in inflammatory carcinogenesis. It has also been shown that free radicals formed through Compton scattering by ionizing radiation have essential roles in ionizing radiation carcinogenesis (65–67), providing probable mechanistic similarities between microwave EMF carcinogenesis and ionizing radiation carcinogenesis, as well. There have been many arguments made by the advocates of the heating/thermal mechanism of action, emphasizing the correct fact that the individual microwave photons have insufficient energy to perturb the chemistry of our bodies and they infer from this that these photons cannot cause cancer or many other pathophysiological responses. But what the Panel of Experts and others fail to realize is that the microwave fields as a whole, acting through downstream effects of VGCC activation, lead to high densities of intracellular free radicals (Figure 1) and can produce therefore similar effects on the body to those produced by ionizing radiation exposure. In any case, it follows from this paragraph, that the statement, in the Report, that there is



**Figure 1:** Mechanisms of action for microwave EMFs leading to diverse pathophysiological responses and therapeutic responses. Microwave/lower frequency electromagnetic fields (EMFs) act to stimulate voltage-gated calcium channels (VGCCs), increasing levels of intracellular calcium  $[Ca^{2+}]_i$ . Elevated  $[Ca^{2+}]_i$  increases nitric oxide (NO) synthesis which can act along two pathways. The NO signaling pathway, raises cyclic GMP (cGMP) levels and G-kinase activity, producing therapeutic effects. In the other pathway of action of NO reacts with superoxide to form peroxynitrite  $[ONOO(O)]$ , which either before or after reaction with carbon dioxide ( $CO_2$ ) can break down to form free radicals, producing oxidative/nitrosative stress. The excessive calcium signaling produced by  $[Ca^{2+}]_i$  and the peroxynitrite/free radical/oxidative stress pathway each contribute to pathophysiological responses.

no viable biophysical mechanism for low level microwave exposure to cause cancer or other diseases is false, with that falsehood apparently based on the failure of the Panel of Experts to consider the information provided to the panel by the author (Refs. 1 and 3).

This issue of biophysical plausibility of a mechanism for such low intensity exposures is a terribly important one. In the Report, there is a quote from a 2009 Health Canada document, which authors of the Report essentially adopt as their own [p. 78, ref. (44)]; “At present, there is no scientific basis for the occurrence of acute, chronic and/or cumulative adverse health risks from RF field exposure at levels below the limits outlined in Safety Code 6. The hypothesis of other proposed health effects occurring at levels below the exposure limits in Safety Code 6 suffer from lack of evidence of causality, biological plausibility and reproducibility and do not provide a credible foundation for making science-based recommendations for limiting human exposures to lower-intensity RF fields (Safety Code 6).” Whether or not this was a defensible position in 2009, it clearly is not defensible in 2014. This issue of biological/biophysical plausibility is a key one in considering various types of epidemiological evidence, such as were considered in the Report, whenever the role of such stressors in initiating disease is being considered based on studies of groups of people. Hennekens and Buring (68), on p. 40 in their textbook *Epidemiology in Medicine* state “The belief in the existence of a cause and effect relationship is enhanced if there is a known or postulated biologic mechanism by which the exposure might reasonably alter risk of developing disease.” Consequently, all of the epidemiological evidence considered in the Report and elsewhere needs to be reconsidered in the light of the biophysical and physiological plausibility of the VGCC mechanism and downstream effects produced by VGCC activation.

## Cataract formation as claimed effects of microwave-caused heating

The Report presents a fairly extensive specific case, arguing that microwave exposure produced cataract formation is produced by their heating/thermal mechanism (44). Unlike most other areas of the Report, the Panel considers substantial amounts of the primary literature on this topic. The studies discussed, provide evidence for the third and weakest test, according to Karl Popper’s analysis

(60), namely that the exposures studied are mostly within the range that produce substantial tissue heating and may therefore produce both cataracts and lens opacification via heating. This type of evidence is considered to be the weakest of the three types of evidence in Popper's schema, because alternative mechanisms are not in any way ruled out.

What is interesting is that there are three published studies which argue strongly against a heating mechanism for cataract formation by microwave exposures. One of these, a study by Cleary and Mills (69), showed that in comparison with other treatments raising lens temperatures, microwave radiation "appears to exert a unique component of thermal stress in the induction of opacification in the mammalian lens," arguing against a strictly thermal mechanism. Two studies have been published testing in effect the "risky prediction" that microwave-induced cataracts are produced by heating. One of these showed that neither eye-localized or whole-body hyperthermia to 42° produced any cataract-like opacity in the rabbit (70). The other showed that localized eye heating in the rabbit, producing the same temperature for the same duration as cataractogenic microwave exposures, produced no opacity in the rabbit eye (71). Both of these "risky predictions" failed to confirm the prediction and strongly suggest falsification of the hypothesis that microwave-induced cataracts are produced through heating. What is particularly disturbing about the Report is that it fails to cite any of these three studies (44) despite the fact that each of them has been cited by others in this context, according to the Google Scholar database. Clearly, the literature the Expert Panel cites regarding cataract formation, which includes the second most extensive primary literature in the Report, does not provide an objective assessment of the scientific literature in this area.

In contrast to studies discussed in the previous paragraph, the equally "risky prediction" that VGCCs and excessive  $[Ca^{2+}]_i$  have roles in such cataract formation have produced validation of the hypothesis that microwave-induced VGCC activation causes cataracts. Walsh and Patterson (72) demonstrated that elevated  $[Ca^{2+}]_i$  in the lens of the frog eye has a central role in cataract formation and that calcium channel blockers, which of course block VGCC activation, can block cataract formation. In a recent review, it was shown that excessive  $[Ca^{2+}]_i$  in the lens of the human and mammalian eye plays a major role in the opacification process producing cataracts and that VGCCs can have a substantial role in this process (73). While these studies do not directly relate to microwave exposures, they clearly show that excessive  $[Ca^{2+}]_i$  in the lens of the eye has essential roles in cataract formation

and that excessive VGCC activity causes cataract formation in experimental animals. Much of the action of  $[Ca^{2+}]_i$  in cataract formation has been shown to occur through the action of several calcium receptors that act independently of NO. However, there is also an established role of oxidative stress in cataract formation, and it is thought that peroxynitrite also has a role because of the elevation of a marker for peroxynitrite, 3-nitrotyrosine in cataracts (74). It is likely therefore that microwaves act to produce cataracts via calcium signaling as well as via downstream effects involving peroxynitrite and oxidative stress (see Figure 1). The difference in confirmation of these "risky predictions" clearly shows that the VGCC/ $[Ca^{2+}]_i$  role in producing cataracts is far better documented than any possible heating role.

It can be seen from the above, that although the Canadian Panel of Experts seems to argue that cataract formation is the strongest example of a strictly thermal EMF response (44), the case for such a thermal mechanism is to the contrary extremely weak. Their case is totally dependent on ignoring both evidence that falsifies their view and also evidence that confirms "risky predictions" of the VGCC mechanism that is ignoring the two strongest types of evidence. Thus the claimed role for heating being the cause of cataract formation following microwave exposure, advocated by the Expert Panel, has now been apparently debunked.

## Summary of the report

In summary, then each of the following failures in the Report can be seen to be important in our rejecting its conclusions:

- It fails to individually assess the thousands of studies that provide evidence apparently falsifying their heating/thermal paradigm. By failing to assess studies containing this most important type of evidence, as shown by Popper (60), this failure provides more than sufficient reason to reject the conclusions of the Report.
- The Report fails to provide any "risky prediction" type evidence (the second most important type of evidence) in favor of the heating/thermal hypothesis, but such risky predictions are available supporting the VGCC mechanism of action.
- The Report bases its conclusion on the weakest type of evidence, evidence that some responses could be generated by heating but does not rule out other types of mechanisms. A close examination of what the Expert Panel considers to be the strongest case for heating,

- that of cataract formation, shows that this is another example of a probable VGCC mechanism, not heating.
- The Report repeatedly fails to provide an objective assessment of the scientific literature. Because omitted citations consistently have the effect of weakening their position, it seems unlikely that these omissions are just coincidental.
  - The Report claims that there is no biophysically viable alternative to the heating/thermal paradigm, a claim clearly shown here to be false.
  - The Report claims extensive inconsistencies (what others have called conflicts) occur in the literature, where what it considers “similar” studies produced different results and it uses these claims of “inconsistencies” to throw out large amounts of the literature. However, these “similar” studies are in fact, dissimilar, differing in cell type being studied, the properties of the fields being studied and/or the end point being studied, with each of these having demonstrated roles in determining outcome. It follows that the Report provides no evidence for any such “inconsistencies.” Any claims of such “inconsistencies” are at best undocumented.
  - The Report fails to use its own inconsistency argument (6 above) in the heart of the report, the part that argues for a heating/thermal mechanism, thus failing to be consistent in its own treatment of this issue.
  - The Report fails to give the reader enough information in the Report itself or in the citations provided to allow the reader to assess its scientific merit.

The author is aware that similar flaws to those described immediately above occur in earlier studies arguing for the heating/thermal/SARs mechanism (9–13). But that only emphasizes the fact that this whole point of view has been on extraordinarily weak ground all along. That makes it crucially important that safety standards on which the health of most Canadians and indeed, most people around the world are dependent, be examined in scientifically defensible ways.

It is perhaps surprising that the case developed by the Panel of Experts is so weak. That is especially so because industry-funded research has been skewed in support of the heating/thermal interpretation (45, 46), so one would think that with a lot of industry-supported research, the Expert Panel would have come up with some stronger evidence.

Let me say that it is my opinion that the Panel of Experts may not have been corrupted by industry influence, but rather it may have fallen victim to a common affliction, that of groupthink. Groups of people each

carrying misconceptions in common, act to encourage their common misconceptions in other members of the group. What was apparently lacking in the Panel of Experts was someone who could challenge those misconceptions, rather than encourage them. However the “logic” presented in the Report provides industry with a strategy to indefinitely prevent any true scientific standards from being used to assess safety. Industry need only fund research that ends up making “inconsistent” conclusions, thus allowing all independently funded studies to be thrown out because of these “inconsistencies” and thus indefinitely preventing adoption of safety standards based on genuine, independent science. It is my hope and expectation that this was not the goal of the Expert Panel, but it is nevertheless an apparent consequence of their Report, if it is viewed as being scientific.

Still, it can be argued, that the Panel of Experts has perhaps unwittingly fulfilled a very valuable function. By clearly showing how weak their case is in 2014, the Panel has shown that none of the more recent evidence has substantially strengthened their case. It is still based on a false premise (biophysical implausibility of alternative mechanisms) and circular reasoning, it is still based on the failure to consider large numbers of apparent falsifying studies, it is still based on ignoring large amounts of the relevant literature and it is still based on the failure to provide the most well supported types of evidence needed to establish biological mechanisms in medicine, just as was true earlier (9–13). Of course, the weakness of the Panel’s case means that the current safety standards are based on quicksand.

## How VGCC activation by microwave/ RF exposure can produce a variety of important biological responses

Table 1 summarizes how VGCC activation may plausibly produce a wide range of reported responses to microwave and, in some cases, lower frequency EMF exposures. It can be seen that a wide range of reported responses to low level microwave exposures can apparently all be understood as being a consequence of VGCC activation and downstream effects of such activation that were outlined in Figure 1. These can all be seen as “risky predictions” of the VGCC activation mechanism produced by EMF exposures. While these mechanisms support the inference that all of these effects seem to be produced by VGCC activation, that inference must be viewed as being surprising. After all,

**Table 1:** Apparent mechanisms of action for microwave exposures producing diverse biological effects (see Figure 1).

Reported biologic response	Apparent mechanism(s)	Citation(s)/Comments
Oxidative stress	Peroxynitrite and consequent free radical formation	(1–3); detected via a large number of oxidative stress markers
Single strand breaks in cellular DNA	Free radical attack on DNA	(1, 3)
Double strand breaks in cellular DNA	Same as above	Same as above; detected from micronuclei and other chromosomal changes
Cancer	Single and double strand breaks, 8-nitroguanine and other pro-mutagenic changes in cellular DNA; produced by elevated NO, peroxynitrite	This paper and (3)
Breakdown of blood-brain barrier	Peroxynitrite activation of matrix metalloproteinases leading to proteolysis of tight junction proteins	(3)
Male and female infertility	Induction of double strand DNA breaks; other oxidative stress mechanisms; [Ca <sup>2+</sup> ] <sub>i</sub> mitochondrial effects causing apoptosis; in males, breakdown of blood-testis barrier	(3)
Therapeutic effects	Increases in [Ca] <sub>i</sub> and NO/NO signaling	(1–3; 13)
Depression; diverse neuropsychiatric symptoms	VGCC activation of neurotransmitter release; other effects? possible role of excess epinephrine/norepinephrine (75)	These were reported in occupational exposures (22); also reported in people living near cell phone towers
Melatonin depletion; sleep disruption	VGCCs, elevated [Ca] <sub>i</sub> leading to disruption of circadian rhythm entrainment as well as melatonin synthesis	(3)
Cataract formation	VGCC activation and [Ca] <sub>i</sub> elevation; calcium signaling and also peroxynitrite/oxidative stress	This paper
Tachycardia, arrhythmia, sometimes leading to sudden cardiac death	Very high VGCC activities found in cardiac (sinoatrial node) pacemaker cells; excessive VGCC activity and [Ca <sup>2+</sup> ] <sub>i</sub> levels produces these electrical changes in the heart	(3)

although low level EMF activation of VGCCs is now well-documented, other possible direct targets of EMFs cannot be ruled out, targets that may produce changes that cannot be easily explained as being caused by VGCC activation and downstream effects of such activation. When the apparent mechanisms summarized in Table 1 are put together with the calcium channel blocker studies and other studies on widespread changes in calcium fluxes and calcium signaling following microwave EMF exposures, we are left without any alternative, non-VGCC target of EMF action that currently can be studied for its role in producing biological effects in humans.

## Biologically-based EMF safety standards

Hardell and Sage (76), the Scientific Panel on Electromagnetic Health Risks (77) and the author (3) have called for biologically-based EMF safety standards that are based on genuine biologically relevant responses to low-level microwave and other EMFs, rather than SARs. The only approaches we have available for this based on a known

biological end point, as shown in the previous section, are approaches based on VGCC activation. There are experimental whole animal approaches based on VGCC activation (3), but my feeling is that initial studies should focus on using cells in culture, cells that have high levels of some VGCCs. Some such studies would use cell lines with such high VGCC levels, such as neuroblastoma cell lines or perhaps cell lines derived from endocrine cells with relatively high VGCC levels. Among these cell lines should be the neuroblastoma cell lines previously studied by Dutta et al. (78) and shown to produce changes in calcium fluxes in response to very low level EMF exposures. PC12 cells, a commonly used chromaffin cell line should also be considered for such studies. In addition, it may useful to use cardiac pacemaker cells which have very high activities of VGCCs (35) and can be derived from stem cells (79).

Two approaches suggest themselves for measuring responses of such cells to EMF exposure: Cells in culture could be monitored for NO production using an NO electrode in the gas phase over the culture, both before and following EMF exposure. This approach was used by Pilla in studying effects of pulsed microwave fields (4) in trying to understand the mechanism of microwave therapy. Pilla found that the NO increase in such cultures on EMF field

exposure was almost instantaneous, using a NO electrode in the gas phase (4). With this sort of approach, many different fields can be quickly and easily studied for their ability to produce NO increases, including different frequencies, pulsation patterns and possibly intensities, with the last of these needed to analyze window effects. Different cordless communication devices can be compared for activity using several cell types. Continuous measurements from an NO electrode can be recorded and easily quantified, allowing accumulation of very large amounts of data in very short time periods. Therefore, issues such as reproducibility should be quickly resolved. One might even be able to determine whether previous exposures produce increased sensitivity to exposure, possibly developing a cell culture model of electromagnetic hypersensitivity.

Another approach to such studies involves using calcium-sensitive fluorescent probes that concentrate into the cytoplasm of cells, allowing assessments of [Ca]<sub>i</sub> levels with a fluorescence microscope. This may allow one to obtain information of different types than described in the previous paragraph. One can get information on heterogeneity of responses at the cellular level and also how raised [Ca]<sub>i</sub> levels may propagate over time from one part of the cell to another. However, a limitation to this approach may occur if the fields generated by the microscope perturb the [Ca]<sub>i</sub> levels and cannot be well shielded using a small Faraday cage that does not cage exposures that are to be studied. It is also true that the NO electrode studies are easier to quantify than such fluorescent probe studies. So these two approaches are distinct from one another and whether they will complement each other as they develop is uncertain. It is my view that both of these should be investigated if only to explore their strong points and weak points but that the NO electrode approach may be a very good place to start because it has already been used to assess EMF effects (4) and because it allows easy quantification.

## Brief overview

Havas' recent review (80) discusses 14 different documents prepared by international scientists (dated 2002 through 2012) expressing deep concern about various non-thermal effects of microwave radiation exposures and other studies have expressed similar views. W.R. Adey's papers (6, 21) reviewed much of the then current evidence for many non-thermal effects of microwave radiation. But his prescience is most clearly shown by his statement that

“Collective evidence points to cell membrane receptors as the probable site of first tissue interactions with both extremely low frequency and microwave fields for many neurotransmitters, hormones, growth-regulating enzyme expression, and cancer-promoting chemicals. *In none of these studies does tissue heating appear to be involved causally in the responses*” [italics added, from a talk at the Royal Society of Physicians, London May 16–17, 2002, quoted in ref. (81)]. The recent Herbert and Sage review (81) discusses “the emergence of ever larger bodies of evidence supporting a large array of non-thermal but profound pathophysiological impacts of EMF/RFR in transforming our understanding of the nature of EMF/RFR impacts on the organism.” In a second paper (82), Herbert and Sage state that “Our EMF/RFR standards are also based on an outdated assumption that it is only heating (thermal injury) which can do harm. These thermal safety limits do not address low-intensity (non-thermal) effects. The evidence is now overwhelming that limiting exposure to those causing thermal injury alone does not address the much broader array of risks and harm now clearly evident with chronic exposure to low-intensity (non-thermal) effects.” The Khurana et al. review (83) states: “The authors reviewed more than 2000 scientific studies and reviews, and have concluded that: (1) the existing public safety limits are inadequate to protect public health; (2) from a public health policy standpoint, new public safety limits on further deployment of risky technologies are warranted based on the total weight of evidence. A precautionary limit of 1 mW/m<sup>2</sup> was suggested ...” The Scientific Panel on Electromagnetic Field Health Risks listed four well-documented central conclusions at the beginning of their publication (77):

- Low-intensity (non-thermal) bioeffects and adverse health effects are demonstrated at levels significantly below existing exposure standards.
- ICNIRP and IEEE/FCC public safety limits are inadequate and obsolete with respect to prolonged, low-intensity exposures.
- New biologically-based public exposure standards are urgently needed to protect public health worldwide.
- It is not in the public interest to wait.

Canadian Panel of Experts do not cite these papers or others providing clear and focused views that contradict the views advocated in the Report, showing again that the Report fails to provide an objective assessment of the scientific literature. The current paper adds a number of specific considerations to the needed debate:

- VGCC activation produces most, possibly even all microwave and lower frequency EMF health-related

responses. Each of the studies on VGCC activation or on changes in calcium fluxes and signaling following low level exposure clearly falsifies the thermal/heating paradigm.

- This VGCC activation mechanism by low level microwave and lower frequency fields, rather than individual photons, is biophysically plausible based on the special properties of the voltage sensor and its localization to lipid region of the plasma membrane.
- Downstream effects of VGCC activation (Figure 1) can generate each of 13 different health effects repeatedly found to be produced by microwave exposure (Table 1).
- Studies document roles of pulsation in influencing biological responses to microwave exposures, influences that are incompatible with these being produced by heating.
- “Window” effects occur, where specific intensities of microwave EMF exposure produce higher biological effects than those produced by both lower and higher intensities, observations incompatible with heating effects.
- Thousands of studies have reported biological effects at intensities well within safety standards, each of which appear to falsify the heating/thermal paradigm, none of which have been considered in this light by the Panel of Experts, despite the scientific requirement to do so under well-accepted scientific principles.
- The claims in the Report that microwave induction of cataracts is produced by heating has been tested in three studies, each contradicting this claim; two of them produce clear falsification, but none of these three studies are cited in the Report. Because VGCC activation can cause cataracts and elevated  $[Ca^{2+}]_i$  has essential roles in producing cataracts, a VGCC mechanism for microwave-induced cataracts is much more strongly supported than is the claimed heating mechanism.
- The claim in the Report of widespread “inconsistency” in the literature is tested here through examination of the literature cited on genotoxic effects. No inconsistencies were found in this literature despite the Report claiming such. Furthermore, no identical studies are cited anywhere in the Report showing inconsistency of results, these being the only types of studies that can clearly show inconsistency. Claims of widespread “inconsistency” or “conflict” in the literature must be viewed as, at best, undocumented.
- Each of the 8 considerations listed immediately above clearly show that the Report fails to provide anything

resembling an objective assessment of the evidence on biological effects of microwave EMF exposures and provides therefore no scientifically valid support for Safety Code 6, ICNIRP or other current safety standards.

- Development of biologically-based safety standards has been called for and approaches to using cell culture-based tests that may be used to develop such safety standards are discussed.

It has been clear for a long time that the heating paradigm is indefensible and that a new paradigm is much needed. We now have that with VGCC activation, and while VGCC activation may not be the entire story behind the biological actions of such EMFs in humans and other mammals, it clearly is most of the story. It is time therefore for a paradigm shift away from strictly thermal effects and toward a central role for VGCC activation in the cellular response to microwave and lower frequency EMFs.

**Acknowledgments:** I wish to thank Dr. Devra Lee Davis for her many helpful suggestions. Any remaining errors in this are, of course, my own. This paper is dedicated to the memory of W. Ross Adey (1922–2004) whose studies in this area were impressively prescient – someone I regret never meeting.

## References

1. Pall ML. Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects. *J Cell Mol Med* 2013;17:958–65.
2. Pall ML. Electromagnetic field activation of voltage-gated calcium channels: role in therapeutic effects. *Electromagn Biol Med* 2014;33:251.
3. Pall ML. Microwave electromagnetic fields act by activating voltage-gated calcium channels: why the current international safety standards do not predict biological hazard. *Recent Res Devel Cell Biol* 2014;7: 0-00 ISBN: 978-81-308-0000-0 Available at (<http://wirelesseducationaction.org/wp-content/uploads/2014/11/microw-vgccnoheat.pdf>).
4. Pilla AA. Electromagnetic fields instantaneously modulate nitric oxide signaling in challenged biological systems. *Biochem Biophys Res Commun* 2012;426:330–3.
5. Walleczek J. Electromagnetic field effects on cells of the immune system: the role of calcium signaling. *FASEB J* 1992;6:3177–85.
6. Adey WR. Biological effects of electromagnetic fields. *J Cell Biochem* 1993;51:410–6.
7. Panagopoulos DJ, Messini N, Karabarbounis A, Philippetis AL, Margaritis LH. A mechanism for action of oscillating electric fields on cells. *Biochem Biophys Res Commun* 2000;272:634–40.
8. Panagopoulos DJ, Karabarbounis A, Margaritis LH. Mechanism for action of electromagnetic fields on cells. *Biochem Biophys Res Commun* 2002;298:95–102.

9. Osepchuk JM, Petersen RC. Historical review of RF exposure standards and the International Committee on Electromagnetic Safety (ICES). *Bioelectromagnetics Supplement* 2003;Suppl 6:S7–16.
10. Osepchuk JM, Petersen RC. Safety standards for exposure to RF electromagnetic fields. *Microwave Magazine IEEE* 2001;2:57–69.
11. D'Andrea JA, Ziriach JM, Adair ER. Neurobiology of hyperthermia. *Prog Brain Res* 2007;162:107–35.
12. Tripathy H, Pathak PP. Thermal effect due to induced field of broadcasting radiation. *Int J Environ Sci* 2012;1:50–5.
13. Lin JC. A new IEEE standard for safety levels with respect to human exposure to radio-frequency radiation. *Antennas and Propagation Magazine* 2006;48:157–9.
14. Pilla AA. Nonthermal electromagnetic fields: from first messenger to therapeutic applications. *Electromagn Biol Med* 2013;32:123–36.
15. Seaman RL, Wachtel H. Slow and rapid responses to CW and pulsed microwave radiation by individual *Aplysia* pacemakers. *J Microwave Power* 1978;13:77–86.
16. Bassett CA, Pawluk RW, Pilla AA. Augmentation of bone repair by inductively coupled electromagnetic fields. *Science* 1974;184:575–7.
17. Pilla AA. Electrochemical information transfer at living cell membranes. *Ann NY Acad Sci* 1974;238:149–70.
18. Baranski S. Effect of chronic microwave radiation on the blood forming system in guinea pigs and rabbits. *Aerospace Med*;1971;42:1196–9.
19. Czernski P. Microwave effects on the blood-forming system with particular reference to the lymphocyte. *Ann NY Acad Sci* 1975;247:232–42.
20. Frey AH, Feld SR, Frey B. Neural function and behavior. *Ann NY Acad Sci* 1975;247:433–9.
21. Adey WR. Tissue interactions with nonionizing electromagnetic fields. *Physiol Rev* 1981;61:435–514.
22. Li Y, Yan X, Liu J, Li L, Hu X, et al. Pulsed electromagnetic field enhances brain-derived neurotrophic factor expression through L-type voltage-gated calcium channel and Erk-dependent signaling pathways in neonatal rat dorsal root ganglion neurons. *Neurochem Int* 2014;75:96–104.
23. Raines JK. *Electromagnetic field interactions with the human body: observed effects and theories*. Greenbelt, MD: National Aeronautics and Space Administration 1981:116.
24. Bawin SM, Kaczmarek LK, Adey WR. Effects of modulated VHF fields on the central nervous system. *Ann NY Acad Sci* 1975;247:74–81.
25. Bawin SM, Adey WR. Sensitivity of calcium binding in cerebral tissue to weak environmental electric fields oscillating at low frequency. *Proc Natl Acad Sci USA* 1976;73:1999–2003.
26. Blackman CF, Benane SG, Elder JA, House DE, Lampe JA, et al. Induction of calcium-ion efflux from brain tissue by radiofrequency radiation: effect of sample number and modulation frequency on the power-density window. *Bioelectromagnetics* 1980;1:35–43.
27. Blackman CF, Kinney LS, House DE, Joines WT. Multiple power-density windows and their possible origin. *Bioelectromagnetics* 1989;10:115–28.
28. Blackman CF, Benane SG, Joines WT, Hollis MA, House DE. Calcium-ion efflux from brain tissue: power-density versus internal field-intensity dependencies at 50-MHz RF radiation. *Bioelectromagnetics* 1980;1:277–83.
29. Goodman EM, Greenebaum B, Marron MT. Effects of electromagnetic fields on molecules and cells. *Int Rev Cytol* 1995;158:279–338.
30. Shcheglov VS, Belyaev IY, Alipov YD, Ushakov VL. Power-dependent rearrangement in the spectrum of resonance effect of millimeter waves on the genome conformational state of *Escherichia Coli* cells. *Electro- Magnetobiol* 1997;16:69–82.
31. Panagopoulos DJ, Margaritis LH. The identification of an intensity 'window' on the bioeffects of mobile telephony radiation. *Int J Radiat Biol* 2010;86:358–66.
32. Panagopoulos DJ, Chavdoula ED, Margaritis LH. Bioeffects of mobile telephony radiation in relation to its intensity or distance from the antenna. *Int J Radiat Biol* 2010;86:345–57.
33. Adams JA, Galloway TS, Mondal D, Esteves SC. Effect of mobile telephones on sperm quality: a systematic review and meta-analysis. *Environment Int* 2014;70:106–12.
34. Sheppard AR, Swicord ML, Balzano Q. Quantitative evaluations of mechanisms of radiofrequency interactions with biological molecules and processes. *Health Phys* 2008;95:365–96.
35. Catterall WA, Perez-Reyes E, Snutch TP, Striessnig J. International Union of Pharmacology. XLVIII. Nomenclature and structure-function relationships of voltage-gated calcium channels. *Pharmacol Rev* 2005;57:411–25.
36. Khosravani H, Zamponi GW. Voltage-gated calcium channels and idiopathic generalized epilepsies. *Physiol Revs* 2006;86:941–66.
37. Dolphin AC. Calcium channel auxiliary  $\alpha 2\delta$  and  $\beta$  subunits: trafficking and one step beyond. *Nature Reviews Neuroscience* 2012;13:542–55.
38. Oesterhelt D. Bacteriorhodopsin. Available at [https://www.biochem.mpg.de/523002/Protein\\_BR](https://www.biochem.mpg.de/523002/Protein_BR).
39. Artacho-Cordón F, Salinas-Asensio Mdel M, Calvente I, Ríos-Arrabal S, León J, et al. Could radiotherapy effectiveness be enhanced by electromagnetic field treatment? *Int J Mol Sci* 2013;14:14974–95.
40. Funk RH, Monsees T, Ozkucur N. Electromagnetic effects – From cell biology to medicine. *Prog Histochem Cytochem* 2009;43:177–264.
41. Huang W, Levitt DG. Theoretical calculation of the dielectric constant of a bilayer membrane. *Biophys J* 1977;17:111–28.
42. Morgavi G, Mela GS. Differences in the dielectric constant of human sera from patients with different pathological conditions. *Med Biol Engineer Comput* 1982;20:108–10.
43. Irimajiri A, Asami K, Ichinowatari T, Kinoshita Y. Passive electrical properties of the membrane and cytoplasm of cultured rat basophil leukemia cells. I. Dielectric behavior of cell suspensions in 0.01-500 MHz and its simulation with a single-shell model. *Biochim Biophys Acta* 1987;896:203–13.
44. Canadian Royal Society Expert Panel Report on Radiofrequency Fields Available at [https://rsc-src.ca/sites/default/files/pdf/SC6\\_Report\\_Formatted\\_1.pdf](https://rsc-src.ca/sites/default/files/pdf/SC6_Report_Formatted_1.pdf).
45. Davis, DL. 2010 *Disconnect: The truth about cell phone radiation, what the industry is doing to hide it, and how to protect your family*. New York: Plume Publishers; 2010:285.
46. Huss A, Egger M, Hug K, Huwiler-Müntener K, Rössli M. Source of funding and results of studies of health effects of mobile phone use: systematic review of experimental studies. *Environ Health Perspect* 2007;115:1–4.

47. IARC (International Agency for Research on Cancer). Non-ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields, International Agency for Research on Cancer (IARC) Monograph, volume 102. 2013. From <http://monographs.iarc.fr/ENG/Monographs/vol102/index.php>.
48. Kesari KK, Siddiqui MH, Meena R, Verma HN, Kumar S. Cell phone radiation exposure on brain and associated biological systems. *Indian J Exp Biol* 2013;51:187–200.
49. Yakymenko I, Sidorik E, Kyrylenko S, Chekhun V. Long-term exposure to microwave radiation provokes cancer growth: evidences from radars and mobile communication systems. *Exp Oncol* 2011;33:62–70.
50. Khurana VG, Teo C, Kundi M, Hardell L, Carlberg M. Cell phones and brain tumors: a review including the long-term epidemiologic data. *Surg Neurol* 2009;72:205–14.
51. Hardell L, Carlberg M, Hansson Mild K. Use of mobile phones and cordless phones is associated with increased risk for glioma and acoustic neuroma. *Pathophysiology* 2013; 20:85–110.
52. Kesari KK, Behari J, Kumar S. Mutagenic response of 2.45 GHz radiation exposure on rat brain. *Int J Radiat Biol* 2010;86: 334–43.
53. Kumar S, Behari J, Sisodia R. Influence of electromagnetic fields on reproductive system of male rats. *Int J Radiat Biol* 2013;89:147–54.
54. Atasoy HI, Gunal MY, Atasoy P, Elgun S, Bugdayci G. Immunohistopathologic demonstration of deleterious effects on growing rat testes of radiofrequency waves emitted from conventional Wi-Fi devices. *J Pediatr Urol* 2013;9:223–9.
55. Liu C, Duan W, Xu S, Chen C, He M, et al. Exposure to 1800 MHz radiofrequency electromagnetic radiation induces oxidative DNA base damage in a mouse spermatocyte-derived cell line. *Toxicol Lett* 2013;218:2–9.
56. Falzone N, Huyser C, Franken DR, Leszczynski D. Mobile phone radiation does not induce pro-apoptosis effects in human spermatozoa. *Radiat Res* 2010;174:169–76.
57. Franzellitti S, Valbonesi P, Ciancaglini N, Biondi C, Contin A, et al. Transient DNA damage induced by high-frequency electromagnetic fields (GSM 1.8 GHz) in the human trophoblast HTR-8/SVneo cell line evaluated with the alkaline comet assay. *Mutat Res* 2010;683:35–42.
58. Bourthoumieu S, Terro F, Leveque P, Collin A, Joubert V, et al. Aneuploidy studies in human cells exposed in vitro to GSM-900 MHz radiofrequency radiation using FISH. *Int J Radiat Biol* 2011;87:400–8.
59. Xu S, Chen G, Chen C, Sun C, Zhang D, et al. Cell type-dependent induction of DNA damage by 1800 MHz radiofrequency electromagnetic fields does not result in significant cellular dysfunctions. *PLoS One* 2013;8(1):e54906.
60. Popper KR. *Conjectures and refutations: the growth of scientific knowledge*. New York: Routledge Publishers (Originally Karl Raimund Publishers), 1963: 582.
61. Graham PM, Li JZ, Dou X, Zhu H, Misra HP, et al. Protection against peroxynitrite-induced DNA damage by mesalamine: implications for anti-inflammation and anti-cancer activity. *Mol Cell Biochem* 2013;378:291–8.
62. Ohshima H, Sawa T, Akaike T. 8-nitroguanine, a product of nitrative DNA damage caused by reactive nitrogen species: formation, occurrence, and implications in inflammation and carcinogenesis. *Antioxid Redox Signal* 2006;8:1033–45.
63. Kim HW, Murakami A, Williams MV, Ohigashi H. Mutagenicity of reactive oxygen and nitrogen species as detected by co-culture of activated inflammatory leukocytes and AS52 cells. *Carcinogenesis* 2003;24:235–41.
64. Kawanishi S, Hiraku Y, Pinlaor S, Ma N. Oxidative and nitrative DNA damage in animals and patients with inflammatory diseases in relation to inflammation-related carcinogenesis. *Biol Chem* 2006;387:365–72.
65. Spitz DR, Hauer-Jensen M. Ionizing radiation-induced responses: where free radical chemistry meets redox biology and medicine. *Antioxid Redox Signal* 2014;20:1407–9.
66. Sun Y. Free radicals, antioxidant enzymes, and carcinogenesis. *Free Radic Biol Med* 1990;8:583–99.
67. Ward JF. Some biochemical consequences of the spatial distribution of ionizing radiation-produced free radicals. *Radiat Res* 1981;86:185–95.
68. Hennekens CH, Buring JE, with Mayrent SL, editors. *Epidemiology in medicine*. Boston: Little Brown and Co., 1989.
69. Cleary SF, Mills WA. Biological effects of microwaves and radiofrequency radiation. In: Taylor LS, Cheung AT, editors. *The physical basis of electromagnetic interactions with biological systems*, College Park, MD: University of Maryland Press, 1977: 1–34.
70. Kramar PO, Harris, C, Guy AW, Lin J. Mechanism of microwave cataractogenesis in rabbits. In: Johnson CC, Shore ML, editors. *Biological effects of electromagnetic waves*. Rockville, MD: Bureau of Radiological Health, HEW Publication 77-8010, 1977: 49–60.
71. Carpenter RL, Hagan GJ, Donovan GL. Are microwave cataracts thermally caused? In: Hazzard DG, editor. *Biological Effects and Measurement of Radio Frequency/Microwaves*. Rockville, MD: Bureau of Radiological Health, HEW Publication 77-8026, 1977: 352–79.
72. Walsh SP, Patterson JW. Effects of hydrogen peroxide oxidation and calcium channel blockers on the equatorial potassium current of the frog lens. *Exp Eye Res* 1994;58:257–65.
73. Rhodes JD, Sanderson J. The mechanisms of calcium homeostasis and signalling in the lens. *Exp Eye Res* 2009;88:226–34.
74. Lupachyk S, Stavniichuk R, Komissarenko JI, Drel VR, Obrosova AA, et al. Na<sup>+</sup>/H<sup>+</sup>-exchanger-1 inhibition counteracts diabetic cataract formation and retinal oxidative-nitrative stress and apoptosis. *Int J Mol Med* 2012;29:989–98.
75. Buchner K, Eger H. Changes of clinically important neurotransmitters under the influence of modulated RF fields – a long-term study under real-life conditions. *Umwelt-Medizin-Gesellschaft* 2011;24:44–57.
76. Hardell L, Sage C. Biological effects from electromagnetic field exposure and public exposure standards. *Biomed Pharmacother* 2008;62:104–9.
77. Fragopoulou A, Grigoriev Y, Johansson O, Margaritis LH, Morgan L, et al. Scientific panel on electromagnetic field health risks: consensus points, recommendations, and rationales. *Rev Environ Health* 2010;25:307–17.
78. Dutta SK, Ghosh B, Blackman CF. Radiofrequency radiation-induced calcium ion efflux enhancement from human and other neuroblastoma cells in culture. *Bioelectromagnetics* 1989;10:197–202.
79. Chauveau S, Brink PR, Cohen IS. Stem cell-based biological pacemakers from proof of principle to therapy: a review. *Cytotherapy* 2014;16:873–80.

80. Havas M. Radiation from wireless technology affects the blood, the heart, and the autonomic nervous system. *Rev Environ Health* 2013;28:75–84.
81. Herbert MR, Sage C. Autism and EMF? Plausibility of a pathophysiological link – Part I. *Pathophysiology* 2013;20:191–209.
82. Herbert MR, Sage C. 2013 Autism and EMF? Plausibility of a pathophysiological link Part II. *Pathophysiology* 2013;20:211–34.
83. Khurana VG, Hardell L, Everaert J, Bortkiewicz A, Carlberg M, et al. Epidemiological evidence for a health risk from mobile phone base stations. *Int J Occup Environ Health* 2010;16:263–7.

## **Introduction to the United Nations EMF Appeal Delivered by Martin Blank, PhD, Department of Physiology and Cellular Biophysics, Columbia University**

I'm here with disturbing news about our favorite gadgets: cell phones, tablets, wi-fi, etc. Putting it bluntly, they are damaging the living cells in our bodies and killing many of us prematurely.

I'm Dr. Martin Blank, from the Department of Physiology and Cellular Biophysics at Columbia University.

It is distressing for me, and more than 160 colleagues, who today are petitioning the United Nations requesting that they address this problem.

We are scientists and engineers, and I am here to tell you - we have created something that is harming us, and it is getting out of control!

Before Edison's lightbulb, there was very little electromagnetic radiation in our environment. The levels today are very *many* times higher than natural background levels and are growing rapidly because of all the new devices that emit this radiation.

An example that a lot of us have in our pockets right now is the cell phone. One study shows that as cell phone usage has spread widely, the incidence of fatal brain cancer in younger people has more than tripled.

We are putting cellular antennas on residential buildings, and on top of hospitals, where people are trying to get well.

Wireless utility meters, and cell towers, are blanketing our neighborhoods with radiation.

It's particularly frightening that radiation from our telecommunication and powerline technology is damaging the DNA in our cells. It is clear to many biologists that this can account for the rising cancer rates.

Future generations - OUR CHILDREN - ARE AT RISK.

These biologists and scientists are not being heard on the committees that set safety standards. The BIOLOGICAL facts are being ignored, and as a result, the safety limits are much too high. THEY ARE NOT PROTECTIVE!

More protection will probably result from full disclosure of possible conflicts of interest between regulators and industry.

Rising exposure to electromagnetic radiation is a GLOBAL problem. The World Health Organization and international standard setting bodies are not acting to protect the public's health and well-being.

International exposure guidelines for electromagnetic fields must be strengthened to reflect the reality of their impact on our bodies, and in particular, on our DNA.

Although we are still in the midst of a great technological transformation, the time to deal with the harmful biological and health effects is long overdue.

We are really all part of a large biological experiment, without our informed consent.

To protect our children, ourselves, and our ecosystem, we must reduce exposure by establishing more protective guidelines.

And so, today, scientists from around the world are submitting an Appeal to the United Nations, its member states and the World Health Organization, to provide leadership in dealing with this emerging public health crisis.

Details of The Appeal can be found at **[EMFScientist.org](http://EMFScientist.org)**



US005159703A

# United States Patent [19]

[11] Patent Number: **5,159,703**

Lowery

[45] Date of Patent: **Oct. 27, 1992**

[54] **SILENT SUBLIMINAL PRESENTATION SYSTEM**

[76] Inventor: **Oliver M. Lowery**, 5188 Falconwood Ct., Norcross, Ga. 30071

[21] Appl. No.: **458,339**

[22] Filed: **Dec. 28, 1989**

[51] Int. Cl.<sup>5</sup> ..... **H04B 7/00; H04R 25/00; H04R 3/02**

[52] U.S. Cl. .... **455/42; 455/46; 455/66; 381/73.1; 128/420.5**

[58] Field of Search ..... **455/46, 47, 66, 109, 455/110, 42-43; 381/73.1, 105, 124; 358/141-143; 600/28; 128/420.5; 380/38**

[56] **References Cited**

**U.S. PATENT DOCUMENTS**

3,060,795	10/1962	Corrigan et al.	352/131
3,278,676	10/1966	Becker	358/142
3,393,279	7/1968	Flanagan	128/420.5
3,712,292	1/1973	Zentmeyer, Jr.	600/28
4,141,344	2/1979	Barbara	600/28

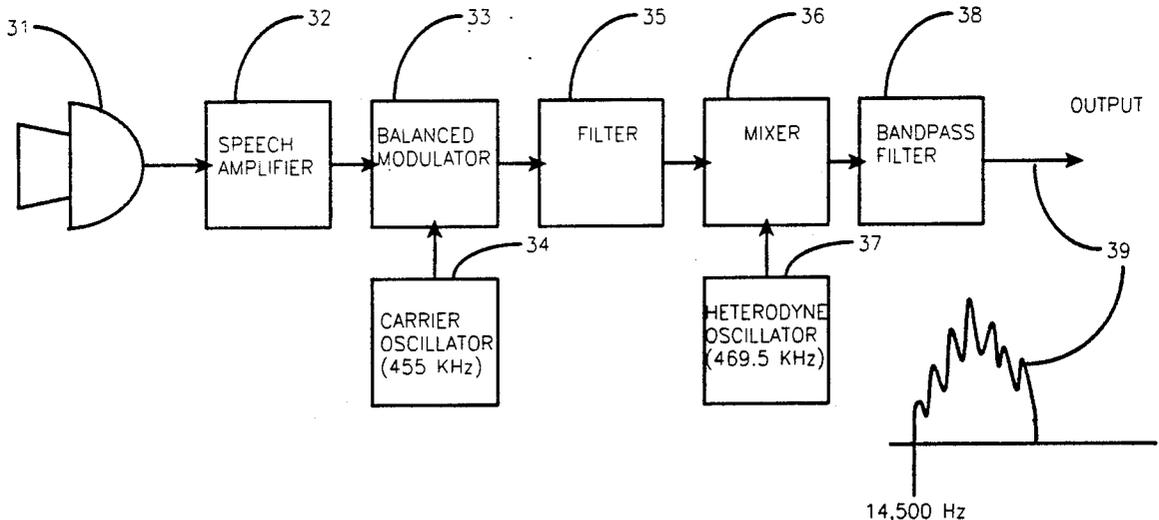
4,395,600	7/1983	Lundy et al.	381/73.1
4,463,392	7/1984	Fischer et al.	360/30
4,777,529	10/1988	Schultz et al.	381/73.1
4,834,701	5/1989	Masaki	600/28
4,877,027	10/1989	Brunkan	128/420.5

*Primary Examiner*—Reinhard J. Eisenzopf  
*Assistant Examiner*—Andrew Faile

[57] **ABSTRACT**

A silent communications system in which nonaural carriers, in the very low or very high audio frequency range or in the adjacent ultrasonic frequency spectrum, are amplitude or frequency modulated with the desired intelligence and propagated acoustically or vibrationally, for inducement into the brain, typically through the use of loudspeakers, earphones or piezoelectric transducers. The modulated carriers may be transmitted directly in real time or may be conveniently recorded and stored on mechanical, magnetic or optical media for delayed or repeated transmission to the listener.

**3 Claims, 3 Drawing Sheets**



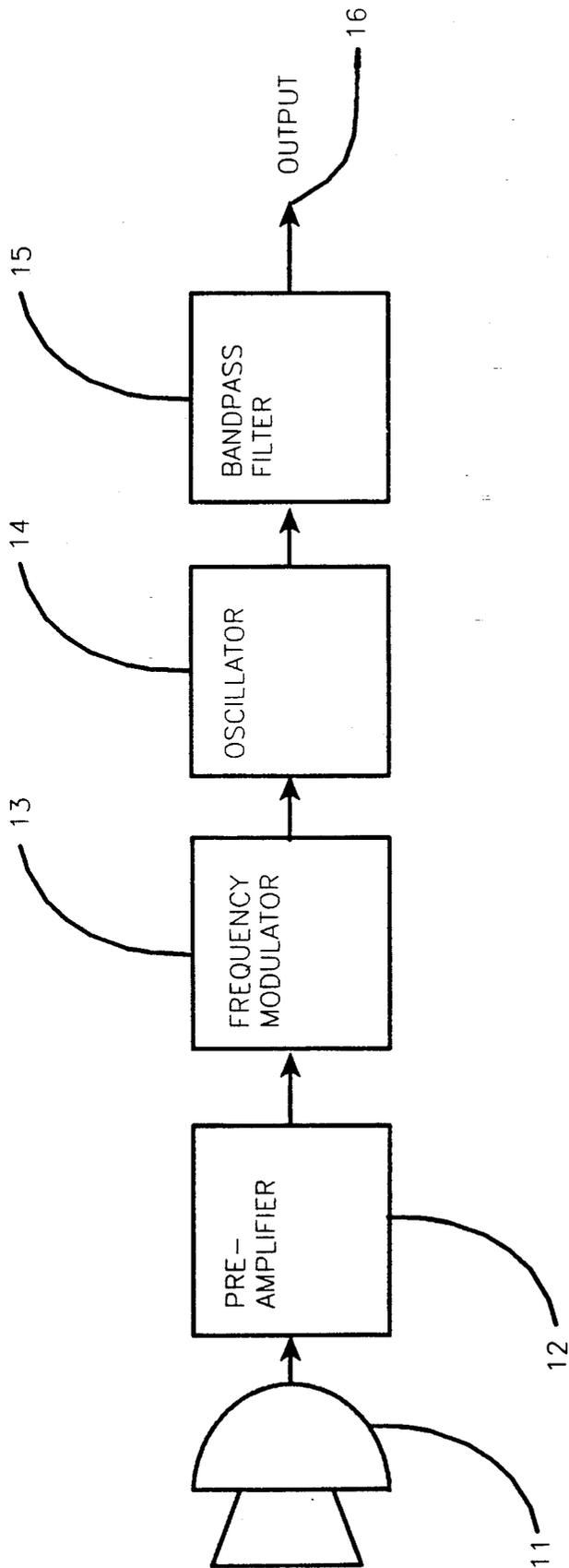


FIG. 1

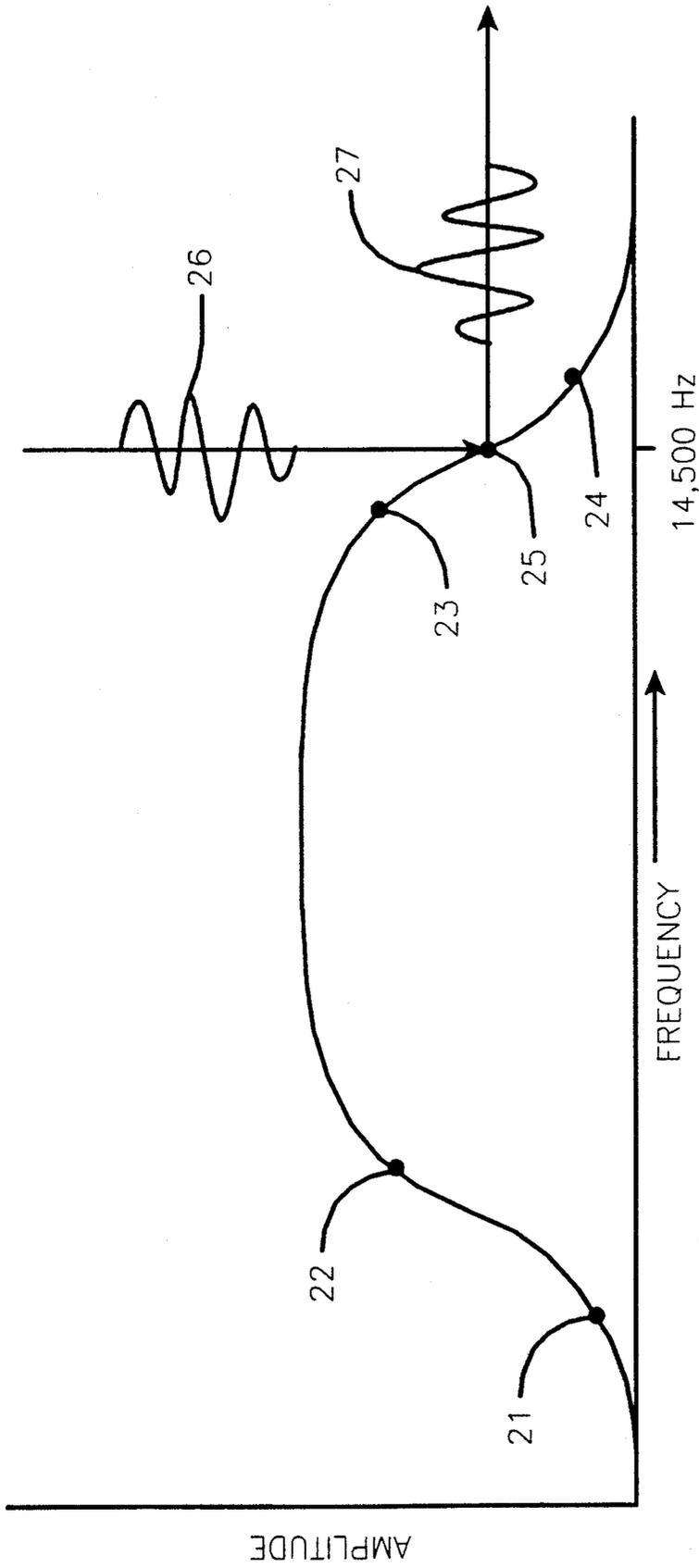


FIG. 2

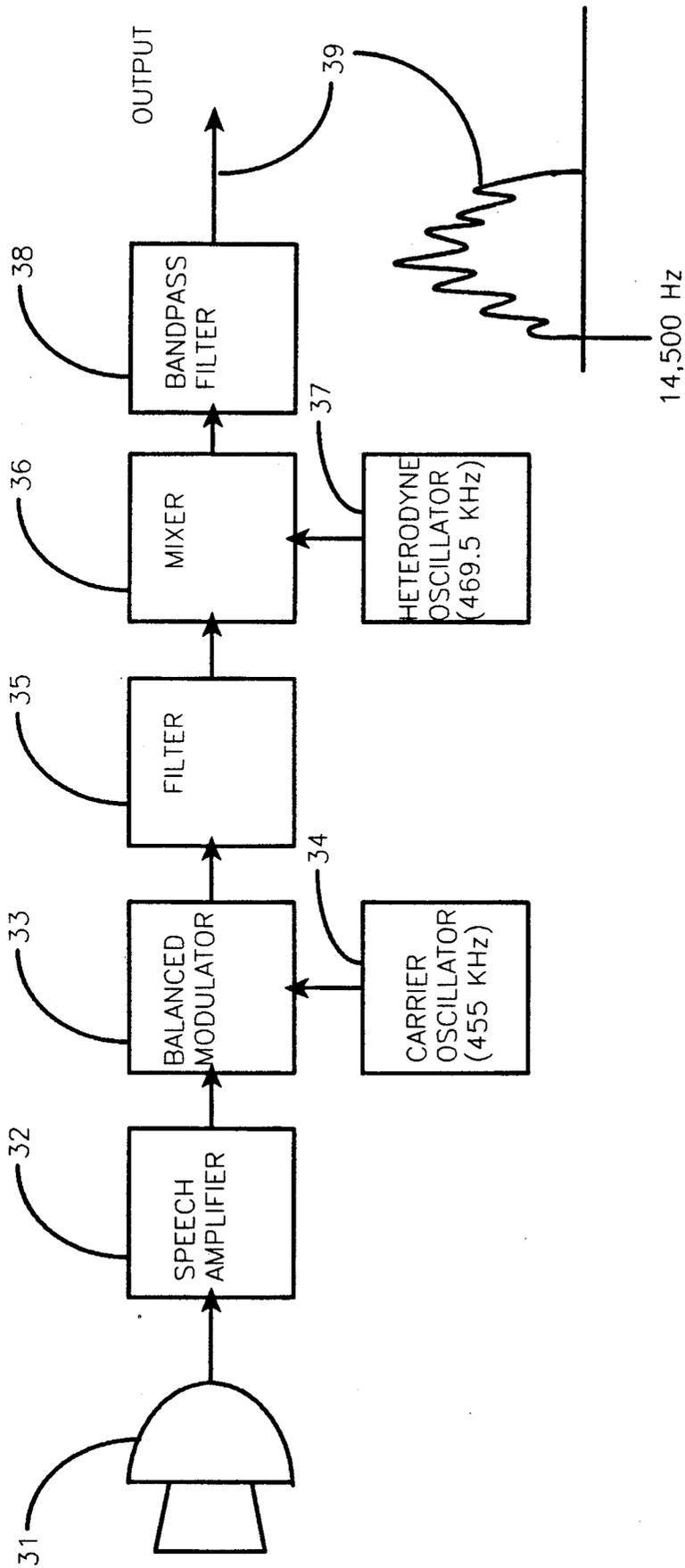


FIG. 3

## SILENT SUBLIMINAL PRESENTATION SYSTEM

### BACKGROUND—FIELD OF THE INVENTION

This invention relates in general to electronic audio signal processing and, in particular, to subliminal presentation techniques.

### BACKGROUND—DESCRIPTION OF PRIOR ART

Subliminal learning enjoys wide use today and subliminal tapes are being manufactured by a number of companies in the United States alone. Several decades of scientific study indicate that subliminal messages can influence a human's attitudes and behavior. Subliminal, in these discussions, can be defined as "below the threshold of audibility to the conscious mind." To be effective however, the subliminally transmitted information (called affirmations by those in the profession) must be presented to the listener's ear in such a fashion that they can be perceived and "decoded" by the listener's subconscious mind. We are referring to audio information in this discussion, however, information could be inputted into the subject's subconscious mind through any of the body's sensors, such as touch, smell, sight or hearing. As an example, early development work in the subliminal field utilized motion pictures and slide projections as the medium. Early research into visual and auditory subliminal stimulation effects is exemplified by U.S. Pat. Nos. 3,060,795 of Corrigan, et al. and 3,278,676 of Becker. U.S. Pat. No. 4,395,600 of Lundy and Tyler is representative of later developments in today's subliminal message techniques.

The majority of the audio subliminal tapes available today are prepared using one basic technique. That is, the verbal affirmations are mixed with, and recorded at a lower level than, a "foreground" of music or sounds of ocean surf or a bubbling mountain brook or other similar "masking" sounds. The affirmations are generally recorded 5 decibels (db) or so below the "foreground" programming and regenerative automatic gain control is usually applied to permit the affirmations to change their recorded amplitude in direct proportion to the short term averaged amplitude of the continually varying "foreground" material. In other words, the volume of the affirmations will follow or track the volume changes of the "foreground" programming, but at a lower volume level. Circuit provisions are also usually included to "gate" the affirmations off when the music amplitude is low or zero. This insures that the affirmations cannot be heard during quiet program periods. Thus, today's subliminal affirmations can be characterized as being "masked" by music or other sounds, of constantly changing amplitude and of being reduced or cut off entirely during periods of low or quiet "foreground" programming.

One of the principal, and most widely objected to, deficiencies in available subliminal tape presentation techniques is that the presence of the "foreground" material is intrusive to both the listener and to anyone else in the immediate area. No matter what "foreground" material is chosen, the fact remains that this material can be heard by anyone within its range and presents a definite distraction to other activities such as conversation, thought, desire to listen to other programming such as radio or television, need to concentrate, etc. Additionally, and because the tapes are used repeatedly by the same listener, any "foreground"

music or material eventually becomes monotonously tiring to that listener.

It is the purpose of the following described invention to eliminate or greatly reduce all of the above deficiencies. Although its application to the magnetic tape medium is described in the following discussion, the technique is equally applicable to most other desired transmission mediums, such as Compact Disc, videocassettes, digital tape recorders, Public Address (PA) systems, background music installations, computer software programs, random access memory (RAM), read only memory (ROM), "live", real time applications and other mediums now in existence or to be developed in the future.

Implemented on tape cassettes, for example, the subliminal presentation described here is inaudible i.e., high audio or ultrasonic frequencies, the affirmations are presented at a constant, high amplitude level, and they occupy their own "clear channel", non-masked frequency allocations. If desired, the previously described "foreground" music or other material can be added to the tape through use of an audio mixer. The "silent" recordings are inaudible to the user or by others present and are therefore very effective for use during periods of sleep or when in the presence of others. Additionally, the basic requirements of subliminal stimulation are met. That is, the affirmations are efficiently transmitted to the ear and, while undetected by the conscious mind, are perceived by and efficiently decoded by the subconscious mind.

### OBJECTS OF THE INVENTION

Accordingly, several objects and advantages of my invention are:

(a) to provide a technique for producing a subliminal presentation which is inaudible to the listener(s), yet is perceived and demodulated (decoded) by the ear for use by the subconscious mind.

(b) to provide a technique for transmitting inaudible subliminal information to the listener(s) at a constant, high level of signal strength and on a clear band of frequencies.

(c) to provide a technique for producing inaudible subliminal presentations to which music or other "foreground" programming may be added, if desired.

Still further objects and advantages will become apparent from a consideration of the ensuing description and drawings.

### BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, the first digit of each component number also refers to the figure number where that component can be located.

FIG. 1 represents the block diagram of a suitable system which will generate a frequency modulated (FM) signal at 14,500 Hz.

FIG. 2 represents an approximation of the frequency response curve of the human ear and the signal decoding process.

FIG. 3 represents the block diagram of a suitable system which will generate a single sideband, suppressed carrier, amplitude modulated (AM) signal at 14,500 Hz.

### REFERENCE NUMERALS IN DRAWINGS

11 microphone or other

14 low distortion

-continued

## REFERENCE NUMERALS IN DRAWINGS

audio input signal	audio oscillator
12 audio preamplifier if required	15 high pass or band pass audio filter
13 frequency modulation circuit	16 output to tape recorder or other device
21 point on low freq end response curve	25 midpoint on curve between points 23 and 24
22 point on low freq end of ear response curve	26 speaker output of FIG. 1 to ear
23 point on high freq end of ear response curve	27 demodulated subliminal audio inputted to ear
24 point on high freq end of ear response curve	31 microphone
32 speech amplifier	33 balanced modulator
34 carrier oscillator (455 KHz)	35 filter
36 mixer	37 heterodyne oscillator (469.5 KHz)
38 bandpass filter	39 output signal

## DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Please refer now to FIG. 1 and FIG. 2, which are drawings of a preferred implementation of the invention.

The principle of operation of the silent subliminal presentation system is as follows:

An audio signal in the upper frequency region of the audio spectrum (for example, 14,500 Hz) is modulated with the desired information. The type of modulation may be any type suitable for subliminal applications; frequency modulation (FM), phase modulation (PM), upper single sideband with suppressed carrier, amplitude modulation (AM), tone modulation, etc.

For broadest application, the high audio frequency selected as the carrier frequency must meet two basic criteria:

(1) be high enough in the audio spectrum that its presence to the human ear is essentially unnoticed or undetectable (without the listener being informed that the signal is actually present) and,

(2) be low enough in the audio spectrum that it (and its modulation content) can produce a useful output power from home entertainment type cassette or reel-to-reel magnetic recorders.

This would also include, of course, small portable and automobile tape decks.

Alternatively, the output of the system can be fed directly into an audio amplifier and its speaker/earphone system, Public Address system, etc.

FIG. 1 provides the block diagram of an example of a system capable of generating the desired silent frequency modulated carrier.

The modulation information is inputted into the microphone 11. Other suitable input devices may be substituted for microphone 11, such as a tape recorder or a radio. The microphone 11 is connected to the preamplifier 12 and should have provisions for adjusting its gain in order that the optimum modulation index can be set in the frequency modulator 13. The frequency modulator 13 modulates the frequency of oscillator 14 which has been adjusted for an output of 14,500 Hz as described above. The output of oscillator 14 is fed through a suitable bandpass filter 15 into the tape recorder or directly into a suitable amplifier/speaker system. It is the purpose of the bandpass filter to remove or attenu-

ate audible products of the modulation process in order to maintain as audibly silent an output as practical.

On the receiving end, FIG. 2 represents an approximate and idealized frequency response curve of the human ear. The frequency modulated carrier (centered at 14,500 Hz), as generated above and played through a tape recorder or amplifier/speaker system, is shown on FIG. 2 as speaker output 26, impinging upon the upper slope of the ear's response curve at point 25. The frequency modulated excursions of the speaker output 26 swing between points 23 and 24 on the ear's upper response curve. Because the response curve between points 23 and 25 is relatively linear, this action results in a relatively linear demodulation of the original modulation intelligence, which is passed on subliminally to the inner ear. The amplitude of the demodulated output is not high enough to be detected by the conscious mind but is sufficient in amplitude to be detected by the sub-conscious mind. In the field of communications engineering design, the above demodulation process in known as slope detection and was used in early FM receiver design. In those receivers, the response curve was formed by the action of a tuned (inductive/capacitance) circuit. In our case, the response curve is formed by the natural response curve of the human ear. The same slope detection technique can be performed at the low frequency end of the human ear response curve. This region is indicated on FIG. 2 as between points 21 and 22. This region, however, has a much smaller available bandwidth and is therefore more restricted as to the amount of information that can be transmitted in an inaudible manner.

In practice, the listener adjusts the volume control of the tape recorder or amplifier to a level just below that at which the listener hears an audible sound or noise from the speaker of the tape recorder. If the recording process is properly done, a spectrum analyzer or a calibrated sound level meter will reveal a strong signal emanating from the tape recorder speaker. A calibrated sound level meter, at a distance of 1 meter (with C weighting and referenced to the standard of 0.0002 micro bar) will typically indicate a silent power output of from 60 to 70 decibels. This is equivalent to the audio power of a loud conversation, yet, in the described system, is inaudible or unnoticed by the listener.

FIG. 3 illustrates a system which generates a suitable amplitude modulated (AM) signal, instead of the frequency modulated (FM) system described above. The output is a modulated, single sideband (SSB), suppressed carrier (AM) signal at 14,500 Hz.

The block diagram represents a common scheme for generating an SSB signal and will be briefly described.

The desired subliminal information is spoken into microphone 31. This signal is amplified by speech amplifier 32 and injected into one port of balanced modulator 33. A continuous wave signal of 455 KHz is generated by carrier oscillator 34 and is injected into the second port of balanced modulator 33. The output of balanced modulator 33 is a double sideband, suppressed carrier signal at 455 KHz. This signal is fed through filter 35, causing one of the two sidebands to be removed. This signal is fed into one port of mixer 36. A continuous wave signal at a frequency of 469.5 KHz from heterodyne oscillator 37 is fed into the other port of mixer 36, resulting in an output of the original subliminal audio information but translated 14,500 Hz higher in frequency. The bandpass filter 38 attenuates signals and noise outside of the frequencies of interest. The ampli-

tude modulated audio output signal is shown as output 39.

Thus, as stated earlier, my invention provides a new system for subliminal presentations which is:

- (a) silent,
- (b) outputs a constant, high level modulated signal and,
- (c) occupies a band of clear channel frequencies.

The foregoing description of the preferred embodiment of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of the above discussions. It is intended that the scope of the invention be limited not only by this detailed description, but rather by the claims appended hereto.

What is claimed:

1. A silent communications system, comprising:

- (a) amplitude modulated carrier means for generating signals located in non-aural portions of the audio and in the lower portion of the ultrasonic frequency spectrum said signals modulated with information to be perceived by a listener's brain and,
- (b) acoustic and ultrasonic transducer means for propagating said signals, for inducement into the brain, of the listener, and,

(c) recording means for storing said modulated signals on mechanical, magnetic and optical media for delayed or repeated transmissions to the listener.

2. A silent communications system, comprising:

- (a) frequency modulated carrier means for generating signals located in non-aural portions of the audio and in the lower portion of the ultrasonic frequency spectrum, said signals modulated with information to be perceived by a listener's brain, and;
- (b) acoustic and ultrasonic transducer means for propagating said signals, for inducement into the brain of the listener, and;
- (c) recording means for storing said modulated signals on mechanical, magnetic and optical media for delayed or repeated transmissions to the listener.

3. A silent communications system, comprising:

- (a) a combination of amplitude and frequency modulated carrier means for generating signals located in non-aural portions of the audio and in the lower portion of the ultrasonic frequency spectrum, said signals modulated with information to be perceived by a listener's brain, and
- (b) acoustic and ultrasonic transducer means for propagating said signals, for inducement into the brain of the listener;
- (c) recording means for storing said modulated signals on mechanical, magnetic and optical media for delayed or repeated transmissions to the listener.

\* \* \* \* \*

5  
10  
15  
20  
25  
30  
35  
40  
45  
50  
55  
60  
65

This document is the doctrine adopted by the Policy Committee of the Bilderberg Group during its first known meeting in 1954.

The following document, dated May 1979, was found on July 7, 1986, in an IBM copier that had been purchased at a surplus sale.

## Silent Weapons for Quiet Wars

<http://www.lawfulpath.com/ref/sw4qw/index.shtml> - preface

<http://www.lawfulpath.com/ref/sw4qw/>

The following document is taken from two sources. The first, was acquired on a website (of which I can't remember the address) listing as its source the book titled *Behold A Pale Horse* by William Cooper; Light Technology Publishing, 1991. The second source is a crudely copied booklet, which does not contain a copyright notice, or a publisher's name. With the exception of the Forward, the Preface, the main thing that was missing from the first source was the illustrations. As we began comparing the two, we realized that the illustrations, and the accompanying text (also missing from the first) made up a significant part of the document. This has now been restored by The Lawful Path, and so far as I know, is the only internet copy available complete with the illustrations.

We have no first-hand knowledge that this document is genuine, however many of the concepts contained herein are certainly reasonable, important, and bear strong consideration.

If anyone has additional knowledge about the source of this document; has better copies of the illustrations than the ones posted here; has any missing pieces to this document, or has any comments which can improve upon the quality of this document, we will appreciate your comments.

The Lawful Path <http://www.lawfulpath.com/>

Additional information includes confirmation that this policy was adopted by the International "Elites" at the first Bilderberg Meeting in 1954.

## **Forward**

This manuscript was delivered to our offices by an unknown person. We did not steal the document, nor are we involved with any theft from the United States Government, and we did not get the document by way of any dishonest methods. We feel that we are not endangering the "National Security" by reproducing this document, quite the contrary; it has been authenticated and we feel that we are not only within our rights to publish it, but morally bound to do so.

Regarding the training manual, you may have detected that we had to block out the marginal notes made by the selectee at the C.I.A. Training Center, but I can assure you that the manual is authentic, and was printed for the purpose of introducing the selectee to the conspiracy. It has been authenticated by four different technical writers for Military Intelligence, one just recently retired who wants very much to have this manual distributed throughout the world, and one who is still employed as an Electronics Engineer by the Federal Government, and has access to the entire series of Training Manuals. One was stationed in Hawaii, and held the highest security clearance in the Naval Intelligence, and another who is now teaching at a university, and has been working with the Central Intelligence Agency for a number of years, and wants out before the axe falls on the conspirators.

We believed that the entire world should know about this plan, so we distributed internationally one-hundred of these manuscripts, to ask individuals at top level positions their opinions. The consensus opinion was to distribute this to as many people as who wanted it, to the end that they would not only understand that "War" had been declared against them, but would be able to properly identify the true enemy to Humanity.

Delamer Duverus

## **Preface**

Conspiracy theories are nothing new to history. Plots to "kill Caesar" and overthrow Rome abounded, for instance. However, it is seldom that concrete clues to such plots come to light, and are generally known.

Silent Weapons for Quiet Wars, An Introduction Programming Manual was uncovered quite by accident on July 7, 1986 when an employee of Boeing Aircraft Co. purchased a surplus IBM copier for scrap parts at a sale, and discovered inside details of a plan, hatched in the embryonic days of the "Cold War" which called for control of the masses through manipulation of industry, peoples' pastimes, education and political leanings. It called for a quiet revolution, putting brother against brother, and diverting the public's attention from what is really going on.

The document you are about to read is real. It is reprinted in its virgin form, with diagrams, as a touch of reality.

## Table of Contents

* Forward	2
* Preface	2
* Security	4
* Historical Introduction	4
* Political Introduction	6
* Energy	6
* Descriptive Introduction of the Silent Weapon	7
* Theoretical Introduction	8
* General Energy Concepts	8
* Mr. Rothschild's Energy Discovery	9
* Apparent Capital as "Paper" Inductor	10
* Breakthrough	10
* Application in Economics	10
* The Economic Model	11
* Industrial Diagrams	12
* Three Industrial Classes	14
* Aggregation	14
* The E-model	14
* Economic Inductance	15
* Inductive Factors to Consider	15
* Translation	15
* Time Flow Relationships and Self-destructive Oscillations	16
* Industry Equivalent Circuits	18
* Stages of Schematic Simplification	20
* Generalization	21
* Final Bill of Goods	21
* The Technical Coefficients	22
* Types of Admittances	22
* The Household Industry	23
* Household Models	24
* Economic Shock Testing	25
* Introduction to the Theory of Shock Testing	26
* Example of Shock Testing	26
* Introduction to Economic Amplifiers	30
* Short List of Inputs	31
* Short List of Outputs	34
* Table of Strategies	35
* Diversion, the Primary Strategy	36
* Diversion Summary	37
* Consent, the Primary Victory	37
* Amplification Energy Sources	37
* Logistics	38
* The Artificial Womb	39
* The Political Structure of a Nation - Dependency	39
* Action/Offense	39
* Responsibility	39
* Summary	40
* System Analysis	40
* The Draft	41
* Enforcement	42

# **TOP SECRET**

## **Silent weapons for quiet wars**

### **Operations Research Technical Manual TW-SW7905.1**

Welcome Aboard

This publication marks the 25th anniversary of the Third World War, called the "Quiet War", being conducted using subjective biological warfare, fought with "silent weapons".

This book contains an introductory description of this war, its strategies, and its weaponry.

May 1979 #74-1120

## **Security**

It is patently impossible to discuss social engineering or the automation of a society, i.e., the engineering of social automation systems (silent weapons) on a national or worldwide scale without implying extensive objectives of social control and destruction of human life, i.e., slavery and genocide.

This manual is in itself an analog declaration of intent. Such a writing must be secured from public scrutiny. Otherwise, it might be recognized as a technically formal declaration of domestic war. Furthermore, whenever any person or group of persons in a position of great power and without full knowledge and consent of the public, uses such knowledge and methodologies for economic conquest - it must be understood that a state of domestic warfare exists between said person or group of persons and the public.

The solution of today's problems requires an approach which is ruthlessly candid, with no agonizing over religious, moral or cultural values.

You have qualified for this project because of your ability to look at human society with cold objectivity, and yet analyze and discuss your observations and conclusions with others of similar intellectual capacity without the loss of discretion or humility. Such virtues are exercised in your own best interest. Do not deviate from them.

## **Historical Introduction**

Silent weapon technology has evolved from Operations Research (O.R.), a strategic and tactical methodology developed under the Military Management in England during

World War II. The original purpose of Operations Research was to study the strategic and tactical problems of air and land defense with the objective of effective use of limited military resources against foreign enemies (i.e., logistics).

It was soon recognized by those in positions of power that the same methods might be useful for totally controlling a society. But better tools were necessary.

Social engineering (the analysis and automation of a society) requires the correlation of great amounts of constantly changing economic information (data), so a high-speed computerized data-processing system was necessary which could race ahead of the society and predict when society would arrive for capitulation.

Relay computers were too slow, but the electronic computer, invented in 1946 by J. Presper Eckert and John W. Mauchly, filled the bill.

The next breakthrough was the development of the simplex method of linear programming in 1947 by the mathematician George B. Dantzig.

Then in 1948, the transistor, invented by J. Bardeen, W.H. Brattain, and W. Shockley, promised great expansion of the computer field by reducing space and power requirements.

With these three inventions under their direction, those in positions of power strongly suspected that it was possible for them to control the whole world with the push of a button.

Immediately, the Rockefeller Foundation got in on the ground floor by making a four-year grant to Harvard College, funding the Harvard Economic Research Project for the study of the structure of the American Economy.<sup>1</sup> One year later, in 1949, The United States Air Force joined in.

In 1952 the grant period terminated, and a high-level meeting of the Elite was held to determine the next phase of social operations research. The Harvard project had been very fruitful, as is borne out by the publication of some of its results in 1953 suggesting the feasibility of economic (social) engineering.

Engineered in the last half of the decade of the 1940's, the new Quiet War machine stood, so to speak, in sparkling gold-plated hardware on the showroom floor by 1954.

With the creation of the maser in 1954, the promise of unlocking unlimited sources of fusion atomic energy from the heavy hydrogen in sea water and the consequent availability of unlimited social power was a possibility only decades away.

The combination was irresistible.

The Quiet War was quietly declared by the International Elite at a meeting held in 1954.

Although the silent weapons system was nearly exposed 13 years later, the evolution of the new weapon-system has never suffered any major setbacks.

This volume marks the 25th anniversary of the beginning of the Quiet War. Already this domestic war has had many victories on many fronts throughout the world.

## **Political Introduction**

In 1954 it was well recognized by those in positions of authority that it was only a matter of time, only a few decades, before the general public would be able to grasp and upset the cradle of power, for the very elements of the new silent-weapon technology were as accessible for a public utopia as they were for providing a private utopia.

The issue of primary concern that of dominance, revolved around the subject of the energy sciences.

## **Energy**

Energy is recognized as the key to all activity on earth. Natural science is the study of the sources and control of natural energy, and social science, theoretically expressed as economics, is the study of the sources and control of social energy. Both are bookkeeping systems: mathematics. Therefore, mathematics is the primary energy science. And the bookkeeper can be king if the public can be kept ignorant of the methodology of the bookkeeping.

All science is merely a means to an end. The means is knowledge. The end is control. Beyond this remains only one issue: Who will be the beneficiary?

In 1954 this was the issue of primary concern. Although the so-called "moral issues" were raised, in view of the law of natural selection [<sup>1</sup>] it was agreed that a nation or world of people who will not use their intelligence are no better than animals who do not have intelligence. Such people are beasts of burden and steaks on the table by choice and consent.

Consequently, in the interest of future world order, peace, and tranquility, it was decided to privately wage a quiet war against the American public with an ultimate objective of permanently shifting the natural and social energy (wealth) of the undisciplined and irresponsible many into the hands of the self-disciplined, responsible, and worthy few. In order to implement this objective, it was necessary to create, secure, and apply new weapons which, as it turned out, were a class of weapons so subtle and sophisticated in their principle of operation and public appearance as to earn for themselves the name "silent weapons".

---

[<sup>1</sup> This concept was never more than a questionable theory of elitist Charles Darwin]

In conclusion, the objective of economic research, as conducted by the magnates of capital (banking) and the industries of commodities (goods) and services, is the establishment of an economy which is totally predictable and manipulatable.

In order to achieve a totally predictable economy, the low-class elements of society must be brought under total control, i.e., must be housebroken, trained, and assigned a yoke and long-term social duties from a very early age, before they have an opportunity to question the propriety of the matter. In order to achieve such conformity, the lower-class family unit must be disintegrated by a process of increasing preoccupation of the parents and the establishment of government-operated day-care centers for the occupationally orphaned children.

The quality of education given to the lower class must be of the poorest sort, so that the moat of ignorance isolating the inferior class from the superior class is and remains incomprehensible to the inferior class. With such an initial handicap, even bright lower class individuals have little if any hope of extricating themselves from their assigned lot in life. This form of slavery is essential to maintain some measure of social order, peace, and tranquility for the ruling upper class.

## **Descriptive Introduction of the Silent Weapon**

Everything that is expected from an ordinary weapon is expected from a silent weapon by its creators, but only in its own manner of functioning.

It shoots situations, instead of bullets; propelled by data processing, instead of chemical reaction (explosion); originating from bits of data, instead of grains of gunpowder; from a computer, instead of a gun; operated by a computer programmer, instead of a marksman; under the orders of a banking magnate, instead of a military general.

It makes no obvious explosive noises, causes no obvious physical or mental injuries, and does not obviously interfere with anyone's daily social life.

Yet it makes an unmistakable "noise," causes unmistakable physical and mental damage, and unmistakably interferes with the daily social life, i.e., unmistakable to a trained observer, one who knows what to look for.

The public cannot comprehend this weapon, and therefore cannot believe that they are being attacked and subdued by a weapon.

The public might instinctively feel that something is wrong, but that is because of the technical nature of the silent weapon, they cannot express their feeling in a rational way, or handle the problem with intelligence. Therefore, they do not know how to cry for help, and do not know how to associate with others to defend themselves against it.

When a silent weapon is applied gradually, the public adjusts/adapts to its presence and learns to tolerate its encroachment on their lives until the pressure (psychological via economic) becomes too great and they crack up.

Therefore, the silent weapon is a type of biological warfare. It attacks the vitality, options, and mobility of the individuals of a society by knowing, understanding, manipulating, and attacking their sources of natural and social energy, and their physical, mental, and emotional strengths and weaknesses.

## **Theoretical Introduction**

Give me control over a nation's currency, and I care not who makes its laws.

-- Mayer Amshel Rothschild (1743-1812)

Today's silent weapons technology is an outgrowth of a simple idea discovered, succinctly expressed, and effectively applied by the quoted Mr. Mayer Amshel Rothschild. Mr. Rothschild discovered the missing passive component of economic theory known as economic inductance. He, of course, did not think of his discovery in these 20th-century terms, and, to be sure, mathematical analysis had to wait for the Second Industrial Revolution, the rise of the theory of mechanics and electronics, and finally, the invention of the electronic computer before it could be effectively applied in the control of the world economy.

## **General Energy Concepts**

In the study of energy systems, there always appears three elementary concepts. These are potential energy, kinetic energy, and energy dissipation. And corresponding to these concepts, there are three idealized, essentially pure physical counterparts called passive components.

(1) In the science of physical mechanics, the phenomenon of potential energy is associated with a physical property called elasticity or stiffness, and can be represented by a stretched spring. In electronic science, potential energy is stored in a capacitor instead of a spring. This property is called capacitance instead of elasticity or stiffness.

(2) In the science of physical mechanics, the phenomenon of kinetic energy is associated with a physical property called inertia or mass, and can be represented by a mass or a flywheel in motion.

In electronic science, kinetic energy is stored in an inductor (in a magnetic field) instead of a mass. This property is called inductance instead of inertia.

(3) In the science of physical mechanics, the phenomenon of energy dissipation is associated with a physical property called friction or resistance, and can be represented by a dashpot or other device which converts energy into heat. In electronic science, dissipation of energy is performed by an element called either a resistor or a conductor, the term "resistor" being the one generally used to describe a more ideal device (e.g., wire) employed to convey electronic energy efficiently from one location to another. The property of a resistance or conductor is measured as either resistance or conductance reciprocals.

In economics these three energy concepts are associated with:

1. Economic Capacitance - Capital (money, stock/inventory, investments in buildings and durables, etc.)
2. Economic Conductance - Goods (production flow coefficients)
3. Economic Inductance - Services (the influence of the population of industry on output)

All of the mathematical theory developed in the study of one energy system (e.g., mechanics, electronics, etc.) can be immediately applied in the study of any other energy system (e.g., economics).

## **Mr. Rothschild's Energy Discovery**

What Mr. Rothschild had discovered was the basic principle of power, influence, and control over people as applied to economics. That principle is "when you assume the appearance of power, people soon give it to you."

Mr. Rothschild had discovered that currency or deposit loan accounts had the required appearance of power that could be used to induce people (inductance, with people corresponding to a magnetic field) into surrendering their real wealth in exchange for a promise of greater wealth (instead of real compensation). They would put up real collateral in exchange for a loan of promissory notes. Mr. Rothschild found that he could issue more notes than he had backing for, so long as he had someone's stock of gold as a persuader to show his customers.

Mr. Rothschild loaned his promissory notes to individuals and to governments. These would create overconfidence. Then he would make money scarce, tighten control of the system, and collect the collateral through the obligation of contracts. The cycle was then repeated. These pressures could be used to ignite a war. Then he would control the availability of currency to determine who would win the war. That government which agreed to give him control of its economic system got his support.

Collection of debts was guaranteed by economic aid to the enemy of the debtor. The profit derived from this economic methodology made Mr. Rothschild all the more able to expand his wealth. He found that the public greed would allow currency to be printed by

government order beyond the limits (inflation) of backing in precious metal or the production of goods and services.

## **Apparent Capital as "Paper" Inductor**

In this structure, credit, presented as a pure element called "currency," has the appearance of capital, but is in effect negative capital. Hence, it has the appearance of service, but is in fact, indebtedness or debt. It is therefore an economic inductance instead of an economic capacitance, and if balanced in no other way, will be balanced by the negation of population (war, genocide). The total goods and services represent real capital called the gross national product, and currency may be printed up to this level and still represent economic capacitance; but currency printed beyond this level is subtractive, represents the introduction of economic inductance, and constitutes notes of indebtedness.

War is therefore the balancing of the system by killing the true creditors (the public which we have taught to exchange true value for inflated currency) and falling back on whatever is left of the resources of nature and regeneration of those resources.

Mr. Rothschild had discovered that currency gave him the power to rearrange the economic structure to his own advantage, to shift economic inductance to those economic positions, which would encourage the greatest economic instability and oscillation.

The final key to economic control had to wait until there was sufficient data and high-speed computing equipment to keep close watch on the economic oscillations created by price shocking and excess paper energy credits - paper inductance/inflation .

## **Breakthrough**

The aviation field provided the greatest evolution in economic engineering by way of the mathematical theory of shock testing. In this process, a projectile is fired from an airframe on the ground and the impulse of the recoil is monitored by vibration transducers connected to the airframe and wired to chart recorders.

By studying the echoes or reflections of the recoil impulse in the airframe, it is possible to discover critical vibrations in the structure of the airframe which either vibrations of the engine or aeolian vibrations of the wings, or a combination of the two, might reinforce resulting in a resonant self-destruction of the airframe in flight as an aircraft. From the standpoint of engineering, this means that the strengths and weaknesses of the structure of the airframe in terms of vibrational energy can be discovered and manipulated.

## **Application in Economics**

To use this method of airframe shock testing in economic engineering, the prices of commodities are shocked, and the public consumer reaction is monitored. The resulting

echoes of the economic shock are interpreted theoretically by computers and the psycho-economic structure of the economy is thus discovered. It is by this process that partial differential and difference matrices are discovered that define the family household and make possible its evaluation as an economic industry (dissipative consumer structure).

Then the response of the household to future shocks can be predicted and manipulated, and society becomes a well-regulated animal with its reins under the control of a sophisticated computer-regulated social energy bookkeeping system.

Eventually every individual element of the structure comes under computer control through a knowledge of personal preferences, such knowledge guaranteed by computer association of consumer preferences (universal product code, UPC; zebra-striped pricing codes on packages) with identified consumers (identified via association with the use of a credit card and later a permanent "tattooed" body number invisible under normal ambient illumination).

## ***Summary***

Economics is only a social extension of a natural energy system. It, also, has its three passive components. Because of the distribution of wealth and the lack of communication and lack of data, this field has been the last energy field for which a knowledge of these three passive components has been developed.

Since energy is the key to all activity on the face of the earth, it follows that in order to attain a monopoly of energy, raw materials, goods, and services and to establish a world system of slave labor, it is necessary to have a first strike capability in the field of economics. In order to maintain our position, it is necessary that we have absolute first knowledge of the science of control over all economic factors and the first experience at engineering the world economy.

In order to achieve such sovereignty, we must at least achieve this one end: that the public will not make either the logical or mathematical connection between economics and the other energy sciences or learn to apply such knowledge.

This is becoming increasingly difficult to control because more and more businesses are making demands upon their computer programmers to create and apply mathematical models for the management of those businesses.

It is only a matter of time before the new breed of private programmer/economists will catch on to the far-reaching implications of the work begun at Harvard in 1948. The speed with which they can communicate their warning to the public will largely depend upon how effective we have been at controlling the media, subverting education, and keeping the public distracted with matters of no real importance.

## **The Economic Model**

Economics, as a social energy science has as a first objective the description of the complex way in which any given unit of resources is used to satisfy some economic want. (Leontief Matrix). This first objective, when it is extended to get the most product from the least or limited resources, comprises that objective of general military and industrial logistics known as Operations Research. (See simplex method of linear programming.)

The *Harvard Economic Research Project* (1948-) was an extension of World War II *Operations Research*. Its purpose was to discover the science of controlling an economy: at first the American economy, and then the world economy. It was felt that with sufficient mathematical foundation and data, it would be nearly as easy to predict and control the trend of an economy as to predict and control the trajectory of a projectile. Such has proven to be the case. Moreover, the economy has been transformed into a guided missile on target.

The immediate aim of the Harvard project was to discover the economic structure, what forces change that structure, how the behavior of the structure can be predicted, and how it can be manipulated. What was needed was a well-organized knowledge of the mathematical structures and interrelationships of investment, production, distribution, and consumption.

To make a short story of it all, it was discovered that an economy obeyed the same laws as electricity and that all of the mathematical theory and practical and computer know-how developed for the electronic field could be directly applied in the study of economics. This discovery was not openly declared, and its more subtle implications were and are kept a closely guarded secret, for example that in an economic model, human life is measured in dollars, and that the electric spark generated when opening a switch connected to an active inductor is mathematically analogous to the initiation of war.

The greatest hurdle which theoretical economists faced was the accurate description of the household as an industry. This is a challenge because consumer purchases are a matter of choice which in turn is influenced by income, price, and other economic factors.

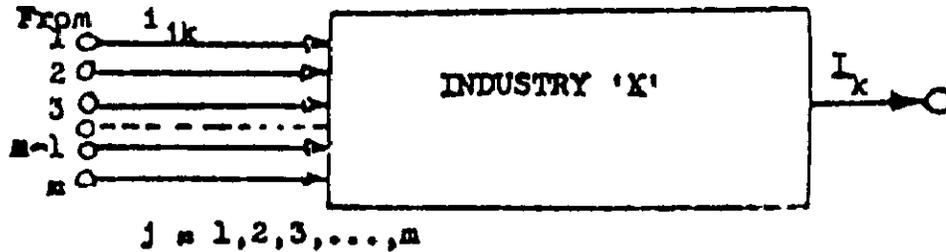
This hurdle was cleared in an indirect and statistically approximate way by an application of shock testing to determine the current characteristics, called current technical coefficients, of a household industry

Finally, because problems in theoretical electronics can be translated very easily into problems of theoretical economics, and the solution translated back again, it follows that only a book of language translation and concept definition needed to be written for economics. The remainder could be gotten from standard works on mathematics and electronics. This makes the publication of books on advanced economics unnecessary, and greatly simplifies project security.

## **Industrial Diagrams**

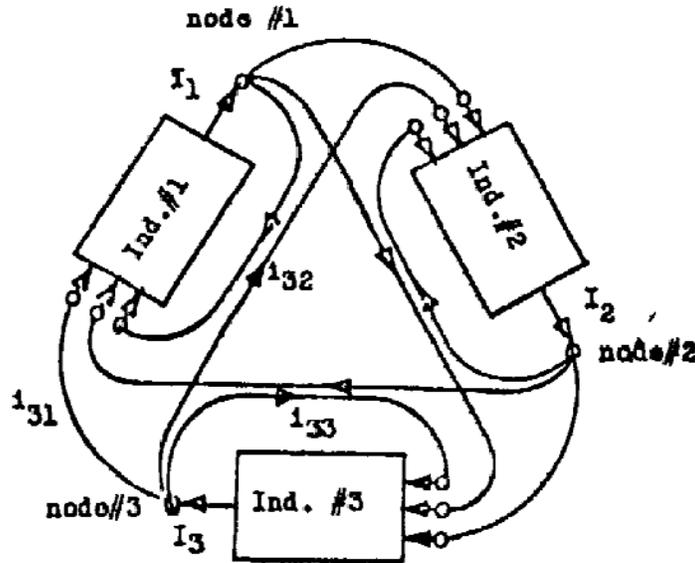
An ideal industry is defined as a device which receives value from other industries in several forms and converts them into one specific product for sales and distribution to other industries. It has several inputs and one output. What the public normally thinks of as one industry is really an industrial complex, where several industries under one roof produce one or more products.

A pure (single output) industry can be represented oversimply by a circuit block as follows:



The flow of product from industry #1 (supply) to industry #2 (demand) is denoted by  $I_{12}$ . The total flow out of industry "K" is denoted by  $I_k$  (sales, etc.).

A three industry network can be diagrammed as follows:



A node is a symbol of collection and distribution of flow. Node #3 receives from industry #3 and distributes to industries #1 and #3. If industry #3 manufactures chairs, then a flow from industry #3 back to industry #3 simply indicates that industry #3 is using part of its own output product, for example, as office furniture. Therefore the flow may be summarized by the equations:

$$\begin{aligned} \text{Node \#1 : } I_1 &= i_{11} + i_{12} + i_{13} = \sum i_{1k} \\ \text{Node \#2 : } I_2 &= i_{21} + i_{22} + i_{23} = \sum i_{2k} \\ \text{Node \#3 : } I_3 &= i_{31} + i_{32} + i_{33} = \sum i_{3k} \\ \text{where } \sum &\text{ denotes } \sum_{k=1}^{k=3} \end{aligned}$$

## Three Industrial Classes

Industries fall into three categories or classes by type of output:

Class #1 - Capital (resources)

Class #2 - Goods (commodities or use - dissipative)

Class #3 - Services (action of population)

**Class #1** industries exist at three levels:

(1) Nature - sources of energy and raw materials.

(2) Government - printing of currency equal to the gross national product (GNP), and extension of currency in excess of GNP.

(3) Banking - loaning of money for interest, and extension (inflation/counterfeiting) of economic value through the deposit loan accounts.

**Class #2** industries exist as producers of tangible or consumer (dissipated) products. This sort of activity is usually recognized and labeled by the public as "industry."

**Class #3** industries are those which have service rather than a tangible product as their output. These industries are called (1) households, and (2) governments. Their output is human activity of a mechanical sort, and their basis is population.

## Aggregation

The whole economic system can be represented by a three-industry model if one allows the names of the outputs to be (1) capital, (2) goods, and (3) services. The problem with this representation is that it would not show the influence, say, the textile industry on the ferrous metal industry. This is because both the textile industry and the ferrous metal industry would be contained within a single classification called the "goods industry" and by this process of combining or aggregating these two industries under one system block they would lose their economic individuality.

## The E-Model

A national economy consists of simultaneous flows of production, distribution, consumption, and investment. If all of these elements including labor and human functions are assigned a numerical value in like units of measure, say, 1939 dollars, then this flow can be further represented by a current flow in an electronic circuit, and its behavior can be predicted and manipulated with useful precision.

The three ideal passive energy components of electronics, the capacitor, the resistor, and the inductor correspond to the three ideal passive energy components of economics called the pure industries of capital, goods, and services, respectively:

- \* Economic capacitance represents the storage of capital in one form or another.
- \* Economic conductance represents the level of conductance of materials for the production of goods.
- \* Economic inductance represents the inertia of economic value in motion. This is a population phenomenon known as services.

## **Economic Inductance**

An electrical inductor (e.g., a coil or wire) has an electric current as its primary phenomenon and a magnetic field as its secondary phenomenon (inertia). Corresponding to this, an economic inductor has a flow of economic value as its primary phenomenon and a population field as its secondary field phenomenon of inertia. When the flow of economic value (e.g., money) diminishes, the human population field collapses in order to keep the economic value (money) flowing (extreme case - war).

This public inertia is a result of consumer buying habits, expected standard of living, etc., and is generally a phenomenon of self-preservation.

## **Inductive Factors to Consider**

- (1) Population
- (2) Magnitude of the economic activities of the government
- (3) The method of financing these government activities (See Peter-Paul Principle - inflation of the currency.)

## **Translation**

(a few examples will be given)

- Charge: Coulombs Dollars (1939)
- Flow/Current: Amperes (coulombs/ second) Dollars of flow per year
- Motivating Force: Volts; Dollars (output) demand
- Conductance: Amperes per volt; Dollars of flow per year per dollar demand
- Capacitance: Coulombs per volt: Dollars of production inventory/ stocks per dollar demand

## **Time Flow Relationships and Self-Destructive Oscillations**

An ideal industry may be symbolized electronically in various ways. The simplest way is to represent a demand by a voltage and a supply by a current. When this is done, the relationship between the two becomes what is called an admittance, which can result from three economic factors: (1) foresight flow, (2) present flow, and (3) hindsight flow.

1. *Foresight flow* is the result of that property of living entities to cause energy (food) to be stored for a period of low energy (e.g., a winter season). It consists of demands made upon an economic system for that period of low energy (winter season).

In a production industry it takes several forms, one of which is known as production stock or inventory. In electronic symbology this specific industry demand (a pure capital industry) is represented by capacitance and the stock or resource is represented by a stored charge. Satisfaction of an industry demand suffers a lag because of the loading effect of inventory priorities.

2. *Present flow* ideally involves no delays. It is, so to speak, input today for output today, a "hand to mouth" flow. In electronic symbology, this specific industry demand (a pure us industry) is represented by a conductance which is then a simple economic valve (a dissipative element).

3. *Hindsight flow* is known as habit or inertia. In electronics this phenomenon is the characteristic of an inductor (economic analog = a pure service industry) in which a current flow (economic analog = flow of money) creates a magnetic field (economic analog = active human population) which, if the current (money flow) begins to diminish, collapse (war) to maintain the current (flow of money - energy).

Other large alternatives to war as economic inductors or economic flywheels are an open-ended social welfare program, or an enormous (but fruitful) open-ended space program.

The problem with stabilizing the economic system is that there is too much demand on account of (1) too much greed and (2) too much population.

This creates excessive economic inductance which can only be balanced with economic capacitance (true resources or value - e.g., in goods or services).

The social welfare program is nothing more than an open-ended credit balance system which creates a false capital industry to give nonproductive people a roof over their heads and food in their stomachs. This can be useful, however, because the recipients become state property in return for the "gift," a standing army for the elite. For he who pays the piper picks the tune.

Those who get hooked on the economic drug must go to the elite for a fix. In this, the method of introducing large amounts of stabilizing capacitance is by borrowing on the future "credit" of the world. This is a fourth law of motion - onset, and consists of performing an action and leaving the system before the reflected reaction returns to the point of action - a delayed reaction.

The means of surviving the reaction is by changing the system before the reaction can return. By this means, politicians become more popular in their own time and the public pays later. In fact, the measure of such a politician is the delay time.

The same thing is achieved by a government by printing money beyond the limit of the gross national product, and economic process called inflation. This puts a large quantity of money into the hands of the public and maintains a balance against their greed, creates a false self-confidence in them and, for awhile, stays the wolf from the door.

They must eventually resort to war to balance the account, because war ultimately is merely the act of destroying the creditor, and the politicians are the publicly hired hit men that justify the act to keep the responsibility and blood off the public conscience. (See section on consent factors and social-economic structuring.)

If the people really cared about their fellow man, they would control their appetites (greed, procreation, etc.) so that they would not have to operate on a credit or welfare social system which steals from the worker to satisfy the bum.

Since most of the general public will not exercise restraint, there are only two alternatives to reduce the economic inductance of the system.

1. Let the populace bludgeon each other to death in war, which will only result in a total destruction of the living earth.
2. Take control of the world by the use of economic "silent weapons" in a form of "quiet warfare" and reduce the economic inductance of the world to a safe level by a process of benevolent slavery and genocide.

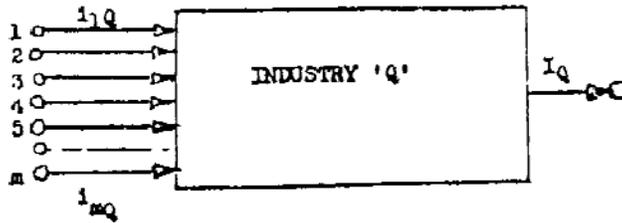
The latter option has been taken as the obviously better option. At this point it should be crystal clear to the reader why absolute secrecy about the silent weapons is necessary. The general public refuses to improve its own mentality and its faith in its fellow man. It has become a herd of proliferating barbarians, and, so to speak, a blight upon the face of the earth.

They do not care enough about economic science to learn why they have not been able to avoid war despite religious morality, and their religious or self-gratifying refusal to deal with earthly problems renders the solution of the earthly problem unreachable to them.

It is left to those few who are truly willing to think and survive as the fittest to survive, to solve the problem for themselves as the few who really care. Otherwise, exposure of the silent weapon would destroy our only hope of preserving the seed of the future true humanity.

## Industry Equivalent Circuits

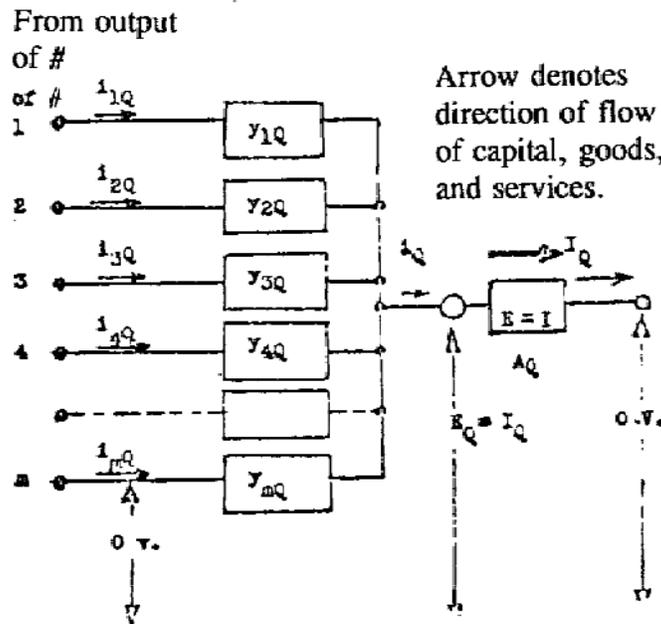
The industry 'Q' can be given a block symbol as follows:



Block Diagram of Industry 'Q'.

Terminals #1 through #m are connected directly to the outputs of industries #1 and #m, respectively.

The equivalent circuit of industry 'Q' is given as follows:

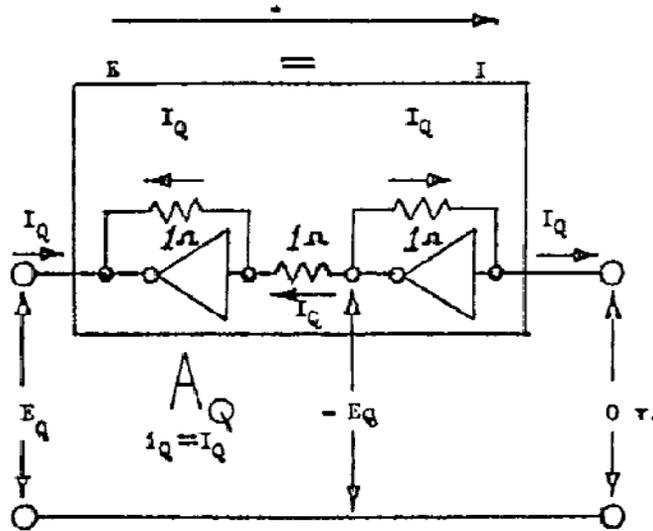


Characteristics:

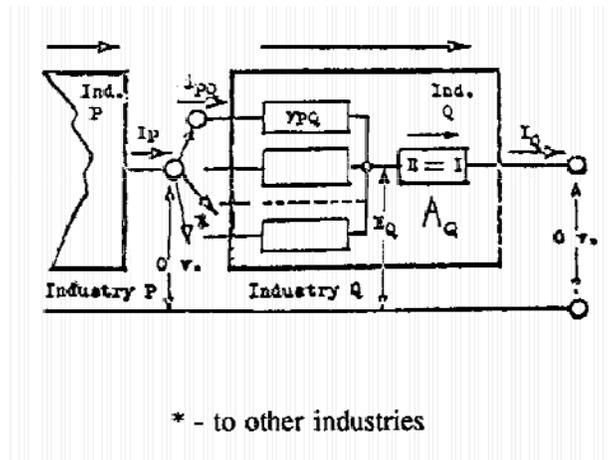
All inputs are at zero volts.

A - Amplifier - causes output current  $I_Q$  to be represented by a voltage  $E_Q$ . Amplifier delivers sufficient current at  $E_Q$  to drive all loads  $Y_{1Q}$  through  $Y_{mQ}$  and sink all currents  $i_{1Q}$  through  $i_{mQ}$ .

The unit transconductance amplifier  $A_Q$  is constructed as follows:



\* Arrow denotes the direction of the flow of capital, goods, and services. The total demand is given as  $E_Q$ , where  $E_Q = I_Q$ .



The coupling network  $Y_{PQ}$  symbolizes the demand which industry Q makes on industry P. the connective admittance  $Y_{PQ}$  is called the 'technical coefficient' of the industry Q stating the demand of industry Q, called the industry of use, for the output in capital, goods, or services of industry P called the industry of origin.

The flow of commodities from industry P to industry Q is given by  $i_{PQ}$  evaluated by the formula:

$$i_{PQ} = Y_{PQ} * E_Q.$$

When the admittance  $Y_{PQ}$  is a simple conductance, this formula takes on the common appearance of Ohm's Law,

$$i_{PQ} = g_{PQ} * I_Q.$$

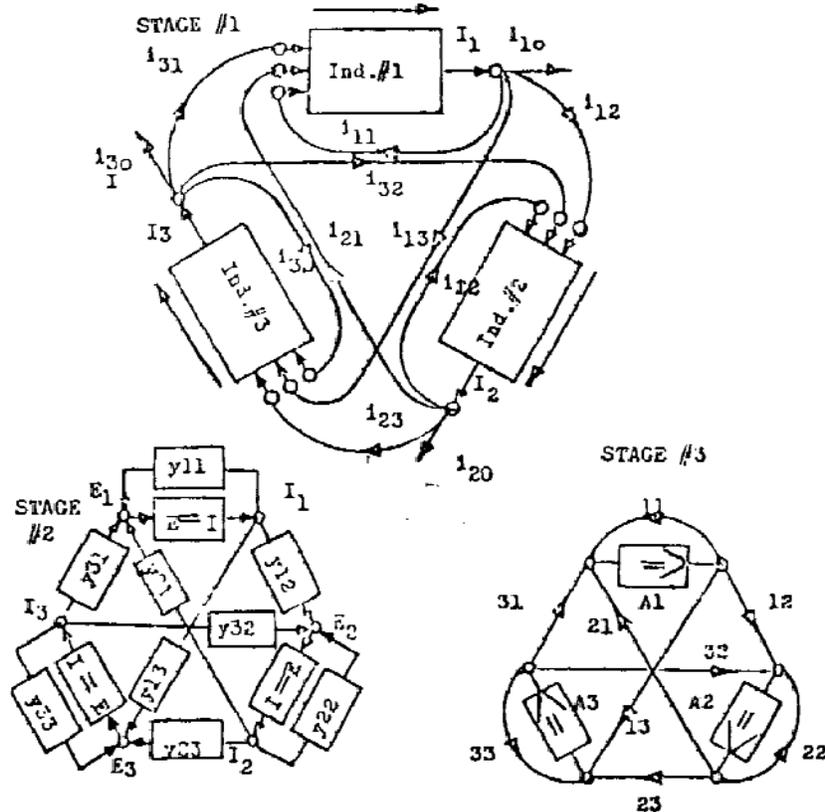
The interconnection of a three industry system can be diagrammed as follows. The blocks of the industry diagram can be opened up revealing the technical coefficients, and a much simpler format. The equations of flow are given as follows:

$$I_1 = i_{11} + i_{12} + i_{13} + i_{10} = \sum i_{1k} + i_{10}$$

$$I_2 = i_{21} + i_{22} + i_{23} + i_{20} = \sum i_{2k} + i_{20}$$

$$I_3 = i_{31} + i_{32} + i_{33} + i_{30} = \sum i_{3k} + i_{30}$$

### Stages of Schematic Simplification



## Generalization

All of this may now be summarized.

Let  $I_j$  represent the output of industry  $j$ , and

- \*  $i_{jk}$ , the amount of the product of industry  $j$  absorbed annually by industry  $k$ , and
- \*  $i_{j0}$ , the amount of the same product  $j$  made available for 'outside' use. Then

$$I_j = i_{j1} + i_{j2} + i_{j3} + \dots + i_{jm} + i_{j0}$$

$$= \sum_{k=1}^{k=m} i_{jk} + i_{j0}$$

Substituting the technical coefficients,  $y_{jk}$

$$i_{jk} = y_{jk} I_k$$

$$I_j = \sum_{k=1}^{k=m} i_{jk} + i_{j0} = \sum_{k=1}^{k=m} y_{jk} I_k + i_{j0}$$

Leontief  
Matrix for  
 $j = 1, 2, 3, \dots, m$

$$\left\{ I_j - \sum_{k=1}^{k=m} y_{jk} I_k = i_{j0} \right.$$

Let  $I_k$  at the output of industry  $k$  be represented by a demand voltage  $E_k$  at its amplifier input, i.e., let  $E_k = I_k$ . Then

$$i_{jk} = y_{jk} E_k$$

which is the general equation of every admittance in the industry circuit.

## Final Bill of Goods

$$\sum_{j=1}^{j=m} i_{j0} = i_{10} + i_{20} + i_{30} + \dots + i_{m0} \text{ is called}$$

is called the final bill of goods or the bill of final demand, and is zero when the system can be closed by the evaluation of the technical coefficients of the 'non-productive'

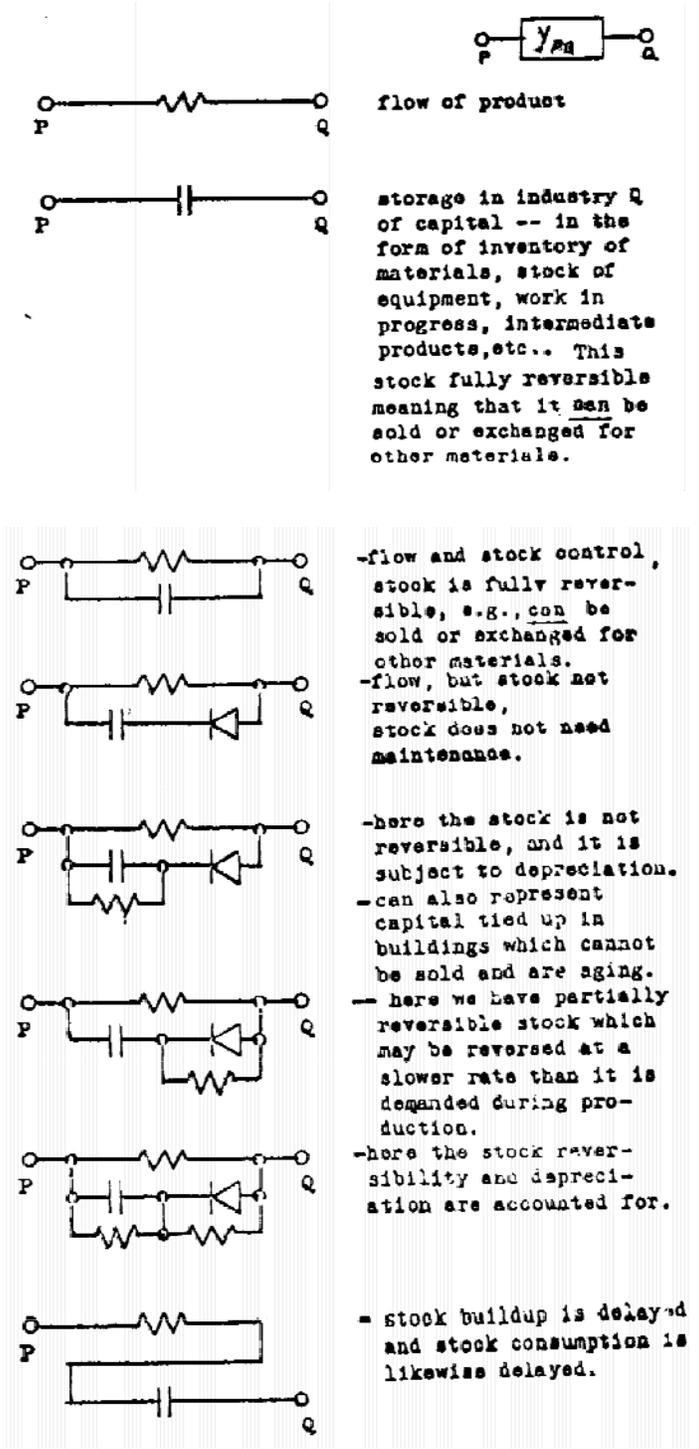
industries, government and households. Households may be regarded as a productive industry with labor as its output product.

## **The Technical Coefficients**

The quantities  $y_{jk}$  are called the technical coefficients of the industrial system. They are admittances and can consist of any combination of three passive parameters, conductance, capacitance, and inductance. Diodes are used to make the flow unidirectional and point against the flow.

- \*  $g_{jk}$  = economic conductance, absorption coefficient
- \*  $y_{jk}$  = economic capacitance, capital coefficient
- \*  $L_{jk}$  = economic inductance, human activity coefficient

## **Types of Admittances**



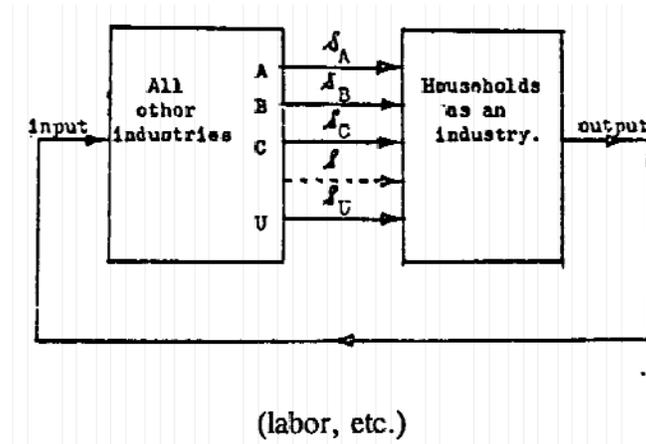
## The Household Industry

The industries of finance (banking), manufacturing, and government, real counterparts of the pure industries of capital, goods, and services, are easily defined because they are

generally logically structured. Because of this their processes can be described mathematically and their technical coefficients can be easily deduced. This, however, is not the case with the service industry known as the household industry.

## Household Models

When the industry flow diagram is represented by a 2-block system of households on the right and all other industries on the left, the following results:



The arrows from left to right labeled A, B, C, etc., denote flow of economic value from the industries in the left hand block to the industry in the right hand block called 'households'. These may be thought of as the monthly consumer flows of the following commodities. A - alcoholic beverages, B - beef, C - coffee, . . . . , U - unknown, etc. . .

The problem which a theoretical economist faces is that the consumer preferences of any household is not easily predictable and the technical coefficients of any one household tend to be a nonlinear, very complex, and variable function of income, prices, etc.

Computer information derived from the use of the universal product code in conjunction with credit-card purchase as an individual household identifier could change this state of affairs, but the U.P.C. method is not yet available on a national or even a significant regional scale. To compensate for this data deficiency, an alternate indirect approach of analysis has been adopted known as economic shock testing. This method, widely used in the aircraft manufacturing industry, develops an aggregate statistical sort of data.

Applied to economics, this means that all of the households in one region or in the whole nation are studied as a group or class rather than individually, and the mass behavior rather than the individual behavior is used to discover useful estimates of

the technical coefficients governing the economic structure of the hypothetical single-household industry...

Notice in the industry flow diagram that the values for the flows A, B, C, etc. are accessible to measurement in terms of selling prices and total sales of commodities.

One method of evaluating the technical coefficients of the household industry depends upon shocking the prices of a commodity and noting the changes in the sales of all of the commodities.

## **Economic Shock Testing**

In recent times, the application of Operations Research to the study of the public economy has been obvious for anyone who understands the principles of shock testing.

In the shock testing of an aircraft airframe, the recoil impulse of firing a gun mounted on that airframe causes shock waves in that structure which tell aviation engineers the conditions under which some parts of the airplane or the whole airplane or its wings will start to vibrate or flutter like a guitar string, a flute reed, or a tuning fork, and disintegrate or fall apart in flight.

Economic engineers achieve the same result in studying the behavior of the economy and the consumer public by carefully selecting a staple commodity such as beef, coffee, gasoline, or sugar, and then causing a sudden change or shock in its price or availability, thus kicking everybody's budget and buying habits out of shape.

They then observe the shock waves which result by monitoring the changes in advertising, prices, and sales of that and other commodities.

The objective of such studies is to acquire the know-how to set the public economy into a predictable state of motion or change, even a controlled self-destructive state of motion which will convince the public that certain "expert" people should take control of the money system and reestablish security (rather than liberty and justice) for all. When the subject citizens are rendered unable to control their financial affairs, they, of course, become totally enslaved, a source of cheap labor.

Not only the prices of commodities, but also the availability of labor can be used as the means of shock testing. Labor strikes deliver excellent tests shocks to an economy, especially in the critical service areas of trucking (transportation), communication, public utilities (energy, water, garbage collection), etc.

By shock testing, it is found that there is a direct relationship between the availability of money flowing in an economy and the real psychological outlook and response of masses of people dependent upon that availability.

For example, there is a measurable quantitative relationship between the price of gasoline and the probability that a person would experience a headache, feel a need to watch a violent movie, smoke a cigarette, or go to a tavern for a mug of beer.

It is most interesting that, by observing and measuring the economic models by which the public tries to run from their problems and escape from reality, and by applying the mathematical theory of Operations Research, it is possible to program computers to predict the most probable combination of created events (shocks) which will bring about a complete control and subjugation of the public through a subversion of the public economy (by shaking the plum tree).

## **Introduction to the Theory of Economic Shock Testing**

Let the prices and total sales of commodities be given and symbolized as follows:

<b>Commodities</b>	<b>Price Function</b>	<b>Total Sales</b>
alcoholic beverages	A	$\mathcal{A}$
beef	B	$\mathcal{B}$
coffee	C	$\mathcal{C}$
gasoline	G	$\mathcal{G}$
sugar	S	$\mathcal{S}$
tobacco	T	$\mathcal{T}$
unknown balance	U	$\mathcal{U}$

Let us assume a simple economic model in which the total number of important (staple) commodities are represented as beef, gasoline, and an aggregate of all other staple commodities which we will call the hypothetical miscellaneous staple commodity 'M' (e.g., M is an aggregate of C, S, T, U, etc.).

## **Example of Shock Testing**

Assume that the total sales,  $P$ , of petroleum products can be described by the linear function of the quantities  $B$ ,  $G$ , and  $M$ , which are functions of the prices of those respective commodities.

$$P = a_{PB} B + a_{PG} G + a_{PM} M$$

Then where  $B$ ,  $G$ , and  $M$  are functions of the prices of beef, gasoline, and miscellaneous, respectively, and  $a_{PB}$ ,  $a_{PG}$ , and  $a_{PM}$  are constant coefficients defining the amount by which each of the functions  $B$ ,  $G$ , and  $M$  affect the sales,  $P$ , of petroleum products. We are assuming that  $B$ ,  $G$ , and  $M$  are variables independent of each other.

If the availability or price of gasoline is suddenly changed, then  $G$  must be replaced by  $G + \Delta G$ . This causes a change in the petroleum sales from  $P$  to  $P + \Delta P$ . Also we will assume that  $B$  and  $M$  remain constant when  $G$  changes to  $G + \Delta G$ .

$$(P + \Delta P) = a_{PB} B + a_{PG} (G + \Delta G) + a_{PM} M.$$

Expanding upon this expression, we get

$$P + \Delta P = a_{PB} B + a_{PG} G + a_{PG} \Delta G + a_{PM} M$$

and subtracting the original value of  $P$  we get for the change in  $P$

$$\text{Change in } P = \Delta P = a_{PG} \Delta G$$

Dividing by  $\Delta G$  we get

$$a_{PG} = \Delta P / \Delta G .$$

This is a rate of change in  $P$  due only to an isolated change in  $G$ ,  $G$ .

In general,  $a_{jk}$  is the partial rate of change in the sales effect  $j$  due to a change in the causal price function of commodity  $k$ . If the interval of time were infinitesimal, this expression would be reduced to the definition of the total differential of a function,  $P$ .

For if  $a_{jk} = \frac{\partial j}{\partial k}$ , and if  $P = a_{PB}B + a_{PG}G + a_{PM}M$  and B, G, and M are independent variables, then

$$a_{PB} = \frac{\partial P}{\partial B} \quad \text{and}$$

$$dP = \frac{\partial P}{\partial B} dB + \frac{\partial P}{\partial G} dG + \frac{\partial P}{\partial M} dM$$

Integrating, we get

$$P = \int \frac{\partial P}{\partial B} dB + \int \frac{\partial P}{\partial G} dG + \int \frac{\partial P}{\partial M} dM.$$

If the  $a_{jk}$  are constant coefficients, then the rates,  $\partial j / \partial k$ , are constant also and can be taken outside of the integrals. Therefore,

$$P = \frac{\partial P}{\partial B} \int dB + \frac{\partial P}{\partial G} \int dG + \frac{\partial P}{\partial M} \int dM \quad \text{or}$$

$$P = \frac{\partial P}{\partial B} B + \frac{\partial P}{\partial G} G + \frac{\partial P}{\partial M} M + K.$$

Furthermore,

$$\begin{aligned} \delta_A &= \frac{\partial \delta_A}{\partial B} B + \frac{\partial \delta_A}{\partial G} G + \frac{\partial \delta_A}{\partial M} M + K_A \\ \delta_B &= \frac{\partial \delta_B}{\partial B} B + \frac{\partial \delta_B}{\partial G} G + \frac{\partial \delta_B}{\partial M} M + K_B \\ \delta_C &= \frac{\partial \delta_C}{\partial B} B + \frac{\partial \delta_C}{\partial G} G + \frac{\partial \delta_C}{\partial M} M + K_C \\ \delta_U &= \frac{\partial \delta_U}{\partial B} B + \frac{\partial \delta_U}{\partial G} G + \frac{\partial \delta_U}{\partial M} M + K_U \end{aligned}$$

When the price of gasoline is shocked, all of the coefficients with round G (2G) in the denominator are evaluated at the same time. If B, G, and M were independent, and sufficient for description of the economy, then three shock tests would be necessary to evaluate the system.

There are other factors which may be represented the same way.

For example, the tendency of a docile sub-nation to withdraw under economic pressure may be given by

$$\phi = \frac{\partial \phi}{\partial G} G + \frac{\partial \phi}{\partial W_P} W_P + \dots$$

where G is the price of gasoline, WP is the dollars spent per unit time (referenced to say 1939) for war production during 'peace' time, etc. These quantities are presented to a computer in matrix format as follows:

$$\begin{array}{cccc|c|c} \frac{\partial F}{\partial G} & \frac{\partial P}{\partial B} & \dots & \frac{\partial P}{\partial U} & G & P - K_P \\ \frac{\partial F}{\partial G} & \frac{\partial F}{\partial B} & \dots & \frac{\partial F}{\partial U} & B & F - K_F \\ \dots & \dots & \dots & \dots & \cdot & \cdot \\ \frac{\partial T}{\partial G} & \frac{\partial T}{\partial B} & \dots & \frac{\partial T}{\partial U} & \cdot & T - K_T \\ \frac{\partial \phi}{\partial G} & \frac{\partial \phi}{\partial B} & \dots & \frac{\partial \phi}{\partial U} & U & \phi - K_\phi \end{array} = \dots$$

$\uparrow \qquad \qquad \uparrow$   
 $X_k \qquad \qquad Y_j$

or  $[a_{jk}] [X_k] = [Y_j]$

where the  $a_{jk}$  are defined by  $a_{jk} = \frac{\partial X_j}{\partial X_k}$

and

$$\begin{array}{ll} X_1 = G & Y_1 = P - K_P \\ X_2 = B & Y_2 = F - K_F \\ X_3 = \text{etc.} & Y_3 = \text{etc.} \end{array}$$

Finally, inverting this matrix, i.e., solving for the  $X_k$  terms of the  $Y_j$ , we get, say,

$$[b_{kj}] [Y_j] = [X_k]$$

This is the result into which we substitute to get that set of conditions of prices of commodities, bad news on TV, etc., which will deliver a collapse of public morale ripe for take over.

Once the economic price and sales coefficients  $a_{jk}$  and  $b_{kj}$  are determined, they may be translated into the technical supply and demand coefficients  $g_{jk}$ ,  $C_{jk}$ , and  $1/L_{jk}$ .

Shock testing of a given commodity is then repeated to get the time rate of change of these technical coefficients.

## **Introduction to Economic Amplifiers**

Economic amplifiers are the active components of economic engineering. The basic characteristic of any amplifier (mechanical, electrical, or economic) is that it receives an input control signal and delivers energy from an independent energy source to a specified output terminal in a predictable relationship to that input control signal.

The simplest form of an economic amplifier is a device called advertising.

If a person is spoken to by a T.V. advertiser as if he were a twelve-year-old, then, due to suggestibility, he will, with a certain probability, respond or react to that suggestion with the uncritical response of a twelve-year-old and will reach in to his economic reservoir and deliver its energy to buy that product on impulse when he passes it in the store.

An economic amplifier may have several inputs and output. Its response might be instantaneous or delayed. Its circuit symbol might be a rotary switch if its options are exclusive, qualitative, "go" or "no-go", or it might have its parametric input/ output relationships specified by a matrix with internal energy sources represented.

Whatever its form might be, its purpose is to govern the flow of energy from a source to an output sink in direct relationship to an input control signal. For this reason, it is called an active circuit element or component.

Economic Amplifiers fall into classes called strategies, and, in comparison with electronic amplifiers, the specific internal functions of an economic amplifier are called logistical instead of electrical.

Therefore, economic amplifiers not only deliver power gain but also, in effect, are used to cause changes in the economic circuitry.

In the design of an economic amplifier we must have some idea of at least five functions, which are:

- (1) the available input signals,
- (2) the desired output-control objectives,
- (3) the strategic objective,
- (4) the available economic power sources,
- (5) the logistical options.

The process of defining and evaluating these factors and incorporating the economic amplifier into an economic system has been popularly called game theory.

The design of an economic amplifier begins with a specification of the power level of the output, which can range from personal to national. The second condition is accuracy of response, i.e., how accurately the output action is a function of the input commands. High gain combined with strong feedback helps to deliver the required precision.

Most of the error will be in the input data signal. Personal input data tends to be specified, while national input data tends to be statistical.

## **Short List of Inputs**

Questions to be answered:

- \* what
- \* where
- \* why
- \* when
- \* how
- \* who

General sources of information:

- \* telephone taps
- \* analysis of garbage
- \* surveillance
- \* behavior of children in school

Standard of living by:

- \* food
- \* shelter
- \* clothing
- \* transportation

Social contacts:

- \* telephone - itemized record of calls
- \* family - marriage certificates, birth certificates, etc.
- \* friends, associates, etc.
- \* memberships in organizations
- \* political affiliation

## **The Personal Paper Trail**

Personal buying habits, i.e., personal consumer preferences:

- \* checking accounts
- \* credit-card purchases
- \* "tagged" credit-card purchases - the credit-card purchase of products bearing the U.P.C. (Universal Product Code)

Assets:

- \* checking accounts
- \* savings accounts
- \* real estate
- \* business
- \* automobile, etc.
- \* safety deposit at bank
- \* stock market

Liabilities:

- \* creditors
- \* enemies (see - legal)
- \* loans

Government sources (ploys)\*:

- \* Welfare
- \* Social Security
- \* U.S.D.A. surplus food
- \* doles
- \* grants
- \* subsidies

\* Principle of this ploy -- the citizen will almost always make the collection of information easy if he can operate on the "free sandwich principle" of "eat now, and pay later."

Government sources (via intimidation):

- \* Internal Revenue Service
- \* OSHA
- \* Census
- \* etc.

Other government sources -- surveillance of U.S. mail.

## **Habit Patterns -- Programming**

Strengths and weaknesses:

- \* activities (sports, hobbies, etc.)
- \* see "legal" (fear, anger, etc. -- crime record)
- \* hospital records (drug sensitivities, reaction to pain, etc.)
- \* psychiatric records (fears, angers, disgusts, adaptability, reactions to stimuli, violence, suggestibility or hypnosis, pain, pleasure, love, and sex)

Methods of coping -- of adaptability -- behavior:

- \* consumption of alcohol
- \* consumption of drugs
- \* entertainment
- \* religious factors influencing behavior
- \* other methods of escaping from reality

Payment modus operandi (MO) -- pay on time, etc.:

- \* payment of telephone bills
- \* energy purchases
- \* water purchases
- \* repayment of loans
- \* house payments
- \* automobile payments
- \* payments on credit cards

Political sensitivity:

- \* beliefs
- \* contacts
- \* position
- \* strengths/weaknesses
- \* projects/activities

Legal inputs -- behavioral control (Excuses for investigation, search, arrest, or employment of force to modify behavior)

- \* court records
- \* police records -- NCIC
- \* driving record
- \* reports made to police
- \* insurance information
- \* anti-establishment acquaintances

### **National Input Information**

Business sources (via I.R.S., etc):

- \* prices of commodities
- \* sales
- \* investments in
  - o stocks/inventory
  - o production tools and machinery
  - o buildings and improvements
  - o the stock market

Banks and credit bureaus:

- \* credit information
- \* payment information

Miscellaneous sources:

- \* polls and surveys
- \* publications
- \* telephone records
- \* energy and utility purchases

### **Short List of Outputs**

Outputs -- create controlled situations -- manipulation of the economy, hence society -- control by control of compensation and income.

Sequence:

1. allocates opportunities
2. destroys opportunities
3. controls the economic environment
4. controls the availability of raw materials
5. controls capital.
6. controls bank rates
7. controls the inflation of the currency
8. controls the possession of property
9. controls industrial capacity

10. controls manufacturing
11. controls the availability of goods (commodities).
12. controls the prices of commodities.
13. controls services, the labor force, etc.
14. controls payments to government officials.
15. controls the legal functions.
16. controls the personal data files -- uncorrectable by the party slandered.
17. controls advertising.
18. controls media contact.
19. controls material available for T.V. viewing
20. disengages attention from real issues.
21. engages emotions.
22. creates disorder, chaos, and insanity.
23. controls design of more probing tax forms.
24. controls surveillance.
25. controls the storage of information.
26. develops psychological analyses and profiles of individuals.
27. controls legal functions [repeat of 15]
28. controls sociological factors.
29. controls health options.
30. preys on weakness.
31. cripples strengths.
32. leaches wealth and substance.

## **Table of Strategies**

<b>Do This</b>	<b>To Get This</b>
Keep the public ignorant	Less public organization
Maintain access to control point for feedback	Required reaction to outputs (prices, sales)
Create preoccupation	Lower defense
Attack the family unit	Control of the education of the young
Give less cash and more credit and doles	More self-indulgence and more data
Attack the privacy of the church	Destroy faith in this sort of government
Social conformity	Computer programming simplicity
Minimize the tax protest	Maximum economic data, minimum enforcement problems

Stabilize the consent	Simplicity coefficients
Tighten control of variables	Simpler computer input data - greater predictability
Establish boundary conditions	Problem simplicity/solutions of differential and difference equations
Proper timing	Less data shift and blurring
Maximize control	Minimum resistance to control
Collapse of currency	Destroy the faith of the American people in each other

## **Diversion, the Primary Strategy**

Experience has prevent that the simplest method of securing a silent weapon and gaining control of the public is to keep the public undisciplined and ignorant of the basic system principles on the one hand, while keeping them confused, disorganized, and distracted with matters of no real importance on the other hand.

This is achieved by:

- \* disengaging their minds; sabotaging their mental activities; providing a low-quality program of public education in mathematics, logic, systems design and economics; and discouraging technical creativity.
- \* engaging their emotions, increasing their self-indulgence and their indulgence in emotional and physical activities, by:
  - o unrelenting emotional affrontations and attacks (mental and emotional rape) by way of constant barrage of sex, violence, and wars in the media - especially the T.V. and the newspapers.
  - o giving them what they desire - in excess - "junk food for thought" - and depriving them of what they really need.
- \* rewriting history and law and subjecting the public to the deviant creation, thus being able to shift their thinking from personal needs to highly fabricated outside priorities.

These preclude their interest in and discovery of the silent weapons of social automation technology.

The general rule is that there is a profit in confusion; the more confusion, the more profit. Therefore, the best approach is to create problems and then offer solutions.

## **Diversion Summary**

Media: Keep the adult public attention diverted away from the real social issues, and captivated by matters of no real importance.

Schools: Keep the young public ignorant of real mathematics, real economics, real law, and real history.

Entertainment: Keep the public entertainment below a sixth-grade level.

Work: Keep the public busy, busy, busy, with no time to think; back on the farm with the other animals.

## **Consent, the Primary Victory**

A silent weapon system operates upon data obtained from a docile public by legal (but not always lawful) force. Much information is made available to silent weapon systems programmers through the Internal Revenue Service. (See *Studies in the Structure of the American Economy* for an I.R.S. source list.)

This information consists of the enforced delivery of well-organized data contained in federal and state tax forms, collected, assembled, and submitted by slave labor provided by taxpayers and employers.

Furthermore, the number of such forms submitted to the I.R.S. is a useful indicator of public consent, an important factor in strategic decision making. Other data sources are given in the Short List of Inputs.

Consent Coefficients - numerical feedback indicating victory status. Psychological basis: When the government is able to collect tax and seize private property without just compensation, it is an indication that the public is ripe for surrender and is consenting to enslavement and legal encroachment. A good and easily quantified indicator of harvest time is the number of public citizens who pay income tax despite an obvious lack of reciprocal or honest service from the government.

## **Amplification Energy Sources**

The next step in the process of designing an economic amplifier is discovering the energy sources. The energy sources which support any primitive economic system are, of course, a supply of raw materials, and the consent of the people to labor and consequently

assume a certain rank, position, level, or class in the social structure, i.e., to provide labor at various levels in the pecking order.

Each class, in guaranteeing its own level of income, controls the class immediately below it, hence preserves the class structure. This provides stability and security, but also government from the top.

As time goes on and communication and education improve, the lower-class elements of the social labor structure become knowledgeable and envious of the good things that the upper-class members have. They also begin to attain a knowledge of energy systems and the ability to enforce their rise through the class structure.

This threatens the sovereignty of the elite.

If this rise of the lower classes can be postponed long enough, the elite can achieve energy dominance, and labor by consent no longer will hold a position of an essential energy source.

Until such energy dominance is absolutely established, the consent of people to labor and let others handle their affairs must be taken into consideration, since failure to do so could cause the people to interfere in the final transfer of energy sources to the control of the elite.

It is essential to recognize that at this time, public consent is still an essential key to the release of energy in the process of economic amplification.

Therefore, consent as an energy release mechanism will now be considered.

## **Logistics**

The successful application of a strategy requires a careful study of inputs, outputs, the strategy connecting the inputs and the outputs, and the available energy sources to fuel the strategy. This study is called logistics.

A logistical problem is studied at the elementary level first, and then levels of greater complexity are studied as a synthesis of elementary factors.

This means that a given system is analyzed, i.e., broken down into its subsystems, and these in turn are analyzed, until by this process, one arrives at the logistical "atom," the individual.

This is where the process of synthesis properly begins, at the time of birth of the individual.

## **The Artificial Womb**

From the time a person leaves its mother's womb, its every effort is directed towards building, maintaining, and withdrawing into artificial wombs, various sorts of substitute protective devices or shells.

The objective of these artificial wombs is to provide a stable environment for both stable and unstable activity; to provide a shelter for the evolutionary processes of growth and maturity - i.e., survival; to provide security for freedom and to provide defensive protection for offensive activity.

This is equally true of both the general public and the elite. However, there is a definite difference in the way each of these classes go about the solution of problems.

## **The Political Structure of a Nation - Dependency**

The primary reason why the individual citizens of a country create a political structure is a subconscious wish or desire to perpetuate their own dependency relationship of childhood. Simply put, they want a human god to eliminate all risk from their life, pat them on the head, kiss their bruises, put a chicken on every dinner table, clothe their bodies, tuck them into bed at night, and tell them that everything will be alright when they wake up in the morning.

This public demand is incredible, so the human god, the politician, meets incredibility with incredibility by promising the world and delivering nothing. So who is the bigger liar? the public? or the "godfather"?

This public behavior is surrender born of fear, laziness, and expediency. It is the basis of the welfare state as a strategic weapon, useful against a disgusting public.

## **Action/Offense**

Most people want to be able to subdue and/or kill other human beings which disturb their daily lives, but they do not want to have to cope with the moral and religious issues which such an overt act on their part might raise. Therefore, they assign the dirty work to others (including their own children) so as to keep the blood off their hands. They rave about the humane treatment of animals and then sit down to a delicious hamburger from a whitewashed slaughterhouse down the street and out of sight. But even more hypocritical, they pay taxes to finance a professional association of hit men collectively called politicians, and then complain about corruption in government.

## **Responsibility**

Again, most people want to be free to do the things (to explore, etc.) but they are afraid to fail.

The fear of failure is manifested in irresponsibility, and especially in delegating those personal responsibilities to others where success is uncertain or carries possible or created liabilities (law), which the person is not prepared to accept. They want authority (root word - "author"), but they will not accept responsibility or liability. So they hire politicians to face reality for them.

## **Summary**

The people hire the politicians so that the people can:

- (1) obtain security without managing it.
- (2) obtain action without thinking about it.
- (3) inflict theft, injury, and death upon others without having to contemplate either life or death.
- (4) avoid responsibility for their own intentions.
- (5) obtain the benefits of reality and science without exerting themselves in the discipline of facing or learning either of these things.

They give the politicians the power to create and manage a war machine:

- (1) provide for the survival of the nation/womb.
- (2) prevent encroachment of anything upon the nation/womb.
- (3) destroy the enemy who threatens the nation/womb.
- (4) destroy those citizens of their own country who do not conform for the sake of stability of the nation/womb.

Politicians hold many quasi-military jobs, the lowest being the police which are soldiers, the attorneys and C.P.A.s next who are spies and saboteurs (licensed), and the judges who shout orders and run the closed union military shop for whatever the market will bear. The generals are industrialists. The "presidential" level of commander-in-chief is shared by the international bankers.

The people know that they have created this farce and financed it with their own taxes (consent), but they would rather knuckle under than be the hypocrite.

Thus, a nation becomes divided into two very distinct parts, a docile sub-nation [great silent majority] and a political sub-nation. The political sub-nation remains attached to the docile sub-nation, tolerates it, and leaches its substance until it grows strong enough to detach itself and then devour its parent.

## **System Analysis**

In order to make meaningful computerized economic decisions about war, the primary economic flywheel, it is necessary to assign concrete logistical values to each element of the war structure - personnel and material alike.

This process begins with a clear and candid description of the subsystems of such a structure.

## **The Draft (As military service)**

Few efforts of human behavior modification are more remarkable or more effective than that of the socio-military institution known as the draft. A primary purpose of a draft or other such institution is to instill, by intimidation, in the young males of a society the uncritical conviction that the government is omnipotent. He is soon taught that a prayer is slow to reverse what a bullet can do in an instant. Thus, a man trained in a religious environment for eighteen years of his life can, by this instrument of the government, be broken down, be purged of his fantasies and delusions in a matter of mere months. Once that conviction is instilled, all else becomes easy to instill.

Even more interesting is the process by which a young man's parents, who purportedly love him, can be induced to send him off to war to his death. Although the scope of this work will not allow this matter to be expanded in full detail, nevertheless, a coarse overview will be possible and can serve to reveal those factors which must be included in some numerical form in a computer analysis of social and war systems.

We begin with a tentative definition of the draft.

The draft (selective service, etc.) is an institution of compulsory collective sacrifice and slavery, devised by the middle-aged and elderly for the purpose of pressing the young into doing the public dirty work. It further serves to make the youth as guilty as the elders, thus making criticism of the elders by the youth less likely (Generational Stabilizer). It is marketed and sold to the public under the label of "patriotic = national" service.

Once a candid economic definition of the draft is achieved, that definition is used to outline the boundaries of a structure called a Human Value System, which in turn is translated into the terms of game theory. The value of such a slave laborer is given in a Table of Human Values, a table broken down into categories by intellect, experience, post-service job demand, etc.

Some of these categories are ordinary and can be tentatively evaluated in terms of the value of certain jobs for which a known fee exists. Some jobs are harder to value because they are unique to the demands of social subversion, for an extreme example: the value of a mother's instruction to her daughter, causing that daughter to put certain behavioral demands upon a future husband ten or fifteen years hence; thus, by suppressing his

resistance to a perversion of a government, making it easier for a banking cartel to buy the State of New York in, say, twenty years.

Such a problem leans heavily upon the observations and data of wartime espionage and many types of psychological testing. But crude mathematical models (algorithms, etc.) can be devised, if not to predict, at least to predetermine these events with maximum certainty. What does not exist by natural cooperation is thus enhanced by calculated compulsion. Human beings are machines, levers which may be grasped and turned, and there is little real difference between automating a society and automating a shoe factory.

These derived values are variable. (It is necessary to use a current Table of Human Values for computer analysis.) These values are given in true measure rather than U.S. dollars, since the latter is unstable, being presently inflated beyond the production of national goods and services so as to give the economy a false kinetic energy ("paper" inductance).

The silver value is stable, it being possible to buy the same amount with a gram of silver today as it could be bought in 1920. Human value measured in silver units changes slightly due to changes in production technology.

## **Enforcement**

### Factor I

As in every social system approach, stability is achieved only by understanding and accounting for human nature (action/reaction patterns). A failure to do so can be, and usually is, disastrous.

As in other human social schemes, one form or another of intimidation (or incentive) is essential to the success of the draft. Physical principles of action and reaction must be applied to both internal and external subsystems.

To secure the draft, individual brainwashing/programming and both the family unit and the peer group must be engaged and brought under control.

### Factor II - Father

The man of the household must be housebroken to ensure that junior will grow up with the right social training and attitudes. The advertising media, etc., are engaged to see to it that father-to-be is pussy-whipped before or by the time he is married. He is taught that he either conforms to the social notch cut out for him or his sex life will be hobbled and his tender companionship will be zero. He is made to see that women demand security more than logical, principled, or honorable behavior.

By the time his son must go to war, father (with jelly for a backbone) will slam a gun into junior's hand before father will risk the censure of his peers, or make a hypocrite of himself by crossing the investment he has in his own personal opinion or self-esteem. Junior will go to war or father will be embarrassed. So junior will go to war, the true purpose notwithstanding.

Factor III - Mother

The female element of human society is ruled by emotion first and logic second. In the battle between logic and imagination, imagination always wins, fantasy prevails, maternal instinct dominates so that the child comes first and the future comes second. A woman with a newborn baby is too starry-eyed to see a wealthy man's cannon fodder or a cheap source of slave labor. A woman must, however, be conditioned to accept the transition to "reality" when it comes, or sooner.

As the transition becomes more difficult to manage, the family unit must be carefully disintegrated, and state-controlled public education and state-operated child-care centers must become more common and legally enforced so as to begin the detachment of the child from the mother and father at an earlier age. Inoculation of behavioral drugs [Ritalin] can speed the transition for the child (mandatory). Caution: A woman's impulsive anger can override her fear. An irate woman's power must never be underestimated, and her power over a pussy-whipped husband must likewise never be underestimated. It got women the vote in 1920.

Factor IV - Junior

The emotional pressure for self-preservation during the time of war and the self-serving attitude of the common herd that have an option to avoid the battlefield - if junior can be persuaded to go - is all of the pressure finally necessary to propel Johnny off to war. Their quiet blackmailings of him are the threats: "No sacrifice, no friends; no glory, no girlfriends."

Factor V - Sister

And what about junior's sister? She is given all the good things of life by her father, and taught to expect the same from her future husband regardless of the price.

Factor VI - Cattle

Those who will not use their brains are no better off than those who have no brains, and so this mindless school of jelly-fish, father, mother, son, and daughter, become useful beasts of burden or trainers of the same.

This concludes what is available of this document

---

<sup>i</sup> "Studies in the Structure of American Economy" (1953), by Wassily Leontief (Director of the Harvard Economic Research Project), International Science Press Inc., White Plains, New York.

OTHER RESOURCES THAT EXPOSE THE IMPLEMENTATION OF  
THE "SILENT WEAPONS" ASSAULT

- *Behold a Pale Horse* by William Cooper, former US Naval Intelligence Officer
- *Studies in the Structure of American Economy* (1953), by Wassily Leontief (director of the Harvard Economic Research Project), International Science Press Inc., White Plains, New York.
- *Diplomacy by Deception; Chapter 6 - Tavistock and Operations Research* by John Coleman, former MI 5 agent
- *The True Story of the Bilderberg Group*, by Daniel Estulin
- *The Deliberate Dumbing Down of America*, by Charlotte Iserbyte
- *Soldiers of Reason and the Rise of the American Empire*, by Alex Abella
- BBC Documentary, *The Trap*, by Adam Curtis
- *Full Spectrum Dominance*, by William Engdahl
- *The Synagogue of Satan*, by Andrew Hitchcock
- *The Illuminati, The Cult That Hijacked the World*, by Henry Makow, PhD.
- *The Great American Adventure - Secrets of America*, by Judge Dale; available for free at [www.anticorruptionsociety.com](http://www.anticorruptionsociety.com)
- *We are the "Enemies of the State"*;  
<http://anticorruptionsociety.com/2011/02/25/we-are-the-enemies-of-the-state/>

More information can be found at:

**[www.StopTheCrime.net](http://www.StopTheCrime.net)**

**[www.AntiCorruptionSociety.com](http://www.AntiCorruptionSociety.com)**

---

*"For we are opposed around the world by a monolithic and ruthless conspiracy that relies on covert means for expanding its sphere of influence - on infiltration instead of invasion, on subversion instead of elections, on intimidation instead of free choice, on guerrillas by night instead of armies by day. It is a system that has conscripted vast human and material resources into the building of a tightly knit, highly efficient machine that combines military, diplomatic, intelligence, economic, scientific and political operations."*

John F. Kennedy

*"The individual is handicapped, by coming face-to-face, with a conspiracy so monstrous, he cannot believe it exists. The American mind, simply has not come to a realization of the evil, which has been introduced into our midst . . . It rejects even the assumption that human creatures could espouse a philosophy, which must ultimately destroy all that is good and decent."*

FBI Director J. Edgar Hoover, 1956



## American Academy of Environmental Medicine

6505 E Central • Ste 296 • Wichita, KS 67206

Tel: (316) 684-5500 • Fax: (316) 684-5709

[www.aaemonline.org](http://www.aaemonline.org)

### Executive Committee

August 30, 2013

#### President

Amy L. Dean, D.O., FAAEM  
1955 Pauline Blvd Ste 100D  
Ann Arbor, MI 48103

Office of the Secretary  
Federal Communications Commission  
445 12<sup>th</sup> Street, SW  
Washington, D.C. 20554

#### President-Elect

Janette Hope, M.D., FAAEM  
304 W Los Olivos  
Santa Barbara, CA 93105

#### Secretary

Jennifer Armstrong, M.D., FAAEM  
3364 Carling Ave.  
Ottawa, Ontario, Canada

#### Treasurer

Richard G. Jaeckle, M.D., FAAEM  
8220 Walnut Hill Ln Ste 404  
Dallas, TX 75231

#### Immediate Past President

A.L. Barrier, M.D., FAAO-HNS

#### Advisor

William J. Rea, M.D., FAAEM  
Gary R. Oberg, M.D., FAAEM

#### Board of Directors

Craig Bass, M.D.  
Robin Bernhoft, M.D., FAAEM  
Martha Grout, M.D., MD(H)  
W. Alan Ingram, M.D.  
Derek Lang, D.O.  
Allan D. Lieberman, M.D., FAAEM  
Lisa Nagy, M.D.  
Kalpana D. Patel, M.D., FAAEM

#### Continuing Medical Education

Chair  
James W. Willoughby, II, D.O.  
24 Main St.  
Liberty, MO 64068

#### Assistant-Chair

Wm. Alan Ingram, M.D.  
18015 Oak St Ste B  
Omaha, NE 68130

Re: ET Docket No. 13-84

Dear Federal Communications Commission Commissioners:

The American Academy of Environmental Medicine is writing to request that the FCC review radiofrequency (RF) exposure limits (reference is made to the FCC's NOI sections 48, 51, 52, 53, 56, 60, 65 and 69), recognize non-thermal effects of RF exposure (NOI sections 66 and 69), and lower limits of RF exposure to protect the public from the adverse health effects of radiofrequency emissions (NOI sections 48, 52, 54, 65 and 71).

Founded in 1965 as a non-profit medical association, the AAEM is an international association of physicians and scientists who study and treat the effects of the environment on human health. With an elite membership of highly trained physicians and clinicians, AAEM is committed to education, public awareness and research regarding Environmental Medicine.

It became clear to AAEM physicians that by the mid 1990's patients were experiencing adverse health reactions and disease as a result of exposure to electromagnetic fields. In the last five years with the advent of wireless devices, there has been an exponential increase in the number of patients with radiofrequency induced disease and hypersensitivity.

Numerous peer reviewed, published studies correlate radiofrequency exposure with a wide range of health conditions and diseases. (NOI sections 54, 59, 60 and 65) These include neurological and neurodegenerative diseases such as Parkinson's Disease, ALS, paresthesias, dizziness, headaches and sleep disruption as well as cardiac, gastrointestinal and immune disease, cancer, developmental and reproductive disorders, and electromagnetic sensitivity. The World Health Organization has classified RF emissions as a group 2 B carcinogen. This research is reviewed and cited in the following attached documents: *AAEM Electromagnetic and Radiofrequency Fields Effect on Human Health* and *AAEM Recommendations Regarding Electromagnetic and Radiofrequency Exposure*.

The scientific literature proves that non-thermal adverse effects of RF exposure exist and negatively impact health and physiology. New guidelines based on measurements of non-thermal effects and lowering limits of exposure are needed and critical to protect public health.

In fact, electromagnetic sensitivity and the health effects of low level RF exposure have already been acknowledged by the federal government. In 2002, the Architectural and Transportation Barriers Compliance Board stated:

*“The Board recognizes...electromagnetic sensitivities may be considered disabilities under the ADA if they so severely impair the neurological, respiratory or other functions on an individual that it substantially limits one or more of the individual’s major life activities”*

Additionally, in 2005, the National Institute of Building Sciences, an organization established by the U.S. Congress in 1974, issued an Indoor Environmental Quality Report which concluded:

*“For people who are electromagnetically sensitive, the presence of cell phones and towers, portable telephones, computers,... wireless devices, security and scanning equipment, microwave ovens, electric ranges and numerous other electrical appliances can make a building inaccessible.”*

By recognizing electromagnetic sensitivity, the federal government and affiliated organizations are clearly acknowledging the existence of non-thermal effects. The AAEM urges the FCC to recognize that non-thermal effects of RF exposure exist and cause symptoms and disease. (NOI sections 66 and 69) The AAEM also requests that the FCC base guidelines of RF exposure on measurements of non-thermal effects and lower the limits of RF exposure to protect the health of the public. (NOI sections 48, 52, 54, 65 and 71)

Sincerely ,

A handwritten signature in black ink, appearing to read "Amy L. Dean, DO.", with a stylized flourish at the end.

Amy L. Dean, DO, FAAEM, DABEM, DAOBIM  
President



# Federal Register

---

Tuesday,  
September 3, 2002

---

## Part II

### **Architectural and Transportation Barriers Compliance Board**

---

**36 CFR Parts 1190 and 1191**

**Americans With Disabilities Act (ADA)  
Accessibility Guidelines for Buildings and  
Facilities; Final Rule**

**Americans With Disabilities Act (ADA)  
Accessibility Guidelines for Buildings and  
Facilities; Architectural Barriers Act (ABA)  
Accessibility Guidelines; Recreation  
Facilities; Supplemental Notice of  
Proposed Rulemaking**

**ARCHITECTURAL AND  
TRANSPORTATION BARRIERS  
COMPLIANCE BOARD**

**36 CFR Part 1191**

[Docket No. 98–5]

RIN 3014–AA16

**Americans With Disabilities Act (ADA)  
Accessibility Guidelines for Buildings  
and Facilities; Recreation Facilities**

**AGENCY:** Architectural and  
Transportation Barriers Compliance  
Board.

**ACTION:** Final rule.

**SUMMARY:** The Architectural and Transportation Barriers Compliance Board (Access Board) is issuing final accessibility guidelines to serve as the basis for standards to be adopted by the Department of Justice for new construction and alterations of recreation facilities covered by the Americans with Disabilities Act (ADA). The guidelines include scoping and technical provisions for amusement rides, boating facilities, fishing piers and platforms, golf courses, miniature golf, sports facilities, and swimming pools and spas. The guidelines will ensure that newly constructed and altered recreation facilities meet the requirements of the ADA and are readily accessible to and usable by individuals with disabilities.

**DATES:** The guidelines are effective October 3, 2002. The incorporation by reference of certain publications listed in the guidelines is approved by the Director of the Federal Register as of October 3, 2002.

**FOR FURTHER INFORMATION CONTACT:** Peggy Greenwell, Office of Technical and Information Services, Architectural and Transportation Barriers Compliance Board, 1331 F Street, NW., suite 1000, Washington, DC 20004–1111. Telephone number (202) 272–0017 (Voice); (202) 272–0082 (TTY). E-mail address: [greenwell@access-board.gov](mailto:greenwell@access-board.gov).

**SUPPLEMENTARY INFORMATION:**

**Availability of Copies and Electronic Access**

Single copies of this publication may be obtained at no cost by calling the Access Board's automated publications order line (202) 272–0080, by pressing 2 on the telephone keypad, then 1, and requesting publication S–43 (Recreation Facilities Final Rule). Persons using a TTY should call (202) 272–0082. Please record a name, address, telephone number and request publication S–43. This document is available in alternate formats upon request. Persons who want

a copy in an alternate format should specify the type of format (cassette tape, Braille, large print, or ASCII disk). This document is also available on the Board's Internet site (<http://www.access-board.gov/recreation/final.htm>).

**Background**

The Americans with Disabilities Act recognizes and protects the civil rights of people with disabilities.<sup>1</sup> Titles II and III of the ADA require, among other things, that newly constructed and altered State and local government facilities, places of public accommodation, and commercial facilities be readily accessible to and usable by individuals with disabilities. Recreation facilities are among the types of facilities covered by titles II and III of the ADA.

The ADA designates the Access Board as the agency responsible for developing minimum accessibility guidelines to ensure that new construction and alterations of facilities covered by titles II and III of the ADA are readily accessible to and usable by individuals with disabilities.<sup>2</sup> The Access Board initially issued the Americans with Disabilities Act Accessibility Guidelines (ADAAG) in 1991.<sup>3</sup> Current ADAAG contains general scoping and technical provisions (ADAAG 1 to 4) that apply to all types of facilities, and special application sections (ADAAG 5 to 12) that include additional scoping and technical provisions for certain types of facilities.<sup>4</sup> As discussed in more detail below, this final rule will amend section 4, and create a new section 15 (Recreation Facilities).

The Department of Justice is responsible for issuing regulations to

implement titles II and III of the ADA. The regulations issued by the Department of Justice must include accessibility standards for newly constructed and altered facilities covered by titles II and III of the ADA. The standards must be consistent with the minimum accessibility guidelines issued by the Access Board. The Department of Justice has adopted ADAAG as the Standard for Accessible Design for title III of the ADA.<sup>5</sup>

This final rule amends ADAAG by adding a new special application section for amusement rides, boating facilities, fishing piers and platforms, golf courses, miniature golf, sports facilities, and swimming pools and spas. This rulemaking has had a long history. In 1993, the Access Board established an advisory committee of 27 members to make recommendations on guidelines for recreation facilities. The Recreation Access Advisory Committee met from July 1993 to May 1994 and submitted a report to the Board, "Recommendations for Accessibility Guidelines: Recreational Facilities and Outdoor Developed Areas". After receiving the committee's report, the Board published it as an advance notice of proposed rulemaking (59 FR 48542, September 21, 1994). Over 600 comments were received on the report and questions asked in the advance notice. To obtain additional information for this rulemaking, the Board also sponsored research on access to swimming pools in 1995; held informational meetings and conducted site visits on access to miniature golf facilities in September 1996; and held informational meetings and conducted site visits on accessible amusement rides in December 1999 and March and April 2000.

A notice of proposed rulemaking (NPRM) was published in the **Federal Register** on July 9, 1999. (64 FR 37326, July 9, 1999). The comment period was originally scheduled to close on November 8, 1999, but was extended until December 8, 1999 to allow more time for the public to submit comments. These comments were submitted electronically, in writing, and as oral testimony received during two public hearings held in Dallas, TX (August 26,

<sup>1</sup> See 42 U.S.C. 12101 *et seq.* (<http://www.usdoj.gov/crt/ada/pubs/ada.txt>).

<sup>2</sup> The Access Board is an independent Federal agency established by section 502 of the Rehabilitation Act whose primary mission is to promote accessibility for individuals with disabilities. The Access Board consists of 25 members. Thirteen are appointed by the President from among the public, a majority of whom are required to be individuals with disabilities. The other twelve are heads of the following Federal agencies or their designees whose positions are Executive Level IV or above: The Departments of Health and Human Services, Education, Transportation, Housing and Urban Development, Labor, Interior, Defense, Justice, Veterans Affairs, and Commerce; General Services Administration; and United States Postal Service.

<sup>3</sup> See 36 CFR part 1191, Appendix A (<http://www.access-board.gov/adaag/html/adaag.html>).

<sup>4</sup> The special application sections cover the following facilities: restaurants and cafeterias (ADAAG 5); medical care facilities (ADAAG 6); business, mercantile and civic (ADAAG 7); libraries (ADAAG 8); transient lodging (ADAAG 9); transportation facilities (ADAAG 10); judicial, legislative, and regulatory facilities (ADAAG 11); and detention and correctional facilities (ADAAG 12). ADAAG 13 is reserved for housing and ADAAG 14 is reserved for public rights-of-way.

<sup>5</sup> See 28 CFR part 36, Appendix A (<http://www.usdoj.gov/crt/ada/reg3a.html>). The Department of Justice standards currently include ADAAG 1 to 10. State and local governments currently have the option of using ADAAG or an earlier standard, the Uniform Federal Accessibility Standards (UFAS), when constructing or altering facilities under the Department of Justice regulations for title II of the ADA. See 28 CFR 35.151(c) (<http://www.usdoj.gov/crt/ada/reg2/html>). The Department of Justice has issued a notice of proposed rulemaking to eliminate this option. 59 FR 31808 (June 20, 1994).

1999) and Boston, MA (November 17, 1999). Over 200 people attended these hearings and approximately 54 people provided testimony. The Board received approximately 300 comments during the public comment period.

The Access Board created an ad hoc committee of Board members to review the comments received on the proposed rule. The ad hoc committee discussed significant issues associated with the comments and made recommendations to the full Board for the final rule. In an effort to provide the public with more opportunities for input into the provisions for the final rule, on July 21, 2000 the Board published a summary of the ad hoc committee's recommendations and put the summary in the rulemaking docket for public review (65 FR 4533, July 21, 2000). The comment period on the summary closed on September 19, 2000. Approximately 70 comments were received during the public comment period. Afterwards, the Board held informational meetings on the summary in Washington, DC (August 21–22, 2000) and San Francisco, CA (September 6–7, 2000).

#### General Issues

##### *Incorporating the Final Rule on Recreation Facilities Into Future Revisions to ADAAG*

A complete review of ADAAG has been underway for several years. ADAAG was first published on July 26, 1991. The Board is committed to ensuring that ADAAG continues to reflect technological developments and is improved in terms of usability. Efforts also include coordination with changes in national standards and model code organizations and reconciling differences between ADAAG and national consensus standards, where possible. The Board published a notice of proposed rulemaking on November 16, 1999 with proposed revisions to ADAAG. The Board plans to issue final changes to ADAAG in the near future.

The Board is issuing the final guidelines for recreation facilities prior to the publication of the final ADAAG revision. The Board then plans to incorporate these final guidelines into the final revisions to ADAAG. To effectively incorporate these guidelines into the new format, some minor formatting changes will be made. For instance, the revised ADAAG will include a new format and numbering system. This rule will need to be formatted to fit that system. Some of the provisions will also be modified slightly to avoid redundancy. No substantive changes to the text are planned. Once incorporated, the Board will develop a

guide to assist users with the new ADAAG.

The incorporation of the final recreation guidelines into the revised ADAAG will enhance the usability of the accessibility guidelines for architects, designers, manufacturers, operators and others using ADAAG. For example, accessibility guidelines for accessible parking spaces, toilet rooms, amusement rides, swimming pools, and exercise facilities will be combined into one document. Other improvements in the format of ADAAG will reduce redundancy through the use of basic technical provisions known as "building blocks," which will provide consistent dimensions for clear spaces, turning spaces, and knee and toe clearances for elements. These basic technical provisions will apply unless otherwise modified in the section containing accessibility guidelines for recreation facilities. For example, handrail requirements for sloped entries into swimming pools modify the requirements otherwise required in the ramp provisions (ADAAG 4.8.5).

##### *Multiple Chemical Sensitivities and Electromagnetic Sensitivities*

Individuals with multiple chemical sensitivities and electromagnetic sensitivities submitted a substantial number of written comments and attended the public information meetings on the draft final rule. They reported that chemicals used in recreation facilities, such as chlorine used in swimming pools and spas, and pesticides and synthetic fertilizers used on golf courses, are barriers that deny them access to those facilities. They requested the Board to include provisions in the final rule to make recreation facilities accessible for them.

The Board recognizes that multiple chemical sensitivities and electromagnetic sensitivities may be considered disabilities under the ADA if they so severely impair the neurological, respiratory or other functions of an individual that it substantially limits one or more of the individual's major life activities. The Board plans to closely examine the needs of this population, and undertake activities that address accessibility issues for these individuals.

The Board plans to develop technical assistance materials on best practices for accommodating individuals with multiple chemical sensitivities and electromagnetic sensitivities. The Board also plans to sponsor a project on indoor environmental quality. In this project, the Board will bring together building owners, architects, building product manufacturers, model code and

standard-setting organizations, individuals with multiple chemical sensitivities and electromagnetic sensitivities, and other individuals. This group will examine building design and construction issues that affect the indoor environment, and develop an action plan that can be used to reduce the level of chemicals and electromagnetic fields in the built environment.

Neither the proposed rule nor the draft final rule included provisions for multiple chemical sensitivities or electromagnetic sensitivities. The Board believes these issues require a thorough examination and public review before they are addressed through rulemaking. The Board does not address these issues in the final rule.

##### *Existing Recreation Facilities*

The Board received a significant number of comments related to the impact of these accessibility guidelines on existing facilities. Some commenters interpreted the proposed rule and the draft final rule to require all existing recreation facilities or elements of these facilities to be modified to meet the new accessibility guidelines. They expressed concern that the guidelines would have a significant economic impact on existing recreation facilities.

To clarify, ADAAG and the final accessibility guidelines for recreation facilities apply to newly designed or newly constructed buildings and facilities and to existing facilities when they are altered. ADAAG and the Department of Justice regulations address whether a change to a building or facility is considered an alteration. The publication of this final rule does not require that all existing facilities be modified to meet these guidelines. State and local governments who provide recreation facilities have a separate obligation under title II of the ADA to provide program accessibility which may require the removal of architectural barriers in existing facilities. See 28 CFR 35.150 (<http://www.usdoj.gov/crt/ada/reg2.html>). Private entities who own, lease (or lease to), or operate recreation facilities have a separate obligation under title III of the ADA to remove architectural barriers in existing facilities where it is readily achievable (*i.e.*, easily accomplishable and able to be carried out without much difficulty or expense). See 28 CFR 36.304 (<http://www.usdoj.gov/crt/ada/reg3a.html>).

Federal tax credits and deductions are available to private entities for architectural barrier removal in existing facilities. Federal funds also are available through the Community Development Block Grant Program to

remove architectural barriers in existing facilities. State and local governments may use Community Development Block Grant funds to remove architectural barriers in publicly and privately operated facilities. Entities requesting guidance on their obligations for existing facilities should contact the Department of Justice.

#### *Equivalent Facilitation*

Commenters addressing various sections of the recreation rule indicated the need for flexibility in designing and constructing accessible recreation facilities and elements. Commenters wanted to ensure that alternative designs would be permitted for providing accessibility with some of the unique elements and facilities addressed in this rule. Specific concerns were raised in comments related to accessible amusement rides and miniature golf courses.

The Board recognizes that many of the facilities and elements addressed in this rule are unique and supports the need for flexibility in making them accessible. Section 2.2 of ADAAG currently permits "departures from particular technical and scoping requirements of this guideline by the use of other designs and technologies \* \* \* where the alternative designs and technologies used will provide substantially equivalent or greater access to and usability of the facility." This provision applies to all facilities and elements addressed by ADAAG, including recreation facilities.

#### *Section-by-Section Analysis*

This section of the preamble contains a concise summary of the final rule and an analysis of the comments the Board received on each section. The final rule amends several existing sections of ADAAG and adds a new special application section. Section 4 of ADAAG has been amended to include provisions addressing miscellaneous sports facilities and elements as explained below.

#### *Miscellaneous Sports Facilities and Elements*

The accessibility guidelines for recreation facilities are primarily set forth in Section 15. Several changes, however, were also required within ADAAG section 4 to adequately address some of the unique sports facilities and elements.

#### *Section 3.5 Definitions "Area of Sport Activity"*

An area of sport activity is defined as "that portion of a room or space where the play or practice of a sport occurs."

The term is defined in order to clarify the requirements for connecting an accessible route with this type of space. The term is used broadly to define spaces where the play or practice of a sport occurs. It includes, but is not limited to, field sports such as softball, football, lacrosse, baseball, and soccer; court sports such as tennis, racquetball, and volleyball; and other sports such as gymnastics.

*Comment.* A few commenters suggested that further clarification would be helpful in the use of the term "sport" and "practice" of a sport.

*Response.* Providing an exhaustive list of sports is not practical, since it may inadvertently omit a sport, or fail to recognize an emerging sport of the future. The "area of sport activity" will vary from sport to sport. Exceptions to technical provisions in ADAAG 4.1.2 (3) and (4) and 4.1.3 (2) and (3) clarify that accessibility is not required in the "area of sport activity." This is consistent with the recommendations of the Recreation Access Advisory Committee and supports access to each "area of sport activity," while not affecting the nature of the sport.

#### *Section 4.1.1(5)(b) General Exceptions*

The following recreation facilities or portions of recreation facilities are exempt from accessibility requirements: Raised structures used for refereeing, judging, or scoring a sport; water slides; animal containment areas not for public use; and raised boxing rings and wrestling rings.

*Comment.* The proposed rule exempted structures used solely for refereeing a sport. A commenter questioned whether structures used for "judging" or "scoring" a sport would also be considered exempt.

*Response.* The exception has been modified in the final rule to include the term "judging" and "scoring." The Board considers the structures used for these activities to be consistent with the intent of this exception.

*Comment.* The proposed rule did not include any specific requirements for access to water slides. Question 4 in the proposed rule requested comments on this issue. Most of the commenters did not support providing access to the top of water slides. A few commenters suggested that access be required to the top of smaller water slides with an exemption for larger slides.

*Response.* An exception has been added in the final rule exempting water slides, including the structure supporting the water slide, from the guidelines. Providing access to water slides would require extensive ramping or elevators which would make the

slides cost prohibitive. Designers and operators are encouraged to provide access to smaller water slides, where possible. Recent designs for "leisure pools" have incorporated an accessible route to the top of water slides using the different elevations on a site. These designs provide increased access for individuals with disabilities.

*Comment.* The proposed rule did not specifically address access to "life guard stands." A few commenters recommended that structures such as life guard stands be addressed.

*Response.* ADAAG 4.1.1(5)(b) specifically exempts life guard stands and was added during a rulemaking for State and local government facilities (63 FR 2000, January 13, 1998).

*Comment.* The proposed rule included exceptions to technical provisions for accessible routes in animal containment areas. The International Association of Amusement Parks and Attractions expressed concern about general requirements for accessibility in animal containment areas that are not open to the public and are specifically limited to animal handlers.

*Response.* An exception has been added in the final rule to clarify that accessibility is not required to animal containment areas that are not for "public use." Where animal containment areas are open to public use such as petting farms, the provisions of ADAAG 4.3 apply. Several exceptions to the provisions of ADAAG 4.3 in animal containment areas are also included in the final rule.

*Comment.* The proposed rule exempted raised boxing rings from accessibility. A few commenters suggested that raised wrestling rings be added to this exception.

*Response.* The exception has been modified in the final rule to add wrestling rings to the exemption.

#### *Section 4.1.2(2)(b) and 4.1.3(1)(b) Accessible Routes for Court Sports*

These sections are amended to require an accessible route complying with ADAAG 4.3 to directly connect both sides of the court in court sports.

*Comment.* The proposed rule required an accessible route to connect both sides of the court in court sports. The American Institute of Architects (AIA) was concerned that an accessible route connecting the two sides of a court may not be a direct route and could require one to go around a multitude of courts to get to the other side of the court where a sport requires changing sides. This is especially critical in sports such as tennis, where changing sides of the court is part of the game.

*Response.* The accessible route must be a direct route from one side of the court to the other side. Requiring players on one side of the court to traverse through or around another court to get to the other side is not permitted.

*Section 4.1.2(3) and 4.1.3(2)  
Protruding Objects in Areas of Sport Activity*

Areas of sport activity are exempt from the requirements of ADAAG 4.4 (Protruding Objects).

No substantive comments were received and no changes have been made for the final rule.

*Section 4.1.2 (4) and 4.1.3(3) Ground Surfaces in Areas of Sport Activity and Animal Containment Areas*

Two exceptions are added to these sections which require ground surfaces along accessible routes and in accessible spaces to comply with ADAAG 4.5. ADAAG 4.5 requires ground and floor surfaces along accessible routes to be stable, firm, and slip resistant. ADAAG 4.5 also addresses changes in level (ADAAG 4.5.2), carpet (ADAAG 4.5.3), and gratings ADAAG (4.5.4). Exception 1 exempts areas of sport activity from all requirements of ADAAG 4.5. Exception 2 exempts animal containment areas designed and constructed for public use from the requirements of ADAAG 4.5.2 and from providing a stable, firm, and slip resistant ground or floor surface.

*Comment.* The proposed rule required an accessible route to connect to each area of sport activity. A commenter questioned the feasibility of this requirement when connecting multiple sand volleyball courts on a beach.

*Response.* The final rule requires an accessible route to each area of sport activity in newly constructed facilities. For example, where a new sports field is planned with multiple fields, an accessible route is required to each field.

With respect to sand volleyball courts located at beaches, the Board plans to more specifically address the accessible route requirement in a future rulemaking on outdoor facilities, including trails, picnic and camping facilities, and beaches. It is expected that this future rule will address accessible routes on beaches, including their location to various elements on a beach.

*Comment.* The proposed rule exempted animal containment areas for hooved animals from the requirements of a stable, firm, and slip resistant surface. Commenters questioned why the exception was limited to "hooved" animal containment areas. Others suggested that other provisions such as

ADAAG 4.5.2 (Changes in Level) not apply within these areas.

*Response.* This exception has been amended in the final rule to include all animal containment areas and is not limited to those for "hooved" animals. The Board agrees that there often are areas where many different types of animals are contained and are not limited solely to hooved animals. Exemption from the requirements to ADAAG 4.5.2 (Changes in Level) has also been included since absorbent surfaces used to ensure the care and health of animals may conflict with this provision. As previously discussed, an exception has been added to ADAAG 4.1.1(5)(b) to clarify that accessibility is not required in animal containment areas that are not for public use.

*Section 4.1.3(5) Exception 4(f)  
Platform Lifts for Team or Player Seating Areas*

An exception is added to this section permitting the use of a platform lift in new construction as a means of providing access to team or player seating areas serving areas of sport activity.

*Comment.* The proposed rule did not include an option to use a platform lift in new construction to provide access to team or player seating areas. The AIA and several architects representing a firm that specializes in sports facilities commented that platform lifts should be an option. They were particularly concerned about providing access to dugouts and other recessed team player seating areas in major league stadiums. They believed that providing a ramp parallel to the playing field presents a dangerous tripping and falling hazard for players attempting to field foul balls. Other groups representing persons with disabilities commended the Board for not allowing platform lifts in this environment in new construction. Among other issues, they cited the problems associated with relying on a mechanical device to provide access in newly constructed buildings and facilities.

*Response.* The final rule includes an option to use a platform lift as part of an accessible route connecting team or player seating areas. While the Board includes this as an option in new construction, it is recommended that where possible, ramps be utilized. This will reduce reliance for persons with disabilities on a mechanical device when providing access. Several minor league stadiums have incorporated a ramp into their design in recent years. It is the Board's understanding that there have been no reported incidents of accidents related to the ramps.

Information on major league stadiums is not available since ramps have not been incorporated into their designs.

*Section 4.1.3(12)(c) Lockers*

This section is amended to require that where lockers are provided, at least 5 percent, but not less than one, of each type of locker, must comply with ADAAG 4.25.

No substantive comments were received and no changes have been made for the final rule.

*Section 4.1.3(13) Controls and Operating Mechanisms for Exercise Equipment and Machines*

An exception is added to this section to exempt exercise machines from the requirements of ADAAG 4.27 (Controls and Operating Mechanisms).

No substantive comments were received and no changes have been made for the final rule.

*Section 4.1.3(19)(c) Team or Player Seating Areas*

This section is amended to require that where team or player seating areas contain fixed seats and serve an accessible area of sport activity, the seating area must contain the number of wheelchair spaces required by ADAAG 4.1.3(19)(a), but not less than one space. Wheelchair spaces must comply with ADAAG 4.33.2, 4.33.3, 4.33.4, and 4.33.5.

An accessible route is required to connect to the team player seating areas. An accessible route is also required to connect to the area of sport activity which is defined as "that portion of a room or space where the practice or play of a sport occurs." For the most part, the requirement is intended to provide access to the boundary of where the sport is played. In some cases, this will provide for a "level" entry to the area of sport activity such as a softball field or football field. In other cases, there may be changes in level and non-accessible surfaces. The Board recognizes that the accessible route requirement may, in some cases, not ensure access directly onto the area of sport activity. Where possible, designers are encouraged to provide for a smooth transition to the area of sport activity. This requirement is not intended to change the nature of the sport to provide access.

*Comment.* The AIA questioned how wheelchair spaces in team or player seating areas could meet the requirements of ADAAG 4.33.3. ADAAG 4.33.3 requires, among other things, that the wheelchair spaces provide a choice of admission prices or lines of sight

comparable to those afforded members of the general public.

*Response.* An exception has been added in the final rule exempting the wheelchair spaces in team or player seating areas from requirements related to choice of admission price or lines of sight comparable to those for members of the general public. Section 4.1.3(19)(c) is intended to ensure that at least one wheelchair space is provided in team or player seating areas. This can easily be accomplished through clear space adjacent to a fixed bench, for example. Bench seating will also serve as companion seating. Where designers and operators are planning facilities to serve a variety of wheelchair sports, it is recommended that the minimum be exceeded to more adequately accommodate wheelchair sports team.

Exception 2 is added to clarify that the requirements for accessible team or player seating does not apply to bowling lanes that are not required to be on an accessible route. Section 15.7.3 requires 5 percent, but not less than one, of each type of bowling lane to be served by an accessible route. Only those team or player seating areas that serve the bowling lanes required to be on an accessible route must have accessible team or player seating.

*Comment.* The proposed rule included an exception to ADAAG 4.1.3(19) for assembly seating in amusement facilities. The exception permitted use of a transfer seat complying with 15.1.4 where the motion of the seats is an integral part of the amusement experience. A few commenters questioned why this was permitted and recommended that wheelchair spaces be designed so as to provide the same general experience or effects as other seats.

*Response.* This exception has been deleted in the final rule. The Board is aware of amusement facilities where the various effects provided within the wheelchair space. Many of the effects, such as misting or smoke, may be easy to incorporate into the wheelchair space. Others effects, such as aggressive seat motion, may be extremely difficult to incorporate and may possibly be unsafe. The Board expects that designers will provide the same effects for the wheelchair space as other seats, to the extent possible. An appendix note also recommends that providing companion seats with removable armrests will provide an option for persons using wheelchairs to transfer into the seat in these venues, if desired.

#### *Section 4.1.3(21) Dressing, Fitting, or Locker Rooms*

This section requires that where dressing, fitting, or locker rooms are provided, the rooms must comply with ADAAG 4.35. An exception permits 5 percent, but not less than one, of the rooms to be accessible when they are provided in a cluster.

No substantive comments were received and no changes have been made for the final rule.

#### *Section 4.1.3(22) Saunas and Steam Rooms*

This section requires where saunas and steam rooms are provided, the rooms must comply with ADAAG 4.36. An exception permits 5 percent, but not less than one, of the rooms to be accessible when they are provided in a cluster.

No substantive comments were received and no changes have been made for the final rule.

#### *Section 4.35 Dressing, Fitting, and Locker Rooms*

##### *Section 4.35.1 General*

This section requires dressing, fitting, and locker rooms required to be accessible by ADAAG 4.1 to comply with ADAAG 4.35 and to be on an accessible route.

No substantive comments were received and no changes have been made for the final rule.

##### *Section 4.35.4 Benches in Accessible Dressing Rooms, Fitting Rooms, and Locker Rooms*

This section requires benches complying with ADAAG 4.37 in accessible dressing, fitting, and locker rooms.

No substantive comments were received and no changes have been made for the final rule.

#### *Section 4.36 Saunas and Steam Rooms*

##### *Section 4.36.1 General*

This section requires saunas and steam rooms required to be accessible by ADAAG 4.1 to comply with ADAAG 4.36.

*Comment.* Several commenters questioned whether an operator would be required to provide a heat resistant wheelchair in accessible saunas and steam rooms.

*Response.* The provision of heat resistant chairs is an operational issue and outside the jurisdiction of the Board. Questions regarding the operational issues related to the use of accessible facilities and elements will be addressed by the Department of Justice

when it adopts accessibility standards for recreation facilities.

##### *Section 4.36.2 Wheelchair Turning Space*

This section requires wheelchair turning space complying with ADAAG 4.2.3 to be provided within a sauna or steam room. An exception permits the wheelchair turning space to be obstructed by readily removable seats.

*Comment.* The proposed rule permitted the maneuvering space to be "temporarily" obstructed by readily removable seats. Commenters questioned what would be considered "temporary".

*Response.* The term "temporarily" has been deleted in the final rule. The intent of the provision is to permit a seat or bench to be located within the required maneuvering space within a room, provided that it can be readily removed. The focus of the exception is on the seat being "readily removable" to enable persons using wheelchairs to avail themselves of smaller saunas and steam rooms.

##### *Section 4.36.3 Sauna and Steam Room Bench*

This section requires that where seating is provided in a sauna or steam room, at least one bench complying with ADAAG 4.37 must be provided. An exception permits the clear floor space required by ADAAG 4.37.1 to be obstructed by readily removable seats.

*Comment.* The proposed rule permitted readily removable seats to "temporarily" obstruct the clear floor space and commenters questioned what would be considered "temporary".

*Response.* As discussed above, the term "temporarily" has been deleted in the final rule.

##### *Section 4.36.4 Door Swing*

This section requires that doors shall not swing into any part of the clear floor space required at an accessible bench.

No substantive comments were received and no changes have been made for the final rule.

#### *Section 4.37 Benches*

##### *Section 4.37.1 General*

Benches required to be accessible by 4.1 must comply with 4.37. No substantive comments were received and no changes have been made for the final rule.

##### *Section 4.37.2 Clear Floor or Ground Space*

This section requires clear floor or ground space complying with ADAAG 4.2.4 to be provided and be positioned for a parallel approach to a short end of

a bench seat. An exception permits the clear floor or ground space required by 4.37.2 to be obstructed by readily removable seats in saunas and steam rooms.

No substantive comments were received and no changes have been made to this provision in the final rule.

#### Section 4.37.3 Size

The final rule requires benches to be fixed and have seats that are 20 inches minimum to 24 inches maximum in depth and 42 inches minimum in length.

*Comment.* A few comments questioned whether a portable bench would meet the requirements for accessible benches.

*Response.* This provision has been modified in the final rule to include the term "fixed".

#### Section 4.37.4 Back Support

This section requires benches to have back support that is 42 inches minimum in length and that extends from a point 2 inches maximum above the seat to a point 18 inches minimum above the bench.

*Comment.* The proposed rule included the requirement for back support under ADAAG 4.37.2 (Size). Commenters expressed confusion over the requirements for back support for benches and some questioned whether back support was required.

*Response.* Back support is required for an accessible bench in a sauna or steam room, or a dressing room. To clarify this requirement, the technical provisions that were part of ADAAG 4.37.2 in the proposed rule have been included in a separate provision, ADAAG 4.37.3, in the final rule.

#### Section 4.37.5 Seat Height

This section requires benches to be 17 inches minimum to 19 inches maximum above the floor or ground.

No substantive comments were received and no changes have been made for the final rule.

#### Section 4.37.6 Structural Strength

This section requires that benches be strong enough to withstand a vertical or horizontal force of 250 pounds applied at any point on the seat, fastener, mounting device, or supporting structure.

No substantive comments were received and no changes have been made for the final rule.

#### Section 4.37.7 Wet Locations

This section requires that where installed in wet locations, the surface of benches must be slip-resistant and shall not accumulate water.

No substantive comments were received and no changes have been made for the final rule.

#### Section 10.5 Boat and Ferry Docks

This section is deleted in the final rule.

*Comment.* The proposed rule applied the accessibility guidelines for recreational boating facilities to boat and ferry docks located at transportation facilities, covered by ADAAG Section 10. This section of the proposed rule received little comment.

*Response.* The Board is concerned that those involved in the design and construction of boat and ferry docks may not have been fully aware of the proposed rule and therefore may not have evaluated its impact on such facilities. In addition, through the proposed rule, the Board sought information to establish access provisions for gangways based on the size of vessels using floating piers. Few commenters responded to the question, and none provided the type of information the Board was seeking.

The Board is not addressing commercial boat and ferry docks at transportation facilities at this time. In the future, the Board will consider whether such transportation facilities should be treated differently than recreational boating facilities covered by 15.2. As a result, ADAAG 10.5 has been deleted.

#### Section 15 Recreation Facilities

Section 15 has been added to ADAAG and contains accessibility guidelines for amusement rides, boating facilities, fishing piers and platforms, golf courses, miniature golf courses, exercise equipment and machines, bowling lanes, shooting facilities, and swimming pools and spas. Unless otherwise modified in section 4 or specifically addressed in 15, all other ADAAG provisions apply. For example, special technical provisions have not been included in section 15 for toilet rooms or for accessible parking. In this case, other appropriate provisions in ADAAG 4.22 and ADAAG 4.6 apply. The accessibility guidelines for play areas, which were issued on October 18, 2000 (65 FR 62498) are reprinted in Section 15.

*Comment.* A few commenters suggested that the term "recreation facilities" be defined. They suggested that the lack of definition leaves some doubt about how to apply the provisions in this section. They questioned whether locker rooms for a professional sports team, for example, would be considered a "recreation facility".

*Response.* Recreation facilities is not defined in the final rule. The term is used generally to address the types of elements and facilities covered by this section. The term is inclusive and applies to buildings and facilities designed and constructed for recreation, as well as elements and spaces located in a facility. For example, section 15.7.1 would apply to exercise equipment and machines located in an office building as a part of employee health club. Also, these provisions would apply to locker rooms for professional and other sports teams.

#### Section 15.1 Amusement Rides

Significant comment on amusement ride accessibility was received on the proposed rule. The proposed rule would have required that one wheelchair space and one transfer seat be provided for each 100 seats on new amusement rides and proposed technical provisions for the wheelchair spaces and transfer seats. The majority of comments were from amusement park operators, and amusement ride manufacturers and designers. The Board also received comments from groups representing persons with disabilities.

Overall, commenters did not support the provisions in the proposed rule for access to amusement rides. The commenters stated that the proposed rule lacked flexibility, making it impossible for most rides to comply with the guidelines given the uniqueness of this industry. They also raised concern about the lack of available manufactured rides that would meet the proposed provisions. Most rides are manufactured outside the United States where there is an absence of accessibility requirements. The ride manufacturers in the United States indicated significant hardship on their businesses to retool to meet some of the proposed technical provisions. Amusement park operators interpreted the proposed rule to require operators to modify manufactured rides. Most indicated that they were either unwilling or unable to modify a ride in a way that would differ from the manufacturer's specifications because they were not willing to accept the liability associated with modifying the ride or did not have sufficient engineering expertise to do so.

Additionally, several groups representing persons with disabilities expressed concern that some rides, such as walk through attractions and fun houses, would be exempt along with rides in traveling carnivals. They wanted the accessibility guidelines to encourage ride manufacturers to make all rides accessible. The Eastern

Paralyzed Veterans Association (EPVA) wanted the number of accessible amusement rides to be doubled from the proposed rule.

Because of these comments, the Board held several information meetings with representatives from the amusement industry and others to gather additional information. Site visits were also made to several amusement parks to better understand the issues raised. The information gained from these meetings and site visits have shaped the amusement ride section of the final rule.

Based on this information, the final rule differs significantly from the proposed rule. The final rule makes major changes in the number of accessible spaces per ride and in the options for providing access. It also includes different requirements for wheelchair spaces and for ride seats designed for individuals to transfer from their wheelchair or other mobility device. The final rule provides the flexibility requested by commenters in this unique environment, while still providing a high level of accessibility to persons with disabilities.

Since this is the first time national accessibility guidelines have been established for amusement rides, the Board intends to monitor the implementation of these guidelines. As with other accessibility guidelines developed by the Board, future updates and revisions are planned to ensure that the guidelines reflect new designs and technology.

### Section 3.5 Definitions

Three terms are defined for amusement rides.

An "amusement ride" is a system that moves persons through a fixed course within a defined area for the purpose of amusement. Editorial changes are made in the final rule to be consistent with terms used within the amusement industry.

*Comment.* A few commenters questioned whether this section would apply to a ski lift, tram, or a gondola. Trams and gondolas are provided at some amusement parks.

*Response.* Section 15.1 is not intended to apply to ski lifts, trams, or gondolas. These devices are designed primarily for the purpose of transporting people from one point to another. While a ride on a ski lift or tram may be enjoyable, it is not designed primarily for the "purpose of amusement". Trams and similar vehicles are already addressed in the ADA Accessibility Guidelines for Transportation Vehicles (Vehicle Guidelines). See 36 CFR 1192.179.

An "amusement ride seat" is defined as a seat that is built-in or mechanically fastened to an amusement ride intended to be occupied by one or more passengers. This is a new term which has been added to the final rule.

"Amusement ride seats" are referenced in several of the technical provisions.

*Comment.* The proposed rule did not include the term "amusement ride seat." Several commenters including those representing the International Association of Amusement Parks and Attractions (IAAPA) questioned the differences between the transfer seat and the amusement ride seat in the proposed rule. Questions were also raised about the application of the guidelines to rides without seats or those designed with a variety of riding postures, such as toboggan style.

*Response.* A definition for amusement ride seats is added to the final rule. The Board intends the guidelines to apply to amusement rides with seats. Specific technical provisions included in this section address clear floor or ground space and maneuvering space requirements for amusement ride seats where transfer access is provided. Technical provisions focus on ensuring that people can transfer from their wheelchairs or mobility aids to the ride seats. With respect to the various riding postures, the Board intends these guidelines to apply to those amusement rides with ride seats, including toboggan style, but not to those amusement rides where the rider is expected to be in the prone position or standing. In these cases, however, an accessible route complying with ADAAG 4.3 is required to the load and unload area.

A "transfer device" is defined as equipment designed to facilitate the transfer of a person from a wheelchair or other mobility device to and from an amusement ride seat. Several new scoping and technical provisions included in the final rule specify a "transfer device." An appendix note provides additional information on available transfer devices, including ways to provide equipment that will provide for a safe and independent transfer from a wheelchair or other mobility device.

### Section 15.1.1 General

Newly designed or newly constructed and altered amusement rides are required to comply with 15.1.1. Four exceptions are included in the final rule. Under Exception 1, portable or mobile amusement rides are not covered by the guidelines. Exceptions 2, 3, and 4 clarify that amusement rides that are controlled or operated by the rider; amusement rides designed primarily for

children, where children are assisted on and off the ride by an adult; and amusement rides without amusement ride seats are only required to comply with 15.1.4 and 15.1.5, which requires an accessible route to and maneuvering space in the load and unload areas.

*Comment.* Amusement park operators requested clarification regarding how the guidelines apply to existing rides.

*Response.* As previously mentioned, the final rule is significantly different from the proposed rule. The term "new" is included in 15.1.1 to clarify that this section applies to "new" rides and not to existing rides. The Department of Justice has the rulemaking authority to address existing rides.

A custom manufactured ride is new upon its "first use", which is the first time amusement park patrons take the ride. With respect to amusement rides purchased from other entities, "new" refers to the first permanent installation of a ride, whether the ride is used "off the shelf" or is modified before it is installed. The application of these guidelines to existing amusement rides that are altered is discussed elsewhere in this preamble. The final rule provides operators with the requested flexibility. Providing opportunities for access for persons with disabilities may be accomplished under the final rule without modifying the ride itself.

*Comment.* The preamble of the proposed rule explained that the guidelines applied to permanent amusement rides with fixed seats that are set up for a long duration and are not regularly assembled and disassembled. Amusement rides set up for short periods of time such as rides that are part of traveling carnivals, State and county fairs, festivals, and other special events are not addressed by these guidelines. The majority of amusement ride manufacturers supported this approach and considered it appropriate given the uniqueness of these rides. However, the commenters were concerned that the proposed rule did not specifically exempt temporary rides. Others suggested that a time frame be attached to this concept of "temporary" to clarify specifically what is meant. They suggested a 90 day or less time frame be used to define how long such rides can operate at the same location. Several groups representing persons with disabilities believed that temporary rides should also be accessible. They believed that manufacturers should be encouraged to make temporary rides as accessible as permanent rides.

*Response.* Exception 1 is added to specify that mobile or portable amusement rides are not covered by

15.1. The Department of Justice is authorized to determine the applicable requirement for these rides.

While mobile rides are not specifically addressed by these guidelines, other ADA requirements including general nondiscrimination obligations, program accessibility, and barrier removal provisions of the ADA apply to covered entities operating mobile or portable amusement rides. Mobile amusement rides are subject to a variety of site conditions that affect the load and unload areas. Because the rides are transported over the road, their size and weight is also restricted. This can limit the size available for the load and unload areas along with the accessible route to the ride.

Ride operators and manufacturers are encouraged to apply the provisions of this section to mobile amusement rides, where possible. Mobile rides are available that provide roll-on access and others may be close to providing transfer access with some minor adaptations in the load and unload areas. The Board will, upon request, work with interested manufacturers to provide guidance on providing either roll-on access or transfer access for someone using a wheelchair or mobility device.

#### *Exception 2*

*Comment.* The proposed rule excluded from the definition of amusement rides, those rides which are controlled or operated by the rider such as bumper cars and go-carts. A few commenters suggested that these types of rides also be addressed by this section. Several commenters requested guidance on whether making a ride turn faster or shake faster would be considered "control".

*Response.* An exception has been added to the final rule for rides that are controlled by the rider requiring such rides to only provide an accessible route to the ride and maneuvering space in the load and unload areas. The Board plans to gather additional information for making these rides accessible for potential rulemaking in the future. In the interim, designers and operators may use the applicable provisions in ADAAG and this final rule as a guide in providing access.

With respect to the issue of control, the exception is not intended to apply to those rides where patrons may affect some incidental movements of the ride, but otherwise have no control.

#### *Exception 3*

*Comment.* The proposed rule did not distinguish between those rides designed for adults and those designed

for young children, also known as "kiddie rides." Many amusement park operators and ride manufacturers commented that "kiddie rides" should be exempt from compliance with the provisions of 15.1.1. Most indicated that size restrictions will prohibit compliance with several of the provisions.

*Response.* Because of their size restrictions, an exception has been added to the final rule for "kiddie" rides requiring such rides to only provide an accessible route to and maneuvering space in the load and unload area. The requirement for an accessible route will provide access for adults and family members assisting children on and off these rides. An amusement industry definition for "kiddie rides" includes rides designed for children up to the age of 12. The Board does not support an exemption for rides designed for children up to age 12. Rather, the exception is limited to those rides designed "primarily" for children, where children are assisted on and off the ride by an adult. The Board intends that this exception be limited to those rides designed for children and not for the occasional adult user.

#### *Exception 4*

*Comment.* Some commenters interpreted the proposed rule to apply to amusement rides without seats.

*Response.* Section 15.1 of the proposed rule limited the application of this section to rides "containing fixed seats". Exception 4 is added in the final rule to further clarify that 15.1 does not apply to amusement rides without ride seats. Amusement rides without seats are required to be served by an accessible route and connect to accessible load and unload areas.

#### *Section 15.1.2 Alterations to Amusement Rides*

Section 15.1 applies to amusement rides that are altered. This section clarifies that a modification to an existing amusement ride is an alteration if one or more of the following conditions apply: (1) The amusement ride's structural or operation characteristics are changed to the extent that the ride's performance differs from that specified by the manufacturer or the original design criteria; or (2) the load and unload area of the amusement ride is newly designed and constructed.

*Comment.* The majority of commenters questioned how the proposed rule applied to existing amusement rides. Many commenters believed that the guidelines require that all existing amusement rides be accessible. Others inquired about the

requirements for existing rides that are modified and the type of modification that would trigger the alteration provisions.

*Response.* The final rule addresses alterations to existing amusement rides. See the discussion at the beginning of this preamble for further information on ADA obligations for existing amusement rides.

Where an existing amusement ride is modified in a way that does not change the ride's structural or operational characteristics to the extent that the ride's performance differs from that specified by the manufacturer's or original design criteria, the amusement ride is not required to comply with 15.1.1. Routine maintenance, painting, and changing of story boards are examples of activities that do not constitute an alteration.

As with other elements or facilities subject to the alterations provisions in ADAAG, "technical infeasibility" applies to alterations of amusement rides. In this case, compliance with the technical provisions is required except where the nature of the existing ride makes it virtually impossible to comply fully. In these circumstances, the alteration should provide the maximum accessibility feasible.

*Comment.* Commenters requested clarification regarding how the guidelines apply where amusement rides are moved.

*Response.* In response to this question, a provision has been added that requires a ride to be accessible when a new load and unload area is designed and constructed for the ride. This provision applies where a ride is moved either within a park or to another park and a new load and unload area is designed and constructed. The ride must comply with 15.1.1. Operators have a choice of providing either a wheelchair space, ride a seat designed for transfer, or a transfer device. In most cases with an existing amusement ride, providing a transfer device may be the most appropriate. This option does not require modification to the ride. Where an amusement ride is moved and the load and unload area is not modified, the provisions of 15.1.1 do not apply. In this case, the on-going obligations of "readily achievable barrier removal" or "program accessibility" will apply.

#### *Section 15.1.3 Number Required*

This section requires each amusement ride to provide at least one wheelchair space complying with 15.1.7, or at least one amusement ride seat designed for transfer complying with 15.1.8, or at least one transfer device complying with 15.1.9.

*Comment.* The proposed rule required one wheelchair space per 100 fixed seats and one transfer seat per 100 fixed seats to be provided on each amusement ride. An exception permitted two transfer seats in lieu of a wheelchair space where a wheelchair space is not operationally or structurally feasible. Significant comment was received on this provision during the comment period. Amusement park operators stated that the number of accessible spaces (both wheelchair and transfer seats) was too high. Several amusement park operators cited safety concerns with respect to evacuation where more than one wheelchair user may be on a ride at one time. Others expressed concern about lengthening the load and unload time. Groups representing persons with disabilities were concerned that the number of wheelchair spaces and transfer seats in the proposed rule was too low. The Eastern Paralyzed Veterans Association (EPVA) wanted the number doubled from the proposed rule, potentially requiring two wheelchair spaces and two transfer seats per ride.

*Response.* The final rule requires that each ride provide: (1) A wheelchair space, or (2) a ride seat designed for transfer, or (3) a device to facilitate the transfer of a person in a wheelchair from the load or unload area to a ride seat. This represents a decrease in the number of accessible spaces from the proposed rule and is no longer dependent on the number of seats per ride. Designers and operators have the choice of deciding which of the three types of access is appropriate for a given ride. Where a manufactured ride does not permit space for a wheelchair, for example, a ride seat designed for transfer or a transfer device may be provided to help an individual transfer into the ride seat.

The Board is aware of amusement rides in certain parks that currently exceed this minimum and provide more than one wheelchair space on a given ride. In these cases, more persons with disabilities and their families are able to ride at the same time. Amusement park operators are encouraged to exceed the minimum with their new rides.

#### Section 15.1.4 Accessible Route

This section requires that, when in the load and unload position, amusement rides with wheelchair spaces, or ride seats designed for transfer, or transfer devices, must be served by an accessible route complying with ADAAG 4.3. Any part of an accessible route serving amusement rides with a slope greater than 1:20 is considered a ramp and must comply

with ADAAG 4.8. The accessible route is required only to the wheelchair space or transfer loading station, and not to all stations. This route can deviate from the main route in order to access the particular station designated.

Three new exceptions to 15.1.4 are provided in the final rule. Exception 1 exempts ramps from the maximum slope specified in ADAAG 4.8.2, where compliance with 4.8.2 is structurally or operationally infeasible, provided that the slope of the ramp may not exceed 1:8. Exception 2 exempts the requirements for handrails on the accessible route where compliance is structurally or operationally infeasible. Exception 3 permits that use of limited-use/limited-application elevators and platform lifts complying with ADAAG 4.11 to be part of an accessible route serving the load and unload area.

*Comment.* The proposed rule required an accessible route to connect the portion of the load and unload area serving each accessible amusement ride and to provide a maneuvering space with a slope not greater than 1:48. Commenters questioned whether the 1:48 slope applied to the accessible route on the ride and the appropriateness of this requirement for those rides where a transfer seat was provided.

*Response.* The requirements for an accessible route are maintained in the final rule, but are modified to clarify that at least one accessible route requirement applies when the ride is in the load and unload position. The requirement for a maneuvering space is moved to 15.1.4, which addresses the load and unload areas. The provision also clarifies that where the running slope serving the amusement ride or transfer devices is greater than 1:20, the provisions of ADAAG 4.8 apply.

*Comment.* Operators expressed concerns with the requirements of ADAAG 4.8 with respect to the maximum slope (1:12) and the maximum rise (30 inches) for the accessible route. They described rides where space limitations will prohibit long ramps and where fundamental changes to amusement rides would be necessary to comply with ADAAG 4.8.2.

*Response.* An exception is added in the final rule that exempts the accessible route serving accessible rides from the maximum slope specified in ADAAG 4.8.2, provided that the slope may not exceed 1:8. The exemption only applies where compliance with ADAAG 4.8.2 is "structurally or operationally" infeasible. The exception for structural or operational limitations is limited to that portion of the accessible route connecting the load and unload areas

with the amusement ride. There is no exception for other portions of the accessible route, such as the queue line leading to the load and unload areas.

*Comment.* Ride operators and designers also stated that the requirement for handrails was not practical on the portion of the accessible route connecting the load and unload areas and the ride. They again cited space limitations especially where ramps are integrated into the ride and folded out of the way when the ride is in use.

*Response.* An exception from the requirement for handrails is added in the final rule. Similar to exception 2, this exception is limited to circumstances where compliance with the handrail requirement is structurally or operationally infeasible.

*Comment.* The proposed rule did not include a provision permitting the use of a limited-use/limited-application elevator or a platform lift as a part of the accessible route in providing access to load and unload areas. The American Institute of Architects (AIA) and others in the amusement industry recommended their use in connecting these areas, especially in connecting elevated load and unload areas and those that cross tracks.

*Response.* An exception is provided in the final rule permitting the use of limited-use/limited-application elevators and platform lifts complying with ADAAG 4.11. The Board has included this option in the final rule to address some of the unique designs and elevated loading areas used within an amusement park. Where platform lifts are used, they must comply with ADAAG 4.11. Future revisions to ADAAG will include technical provisions for limited-use/limited-application elevators. At that time, appropriate provisions will be referenced for these elevators. Currently available design and safety standards should be applied in the interim.

*Comment.* Some commenters questioned whether moving turnstiles and walkways can serve as part of an accessible route connecting amusement rides.

*Response.* The Board has not specifically addressed moving turnstiles and walkways, since they are always capable of stopping or slowing to accommodate guests needing additional time. At this time there is not sufficient information to suggest a consistent safe speed for use for all persons with disabilities. Some individuals will be able to maneuver within the speed and time provided on the moving walkway or turnstile, while others will need additional time. Operators may need to

adjust the speed accordingly to reasonably accommodate guests with disabilities.

#### *Section 15.1.5 Load and Unload Areas*

This section requires load and unload areas serving amusement rides required to comply with 15.1 to provide a maneuvering space complying with ADAAG 4.2.3. The maneuvering space must have a slope not steeper than 1:48. The maneuvering space is permitted to overlap the accessible route and the required clear floor spaces.

No substantive comment was received and no changes have been made for the final rule.

#### *Section 15.1.6 Signage*

This section requires signage to be provided at the entrance of the queue or waiting line for each amusement ride to identify the type of access provided (e.g., wheelchair access or transfer access). Where an accessible unload area also serves as the accessible load area, signage must be provided at the entrance to the queue or waiting line indicating the location of the accessible load and unload area. This is important to avoid unnecessary backtracking when patrons begin the process of waiting in line for a particular ride. No substantive comments were received and no changes have been made to this provision in the final rule.

#### *Section 15.1.7 Amusement Rides With Wheelchair Spaces*

This section contains technical provisions for amusement rides with wheelchair spaces.

*Comment.* Several amusement ride designers and manufacturers raised concerns about technical provisions for wheelchair spaces on amusement rides. Most commenters believed that the space required was too large and boxy, and would significantly limit the number of amusement rides that could incorporate such a space. Some recommended that knee and toe clearances be incorporated into the space. In general, designers and operators requested more flexibility with wheelchair spaces on amusement rides.

*Response.* The Board has significantly modified the requirements for wheelchair spaces on amusement rides. The final rule includes changes which address the commenters concerns, while still requiring a minimum space that would serve most mobility devices on an amusement ride. The Board recommends that where possible, designers and manufacturers exceed the minimum space. Providing additional space will greatly enhance the ease in

loading and unloading and accommodate a greater variety of mobility devices.

#### *Section 15.1.7.1 Floor and Ground Surface*

This section contains technical provisions for floor or ground surface of wheelchair spaces.

*Comment.* The proposed rule required wheelchair spaces to comply with several provisions of ADAAG 4.5 (4.5.1, 4.5.3, 4.5.4). Commenters expressed some confusion over these references and sought clarification.

*Response.* Rather than referencing ADAAG 4.5, the final rule incorporates these provisions into 15.1.7.1 for clarity. Other editorial changes are also made within this section.

##### *Section 15.1.7.1.1 Slope*

This section requires the floor or ground surface of wheelchair spaces to have a maximum slope of 1:48 when in the load and unload position and to be firm and stable.

*Comment.* Commenters questioned the appropriateness of requiring the clear space to be level when the amusement ride is in motion.

*Response.* The section is modified to clarify that the maximum 1:48 slope is only required when the amusement ride is in the load and unload position.

##### *Section 15.1.7.1.2 Gaps*

This section requires floors of amusement rides with wheelchair spaces and floors of load and unload areas to be coordinated so that when the amusement rides are at rest in the load and unload position, the vertical difference between the floors must be within plus or minus  $\frac{5}{8}$  inches and the horizontal gap should be no greater than 3 inches under normal passenger load conditions. An exception permits that where it is not operationally or structurally feasible to meet the horizontal or vertical difference requirements, ramps, bridge plates, or similar devices complying with the applicable requirements of 36 CFR 1192.83(c) (the Board's vehicle accessibility guidelines) must be provided.

*Comment.* No substantive comment was received on this section. Several representatives from the amusement industry, however, recommended that the Board reference an ASTM Standard Practice for the Design and Manufacture of Amusement Rides and Devices where ramps, bridge plates, lifts, or similar devices are used.

*Response.* The Board carefully examined the suggested ASTM Standard Practice and determined that it was

designed as a safety standard rather than a standard that provides guidance on the minimum access requirements for ramps, bridge plates, lifts, and similar devices. Operators and manufacturers are not precluded from also following the standards in the ASTM Standard Practice for the operation of these elements. The applicable requirements of 36 CFR 1192.83(c) (ADA Accessibility Guidelines for Transportation Vehicles—Light Rail Vehicles and Systems—Mobility Aid Accessibility) are available on the Board's Web site at [www.access-board.gov/transit/html/vguide.htm#LRVM](http://www.access-board.gov/transit/html/vguide.htm#LRVM).

#### *Section 15.1.7.2 Clearances*

This section requires clearances for wheelchair spaces to comply with 15.1.7.2. Three new exceptions are added. Exception 1 permits securement devices, where provided, to overlap the required clearances of the wheelchair space. Exception 2 permits the wheelchair space to be mechanically or manually repositioned. Exception 3 permits departure from the requirements of ADAAG 4.4.2 (Head Room) for the wheelchair space.

*Comment.* The proposed rule did not specifically address securement devices in wheelchair spaces. Commenters questioned whether securement devices could be located within the minimum clear space requirements for wheelchair spaces on amusement rides. They noted that while the proposed rule did not specifically address or require these devices, many operators have provided them where wheelchair spaces are provided on amusement rides.

*Response.* The final rule adds an exception to 15.1.7.2 to permit securement devices to overlap required clearances for wheelchair spaces on amusement rides. However, the final rule does not require securement devices. The decision about whether securement devices are needed is left up to the designer or manufacturer. Where provided, these devices may overlap the required clearances for wheelchair spaces.

*Comment.* As previously discussed, the Board received a significant number of comments from representatives in the amusement industry on the need for more flexibility. Several operators of large parks demonstrated ways that wheelchair spaces were provided on rides through the use of a turntable. This permits the space to be orientated for a forward approach and later turned to be in line with the direction of the motion of the amusement ride. Commenters did not consider repositioning to be an option under the proposed rule.

*Response.* Exception 2 has been added to the final rule and permits the wheelchair space on an amusement ride to be either manually or mechanically repositioned.

*Comment.* A few amusement park designers raised concern about the head clearance requirements of ADAAG 4.4 (Protruding Objects) for the wheelchair space located on an amusement ride. Amusement rides are often designed to move through confined spaces in order to enhance the amusement experience. Since most of these rides are designed for seated patrons, designers requested exemption from this requirement.

*Response.* Exception 3 is added in the final rule and exempts wheelchair spaces on rides from ADAAG 4.4.2 (Head Room). This exception applies to circulation space and clear space requirements on the ride. It does not apply to circulation areas and accessible routes in the queue line or the load and unload areas.

#### *Section 15.1.7.2.1 Width and Length*

This section requires wheelchair spaces to have a width of 30 inches minimum and a length of 48 inches minimum measured 9 inches minimum above the ground or floor surface.

*Comment.* The proposed rule required the wheelchair space to be a minimum of 36 inches in width. This width was based on the minimum 30 inch width needed for a stationary wheelchair with the additional 6 inches necessary for repositioning in confined spaces which allows space for the front casters of a wheelchair to turn and move when backing up. Designers expressed significant concern over the 36 minimum width and questioned why it was necessary where the space is reached in a forward direction. They further cited designs where the space is manually or mechanically repositioned and therefore should not require further maneuvering. Some commenters also suggested that the depth of the clear space could be 48 inches in all cases.

*Response.* The minimum width of the wheelchair space is reduced to 30 inches in the final rule. While the Board has decreased the minimum width, it recommends that designers and manufacturers exceed the minimum where possible to allow for increased maneuvering space.

#### *Section 15.1.7.2.2 Wheelchair Spaces—Side Entry*

This section requires that where the wheelchair space can be entered only from the side, the ride must be designed to permit sufficient maneuvering space for individuals using a wheelchair or

mobility device to enter and exit the ride.

*Comment.* A few commenters questioned what the minimum space requirements would be for a ride entered from the side. They questioned whether a 32 inch side opening leading to a 30 inch wide by 48 inch long space would be sufficient.

*Response.* Section 15.1.7.2.2 is added to address rides with side entries. A center opening of 32 inches combined with a minimum space of 30 inches wide and 48 inches long is not adequate space for maneuvering. Designers must consider the position of the opening in relation to the minimum space. In some cases, additional clear space and larger openings will be necessary to allow for maneuvering a wheelchair on the ride. An appendix note is included to provide further guidance.

#### *Section 15.1.7.2.3 Protrusions in Wheelchair Space*

This section permits protrusions in the wheelchair spaces on amusement rides. Objects are permitted to protrude a distance of 6 inches maximum along the front of the wheelchair space where located 9 inches minimum and 27 inches maximum above the wheelchair space. Objects are also permitted to protrude a distance of 25 inches maximum along the front of the wheelchair space where located more than 27 inches above the wheelchair space.

*Comment.* As previously noted, amusement ride designers and operators commented that the wheelchair space clearances in the proposed rule were too restrictive and did not permit knee and toe clearances. They suggested that the clearances could be reduced without compromising the minimum space requirements.

*Response.* The final rule permits protrusions in the wheelchair space on amusement rides.

#### *Section 15.1.7.3 Openings*

This section requires that where openings are provided to access wheelchair spaces on amusement rides, the entry must provide a 32 inch minimum clear opening.

*Comment.* The proposed rule did not specify a minimum opening space where wheelchair spaces are provided on amusement rides. Commenters requested guidance on this dimension.

*Response.* A provision is added in the final rule to address the minimum width of openings where wheelchair spaces are provided on an amusement ride. This is consistent with minimum width requirements for doors and other

passageways that are part of an accessible route.

#### *Section 15.1.7.4 Approach*

This section requires one side of the wheelchair space to adjoin an accessible route.

No substantive comment was received on this provision.

#### *Section 15.1.7.5 Companion Seats*

This section requires that where the interior of an amusement ride is greater than 53 inches in width, seating is provided for more than one rider, and the wheelchair is not required to be centered within the amusement ride, a companion seat must be provided for each wheelchair space.

*Comment.* The proposed rule required companion seating where seating for more than one rider is provided. Ride manufacturers commented that providing companion seating may not be possible on rides where the center of gravity is critical to its operation. They noted that providing space for an individual seated in a wheelchair and a seated companion may increase and change the weight distribution on a ride. They supported a provision with limits that are linked to the minimum width of the ride, whether or not seating is provided for more than one rider, and whether the wheelchair space is centered on the ride.

*Response.* This section is modified in the final rule to address the concerns raised. Consistent with the proposed rule, companion seating is required only where seating is provided for more than one rider. Additionally, companion seating is required only where the interior of an amusement ride is greater than 53 inches in width and the wheelchair is not required to be centered within the amusement ride.

#### *Section 15.1.7.5.1 Shoulder-to-Shoulder Seating*

This section requires that where an amusement ride provides shoulder-to-shoulder seating, companion seats must be shoulder-to-shoulder with the adjacent wheelchair space.

*Comment.* Commenters suggested that in some circumstances, shoulder-to-shoulder seating may not be possible. They cited examples of water rides where the rider's center of gravity is critical. Adding two riders side by side can alter the balance of the ride.

*Response.* An exception is added in the final rule that shoulder-to-shoulder companion seating is required only to the maximum extent feasible, where compliance is not operationally or structurally feasible.

### Section 15.1.8 Amusement Ride Seats Designed for Transfer

This section requires that amusement rides with ride seats designed for transfer must comply with 15.1.8 when positioned for loading and unloading.

*Comment.* Significant comment was received on the technical provisions addressing transfer seats. Some interpreted the proposed rule to require a "special seat" in addition to other ride seats. Others believed that the technical provisions did not provide sufficient flexibility, especially given the diversity of rides and ride seats.

*Response.* The final rule requires that each ride provide: (1) A wheelchair space, or (2) an amusement ride seat designed for transfer, or (3) a system to facilitate the transfer of a person in a wheelchair from the load or unload area to a ride seat. Where ride seats are designed for transfer, this section applies. For the most part, the technical provisions for space and other features are applied to both the ride seat and the transfer device since both elements are designed for an individual to transfer from their wheelchair or mobility device to an element. A ride seat designed for transfer is usually a seat that is a permanent part of the ride itself.

#### Section 15.1.8.1 Clear Floor Space

This section requires clear floor space complying with ADAAG 4.2.4 to be provided in the load and unload area adjacent to amusement ride seats designed for transfer.

*Comment.* The proposed rule required the clear floor space to comply with ADAAG 4.2.4 and be positioned with the longer dimension parallel to the unobstructed side of the transfer seat. The space was also required to be located within 3 inches maximum of the transfer seat. Commenters supported the basic clear floor space requirement of 30 inches by 48 inches. Several commenters however, believed that the requirements for the orientation of the clear space were too stringent for two reasons. First, the orientation required in the proposed rule was potentially limited to a side transfer. Many individuals choose to transfer using a diagonal or front approach. Second, they were concerned about the variety of amusement rides and load and unload areas. They recommended that the orientation of the clear space with respect to its location to the ride seat be left up to the designer.

*Response.* The final rule requires a 30 inch wide by 48 inch deep clear space to be adjacent to the ride seat designed for transfer. The position of the clear space is not specified in the final rule.

Designers will decide its location based on what is best suited for transfer on a particular ride.

#### Section 15.1.8.2 Transfer Height

This section requires the height of ride transfer seats to be located 14 inches minimum to 24 inches maximum measured above the load and unload surface.

*Comment.* The proposed rule required the transfer seat to be between 17 and 19 inches based on other elements within ADAAG where individuals using wheelchairs and other mobility devices are expected to transfer. Commenters requested the range to be greater.

*Response.* The final rule provides a greater range in the height of the ride seat designed for transfer. Providing a greater range in this height should reduce reliance on transfer devices and have the effect of decreasing the number of transfers to get from one's wheelchair or mobility device to a ride seat. The Board recognizes that amusement rides have unique designs. The increase in the transfer height range is limited to amusement rides because of their unique designs. The goal is to provide designs that afford the least amount of transfers for the least amount of distance. The Board recognizes that providing a greater range in the transfer height may make transfers more difficult for some people with disabilities. Based on this concern, and the fact that the transfer height for amusement rides is new, the Board will closely monitor how well the range provides access to amusement rides. Where possible, designers are encouraged to locate the transfer seat between 17 inches and 19 inches above the load and unload surface.

#### Section 15.1.8.3 Transfer Entry

This section requires that where openings are provided to transfer to amusement ride seats, the space must be designed to provide clearance for transfer from a wheelchair or other mobility device to the amusement ride seat.

*Comment.* The proposed rule required the transfer entry on the amusement ride to be a minimum of 36 inches wide. The entry was also required to be positioned parallel and adjacent to the longer dimension of the clear floor space. Amusement ride designers and manufacturers commented that the 36 inch width was excessive and believed that few rides, if any, could comply with this dimension. They further explained that openings are generally kept to a minimum since the sides of the ride often serve as a part of the restraint or securement system for the ride.

*Response.* Due to the large variance of amusement rides and the potential interference with the securement system, the final rule requires a space to be designed to provide clearance for transfer from a wheelchair or mobility device to the amusement ride seat. Specific dimensions for the opening are not provided in the final rule.

#### Section 15.1.8.4 Wheelchair Storage Space

This section requires wheelchair storage spaces complying with ADAAG 4.2.4 to be provided in or adjacent to unload areas for each required amusement ride seat designed for transfer. The space must not overlap any required means of egress or accessible route.

*Comment.* Some commenters interpreted the provision to require some type of constructed storage space.

*Response.* Clear space is needed in the load and unload areas for individuals to leave their wheelchairs when they transfer onto amusement rides. ADAAG 4.2.4 specifies a minimum 30 inch by 48 inch space for a stationary wheelchair. For safety reasons, the space must not overlap any required means of egress or accessible route. This provision does not require a constructed element for storage, only a space. Most current designs used for load and unload areas will include sufficient space to comply with this provision.

#### Section 15.1.9 Transfer Devices for Use With Amusement Rides

This section requires that transfer devices for use with amusement rides must comply with 15.1.9 when positioned for loading and unloading.

*Comment.* As previously discussed, significant comment was received on the technical provisions addressing transfer seats. Some interpreted the proposed rule to require a "special seat" in addition to other ride seats. Others believed that the technical provisions did not provide sufficient flexibility, especially given the diversity of rides and ride seats.

*Response.* The final rule requires that each ride provide: (1) A wheelchair space, or (2) an amusement ride seat designed for transfer, or (3) a system to facilitate transfer of a person in a wheelchair from the load or unload area to a ride seat. This section applies where transfer devices are used to provide access to an amusement ride seat. A transfer device can be provided as an integral part of the ride, or as a permanent or temporary part of the facility. Significant flexibility is provided for ride designers or park

operators to develop these transfer devices. Transfer devices may include lifts, ramps, transfer platforms and steps, or other similar systems and do not require modification to manufactured rides. Information is provided in the appendix to assist operators in selecting from different types of transfer devices.

#### Section 15.1.9.1 Clear Floor Space

This section requires clear floor space complying with ADAAG 4.2.4 to be provided in the load and unload area adjacent to transfer devices.

Consistent with the clear space requirement for ride seats designed for transfer, the position of the clear space adjacent to the transfer devices is not specified in the final rule. Designers will decide its location based on what is best suited for transfer on a particular transfer device.

#### Section 15.1.9.2 Transfer Height

This section requires the height of transfer device seats to be located 14 inches minimum to 24 inches maximum measured above the load and unload surface.

The Board has applied the same range established for amusement ride seats designed for transfer to transfer devices. As previously stated, the goal is to provide designs that afford the least amount of transfers for the least amount of distance.

Where possible, designers are encouraged to locate the transfer device between 17 inches and 19 inches above the load and unload surface. Further guidance related to maximum heights for vertical movements when transferring within a transfer device is provided in the appendix.

#### Section 15.1.9.3 Wheelchair Storage Space

This section requires wheelchair storage spaces complying with ADAAG 4.2.4 to be provided in or adjacent to unload areas for each required transfer device and must not overlap any required means of egress or accessible route.

*Comment.* Some commenters interpreted the provision to require some type of constructed storage space.

*Response.* Clear space is needed in the load and unload areas for individuals to leave their wheelchairs when they transfer onto transfer devices. ADAAG 4.2.4 specifies a minimum 30 inch by 48 inch space for a stationary wheelchair. For safety reasons, the space must not overlap any required means of egress or accessible route. This provision does not require a constructed element for storage, only a

space. Most current designs used for load and unload areas will include sufficient space to comply with this provision.

#### Other Issues

##### Accessible Routes in Temporary Places of Amusement

*Comment.* The proposed rule requested comment on providing accessible routes on sites used for fairs, carnivals, and other temporary places of amusement. Usually a site such as a field or parking lot may be used for a short period of time for temporary places of amusement.

*Response.* The Board received few comments on this issue. The final rule does not include any provisions for accessible routes in temporary places of amusement. The Department of Justice has the authority to address this issue. Given the diversity of sites and complexity of agreements involved when using sites on a temporary basis, one set of guidelines is not practical. State and local government entities covered by title II may not, in determining the site or location of a facility, make selections that have the effect of excluding individuals with disabilities (28 CFR 35.130(b)(4)). Where a site is altered by installing some type of surface, that surface must be stable, firm, and slip resistant and meet other requirements in ADAAG 4.3 for the accessible route. Temporary structures are covered by ADAAG 4.1.1(4) and are required to comply with ADAAG. As with other alterations, "technical infeasibility" permits departure from technical provisions where existing physical or site constraints prohibit modification or addition of elements, spaces, or features.

#### Section 15.2 Boating Facilities

##### Section 3.5 Definitions

This section defines five terms for boating facilities.

A "boat launch ramp" is a sloped surface designed for launching and retrieving trailered boats and other water craft to and from a body of water.

A "boat slip" is that portion of a pier, main pier, finger pier, or float where a boat is moored for the purpose of berthing, embarking, or disembarking.

A "boarding pier" is a portion of a pier where a boat is temporarily secured for purposes of embarking and disembarking.

A "gangway" is a variable-sloped pedestrian walkway linking a fixed structure or land with a floating structure. This definition does not apply to gangways which connect to vessels.

A "transition plate" is a sloping pedestrian walking surface located at the end(s) of a gangway.

*Comment.* The proposed rule included definitions for boat launch ramp, boat slip, design high point, and gangway. Commenters recommended rewording these definitions. Commenters also recommended that additional definitions be added, such as handrail, landings, pier, main pier, finger pier, boarding pier, fixed and floating piers, mooring space, transient slips, and transition plate.

*Response.* The final rule provides five definitions. Definitions for boat launch ramp, boat slip, and gangway, have been retained but have been changed to improve clarity. Definitions for boarding pier and transition plate have been added, and the definition for design high point has been removed. Additional terms suggested by commenters were not added since they were not used in the technical or scoping provisions of the boating section.

##### Section 15.2.1 General

This section requires newly designed or newly constructed and altered boating facilities to comply with 15.2.

*Comment.* Some commenters did not want the rule to apply to each boating facility. They noted that designers and facility managers needed flexibility to provide reasonable accommodations in an environment which may contain extreme physical conditions. Several commenters requested that where two or more boating facilities are located within 10 miles of each other, only one facility should be accessible. Other commenters assumed that all existing facilities would have to immediately conform to the final rule.

*Response.* These guidelines apply to each newly designed or newly constructed boating facilities. Altered facilities must conform to the guidelines to the degree required by ADAAG 4.1.6. Where an existing facility is not being altered, the guidelines do not require that alterations be performed.

*Comment.* Commenters requested clarification on the term "recreational boating facility."

*Response.* This section primarily applies to piers and docks typically found at marinas where recreational boats are moored for embarking and disembarking occupants, but will apply in other non-marina settings. Where a vessel is primarily used for recreation, generally piers and docks designed and constructed to provide mooring and other services for such vessels would be covered by this section. Recreational boats range in size from small canoes to

large sailboats and power boats. The final rule is not intended to cover piers used solely by ferries or other commercial vessels, such as freighters, ocean supply vessels, and commercial fishing vessels.

Boating facilities covered by this final rule vary in size. Some contain as few as one boat slip (for example, a small campground with a short non-demarcated pier) and others are large enough to contain several thousand boat slips (for example, a large marina with many boat basins). Some have piers and boat launch ramps, while others only have piers. A boating facility may only contain a single launch ramp with no boarding pier or may contain multiple launch ramps with multiple boarding piers. In some cases, a site (such as a State park with a large lake) may contain more than one boating facility. In other cases, several boating facilities may be located in the same waterfront area, each operated by different operators.

#### Section 15.2.2 Accessible Route

This section requires that accessible routes, including gangways that are part of an accessible route, comply with ADAAG 4.3. ADAAG 4.1.2(2) requires that at least one accessible route connect accessible buildings, facilities, elements, and spaces on the same site. Therefore, an accessible route must connect accessible boat slips with other accessible elements on the same site. Eight exceptions, discussed below, have been added which modify the accessible route requirements as they relate to connecting floating piers.

No exceptions have been provided for accessing fixed piers. Therefore, accessible routes serving fixed piers must meet all the requirements of ADAAG 4.3.

#### Exception 1 Alterations to Existing Gangways

Exception 1 permits the replacement and alteration of existing gangways or series of gangways without triggering an increase in the length of the gangways, unless required by ADAAG 4.1.6(2).

*Comment.* Commenters noted that for maintenance or safety reasons, gangways are sometimes replaced or altered without any other changes being made to the floating piers and land based features located at the ends of the gangways. Under ADAAG's requirements for alterations, a replaced gangway would have to meet the requirements of section 15.2.2. The primary difficulty typically involves meeting slope requirements, rather than meeting handrail and transition plate requirements. In many cases,

compliance with section 15.2.2 would require longer gangways to be installed. To install a longer gangway, changes to adjacent structures may be needed and such changes could also lead to reductions in the number of boat slips available. Available water sheet may also prevent lengthening of the gangways in an existing boating facility.

*Response.* The final rule includes an exception that does not require an increase in the length of the gangway, where gangways are replaced or altered. However, under ADAAG 4.1.6(2), alterations to areas containing primary functions may require existing gangways and adjacent structures to be brought into conformance with section 15.2.2. ADAAG 4.1.6(2) provides that, when an area containing a primary function is altered, an accessible path of travel must be provided to the altered area unless the cost and scope of the alterations to provide an accessible path of travel is disproportionate to the overall alterations as determined under criteria established by the Department of Justice. The Department of Justice regulations for title III of the ADA deem alterations to provide an accessible path of travel to be disproportionate when the cost exceeds 20 percent of the cost of the overall alterations.<sup>6</sup>

#### Exceptions 2 and 3 Maximum Gangway Rise and Slope

Exception 2 permits gangways or series of gangways to exceed the maximum rise specified in ADAAG 4.8.2. Exception 3 permits gangways to exceed the maximum slope specified in ADAAG 4.8.2, where the total length of the gangways serving as part of a required accessible route is at least 80 feet.

*Comment.* One of the most difficult issues relating to accessibility in floating boating facilities is gangway slopes. The proposed rule permitted gangway slopes to exceed a maximum slope of 1:12 at such times as when the distance between the design high point and water level exceeded a specific value depending on the size of the pier. In addition, the proposed rule exempted gangways from the maximum rise in ADAAG 4.8.2.

Over 60 organizations and individuals responded to the above proposals. Most indicated that they did not support the provisions. The comments raised concerns about how to calculate the pier square footage and what was considered a "pier." Some asked whether levees, boardwalks, or retaining walls are fixed piers and how to measure the square

footage. Others asked about private operators using floating piers and leasing space at a city pier. They questioned whether the square footage of the city pier is included in the calculations for determining access to the privately owned floating pier. One commenter noted that facility size determinations based on square footage may tend to drive entities to reduce pier widths which could compromise safety and stability.

A few commenters questioned how the design high point was selected. They questioned whether this point was the 100 year flood line, mean high tide, extreme high tide, ordinary high water, or high pool water line. One commenter noted that what is a safe and practical upper limit is not constant and easily determined.

Some commenters were concerned that facilities located where water level fluctuations are over 40 feet, would end up with no access or only limited access. A number of commenters suggested that a maximum gangway slope be established for most conditions, if not all conditions. Recommended slope maximums ranged from 5 percent to 15 percent.

At least 10 commenters noted that the requirements should ideally be site specific because of the varying logistical problems and differing geographic conditions at locations where water level fluctuations range from a few inches to over 100 feet. These commenters said that the table in the proposed rule would create hardships for existing facilities where space limitations are present, by requiring reductions in boat slip counts and by discouraging operators from upgrading their facilities. A number of commenters recommended that accessible gangways only be required where they serve 100 or more boat slips.

Using recommendations made by a number of commenters and combined with an effort to reduce the complexity of the final rule, the Board published a summary of a draft final rule for comment. In this draft, the Board indicated that the slope of a gangway would be permitted to exceed the maximum slope of 1:12 where the linear feet of mooring space along the perimeter of the piers at a facility was less than 1,000 feet (approximately 20–30 slips) and the water fluctuation was more than one foot. The provision, which was a general exception from the maximum slope requirement, was intended to provide regulatory relief for smaller boating facilities where an extensive gangway system may be cost prohibitive. Linear feet of mooring space was used instead of the square footage

<sup>6</sup> See 28 CFR 36.403(f)(1) (<http://www.usdoj.gov/crt/ada/reg3a.html>).

of a facility to more effectively measure the size of usable space where boats can dock rather than other spaces at a boating facility.

The draft final rule also required that where the linear feet of mooring spaces along the perimeter of the piers at a facility was less than 3,000 feet (approximately 50–70 slips) and the water fluctuation was more than 5 feet, the maximum gangway slope would be permitted to be 1:8 maximum. This exception allowed for a steeper slope than generally provided in ADAAG.

Lastly, the draft final rule stated that where the water fluctuation was more than 10 feet, gangways would be permitted to exceed the maximum slope of 1:12. Providing complying gangway slopes where the water fluctuation exceeds 10 feet requires extensive gangway systems and supporting facilities. It was noted in the draft final rule that although the gangway slope was permitted to be any slope, the gangway was not allowed to consist of stairs, since stairs are not permitted to be part of an accessible route.

During two public information meetings and from written comment received on the summary of the draft final rule, commenters generally supported simplifying the rule. Some expressed concerns about allowing a 1:8 slope on gangways, and others objected to using linear feet to determine the size of smaller facilities. A few commenters noted that the maximum feasible length of a gangway is between 60 and 70 feet. These commenters indicated that providing longer gangways, or providing two or more shorter gangways as part of a gangway and ramp system, dramatically increased the costs, complexity, and maintenance of the structure. Some commenters pointed out that because gangways often depart from a landside connection which is positioned at least 3 to 4 feet above high water, a 120-foot gangway provided to handle a 10-foot water level change actually needs to be at least 156 to 168 feet long (or a series of gangways and ramps with the same aggregate length).

*Response.* It is recognized that many factors which vary throughout the country add to the complications of providing larger gangway and ramp systems to handle greater changes in water fluctuation and elevation. Factors include water level changes, distance of gangway departure points above high water marks, available water sheet to construct within, location of shipping channels into which piers and gangways cannot project, wind load on floating structures as they get bigger, types of mooring systems, dead and live loads of gangways and the size of floating

facilities to support them, currents, boat wakes, and the ability to remove floating structures when bodies of water freeze over. In the proposed rule, the Board attempted to define the level of access based on the size of a facility (*i.e.*, pier square footage). Comments noted that many other factors besides facility size, play a role in determining what is feasible. Because factors vary throughout the country and could vary between adjacent sites and adjacent facilities, selecting one factor or a list of factors to measure for determining appropriate gangway slope is not feasible.

In an effort to provide a simplified rule and establish a starting point for determining gangway access, the final rule focuses on a maximum feasible gangway length. In response to the draft final rule, a recommendation was developed by the California Department of Boating and Waterways, Oregon State Marine Board, Clean Harbor Action, and Revitalize Our Waterways (and supported by over 20 other commenters). This recommendation showed that it would be feasible in new construction to provide up to 80-foot gangways. From this comment (which also contained recommendations for different gangway slopes for varying changes in elevation), the Board developed the final rule which is based only on gangway length. Exception 3 requires that an entity either (1) provide a gangway (or series of gangways) at least 80 feet in total length, or (2) provide a gangway (or series of gangways) which does not exceed a maximum slope of 1:12. The final rule also retains the exception permitting gangways to be any length without a landing. As these exceptions only apply to gangways, ramps constructed on floating piers and ramps providing access to landside connections of gangways are not permitted to use these exceptions. Since the final rule does not use water level change as a mechanism for determining gangway accessibility, the definition for design high point was removed. The appendix includes the following two examples.

*Example 1.* Boat slips which are required to be accessible are provided at a floating pier. The vertical distance an accessible route must travel to the pier when the water is at its lowest level is 6 feet, although the water level only fluctuates 3 feet. To comply with exceptions 2 and 3, at least one design solution would provide a gangway at least 72.25 feet long which ensures the slope does not exceed 1:12.

*Example 2.* A gangway is provided to a floating pier which is required to be on an accessible route. The vertical distance is 10 feet between the elevation where the gangway departs the landside connection and

the elevation of the pier surface at the lowest water level. Exceptions 2 and 3, which modify 4.8.2, permit the gangway to be at least 80 feet long. Another design solution would be to have two 40-foot continuous gangways joined together at a float, where the float (as the water level falls) will stop dropping at an elevation five feet below the landside connection.

*Comment.* A number of commenters expressed concern that steeper gangway slopes and the absence of level landings every 30 feet created barriers for persons with disabilities. Some commenters also noted that State and local governments should be held to a higher standard than private entities.

*Response.* As water levels rise and fall, gangway slopes also rise and fall. In some areas, there will be times that a gangway slope is less than 1:20 and at other times it will be greater than 1:12. The Board has attempted to balance the needs of persons with disabilities with the cost of providing access in an environment that can vary dramatically throughout the country. The Board also decided against providing different requirements for boating facilities operated by State and local government or private entities. As this is the first time Federal accessibility guidelines have been developed to address these types of facilities, the Board plans to closely monitor how well the guidelines provide access and what new technologies are developed to provide equivalent or better access.

*Comment.* A few commenters representing passenger vessel owners were concerned that the gangway provisions would also apply to gangways serving passenger vessels.

*Response.* The gangway provisions of this rulemaking only apply to gangways which access floating piers from the land or fixed structures. The Board is working on a separate rulemaking which will address passenger vessel access. A statement has been added to the gangway definition indicating that the definition does not apply to gangways which connect to vessels.

#### *Exception 4 Small Boating Facilities With Less Than 25 Boat Slips*

Exception 4 permits gangways to exceed the maximum slope specified in ADAAG 4.8.2, where a facility contains less than 25 boat slips and where the total length of the gangway, or series of gangways, serving as part of a required accessible route is at least 30 feet.

*Comment.* Commenters were concerned about how the gangway requirements would impact smaller facilities.

*Response.* The proposed rule and the draft final rule lessened the impact on

smaller boating facilities based on pier square footage or linear feet. Most commenters recommended using number of boat slips. Since the final rule does not address piers used by transportation vessels covered by ADAAG 10.5, which are more likely to contain a limited number of very large slips, basing the exception on boat slip numbers is appropriate.

#### *Exception 5 Transition Plates*

Exception 5 permits transition plates to be located at the ends of gangways instead of the landings specified by ADAAG 4.8.4.

*Comment.* The proposed rule permitted gangways to have transition plates at the top and bottom. Comments ranged from noting the need for a definition, setting out maximum lengths and slopes, and having them meet gangway requirements.

*Response.* In the final rule, a definition for transition plate has been added to ADAAG 3.5. Where transition plates are part of an accessible route, the transition plates must comply with ADAAG 4.3, unless one of the exceptions in 15.2.2 applies. For example, ADAAG 4.3.7 and 4.8.2 would prohibit transition plates from having a slope greater than 1:12. Where the requirements of ADAAG 4.8 apply (because the slope is greater than 1:20), the transition plates must have landings complying with ADAAG 4.8.4 at the non-gangway end.

#### *Exception 6 Handrail Extensions*

Exception 6 does not require handrail extensions, where gangways and transition plates connect and both are required to have handrails. In addition, the exception provides that where handrail extensions are provided on gangways or transition plates, the extensions are not required to be parallel with the ground or floor surface.

*Comment.* The proposed rule did not require handrail extensions on gangways or landings where they connect to transition plates and did not require handrail extensions at transitions plates. Although some commenters supported the exception, others noted that handrail extensions were needed, particularly on gangways when the transition plate had no handrail. Commenters also noted the difficulty in complying with ADAAG 4.8.5, which requires handrail extensions to be parallel with the ground or floor surface. As gangway slopes change, handrails extensions at the end of gangways and transition plates are no longer parallel. Other commenters requested that transition plates always have handrails and

questioned whether gangway handrails had to be connected or continuous with landing handrails.

*Response.* The exception has been rewritten to address most of the concerns raised. The determination of whether a transition plate is required to have a handrail will be triggered by the requirements of ADAAG 4.3.7 and 4.8.5. Regarding connections to landing handrails, gangways required to comply with ADAAG 4.8.5 are required to have continuous handrails on both sides. When gangway handrail extensions are required, subject to exception 5 exclusions, the extensions would overhang landings and transition plates 12 inches minimum. ADAAG contains no requirement that these extensions connect handrails which might be provided on landings or guardrails which also may be provided.

#### *Exception 7 Cross Slope*

Exception 7 permits the cross slope of gangways, transition plates, and floating piers that are part of an accessible route to be 2 percent maximum measured in the static position.

*Comment.* Commenters representing State recreational boating agencies expressed concern about constructing floating piers and gangways which must conform to a 2 percent maximum cross slope 100 percent of the time in all weather and water conditions.

*Response.* Exception 7 was added to address this concern by specifying that the maximum cross slope is measured in the static condition. Gangways and piers which are part of an accessible route are expected to be designed and constructed to meet the 2 percent maximum cross slope. Once they are placed in the water, measurements absent live loads are to be made from a static condition without motion or wave action. Where floating piers are grounded out due to low water conditions, the slope requirements would not apply to such floating piers and associated gangways and transition plates.

#### *Exception 8 Limited-Use/Limited-Application Elevators and Platform Lifts*

Exception 8 permits limited-use/limited-application elevators or platform lifts complying with ADAAG 4.11 to be used in lieu of gangways complying with ADAAG 4.3.

*Comment.* One commenter pointed out that other methods, such as platform lifts and elevators should be used to provide access to a floating pier. Another commenter noted that a product, similar to a platform lift, had been developed for accessing floating piers. They believed that the final rule

should encourage technological developments in this area.

*Response.* ADAAG 4.3 and 15.2 allow accessible routes to consist of elevators, ramps, and (when accessing floating piers) gangways. However, under ADAAG 4.1.3(5), Exception 4, the use of a platform lift to access a pier (floating or fixed) would be prohibited in new construction. In alterations to existing facilities, this restriction does not apply. (See ADAAG 4.1.6(3)(g) regarding platform lift usage in alterations.) Exception 8 was added to allow more flexibility in providing access to floating piers and to encourage the development of other methods of access using mechanical means. This exception modifies the requirements of ADAAG 4.1.3(5) and allows the use of platform lifts and limited-use/limited-application elevators in new construction as part of an accessible route connecting floating piers.

#### *Section 15.2.3 Boat Slips: Minimum Number*

This section requires that where boat slips are provided, accessible boat slips complying with section 15.2.5 must be provided in accordance with Table 15.2.3. Boarding piers at boat launch ramps are not counted for this purpose. Where the number of boat slips is not identified, each 40 feet of boat slip edge provided along the perimeter of the pier shall be counted as one boat slip for purposes of this section.

*Comment.* The proposed rule required that where boat slips are provided, at least 3 percent of all boat slips, but not less than one boat slip, be accessible. Comments varied between supporting a range from 1 percent to 4 percent. Some comments recommended that the number of accessible boat slips be the same as the number of required accessible vehicle parking spaces. One commenter recommended that one of each type of slip be accessible. A facility operator noted that at large facilities, a 3 percent scoping provision would require more accessible boat slips than a similar number of vehicle parking spaces. Several commenters questioned whether the need for accessible slips was as high as the need for accessible parking.

*Response.* The Board is not convinced that the scoping for accessible boat slips needs to be the same as the scoping for accessible vehicle parking spaces and is concerned that the proposed 3 percent would require more accessible slips in larger facilities than a similar number of parking spaces. The final rule modifies the scoping by reducing the percentage of accessible boat slips in larger facilities. A table is added to the final

rule to show the required number of accessible boat slips. The table starts with 3 percent and reduces down to 1 percent as the number of boat slips increase. For example, a 100-slip marina would need 3 accessible slips, and a 1,450-slip marina would need 17 accessible slips. Since this is the first time Federal guidelines have addressed the minimum number of accessible boat slips, the Board plans to closely monitor how the numbers meet the needs of individuals with disabilities.

*Comment.* The proposed rule also required that where the number of slips cannot be identified, each 40 feet of mooring space provided along the perimeter of a pier be counted as one boat slip for the purpose of applying this section. Most commenters supported the requirement. A few commenters noted that most recreational boats are less than 40 feet in length and recommended a number less than 40 feet.

*Response.* Although most recreational boats are less than 40 feet, the final rule seeks to increase the likelihood that accessible slips at non-demarcated piers are long enough to accommodate most types of common recreational boats. For this reason, the final rule has retained using 40 feet as the distance for determining the number of slips at piers where slips are not demarcated. (See section 15.2.4.1 regarding lengths of boarding piers at launch ramps.) The following two examples are included in the appendix.

*Example 1.* A site contains a new boating facility which consists of a single 60-foot pier. Boats are only moored parallel with the pier on both sides to allow occupants to embark or disembark. Since the number of slips cannot be identified, section 15.2.3 requires each 40 feet of boat slip edge to be counted as one slip for purposes of determining the number of slips available and determines the number required to be accessible. The 120 feet of boat slip edge at the pier would equate with 3 boat slips.

Table 15.2.3 would require 1 slip to be accessible and comply with 15.2.5. Section 15.2.5 (excluding the exceptions within the section) requires a clear pier space 60 inches wide minimum extending the length of the slip. In this example, because the pier is at least 40 feet long, the accessible slip must contain a clear pier space at least 40 feet long which has a minimum width of 60 inches.

*Example 2.* A new boating facility consisting of a single pier 25 feet long and 3 feet wide is being planned for a site. The design intends to allow boats to moor and occupants to embark and disembark on both sides, and at one end. As the number of boat slips cannot be identified, applying section 15.2.3 would translate to 53 feet of boat slip edge at the pier. This equates with two slips. Table 15.2.5 would require 1 slip to be accessible. To comply with 15.2.5 (excluding

the exceptions within the section), the width of the pier must be increased to 60 inches. Neither (15.2.3 nor 15.2.5) requires the pier length to be increased to 40 feet.

*Comment.* The proposed rule counted boat launch ramp boarding piers as boat slips for determining the number of accessible slips required at a facility. The proposed rule also required at least one additional accessible boat slip to be provided adjacent to accessible launch ramps, where boarding piers were provided. Some commenters thought that this requirement would cause confusion. A few commenters questioned whether boat slips should be provided on boarding piers because boat slips are rented, leased or purchased, but boarding piers are used in a short-term manner. A number of commenters believed the provision required that launch ramps must have boarding piers.

*Response.* To avoid confusion, the final rule addresses scoping requirements for launch ramp boarding piers separately from boat slips. A definition has been added to ADAAG 3.5 for boarding piers.

*Comment.* Many commenters expressed concern that accessible slips had to be reserved only for persons with disabilities similar to how vehicle parking spaces are reserved.

*Response.* Accessible boat slips are not "reserved" for persons with disabilities in the same manner as accessible vehicle parking spaces. Rather, accessible boat slip use is comparable to accessible hotel rooms. The Department of Justice is responsible for addressing operational issues relating to the use of accessible facilities and elements. The Department of Justice currently advises that hotels should hold accessible rooms for persons with disabilities until all other rooms are filled. At that point, accessible rooms can be open for general use on a first come, first serve basis. This information has also been included in the appendix.

#### Section 15.2.3.1 Dispersion

This section requires that accessible boat slips be dispersed throughout the various types provided. It does not require an increase in the minimum number of boat slips required to be accessible.

*Comment.* Commenters expressed concern about how many accessible gangways would be required due to this dispersion requirement. Commenters noted that some facilities have several floating piers, each connected by an individual gangway. If accessible slips must be placed on more than one pier (due to the dispersion requirement), more than one accessible gangway system would be required.

*Response.* This provision does not prohibit accessible boat slips from being grouped at one or more piers, where such grouping does not reduce the number of type of slips that are required to be accessible. In cases where relocation of types of accessible boat slips to one pier is not possible, this dispersion provision will require more than one conforming gangway system.

*Comment.* Commenters requested more information on the different "types" of boat slips.

*Response.* Features to be considered in determining types of boat slips include the size of the boat slips, whether there are single berths or double berths, shallow water or deep water, transient, longer-term lease, covered or uncovered, and whether slips are equipped with features such as telephone, water, electricity, and cable connections. Because the term "boat slip" is intended to cover any pier area where passengers or occupants embark or disembark, unless classified as a launch ramp boarding pier, other piers not typically thought of as containing "boat slips" are covered by this dispersion requirement. Therefore, for example, a fuel pier used on a short term basis may contain boat slips, and this type of slip would be included in determining compliance with section 15.2.3.1. This information has also been included in the appendix.

*Comment.* The proposed rule required that accessible boat slips be located nearest to the amenities provided in the boating facility. Some commenters noted that adding this requirement to the dispersion provision increased the difficulty in providing accessible slips in existing facilities. It also tended to require more accessible gangways even in new construction. Commenters also questioned how to identify an amenity and if it is desirable to be located nearest an amenity. For example, being located near the toilet room might be desirable for one person but not for someone sensitive to noise and odors. Likewise, having an accessible slip located nearest the fuel pier may be beneficial for one person and not desired by others. One commenter noted that at existing facilities, corner slips are already accessible, but may not be closest to amenities.

*Response.* The "amenities" section has been removed from the final rule, because the rule intends to allow accessible boat slips to be grouped on one or more piers. In addition, the provision was removed due to comments which questioned whether being closest to an amenity is desirable.

### Section 15.2.4 Boarding Piers at Boat Launch Ramps

This section requires where boarding piers are provided at boat launch ramps, at least 5 percent, but not less than one, of the boarding piers must comply with 15.2.4 and be served by an accessible route complying with ADAAG 4.3.

Exception 1 permits accessible routes serving floating boarding piers to use the exceptions in section 15.2.2.

Exception 2 permits gangways to exceed the maximum slope and rise specified by ADAAG 4.8.2, where the total length of the gangways serving as part of a required accessible route is greater than 30 feet. Lastly, exception 3 indicates that where the accessible route serving a floating boarding pier or skid pier is located within a boat launch ramp, ADAAG 4.8 does not apply to the portion located within the boat launch ramp.

*Comment.* As noted above, some commenters thought that the proposed rule required that an accessible slip or boarding pier had to be provided at boat launch ramps.

*Response.* The proposed rule did not require that accessible boarding piers be provided at every facility with a launch ramp. Where boarding piers are provided, the proposed rule required that at least one accessible boat slip be provided adjacent to the launch ramp to ensure that at least one boarding pier complied with the pier clearance requirements. By using the term "boat slip", the Board did not intend to ensure that a rented, leased, or purchased mooring space would be available at the launch ramp, as some commenters concluded.

*Comment.* The proposed rule required that where boat launch ramps are provided with boarding piers, at least one accessible slip be provided adjacent to a boat launch ramp. A few commenters suggested that 50 percent, but not less than one boarding pier, be accessible.

*Response.* The final rule requires 5 percent, but not less than one, of boarding piers to be accessible. Most facilities with launch ramps only have one or two launch ramps. Compliance with this provision would translate to 100 percent or 50 percent access, assuming each launch ramp had its own boarding pier. Since some facilities have more than 20 launch ramps, the provision is consistent with how ADAAG addresses some conditions where multiple features are provided for the same use.

*Comment.* Some commenters were concerned that to serve an accessible floating boarding pier, the accessible

route would have to run down the launch ramp and would require the slope of the launch ramp to be 1:12 maximum. Such a slope would dramatically effect the ability to launch and retrieve trailered boats. A few commenters noted that in designs using a string of boarding piers connected together, as water levels decline, the boarding piers end up resting on the launch ramp surface. Therefore, they would match the slope of the launch ramp which is generally steeper than 1:8. In such a design, some piers actually function as gangways for a period of time.

In another design, a stationary boarding pier (also known as a skid pier) rests on the launch ramp surface, but is repositioned as water levels rise and fall. This design also allows the skid pier to be easily removed where the body of water becomes ice bound and deicing equipment is not practical. An example of a fixed boarding pier was provided which showed two levels connected by handrail equipped ramps. During high water, boaters used the upper level while the lower level and the ramp connecting it were covered by water. At low water, the lower level is used.

One commenter noted the value floating boarding piers provide for persons with disabilities when accessing a boat since the pier remains at a set height above the water. A few pointed out that accessible routes serving boarding piers were not required to run down the launch ramp but could be provided alongside the ramp. Another commenter noted that constructing switchback ramps or any other structure within the area near the shoreline was subject to more environmental limitations and was a problem particularly for providing access at existing launch ramps. Several commenters pointed out that at launch ramps, handrails and guardrails on some gangways (primarily on short gangways) are not provided because they interfere with boat lines as boats are launched or retrieved. One commenter mentioned that providing accessible boarding piers was not a problem, but providing the accessible route to it was a problem. The commenter noted that if the requirements were too difficult, entities would stop providing boarding piers.

*Response.* Anecdotal information indicates that boarding piers are not provided at all launch ramps. For example, the Michigan Department of Natural Resources reported that of their over 900 boating access sites, approximately half are provided with boarding piers (also known as courtesy

piers or docks). Since boarding piers may improve the ability for persons with disabilities to embark and disembark boats at launch ramps, the final rule seeks to not discourage entities from providing them. The Board has identified two areas of concern.

The first concern relates to accessing floating boarding piers. Boarding piers, when provided, tend to be quite small as compared to the square footage of piers used as boat slips. Many boating facilities consist of only one or two launch ramps and maybe a boarding pier, and contain no other boating structures. Providing access to floating boarding piers are subject to many of the same factors as providing access to floating piers which contain boat slips. In the final rule, the Board added exception 1 to section 15.2.4. This exception allows launch ramp boarding piers to use specified exceptions contained in section 15.2.2.

Exception 4 in section 15.2.2 allows boating facilities with less than 25 slips to have shorter gangways. To provide a similar small facility exception for boarding piers, exception 2 was added to 15.2.4. The exception exempts gangways accessing floating boarding piers at launch ramps from complying with the maximum slope requirements of ADAAG 4.8.2 where the gangways are at least 30 feet in length.

The Board's second area of concern focused on the effect of the accessible route requirements on a launch ramp, where the connection to a boarding pier is located within a launch ramp. As noted in the comments, the issue is not only the running slope requirement of an accessible route, but also includes the handrail, landing, and maximum rise requirements.

To address this concern, the Board added exception 3 to this section of the final rule. This exception provides that the requirements of ADAAG 4.8 do not apply to accessible routes located within launch ramps which serve floating boarding piers or skid piers also located within launch ramps. Although ADAAG 4.8 does not apply, other requirements of ADAAG 4.3 are applicable. For example, an accessible route with a minimum width of 36 inches must serve the boarding pier. Large "V" shaped groves which are typically provided to increase tire traction would not be allowed by ADAAG 4.3.6 (which references ADAAG 4.5) within the accessible route. Cross slopes requirements of ADAAG 4.3.7 remain 1:50 maximum. It is noted that ADAAG 4.3 does not require the entire launch ramp to meet these requirements, but does apply them to the 36 inch wide minimum accessible

route which shares the launch ramp surface and connects to the boarding pier and accessible elements on the boarding pier. Exception 3 only exempts the ramp requirements contained in ADAAG 4.8, such as maximum slope, maximum rise, handrails, and level landings. The following two examples are included in the appendix.

*Example 1.* A chain of floats are provided on a launch ramp to be used as a boarding pier which is required to be accessible by 15.2.4. At high water, the entire chain is floating and a transition plate connects the first float to the surface of the launch ramp. As the water level decreases, segments of the chain end up resting on the launch ramp surface, matching the slope of the launch ramp. As water levels drop, segments function also as gangways because one end of a segment is resting on the launch ramp surface and the other end is connecting to another floating segment in the chain.

Under ADAAG 4.1.2(2), an accessible route must serve the last float because it would function as the boarding pier at the lowest water level, before it possibly grounded out. Under exception 3, because the entire chain of floats is part of the accessible route, each float is not required to comply with ADAAG 4.8, but must meet all other requirements in ADAAG 4.3, unless exempted by exception 1. In this example, because the entire chain also functions as a boarding pier, the entire chain must comply with the requirements of 15.2.5, including the 60 inch minimum clear pier width provision.

*Example 2.* A non-floating boarding pier supported by piles divides a launching area into two launch ramps and is required to be accessible. Under ADAAG 4.1.2(2), an accessible route must connect the boarding pier with other accessible buildings, facilities, elements, and spaces on the site. Although the boarding pier is located within a launch ramp, because the pier is not a floating pier or a skid pier, none of the exceptions in 15.2.4 apply. To comply with ADAAG 4.3, either the accessible route must run down the launch ramp or the fixed boarding pier could be relocated to the side of the two launch ramps. The second option leaves the slope of the launch ramps unchanged, because the accessible route runs outside the launch ramps.

*Comment.* A few commenters questioned how the accessible route required by ADAAG 4.1.2 should connect a launch ramp which does not have a boarding pier.

*Response.* In the Recreation Access Advisory Committee, Boating and Fishing Facilities subcommittee report, the subcommittee recommended that the accessible route run to the crown of the launch ramp. In response to the ANPRM, commenters questioned how the "crown" would be determined. Because a precise spot at the launch ramp could not be identified to which the accessible route connects, neither the proposed rule nor the final rule

addresses this issue. As the final rule does not intend to change the slope of launch ramps, the accessible route required by ADAAG 4.1.2 is required to connect the launch ramp, but the specific point of connection is not set out.

#### *Section 15.2.4.1 Boarding Pier Clearances*

This section requires that at boarding piers, the entire length of the piers required to be accessible by section 15.2.4, must comply with section 15.2.5.

*Comment.* Some commenters questioned if the proposed rule required a minimum length of 40 feet for the accessible boarding piers.

*Response.* Neither the proposed rule, nor the final rule establishes a minimum length for accessible boarding piers. The accessible boarding pier would have a length which is at least equal to other boarding piers provided at the facility. Where only one boarding pier is provided, it would have a length equal to what would have been provided if no access requirements applied. The entire length of accessible boarding piers would be required to comply with the same technical provisions that apply to accessible boat slips. For example, at a launch ramp, if a 20-foot long accessible boarding pier is provided, the entire 20 feet must comply with the pier clearance requirements in section 15.2.5. Likewise, if a 60-foot long accessible boarding pier is provided, the pier clearance requirements in section 15.2.5 would apply to the entire 60 feet. An advisory note has been added to the appendix which provides similar information regarding lengths of boarding piers.

#### *Section 15.2.5 Accessible Boat Slips*

This section sets out requirements for accessible boat slips. Section 15.2.5.2 specifically addresses cleats and other boat securement devices.

##### *Section 15.2.5.1 Clearances*

This section requires that accessible boat slips be served by clear pier space 60 inches wide minimum and at least as long as the accessible boat slips. Additionally, every 10 feet maximum of linear pier edge serving the accessible boat slips must contain at least one continuous clear opening 60 inches minimum in width. The provision is unchanged from the proposed rule, although three exceptions have been added.

##### *Exception 1 Reduced Width*

Exception 1 allows the width of the clear pier space to be 36 inches minimum for a length of 24 inches

maximum, provided that multiple 36 inch wide segments are separated by segments that are 60 inches wide and 60 inches long.

*Comment.* Some commenters requested piers to be 72 to 96 inches wide to improve safety for persons who use wheelchairs. Others commenters were satisfied with the 60 inch minimum width but wanted the ability to reduce the width down to 36 inches in places to get around objects like supporting piles located within the clear pier space. One commenter requested, in response to the draft final rule, a reduced width because environmental agencies are making it harder to install finger piers wider than 4 feet.

*Response.* The 60 inch minimum width is consistent with the width required at access aisles for standard accessible parking spaces and was supported in the Recreation Access Advisory Committee, Boating and Fishing Facilities subcommittee report. Because the final rule allows obstructions to be located around the edge of the finger piers where 60 inch openings are available, unlike vehicle access aisles, it is not necessary for the entire pier to have a 60 inches clear width. Exception 1 allows reductions in the width of the pier clearance. The exception was included in the draft final rule and received little comment. An advisory note has been added to the appendix which recommends that clear pier spaces be wider than 60 inches, particularly on floating piers which are less stable, to improve the safety for persons with disabilities.

*Comment.* A number of commenters recommended that instead of the 60 inch clear width running the length of the slip, only one 60 inch by 60 inch space be required at the accessible boat slip. This space could be placed either alongside the slip or at the head of the slip on the main pier. These commenters also recommended that where finger piers at the facility are longer than 20 feet, a second 60 inch by 60 inch space should be provided at the slip.

*Response.* As recreational boats vary in shape, size, and layout, it cannot easily be known where persons with disabilities would embark or disembark a boat. By requiring the clear pier space along the entire length of the slip, access options between the boat and the pier are improved. Although the final rule does not require the entire edge of the clear pier space to be unobstructed, by extending the clear pier space the length of the slip, the number of 60 inch continuous clear openings increases which further improves access between the boat and the pier.

### Exception 2 Edge Protection

Exception 2 permits edge protection 4 inches high maximum and 2 inches deep maximum at the continuous clear openings.

*Comment.* The proposed rule required that every 120 inches maximum of linear pier edge serving the accessible boat slips contain at least one continuous clear opening 60 inches minimum. A few commenters noted that the provision would not allow edge protection to be placed within the opening.

*Response.* In response to the ANPRM, commenters had mixed views on the use of edge protection. Some maintained that edge protection was necessary to protect persons who use wheelchairs from falling off the pier edges. Others maintained that edge protection created a tripping hazard as persons moved between a pier and boat. The proposed rule did not address edge protection at piers but did prohibit its installation at the continuous clear openings at the accessible slips. The Board has not taken a position on whether edge protection should be provided at piers, but has provided exception 2 so as not to prohibit its use at the continuous clear openings. Maximum dimensions are provided to control the size of the edge protection so as not to block the clear openings.

### Exception 3 Alterations to Existing Facilities

Exception 3 provides that in alterations to existing facilities, the clear pier space can be located perpendicular to the boat slip and extend the width of the boat slip. This exception is available only if the facility has at least one boat slip complying with section 15.2.5 and where further compliance with 15.2.5 would result in a reduction in the number of boat slips available or result in a reduction in the widths of existing slips.

*Comment.* Some commenters disagreed with requiring clear pier spaces alongside accessible boat slips where finger piers are not provided within the facility. Others noted that at existing facilities, increasing finger pier widths, on which pier clearances would be provided, may reduce the number of slips available.

*Response.* Although commenters at the two information meetings on the draft final rule indicated that more recreational boats are designed to be boarded from the stern, many recreational boats still provide for side boarding. To maximize the options for persons with disabilities to board, the requirement that the clear pier space

extend the length of the accessible boat slip in newly constructed facilities has not been modified. However, exception 3 has been added to the final rule to reduce the impact of this provision on existing facilities.

### Section 15.2.5.2 Cleats and Other Boat Securement Devices

This section clarifies that cleats and other boat securement devices are not required to comply with ADAAG 4.27.3.

*Comment.* A few commenters noted that at accessible boat slips, controls and operating mechanisms (such as power receptacles, and water and sewage connections) should comply with ADAAG 4.27.

*Response.* Although section 15.2 contains requirements for recreational boating facilities, other requirements in ADAAG 4.1 still apply. Therefore, ADAAG 4.1.3(13) would require controls and operating mechanisms, such as electrical and water connections, at accessible boat slips to comply with ADAAG 4.27. However, because mooring features used to secure a boat, when raised, exert higher load pressures at the point of pier attachment, the danger of failure increases, particularly on floating piers. For this reason, section 15.2.5.2 was added which states that the reach range requirements of ADAAG 4.27.3 do not apply to boat securement devices.

### Section 15.3 Fishing Piers and Platforms

#### Section 15.3.1 General

This section requires that newly designed or newly constructed and altered fishing piers and platforms comply with section 15.3.

*Comment.* Commenters questioned how the guidelines would apply to places that people may fish from, but were not constructed for fishing (e.g., a breakwater jetty, a bridge, or a flood control dam).

*Response.* Structures that have been designed and constructed for purposes other than fishing, even though persons may use the structure for fishing, are not required to comply with this section. However, piers and platforms that are newly designed or constructed and altered for the specific purpose of fishing are required to comply with this section.

#### Section 15.3.2 Accessible Route

This section requires that accessible routes, including gangways that are part of accessible routes serving fishing piers and platforms comply with ADAAG 4.3. Exception 1 permits the accessible route, serving floating fishing piers and platforms to use exceptions 1, 2, 5, 6, 7,

and 8 in section 15.2.2. Exception 2 provides that where the total length of the gangway or series of gangways serving as part of a accessible route is at least 30 feet, the maximum slope specified by ADAAG 4.8.2 does not apply to the gangways.

*Comment.* The proposed rule required the accessible route connecting to floating fishing piers and platforms to comply with the provisions for accessible routes at boating facilities. This section received only a few comments. One commenter recommended that the square footage values in the proposed rule be reduced for application to floating fishing piers. Another commenter noted that such a requirement would discourage entities from providing fishing piers.

*Response.* The final rule references exceptions 1, 2, 5, 6, 7 and 8 of 15.2.2 (Boating Facilities) for floating fishing piers and platforms. Exception 4 in section 15.2.2 allows boating facilities with less than 25 slips to have shorter gangways. To provide a similar small facility exception for floating fishing piers, exception 2 was added to section 15.3.2 and is based on a similar exception in section 15.2.4 which applies to floating boarding piers. The following example is included in the appendix.

*Example.* To provide access to an accessible floating fishing pier, a gangway is used. The vertical distance is 60 inches between the elevation that the gangway departs the landside connection and the elevation of the pier surface at the lowest water level. Exception 2 permits the use of a gangway at least 30 feet long, or a series of connecting gangways with a total length of at least 30 feet. The length of transition plates would not be included in determining if the gangway(s) meet the requirements of the exception.

*Comment.* One designer questioned whether the proposed rule prohibited gangways which comply with ADAAG 4.8.

*Response.* ADAAG 4.1.2(2) requires at least one accessible route complying with ADAAG 4.3 to connect accessible buildings, facilities, elements, and spaces that are on a site. ADAAG 4.3.7 requires an accessible route with a running slope greater than 1:20 to comply with the ramp requirements of ADAAG 4.8. Although the final rule contains exceptions which modify the requirements of ADAAG 4.8, the use of these exceptions is not mandatory. Designers are encouraged to provide greater access for gangways and exceed the minimums contained in the exceptions and the minimum requirements of ADAAG 4.8.

### Section 15.3.3 Railings

This section requires that where railings, guards, or handrails are provided, they must comply with 15.3.3.

#### Section 15.3.3.1 Edge Protection

This provision requires edge protection that extends 2 inches minimum above the ground or deck surface. An exception provides that where the railing, guardrail, or handrail is 34 inches or less above the ground or deck surface, edge protection is not required if the deck surface extends 12 inches minimum beyond the inside face of the railing. The toe clearance must be 9 inches minimum above the ground or deck surface beyond the railing and be 30 inches minimum wide.

*Comment.* The proposed rule did not permit other options for edge protection on floating fishing piers and platforms. Commenters provided designs of fishing stations incorporating an extended deck past the rail or guard that enable a person using a wheelchair or mobility device the opportunity for toe clearance beyond the face of the railing or guard. They felt that this design should be permitted and encouraged the Board to incorporate into the final rule.

*Response.* The proposed rule required edge protection where railings are provided and did not provide the flexibility designers of fishing piers and platform requested. An exception has been added to the final rule to permit more flexibility in providing a variety of designs that promote increased levels of accessibility to anglers with disabilities.

#### Section 15.3.3.2 Height

This section requires at least 25 percent of the railings to be a maximum of 34 inches above the ground or deck surface.

The Board sought comment on the height of lowered guards and what steps have been taken to ensure that their use was permitted under applicable building codes and standards. Additionally, in light of concerns that have been raised about safety issues related to lower guards, the Board also sought information on experiences designers or operators have had where guards on floating fishing piers and platforms have been lowered to accommodate individuals using wheelchairs and other mobility devices while fishing.

*Comment.* Many commenters supported the use of lowered rails or guards to provide persons using wheelchairs or other mobility devices the opportunity to fish. Commenters gave examples of providing lowered

rails or guards for many years, in many different applications, with no reported safety or injury problems. Commenters provided descriptions of unique and innovative designs of fishing stations constructed for use by persons with disabilities.

*Response.* The final rule retains the requirement that, where provided, 25 percent of the railing must be at a lowered height. Current designs, provided by commenters, supported a maximum height of the lowered rail or guard to be at 34 inches above the ground or deck surface. The height requirement for 25 percent of the rail has been changed in the final rule to 34 inches maximum above the ground or deck surface.

*Comment.* Some commenters believed that the Occupational Safety and Health Administration (OSHA) standards apply to recreational fishing piers and platforms. The OSHA standards apply to places where employment is performed and prescribe a 42 inch high railing along open sides of platforms located 4 feet or more above the floor. 29 CFR 1910.5 and 1910.23 (c) and (e). Other commenters believed that recreational fishing piers and platforms are covered by State and local building codes, which typically prescribe 42 inch high guards along open sides of platforms located more than 30 inches above the floor. These commenters were concerned that requiring at least 25 percent of railings to be a maximum 34 inches high conflicts with the OSHA standards, and State and local building codes.

*Response.* Recreational fishing piers and platforms are subject to OSHA safety standards only if they are places of work. In some cases there may be both workers and recreational users on a pier. In those cases, OSHA standards would apply, and the pier would be exempted from the height requirements in the final rule, as discussed below.

The International Code Council has advised the Board that recreational fishing piers and platforms are not covered by model building codes unless they are an integral part of a building that is regulated by the adopting State or local authority. To avoid potential conflicts, an exception has been added to the final rule that permits a higher guard to be provided along a recreational fishing pier or platform where the guard complies with the International Building Code (IBC) (2000 edition) requirements for height (not less than 42 inches high) and opening limitations (4 inch diameter sphere cannot pass through any opening up to a height of 34 inches; and 8 inch diameter sphere cannot pass through

any opening from a height of 34 inches to 42 inches). This exception can be used if a recreational fishing pier or platform is covered by a State or local building code; or if a design professional believes that a specific location warrants enhanced safety measures; or if an employer provides a 42 inch high railing to comply with OSHA standards.

#### Section 15.3.3.3 Dispersion

This section requires that lowered railings be dispersed throughout a fishing pier or platform.

*Comment.* A commenter requested guidance on the criteria used to determine dispersion.

*Response.* Anglers who stand can fish from any part of a pier or platform and can change location depending on the fishing or water conditions. Where railings, guards, and handrails have been installed on fishing piers and platforms, the height of the railings interfere with fishing and block vision for persons who use wheelchairs and other mobility devices. This provision requires that where railings are provided, the dispersion of the lowered railings provide similar choices to fish from a variety of locations. The distribution of lower railings could include locations of different water depths with some that provide shading or are close to shore, and could take into account the tides or water fluctuations.

#### Section 15.3.4 Clear Floor or Ground Space

This section requires that at least one clear floor or ground space complying with ADAAG 4.2.4 be provided where the lowered railing height is located. Where no railings are provided, at least one clear floor or ground space complying with ADAAG 4.2.4 must be provided. No substantive comments were received and no changes were made to this provision for the final rule.

#### Section 15.3.5 Maneuvering Space

This section requires that at least one maneuvering space complying with ADAAG 4.2.3 be provided on a fishing pier or platform. The maneuvering space is permitted to overlap the accessible route and the clear floor space required by 15.3.4. No substantive comments were received and no changes were made to this provision for the final rule.

#### Golf

#### Section 3.5 Definitions

Two terms used in this section are added to ADAAG 3.5 (Definitions).

A "golf car passage" is defined as a continuous passage on which a

motorized golf car, also known as a golf cart, can operate. Designers and operators sometimes use the term "golf car path" to identify what the Board is defining as a "golf car passage." Because the term "golf car path" may connote a prepared surface, the term was not used. While a golf car passage must be usable by golf cars, it does not necessarily need to have a prepared surface.

A "teeing ground" is the starting place for a hole to be played. This definition is consistent with the United States Golf Association definition, which describes a teeing ground as a rectangular area two club-lengths in depth, with the front and sides defined by the outside limits of two tee-markers.

#### Section 15.4.1 General

This section requires newly designed or newly constructed and altered golf courses, driving ranges, practice putting greens, and practice teeing grounds to comply with 15.4.

#### Section 15.4.2 Accessible Route—Golf Courses

This section requires an accessible route to be 48 inches wide minimum, or 60 inches minimum if handrails are provided, to connect accessible elements and spaces located within the boundary of a golf course. Additionally, an accessible route must connect the golf car rental area, bag drop areas, practice putting greens, accessible practice teeing grounds, course toilet rooms, and course weather shelters.

Exception 1 permits the use of a golf car passage complying with section 15.4.7 in lieu of all or part of an accessible route. This exception does not apply to the required accessible route complying with 4.3 when connecting elements and amenities outside of the boundary of the golf course (*i.e.*, accessible vehicle parking spaces with the golf course clubhouse entrance). Exception 2 provides that handrails are not required on accessible routes within the boundary of a golf course. It is hazardous for handrails to be located through a green, or on teeing grounds, because of the danger of golf balls ricocheting off rails. Since course elements could be accessible from golf car passages in lieu of an accessible route, handrails would be of little utility along these routes.

The guidelines recognize that providing an accessible route may be impractical on a golf course for several reasons. First, the route of play for a golfer is dependent on where the ball lands and is therefore unpredictable. Secondly, there is an assumption that on many courses, golfers use a golf car to move throughout the course. Finally,

requiring an accessible route throughout a course could alter the slopes within some courses and eliminate some of the challenge of the game. The guidelines permit accessible elements and spaces within the boundary of the course and areas used for practice putting or driving and other course amenities outside the boundary of the course to be connected through either an accessible route or a golf car passage.

The 48 inch minimum width for the accessible route is necessary to ensure passage of a golf car on either the accessible route or the golf car passage. This is important where the accessible route is used to connect the golf car rental area, bag drop areas, practice putting greens, accessible practice teeing grounds, course toilet rooms, and course weather shelters. These are areas outside the boundary of the golf course, but are areas where an individual using an adapted golf car may travel. A golf car passage may not be substituted for other accessible routes, required by ADAAG 4.1.2, located outside the boundary of the course. The following example is included in the appendix.

*Example.* An accessible route connecting an accessible parking space to the entrance of a golf course clubhouse is not covered by this provision permitting a golf car passage in lieu of an accessible route required by 4.1.2.

*Comment.* The proposed rule sought comment on the option of using a golf car passage in lieu of an accessible route for smaller courses (*i.e.*, 3 or 6 holes).

*Response.* Commenters supported the use of the golf car passage on smaller courses. The final rule provides golf course designers and operators the opportunity to choose between providing either a golf car passage or an accessible route for all courses regardless of size.

*Comment.* Commenters questioned who would be responsible for providing single rider adaptive golf cars. Additionally, commenters questioned if a course could establish criteria for restricting use due to terrain conditions. Others wanted to know if there are plans to create regulations or guidelines for accessible golf cars. Persons with disabilities supported the use of adaptive or single rider golf cars and gave examples of experiences at courses currently permitting or providing access via golf cars to courses.

*Response.* The Board develops and maintains accessibility guidelines for the built environment. It is outside the jurisdiction of the Board to address the operational and procedural requirements of a golf course. Operational and procedural issues are

within the jurisdiction of the Department of Justice.

*Comment.* The requirements for an accessible route or golf car passage seek to provide access for players with disabilities to either practice or play the game of golf. The Board requested comments on how access should be provided for spectators during golf tournaments and competitions. Commenters provided examples and experiences of current accessibility practices encountered at many levels of tournaments and supported allowing the tournament committees to select holes (teeing areas, fairways, and putting greens) to provide accommodations and transportation to the selected areas throughout the golf course and surrounding areas.

*Response.* No additional requirements have been included in the final rule for spectators with disabilities attending tournaments or competitions. Facilities hosting tournaments or competitions must comply with all the other requirements of the ADA, including the general obligation to provide an equal opportunity to individuals with disabilities to enjoy the services provided. Additionally, ADAAG requires temporary facilities used during tournaments or competitions to provide access to assembly seating areas, portable restroom facilities, concessions, and all other available amenities. Access to these temporary facilities on a golf course may be achieved through either an accessible route or golf car passage.

#### Section 15.4.3 Accessible Routes—Driving Ranges

This section provides that an accessible route must connect accessible teeing stations at driving ranges with accessible parking spaces and must be 48 inches minimum in width. Where handrails are provided, the accessible route must be a minimum of 60 inches in width. An exception has also been added which permits a golf car passage to be used at driving ranges instead of an accessible route.

*Comment.* The proposed rule did not specifically address the accessible route provided at driving ranges. A commenter stated that a person who plays from a golf car would need to practice driving a golf ball from the same position and stance used when playing the game.

*Response.* The final rule requires both a stand alone driving range and a driving range located at a golf course to provide an accessible route that is 48 inches wide minimum or 60 inches minimum where handrails are provided,

to connect the accessible parking spaces to required accessible teeing stations.

#### Section 15.4.4 Teeing Grounds

This section requires teeing grounds to comply with section 15.4.4.

##### Section 15.4.4.1 Number Required

This section requires that where one or two teeing grounds are provided for a hole, one teeing ground must be accessible. Where three or more teeing grounds are provided for a hole, at least two teeing grounds serving a hole must be accessible.

*Comment.* The proposed rule required that if two teeing grounds were provided both must be accessible. Course designers and operators expressed concerns that if only two teeing grounds are provided at a hole requiring both to be accessible was too restrictive.

*Response.* The final rule has been revised to require two teeing grounds to be accessible when three or more teeing grounds are provided for a hole. The Board believes that requiring two teeing grounds to be accessible when three or more are provided will provide persons with disabilities with an option to play from different tees appropriate to their skill level and also provide course operators and designers with the flexibility they requested.

##### Section 15.4.4.2 Forward Teeing Ground

This section requires the forward teeing ground to be accessible. The forward teeing ground need not be accessible in alterations of existing courses when terrain makes compliance infeasible.

*Comment.* The proposed rule sought comment on the number of accessible teeing grounds that should be required for each hole and, if more than one accessible teeing ground is provided, whether it should be the forward tee. Commenters supported the option to play from different teeing grounds appropriate to player skill levels if multiple teeing grounds are provided per hole. Additionally, golfers with disabilities overwhelmingly supported requiring the forward teeing ground to be accessible regardless of the number of teeing grounds provided.

*Response.* The final rule provides a choice of teeing grounds for golfers with disabilities when three or more teeing grounds are provided per hole and also provides flexibility to course designers and operators. The final rule also requires that the forward teeing ground be the accessible tee regardless of the number of teeing grounds provided per hole.

*Comment.* The proposed rule did not provide an exception for alterations of existing teeing grounds from making the forward tee accessible. Commenters stated that requiring access to the forward teeing ground in alterations to existing courses may be too restrictive.

*Response.* Some teeing grounds on existing courses may be located on steep slopes and it may not be possible to provide a golf car passage to the forward teeing ground. The final rule exempts the forward teeing ground from being accessible in alterations where compliance is not feasible due to terrain.

##### Section 15.4.4.3 Teeing Grounds

This section requires accessible teeing grounds to be designed and constructed to allow a golf car to enter and exit the teeing ground.

*Comment.* The proposed rule required teeing grounds to provide a minimum clear area 10 feet by 10 feet with a surface slope not exceeding 1:48 in all directions. Course designers and operators stated that current designs of teeing grounds provide a clear area of at least 10 feet by 10 feet. Additionally, they expressed concern about maintaining a slope no greater than 1:48, and noted that settling of the soil and drainage problems occur with such a minimal slope. Others questioned how the slope of the teeing ground should be measured.

*Response.* Current design and construction practices for teeing grounds provide the needed space for golf car passages. Designers currently limit the slope of the teeing grounds to provide a level surface from which golfers tee off. The maximum slopes and minimum size requirements have been deleted from the final rule. The final rule requires teeing grounds to be designed and constructed to allow a golf car to enter and exit the teeing ground.

##### Section 15.4.5 Teeing Stations at Driving Ranges and Practice Teeing Grounds

This section requires that where teeing stations or practice teeing grounds are provided, at least 5 percent, but not less than one, of the practice teeing grounds must be accessible. This provision applies to practice facilities adjacent to a golf course, in addition to stand-alone facilities. No substantive comments were received and no changes have been made for the final rule.

##### Section 15.4.6 Weather Shelters

This section requires weather shelters that are provided on a golf course to be designed and constructed to allow a golf

car to enter and exit and have a clear floor or ground space 60 inches by 96 inches. This space will allow a golf car to be driven directly into a weather shelter. No substantive comments were received and no changes have been made for the final rule.

##### Section 15.4.7 Golf Car Passage

This section requires openings at least 60 inches wide to be provided at intervals, not exceeding 75 yards, where curbs or other man-made barriers are provided along a golf car passage that would prohibit a golf car from entering a fairway.

*Comment.* The proposed rule required the 60 inch openings at intervals of 75 yards of golf car passage. Course designers and operators expressed concern that requiring openings at a fixed distance of 75 yards would be too restrictive and would not allow enough flexibility for natural characteristics of the course, hazard placement, and erosion control.

*Response.* The final rule requires the openings at intervals not to exceed 75 yards. These openings will provide access to the course at reasonable intervals, enabling a golfer using a golf car to play the game without extended travel distances and time requirements and also provide the flexibility the course designer and course operator need.

##### Section 15.4.7.1 Width

This section requires a golf car passage to be 48 inches wide minimum.

*Comment.* Commenters supported limited technical requirements for golf car passages. Currently there are no standards that govern the design or construction of golf car passages. Commenters felt that additional requirements would restrict designers and have the potential of altering the game.

*Response.* The 48 inch minimum dimension for a golf car passage is based on the standard width of gasoline or electric powered golf cars. The golf car passage may at times coincide with the golf car path, however, it is not required to include a prepared surface. The golf car passage is a continuous passage on which a motorized golf car can operate. No additional technical provisions for golf car passages have been included in the final rule.

##### Section 15.4.8 Putting Greens

This section requires space to allow a golf car to enter and exit the green.

*Comment.* Substantial comment was received on requiring putting greens and fairways to be accessible to golfers using adaptive single rider golf cars. Course

operators are concerned that allowing golf cars access to the green will cause damage to the greens and potentially cause holes to be closed for extended periods of time. Golfers with disabilities, organizations supporting golfers with disabilities, and golf car manufacturers provided information on current courses that allow for golf car passage on putting greens which showed little or no damage to the putting green surface.

*Response.* Single rider golf cars adapted for golfers with disabilities are available from about a dozen companies. These golf cars are generally designed to be "greens friendly" and have low ground pressure that is evenly distributed on all four tires. Some manufacturers report that the ground pressure of these golf cars is less than the ground pressure of a typically standing person and cause no turf damage even in wet conditions.

*Comment.* Course operators also raised operational issues such as whether they are required to make single rider adapted golf cars available for rental and whether they can restrict the use of golf cars on fairways and greens for certain weather or agronomic conditions.

*Response.* These issues go beyond the Board's jurisdiction and the requirements in this final rule. The Board anticipates that the Department of Justice will answer these operational issues when it amends its ADA regulations to incorporate the recreation facilities guidelines as standards.

### Section 15.5 Miniature Golf

#### Section 15.5.1 General

This section requires newly designed or newly constructed and altered miniature golf courses to comply with section 15.5.

#### Section 15.5.2 Accessible Holes

This section requires at least 50 percent of all holes to be accessible and that the accessible holes be consecutive. With the reduction in the minimum number of accessible holes on a miniature golf course, the Board wants to provide a more socially integrated golfing experience for people using wheelchairs or other mobility devices. An exception also permits one break in the sequence of consecutive accessible holes, provided that the last hole on the miniature golf course is the last hole in the sequence. This exception is provided to allow some flexibility in the layout and design of a miniature golf course.

*Comment.* Significant comment was received from miniature golf course

owners and operators regarding the number of holes required to be accessible. The proposed rule required each hole on a miniature golf course to be accessible, with an exception for 50 percent of elevated holes. Commenters were asked to give the Board guidance on differentiating between level and elevated holes. Few comments were received on definition alternatives. Some owners and operators believed that the requirement for all holes to be accessible would significantly impact course design to the extent that the experience may be "fundamentally altered." Others cited space limitations, concerns about slowing the game down, and having the effect of "compromising the challenge of the game."

*Response.* The Board has significantly reduced the number of holes required to be accessible in newly constructed miniature golf courses to 50 percent of all holes.

*Comment.* During the comment period following the draft final rule, the Miniature Golf Association recommended that instead of making 50 percent of the holes accessible, miniature golf facilities should have the option of providing tools, equipment, or assistive devices to provide access. They specifically requested that assistive devices such as electric carts be permitted as an alternative to an accessible route. Several other commenters opposed the reduction in the number of accessible holes, expressing concerns about limiting the game for persons with disabilities to only half of the holes.

*Response.* The Board has maintained the requirement that a minimum of 50 percent of all holes in new construction be accessible. The final rule does not recognize the alternative use of assistive devices for providing access in new construction. Designing miniature golf course holes so electric carts can safely maneuver through the holes is likely to have as great or greater impacts than designing an accessible route. Requiring individuals with disabilities to use electric carts on miniature golf courses is also inconsistent with other provisions of the ADA which require goods, services, and facilities to be afforded in the most integrated setting appropriate.

Given the diversity of layouts and designs of miniature golf courses, the final rule does not distinguish between courses with elevated holes or those with largely level holes. The 50 percent reduction represents a compromise given the concerns presented. Other considerations relate to the accessible route connecting accessible holes. The Board has established this reduction to

give relief where courses are designed on small parcels of land with existing terrain limitations. It is recommended that all holes on a miniature golf course be made accessible where space limitations and existing steep terrain are not present.

#### Section 15.5.3 Accessible Route

This section requires that the accessible route must connect the course entrance with the first accessible hole and the start of play area on each accessible hole. Since accessible holes must be consecutive, this section also requires the course to be configured to allow exit from the last accessible hole to the course exit or entrance. The course must be designed so as not to require an individual to back track through other holes to exit or move around the course. Where the accessible route is located on the playing surface of the accessible hole, five exceptions are permitted and are discussed below.

*Comment.* Miniature golf course operators were concerned that the surface commonly used on miniature golf course holes would not meet the requirements for accessible carpet. Their concerns were centered around the thickness of the surface. ADAAG 4.5.3 includes a requirement that the maximum pile thickness must be no more than 1/2 inch and be securely attached with a firm cushion, pad, or backing. Exposed edges must be fastened to floor surfaces and must have trim along the entire length of the exposed edge.

*Response.* The Board has added Exception 1 which exempts carpet used on miniature golf course holes from the provisions of ADAAG 4.5.3. Surfaces provided as a part of an accessible route, whether on or off the playing surface, must comply with ADAAG 4.5.2. ADAAG 4.5.2 requires the surface to be "stable, firm, and slip resistant."

*Comment.* Commenters raised concern about the use of readily removable curbs permitted in the proposed rule. Operators were concerned that their removable qualities would tempt younger players to use them inappropriately. Persons with disabilities questioned who would actually move the curbs and how problems related to their use would be addressed.

*Response.* The final rule does not allow the use of "readily removable curbs". This option was included to allow for passage on and off the course while containing the ball while in play. As an alternative, Exception 2 has been added which permits a 1 inch curb for an opening distance of 32 inches where the accessible route intersects the

playing surface of a hole. This permits passage of wheelchairs while containing the ball within the hole.

*Comment.* The proposed rule permitted a maximum slope of 1:4 for a 4 inch rise where the accessible route is located on the playing surface. A few commenters questioned how close together a designer could locate these steeply sloped surfaces. They were concerned about the appropriateness where these steep slopes existed for long distances without areas to rest.

*Response.* Exception 3 permits a slope of 1:4 maximum for a 4 inch rise where the accessible route is located on the playing surface of a hole. Exception 4 specifically addresses the issue of landings where sloped surfaces are provided. This exception permits the landings to be 48 inches long with slopes no greater than 1:20. ADAAG 4.8.4(3) requires landings to be 48 inches by 60 inches minimum, where ramps change direction. Providing a separation or break from the steeper slopes is necessary for individuals with disabilities to safely maneuver on the hole.

Exception 5 states that where the accessible route is located on the playing surface of a hole, handrails are not required.

#### *Section 15.5.3.2 Accessible Route—Adjacent to the Playing Surface*

Where the accessible route is located adjacent to the playing surface, the requirements of 4.3 apply. This provision clarifies that the accessible route may be located on the playing surface of the accessible hole or adjacent to the hole.

#### *Section 15.5.4 Start of Play Areas*

This section requires start of play areas required to comply with 15.5.2 to have a slope not steeper than 1:48 and to be 48 inches minimum by 60 inches minimum.

*Comment.* The proposed rule required the minimum space for the start of play area to be 60 inches by 60 inches. Commenters questioned the need for this space and recommended a reduction where possible especially where space limitations exist. Questions were also raised regarding the appropriateness of overlapping the accessible route with the start of play area.

*Response.* The final rule reduces the space required since the start of play area will usually not require a person using a wheelchair or mobility aid to make a complete turn. Rather, space is necessary for positioning to take the first shot of the hole. Consistent with ADAAG, unless otherwise specified, the accessible route and the clear space

required at the start of play area are permitted to overlap.

#### *Section 15.5.5 Golf Club Reach Range*

This section requires all areas within accessible holes where golf balls rest to be within 36 inches maximum of an accessible route having a maximum slope of 1:20.

*Comment.* The proposed rule required that all level areas within accessible holes where golf balls rest be within 27 inches maximum of an accessible route. A few commenters questioned the appropriateness of the 27 inch dimension. They recommended an increase to include a broader range of skill levels and golf club lengths.

*Response.* The distance from the level areas has been increased to 36 inches to balance the impact on course design and incorporate the reach of a typical adult size golf club. This is a maximum distance from the accessible route which may be located either on the hole or adjacent to the hole. Where possible, designers should locate the accessible route as close as possible to the level areas on the course. This will improve the ability to reach the golf ball for a variety of users.

#### *Section 15.7 Exercise Equipment and Machines, Bowling Lanes, and Shooting Facilities*

##### *Section 15.7.1 General*

This section requires all newly designed or newly constructed and altered exercise equipment and machines, bowling lanes, and shooting facilities to comply with section 15.7.

##### *Section 15.7.2 Exercise Equipment and Machines*

This section requires at least one of each type of exercise equipment and machines to be provided with clear floor space complying with ADAAG 4.2.4 and be served by an accessible route. Clear floor space must be positioned for transfer or for use by an individual seated in a wheelchair. Clear floor spaces for more than one piece of equipment are permitted to overlap. Permitting clear spaces to overlap should reduce the space requirements within an exercise or health club facility.

*Comment.* The American Hotel and Lodging Association commented that the requirement for clear space at exercise equipment and machines created a burden for the lodging industry. Similar comments were also received from the International Health, Racquet, and Sport Club Association, who indicated that space limitations present in existing facilities will prohibit compliance with this provision.

*Response.* These guidelines apply only to newly constructed and altered buildings and facilities. Where exercise equipment and machines are altered or added to a facility, the provisions of 15.7.1 apply to those pieces that are altered or added. In the case of altered exercise equipment or machines, the provisions of ADAAG 4.1.6(1)(j) related to “technical infeasibility” will also apply. ADAAG 4.1.6(1)(j) permits departure from the technical provisions where existing physical or site constraints prohibit full compliance. Space limitations may prohibit full compliance with 15.7.2. In this case, designers and operators must comply to the “maximum extent feasible”.

Requirements for existing buildings and facilities are addressed in the Department of Justice regulations and are subject to the requirements for “readily achievable barrier removal” where the facility is covered by title III of the ADA. Facilities covered by title II of the ADA are subject to the requirements for “program accessibility”. See discussion in the background section of this preamble.

An appendix note is added to provide guidance on exercise equipment and machine layout to maximize space.

*Comment.* A few commenters requested guidance on what is intended with respect to “types” of exercise equipment and machines. Others suggested that the Board should not require access to exercise machines or equipment that require the user to stand such as tread mills or stair climbers.

*Response.* The final rule is not limited to exercise equipment or machines that do not require standing. Access to the various pieces of exercise equipment serves individuals who use mobility aids such as scooters and wheelchairs. Individuals with ambulatory disabilities including those using walkers, canes, and crutches will also benefit from an accessible route and clear floor space next to a treadmill or stationary bike or other exercise equipment. An appendix note provides guidance on the different types of exercise equipment and machines. It also suggests that owners and operators consider including exercise equipment and machines within their facilities that provide for upper body cardiovascular exercise. This will add to the diversity of exercise options for everyone.

With respect to the issue of “type”, a stationary bicycle would be considered one type. A rowing machine would also be considered a type. While both provide a cardiovascular exercise, they are considered two different types for purposes of these guidelines. In terms of strength training machines, a bench

press machine is considered a different type than a biceps curl machine. The requirement for providing access to each type is intended to cover the variety of strength training machines. Where operators provide a biceps curl machine and free weights, both are required to meet the provisions in this section, even though an individual may be able to work on their biceps through both types of equipment. Where the exercise equipment and machines are only different in that different manufacturers provide them, only one of each type of machine is required to meet these guidelines. For example, where two bench press machines are provided and each is manufactured by a different company, only one is required to comply.

#### Section 15.7.3 Bowling Lanes

This section requires that where bowling lanes are provided, at least 5 percent, but not less than one lane of each type must be accessible.

*Comment.* The Bowlers Proprietors Association expressed concern about requiring 5 percent of bowling lanes to be accessible. Their comments focused on the difficulty of providing ramps to gain access to bowling lanes within existing facilities. They also questioned how to apply the 5 percent minimum requirement where a bowling facility has multiple lanes.

*Response.* As previously indicated, these guidelines apply to newly constructed and altered facilities. When a bowling facility is altered, the provisions of 15.7.2 will apply to the lane that is undergoing an alteration and does not require all other lanes to be modified unless required by ADAAG 4.1.6 (Path of Travel). Other obligations related to existing facilities covered by titles II and III of the ADA are addressed in the Department of Justice regulations.

Where the required number of accessible elements to be provided is determined by calculations of ratios or percentages and remainders or fractions result, the next greater whole number of such elements should be provided. For example, if 18 lanes of one type are provided, one lane would be required to be accessible in new construction. If 24 bowling lanes of one type are provided in new construction, a minimum of two accessible bowling lanes would be required in new construction.

*Comment.* The Bowlers Proprietors Association also expressed concern about the number of accessible bowling lanes required in those facilities where different types of bowling is provided. They were also concerned about facilities that provide both ten pin and duck pin bowling. They believed that a

5 percent requirement for both types was excessive and recommended that the requirement be limited to the type that is dominant within a given facility. Further, the Bowlers Proprietors Association questioned what made a bowling lane accessible.

*Response.* In facilities where both ten pin and duck pin bowling are provided, the 5 percent requirement for each type will typically result in one of each type of lane being accessible.

The final rule does not include any further technical provisions for bowling lanes required to be accessible. Like other areas of sport activity, the requirement is for an accessible route to connect to the area of sport activity, in this case, the bowling lane. Specific exemptions to ADAAG 4.4 (protruding objects) and 4.5 (surfacing requirements) are applied within the area of sport activity. Therefore, bowling lanes which are necessarily waxed to allow the ball to travel, are not required to be slip resistant.

#### Section 15.7.4 Shooting Facilities

This section requires that where fixed firing positions are provided at a site, at least 5 percent, but not less than one, of each type of firing position must be accessible.

*Comment.* A few commenters questioned why the Board did not require an accessible route to the target areas as well as the fixed firing positions. Commenters also questioned the application of this section to trap and skeet facilities where the facilities are not entirely fixed. Others questioned what factors should be considered in determining the different types of firing positions.

*Response.* The Board has not included a requirement for an accessible route to the target areas since targets are often moveable, making it difficult to locate the accessible route effectively. There is also difficulty in defining what is considered the "target" area. Where facilities contain a combination of fixed and non-fixed elements, operators should consider the general nondiscrimination requirements of the ADA. Direction on these and other issues related to the use of shooting facilities should be obtained from the Department of Justice. Factors to be considered in determining the types of fixed firing positions include whether covering and lighting is provided, and which shooting events the fixed firing position is intended to support.

#### Section 15.7.4.1 Fixed Firing Positions

This section requires that accessible fixed firing positions contain a 60 inch diameter space and have a slope not

steeper than 1:48. No substantive comments were received and no changes have been made to this provision in the final rule.

#### Section 15.8 Swimming Pools, Wading Pools, and Spas

##### Section 3.5 Definitions

The final rule provides a definition for a catch pool which is defined as a pool used as a terminus for water slide flumes.

*Comment.* The proposed rule did not define the term catch pool. Commenters requested that catch pools be exempt since access is not required for water slides.

*Response.* The term "catch pool" is added to the final rule since it is used in an exception in the final rule. Exception 3 to section 15.8.1 exempts catch pools from complying with the requirements of this section, provided that an accessible route connects to the catch pool edge.

##### Section 15.8.1 General

This section requires newly designed or newly constructed and altered swimming pools, wading pools, and spas to comply with 15.8. An exception has been added to the final rule that provides that an accessible route is not required to serve raised diving boards or diving platforms provided that an accessible route is provided to the base of the raised diving board or platform.

##### Section 15.8.2 Swimming Pools

This section requires that at least two means of entry be provided for each public or common use swimming pool. A sloped entry or lift must be one of the primary means of access. The secondary means of access could include a pool lift, sloped entry, transfer wall, transfer system, or pool stairs.

*Comment.* The proposed rule permitted a moveable floor as a secondary means of entry. Commenters stated that even though moveable floors may have some practical applications they do not provide independent access and often place a person with a disability on display while the pool is evacuated and the floor raised to provide access. Additionally, commenters raised concerns regarding the removal of handrails and other means of egress prior to lifting the pool floor.

*Response.* The option of using a moveable floor as a secondary means of accessible entry in public or common use swimming pools has been deleted from the final rule.

The Board has also deleted the requirement that the second means of access not duplicate the first means of

access in larger pools in the final rule. This should give designers additional flexibility in choosing between the various means of access. An appendix note recommends that where two means of access into the water are provided, different means are recommended.

*Exception 1 Small Pools With Less Than 300 Linear Feet of Pool Wall*

Exception 1 permits public or common use swimming pools with less than 300 linear feet of pool wall to only provide one accessible means of entry by either a swimming pool lift or a sloped entry.

*Comment.* A commenter suggested that Exception 1 should be modified to refer to pool wall that is available for entry into the pool. They explained that pool walls at diving areas and pool decks where there is no available pool entry because of landscaping or adjacent structures should not be counted when determining the number of accessible means of entry required.

*Response.* Exception 1 is intended to provide small pools with relief from providing more than one accessible means of entry. It was not intended for large pools that could limit the locations of entry with landscaping or other structures from requiring additional accessible means of entry.

*Exception 2 Pools Where Access Is Limited to One Area*

Exception 2 has been added to the final rule and permits wave action pools, leisure rivers, sand bottom pools, and other pools where user access is limited to only one area, to provide one accessible means of entry by either a swimming pool lift, sloped entry, or a transfer system.

*Comment.* Commenters from speciality pool operators and leisure river designers expressed concerns for safety, where there is wave action or moving water, when providing additional accessible means of entry in these unique water environments. Wave action pools typically provide a large area of zero grade entry, where everyone enters the water. Providing an accessible means of entry along the high walls could be very dangerous. Leisure rivers are constructed to provide a safe area where staff can assist individuals into the current at one location to control access to and from the moving water.

*Response.* In response to the safety concerns provided by designers and operators of these moving water experiences, only one accessible means of entry is required in the final rule, when user access is limited to one area.

*Exception 3 Catch Pools*

Exception 3 exempts catch pools from these requirements, provided that an accessible route connects to the catch pool edge.

*Comment.* The proposed rule did not include any specific requirements for access to water slides. Comments on the proposed rule and the draft final rule supported not requiring access to the top of water slides.

*Response.* An exception has been added to the final rule exempting water slides from accessibility. See ADAAG 4.1.1 (5) (b) (v). To be consistent with the water slide exception, the final rule also exempts the catch pool at the discharge area of a water slide from providing an accessible means of entry or exit from the catch pool, provided that an accessible route connects to the catch pool edge.

*Section 15.8.3 Wading Pools*

This section requires at least one accessible means of entry into each wading pool. The means of entry must be a sloped entry.

*Comment.* The proposed rule required the means of entry into wading pools to be either a sloped entry, transfer wall, or a transfer system. The proposed rule also sought comment on the appropriateness of providing a transfer wall or other transfer system as a means of access into a wading pool. Several commenters expressed concern about the potential dangers to children that may use the transfer walls or systems inappropriately for play or diving.

*Response.* The final rule limits the accessible means of entry into a wading pool to a sloped entry only. Examination of the different means of access into wading pools found zero grade entry to be the most appropriate and currently most provided means of entry.

*Section 15.8.4 Spas*

This section requires at least one accessible means of entry into spas. The means of entry must be a pool lift, transfer wall, or transfer system. An exception allows for five percent, but not less than one spa, where spas are provided in a cluster, to be accessible. No substantive comment was received and no changes have been made to this section in the final rule.

*Section 15.8.5 Pool Lifts*

This section provides the technical requirements for pool lifts.

*Section 15.8.5.1 Pool Lift Location*

This provision requires pool lifts to be located where the water level does not exceed 48 inches.

*Comment.* The proposed rule did not specify the location of a pool lift. Commenters with disabilities and individuals who work in environments where people with disabilities use pool lifts expressed concern that pool lifts may be placed in areas where the water depth would not permit assistance in the water if needed. Comments on the draft final rule supported the requirement for a pool lift to be located in a water depth of 48 inches or less whenever possible. Commenters also gave examples of when the location of a pool lift should be allowed in an area where the water depth is greater than 48 inches.

*Response.* The final rule requires a pool lift to be located where the water level does not exceed 48 inches. Two exceptions have been added to the final rule in response to comments received. Exception 1 permits the use of pool lifts at any location where the entire pool has a depth greater than 48 inches. Exception 2 permits pools with multiple pool lift locations to provide at least one where the water depth does not exceed 48 inches.

*Section 15.8.5.2 Seat Location*

This section requires the centerline of the seat, when in the raised position, to be located over the deck and 16 inches minimum from the edge of the pool. Additionally, the deck surface between the centerline of the seat and the pool edge must not have a slope greater than 1:48.

*Comment.* The proposed rule required the centerline of the seat, when in the raised position, to be located over the deck and 20 inches minimum from the pool edge. Comments from lift manufacturers expressed concern about the 20 inch minimum distance. They elaborated on the difficulties associated with providing a lift that places the user away from the pivot point of the lift a distance of 20 inches. Additionally, they commented that aquatic lifts with the centerline of the seat at least 20 inches away from the pool edge may not clear the footrest over the curbing or pool edge provided on some pools.

*Response.* Based on the concerns of commenters, the distance measured from the centerline of the lift seat to the edge of the pool has been reduced from 20 inches to 16 inches minimum. The location of the seat in relation to the edge of the pool is especially important to facilitate safe transfers. The Board is concerned about locating the seat either over the water or too close to the deck edge for safety reasons. This provision has been modified to address design limitations and incorporate the

maximum distance from the pool edge to ensure safety.

#### *Section 15.8.5.3 Clear Deck Space*

This section requires a clear deck space on the side of the seat opposite the water and parallel with the seat. The space is required to be 36 inches wide minimum and to extend forward 48 inches minimum from a line located 12 inches behind the rear edge of the seat. The clear space is specified in relationship to the seat to allow unobstructed space for either side or diagonal transfer. Additionally, the clear deck space must have a slope not greater than 1:48.

*Comment.* The proposed rule required the clear deck space to be a minimum of 30 inches wide. Commenters requested additional space to permit greater flexibility for transfer position preferences and the varied abilities of persons requiring the use of a pool lift. Commenters expressed a preference that the clear deck space should be required to provide a level surface from which to transfer from a mobility device to the lift seat.

*Response.* The final rule increases the clear deck space required on the side of the seat opposite the water to be a width of 36 inches minimum and that the clear deck space provide a surface with a slope not greater than 1:48. The additional space will facilitate the maneuvering that may be needed by a person using a mobility device preparing for a transfer to the seat of a pool lift.

#### *Section 15.8.5.4 Seat Height*

This section requires the height of a lift seat to be designed to allow a stop at 16 inches minimum to 19 inches maximum measured from the deck to the top of the seat surface when the seat is in the raised (load) position.

*Comment.* The proposed rule required the height of the lift seat to be 16 inches minimum to 18 inches maximum. Commenters requested a greater range of seat heights to transfer to or from when the lift is in the up position. They suggested a seat height that could accommodate the needs of users of all ages and abilities would be more beneficial.

*Response.* Information obtained from the Board sponsored research project supported the height requirement of a lift seat while in the upper load position to be at a height between 16 and 18 inches from the deck surface. In response to the comments received, the final rule departs slightly from the proposed rule, by permitting the lift seat to make a stop at the 16 to 19 inch height above the deck surface. The lift

could provide additional stops at various heights provided that a stop is provided between 16 and 19 inches above the surface of the deck.

#### *Section 15.8.5.5 Seat Width*

This section requires a lift seat to be 16 inches wide minimum. No substantive comment was received and no changes have been made to this section in the final rule.

*Comment.* The proposed rule sought information on the different types of seats that are available on pool lifts and whether a specific type should be required in the final rule. Commenters did not provide a consensus on either the type of pool lift seat or the type of materials preferred by pool lift users.

*Response.* The final rule does not specify the type of material or the type of seat to be provided by a pool lift. Persons with disabilities involved in the Board sponsored research project expressed interest in all types of seats. An appendix note provides additional information on pool lift seats.

#### *Section 15.8.5.6 Footrests and Armrests*

This section requires footrests to be provided and that they move in conjunction with the seat. Additionally, this provision requires that, if provided, the armrest opposite the water be removable or fold clear of the seat when the seat is in the raised (load) position.

*Comment.* The proposed rule requested information on the appropriateness of requiring armrests on pool lifts and on their size and location. Commenters supported requirements based on their own personal needs with no consistent guidance on the location or size of armrests on a pool lift. One commenter questioned the appropriateness of providing a footrest on a lift for entry into a spa due to the water depth in some smaller spas.

*Response.* An exception has been added that provides that footrests are not required on pool lifts that provide an accessible means of entry into a spa. An appendix note encourages the use of a footrest in larger spas where possible and some type of retractable leg support is recommended for pool lifts used in all spas.

#### *Section 15.8.5.7 Operation*

This section requires that a pool lift be capable of unassisted operation from both the deck and water levels. This section also requires that controls and operating mechanisms be unobstructed when a lift is in use and comply with ADAAG 4.27.4. That section requires that operating controls not require tight grasping, pinching, or twisting of the

wrist or more than 5 pounds of pressure to operate.

*Comment.* The proposed rule required that the lift controls and operating mechanisms may not require continuous manual pressure for operation. Commenters with disabilities supported the requirement of unassisted operation from both the deck and water levels. They reported the difficulty in finding the responsible person when lifts require assistance, especially in environments where pools are not routinely staffed. Commenters expressed concerns about getting out of the water, if assistance is required, especially where the pool is not staffed. Someone could be stranded in the water for extended periods of time awaiting assistance. Commenters suggested that pool lifts that require continuous manual pressure give the user greater control of their descent into the water and ascent back to the deck. Concern was expressed by a manufacturer of pool lifts that providing unassisted operation encourages individuals to swim alone and the potential dangers of causing injury are greatly increased when using an automatic lift without assistance.

*Response.* A large percentage of the respondents in the Board sponsored research project noted the importance of using a lift without assistance. Pool facility staff also indicated the importance of a device or design that could be used without pool staff assistance. While this provision requires the lift to be independently operable it does not preclude assistance from being provided. The final rule removes the requirement that pool lifts may not require continuous manual pressure for operation.

*Comment.* A few commenters expressed safety concerns where pool lifts are provided in pools that are unattended.

*Response.* Pool lifts have been commercially available for over 20 years. While the Board recognizes that inappropriate use of pool lifts may result in accident or injury, the Board is not aware of any incidents of injury or accidents involving pool lifts. The Board is also not aware of any evidence that shows that pool lifts are any less safe than other components of a pool facility, such as other means of pool entry, when they are used inappropriately. Manufacturers are also incorporating features which are intended to discourage inappropriate use, such as fold-up seats and covers.

#### *Section 15.8.5.8 Submerged Depth*

This section requires that a pool lift be designed so that the seat will

submerge to a water depth of 18 inches minimum. This depth is necessary to ensure buoyancy for the person on the lift seat once in the water. No substantive comment was received and no changes have been made to this section for the final rule.

#### *Section 15.8.5.9 Lifting Capacity*

This section requires that single person pool lifts provide a minimum weight capacity of 300 pounds. Lifts also must be capable of sustaining a static load of at least one and a half times the rated load.

*Comment.* The proposed rule required pool lifts to provide a minimum weight capacity of 300 pounds and be capable of sustaining a static load of at least three times the rated load. Several pool lift manufacturers supported the minimum weight requirement of 300 pounds. They questioned requiring a static load of three times the weight limit. They believed it was too excessive and would eliminate viable lifts from being provided. A commenter suggested that the static load requirement reference an international standard for lifts that require a static load of 1.6 times the weight capacity.

*Response.* The static load requirement has been reduced to one and a half times the weight capacity requirement.

#### *Section 15.8.6 Sloped Entries*

This section provides technical requirements for sloped entries designed to provide access into the water. Due to the similarities of this type of entry with ramps used in other buildings and facilities, existing ADAAG requirements have been referenced accordingly.

##### *Section 15.8.6.1 Sloped Entries*

This section requires sloped entries to comply with ADAAG 4.3 (Accessible Route), except for slip resistance.

*Comment.* Commenters questioned the ability of providing a slip resistant surface on a sloped entry that is under water.

*Response.* The final rule provides an exception for sloped entries from being slip resistant.

##### *Section 15.8.6.2 Submerged Depth*

This section requires sloped entries to extend to a depth of 24 to 30 inches below the stationary water level. This section also requires that where landings are required by ADAAG 4.8, at least one landing must be located between 24 and 30 inches below the stationary water level. Since wading pools are typically less than 24 to 30 inches deep, an exception provides that sloped entries are only required to

extend to the deepest part of a wading pool. No substantive comment was received and no changes have been made to this section in the final rule.

##### *Section 15.8.6.3 Handrails*

This section requires handrails that comply with ADAAG 4.8.5 on both sides of all sloped entries. The clear width between handrails must be between 33 and 38 inches. Exception 1 does not require handrail extensions to be provided at the bottom of a landing serving a sloped entry. Exception 2 does not require the clear width between handrails where a sloped entry is provided for wave action pools, leisure rivers, sand bottom pools, and other pools where user access is limited to one area. Exception 3 exempts sloped entries in wading pools from providing handrails.

*Comment.* The proposed rule did not specifically address handrails in wading pools. Commenters expressed great concern about the potential dangers from children using handrails to play on or jump into the shallow water or the risk to other children in the wading pool.

*Response.* The Board is concerned about the potential dangers to children using handrails inappropriately. Exception 3 has been added to the final rule exempting wading pools from providing handrails.

#### *Section 15.8.7 Transfer Walls*

This section provides technical requirements for transfer walls.

##### *Section 15.8.7.1 Clear Deck Space*

This section requires clear deck space of 60 inches by 60 inches minimum with a slope not steeper than 1:48 to be provided at the base of a transfer wall. Where one grab bar is provided on a transfer wall, the clear deck space must be centered on the grab bar. This allows sufficient space for a transfer on either side of the grab bar. Where two grab bars are provided, the clear deck space must be centered on the clearance between the grab bars. No substantive comment was received and no changes have been made to this section for the final rule.

##### *Section 15.8.7.2 Height*

This section requires the height of transfer walls to be 16 to 19 inches measured from the deck below. The height requirement is consistent with pool lift seat heights and similarly addresses the needs of some children. The maximum height above the deck has been changed to 19 inches to be consistent with other transfer heights in ADAAG.

##### *Section 15.8.7.3 Wall Depth and Length*

This section requires the depth of a transfer wall to be 12 to 16 inches. As a minimum, the 12 inch depth of the transfer wall provides adequate space for a person to comfortably sit on the surface of the wall. The wall depth is limited to 16 inches maximum so that users are not required to traverse the wall to transfer to the water. The length of the transfer wall must be 60 inches minimum and must be centered on the clear deck space.

##### *Section 15.8.7.4 Surface*

This section requires that the surface of a transfer wall must not be sharp and must have rounded edges. Commenters overwhelmingly supported this section and no changes have been made to this section for the final rule.

##### *Section 15.8.7.5 Grab Bars*

This section requires at least one grab bar to be provided on a transfer wall. Grab bars are required to be perpendicular to the pool wall and extend the full depth of the wall. The top of the gripping surface must be 4 to 6 inches above the wall. Where two grab bars are provided, clearance between grab bars must be 24 inches minimum. Where one grab bar is provided, clearance must be 24 inches minimum on both sides of the grab bar. Grab bars must comply with ADAAG 4.26.

*Comment.* The proposed rule required the top of the gripping surface to be a maximum of 4 inches above the wall. Commenters expressed concern that 4 inches maximum above the wall surface, after factoring in the diameter of the grab bar, would not provide sufficient gripping space for persons transferring.

*Response.* The final rule provides a range from 4 to 6 inches above the wall to the top of the gripping surface. The range will provide greater flexibility and incorporate the diameter of the grab bar in providing users of all ages and abilities with an appropriate gripping surface.

##### *Section 15.8.8 Transfer Systems*

This section provides technical requirements for transfer systems used as a means of access into the water. A transfer system consists of a transfer platform, combined with a series of transfer steps that descend into the water. Users must transfer from their wheelchair or mobility device to the transfer platform and continue transferring from step to step.

#### Section 15.8.8.1 Transfer Platform

This section requires a transfer platform to be 19 inches deep by 24 inches wide. Transfer platforms must be provided at the head of each transfer system. No substantive comment was received and no changes have been made to this section for the final rule.

#### Section 15.8.8.2 Clear Deck Space

This section requires a clear deck space of 60 by 60 inches minimum with a slope not steeper than 1:48 at the base of the transfer platform. A level unobstructed space at the base of the transfer platform, centered along the 24 inch side, is necessary to facilitate a transfer from a wheelchair or mobility device. No substantive comment was received and no changes have been made to this section for the final rule.

#### Section 15.8.8.3 Height

This section requires the height of transfer platforms to be 16 to 19 inches measured from the deck. No substantive comment was received and no changes have been made to this section for the final rule.

#### Section 15.8.8.4 Transfer Steps

This section requires transfer steps to be 8 inches maximum in height. It also requires that transfer steps extend to a water depth of 18 inches minimum.

*Comment.* The proposed rule required transfer steps to be 7 inches maximum in height. Commenters questioned the inconsistencies between the transfer step height of 8 inches required on a play area transfer step (15.6.5.2.2) to that provided in an aquatic setting.

*Response.* The final rule has been changed to require an 8 inch maximum step height in aquatic settings to be consistent with the play areas transfer step (15.6.5.2.2). An appendix note has been included recommending the height of the transfer step be minimized whenever possible.

#### Section 15.8.8.5 Surface

This section requires that the surface of a transfer system must not be sharp and provide rounded edges. Similar to other transfer surfaces, this is necessary to reduce the potential for injury. No substantive comment was received and no changes have been made to this section in the final rule.

#### Section 15.8.8.6 Size

This section requires each transfer step to have a tread depth of 14 to 17 inches and a minimum tread width of 24 inches.

*Comment.* The proposed rule required a range for the transfer step depth from 12 to 17 inches and a tread width of 22

inches minimum. Commenters pointed out the inconsistencies between the size of the transfer step in the play areas final rule (15.6.5.2.1) and for swimming pools.

*Response.* In an effort to provide uniformity between the play areas transfer steps and those located at swimming pools, the final rule modifies the transfer step to incorporate a range of 14 to 17 inches in depth and a minimum width of 24 inches.

#### Section 15.8.8.7 Grab Bars

This section requires one grab bar to be provided on each step and the transfer platform, or a continuous grab bar serving each transfer step and the transfer platform. Where provided on each step, the top of the gripping surface must be 4 to 6 inches above each step. Where a continuous grab bar is provided, the top of the gripping surface must be 4 to 6 inches above the step nosing. Grab bars must comply with ADAAG 4.26 and be located on at least one side of the transfer system. The grab bar located at the transfer platform must not obstruct transfer.

*Comment.* As previously discussed in section 15.8.7.5, the proposed rule required the top of the gripping surface to be 4 inches above the wall.

Commenters expressed concern that 4 inches above the wall surface, after factoring in the diameter of the grab bar, would not provide sufficient space for persons transferring.

*Response.* The final rule requires the top of the gripping surface to be 4 to 6 inches above the wall. It is believed that the range will provide greater flexibility to users of all ages and abilities with an appropriate gripping surface.

#### Section 15.8.9 Pool Stairs

This section provides technical requirements for pool stairs used as a means of entry and exit to the water.

##### Section 15.8.9.1 Pool Stairs

This section requires pool stairs to comply with ADAAG 4.9 (Stairs), except as modified. ADAAG 4.9 has been referenced since stairs in pools are used in a similar manner as stairs elsewhere. No substantive comment was received and no changes have been made to this section in the final rule.

##### Section 15.8.9.2 Handrails

This section requires the width between handrails to be 20 to 24 inches. To reduce the potential for underwater protrusions, handrail extensions are not required at the bottom landing serving a pool stair.

*Comment.* The proposed rule required a 22 inch maximum width between

handrails on pool stairs. Commenters expressed concern that a maximum distance of 22 inches may be too close for people that are large in size. Commenters with mobility impairments supported the handrail distance of 22 inches for providing the needed support while entering a pool by stairs.

*Response.* The final rule increases the maximum width between handrails to 24 inches. Separating the handrails more than 24 inches apart would make them too far apart for a larger class of people that require the support on pool stairs.

#### Section 15.8.10 Water Play Components

This section requires that where water play components are provided, the provisions of 15.6 (Play Areas) and ADAAG 4.3 apply, except where modified by this section.

*Comment.* The proposed rule sought comment on specific features within aquatic recreation facilities where it may be technically infeasible in new construction to comply with the proposed requirements in 15.8. Manufacturers and designers of water play components expressed concerns about having to provide ramp access to elevated play structures in standing water. Many of these components are at considerable distances from the top of the water surface and ramping would be very challenging and costly. Commenters with disabilities or individuals representing individuals with disabilities expressed a great desire to have access to these unique water experiences.

*Response.* The final rule requires that where water play components are provided, they must comply with 15.6 (Play Areas) and ADAAG 4.3, except as modified or otherwise provided in this section. The final rule is responsive to manufacturers and designers by providing an exception to providing ramp access, while providing persons with disabilities the opportunity to enjoy this unique family oriented water experience with their family and friends. Exception 1 exempts accessible routes, clear floor spaces, and maneuvering spaces that are submerged from the requirements for cross slope, running slope, and surface. Exception 2 permits transfer systems to be used in lieu of ramps to connect elevated play components.

#### Regulatory Process Matters

##### Executive Order 12866: Regulatory Planning and Review

This final rule is a significant regulatory action under Executive Order

12866 and has been reviewed by the Office of Management and Budget. The Board has assessed the benefits and costs of the rule. The assessment has been placed in the public docket and is available for inspection. The assessment is also available on the Board's Internet site (<http://www.access-board.gov>). The assessment is summarized below:

#### Benefits

The benefits of the final rule are not quantifiable, but are significant and are consistent with the President's New Freedom Initiative. The primary benefit is the fulfillment of civil rights realized by individuals with disabilities. There are 52.5 million Americans with disabilities. Almost one in five adults has some type of disability. Among individuals 15 years old and over, 25 million have difficulty walking or using stairs. The final guidelines will result in newly constructed and altered recreation facilities that are accessible to individuals with disabilities and will enable them to participate in a wide range of recreational opportunities. Individuals with disabilities can also realize significant health benefits by participating in the range of recreational opportunities made accessible as a result of the final guidelines.

#### Costs

For each type of facility addressed by the final rule, the assessment estimates the number of existing facilities and new facilities constructed annually, identifies the requirements that have cost impacts for new construction and alterations, estimates the unit costs per facility, and calculates the total annual compliance costs. The number of small entities is reported as a percentage of the facilities. To estimate cost impacts, the assessment relies on assumptions where sufficient data is not available. The assumptions are based on interviews with professionals in the affected industries and are disclosed in the assessment. The assumptions cannot be validated and may not reflect the real world. The assumptions may result in under or overestimating the impacts of the final rule. The relevant data for each facility type is presented below.

#### Amusement Rides

*Existing Facilities:* 377 amusement parks.

*New Construction:* 4 new amusement parks per year.

*Small Entities:* 81 percent of amusement parks.

*New Amusement Rides:* 343 new rides per year; 68 will be platform type rides with stepped entrances.

*New Construction Impacts:* New platform type rides with stepped entrances will need a ramp (\$4,000 to \$6,700 unit cost) or a platform lift (\$12,000 to \$15,000 unit cost) to provide an accessible route to the load and unload area; and additional space (\$1,175 unit cost) in the load and unload area to provide wheelchair turning space and wheelchair storage space if a ride seat designed for transfer or transfer device is provided. For purposes of estimating the costs of providing access to new rides, the assessment assumes that a transfer device (\$5,000 unit cost) would be provided for all new rides. New rides will need a sign (\$100 unit cost) at the entrance of the queue or waiting line indicating the type of access provided (e.g., wheelchair access or transfer access).

*Alterations Impacts:* Minimal.

*Total Annual Compliance Costs:* \$2.5 million.

#### Boating Facilities

*Existing Facilities:* 12,000 marinas; no data on boat launch ramps.

*New Construction:* 240 new marinas per year.

*Alterations:* 600 existing marinas per year.

*Small Entities:* 99 percent of marinas.

*New Construction Impacts:* Gangways that are part of an accessible route will need to provide a 1:12 maximum slope or a gangway at least 80 feet long. The unit cost will be site specific. The assessment assumes unit costs will range from \$15,000 to \$35,000 where the maximum vertical level change is more than 2.5 feet, but less than 10 feet; and \$33,000 to \$45,000 where the maximum vertical level change is more than 10 feet. The impacts on new accessible boat slips and new accessible boarding piers at new boat launch ramps will be minimal.

*Alterations Impacts:* Alterations to existing boat slips are a primary function area and may trigger provision of an accessible route, unless the additional cost is disproportionate to the overall costs of the alterations or compliance is technically infeasible. The impacts on altered boat slips will be minimal.

*Total Annual Compliance Costs:* \$10.8 million to \$18.0 million.

#### Fishing Piers and Platforms

*Existing Facilities:* No data.

*New Construction:* No data.

*Small Entities:* No data.

*New Construction Impacts:* Minimal.

*Alterations Impacts:* Minimal.

*Total Annual Compliance Costs:* Minimal

#### Golf Courses

*Existing Facilities:* 17,108 golf courses.

*New Construction:* 377 to 524 new golf courses per year.

*Small Entities:* 99 percent of golf courses.

*New Construction Impacts:* Minimal.

*Alterations Impacts:* Minimal.

*Total Annual Compliance Costs:* Minimal.

#### Miniature Golf Courses

*Existing Facilities:* 7,500 to 10,000 miniature golf courses.

*New Construction:* 150 new custom design and 170 new modular miniature golf courses per year.

*Small Entities:* 100 percent of miniature golf courses.

*New Construction Impacts:* The assessment discusses potential impacts on new custom design courses (low profile courses, challenge courses, and adventure style courses) and new modular courses (indoor courses and outdoor courses). The impacts on new custom design low profile courses will be minimal. For purposes of estimating the costs for making at least 50 percent of the holes on the other custom design courses accessible, the assessment assumes a 10 percent increase in construction costs for new challenge type courses, and a 25 percent increase for new adventure style courses. New indoor modular courses may need to lease additional space to provide an accessible route for at least 50 percent of the holes, and new outdoor modular courses that are not recessed in the ground will have to provide an accessible route for at least 50 percent of the holes. The assessment assumes the additional cost for new modular courses will \$5,000 per course.

*Alterations Impacts:* Minimal.

*Total Annual Compliance Costs:* \$5.4 million.

#### Exercise Equipment, Bowling Lanes, and Shooting Facilities

*Existing Facilities:* 17,531 physical fitness facilities; 5,500 bowling centers; and 10,000 shooting facilities. No data on other facilities that provide exercise equipment.

*New Construction:* 800 to 1,000 new physical fitness facilities; 25 new bowling centers; and 100 new shooting facilities per year.

*Small Entities:* 99 percent of physical fitness facilities; and 100 percent of bowling centers and shooting facilities.

*New Construction Impacts:* Minimal.

*Alterations Impacts:* Minimal.

*Total Annual Compliance Costs:* Minimal.

## Swimming Pools, Wading Pools, and Spas

*Existing Facilities:* 124,577 pools; no data on spas.

*New Construction:* 1,245 new pools per year; 565 new spas per year. The assessment assumes 715 new pools per year have less than 300 linear feet of pool wall and will need at least one means of accessible entry into the pool.

*Small Entities:* Ranges from 15 percent for private hospitals to 100 percent for camps and recreational vehicle parks.

*New Construction Impacts:* For new pools with less than 300 linear feet of pool wall, the assessment assumes that a pool lift will be provided (\$4,000 unit cost). For pools with 300 linear feet or more of pool wall, the assessment assumes 250 of these new pools per year will provide an accessible means of entry in the absence of the final rule and will add a pool lift (\$4,000 unit cost). The assessment assumes the other new pools with 300 linear feet or more of pool wall will provide a pool lift (\$4,000 unit cost) and pool stairs (\$2,500 unit cost). The impacts on wading pools will be minimal. The assessment assumes new spas will provide a pool lift (\$4,000 unit cost).

*Alterations Impacts:* Minimal.

*Total Annual Compliance Costs:* \$8.0 million.

### Regulatory Flexibility Act

The final regulatory flexibility analysis has been performed in conjunction with the assessment of the benefits and costs of the final rule required by Executive Order 12866 and the preparation of the preamble for the final rule. The analysis is summarized below.

#### Need for and Objectives of Guidelines

The Access Board is required to issue accessibility guidelines under the Americans with Disabilities Act (ADA) to ensure that new construction and alterations of facilities covered by the law are readily accessible to and usable by individuals with disabilities. Recreation facilities are among the facilities covered by the ADA. Recreation facilities have unique features that are not adequately addressed by the Americans with Disabilities Act Accessibility Guidelines (ADAAG). The final rule will amend ADAAG to provide supplemental guidelines for making recreation facilities accessible.

#### Significant Issues Raised During Public Comment Period

The significant comments raised during the public comment period are

summarized in the preamble to the final rule, along with the Access Board's assessment of the comments and the reason for selecting the alternative adopted in the final rule. The alternatives considered in the proposed rule and the final rule, and changes made from the proposed rule for each type of recreation facility are presented in the assessment of the benefits and costs of the final rule required by Executive Order 12866.

#### Numbers of Small Entities Affected by Final Rule

The numbers of small entities affected by the final rule are reported under the summary of the assessment of the benefits and costs of the final rule required by Executive Order 12866.

#### Reporting and Recordkeeping Requirements

There are no reporting and recordkeeping requirements.

#### Steps Taken To Minimize Significant Economic Impact on Small Entities

The Access Board has taken steps to minimize the significant economic impact on small entities for each of the different types of recreation facilities addressed in the final rule. These steps are listed below.

- *Amusement Rides*—The final rule allows designers and operators of new amusement rides the choice of providing at least one wheelchair space, or an amusement ride seat designed for transfer, or a transfer device. The final rule limits application of the guidelines to existing rides that are altered. The final rule also allows designers and operators greater flexibility in applying ADAAG to amusement rides.

- *Boating Facilities*—The final rule permits gangways that are part of an accessible route to exceed the 1:12 maximum slope requirement for ramps where the total length of the gangways is at least 80 feet (30 feet for smaller facilities with fewer than 25 boat slips). The final rule reduces the number of boat slips required to be accessible in new construction, and modifies the requirements for accessible boat slips in alterations so no more than one boat slip is lost. The final rule also allows designers and operators greater flexibility in applying ADAAG to boating facilities.

- *Fishing Piers and Platforms*—The final rule permits gangways that are part of an accessible route to exceed the maximum 1:12 requirement for ramps where the total length of the gangways is at least 30 feet. The final rule also exempts guards that comply with certain sections of the International

Building Code from the maximum 34 inch height requirement.

- *Golf Courses*—The final rule permits a golf car passage to be provided on golf courses and driving ranges, instead of an accessible route.

- *Miniature Golf Courses*—The final rule requires at least 50 percent of holes on miniature golf courses to be accessible, and permits one break in the sequence of accessible holes provided the last hole in the sequence is the last hole on the course. The final rule also allows designers and operators greater flexibility in applying ADAAG to miniature golf courses.

- *Swimming Pools, Wading Pools, and Spas*—The final rule permits small pools with less than 300 linear feet of pool wall to provide at least one means of access into the water, and permits water play components to use transfer systems to connect elevated water play components.

#### Technical Assistance

The Access Board will provide technical assistance materials to help small entities understand the accessibility guidelines for recreation facilities. The Access Board also operates a toll-free technical assistance service to answer questions from the public about the guidelines.

#### Executive Order 13132: Federalism

The final rule adheres to the fundamental federalism principles and policy making criteria in Executive Order 13132. The final rule implements Federal civil rights legislation that was enacted pursuant to the Congress' authority to enforce the fourteenth amendment and to regulate commerce. Ensuring the civil rights of groups who have experienced irrational discrimination has long been recognized as a national issue and a proper function of the Federal government. The ADA was enacted "to provide a clear and comprehensive national mandate for the elimination of discrimination against individuals with disabilities \* \* \* and to ensure that the Federal government plays a central role in enforcing the standards established in this chapter on behalf of individuals with disabilities." 42 U.S.C. 12101(b)(1) and (3). The ADA recognizes the authority of State and local governments to enact and enforce laws that "provide greater or equal protection for the rights of individuals with disabilities than are afforded by this chapter." 42 U.S.C. 12201(b). The final rule establishes minimum guidelines. States and local governments can adopt accessibility standards that provide individuals with

disabilities equal or greater access to recreation facilities.

The Access Board has consulted with State and local governments throughout the rulemaking process. The National Recreation and Park Association, States Organization for Boating Access, New Jersey Department of Community Affairs, San Francisco Department of Public Works, and the Hawaii Disability and Communication Access Board represented the interests of State and local governments on the Recreation Access Advisory Committee. State and local governments participated in the public hearings and information meetings held on the NPRM and the draft final rule, and submitted more than 70 comments. Most of the comments were centered on boating facilities. The California Department of Boating and Waterways, Oregon State Marine Board, and Michigan Department of Natural Resources were actively involved in providing information and alternative proposals for consideration during the rulemaking. Approximately 30 other State and local governments joined in supporting the

various proposals submitted by those States.

*Unfunded Mandates Reform Act*

The Unfunded Mandates Reform Act does not apply to proposed or final rules that enforce constitutional rights of individuals or enforce any statutory rights that prohibit discrimination on the basis of race, color, sex, national origin, age, handicap, or disability. Since the final rule is issued under the authority of the Americans with Disabilities Act, an assessment of the rule's effects on State, local, and tribal governments, and the private sector is not required by the Unfunded Mandates Reform Act.

**List of Subjects in 36 CFR Part 1191**

Buildings and facilities, Civil rights, Incorporation by reference, Individuals with disabilities, Transportation.

**Thurman M. Davis, Sr.,**

*Chair, Architectural and Transportation Barriers Compliance Board.*

For the reasons stated in the preamble, part 1191 of title 36 of the Code of Federal Regulations is amended as follows:

**PART 1191—AMERICANS WITH DISABILITIES ACT (ADA) ACCESSIBILITY GUIDELINES FOR BUILDINGS AND FACILITIES**

1. The authority citation for 36 CFR Part 1191 continues to read as follows:

**Authority:** 42 U.S.C. 12204.

2. Appendix A to Part 1191 is amended as follows:

a. By revising the title page and pages i, ii, 1A, 2, 3, 4, 4A, 5 through 11, 58A, and 76 through 81 as set forth below.

b. By removing the blank page following the title page.

c. By adding pages 4B, 11A, 58B, and 82 through 96 as set forth below.

d. In the appendix to Appendix A by revising pages A1, A1A, A16, and A22 through A25 and adding pages A1B, A16A, and A26 through A32 as set forth below.

The additions and revisions read as follows:

**Appendix A to Part 1191—Americans With Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities**

BILLING CODE 8150-01-P

# **Americans with Disabilities Act (ADA)**

## **Accessibility Guidelines for Buildings and Facilities**

**U.S. Architectural and Transportation Barriers  
Compliance Board (Access Board)  
1331 F Street, N.W., Suite 1000  
Washington, D.C. 20004-1111  
(202) 272-0080  
(202) 272-0082 TTY  
(202) 272-0081 FAX**

**ADA ACCESSIBILITY GUIDELINES  
FOR BUILDINGS AND FACILITIES  
TABLE OF CONTENTS**

<b>1. PURPOSE</b>	<b>1</b>
<b>2. GENERAL</b>	<b>1</b>
2.1 Provisions for Adults and Children	1
2.2 Equivalent Facilitation	1
2.3 Incorporation by Reference	1A
<b>3. MISCELLANEOUS INSTRUCTIONS AND DEFINITIONS</b>	<b>2</b>
3.1 Graphic Conventions	2
3.2 Dimensional Tolerances	2
3.3 Notes	2
3.4 General Terminology	2
3.5 Definitions	2
<b>4. ACCESSIBLE ELEMENTS AND SPACES: SCOPE AND TECHNICAL REQUIREMENTS</b>	<b>5</b>
4.1 Minimum Requirements	5
4.1.1 Application	5
4.1.2 Accessible Sites and Exterior Facilities: New Construction	6
4.1.3 Accessible Buildings: New Construction	7
4.1.4 (Reserved)	11A
4.1.5 Accessible Buildings: Additions	11A
4.1.6 Accessible Buildings: Alterations	12
4.1.7 Accessible Buildings: Historic Preservation	14
4.2 Space Allowance and Reach Ranges	14A
4.3 Accessible Route	15
4.4 Protruding Objects	21
4.5 Ground and Floor Surfaces	22
4.6 Parking and Passenger Loading Zones	24
4.7 Curb Ramps	26
4.8 Ramps	27
4.9 Stairs	30
4.10 Elevators	30
4.11 Platform Lifts (Wheelchair Lifts)	36
4.12 Windows	36
4.13 Doors	36
4.14 Entrances	40
4.15 Drinking Fountains and Water Coolers	40

4.16	Water Closets . . . . .	40
4.17	Toilet Stalls . . . . .	41A
4.18	Urinals . . . . .	44
4.19	Lavatories and Mirrors . . . . .	44A
4.20	Bathtubs . . . . .	45
4.21	Shower Stalls . . . . .	45
4.22	Toilet Rooms . . . . .	45
4.23	Bathrooms, Bathing Facilities, and Shower Rooms . . . . .	48
4.24	Sinks . . . . .	49
4.25	Storage . . . . .	49
4.26	Handrails, Grab Bars, and Tub and Shower Seats . . . . .	50
4.27	Controls and Operating Mechanisms . . . . .	51
4.28	Alarms . . . . .	52
4.29	Detectable Warnings . . . . .	53
4.30	Signage . . . . .	53
4.31	Telephones . . . . .	54
4.32	Fixed or Built-in Seating and Tables . . . . .	56
4.33	Assembly Areas . . . . .	56
4.34	Automated Teller Machines . . . . .	58
4.35	Dressing, Fitting, and Locker Rooms . . . . .	58A
4.36	Saunas and Steam Rooms . . . . .	58A
4.37	Benches . . . . .	58A
<b>5.</b>	<b>RESTAURANTS AND CAFETERIAS . . . . .</b>	<b>59</b>
<b>6.</b>	<b>MEDICAL CARE FACILITIES . . . . .</b>	<b>60</b>
<b>7.</b>	<b>BUSINESS, MERCANTILE AND CIVIC . . . . .</b>	<b>61</b>
<b>8.</b>	<b>LIBRARIES . . . . .</b>	<b>62</b>
<b>9.</b>	<b>ACCESSIBLE TRANSIENT LODGING . . . . .</b>	<b>63</b>
<b>10.</b>	<b>TRANSPORTATION FACILITIES . . . . .</b>	<b>67</b>
<b>11.</b>	<b>JUDICIAL, LEGISLATIVE AND REGULATORY FACILITIES . . . . .</b>	<b>72</b>
<b>12.</b>	<b>DETENTION AND CORRECTIONAL FACILITIES . . . . .</b>	<b>74</b>
<b>13.</b>	<b>RESIDENTIAL HOUSING (Reserved) . . . . .</b>	<b>76</b>
<b>14.</b>	<b>PUBLIC RIGHTS-OF-WAY (Reserved) . . . . .</b>	<b>76</b>
<b>15.</b>	<b>RECREATION FACILITIES . . . . .</b>	<b>76</b>
	<b>APPENDIX . . . . .</b>	<b>A1</b>

## 2.3 Incorporation by Reference

### 2.3 Incorporation by Reference.

**2.3.1 General.** The publications listed in 2.3.2 are incorporated by reference in this document. The Director of the Federal Register has approved these materials for incorporation by reference in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies of the referenced publications may be inspected at the Architectural and Transportation Barriers Compliance Board, 1331 F Street, NW., Suite 1000, Washington, DC; at the Department of Justice, Civil Rights Division, Disability Rights Section, 1425 New York Avenue, NW., Washington, DC; or at the Office of the Federal Register, 800 North Capitol Street, NW., Suite 700, Washington, DC.

**2.3.2 Referenced Publications.** The specific edition of the publications listed below are referenced in this document. Where differences occur between this document and the referenced publications, this document applies.

**2.3.2.1 American Society for Testing and Materials (ASTM) Standards.** Copies of the referenced publications may be obtained from the American Society for Testing and Materials, 100 Bar Harbor Drive, West Conshohocken, Pennsylvania 19428 (<http://www.astm.org>).

ASTM F 1292-99 Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment (see 15.6.7.2 Ground Surfaces, Use Zones).

ASTM F 1487-98 Standard Consumer Safety Performance Specification for Playground Equipment for Public Use (see 3.5 Definitions, Use Zone).

ASTM F 1951-99 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment (see 15.6.7.1 Ground Surfaces, Accessibility).

**2.3.2.2 International Code Council (ICC) Codes.** Copies of the referenced publications may be obtained from the International Code Council, 5203 Leesburg Pike, Suite 600, Falls Church, VA 22041-3401 (<http://www.intlcode.org>).

International Building Code 2000 (see 15.3.3.2 Height).

### 3.0 Miscellaneous Instructions and Definitions

## 3. MISCELLANEOUS INSTRUCTIONS AND DEFINITIONS.

**3.1 Graphic Conventions.** Graphic conventions are shown in Table 1. Dimensions that are not marked minimum or maximum are absolute, unless otherwise indicated in the text or captions.

**3.2 Dimensional Tolerances.** All dimensions are subject to conventional building industry tolerances for field conditions.

**3.3 Notes.** The text of these guidelines does not contain notes or footnotes. Additional information, explanations, and advisory materials are located in the Appendix.

### 3.4 General Terminology.

comply with. Meet one or more specifications of *these guidelines*.

if, if ... then. Denotes a specification that applies only when the conditions described are present.

may. Denotes an option or alternative.

shall. Denotes a mandatory specification or requirement.

should. Denotes an advisory specification or recommendation.

### 3.5 Definitions.

**Access Aisle.** An accessible pedestrian space between elements, such as parking spaces, seating, and desks, that provides clearances appropriate for use of the elements.

**Accessible.** Describes a site, building, facility, or portion thereof that complies with *these guidelines*.

**Accessible Element.** An *element* specified by *these guidelines* (for example, telephone, controls, and the like).

**Accessible Route.** A continuous unobstructed path connecting all accessible elements and spaces of a building or facility. Interior accessible routes may include corridors, floors, ramps, elevators, lifts, and clear floor space at fixtures. Exterior accessible routes may include parking access aisles, curb ramps, *crosswalks at vehicular ways*, walks, ramps, and lifts.

**Accessible Space.** Space that complies with *these guidelines*.

**Adaptability.** The ability of certain building spaces and elements, such as kitchen counters, sinks, and grab bars, to be added or altered so as to accommodate the needs of *individuals with or without disabilities* or to accommodate the needs of persons with different types or degrees of disability.

**Addition.** *An expansion, extension, or increase in the gross floor area of a building or facility.*

**Administrative Authority.** A governmental agency that adopts or enforces regulations and *guidelines* for the design, construction, or *alteration* of buildings and facilities.

**Alteration.** *An alteration is a change to a building or facility that affects or could affect the usability of the building or facility or part thereof. Alterations include, but are not limited to, remodeling, renovation, rehabilitation, reconstruction, historic restoration, resurfacing of circulation paths or vehicular ways, changes or rearrangement of the structural parts or elements, and changes or rearrangement in the plan configuration of walls and full-height partitions. Normal maintenance, reroofing, painting or wallpapering, or changes to mechanical and electrical systems are not alterations unless they affect the usability of the building or facility.*

**Amusement Attraction.** *Any facility, or portion of a facility, located within an amusement park or theme park which provides amusement without*

*the use of an amusement device. Examples include, but are not limited to, fun houses, barrels, and other attractions without seats.*

**Amusement Ride.** *A system that moves persons through a fixed course within a defined area for the purpose of amusement.*

**Amusement Ride Seat.** *A seat that is built-in or mechanically fastened to an amusement ride intended to be occupied by one or more passengers.*

**Area of Rescue Assistance.** *An area, which has direct access to an exit, where people who are unable to use stairs may remain temporarily in safety to await further instructions or assistance during emergency evacuation.*

**Area of Sport Activity.** *That portion of a room or space where the play or practice of a sport occurs.*

**Assembly Area.** *A room or space accommodating a group of individuals for recreational, educational, political, social, civic, or amusement purposes, or for the consumption of food and drink.*

**Automatic Door.** *A door equipped with a power-operated mechanism and controls that open and close the door automatically upon receipt of a momentary actuating signal. The switch that begins the automatic cycle may be a photoelectric device, floor mat, or manual switch (see power-assisted door).*

**Boarding Pier.** *A portion of a pier where a boat is temporarily secured for the purpose of embarking or disembarking.*

**Boat Launch Ramp.** *A sloped surface designed for launching and retrieving trailered boats and other water craft to and from a body of water.*

**Boat Slip.** *That portion of a pier, main pier, finger pier, or float where a boat is moored for the purpose of berthing, embarking, or disembarking.*

**Building.** *Any structure used and intended for supporting or sheltering any use or occupancy.*

**Catch Pool.** *A pool or designated section of a pool used as a terminus for water slide flumes.*

**Circulation Path.** *An exterior or interior way of passage from one place to another for pedestrians, including, but not limited to, walks, hallways, courtyards, stairways, and stair landings.*

**Clear.** *Unobstructed.*

**Clear Floor Space.** *The minimum unobstructed floor or ground space required to accommodate a single, stationary wheelchair and occupant.*

**Closed Circuit Telephone.** *A telephone with dedicated line(s) such as a house phone, courtesy phone or phone that must be used to gain entrance to a facility.*

**Common Use.** *Refers to those interior and exterior rooms, spaces, or elements that are made available for the use of a restricted group of people (for example, occupants of a homeless shelter, the occupants of an office building, or the guests of such occupants).*

**Cross Slope.** *The slope that is perpendicular to the direction of travel (see running slope).*

**Curb Ramp.** *A short ramp cutting through a curb or built up to it.*

**Detectable Warning.** *A standardized surface feature built in or applied to walking surfaces or other elements to warn visually impaired people of hazards on a circulation path.*

**Egress, Means of.** *A continuous and unobstructed way of exit travel from any point in a building or facility to a public way. A means of egress comprises vertical and horizontal travel and may include intervening room spaces, doorways, hallways, corridors, passageways, balconies, ramps, stairs, enclosures, lobbies, horizontal exits, courts and yards. An accessible means of egress is one that complies with these guidelines and does not include stairs, steps, or escalators. Areas of rescue assistance or evacuation elevators*

### 3.5 Definitions

may be included as part of accessible means of egress.

**Element.** *An architectural or mechanical component of a building, facility, space, or site, e.g., telephone, curb ramp, door, drinking fountain, seating, or water closet.*

**Elevated Play Component.** *A play component that is approached above or below grade and that is part of a composite play structure consisting of two or more play components attached or functionally linked to create an integrated unit providing more than one play activity.*

**Entrance.** *Any access point to a building or portion of a building or facility used for the purpose of entering. An entrance includes the approach walk, the vertical access leading to the entrance platform, the entrance platform itself, vestibules if provided, the entry door(s) or gate(s) and the hardware of the entry door(s) or gate(s).*

**Facility.** *All or any portion of buildings, structures, site improvements, complexes, equipment, roads, walks, passageways, parking lots, or other real or personal property located on a site.*

**Gangway.** *A variable-sloped pedestrian walkway that links a fixed structure or land with a floating structure. Gangways which connect to vessels are not included.*

**Golf Car Passage.** *A continuous passage on which a motorized golf car can operate.*

**Ground Floor.** *Any occupiable floor less than one story above or below grade with direct access to grade. A building or facility always has at least one ground floor and may have more than one ground floor as where a split level entrance has been provided or where a building is built into a hillside.*

**Ground Level Play Component.** *A play component that is approached and exited at the ground level.*

**Mezzanine or Mezzanine Floor.** *That portion of a story which is an intermediate floor level placed within the story and having occupiable space above and below its floor.*

**Marked Crossing.** *A crosswalk or other identified path intended for pedestrian use in crossing a vehicular way.*

**Multifamily Dwelling.** *Any building containing more than two dwelling units.*

**Occupiable.** *A room or enclosed space designed for human occupancy in which individuals congregate for amusement, educational or similar purposes, or in which occupants are engaged at labor, and which is equipped with means of egress, light, and ventilation.*

**Operable Part.** *A part of a piece of equipment or appliance used to insert or withdraw objects, or to activate, deactivate, or adjust the equipment or appliance (for example, coin slot, push button, handle).*

**Path of Travel.** (Reserved).

**Play Area.** *A portion of a site containing play components designed and constructed for children.*

**Play Component.** *An element intended to generate specific opportunities for play, socialization, or learning. Play components may be manufactured or natural, and may be stand alone or part of a composite play structure.*

**Power-assisted Door.** *A door used for human passage with a mechanism that helps to open the door, or relieves the opening resistance of a door, upon the activation of a switch or a continued force applied to the door itself.*

**Private Facility.** *A place of public accommodation or a commercial facility subject to title III of the ADA and 28 CFR part 36 or a transportation facility subject to title III of the ADA and 49 CFR 37.45.*

**Public Facility.** *A facility or portion of a facility constructed by, on behalf of, or for the use of a public entity subject to title II of the ADA and 28 CFR part 35 or to title II of the ADA and 49 CFR 37.41 or 37.43.*

**Public Use.** Describes interior or exterior rooms or spaces that are made available to the general public. Public use may be provided at a building or facility that is privately or publicly owned.

**Ramp.** A walking surface which has a running slope greater than 1:20.

**Running Slope.** The slope that is parallel to the direction of travel (see cross slope).

**Service Entrance.** An entrance intended primarily for delivery of goods or services.

**Signage.** *Displayed* verbal, symbolic, *tactile*, and pictorial information.

**Site.** A parcel of land bounded by a property line or a designated portion of a public right-of-way.

**Site Improvement.** Landscaping, paving for pedestrian and vehicular ways, outdoor lighting, recreational facilities, and the like, added to a site.

**Sleeping Accommodations.** Rooms in which people sleep; for example, dormitory and hotel or motel guest rooms or suites.

**Soft Contained Play Structure.** *A play structure made up of one or more components where the user enters a fully enclosed play environment that utilizes pliable materials (e.g., plastic, netting, fabric).*

**Space.** *A definable area, e.g., room, toilet room, hall, assembly area, entrance, storage room, alcove, courtyard, or lobby.*

**Story.** *That portion of a building included between the upper surface of a floor and upper surface of the floor or roof next above. If such portion of a building does not include occupiable space, it is not considered a story for purposes of these guidelines. There may be more than one*

*floor level within a story as in the case of a mezzanine or mezzanines.*

**Structural Frame.** The structural frame shall be considered to be the columns and the girders, beams, trusses and spandrels having direct connections to the columns and all other members which are essential to the stability of the building as a whole.

**TDD.** *(Telecommunication Devices for the Deaf). See text telephone.*

**TTY (Tele-Typewriter).** *See text telephone.*

**Tactile.** Describes an object that can be perceived using the sense of touch.

**Technically Infeasible.** *See 4.1.6(1)(j) EXCEPTION.*

**Teeing Ground.** *In golf, the starting place for the hole to be played.*

**Text Telephone (TTY).** *Machinery or equipment that employs interactive text based communications through the transmission of coded signals across the standard telephone network. Text telephones can include, for example, devices known as TDDs (telecommunication display devices or telecommunication devices for deaf persons) or computers with special modems. Text telephones are also called TTYs, an abbreviation for tele-typewriter.*

**Transient Lodging.\*** *A building, facility, or portion thereof, excluding inpatient medical care facilities and residential facilities, that contains sleeping accommodations. Transient lodging may include, but is not limited to, resorts, group homes, hotels, motels, and dormitories.*

**Transfer Device.** *Equipment designed to facilitate the transfer of a person from a wheelchair or other mobility device to and from an amusement ride seat.*

**Transition Plate.** *A sloping pedestrian walking surface located at the end(s) of a gangway.*

### 3.5 Definitions

**Use Zone.** *The ground level area beneath and immediately adjacent to a play structure or equipment that is designated by ASTM F 1487 Standard Consumer Safety Performance Specification for Playground Equipment for Public Use (incorporated by reference, see 2.3.2) for unrestricted circulation around the equipment and on whose surface it is predicted that a user would land when falling from or exiting the equipment.*

**Vehicular Way.** A route intended for vehicular traffic, such as a street, driveway, or parking lot.

**Walk.** An exterior pathway with a prepared surface intended for pedestrian use, including general pedestrian areas such as plazas and courts.

## 4.0 Accessible Elements and Spaces: Scope and Technical Requirements

Note: Sections 4.1.1 through 4.1.7 are different from ANSI A117.1 in their entirety and are printed in standard type (ANSI A117.1 does not include scoping provisions).

### **4. ACCESSIBLE ELEMENTS AND SPACES: SCOPE AND TECHNICAL REQUIREMENTS.**

#### **4.1 Minimum Requirements**

##### **4.1.1\* Application.**

(1) General. All areas of newly designed or newly constructed buildings and facilities and altered portions of existing buildings and facilities shall comply with section 4, unless otherwise provided in this section or as modified in a special application section.

(2) Application Based on Building Use. Special application sections provide additional requirements based on building use. When a building or facility contains more than one use covered by a special application section, each portion shall comply with the requirements for that use.

(3)\* Areas Used Only by Employees as Work Areas. Areas that are used only as work areas shall be designed and constructed so that individuals with disabilities can approach, enter, and exit the areas. These guidelines do not require that any areas used only as work areas be constructed to permit maneuvering within the work area or be constructed or equipped (i.e., with racks or shelves) to be accessible.

(4) Temporary Structures. These guidelines cover temporary buildings or facilities as well as permanent facilities. Temporary buildings and facilities are not of permanent construction but are extensively used or are essential for public use for a period of time. Examples of temporary buildings or facilities covered by these guidelines include, but are not limited to: reviewing stands, temporary classrooms, bleacher areas, exhibit

areas, temporary banking facilities, temporary health screening services, or temporary safe pedestrian passageways around a construction site. Structures, sites and equipment directly associated with the actual processes of construction, such as scaffolding, bridging, materials hoists, or construction trailers are not included.

##### (5) General Exceptions.

(a) In new construction, a person or entity is not required to meet fully the requirements of these guidelines where that person or entity can demonstrate that it is structurally impracticable to do so. Full compliance will be considered structurally impracticable only in those rare circumstances when the unique characteristics of terrain prevent the incorporation of accessibility features. If full compliance with the requirements of these guidelines is structurally impracticable, a person or entity shall comply with the requirements to the extent it is not structurally impracticable. Any portion of the building or facility which can be made accessible shall comply to the extent that it is not structurally impracticable.

##### (b) Accessibility is not required to or in:

(i) raised areas used primarily for purposes of security or life or fire safety, including, but not limited to, observation or lookout galleries, prison guard towers, fire towers, or fixed life guard stands;

(ii) non-occupiable spaces accessed only by ladders, catwalks, crawl spaces, very narrow passageways, tunnels, or freight (non-passenger) elevators, and frequented only by service personnel for maintenance, repair, or occasional monitoring of equipment; such spaces may include, but are not limited to, elevator pits, elevator penthouses, piping or equipment catwalks, water or sewage treatment pump rooms and stations, electric substations and transformer vaults, and highway and tunnel utility facilities;

(iii) single occupant structures accessed only by a passageway that is below grade or that is

**4.1.2 Accessible Sites and Exterior Facilities: New Construction**

elevated above standard curb height, including, but not limited to, toll booths accessed from underground tunnels;

(iv) raised structures used solely for refereeing, judging, or scoring a sport;

(v) water slides;

(vi) animal containment areas that are not for public use; or

(vii) raised boxing or wrestling rings.

**4.1.2 Accessible Sites and Exterior Facilities: New Construction.** An accessible site shall meet the following minimum requirements:

(1) At least one accessible route complying with 4.3 shall be provided within the boundary of the site from public transportation stops, accessible parking spaces, passenger loading zones if provided, and public streets or sidewalks, to an accessible building entrance.

(2) (a) At least one accessible route complying with 4.3 shall connect accessible buildings, accessible facilities, accessible elements, and accessible spaces that are on the same site.

(b)\* Court Sports: An accessible route complying with 4.3 shall directly connect both sides of the court in court sports.

(3) All objects that protrude from surfaces or posts into circulation paths shall comply with 4.4.

EXCEPTION: The requirements of 4.4 shall not apply within an area of sport activity.

(4) Ground surfaces along accessible routes and in accessible spaces shall comply with 4.5.

EXCEPTION 1\*: The requirements of 4.5 shall not apply within an area of sport activity.

EXCEPTION 2\*: Animal containment areas designed and constructed for public use shall not be required to provide stable, firm, and slip resistant ground and floor surfaces and shall not be required to comply with 4.5.2.

(5) (a) If parking spaces are provided for self-parking by employees or visitors, or both, then accessible spaces complying with 4.6 shall be provided in each such parking area in conformance with the table below. Spaces required by the table need not be provided in the particular lot. They may be provided in a different location if equivalent or greater accessibility, in terms of distance from an accessible entrance, cost and convenience is ensured.

TOTAL PARKING IN LOT	REQUIRED MINIMUM NUMBER OF ACCESSIBLE SPACES
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8
401 to 500	9
501 to 1000	2 percent of total
1001 and over	20 plus 1 for each 100 over 1000

Except as provided in (b), access aisles adjacent to accessible spaces shall be 60 in (1525 mm) wide minimum.

(b) One in every eight accessible spaces, but not less than one, shall be served by an access aisle 96 in (2440 mm) wide minimum and shall be designated "van accessible" as required by 4.6.4. The vertical clearance at such spaces shall comply with 4.6.5. All such spaces may be grouped on one level of a parking structure.

EXCEPTION: Provision of all required parking spaces in conformance with "Universal Parking Design" (see appendix A4.6.3) is permitted.

(c) If passenger loading zones are provided, then at least one passenger loading zone shall comply with 4.6.6.

(d) At facilities providing medical care and other services for persons with mobility

### 4.1.3 Accessible Buildings: New Construction

impairments, parking spaces complying with 4.6 shall be provided in accordance with 4.1.2(5)(a) except as follows:

(i) Outpatient units and facilities: 10 percent of the total number of parking spaces provided serving each such outpatient unit or facility;

(ii) Units and facilities that specialize in treatment or services for persons with mobility impairments: 20 percent of the total number of parking spaces provided serving each such unit or facility.

(e)\* Valet parking: Valet parking facilities shall provide a passenger loading zone complying with 4.6.6 located on an accessible route to the entrance of the facility. Paragraphs 5(a), 5(b), and 5(d) of this section do not apply to valet parking facilities.

(6) If toilet facilities are provided on a site, then each such public or common use toilet facility shall comply with 4.22. If bathing facilities are provided on a site, then each such public or common use bathing facility shall comply with 4.23.

For single user portable toilet or bathing units clustered at a single location, at least five percent but no less than one toilet unit or bathing unit complying with 4.22 or 4.23 shall be installed at each cluster whenever typical inaccessible units are provided. Accessible units shall be identified by the International Symbol of Accessibility.

EXCEPTION: Portable toilet units at construction sites used exclusively by construction personnel are not required to comply with 4.1.2(6).

(7) Building Signage. Signs which designate permanent rooms and spaces shall comply with 4.30.1, 4.30.4, 4.30.5 and 4.30.6. Other signs which provide direction to, or information about, functional spaces of the building shall comply with 4.30.1, 4.30.2, 4.30.3, and 4.30.5. Elements and spaces of accessible facilities which shall be identified by the International Symbol of

Accessibility and which shall comply with 4.30.7 are:

(a) Parking spaces designated as reserved for individuals with disabilities;

(b) Accessible passenger loading zones;

(c) Accessible entrances when not all are accessible (inaccessible entrances shall have directional signage to indicate the route to the nearest accessible entrance);

(d) Accessible toilet and bathing facilities when not all are accessible.

**4.1.3 Accessible Buildings: New Construction.** Accessible buildings and facilities shall meet the following minimum requirements:

(1) (a) At least one accessible route complying with 4.3 shall connect accessible building or facility entrances with all accessible spaces and elements within the building or facility.

(b)\* Court Sports: An accessible route complying with 4.3 shall directly connect both sides of the court in court sports.

(2) All objects that overhang or protrude into circulation paths shall comply with 4.4.

EXCEPTION: The requirements of 4.4 shall not apply within an area of sport activity.

(3) Ground and floor surfaces along accessible routes and in accessible rooms and spaces shall comply with 4.5.

EXCEPTION 1\*: The requirements of 4.5 shall not apply within an area of sport activity.

EXCEPTION 2\*: Animal containment areas designed and constructed for public use shall not be required to provide stable, firm, and slip resistant ground and floor surfaces and shall not be required to comply with 4.5.2.

(4) Interior and exterior stairs connecting levels that are not connected by an elevator, ramp, or

### 4.1.3 Accessible Buildings: New Construction

other accessible means of vertical access shall comply with 4.9.

(5)\* One passenger elevator complying with 4.10 shall serve each level, including mezzanines, in all multi-story buildings and facilities unless exempted below. If more than one elevator is provided, each passenger elevator shall comply with 4.10.

EXCEPTION 1: Elevators are not required in:

(a) private facilities that are less than three stories or that have less than 3000 square feet per story unless the building is a shopping center, a shopping mall, or the professional office of a health care provider, or another type of facility as determined by the Attorney General; or

(b) public facilities that are less than three stories and that are not open to the general public if the story above or below the accessible ground floor houses no more than five persons and is less than 500 square feet. Examples may include, but are not limited to, drawbridge towers and boat traffic towers, lock and dam control stations, and train dispatching towers.

The elevator exemptions set forth in paragraphs (a) and (b) do not obviate or limit in any way the obligation to comply with the other accessibility requirements established in section 4.1.3. For example, floors above or below the accessible ground floor must meet the requirements of this section except for elevator service. If toilet or bathing facilities are provided on a level not served by an elevator, then toilet or bathing facilities must be provided on the accessible ground floor. In new construction, if a building or facility is eligible for exemption but a passenger elevator is nonetheless planned, that elevator shall meet the requirements of 4.10 and shall serve each level in the building. A passenger elevator that provides service from a garage to only one level of a building or facility is not required to serve other levels.

EXCEPTION 2: Elevator pits, elevator penthouses, mechanical rooms, piping or equipment catwalks are exempted from this requirement.

EXCEPTION 3: Accessible ramps complying with 4.8 may be used in lieu of an elevator.

EXCEPTION 4: Platform lifts (wheelchair lifts) complying with 4.11 of this guideline and applicable State or local codes may be used in lieu of an elevator only under the following conditions:

(a) To provide an accessible route to a performing area in an assembly occupancy.

(b) To comply with the wheelchair viewing position line-of-sight and dispersion requirements of 4.33.3.

(c) To provide access to incidental occupiable spaces and rooms which are not open to the general public and which house no more than five persons, including but not limited to equipment control rooms and projection booths.

(d) To provide access where existing site constraints or other constraints make use of a ramp or an elevator infeasible.

(e) To provide access to raised judges' benches, clerks' stations, speakers' platforms, jury boxes and witness stands or to depressed areas such as the well of a court.

(f)\* To provide access to player seating areas serving an area of sport activity.

EXCEPTION 5: Elevators located in air traffic control towers are not required to serve the cab and the floor immediately below the cab.

(6) Windows: (Reserved).

(7) Doors:

(a) At each accessible entrance to a building or facility, at least one door shall comply with 4.13.

(b) Within a building or facility, at least one door at each accessible space shall comply with 4.13.

(c) Each door that is an element of an accessible route shall comply with 4.13.

### 4.1.3 Accessible Buildings: New Construction

(d) Each door required by 4.3.10, Egress, shall comply with 4.13.

(8)\* The requirements in (a) and (b) below shall be satisfied independently:

(a)(i) At least 50 percent of all public entrances (excluding those in (b) below) shall comply with 4.14. At least one must be a ground floor entrance. Public entrances are any entrances that are not loading or service entrances.

(ii) Accessible public entrances must be provided in a number at least equivalent to the number of exits required by the applicable building or fire codes. (This paragraph does not require an increase in the total number of public entrances planned for a facility.)

(iii) An accessible public entrance must be provided to each tenancy in a facility (for example, individual stores in a strip shopping center).

(iv) In detention and correctional facilities subject to section 12, public entrances that are secured shall be accessible as required by 12.2.1.

One entrance may be considered as meeting more than one of the requirements in (a). Where feasible, accessible public entrances shall be the entrances used by the majority of people visiting or working in the building.

(b)(i) In addition, if direct access is provided for pedestrians from an enclosed parking garage to the building, at least one direct entrance from the garage to the building must be accessible.

(ii) If access is provided for pedestrians from a pedestrian tunnel or elevated walkway, one entrance to the building from each tunnel or walkway must be accessible.

(iii) In judicial, legislative, and regulatory facilities subject to section 11, restricted and secured entrances shall be accessible in the number required by 11.1.1.

One entrance may be considered as meeting more than one of the requirements in (b).

Because entrances also serve as emergency exits whose proximity to all parts of buildings and facilities is essential, it is preferable that all entrances be accessible.

(c) If the only entrance to a building, or tenancy in a facility, is a service entrance, that entrance shall be accessible.

(d) Entrances which are not accessible shall have directional signage complying with 4.30.1, 4.30.2, 4.30.3, and 4.30.5, which indicates the location of the nearest accessible entrance.

(9)\* In buildings or facilities, or portions of buildings or facilities, required to be accessible, accessible means of egress shall be provided in the same number as required for exits by local building/life safety regulations. Where a required exit from an occupiable level above or below a level of accessible exit discharge is not accessible, an area of rescue assistance shall be provided on each such level (in a number equal to that of inaccessible required exits). Areas of rescue assistance shall comply with 4.3.11. A horizontal exit, meeting the requirements of local building/life safety regulations, shall satisfy the requirement for an area of rescue assistance.

EXCEPTION: Areas of rescue assistance are not required in buildings or facilities having a supervised automatic sprinkler system.

(10)\* Drinking Fountains:

(a) Where only one drinking fountain is provided on a floor there shall be a drinking fountain which is accessible to individuals who use wheelchairs in accordance with 4.15 and one accessible to those who have difficulty bending or stooping. (This can be accommodated by the use of a "hi-lo" fountain; by providing one fountain accessible to those who use wheelchairs and one fountain at a standard height convenient for those who have difficulty bending; by providing a fountain accessible under 4.15 and a water cooler; or by such other means as would achieve the required accessibility for each group on each floor.)

**4.1.3 Accessible Buildings: New Construction**

(b) Where more than one drinking fountain or water cooler is provided on a floor, 50% of those provided shall comply with 4.15 and shall be on an accessible route.

(11) Toilet Facilities: If toilet rooms are provided, then each public and common use toilet room shall comply with 4.22. Other toilet rooms provided for the use of occupants of specific spaces (i.e., a private toilet room for the occupant of a private office) shall be adaptable. If bathing rooms are provided, then each public and common use bathroom shall comply with 4.23. Accessible toilet rooms and bathing facilities shall be on an accessible route.

(12) Storage, Shelving and Display Units:

(a) If fixed or built-in storage facilities such as cabinets, shelves, closets, and drawers are provided in accessible spaces, at least one of each type provided shall contain storage space complying with 4.25. Additional storage may be provided outside of the dimensions required by 4.25.

(b) Shelves or display units allowing self-service by customers in mercantile occupancies shall be located on an accessible route complying with 4.3. Requirements for accessible reach range do not apply.

(c)\* Where lockers are provided in accessible spaces, at least 5 percent, but not less than one, of each type of locker shall comply with 4.25.

(13) Controls and operating mechanisms in accessible spaces, along accessible routes, or as parts of accessible elements (for example, light switches and dispenser controls) shall comply with 4.27.

EXCEPTION: The requirements of 4.27 shall not apply to exercise machines.

(14) If emergency warning systems are provided, then they shall include both audible alarms and visual alarms complying with 4.28. Sleeping accommodations required to comply with 9.3 shall have an alarm system complying

with 4.28. Emergency warning systems in medical care facilities may be modified to suit standard health care alarm design practice.

(15) Detectable warnings shall be provided at locations as specified in 4.29.

(16) Building Signage:

(a) Signs which designate permanent rooms and spaces shall comply with 4.30.1, 4.30.4, 4.30.5 and 4.30.6.

(b) Other signs which provide direction to or information about functional spaces of the building shall comply with 4.30.1, 4.30.2, 4.30.3, and 4.30.5.

EXCEPTION: Building directories, menus, and all other signs which are temporary are not required to comply.

(17) Public Telephones:

(a) If public pay telephones, public closed circuit telephones, or other public telephones are provided, then they shall comply with 4.31.2 through 4.31.8 to the extent required by the following table:

<b>Number of each type of telephone provided on each floor</b>	<b>Number of telephones required to comply with 4.31.2 through 4.31.8<sup>1</sup></b>
--	---

1 or more single unit	1 per floor
1 bank <sup>2</sup>	1 per floor
2 or more banks <sup>2</sup>	1 per bank. Accessible unit may be installed as a single unit in proximity (either visible or with signage) to the bank. At least one public telephone per floor shall meet the requirements for a forward reach telephone <sup>3</sup>

<sup>1</sup> Additional public telephones may be installed at any height. Unless otherwise specified, accessible

### 4.1.3 Accessible Buildings: New Construction

telephones may be either forward or side reach telephones.

<sup>2</sup> A bank consists of two or more adjacent public telephones, often installed as a unit.

<sup>3</sup> EXCEPTION: For exterior installations only, if dial tone first service is available, then a side reach telephone may be installed instead of the required forward reach telephone.

(b)\* All telephones required to be accessible and complying with 4.31.2 through 4.31.8 shall be equipped with a volume control. In addition, 25 percent, but never less than one, of all other public telephones provided shall be equipped with a volume control and shall be dispersed among all types of public telephones, including closed circuit telephones, throughout the building or facility. Signage complying with applicable provisions of 4.30.7 shall be provided.

(c) The following shall be provided in accordance with 4.31.9:

(i) If four or more public pay telephones (including both interior and exterior telephones) are provided at a site of a private facility, and at least one is in an interior location, then at least one interior public text telephone (TTY) shall be provided. If an interior public pay telephone is provided in a public use area in a building of a public facility, at least one interior public text telephone (TTY) shall be provided in the building in a public use area.

(ii) If an interior public pay telephone is provided in a private facility that is a stadium or arena, a convention center, a hotel with a convention center, or a covered mall, at least one interior public text telephone (TTY) shall be provided in the facility. In stadiums, arenas and convention centers which are public facilities, at least one public text telephone (TTY) shall be provided on each floor level having at least one interior public pay telephone.

(iii) If a public pay telephone is located in or adjacent to a hospital emergency room, hospital recovery room, or hospital waiting room,

one public text telephone (TTY) shall be provided at each such location.

(iv) If an interior public pay telephone is provided in the secured area of a detention or correctional facility subject to section 12, then at least one public text telephone (TTY) shall also be provided in at least one secured area. Secured areas are those areas used only by detainees or inmates and security personnel.

(d) Where a bank of telephones in the interior of a building consists of three or more public pay telephones, at least one public pay telephone in each such bank shall be equipped with a shelf and outlet in compliance with 4.31.9(2).

EXCEPTION: This requirement does not apply to the secured areas of detention or correctional facilities where shelves and outlets are prohibited for purposes of security or safety.

(18) If fixed or built-in seating or tables (including, but not limited to, study carrels and student laboratory stations), are provided in accessible public or common use areas, at least five percent (5%), but not less than one, of the fixed or built-in seating areas or tables shall comply with 4.32. An accessible route shall lead to and through such fixed or built-in seating areas, or tables.

(19)\* Assembly Areas:

(a) In places of assembly with fixed seating accessible wheelchair locations shall comply with 4.33.2, 4.33.3, and 4.33.4 and shall be provided consistent with the following table:

Capacity of Seating in Assembly Areas	Number of Required Wheelchair Locations
4 to 25	1
26 to 50	2
51 to 300	4
301 to 500	6
over 500	6 plus 1 additional space for each total seating capacity increase of 100

#### 4.1.5 Accessible Buildings: Additions

In addition, one percent, but not less than one, of all fixed seats shall be aisle seats with no armrests on the aisle side, or removable or folding armrests on the aisle side. Each such seat shall be identified by a sign or marker. Signage notifying patrons of the availability of such seats shall be posted at the ticket office. Aisle seats are not required to comply with 4.33.4.

(b) This paragraph applies to assembly areas where audible communications are integral to the use of the space (e.g., concert and lecture halls, playhouses and movie theaters, meeting rooms, etc.). Such assembly areas, if (1) they accommodate at least 50 persons, or if they have audio-amplification systems, and (2) they have fixed seating, shall have a permanently installed assistive listening system complying with 4.33. For other assembly areas, a permanently installed assistive listening system, or an adequate number of electrical outlets or other supplementary wiring necessary to support a portable assistive listening system shall be provided. The minimum number of receivers to be provided shall be equal to 4 percent of the total number of seats, but in no case less than two. Signage complying with applicable provisions of 4.30 shall be installed to notify patrons of the availability of a listening system.

(c) Where a team or player seating area contains fixed seats and serves an area of sport activity, the seating area shall contain the number of wheelchair spaces required by 4.1.3(19)(a), but not less than one wheelchair space. Wheelchair spaces shall comply with 4.33.2, 4.33.3, 4.33.4, and 4.33.5.

EXCEPTION 1: Wheelchair spaces in team or player seating areas shall not be required to provide a choice of admission price or lines of sight comparable to those for members of the general public.

EXCEPTION 2: This provision shall not apply to team or player seating areas serving bowling lanes not required to be accessible by 15.7.2.

(20) Where automated teller machines (ATMs) are provided, each ATM shall comply with the

requirements of 4.34 except where two or more are provided at a location, then only one must comply.

EXCEPTION: Drive-up-only automated teller machines are not required to comply with 4.27.2, 4.27.3 and 4.34.3.

(21) Where dressing, fitting, or locker rooms are provided, the rooms shall comply with 4.35.

EXCEPTION: Where dressing, fitting, or locker rooms are provided in a cluster, at least 5 percent, but not less than one, of the rooms for each type of use in each cluster shall comply with 4.35.

(22) Where saunas or steam rooms are provided, the rooms shall comply with 4.36.

EXCEPTION: Where saunas or steam rooms are provided in a cluster, at least 5 percent, but not less than one, of the rooms for each type of use in each cluster shall comply with 4.36.

#### 4.1.4 (Reserved)

**4.1.5 Accessible Buildings: Additions.** Each addition to an existing building or facility shall be regarded as an alteration. Each space or element added to the existing building or facility shall comply with the applicable provisions of 4.1.1 to 4.1.3, Minimum Requirements (for New Construction) and the applicable technical specifications of section 4 and the special application sections. Each addition that affects or could affect the usability of an area containing a primary function shall comply with 4.1.6(2).

## 4.35 Dressing, Fitting, and Locker Rooms

**4.34.5 Equipment for Persons with Vision Impairments.** Instructions and all information for use shall be made accessible to and independently usable by persons with vision impairments.

### 4.35 Dressing, Fitting, and Locker Rooms.

**4.35.1 General.** Dressing, fitting, and locker rooms required to be accessible by 4.1 shall comply with 4.35 and shall be on an accessible route.

**4.35.2 Clear Floor Space.** A clear floor space allowing a person using a wheelchair to make a 180-degree turn shall be provided in every accessible dressing room entered through a swinging or sliding door. No door shall swing into any part of the turning space. Turning space shall not be required in a private dressing room entered through a curtained opening at least 32 in (815 mm) wide if clear floor space complying with section 4.2 renders the dressing room usable by a person using a wheelchair.

**4.35.3 Doors.** All doors to accessible dressing rooms shall be in compliance with section 4.13.

**4.35.4 Bench.** A bench complying with 4.37 shall be provided within the room.

**4.35.5 Mirror.** Where mirrors are provided in dressing rooms of the same use, then in an accessible dressing room, a full-length mirror, measuring at least 18 in wide by 54 in high (460 mm by 1370 mm), shall be mounted in a position affording a view to a person on the bench as well as to a person in a standing position.

### 4.36 Saunas and Steam Rooms.

**4.36.1 General.** Saunas and steam rooms required to be accessible by 4.1 shall comply with 4.36.

**4.36.2\* Wheelchair Turning Space.** A wheelchair turning space complying with 4.2.3 shall be provided within the room.

*EXCEPTION:* Wheelchair turning space shall be permitted to be obstructed by readily removable seats.

**4.36.3 Sauna and Steam Room Bench.** Where seating is provided, at least one bench shall be provided and shall comply with 4.37.

**4.36.4 Door Swing.** Doors shall not swing into any part of the clear floor or ground space required at a bench complying with 4.37.

### 4.37 Benches.

**4.37.1 General.** Benches required to be accessible by 4.1 shall comply with 4.37.

**4.37.2 Clear Floor or Ground Space.** Clear floor or ground space complying with 4.2.4 shall be provided and shall be positioned for parallel approach to a short end of a bench seat.

*EXCEPTION:* Clear floor or ground space required by 4.37.2 shall be permitted to be obstructed by readily removable seats in saunas and steam rooms.

**4.37.3\* Size.** Benches shall be fixed and shall have seats that are 20 inches (510 mm) minimum to 24 inches (610 mm) maximum in depth and 42 inches (1065 mm) minimum in length (see Fig. 47).

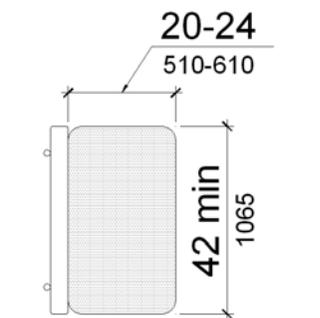


Fig. 47  
Size of Bench

## 4.37 Benches

**4.37.4 Back Support.** Benches shall have back support that is 42 inches (1065 mm) minimum in length and that extends from a point 2 inches (51 mm) maximum above the seat to a point 18 inches (455 mm) minimum above the seat (see Fig. 48).

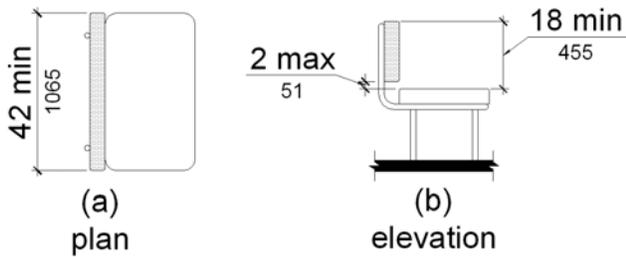


Fig. 48  
Bench Back Support

**4.37.5 Seat Height.** Bench seats shall be 17 inches (430 mm) minimum to 19 inches (485 mm) maximum above the floor or ground.

**4.37.6 Structural Strength.** Allowable stresses shall not be exceeded for materials used when a vertical or horizontal force of 250 lbs. (1112 N) is applied at any point on the seat, fastener, mounting device, or supporting structure.

**4.37.7 Wet Locations.** The surface of benches installed in wet locations shall be slip-resistant and shall not accumulate water.

**12.6 Visible Alarms and Telephones**

back support (e.g., attachment to wall). The structural strength of the bench attachments shall comply with 4.26.3.

(7) Storage. Fixed or built-in storage facilities, such as cabinets, shelves, closets, and drawers, shall contain storage space complying with 4.25.

(8) Controls. All controls intended for operation by inmates shall comply with 4.27.

(9) Accommodations for persons with hearing impairments required by 12.4.3 and complying with 12.6 shall be provided in accessible cells or rooms.

**12.6 Visible Alarms and Telephones.** Where audible emergency warning systems are provided to serve the occupants of holding or housing cells or rooms, visual alarms complying with 4.28.4 shall be provided. Where permanently installed telephones are provided within holding or housing cells or rooms, they shall have volume controls complying with 4.31.5.

EXCEPTION: Visual alarms are not required where inmates or detainees are not allowed independent means of egress.

**13. RESIDENTIAL HOUSING.  
(Reserved).**

**14. PUBLIC RIGHTS-OF-WAY.  
(Reserved).**

**15. RECREATION FACILITIES.**

Newly designed or newly constructed and altered recreation facilities shall comply with the applicable requirements of section 4 and the special application sections, except as modified or otherwise provided in this section.

**15.1\* Amusement Rides.**

**15.1.1 General.** Newly designed or newly constructed and altered amusement rides shall comply with 15.1.

EXCEPTION 1\*: Mobile or portable amusement rides shall not be required to comply with 15.1.

EXCEPTION 2\*: Amusement rides which are controlled or operated by the rider shall be required to comply only with 15.1.4 and 15.1.5.

EXCEPTION 3\*: Amusement rides designed primarily for children, where children are assisted on and off the ride by an adult, shall be required to comply only with 15.1.4 and 15.1.5.

EXCEPTION 4: Amusement rides without amusement ride seats shall be required to comply only with 15.1.4 and 15.1.5.

**15.1.2\* Alterations to Amusement Rides.** A modification to an existing amusement ride is an alteration subject to 15.1 if one or more of the following conditions apply:

(1) The amusement ride’s structural or operational characteristics are changed to the extent that the ride’s performance differs from that specified by the manufacturer or the original design criteria; or

(2) The load and unload area of the amusement ride is newly designed and constructed.

**15.1.3 Number Required.** Each amusement ride shall provide at least one wheelchair space complying with 15.1.7, or at least one amusement ride seat designed for transfer complying with 15.1.8, or at least one transfer device complying with 15.1.9.

**15.1.4\* Accessible Route.** When in the load and unload position, amusement rides required to comply with 15.1 shall be served by an accessible route complying with 4.3. Any part of an accessible route serving amusement rides with a slope greater than 1:20 shall be considered a ramp and shall comply with 4.8.

EXCEPTION 1: The maximum slope specified in 4.8.2 shall not apply in the load and unload areas or on the amusement ride where compliance is structurally or operationally infeasible, provided that the slope of the ramp shall not exceed 1:8.

EXCEPTION 2: Handrails shall not be required in the load and unload areas or on the amusement ride where compliance is structurally or operationally infeasible.

EXCEPTION 3: Limited-use/limited-application elevators and platform lifts complying with 4.1.1 shall be permitted to be part of an accessible route serving the load and unload area.

**15.1.5 Load and Unload Areas.** Load and unload areas serving amusement rides required to comply with 15.1 shall provide a maneuvering space complying with 4.2.3. The maneuvering space shall have a slope not steeper than 1:48.

**15.1.6 Signage.** Signage shall be provided at the entrance of the queue or waiting line for each amusement ride to identify the type of access provided. Where an accessible unload area also serves as the accessible load area, signage shall be provided at the entrance to the queue or waiting line indicating the location of the accessible load and unload area.

**15.1.7 Amusement Rides with Wheelchair Spaces.** Amusement rides with wheelchair spaces shall comply with 15.1.7.

**15.1.7.1 Floor or Ground Surface.** The floor or ground surface of wheelchair spaces shall comply with 15.1.7.1.

**15.1.7.1.1 Slope.** The floor or ground surface of wheelchair spaces shall have a slope not steeper than 1:48 when in the load and unload position and shall be stable and firm.

**15.1.7.1.2\* Gaps.** Floors of amusement rides with wheelchair spaces and floors of load and unload areas shall be coordinated so that, when the amusement rides are at rest in the load and unload position, the vertical difference between the floors shall be within plus or minus 5/8 inches

(16 mm) and the horizontal gap shall be no greater than 3 inches (75 mm) under normal passenger load conditions.

EXCEPTION: Where compliance is not operationally or structurally feasible, ramps, bridge plates, or similar devices complying with the applicable requirements of 36 CFR 1192.83(c) shall be provided.

**15.1.7.2 Clearances.** Clearances for wheelchair spaces shall comply with 15.1.7.2.

EXCEPTION 1: Where provided, securement devices shall be permitted to overlap required clearances.

EXCEPTION 2: Wheelchair spaces shall be permitted to be mechanically or manually repositioned.

EXCEPTION 3\*: Wheelchair spaces shall not be required to comply with 4.4.2.

**15.1.7.2.1 Width and Length.** Wheelchair spaces shall provide a clear width of 30 inches (760 mm) minimum and a clear length of 48 inches (1220 mm) minimum measured to 9 inches (230 mm) minimum above the floor surface.

**15.1.7.2.2\* Wheelchair Spaces - Side Entry.** Where the wheelchair space can be entered only from the side, the ride shall be designed to permit sufficient maneuvering space for individuals using a wheelchair or mobility device to enter and exit the ride.

**15.1.7.2.3 Protrusions in Wheelchair Spaces.** Objects are permitted to protrude a distance of 6 inches (150 mm) maximum along the front of the wheelchair space where located 9 inches (230 mm) minimum and 27 inches (685 mm) maximum above the floor or ground surface of the wheelchair space. Objects are permitted to protrude a distance of 25 inches (635 mm) maximum along the front of the wheelchair space, where located more than 27 inches (685 mm) above the floor or ground surface of the wheelchair space (see Fig. 58).

## 15.1 Amusement Rides

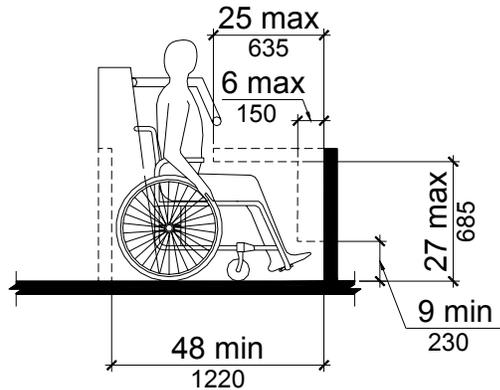


Fig. 58  
Protrusions in Wheelchair Spaces

**15.1.7.3 Openings.** Where openings are provided to access wheelchair spaces on amusement rides, the entry shall provide a 32 inch (815 mm) minimum clear opening.

**15.1.7.4 Approach.** One side of the wheelchair space shall adjoin an accessible route.

**15.1.7.5 Companion Seats.** Where the interior width of the amusement ride is greater than 53 inches (1346 mm), seating is provided for more than one rider, and the wheelchair is not required to be centered within the amusement ride, a companion seat shall be provided for each wheelchair space.

**15.1.7.5.1 Shoulder-to-Shoulder Seating.** Where an amusement ride provides shoulder-to-shoulder seating, companion seats shall be shoulder-to-shoulder with the adjacent wheelchair space.

**EXCEPTION:** Where shoulder-to-shoulder companion seating is not operationally or structurally feasible, compliance with this provision shall be required to the maximum extent feasible.

**15.1.8\* Amusement Ride Seats Designed for Transfer.** Amusement ride seats designed for transfer shall comply with 15.1.8 when positioned for loading and unloading.

**15.1.8.1 Clear Floor or Ground Space.** Clear floor or ground space complying with 4.2.4 shall be provided in the load and unload area adjacent to the amusement ride seats designed for transfer.

**15.1.8.2 Transfer Height.** The height of the amusement ride seats shall be 14 inches (355 mm) minimum to 24 inches (610mm) maximum measured above the load and unload surface.

**15.1.8.3 Transfer Entry.** Where openings are provided to transfer to amusement ride seats, the space shall be designed to provide clearance for transfer from a wheelchair or mobility device to the amusement ride seat.

**15.1.8.4 Wheelchair Storage Space.** Wheelchair storage spaces complying with 4.2.4 shall be provided in or adjacent to unload areas for each required amusement ride seat designed for transfer and shall not overlap any required means of egress or accessible route.

**15.1.9\* Transfer Devices for Use with Amusement Rides.** Transfer devices for use with amusement rides shall comply with 15.1.9 when positioned for loading and unloading.

**15.1.9.1 Clear Floor or Ground Space.** Clear floor or ground space complying with 4.2.4 shall be provided in the load and unload area adjacent to the transfer devices.

**15.1.9.2 Transfer Height.** The height of the transfer device seats shall be 14 inches (355 mm) minimum to 24 inches (610 mm) maximum measured above the load and unload surface.

**15.1.9.3 Wheelchair Storage Space.** Wheelchair storage spaces complying with 4.2.4 shall be provided in or adjacent to unload areas for each required transfer device and shall not overlap any required means of egress or accessible route.

**15.2 Boating Facilities.**

**15.2.1 General.** Newly designed or newly constructed and altered boating facilities shall comply with 15.2.

**15.2.2\* Accessible Route.** Accessible routes, including gangways that are part of accessible routes, shall comply with 4.3.

EXCEPTION 1: Where an existing gangway or series of gangways is replaced or altered, an increase in the length of the gangway is not required to comply with 15.2.2, unless required by 4.1.6(2).

EXCEPTION 2: The maximum rise specified in 4.8.2 shall not apply to gangways.

EXCEPTION 3: Where the total length of the gangway or series of gangways serving as part of a required accessible route is at least 80 feet (24 m), the maximum slope specified in 4.8.2 shall not apply to the gangways.

EXCEPTION 4: In facilities containing fewer than 25 boat slips and where the total length of the gangways or series of gangways serving as part of a required accessible route is at least 30 feet (9140 mm), the maximum slope specified in 4.8.2 shall not apply to the gangways.

EXCEPTION 5: Where gangways connect to transition plates, landings specified by 4.8.4 shall not be required.

EXCEPTION 6: Where gangways and transition plates connect and are required to have handrails, handrail extensions specified by 4.8.5 shall not be required. Where handrail extensions are provided on gangways or transition plates, such extensions are not required to be parallel with the ground or floor surface.

EXCEPTION 7: The cross slope of gangways, transition plates, and floating piers that are part of an accessible route shall be 1:50 maximum measured in the static position.

EXCEPTION 8: Limited-use/limited-application elevators or platform lifts complying with 4.11 shall be permitted in lieu of gangways complying with 4.3.

**15.2.3\* Boat Slips: Minimum Number.** Where boat slips are provided, boat slips complying with 15.2.5 shall be provided in accordance with Table 15.2.3. Where the number of boat slips is not identified, each 40 feet (12 m) of boat slip edge provided along the perimeter of the pier shall be counted as one boat slip for the purpose of this section.

**Table 15.2.3**

Total Boat Slips in Facility	Minimum Number of Required Accessible Boat Slips
1 to 25	1
26 to 50	2
51 to 100	3
101 to 150	4
151 to 300	5
301 to 400	6
401 to 500	7
501 to 600	8
601 to 700	9
701 to 800	10
801 to 900	11
901 to 1000	12
1001 and over	12 plus 1 for each 100 or fraction thereof over 1000

**15.2.3.1\* Dispersion.** Accessible boat slips shall be dispersed throughout the various types of slips provided. This provision does not require an increase in the minimum number of boat slips required to be accessible.

**15.2.4\* Boarding Piers at Boat Launch Ramps.** Where boarding piers are provided at boat launch ramps, at least 5 percent, but not less than one of the boarding piers shall comply with 15.2.4 and shall be served by an accessible route complying with 4.3.

## 15.2 Boating Facilities

EXCEPTION 1: Accessible routes serving floating boarding piers shall be permitted to use exceptions 1, 2, 5, 6, 7, and 8 in 15.2.2.

EXCEPTION 2: Where the total length of the gangway or series of gangways serving as part of a required accessible route is at least 30 feet (9140 mm), the maximum slope specified by 4.8.2 shall not apply to the gangways.

EXCEPTION 3: Where the accessible route serving a floating boarding pier or skid pier is located within a boat launch ramp, the portion of the accessible route located within the boat launch ramp shall not be required to comply with 4.8.

**15.2.4.1\* Boarding Pier Clearances.** The entire length of the piers shall comply with 15.2.5.

**15.2.5\* Accessible Boat Slips.** Accessible boat slips shall comply with 15.2.5.

**15.2.5.1 Clearances.** Accessible boat slips shall be served by clear pier space 60 inches (1525 mm) wide minimum and at least as long as the accessible boat slips. Every 10 feet (3050 mm) maximum of linear pier edge serving the accessible boat slips shall contain at least one continuous clear opening 60 inches (1525 mm) minimum in width (see Fig. 59).

EXCEPTION 1: The width of the clear pier space shall be permitted to be 36 inches (915 mm) minimum for a length of 24 inches (610 mm) maximum, provided that multiple 36 inch (915 mm) wide segments are separated by segments that are 60 inches (1525 mm) minimum clear in width and 60 inches (1525 mm) minimum clear in length (see Fig. 60).

EXCEPTION 2: Edge protection 4 inches (100 mm) high maximum and 2 inches (51 mm) deep maximum shall be permitted at the continuous clear openings (see Fig. 61).

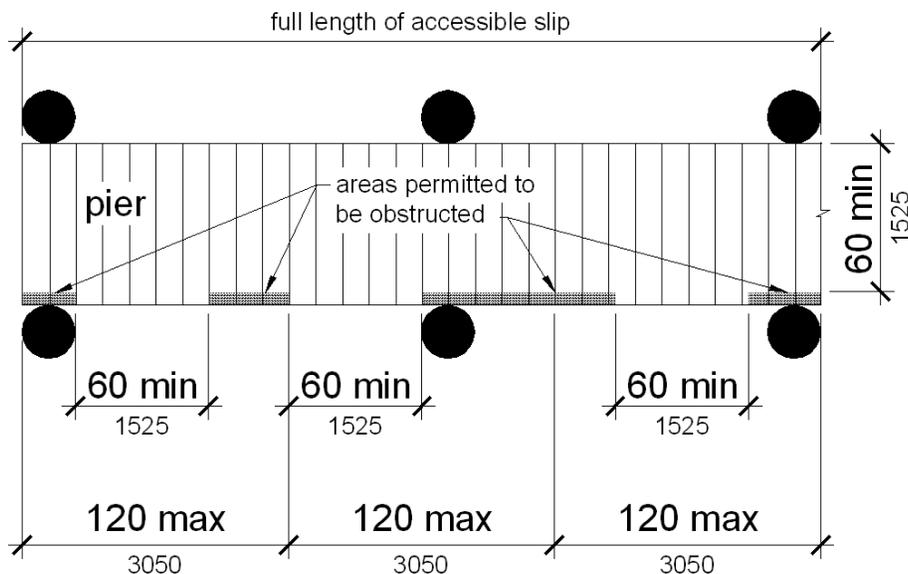


Fig. 59  
Pier Clearances

**EXCEPTION 3\*:** In alterations to existing facilities, clear pier space shall be permitted to be located perpendicular to the boat slip and shall extend the width of the boat slip, where the facility has at least one boat slip complying with 15.2.5, and further compliance with 15.2.5 would result in a reduction in the number of boat slips available or result in a reduction of the widths of existing slips.

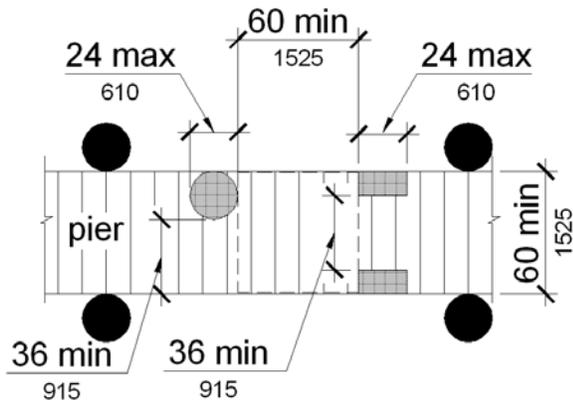


Fig. 60  
Pier Clear Space Reduction

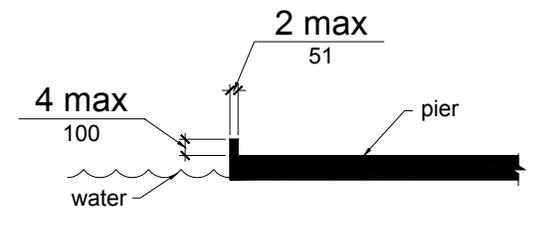


Fig. 61  
Edge Protection at Pier

**15.2.5.2 Cleats and Other Boat Securement Devices.** Cleats and other boat securement devices shall not be required to comply with 4.27.3.

**15.3 Fishing Piers and Platforms.**

**15.3.1 General.** Newly designed or newly constructed and altered fishing piers and platforms shall comply with 15.3.

**15.3.2 Accessible Route.** Accessible routes, including gangways that are part of accessible routes, serving fishing piers and platforms shall comply with 4.3.

**EXCEPTION 1:** Accessible routes serving floating fishing piers and platforms shall be permitted to use exceptions 1, 2, 5, 6, 7, and 8 in 15.2.2.

**EXCEPTION 2\*:** Where the total length of the gangway or series of gangways serving as part of a required accessible route is at least 30 feet (9140 mm), the maximum slope specified by 4.8.2 shall not apply to the gangways.

**15.3.3 Railings.** Where railings, guards, or handrails are provided, they shall comply with 15.3.3.

**15.3.3.1\* Edge Protection.** Edge protection shall be provided and shall extend 2 inches (51 mm) minimum above the ground or deck surface.

**EXCEPTION:** Where the railing, guard, or handrail is 34 inches (865 mm) or less above the ground or deck surface, edge protection shall not be required if the deck surface extends 12 inches (305 mm) minimum beyond the inside face of the railing. Toe clearance shall be 9 inches (230 mm) minimum above the ground or deck surface beyond the railing. Toe clearance shall be 30 inches (760 mm) minimum wide (see Fig. 62).

**15.3.3.2 Height.** At least 25 percent of the railings, guards, or handrails shall be 34 inches (865 mm) maximum above the ground or deck surface.

**EXCEPTION:** This provision shall not apply to that portion of a fishing pier or platform where a guard which complies with sections 1003.2.12.1 (Height) and 1003.2.12.2 (Opening limitations) of the International Building Code (incorporated by reference, see 2.3.2) is provided.

## 15.4 Golf

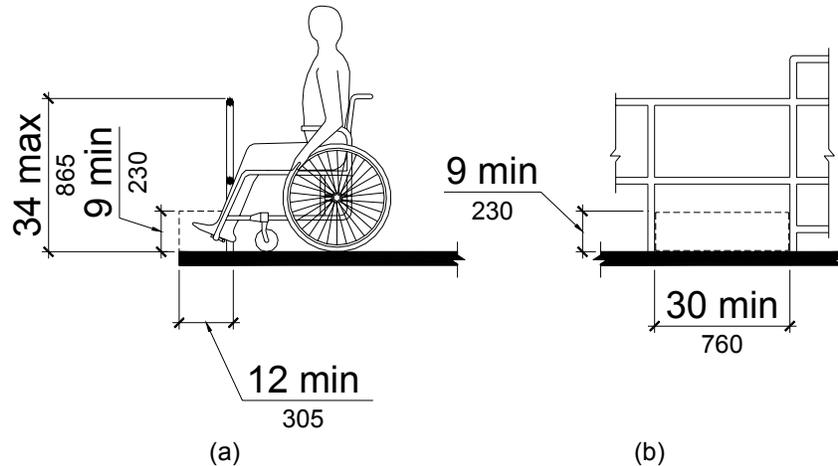


Fig. 62  
Edge Protection at Fishing Piers

**15.3.3.3\* Dispersion.** Railings required to comply with 15.3.3.2 shall be dispersed throughout a fishing pier or platform.

**15.3.4 Clear Floor or Ground Space.** At least one clear floor or ground space complying with 4.2.4 shall be provided where the railing height required by 15.3.3.2 is located. Where no railings are provided, at least one clear floor or ground space complying with 4.2.4 shall be provided.

**15.3.5 Maneuvering Space.** At least one maneuvering space complying with 4.2.3 shall be provided on the fishing pier or platform.

### 15.4 Golf.

**15.4.1 General.** Newly designed or newly constructed and altered golf courses, driving ranges, practice putting greens, and practice teeing grounds shall comply with 15.4.

**15.4.2\* Accessible Route - Golf Course.** An accessible route shall connect accessible elements and spaces within the boundary of the golf course.

In addition, an accessible route shall connect the golf car rental area, bag drop areas, practice putting greens, accessible practice teeing grounds, course toilet rooms, and course weather shelters. The accessible route required by this section shall be 48 inches (1220 mm) minimum wide. Where handrails are provided, the accessible route shall be 60 inches (1525 mm) minimum wide.

**EXCEPTION 1:** A golf car passage complying with 15.4.7 shall be permitted in lieu of all or part of an accessible route required by 15.4.2.

**EXCEPTION 2:** The handrail requirements of 4.8.5 shall not apply to an accessible route located within the boundary of a golf course.

**15.4.3\* Accessible Route - Driving Ranges.** An accessible route shall connect accessible teeing stations at driving ranges with accessible parking spaces and shall be 48 inches (1220 mm) wide minimum. Where handrails are provided, the accessible route shall be 60 inches (1525 mm) wide minimum.

EXCEPTION: A golf car passage complying with 15.4.7 shall be permitted in lieu of all or part of an accessible route required by 15.4.3.

**15.4.4 Teeing Grounds.** Teeing grounds shall comply with 15.4.4.

**15.4.4.1 Number Required.** Where one or two teeing grounds are provided for a hole, at least one teeing ground serving the hole shall comply with 15.4.4.3. Where three or more teeing grounds are provided for a hole, at least two teeing grounds shall comply with 15.4.4.3.

**15.4.4.2 Forward Teeing Ground.** The forward teeing ground shall be accessible.

EXCEPTION: In alterations, the forward teeing ground shall not be required to be accessible where compliance is not feasible due to terrain.

**15.4.4.3 Teeing Grounds.** Teeing grounds required by 15.4.4.1 and 15.4.4.2 shall be designed and constructed so that a golf car can enter and exit the teeing ground.

**15.4.5 Teeing Stations at Driving Ranges and Practice Teeing Grounds.** Where teeing stations or practice teeing grounds are provided, at least 5 percent of the practice teeing stations or practice teeing grounds, but not less than one, shall comply with 15.4.4.3.

**15.4.6 Weather Shelters.** Where weather shelters are provided on a golf course, each weather shelter shall have a clear floor or ground space 60 inches (1525 mm) minimum by 96 inches (2440 mm) minimum and shall be designed and constructed so that a golf car can enter and exit.

**15.4.7 Golf Car Passage.** Where curbs or other constructed barriers are provided along a golf car passage to prohibit golf cars from entering a fairway, openings at least 60 inches (1525 mm) wide shall be provided at intervals not to exceed 75 yds (69 m).

**15.4.7.1 Width.** The golf car passage shall be 48 inches (1220 mm) minimum wide.

**15.4.8 Putting Greens.** Each putting green shall be designed and constructed so that a golf car can enter and exit the putting green.

**15.5\* Miniature Golf.**

**15.5.1 General.** Newly designed or newly constructed and altered miniature golf courses shall comply with 15.5.

**15.5.2 Accessible Holes.** At least fifty percent of holes on a miniature golf course shall comply with 15.5.3 through 15.5.5 and shall be consecutive.

EXCEPTION: One break in the sequence of consecutive accessible holes shall be permitted, provided that the last hole on a miniature golf course is the last hole in the sequence.

**15.5.3\* Accessible Route.** An accessible route complying with 4.3 shall connect the course entrance with the first accessible hole and the start of play area on each accessible hole. The course shall be configured to allow exit from the last accessible hole to the course exit or entrance and shall not require travel back through other holes.

**15.5.3.1 Accessible Route - Located On the Playing Surface.** Where the accessible route is located on the playing surface of the accessible hole, exceptions 1-5 shall be permitted.

EXCEPTION 1: Where carpet is provided, the requirements of 4.5.3 shall not apply.

EXCEPTION 2: Where the accessible route intersects the playing surface of a hole, a 1 inch (26 mm) maximum curb shall be permitted for a width of 32 inches (815 mm) minimum.

EXCEPTION 3: A slope of 1:4 maximum for a 4 inch (100 mm) maximum rise shall be permitted.

EXCEPTION 4: Landings required by 4.8.4 shall be permitted to be 48 inches (1220 mm) in length minimum. Landing size required by 4.8.4(3) shall be permitted to be 48 inches (1220 mm) minimum by 60 inches (1525 mm) minimum.

## 15.6 Play Areas

Landing slopes shall be permitted to be 1:20 maximum.

EXCEPTION 5: Handrail requirements of 4.8.5 shall not apply.

**15.5.3.2 Accessible Route - Adjacent to the Playing Surface.** Where the accessible route is located adjacent to the playing surface, the requirements of 4.3 shall apply.

**15.5.4 Start of Play Areas.** Start of play areas at holes required to comply with 15.5.2 shall have a slope not steeper than 1:48 and shall be 48 inches (1220 mm) minimum by 60 inches (1525 mm) minimum.

**15.5.5\* Golf Club Reach Range.** All areas within accessible holes where golf balls rest shall be within 36 inches (915 mm) maximum of an accessible route having a maximum slope of 1:20 for 48 inches (1220 mm) in length (see Fig. 63).

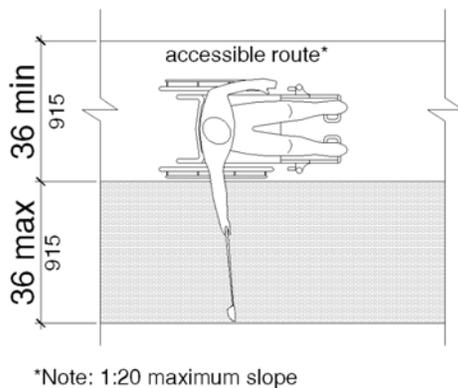


Fig. 63  
Golf Club Reach Range

### 15.6 Play Areas.

**15.6.1\* General.** Newly designed and newly constructed play areas for children ages 2 and over and altered portions of existing play areas shall comply with the applicable provisions of section 4, except as modified or otherwise provided by this section. Where separate play

areas are provided within a site for specified age groups, each play area shall comply with this section. Where play areas are designed or constructed in phases, this section shall be applied so that when each successive addition is completed, the entire play area complies with all the applicable provisions of this section.

EXCEPTION 1: Play areas located in family child care facilities where the proprietor actually resides shall not be required to comply with 15.6.

EXCEPTION 2: Where play components are relocated in existing play areas for the purpose of creating safe use zones, 15.6 shall not apply, provided that the ground surface is not changed or extended for more than one use zone.

EXCEPTION 3: Where play components are altered and the ground surface is not altered, the ground surface shall not be required to comply with 15.6.7, unless required by 4.1.6(2).

EXCEPTION 4: The provisions of 15.6.1 through 15.6.7 shall not apply to amusement attractions.

EXCEPTION 5: Compliance with 4.4 shall not be required within the boundary of the play area.

EXCEPTION 6: Stairs shall not be required to comply with 4.9.

### 15.6.2\* Ground Level Play Components.

Ground level play components shall be provided in the number and types required by 15.6.2.1 and 15.6.2.2. Ground level play components that are provided to comply with 15.6.2.1 shall be permitted to satisfy the number required by 15.6.2.2, provided that the minimum required types of play components are provided. Where more than one ground level play component required by 15.6.2.1 and 15.6.2.2 is provided, the play components shall be integrated in the play area.

**15.6.2.1 General.** Where ground level play components are provided, at least one of each type provided shall be located on an accessible route complying with 15.6.4 and shall comply with 15.6.6.

**15.6.2.2 Additional Number and Types.** Where elevated play components are provided, ground level play components shall be provided in accordance with Table 15.6.2.2. Ground level play components required by 15.6.2.2 shall be located on an accessible route complying with 15.6.4 and shall comply with 15.6.6.

EXCEPTION: If at least 50 percent of the elevated play components are connected by a ramp, and if at least 3 of the elevated play components connected by the ramp are different types of play components, 15.6.2.2 shall not apply.

**15.6.3\* Elevated Play Components.** Where elevated play components are provided, at least 50 percent shall be located on an accessible route complying with 15.6.4. Elevated play components connected by a ramp shall comply with 15.6.6.

**15.6.4\* Accessible Routes.** At least one accessible route complying with 4.3, as modified by 15.6.4, shall be provided.

EXCEPTION 1: Transfer systems complying with 15.6.5 shall be permitted to connect elevated play components, except where 20 or more elevated play components are provided, no more than 25 percent of the elevated play components shall be permitted to be connected by transfer systems.

EXCEPTION 2: Where transfer systems are provided, an elevated play component shall be permitted to connect to another elevated play component in lieu of an accessible route.

EXCEPTION 3: Platform lifts (wheelchair lifts) complying with 4.1.1 and applicable State or local codes shall be permitted to be used as part of an accessible route.

**Table 15.6.2.2 Number and Types of Ground Level Play Components Required to be on Accessible Route**

Number of Elevated Play Components Provided	Minimum Number of Ground Level Play Components Required to be on Accessible Route	Minimum Number of Different Types of Ground Level Play Components Required to be on Accessible Route
1	Not applicable	Not applicable
2 to 4	1	1
5 to 7	2	2
8 to 10	3	3
11 to 13	4	3
14 to 16	5	3
17 to 19	6	3
20 to 22	7	4
23 to 25	8	4
More than 25	8 plus 1 for each additional 3 over 25, or fraction thereof	5

## 15.6 Play Areas

**15.6.4.1 Location.** Accessible routes shall be located within the boundary of the play area and shall connect ground level play components as required by 15.6.2.1 and 15.6.2.2 and elevated play components as required by 15.6.3, including entry and exit points of the play components.

**15.6.4.2 Protrusions.** Objects shall not protrude into ground level accessible routes at or below 80 in (2030 mm) above the ground or floor surface.

**15.6.4.3 Clear Width.** The clear width of accessible routes within play areas shall comply with 15.6.4.3.

**15.6.4.3.1 Ground Level.** The clear width of accessible routes at ground level shall be 60 in (1525 mm) minimum.

EXCEPTION 1: In play areas less than 1,000 square feet, the clear width of accessible routes shall be permitted to be 44 in (1120 mm) minimum, provided that at least one turning space complying with 4.2.3 is provided where the restricted accessible route exceeds 30 feet (9.14 m) in length.

EXCEPTION 2: The clear width of accessible routes shall be permitted to be 36 in (915 mm) minimum for a distance of 60 in (1525 mm) maximum, provided that multiple reduced width segments are separated by segments that are 60 in (1525 mm) minimum in width and 60 in (1525 mm) minimum in length.

**15.6.4.3.2 Elevated.** The clear width of accessible routes connecting elevated play components shall be 36 in (915 mm).

EXCEPTION 1: The clear width of accessible routes connecting elevated play components shall be permitted to be reduced to 32 in (815 mm) minimum for a distance of 24 in (610 mm) maximum provided that reduced width segments are separated by segments that are 48 in (1220 mm) minimum in length and 36 in (915 mm) minimum in width.

EXCEPTION 2: The clear width of transfer systems connecting elevated play components

shall be permitted to be 24 in (610 mm) minimum.

**15.6.4.4 Ramp Slope and Rise.** Any part of an accessible route with a slope greater than 1:20 shall be considered a ramp and shall comply with 4.8, as modified by 15.6.4.4.

**15.6.4.4.1 Ground Level.** The maximum slope for ramps connecting ground level play components within the boundary of a play area shall be 1:16.

**15.6.4.4.2 Elevated.** Where a ramp connects elevated play components, the maximum rise of any ramp run shall be 12 in (305 mm).

**15.6.4.5 Handrails.** Where required on ramps, handrails shall comply with 4.8.5, as modified by 15.6.4.5.

EXCEPTION 1: Handrails shall not be required at ramps located within ground level use zones.

EXCEPTION 2: Handrail extensions shall not be required.

**15.6.4.5.1 Handrail Gripping Surface.** Handrails shall have a diameter or width of 0.95 in (24.1 mm) minimum to 1.55 in (39.4 mm) maximum, or the shape shall provide an equivalent gripping surface.

**15.6.4.5.2 Handrail Height.** The top of handrail gripping surfaces shall be 20 in (510 mm) minimum to 28 in (710 mm) maximum above the ramp surface.

**15.6.5\* Transfer Systems.** Where transfer systems are provided to connect elevated play components, the transfer systems shall comply with 15.6.5.

**15.6.5.1 Transfer Platforms.** Transfer platforms complying with 15.6.5.1 shall be provided where transfer is intended to be from a wheelchair or other mobility device (see Fig. 64).

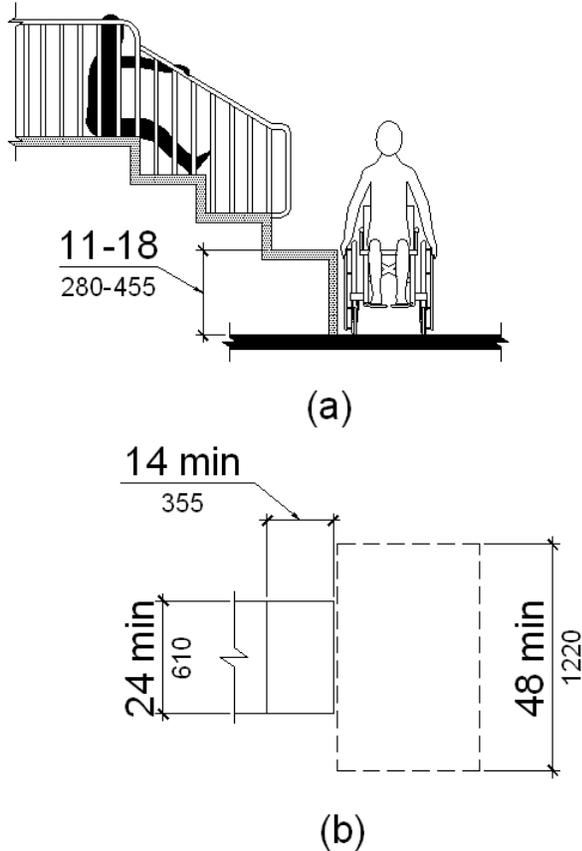


Fig. 64

**15.6.5.1.1 Size.** Platforms shall have a level surface 14 in (355 mm) minimum in depth and 24 in (610 mm) minimum in width.

**15.6.5.1.2 Height.** Platform surfaces shall be 11 in (280 mm) minimum to 18 in (455 mm) maximum above the ground or floor surface.

**15.6.5.1.3 Transfer Space.** A level space complying with 4.2.4 shall be centered on the 48 in (1220 mm) long dimension parallel to the 24 in (610 mm) minimum long unobstructed side of the transfer platform.

**15.6.5.1.4 Transfer Supports.** A means of support for transferring shall be provided.

**15.6.5.2 Transfer Steps.** Transfer steps complying with 15.6.5.2 shall be provided where movement is intended from a transfer platform to a level with elevated play components required to be located on an accessible route (see Fig. 65).

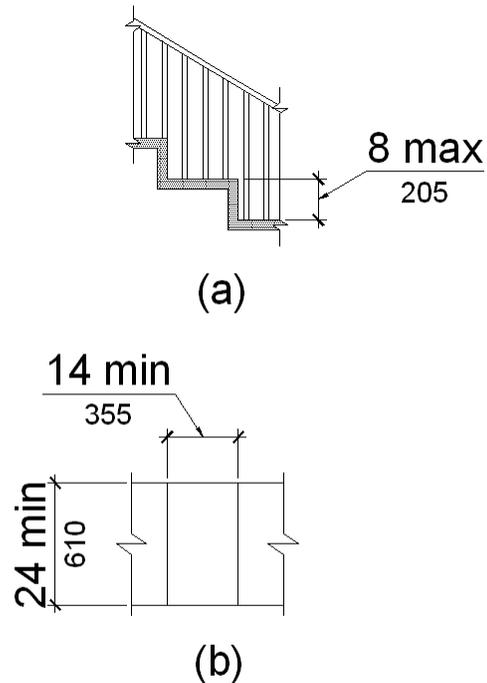


Fig. 65

**15.6.5.2.1 Size.** Transfer steps shall have a level surface 14 in (355 mm) minimum in depth and 24 in (610 mm) minimum in width.

**15.6.5.2.2 Height.** Each transfer step shall be 8 in (205 mm) maximum high.

**15.6.5.2.3 Transfer Supports.** A means of support for transferring shall be provided.

**15.6.6\* Play Components.** Ground level play components located on accessible routes and

## 15.7 Exercise Equipment and Machines

elevated play components connected by ramps shall comply with 15.6.6.

**15.6.6.1 Maneuvering Space.** Maneuvering space complying with 4.2.3 shall be provided on the same level as the play components. Maneuvering space shall have a slope not steeper than 1:48 in all directions. The maneuvering space required for a swing shall be located immediately adjacent to the swing.

**15.6.6.2 Clear Floor or Ground Space.** Clear floor or ground space shall be provided at the play components and shall be 30 in (760 mm) by 48 in (1220 mm) minimum. Clear floor or ground space shall have a slope not steeper than 1:48 in all directions.

**15.6.6.3 Play Tables: Height and Clearances.** Where play tables are provided, knee clearance 24 in (610 mm) high minimum, 17 in deep (430 mm) minimum, and 30 in (760 mm) wide minimum shall be provided. The tops of rims, curbs, or other obstructions shall be 31 in (785 mm) high maximum.

EXCEPTION: Play tables designed or constructed primarily for children ages 5 and under shall not be required to provide knee clearance if the clear floor or ground space required by 15.6.6.2 is arranged for a parallel approach and if the rim surface is 31 in (785 mm) high maximum.

**15.6.6.4 Entry Points and Seats: Height.** Where a play component requires transfer to the entry point or seat, the entry point or seat shall be 11 in (280 mm) minimum and 24 in (610 mm) maximum above the clear floor or ground space.

EXCEPTION: The entry point of a slide shall not be required to comply with 15.6.6.4.

**15.6.6.5 Transfer Supports.** Where a play component requires transfer to the entry point or seat, a means of support for transferring shall be provided.

**15.6.7\* Ground Surfaces.** Ground surfaces along accessible routes, clear floor or ground

spaces, and maneuvering spaces within play areas shall comply with 4.5.1 and 15.6.7.

**15.6.7.1 Accessibility.** Ground surfaces shall comply with ASTM F 1951 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment (incorporated by reference, see 2.3.2). Ground surfaces shall be inspected and maintained regularly and frequently to ensure continued compliance with ASTM F 1951.

**15.6.7.2 Use Zones.** If located within use zones, ground surfaces shall comply with ASTM F 1292 Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment (incorporated by reference, see 2.3.2).

**15.6.8 Soft Contained Play Structures.** Soft contained play structures shall comply with 15.6.8.

**15.6.8.1 Accessible Routes to Entry Points.** Where three or fewer entry points are provided, at least one entry point shall be located on an accessible route. Where four or more entry points are provided, at least two entry points shall be located on an accessible route. Accessible routes shall comply with 4.3.

EXCEPTION: Transfer systems complying with 15.6.5 or platform lifts (wheelchair lifts) complying with 4.1.1 and applicable State or local codes shall be permitted to be used as part of an accessible route.

### **15.7 Exercise Equipment and Machines, Bowling Lanes, and Shooting Facilities.**

**15.7.1 General.** Newly designed or newly constructed and altered exercise equipment and machines, bowling lanes, and shooting facilities shall comply with 15.7.

**15.7.2\* Exercise Equipment and Machines.** At least one of each type of exercise equipment and machines shall be provided with clear floor or ground space complying with 4.2.4 and shall be served by an accessible route. Clear floor or ground space shall be positioned for transfer or

## 15.8 Swimming Pools, Wading Pools, and Spas

for use by an individual seated in a wheelchair. Clear floor or ground spaces for more than one piece of equipment shall be permitted to overlap .

**15.7.3 Bowling Lanes.** Where bowling lanes are provided, at least 5 percent, but not less than one of each type of lane shall be served by an accessible route.

**15.7.4\* Shooting Facilities.** Where fixed firing positions are provided at a site, at least 5 percent, but not less than one, of each type of firing position shall comply with 15.7.4.1.

**15.7.4.1 Fixed Firing Position.** Fixed firing positions shall contain a 60 inch (1525 mm) diameter space and shall have a slope not steeper than 1:48.

### 15.8 Swimming Pools, Wading Pools, and Spas.

**15.8.1 General.** Newly designed or newly constructed and altered swimming pools, wading pools, and spas shall comply with 15.8.

EXCEPTION: An accessible route shall not be required to serve raised diving boards or diving platforms.

**15.8.2\* Swimming Pools.** At least two accessible means of entry shall be provided for each public use and common use swimming pool. The primary means of entry shall comply with 15.8.5 (Swimming Pool Lifts) or 15.8.6 (Sloped Entries). The secondary means of entry shall comply with one of the following: 15.8.5 (Swimming Pool Lifts), 15.8.6 (Sloped Entries), 15.8.7 (Transfer Walls), 15.8.8 (Transfer Systems), or 15.8.9 (Pool Stairs).

EXCEPTION 1\*: Where a swimming pool has less than 300 linear feet (91 m) of swimming pool wall, at least one accessible means of entry shall be provided and shall comply with 15.8.5 (Swimming Pool Lifts) or 15.8.6 (Sloped Entries).

EXCEPTION 2: Wave action pools, leisure rivers, sand bottom pools, and other pools where user access is limited to one area, shall provide at least one accessible means of entry that complies with

15.8.5 (Swimming Pool Lifts), 15.8.6 (Sloped Entries), or 15.8.8 (Transfer Systems).

EXCEPTION 3: Catch pools shall be required only to be served by an accessible route that connects to the pool edge.

**15.8.3 Wading Pools.** At least one accessible means of entry complying with 15.8.6 (Sloped Entries) shall be provided for each wading pool.

**15.8.4 Spas.** At least one accessible means of entry complying with 15.8.5 (Swimming Pool Lifts), 15.8.7 (Transfer Walls), or 15.8.8 (Transfer Systems) shall be provided for each spa.

EXCEPTION: Where spas are provided in a cluster, 5 percent, but not less than one, in each cluster shall be accessible.

**15.8.5\* Pool Lifts.** Pool lifts shall comply with 15.8.5.

**15.8.5.1 Pool Lift Location.** Pool lifts shall be located where the water level does not exceed 48 inches (1220 mm).

EXCEPTION 1: Where the entire pool depth is greater than 48 inches (1220 mm), 15.8.5.1 shall not apply.

EXCEPTION 2: Where multiple pool lift locations are provided, no more than one shall be required to be located in an area where the water level does not exceed 48 inches (1220 mm).

**15.8.5.2 Seat Location.** In the raised position, the centerline of the seat shall be located over the deck and 16 inches (405 mm) minimum from the edge of the pool. The deck surface between the centerline of the seat and the pool edge shall have a slope not greater than 1:48 (see Fig. 68).

## 15.8 Swimming Pools, Wading Pools, and Spas

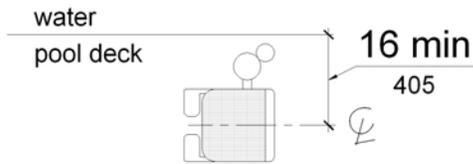


Fig. 68  
Pool Lift Seat Location

**15.8.5.3 Clear Deck Space.** On the side of the seat opposite the water, a clear deck space shall be provided parallel with the seat. The space shall be 36 inches (915 mm) wide minimum and shall extend forward 48 inches (1220 mm) minimum from a line located 12 inches (305 mm) behind the rear edge of the seat. The clear deck space shall have a slope not greater than 1:48 (see Fig. 69).

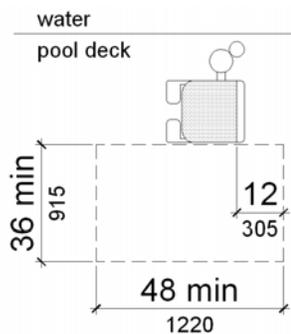


Fig. 69  
Clear Deck Space at Pool Lifts

**15.8.5.4 Seat Height.** The height of the lift seat shall be designed to allow a stop at 16 inches (405 mm) minimum to 19 inches (485 mm) maximum measured from the deck to the top of the seat

surface when in the raised (load) position (see Fig. 70).

**15.8.5.5 Seat Width.** The seat shall be 16 inches (405 mm) minimum wide.

**15.8.5.6\* Footrests and Armrests.** Footrests shall be provided and shall move with the seat. If provided, armrests positioned opposite the water shall be removable or shall fold clear of the seat when the seat is in the raised (load) position.

EXCEPTION: Footrests shall not be required on pool lifts provided in spas.

**15.8.5.7\* Operation.** The lift shall be capable of unassisted operation from both the deck and water levels. Controls and operating mechanisms shall be unobstructed when the lift is in use and shall comply with 4.27.4.

**15.8.5.8 Submerged Depth.** The lift shall be designed so that the seat will submerge to a water depth of 18 inches (455 mm) minimum below the stationary water level (see Fig. 71).

**15.8.5.9\* Lifting Capacity.** Single person pool lifts shall have a minimum weight capacity of 300 lbs. (136 kg) and be capable of sustaining a static load of at least one and a half times the rated load.

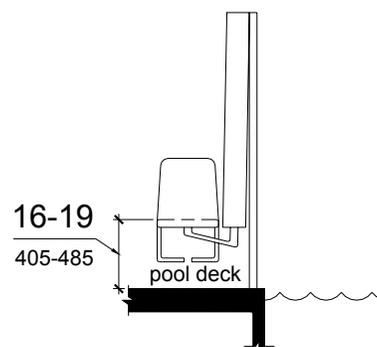
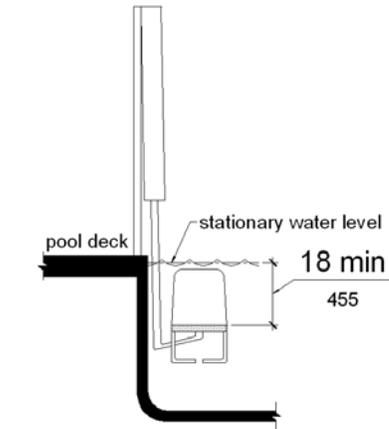


Fig. 70  
Pool Lift Seat Height

**15.8 Swimming Pools, Wading Pools, and Spas**



**Fig 71**  
Pool Lift Submerged Depth

minimum to 30 inches (760 mm) maximum below the stationary water level. Where landings are required by 4.8, at least one landing shall be located 24 inches (610 mm) minimum to 30 inches (760 mm) maximum below the stationary water level (see Fig. 72).

**EXCEPTION:** In wading pools, the sloped entry and landings, if provided, shall extend to the deepest part of the wading pool.

**15.8.6.3\* Handrails.** Handrails shall be provided on both sides of the sloped entry and shall comply with 4.8.5. The clear width between handrails shall be 33 inches (840 mm) minimum and 38 inches (965 mm) maximum (see Fig. 73).

**EXCEPTION 1:** Handrail extensions specified by 4.8.5 shall not be required at the bottom landing serving a sloped entry.

**EXCEPTION 2:** Where a sloped entry is provided for wave action pools, leisure rivers, sand bottom pools, and other pools where user access is limited to one area, the required clear width between handrails shall not apply.

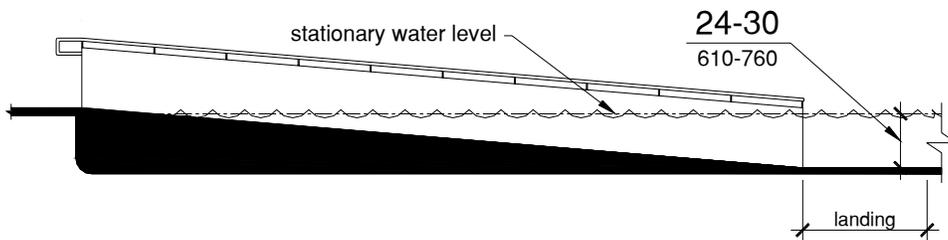
**EXCEPTION 3:** The handrail requirements of 4.8.5 and 15.8.6.3 shall not be required on sloped entries in wading pools.

**15.8.6 Sloped Entries.** Sloped entries designed to provide access into the water shall comply with 15.8.6.

**15.8.6.1\* Sloped Entries.** Sloped entries shall comply with 4.3, except as modified below.

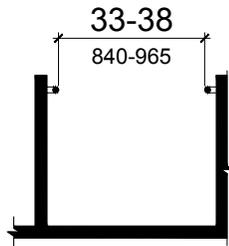
**EXCEPTION:** Where sloped entries are provided, the surfaces shall not be required to be slip resistant.

**15.8.6.2 Submerged Depth.** Sloped entries shall extend to a depth of 24 inches (610 mm)



**Fig. 72**  
Sloped Entry Submerged Depth

**15.8 Swimming Pools, Wading Pools, and Spas**



**Fig. 73**  
Sloped Entry Handrails

**15.8.7 Transfer Walls.** Transfer walls shall comply with 15.8.7.

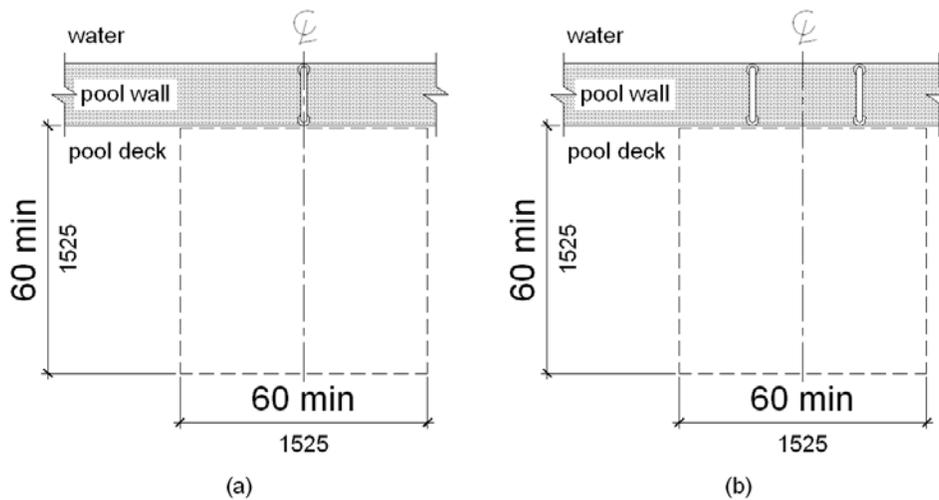
**15.8.7.1 Clear Deck Space.** A clear deck space of 60 inches (1525 mm) minimum by 60 inches (1525 mm) minimum with a slope not steeper

than 1:48 shall be provided at the base of the transfer wall. Where one grab bar is provided, the clear deck space shall be centered on the grab bar. Where two grab bars are provided, the clear deck space shall be centered on the clearance between the grab bars (see Fig. 74).

**15.8.7.2 Height.** The height of the transfer wall shall be 16 inches (405 mm) minimum to 19 inches (485 mm) maximum measured from the deck (see Fig. 75).

**15.8.7.3 Wall Depth and Length.** The depth of the transfer wall shall be 12 inches (305 mm) minimum to 16 inches (405 mm) maximum. The length of the transfer wall shall be 60 inches (1525 mm) minimum and shall be centered on the clear deck space (see Fig. 76).

**15.8.7.4 Surface.** Surfaces of transfer walls shall not be sharp and shall have rounded edges.



**Fig. 74**  
Clear Deck Space at Transfer Walls

**15.8 Swimming Pools, Wading Pools, and Spas**

**15.8.7.5 Grab Bars.** At least one grab bar shall be provided on the transfer wall. Grab bars shall be perpendicular to the pool wall and shall extend the full depth of the transfer wall. The top of the gripping surface shall be 4 inches (100 mm) minimum and 6 inches (150 mm) maximum above walls. Where one grab bar is provided, clearance shall be 24 inches (610 mm) minimum on both sides of the grab bar. Where two grab bars are provided, clearance between grab bars

shall be 24 inches (610 mm) minimum. Grab bars shall comply with 4.26 (see Fig. 77).

**15.8.8 Transfer Systems.** Transfer systems shall comply with 15.8.8.

**15.8.8.1 Transfer Platform.** A transfer platform 19 inches (485 mm) minimum clear depth by 24 inches (610 mm) minimum clear width shall be provided at the head of each transfer system (see Fig. 78).

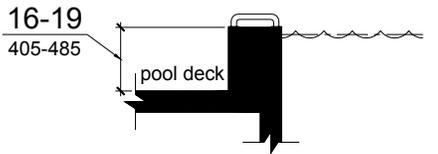


Fig. 75  
Transfer Wall Height

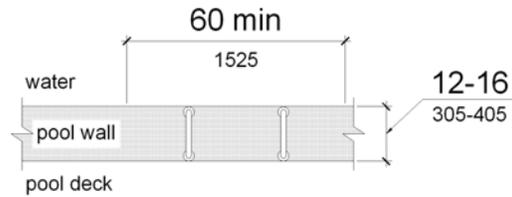


Fig. 76  
Transfer Wall Depth and Length

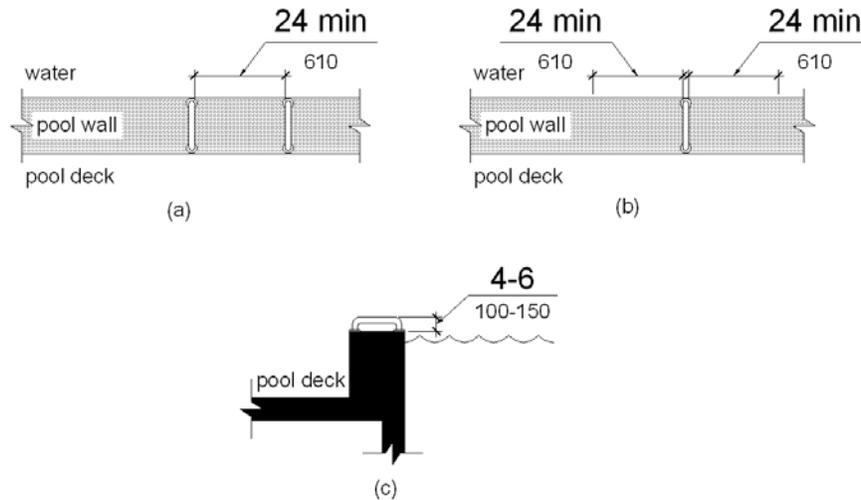
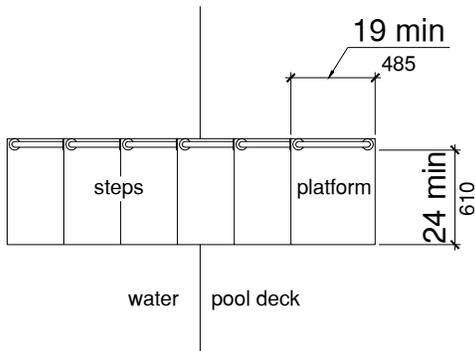


Fig. 77  
Grab Bars at Transfer Walls

**15.8 Swimming Pools, Wading Pools, and Spas**



**Fig. 78**  
Transfer System Platform

**15.8.8.2 Clear Deck Space.** A clear deck space of 60 inches (1525 mm) minimum by 60 inches (1525 mm) minimum with a slope not steeper than 1:48 shall be provided at the base of the

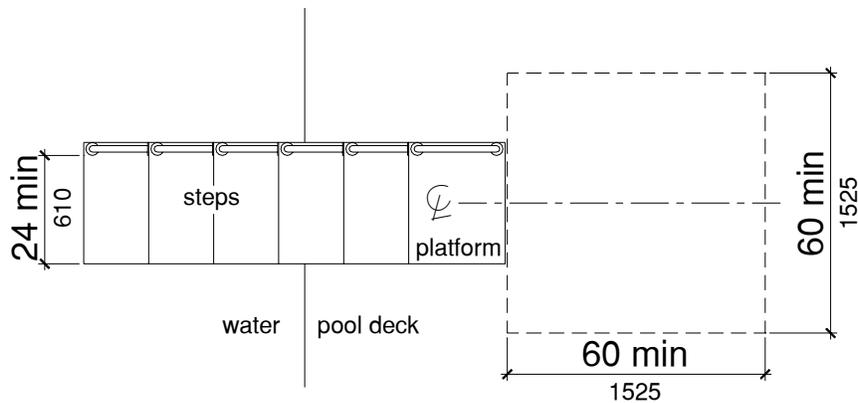
transfer platform surface and shall be centered along a 24 inch (610 mm) minimum unobstructed side of the transfer platform (see Fig. 79).

**15.8.8.3 Height.** The height of the transfer platform shall comply with 15.8.7.2.

**15.8.8.4\* Transfer Steps.** Transfer step height shall be 8 inches (205 mm) maximum. Transfer steps shall extend to a water depth of 18 inches (455 mm) minimum below the stationary water level (see Fig. 80).

**15.8.8.5 Surface.** The surface of the transfer system shall not be sharp and shall have rounded edges.

**15.8.8.6 Size.** Each transfer step shall have a tread clear depth of 14 inches (355 mm) minimum and 17 inches (430 mm) maximum and shall have a tread clear width of 24 inches (610 mm) minimum (see Fig. 81).

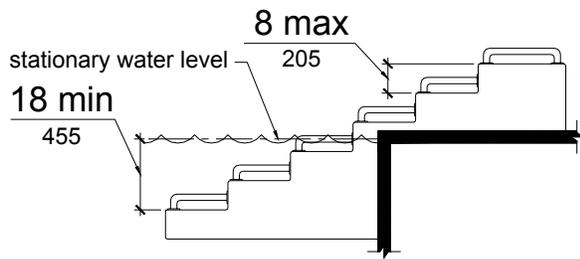


**Fig. 79**  
Clear Deck Space at Transfer Systems

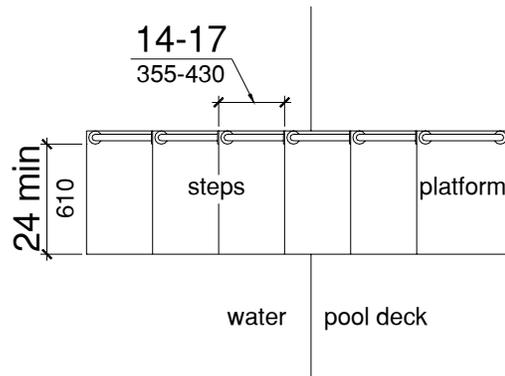
**15.8 Swimming Pools, Wading Pools, and Spas**

**15.8.8.7\* Grab Bars.** At least one grab bar on each transfer step and the transfer platform, or a continuous grab bar serving each transfer step and the transfer platform, shall be provided. Where provided, the top of the gripping surface shall be 4 inches (100 mm) minimum and 6 inches (150 mm) maximum above each step and transfer platform. Where a continuous grab bar is

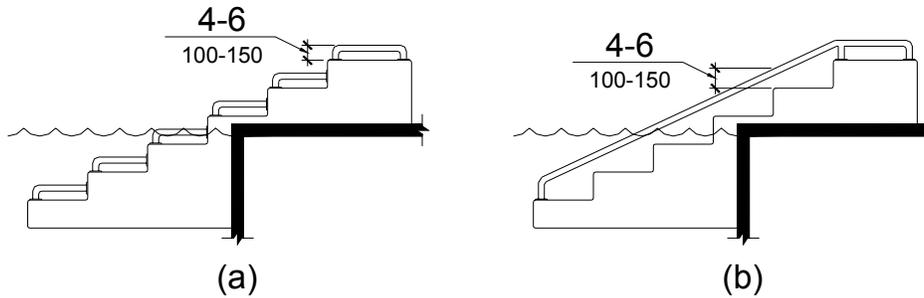
provided, the top of the gripping surface shall be 4 inches (100 mm) minimum and 6 inches (150 mm) maximum above the step nosing and transfer platform. Grab bars shall comply with 4.26 and be located on at least one side of the transfer system. The grab bar located at the transfer platform shall not obstruct transfer (see Fig. 82).



**Fig. 80**  
Transfer System Steps



**Fig. 81**  
Size of Transfer System Steps



**Fig. 82**  
Grab Bars at Transfer Systems

## 15.8 Swimming Pools, Wading Pools, and Spas

**15.8.9 Pool Stairs.** Pool stairs shall comply with 15.8.9.

**15.8.9.1 Pool Stairs.** Pool stairs shall comply with 4.9, except as modified below.

**15.8.9.2 Handrails.** The width between handrails shall be 20 inches (510 mm) minimum and 24 inches (610 mm) maximum. Handrail extensions required by 4.9.4 shall not be required at the bottom landing serving a pool stair.

**15.8.10\* Water Play Components.** Where water play components are provided, the provisions of 15.6 and 4.3 shall apply, except as modified or otherwise provided in this section.

EXCEPTION 1: Where the surface of the accessible route, clear floor or ground spaces and maneuvering spaces connecting play components is submerged, the provisions of 15.6 and 4.3 for cross slope, running slope, and surface shall not apply.

EXCEPTION 2: Transfer systems complying with 15.6.5 shall be permitted to be used in lieu of ramps to connect elevated play components.

## APPENDIX

This appendix contains materials of an advisory nature and provides additional information that should help the reader to understand the minimum requirements of the guidelines or to design buildings or facilities for greater accessibility. The paragraph numbers correspond to the sections or paragraphs of the guideline to which the material relates and are therefore not consecutive (for example, A4.2.1 contains additional information relevant to 4.2.1). Sections of the guidelines for which additional material appears in this appendix have been indicated by an asterisk. Nothing in this appendix shall in any way obviate any obligation to comply with the requirements of the guidelines itself.

### A2.0 General.

**A2.2 Equivalent Facilitation.** Specific examples of equivalent facilitation are found in the following sections:

4.1.6(3)(c)	Elevators in Alterations
4.31.9	Text Telephones
7.2	Sales and Service Counters, Teller Windows, Information Counters
9.1.4	Classes of Sleeping Accommodations
9.2.2(6)(d)	Requirements for Accessible Units, Sleeping Rooms, and Suites

### A3.0 Miscellaneous Instructions and Definitions.

#### A3.5 Definitions.

**Transient Lodging.** The Department of Justice's policy and rules further define what is covered as transient lodging.

### A4.0 Accessible Elements and Spaces: Scope and Technical Requirements.

#### A4.1.1 Application.

**A4.1.1(3) Areas Used Only by Employees as Work Areas.** Where there are a series of individual work stations of the same type (e.g., laboratories, service counters, ticket booths), 5%, but not less

than one, of each type of work station should be constructed so that an individual with disabilities can maneuver within the work stations. Rooms housing individual offices in a typical office building must meet the requirements of the guidelines concerning doors, accessible routes, etc. but do not need to allow for maneuvering space around individual desks. Modifications required to permit maneuvering within the work area may be accomplished as a reasonable accommodation to individual employees with disabilities under Title I of the ADA.

Consideration should also be given to placing shelves in employee work areas at a convenient height for accessibility or installing commercially available shelving that is adjustable so that reasonable accommodations can be made in the future.

If work stations are made accessible they should comply with the applicable provisions of 4.2 through 4.35.

#### A4.1.2 Accessible Sites and Exterior Facilities: New Construction.

**A4.1.2(2)(b) Court Sports:** The accessible route must be direct and connect both sides of the court without requiring players on one side of the court to traverse through or around another court to get to the other side of the court.

**A4.1.2(4) Exception 1.** An accessible route is required to connect to the boundary of the area of sport activity. The term "area of sport activity" distinguishes that portion of a room or space where the play or practice of a sport occurs from adjacent areas. Examples of areas of sport activity include: basketball courts, baseball fields, running tracks, bowling lanes, skating rinks, and the area surrounding a piece of gymnastic equipment. While the size of an area of sport activity may vary from sport to sport, each includes only the space needed to play. The following example is provided for additional clarification.

*Example.* Boundary lines define the field where a football game is played. A safety border is also provided around the field. The game may

### A4.1.3 Accessible Buildings: New Construction

temporarily be played in the space between the boundary lines and the safety border when players are pushed out of bounds or momentum carries them forward while receiving a pass. In the game of football, the space between the boundary line and the safety border is used to play the game. This space and the football field are included in the area of sport activity.

**A4.1.2(4) Exception 2.** Public circulation routes where animals may also travel, such as in petting zoos and passageways alongside animal pens in State fairs, are not eligible for the exception.

**A4.1.2(5)(e)** Valet parking is not always usable by individuals with disabilities. For instance, an individual may use a type of vehicle controls that render the regular controls inoperable or the driver's seat in a van may be removed. In these situations, another person cannot park the vehicle. It is recommended that some self-parking spaces be provided at valet parking facilities for individuals whose vehicles cannot be parked by another person and that such spaces be located on an accessible route to the entrance of the facility.

#### A4.1.3 Accessible Buildings: New Construction.

**4.1.3(1)(b) Court Sports:** The accessible route must be direct and connect both sides of the court without requiring players on one side of the court to traverse through or around another court to get to the other side of the court.

**4.1.3(3) Exception 1.** An accessible route is required to connect to the boundary of the area of sport activity. The term "area of sport activity" distinguishes that portion of a room or space where the play or practice of a sport occurs from adjacent areas. Examples of areas of sport activity include: basketball courts, baseball fields, running tracks, bowling lanes, skating rinks, and the area surrounding a piece of fixed gymnastic equipment. While the size of an area of sport activity may vary from sport to sport, each includes only the space needed to play. The following example is provided for additional clarification.

*Example.* Boundary lines define the field where a football game is played. A safety border is also provided around the field. The game may temporarily be played in the space between the boundary lines and the safety border when players are pushed out of bounds or momentum carries them forward while receiving a pass. In the game of football, the space between the boundary line and the safety border is used to play the game. This space and the football field are included in the area of sport activity.

**4.1.3(3) Exception 2.** Public circulation routes where animals may also travel, such as in petting zoos and passageways alongside animal pens in State fairs, are not eligible for the exception.

**A4.1.3(5)** Only passenger elevators are covered by the accessibility provisions of 4.10. Materials and equipment hoists, freight elevators not intended for passenger use, dumbwaiters, and construction elevators are not covered by these guidelines. If a building is exempt from the elevator requirement, it is not necessary to provide a platform lift or other means of vertical access in lieu of an elevator.

Under Exception 4, platform lifts are allowed where existing conditions make it impractical to install a ramp or elevator. Such conditions generally occur where it is essential to provide access to small raised or lowered areas where space may not be available for a ramp. Examples include, but are not limited to, raised pharmacy platforms, commercial offices raised above a sales floor, or radio and news booths.

While the use of platform lifts is allowed, ramps are recommended to provide access to player seating areas serving an area of sport activity.

**A4.1.3(9)** Supervised automatic sprinkler systems have built in signals for monitoring features of the system such as the opening and closing of water control valves, the power supplies for needed pumps, water tank levels, and for indicating conditions that will impair the satisfactory operation of the sprinkler system. Because of these monitoring features, supervised automatic sprinkler systems have a high level of

### A4.1.3 Accessible Buildings: New Construction

satisfactory performance and response to fire conditions.

**A4.1.3(10)** If an odd number of drinking fountains is provided on a floor, the requirement in 4.1.3(10)(b) may be met by rounding down the odd number to an even number and calculating 50% of the even number. When more than one drinking fountain on a floor is required to comply with 4.15, those fountains should be dispersed to allow wheelchair users convenient access. For example, in a large facility such as a convention center that has water fountains at several locations on a floor, the accessible water fountains should be located so that wheelchair users do not have to travel a greater distance than other people to use a drinking fountain.

**A4.1.3(12)(c)** Different types of lockers may include full-size and half-size lockers, as well as those specifically designed for storage of various sports equipment.

#### A4.33.6 Placement of Listening Systems

within the seating area are provided. This will allow choice in viewing and price categories.

Building and life safety codes set minimum distances between rows of fixed seats with consideration of the number of seats in a row, the exit aisle width and arrangement, and the location of exit doors. "Continental" seating, with a greater number of seats per row and a commensurate increase in row spacing and exit doors, facilitates emergency egress for all people and increases ease of access to mid-row seats especially for people who walk with difficulty. Consideration of this positive attribute of "continental" seating should be included along with all other factors in the design of fixed seating areas.

Removable armrests are recommended on fixed companion seats provided in assembly areas in amusement facilities. This provides the option for an individual using a wheelchair or other mobility device to transfer into a seat where motion and other effects may be provided as part of the amusement experience.

**A4.33.6 Placement of Listening Systems.** A distance of 50 ft (15 m) allows a person to distinguish performers' facial expressions.

**A4.33.7 Types of Listening Systems.** An assistive listening system appropriate for an assembly area for a group of persons or where the specific individuals are not known in advance, such as a playhouse, lecture hall or movie theater, may be different from the system appropriate for a particular individual provided as an auxiliary aid or as part of a reasonable accommodation. The appropriate device for an individual is the type that individual can use, whereas the appropriate system for an assembly area will necessarily be geared toward the "average" or aggregate needs of various individuals. A listening system that can be used from any seat in a seating area is the most flexible way to meet this specification. Earphone jacks with variable volume controls can benefit only people who have slight hearing loss and do not help people who use hearing aids. At the present time, magnetic induction loops are the most feasible type of

listening system for people who use hearing aids equipped with "T- coils," but people without hearing aids or those with hearing aids not equipped with inductive pick-ups cannot use them without special receivers. Radio frequency systems can be extremely effective and inexpensive. People without hearing aids can use them, but people with hearing aids need a special receiver to use them as they are presently designed. If hearing aids had a jack to allow a bypass of microphones, then radio frequency systems would be suitable for people with and without hearing aids. The Department of Justice's regulations implementing titles II and III of the ADA require public entities and public accommodations to provide appropriate auxiliary aids and services to ensure effective communication. See 28 CFR 35.160, 28CFR 35.164, and 28 CFR 36.303. Where assistive listening systems are used to provide effective communication, the Department of Justice considers it essential that a portion of receivers be compatible with hearing aids.

Some listening systems may be subject to interference from other equipment and feedback from hearing aids of people who are using the systems. Such interference can be controlled by careful engineering design that anticipates feedback sources in the surrounding area.

Table A2, shows some of the advantages and disadvantages of different types of assistive listening systems. In addition, the Access Board has published a pamphlet on Assistive Listening Systems which lists demonstration centers across the country where technical assistance can be obtained in selecting and installing appropriate systems. The state of New York has also adopted a detailed technical specification which may be useful.

**A4.36.2 Saunas and Steam Rooms.** A 60-inch turning diameter space or a T-shaped space is required within the sauna or steam room. Removable benches or seats are permitted to obstruct the 60-inch or T-shaped space.

**A4.37.3 Benches.** Back support may be achieved through locating benches adjacent to walls or by other designs that will meet the minimum dimensions specified.

**A5.0 Restaurants and Cafeterias.**

**A5.1 General.** Dining counters (where there is no service) are typically found in small carry-out restaurants, bakeries, or coffee shops and may only be a narrow eating surface attached to a wall. This section requires that where such a dining counter is provided, a portion of the counter shall be at the required accessible height.

**A7.0 Business, Mercantile and Civic.**

**A7.2(3)(iii) Counter or Teller Windows with Partitions.** Methods of facilitating voice communication may include grilles, slats, talk-through baffles, and other devices mounted directly into the partition which users can speak directly into for effective communication. These methods are required to be designed or placed so that they are accessible to a person who is standing or seated. However, if the counter is only used by persons in a seated position, then a method of facilitating communication which is accessible to standing persons would not be necessary.

## A15.0 Recreation Facilities

### A15.0 Recreation Facilities.

Unless otherwise modified in Section 4 or specifically addressed in section 15, all other ADAAG provisions apply for the design and construction of recreation facilities and elements. The provisions in this section apply wherever these elements are provided. For example, office buildings may contain a room with exercise equipment and these sections therefore apply.

### A15.1 Amusement Rides.

These guidelines apply to newly designed or newly constructed amusement rides. A custom designed and constructed ride is new upon its "first use," which is the first time amusement park patrons take the ride. With respect to amusement rides purchased from other entities, "new" refers to the first permanent installation of the ride, whether it is used "off the shelf" or it is modified before it is installed. Where amusement rides are moved after several seasons to another area of the park or to another park, the ride would not be considered newly designed or newly constructed.

Amusement rides designed primarily for children, amusement rides that are controlled or operated by the rider, and amusement rides without seats, are not required to provide wheelchair spaces, transfer seats, or transfer systems, and need not meet the signage requirements in 15.1.6. The load and unload areas of these rides must, however, be on an accessible route and must provide maneuvering space under 15.1.4 and 15.1.5.

The scoping and technical provisions of the guidelines were developed to address common amusement rides. There will be other amusement attractions that have unique designs and features which are not adequately addressed by the guidelines. In those situations, the guidelines are to be applied to the extent possible.

An accessible route must be provided to these areas. Where an attraction or ride has unique features for which there are no applicable scoping provisions, then a reasonable number, but at least one, of the features must be located on an

accessible route. Where there are appropriate technical provisions, they must be applied to the elements that are covered by the scoping provisions. Where an attraction has unique designs for which the technical provisions are not appropriate, the operators of those attractions are still subject to all the other requirements of the ADA, including program accessibility, barrier removal and the general obligation to provide individuals with disabilities an equal opportunity to enjoy the goods and services provided by their facilities. An example of an amusement ride not specifically addressed by the guidelines includes "virtual reality" rides where the device does not move through a fixed course within a defined area.

**A15.1 Exception 1.** Mobile or temporary rides are those set up for short periods of time such as traveling carnivals, State and county fairs, and festivals. The amusement rides that are covered by section 15.1 are ones that are not regularly assembled and disassembled.

**A15.1 Exception 2.** The exception does not apply to those rides where patrons may cause the ride to make incidental movements, but where the patron otherwise has no control over the ride.

**A15.1 Exception 3.** The exception is limited to those rides designed "primarily" for children, where children are assisted on and off the ride by an adult. This exception is limited to those rides designed for children and not for the occasional adult user. An accessible route to and maneuvering space in the load and unload area will provide access for adults and family members assisting children on and off these rides.

### A15.1.2 Alterations to Amusement Rides.

Routine maintenance, painting, and changing of theme boards are examples of activities that do not constitute an alteration subject to section 15.1.2. Where existing amusement rides are moved and not altered, section 15.1 does not apply unless the load and unload area of the amusement ride is newly designed and constructed. If a load or unload area is altered, the alteration provisions of ADAAG 4.1.6 must be applied to the altered area.

**A15.1.4 Accessible Route.** Steeper slopes are permitted (not to exceed 1:8) where the accessible route connects to the amusement ride in the load and unload position. This is permitted only where compliance with 4.8.2 (maximum slope 1:12) is “structurally or operationally infeasible”. In most cases, this will be limited to areas where the accessible route leads directly to the amusement ride and where there are space limitations on the ride, not the queue line. Where possible, the least possible slope should be used on the accessible route that serves the amusement ride.

**A15.1.7.1.2 Amusement Rides with Wheelchair Spaces.** 36 CFR 1192.83(c) ADA Accessibility Guidelines for Transportation Vehicles - Light Rail Vehicles and Systems - Mobility Aid Accessibility is available at [www.access-board.gov/transit/html/vguide.htm#LRVM](http://www.access-board.gov/transit/html/vguide.htm#LRVM). It references provisions for bridge plates and ramps used for gaps between wheelchair spaces and floors of load and unload areas.

**A15.1.7.2 Exception 3.** This exception for protruding objects applies to the ride devices, not to circulation areas or accessible routes in the queue lines or the load and unload areas.

**A15.1.7.2.2 Wheelchair Spaces - Side Entry.** Under certain circumstances, a 32-inch clear opening will not provide sufficient width to accommodate a turn into an amusement ride. The amount of clear space needed within the ride, and the size and position of the opening are interrelated. Additional space for maneuvering and a wider door will be needed where a side opening is centered on the ride. For example, where a 42-inch opening is provided, a minimum clear space of 60 inches in length and 36 inches in depth is needed (see Fig. A9). This is necessary to ensure adequate space for maneuvering. For additional guidance refer to Figure 3 (Wheelchair Turning Space) and Figure 4 (Minimum Clear Floor Space for Wheelchairs) on minimum space requirements.

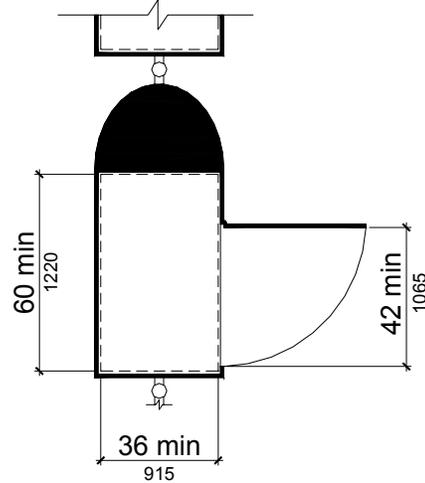


Fig. A9  
Wheelchair Spaces - Side Entry

**A15.1.8 Amusement Ride Seats Designed for Transfer.** There are many different ways that individuals transfer to and from their wheelchairs or mobility devices. The proximity of the clear floor or ground space next to an element and the height of the element one is transferring to are both critical for a safe and independent transfer. Providing additional clear floor or ground space both in front of and diagonally to the element will provide flexibility and increased usability for a more diverse population of individuals with disabilities. Ride seats designed for transfer should involve only one transfer. Where possible, designers are encouraged to locate the ride seat no higher than 17 to 19 inches above the load and unload surface. Where greater distances are required for transfers, consideration should be given to providing gripping surfaces, seat padding, and avoiding sharp or protruding objects in the path of transfer to better facilitate the transfer process.

**A15.1.9 Transfer Devices for Use with Amusement Rides.** Transfer devices for use with

## A15.2 Boating Facilities

amusement rides should permit individuals to make independent transfers to and from their wheelchairs or mobility devices. There are a variety of transfer devices available that could be adapted to provide access onto an amusement ride. Examples of devices that may provide for transfers include, but are not limited to, transfer systems (see 15.8.8), lifts, mechanized seats, and other custom designed systems. Operators and designers have flexibility in developing designs that will facilitate individuals to transfer onto amusement rides. These systems or devices should be designed to be reliable and sturdy. A transfer board, for example, would not be sufficient because it will not provide enough support or stability and may cause injury.

Designs which limit the number of transfers required from one's wheelchair or mobility device to the ride seat are encouraged. When using a transfer device to access an amusement ride, the least amount of transfers for the least amount of distance is desired. Where possible, designers are encouraged to locate the transfer device seat no higher than 17 to 19 inches above the load and unload surface. Where greater distances are required for transfers, consideration should be given to providing gripping surfaces, seat padding, and avoiding sharp or protruding objects in the path of transfer to better facilitate the transfer process. Where a series of transfers are required to reach the amusement ride seat, each vertical transfer should not exceed 8 inches.

As discussed with amusement rides seats designed for transfer, there are many different ways that individuals transfer to and from their wheelchairs or mobility devices. The proximity of the clear floor or ground space next to an element and the height of the element one is transferring to are both critical for a safe and independent transfer. Providing additional clear floor or ground space both in front of and diagonally to the element will provide flexibility and increased usability for a more diverse population of individuals with disabilities.

### A15.2 Boating Facilities.

**A15.2.2 Accessible Route.** The following two examples apply exceptions two and three.

Example 1. Boat slips which are required to be accessible are provided at a floating pier. The vertical distance an accessible route must travel to the pier when the water is at its lowest level is six feet, although the water level only fluctuates three feet. To comply with exceptions 2 and 3, at least one design solution would provide a gangway at least 72.25 feet long which ensures the slope does not exceed 1:12.

Example 2. A gangway is provided to a floating pier which is required to be on an accessible route. The vertical distance is 10 feet between the elevation where the gangway departs the landside connection and the elevation of the pier surface at the lowest water level. Exceptions 2 and 3, which modify 4.8.2, permit the gangway to be at least 80 feet long. Another design solution would be to have two 40-foot continuous gangways joined together at a float, where the float (as the water level falls) will stop dropping at an elevation five feet below the landside connection.

### A15.2.3 Boat Slips: Minimum Number.

Accessible boat slips are not "reserved" for persons with disabilities in the same manner as accessible vehicle parking spaces. Rather, accessible boat slip use is comparable to accessible hotel rooms. The Department of Justice is responsible for addressing operational issues relating to the use of accessible facilities and elements. The Department of Justice currently advises that hotels should hold accessible rooms for persons with disabilities until all other rooms are filled. At that point, accessible rooms can be open for general use on a first come, first serve basis.

The following two examples apply to a boating facility with a single non-demarked pier.

Example 1. A site contains a new boating facility which consists of a single 60-foot pier. Boats are only moored parallel with the pier on both sides to allow occupants to embark or disembark.

Since the number of slips cannot be identified, section 15.2.3 requires each 40 feet of boat slip edge to be counted as one slip for purposes of determining the number of slips available and determines the number required to be accessible. The 120 feet of boat slip edge at the pier would equate with 3 boat slips. Table 15.2.3 would require 1 slip to be accessible and comply with 15.2.5. Section 15.2.5 (excluding the exceptions within the section) requires a clear pier space 60 inches wide minimum extending the length of the slip. In this example, because the pier is at least 40 feet long, the accessible slip must contain a clear pier space at least 40 feet long which has a minimum width of 60 inches.

**Example 2.** A new boating facility consisting of a single pier 25 feet long and 3 feet wide is being planned for a site. The design intends to allow boats to moor and occupants to embark and disembark on both sides, and at one end. As the number of boat slips cannot be identified, applying section 15.2.3 would translate to 53 feet of boat slip edge at the pier. This equates with two slips. Table 15.2.5 would require 1 slip to be accessible. To comply with 15.2.5 (excluding the exceptions within the section), the width of the pier must be increased to 60 inches. Neither 15.2.3 or 15.2.5 requires the pier length to be increased to 40 feet.

**A15.2.3.1 Dispersion.** Types of boat slips are based on the size of the boat slips; whether single berths or double berths, shallow water or deep water, transient or longer-term lease, covered or uncovered; and whether slips are equipped with features such as telephone, water, electricity and cable connections. The term “boat slip” is intended to cover any pier area where recreational boats embark or disembark, unless classified as a launch ramp boarding pier. For example, a fuel pier may contain boat slips, and this type of short term slip would be included in determining compliance with 15.2.3.1.

**A15.2.4 Boarding Piers at Boat Launch Ramps.** The following two examples apply to a boat launch ramp boarding pier.

**Example 1.** A chain of floats is provided on a launch ramp to be used as a boarding pier which is required to be accessible by 15.2.4. At high water, the entire chain is floating and a transition plate connects the first float to the surface of the launch ramp. As the water level decreases, segments of the chain end up resting on the launch ramp surface, matching the slope of the launch ramp. As water levels drop, segments function also as gangways because one end of a segment is resting on the launch ramp surface and the other end is connecting to another floating segment in the chain.

Under ADAAG 4.1.2(2), an accessible route must serve the last float because it would function as the boarding pier at the lowest water level. Under exception 3 in 15.2.4, each float is not required to comply with ADAAG 4.8, but must meet all other requirements in ADAAG 4.3, unless exempted by exception 1 in 15.2.4. In this example, because the entire chain also functions as a boarding pier, the entire chain must comply with the requirements of 15.2.5, including the 60-inch minimum clear pier width provision.

**Example 2.** A non-floating boarding pier supported by piles divides a launching area into two launch ramps and is required to be accessible. Under ADAAG 4.1.2(2), an accessible route must connect the boarding pier with other accessible buildings, facilities, elements, and spaces on the site. Although the boarding pier is located within a launch ramp, because the pier is not a floating pier or a skid pier, none of the exceptions in 15.2.4 apply. To comply with ADAAG 4.3, either the accessible route must run down the launch ramp or the fixed boarding pier could be relocated to the side of the two launch ramps. The second option leaves the slope of the launch ramps unchanged, because the accessible route runs outside the launch ramps.

**A15.2.4.1 Boarding Pier Clearances.** The guidelines do not establish a minimum length for accessible boarding piers at boat launch ramps. The accessible boarding pier would have a length which is at least equal to other boarding piers provided at the facility. If no other boarding pier

### A15.3 Fishing Piers and Platforms

is provided, the pier would have a length equal to what would have been provided if no access requirements applied. The entire length of accessible boarding piers would be required to comply with the same technical provisions that apply to accessible boat slips. For example, at a launch ramp, if a 20-foot long accessible boarding pier is provided, the entire 20 feet must comply with the pier clearance requirements in 15.2.5. Likewise, if a 60-foot long accessible boarding pier is provided, the pier clearance requirements in 15.2.5 would apply to the entire 60 feet.

**A15.2.5 Accessible Boat Slips.** Although the minimum width of the clear pier space is 60 inches, it is recommended that piers be wider than 60 inches to improve the safety for persons with disabilities, particularly on floating piers.

**A15.2.5.1 Clearances, Exception 3.** Where the conditions in exception 3 are satisfied, existing facilities are only required to have one accessible boat slip with a pier clearance which runs the length of the slip. All other accessible slips are allowed to have the required pier clearance at the head of the slip. Under this exception, at piers with perpendicular boat slips, the width of most “finger piers” will remain unchanged. However, where mooring systems for floating piers are replaced as part of pier alteration projects, an opportunity may exist for increasing accessibility. Piers may be reconfigured to allow an increase in the number of wider finger piers, and serve as accessible boat slips.

#### A15.3 Fishing Piers and Platforms.

**A15.3.3.1 Edge Protection.** Edge protection is required only where railings, guards, or handrails are provided on a fishing pier or platform. Edge protection will prevent wheelchairs or other mobility devices from slipping off the fishing pier or platform. Extending the deck of the fishing pier or platform 12 inches where the 34-inch high railing is provided is an alternative design, permitting individuals using a wheelchair or other mobility device to pull into a clear space and move beyond the face of the railing. In such a design, edge protection is not required.

**A15.3.2 Accessible Route, Exception 2.** For example, to provide access to an accessible floating fishing pier, a gangway is used. The vertical distance is 60 inches between the elevation that the gangway departs the landside connection and the elevation of the pier surface at the lowest water level. Exception 2 permits the use of a gangway at least 30 feet long, or a series of connecting gangways with a total length of at least 30 feet. The length of transition plates would not be included in determining if the gangway(s) meet the requirements of the exception.

**A15.3.3.3 Dispersion.** Portions of the railings that are lowered to provide fishing opportunities for persons with disabilities must be located in a variety of locations on the fishing pier or platform to give people a variety of locations to fish. Different fishing locations may provide varying water depths, shade (at certain times of the day), vegetation, and proximity to the shoreline or bank.

#### A15.4 Golf.

**A15.4.2 Accessible Routes.** The accessible route or golf car passage must serve accessible elements and spaces located within the boundary of a golf course. The 48-inch minimum width for the accessible route is necessary to ensure passage of a golf car on either the accessible route or the golf car passage. This is important where the accessible route is used to connect the golf car rental area, bag drop areas, practice putting greens, accessible practice teeing grounds, course toilet rooms, and course weather shelters. These are areas outside the boundary of the golf course, but are areas where an individual using an adapted golf car may travel. A golf car passage may not be substituted for other accessible routes, required by ADAAG 4.1.2, located outside the boundary of the course. For example, an accessible route connecting an accessible parking space to the entrance of a golf course clubhouse is not covered by this provision.

**A15.4.3 Accessible Route - Driving Ranges.** Both a stand alone driving range or a driving range next to a golf course must provide an

accessible route or golf car passage that connects accessible teeing stations with accessible parking spaces. The accessible route must be a minimum width of 48 inches; 60 inches if handrails are provided. The additional width permits the use of a golf car on the accessible route. Providing a golf car passage will permit a person that uses a golf car to practice driving a golf ball from the same position and stance used when playing the game. Additionally, the space required for a person using a golf car to enter and exit the teeing stations required to be accessible should be considered.

**A15.5 Miniature Golf.**

Where possible, providing access to all holes on a miniature golf course is recommended. If a course is designed with the minimum 50 percent accessible holes, designers or operators are encouraged to select holes which provide for an equivalent experience to the maximum extent possible. Accessible holes are required to be consecutive with one break permitted, if the last hole on the course is in the sequence.

**A15.5.3 Accessible Route.** Where only the minimum 50 percent of the holes are accessible, an accessible route from the last accessible hole to the course exit or entrance must not require travel back through other holes. In some cases, this may require an additional route. Other options include increasing the number of accessible holes in a way that limits the distance needed to connect the last accessible hole with the course exit or entrance. In any case, careful consideration to the layout of the course will be important to minimize space impacts.

The 1-inch curb for a 32-inch minimum opening can be located in an area where the ball is less likely to ricochet. Where the accessible route on the hole is provided, steeper slopes are permitted for a limited distance. A landing or level area must separate each of these steeper sloping segments. This will provide a resting area between the steeper segments.

**A15.5.5 Golf Club Reach Range.** Accessible holes on a miniature golf course may be provided with an accessible route leading through the hole

or with the accessible route next to the hole. Where the accessible route is provided adjacent to the hole, the route must be located within the golf club reach range. This allows individuals sufficient space and reach to play the game outside of the hole. Where possible, the distance between the level areas and the accessible route should be as close as possible, affording more opportunities for play.

**A15.6 Play Areas.**

**A15.6.1 General.** This section is to be applied during the design, construction, and alteration of play areas for children ages 2 and over. Play areas are the portion of a site where play components are provided. This section does not apply to other portions of a site where elements such as sports fields, picnic areas, or other gathering areas are provided. Those areas are addressed by other sections of ADAAG. Play areas may be located on exterior sites or within a building. Where separate play areas are provided within a site for children in specified age groups (e.g., preschool (ages 2 to 5) and school age (ages 5 to 12)), each play area must comply with this section. Where play areas are provided for the same age group on a site but are geographically separated (e.g., one is located next to a picnic area and another is located next to a softball field), they are considered separate play areas and each play area must comply with this section.

**A15.6.2 Ground Level Play Components.** A ground level play component is a play component approached and exited at the ground level. Examples of ground level play components include spring rockers, swings, diggers, and stand alone slides. When distinguishing between the different types of ground level play components, consider the general experience provided by the play component. Examples of different types of experiences include, but are not limited to, rocking, swinging, climbing, spinning, and sliding. A spiral slide may provide a slightly different experience from a straight slide, but sliding is the general experience and therefore a spiral slide is not considered a different type of play component than a straight slide.

## A15.6 Play Areas

The number of ground level play components is not dependent on the number of children who can play on the play component. A large seesaw designed to accommodate ten children at once is considered one ground level play component.

Where a large play area includes two or more composite play structures designed for the same age group, the total number of elevated play components on all the composite play structures must be added to determine the additional number and types of ground level play components that must be provided on an accessible route, and the type of accessible route (e.g., ramps or transfer systems) that must be provided to the elevated play components.

Ground level play components accessed by children with disabilities must be integrated in the play area. Designers should consider the optimal layout of ground level play components accessed by children with disabilities to foster interaction and socialization among all children. Grouping all ground level play components accessed by children with disabilities in one location is not considered integrated.

**A15.6.3 Elevated Play Components.** Elevated play components are approached above or below grade and are part of a composite play structure. A double or triple slide that is part of a composite play structure is one elevated play component. For purposes of this section, ramps, transfer systems, steps, decks, and roofs are not considered elevated play components. These elements are generally used to link other elements on a composite play structure. Although socialization and pretend play can occur on these elements, they are not primarily intended for play. Some play components that are attached to a composite play structure can be approached or exited at the ground level or above grade from a platform or deck. For example, a climber attached to a composite play structure can be approached or exited at the ground level or above grade from a platform or deck on a composite play structure. Play components that are attached to a composite play structure and can be approached from a platform or deck (e.g.,

climbers and overhead play components), are considered elevated play components. These play components are not considered ground level play components also, and do not count toward the requirements in 15.6.2 regarding the number of ground level play components that must be located on an accessible route.

**A15.6.4 Accessible Routes.** Accessible routes within the boundary of the play area must comply with 15.6.4. Accessible routes connecting the play area to parking, drinking fountains, and other elements on a site must comply with 4.3. Accessible routes provide children who use wheelchairs or other mobility devices the opportunity to access play components. Accessible routes should coincide with the general circulation path used within the play area. Careful placement and consideration of the layout of accessible routes will enhance the ability of children with disabilities to socialize and interact with other children.

Where possible, designers and operators are encouraged to provide wider ground level accessible routes within the play area or consider designing the entire ground surface to be accessible. Providing more accessible spaces will enhance the integration of all children within the play area and provide access to more play components. A maximum slope of 1:16 is required for ground level ramps; however, a lesser slope will enhance access for those children who have difficulty negotiating the 1:16 maximum slope. Handrails are not required on ramps located within ground level use zones.

Where a stand alone slide is provided, an accessible route must connect the base of the stairs at the entry point, and the exit point of the slide. A ramp or transfer system to the top of the slide is not required. Where a sand box is provided, an accessible route must connect to the border of the sand box. Accessibility to the sand box would be enhanced by providing a transfer system into the sand or by providing a raised sand table with knee clearance complying with 15.6.6.3.

Elevated accessible routes must connect the entry and exit points of at least 50 percent of elevated play components. Ramps are preferred over transfer systems since not all children who use wheelchairs or other mobility devices may be able to use or may choose not to use transfer systems. Where ramps connect elevated play components, the maximum rise of any ramp run is limited to 12 inches. Where possible, designers and operators are encouraged to provide ramps with a lesser slope than the 1:12 maximum. Berms or sculpted dirt may be used to provide elevation and may be part of an accessible route to composite play structures.

Platform lifts complying with 4.11 and applicable State and local codes are permitted as a part of an accessible route. Because lifts must be independently operable, operators should carefully consider the appropriateness of their use in unsupervised settings.

**A15.6.5 Transfer Systems.** Transfer systems are a means of accessing composite play structures. Transfer systems generally include a transfer platform and a series of transfer steps. Children who use wheelchairs or other mobility devices transfer from their wheelchair or mobility devices onto the transfer platform and lift themselves up or down the transfer steps and scoot along the decks or platforms to access elevated play components. Some children may be unable or may choose not to use transfer systems. Where transfer systems are provided, consideration should be given to the distance between the transfer system and the elevated play components. Moving between a transfer platform and a series of transfer steps requires extensive exertion for some children. Designers should minimize the distance between the points where a

child transfers from a wheelchair or mobility device and where the elevated play components are located. Where elevated play components are used to connect to another elevated play component in lieu of an accessible route, careful consideration should be used in the selection of the play components used for this purpose. Transfer supports are required on transfer platforms and transfer steps to assist children when transferring. Some examples of supports include a rope loop, a loop type handle, a slot in the edge of a flat horizontal or vertical member, poles or bars, or D rings on the corner posts.

**A15.6.6 Play Components.** Clear floor or ground spaces, maneuvering spaces, and accessible routes may overlap within play areas. A specific location has not been designated for the clear floor or ground spaces or maneuvering spaces, except swings, because each play component may require that the spaces be placed in a unique location. Where play components include a seat or entry point, designs that provide for an unobstructed transfer from a wheelchair or other mobility device are recommended. This will enhance the ability of children with disabilities to independently use the play component.

When designing play components with manipulative or interactive features, consider appropriate reach ranges for children seated in wheelchairs. The following table provides guidance on reach ranges for children seated in wheelchairs. These dimensions apply to either forward or side reaches. The reach ranges are appropriate for use with those play components that children seated in wheelchairs may access and reach. Where transfer systems provide access to elevated play components, the reach ranges are not appropriate.

**Children's Reach Ranges**

<b>Forward or Side Reach</b>	<b>Ages 3 and 4</b>	<b>Ages 5 through 8</b>	<b>Ages 9 through 12</b>
<b>High (maximum)</b>	36 in (915 mm)	40 in (1015 mm)	44 in (1120 mm)
<b>Low (minimum)</b>	20 in (510 mm)	18 in (455 mm)	16 in (405 mm)

## A15.7 Exercise Equipment and Machines

Where a climber is located on a ground level accessible route, some of the climbing rings should be within the reach ranges. A careful balance of providing access to play components but not eliminating the challenge and nature of the activity is encouraged.

**A15.6.7 Ground Surfaces.** Ground surfaces along clear floor or ground spaces, maneuvering spaces, and accessible routes must comply with the ASTM F 1951 Standard Specification for Determination of Accessibility to Surface Systems Under and Around Playground Equipment. The ASTM F 1951 standard is available from the American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, telephone (610) 832-9585. The ASTM F 1951 standard may be ordered online from ASTM (<http://www.astm.org>). The ASTM F 1951 standard determines the accessibility of a surface by measuring the work required to propel a wheelchair across the surface. The standard includes tests of effort for both straight ahead and turning movement, using a force wheel on a rehabilitation wheelchair as the measuring device. To meet the standard, the force required must be less than that required to propel the wheelchair up a ramp with a 1:14 slope. When evaluating ground surfaces, operators should request information about compliance with the ASTM F 1951 standard.

Ground surfaces must be inspected and maintained regularly and frequently to ensure continued compliance with the ASTM F 1951 standard. The type of surface material selected and play area use levels will determine the frequency of inspection and maintenance activities.

When using a combination of surface materials, careful design is necessary to provide appropriate transitions between the surfaces. Where a rubber surface is installed on top of asphalt to provide impact attenuation, the edges of the rubber surface may create a change in level between the adjoining ground surfaces. Where the change in level is greater than ½ inch, a sloped surface with a maximum slope of 1:12 must be provided.

Products are commercially available that provide a 1:12 slope at transitions. Transitions are also necessary where the combination of surface materials include loose fill products. Where edging is used to prevent the loose surface from moving onto the firmer surface, the edging may create a tripping hazard. Where possible, the transition should be designed to allow for a smooth and gradual transition between the two surfaces.

### **A15.7 Exercise Equipment and Machines, Bowling Lanes, and Shooting Facilities.**

#### **A15.7.2 Exercise Equipment and Machines.**

Fitness facilities often provide a range of choices of exercise equipment. At least one of each type of exercise equipment and machine must be served by an accessible route. Most strength training equipment and machines are considered different types. For example, a bench press machine is considered a different type than a biceps curl machine. The requirement for providing access to each type is intended to cover the variety of strength training machines. Where operators provide a biceps curl machine and free weights, both are required to meet the provisions in this section, even though an individual may be able to work on their biceps through both types of equipment. Where the exercise equipment and machines provided are only different in that different manufacturers provide them, only one of each type of machine is required to meet these guidelines. For example, where two bench press machines are provided and each is manufactured by a different company, only one is required to comply.

Similarly, there are many types of cardiovascular exercise machines, such as stationary bicycles, rowing machines, stair climbers, and treadmills. Each machine provides a cardiovascular exercise and is considered a different type for purposes of these guidelines.

One clear floor or ground space is permitted to be shared between two pieces of exercise equipment. Designers should carefully consider layout

## A15.8 Swimming Pools, Wading Pools, and Spas

options to maximize space such as connecting ends of the row and center aisle spaces.

The position of the clear floor space may vary greatly depending on the use of the equipment or machine. For example, to make a shoulder press accessible, clear floor space next to the seat would be appropriate to allow for transfer. Clear floor space for a bench press machine designed for use by an individual seated in a wheelchair, however, will most likely be centered on the operating mechanisms.

Designers and operators are encouraged to select exercise equipment and machines that provide fitness opportunities for persons with lower body extremity disabilities. Upper body exercise equipment and machines that offer either cardiovascular or strength training will enhance fitness opportunities for persons with disabilities from a wheelchair or mobility device. Examples include: equipment or machines that provide arm ergometry, free weights, and weighted pulley systems that are usable from a wheelchair or mobility device.

**A15.7.4. Shooting Facilities.** Examples of different types of firing positions include, but are not limited to: positions having different admission prices, positions with or without weather covering or lighting, and positions supporting different shooting events such as argon, muzzle loading rifle, small bore rifle, high power rifle, bull's eye pistol, action pistol, silhouette, trap, skeet, and archery (bow and crossbow).

### **A15.8 Swimming Pools, Wading Pools, and Spas.**

**A15.8.2 Swimming Pools.** Where more than one means of access is provided into the water, it is recommended that the means be different. Providing different means of access will better serve the varying needs of people with disabilities in getting into and out of a swimming pool. It is also recommended that where two or more means of access are provided, they not be provided in the same location in the pool. Different locations will

provide increased options for entry and exit, especially in larger pools.

**A15.8.2 Swimming Pools, Exception 1.** Pool walls at diving areas and areas along pool walls where there is no pool entry because of landscaping or adjacent structures should be counted when determining the number of accessible means of entry required.

**A15.8.5 Pool Lifts.** There are a variety of seats available on pool lifts ranging from sling seats to those that are preformed or molded. Pool lift seats with backs will enable a larger population of persons with disabilities to use the lift. Pool lift seats that consist of materials that resist corrosion and provide a firm base to transfer will be usable by a wider range of people with disabilities. Additional options such as armrests, head rests, seat belts, and leg support will enhance accessibility and better accommodate people with a wide range of disabilities.

**A15.8.5.6 Footrests and Armrests.** Footrests are encouraged on lifts used in larger spas, where the foot well water depth is 34 inches or greater. Providing footrests, especially ones that support the entire foot, will facilitate safe and independent transfers by a larger population of persons with disabilities.

**A15.8.5.7 Operation.** Pool lifts must be capable of unassisted operation from both the deck and water levels. This will permit a person to call the pool lift when the pool lift is in the opposite position. It is extremely important for a person who is swimming alone to be able to call the pool lift when it is in the up position so he or she will not be stranded in the water for extended periods of time awaiting assistance. The requirement for a pool lift to be independently operable does not preclude assistance from being provided.

**A15.8.5.9 Lifting Capacity.** Single person pool lifts must be capable of supporting a minimum weight of 300 pounds and sustaining a static load of at least one and a half times the rated load. Pool lifts should be provided that meet the needs of the population it is serving. Providing a pool lift

## A15.8 Swimming Pools, Wading Pools and Spas

with a weight capacity greater than 300 pounds may be advisable.

**A15.8.6.1 Sloped Entries.** Personal wheelchairs and mobility devices may not be appropriate for submerging in water. Some may have batteries, motors, and electrical systems that when submerged in water may cause damage to the personal mobility device or wheelchair or may contaminate the pool water. Providing an aquatic wheelchair made of non-corrosive materials and designed for access into the water will protect the water from contamination and avoid damage to personal wheelchairs or other mobility aids.

**A15.8.6.3 Handrails.** Handrails on both sides of a sloped entry provides stability to both persons with mobility impairments and persons using wheelchairs. For safety reasons, a single handrail is permitted on sloped entries provided at wave action pools, leisure rivers, sand bottom pools, and other pools where user access is limited to one area.

**A15.8.8.4 Transfer Steps.** Where possible, the height of the transfer step should be as minimal as possible. This will decrease the distance an individual is required to lift up or move down to reach the next step to gain access.

**A15.8.8.7 Grab Bars.** Pool operators have the choice of providing a grab bar on one side of each step and transfer platform or a continuous grab bar on one side serving each transfer step and the transfer platform. If provided on each step, the top of the gripping surface must be 4 to 6 inches above each step. Where a continuous grab bar is provided, the top of the gripping surface must be 4 to 6 inches above the step nosing. Each type has its advantages. A continuous handrail allows the person that is transferring to maintain a constant grip on the handrail while moving up or down the transfer steps. Grab bars provided on each step provide the gripping surface parallel to each step rather than on a diagonal.

**A15.8.10 Water Play Components.** Personal wheelchairs and mobility devices may not be appropriate for submerging in water when accessing play components located in water.

Some may have batteries, motors, and electrical systems that when submerged in water may cause damage to the personal mobility device or wheelchair or may contaminate the water. Providing an aquatic wheelchair made of non-corrosive materials and designed for access into the water will protect the water from contamination and avoid damage to personal wheelchairs.

# IEQ Indoor Environmental Quality

A project of the National Institute of Building Sciences (NIBS) with funding support from The Architectural and Transportation Barriers Compliance Board (Access Board)



© 2005, National Institute of Building Sciences. All rights reserved.

<b>Table of Contents</b>	<b>Page</b>
<b>Introduction</b>	<b>4</b>
<b>Summary Recommendations</b>	<b>5</b>
<b>Steering Committee</b>	<b>6</b>
<b>Operations &amp; Maintenance</b>	<b>7</b>
<b>Introduction and Overview</b>	<b>8</b>
<b>Barriers &amp; Issues</b>	<b>9</b>
<b>Fragrances</b>	
<b>Pesticides</b>	
<b>Cleaning Products &amp; Disinfectants</b>	
<b>Electromagnetic Fields</b>	
<b>Renovation/Remodeling/Furniture</b>	
<b>Smoke &amp; Combustion</b>	
<b>Noise &amp; Vibration</b>	
<b>Synergistic Effects of Indoor Air Pollutants</b>	
<b>Indoor Air Chemistry</b>	
<b>Persistence of Indoor Air Pollutants</b>	
<b>Recommended Actions for Facility Managers and O&amp;M Staff</b>	<b>13</b>
<b>Pest Control</b>	
<b>Cleaning &amp; Disinfecting</b>	
<b>Mechanical Equipment / HVAC</b>	
<b>Landscape Maintenance</b>	
<b>Enclosure Maintenance</b>	
<b>Renovation/Remodeling/Furnishings</b>	
<b>General Recommendations</b>	<b>18</b>
<b>Indoor Air &amp; Environmental Quality Programs</b>	
<b>Policies (Smoking, Fragrance, Cell phone, Notification, Vehicle idling)</b>	
<b>Recommendations for Future Actions</b>	
<b>References</b>	<b>20</b>
<b>Appendices - Detailed Recommendations</b>	
<b>Pest Control / Resources</b>	<b>22</b>
<b>Cleaning &amp; Disinfecting / Resources</b>	<b>27</b>

<b>Mechanical Equipment / Resources</b>	<b>30</b>
<b>Landscape Maintenance / Resources</b>	<b>32</b>
<b>Enclosure Maintenance / Resources</b>	<b>33</b>
<b>Committee and other contributors to the report</b>	<b>34</b>
<b>Additional Resources</b>	
<b>General Guidance for Building Cleaning Programs</b>	<b>35</b>
<b>Steps for Implementing a Scent-free Policy in the Workplace</b>	<b>44</b>
<b>Designated Cleaner Air Rooms</b>	
<b>Introduction and Overview</b>	<b>46</b>
<b>Promising Practices</b>	
<b>Recommended Actions</b>	
<b>Committee Recommendations</b>	
<b>National Cleaner Air Signage</b>	<b>48</b>
<b>Background</b>	
<b>Purpose</b>	
<b>Proposed Language</b>	
<b>Conditions of Use</b>	
<b>Paths of Travel</b>	<b>49</b>
<b>Restrooms</b>	
<b>Contact Information</b>	
<b>Maintaining A Cleaner Air Record Log</b>	
<b>Removal Of The Symbol</b>	
<b>Temporary Use Of Cleaner Air Symbol</b>	
<b>Further Explanation of the Criteria for Conditions of Use</b>	<b>50</b>
<b>No Smoking</b>	
<b>Fragrance-Free</b>	
<b>Pesticide-Free Indoors and Outdoors</b>	
<b>Least Toxic/Risk Cleaning Products</b>	
<b>No Recent Construction or Remodeling Including Carpet Installation</b>	
<b>Cell Phones Turned Off</b>	
<b>Ability to turn off or unplug computers and other electrical equipment by occupant or staff</b>	
<b>Ability to turn off fluorescent lighting by occupant or staff</b>	
<b>Ability to adjust temperature and air flow by occupant or staff, or the availability of operable window(s)</b>	
<b>Recommendations for Accommodations</b>	<b>52</b>
<b>References</b>	<b>53</b>
<b>Resources for Access and Accommodations</b>	<b>53</b>
<b>Committee</b>	<b>54</b>
<b>Appendices</b>	
<b>California Code Regulations</b>	<b>54</b>
<b>Southwest Community Health System Policy Guideline</b>	<b>56</b>
<b>MCS Nursing Protocol</b>	<b>63</b>

<b>Design &amp; Construction</b>	<b>67</b>
<b>Introduction</b>	<b>68</b>
<b>Recommendations</b>	<b>69</b>
<b>Site and General Building Design</b>	
Enclosure	
Plumbing, Mechanical and Electrical Equipment	
Finishes and Furnishings	
Construction Related Activities for Renovations	
Occupancy	
Commissioning	
Exterior Landscaping	
<b>Appendices</b>	<b>74</b>
Site Selection	
Roof Gardens	
Pest Prevention	
Carpet	
Use and Occupancy	
Landscaping	
<b>References</b>	<b>81</b>
<b>Bibliography</b>	<b>83</b>
<b>Committee</b>	<b>85</b>
<b>Building Products &amp; Materials</b>	<b>86</b>
<b>Introduction</b>	<b>86</b>
Overview – Design	<b>87</b>
Overview – Building Operations and Maintenance	<b>88</b>
CHPS Section 01350 Part 1.3B and 1.4D and GREENGUARD Allowable	
Emission Levels	
Formaldehyde	<b>88</b>
Adhesives and Sealants	<b>91</b>
Appliances	<b>91</b>
Ceilings	<b>92</b>
Composite Wood Products (plywood, particle board, OSB, paneling, etc.)	
Fireproofing	<b>92</b>
Flooring and Floor Systems	<b>93</b>
Insulation	<b>94</b>
Paint	<b>95</b>
Textiles	<b>95</b>
Walls	<b>95</b>
Wallcovering	<b>95</b>
Conclusion & Recommendations	<b>96</b>
Committee	<b>96</b>

## Introduction

The Architectural and Transportation Barriers Compliance Board (Access Board) is an independent federal agency devoted to accessibility for people with disabilities. The Access Board is responsible for developing and maintaining accessibility guidelines to ensure that newly constructed and altered buildings and facilities covered by the Americans with Disabilities Act and the Architectural Barriers Act are accessible to and usable by people with disabilities. In November 1999, the Access Board issued a proposed rule to revise and update its accessibility guidelines. During the public comment period on the proposed rule, the Access Board received approximately 600 comments from individuals with multiple chemical sensitivities (MCS) and electromagnetic sensitivities (EMS). They reported that chemicals released from products and materials used in construction, renovation, and maintenance of buildings, electromagnetic fields, and inadequate ventilation are barriers that deny them access to most buildings.

Americans spend about 90 percent of their time indoors, where concentrations of air pollutants are often much higher than those outside. According to the U.S. EPA Healthy Buildings, Healthy People: A Vision for the 21st Century, [www.epa.gov/iaq/hbhp/hbhptoc.html](http://www.epa.gov/iaq/hbhp/hbhptoc.html) "Known health effects of indoor pollutants include asthma; cancer; developmental defects and delays, including effects on vision, hearing, growth, intelligence, and learning; and effects on the cardiovascular system (heart and lungs). Pollutants found in the indoor environment may also contribute to other health effects, including those of the reproductive and immune systems." (p. 4). The report further notes that "Most chemicals in commercial use have not been tested for possible health effects. (p. 8).

There are a significant number of people who are sensitive to chemicals and electromagnetic fields. Surveys conducted by the California and New Mexico Departments of Health and by medical researchers in North Carolina found 16 to 33 percent of the people interviewed reported that they are unusually sensitive to chemicals, and in the California and New Mexico health departments' surveys 2 percent to 6 percent reported that they have been diagnosed as having multiple chemical sensitivities. C. Miller and N. Ashford, "Multiple Chemical Intolerance and Indoor Air Quality," in *Indoor Air Quality Handbook* Chapter 27.8 (McGraw-Hill 2001). Another California Department of Health Services survey has found that 3 percent of the people interviewed reported that they are unusually sensitive to electric appliances or power lines. P. LeVallois, et al., "Prevalence and Risk Factors of Self-Reported Hypersensitivity to Electromagnetic Fields in California," in California EMF Program, "An Evaluation of the Possible Risks From Electric and Magnetic Fields (EMFs From Power Lines, Internal Wiring, Electrical Occupations and Appliances, Draft 3 for Public Comment, April 2001" Appendix 3 (<http://www.dhs.ca.gov/ehib/emf/RiskEvaluation/riskeval.html>).

Individuals with multiple chemical sensitivities and electromagnetic sensitivities, who submitted written comments and/or attended the public information meetings on the draft final rule, requested that the Access Board include provisions in the final rule to make buildings and facilities accessible for them.

The Board has not included such provisions in their rules, but they have taken the commentary very seriously and acted upon it. As stated in the Background for its Final Rule **Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Recreation Facilities**: <http://www.access-board.gov/recreation/final.htm>

"The Board recognizes that multiple chemical sensitivities and electromagnetic sensitivities may be considered disabilities under the ADA if they so severely impair the neurological, respiratory or other functions of an individual that it substantially limits one or more of the

individual's major life activities. The Board plans to closely examine the needs of this population, and undertake activities that address accessibility issues for these individuals.

The Board plans to develop technical assistance materials on best practices for accommodating individuals with multiple chemical sensitivities and electromagnetic sensitivities. The Board also plans to sponsor a project on indoor environmental quality. In this project, the Board will bring together building owners, architects, building product manufacturers, model code and standard-setting organizations, individuals with multiple chemical sensitivities and electromagnetic sensitivities, and other individuals. This group will examine building design and construction issues that affect the indoor environment, and develop an action plan that can be used to reduce the level of chemicals and electromagnetic fields in the built environment.”

This report and the recommendations included within are a direct outgrowth from that public comment process. The Access Board contracted with the National Institute of Building Sciences (NIBS) to establish this Indoor Environmental Quality Project as a first step in implementing that action plan.

A broad and distinguished Steering Committee was established and met in January 2004 in Bethesda, Maryland, to review the project objectives. Subsequently four task teams (committees) were established to address specific issues in buildings related to Operations & Maintenance, Cleaner Air Rooms, Design and Construction, and Products and Materials. The following reports from these four committees offer recommendations for improving IEQ in buildings. They also list valuable resources and references to allow readers to investigate the pertinent issues in greater depth. The focus of the project was on commercial and public buildings, but many of the issues addressed and recommendations offered are applicable in residential settings.

Many volunteers worked diligently to create the recommendations in this report. These individuals are listed in the separate committee sections of the report, but special thanks go to the committee chairs: respectively Hal Levin, Building Ecology Research Group; Michael Mankin, California Division of the State Architect; Roger Morse, Morse-Zentner Associates; and Brent Kynoch, Kynoch Environmental Management, Inc. Lastly, an enormous debt of gratitude is owed to four amazing individuals who made significant contributions to the work of all four committees: Mary Lamielle, National Center for Environmental Health Strategies; Ann McCampbell, MD, Multiple Chemical Sensitivities Task Force of New Mexico; Susan Molloy, National Coalition for the Chemically Injured; and Toni Temple, Ohio Network for the Chemically Injured.

The overall objectives of this project were to establish a collaborative process among a range of stakeholders to recommend practical, implementable actions to both improve access to buildings for people with MCS and EMS while at the same time raising the bar and improving indoor environmental quality to create healthier buildings for the entire population.

This IEQ project supports and helps achieve the goals of the Healthy Buildings, Healthy People project, which acknowledges that "We will create indoor environments that are healthier for everyone by making indoor environments safer for the most vulnerable among us, especially children." (p.17)

## **Summary Recommendations**

The recommendations in this report are only a first step toward the action plan envisioned by the Access Board.

The NIBS IEQ committee offers several recommendations for further action. It is recommended that a follow-on project organize and convene one, or more, workshops to deliberate the issues and recommendations in this report. It is also recommended that a project be organized to develop a single guidelines document. Such guidelines would be built on refinement and coordination of the recommendations of the Design & Construction and Products & Materials committees in this report. This same, or a separate project, should develop new building code provisions to accelerate the implementation of improved IEQ. Lastly, it is recommended that a project be organized to develop guidelines for the design of an “ideal space” for people with MCS and EMS. The recommended follow-up projects should involve collaborative effort and funding from a range of organizations across the building community; e.g., American Institute of Architects (AIA), Associated General Contractors of America (AGC), Building Owners & Managers Association International (BOMA), American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Environmental Protection Agency (EPA), and, of course, the Access Board.

### **Steering Committee**

Nicolas Ashford, Massachusetts Institute of Technology

Kathy Barcus, Clarke Construction Company, Inc.

Marilyn Golden, Disability Rights Education and Defense Fund (DREDF)

Harry Gordon, Burt Hill Kosar and Rittelmann Associates

Mark Jackson, Lennox Industries, Inc.

Brent Kynoch, Kynoch Environmental Management, Inc.

Mary Lamielle, National Center for Environmental Health Strategies

Ann McCampbell, Multiple Chemical Sensitivities Task Force of New Mexico

Claudia Miller, University of Texas Health Sciences Center - San Antonio

Susan Molloy, National Coalition for the Chemically Injured

Roger Morse, Morse Zentner Associates

Larry Perry, Building Owners and Managers Association

Bruce Small, Building Inspections

Toni Temple, Ohio Network for the Chemically Injured

James Wasley, University of Wisconsin-Milwaukee

James Raggio, Access Board

Alexander Shaw, National Institute of Building Sciences

**National Institute of Building Sciences (NIBS)  
Indoor Environmental Quality (IEQ) Project  
Operations & Maintenance Committee**

**May 26, 2005**

**Table of Contents**

**Introduction and Overview**

**Barriers & Issues**

**Fragrances**

**Pesticides**

**Cleaning Products & Disinfectants**

**Electromagnetic Fields**

**Renovation/Remodeling/Furniture**

**Smoke & Combustion**

**Noise & Vibration**

**Synergistic Effects of Indoor Air Pollutants**

**Indoor Air Chemistry**

**Persistence of Indoor Air Pollutants**

**Recommended Actions for Facility Managers and Operations & Maintenance Staff**

**Pest Control**

**Cleaning & Disinfecting**

**Mechanical Equipment / HVAC**

**Landscape Maintenance**

**Enclosure Maintenance**

**Renovation/Remodeling/Furnishings**

**General Recommendations**

**Indoor Air & Environmental Quality Programs**

**Policies (Smoking, Fragrance, Cell phone, Notification, Vehicle idling)**

**Recommendations for Future Actions**

**References**

**Appendices - Detailed Recommendations**

**Pest Control / Resources**

**Cleaning & Disinfecting / Resources**

**Mechanical Equipment / Resources**

**Landscape Maintenance / Resources**

**Enclosure Maintenance / Resources**

**Committee and other contributors to the report**

**Additional Resources**

**General Guidance for Building Cleaning Programs**

**Steps for Implementing a Scent-free Policy in the Workplace**

## **INTRODUCTION AND OVERVIEW**

### **Problem Summary**

The operation and maintenance of commercial and public buildings can affect their accessibility for people with asthma and multiple chemical and/or electromagnetic sensitivities. The presence of many products or conditions involved in cleaning, maintaining, using, and operating buildings often contributes to poor indoor environmental quality and are access barriers for these individuals.

Problematic substances include, but are not limited to, pesticides, fragrances, disinfectants, many cleaners and new building materials and furnishings, and smoke and other engine exhaust. Inadequate ventilation of a building further contributes to poor indoor environmental quality.

The presence of electromagnetic fields from office equipment and other sources is a barrier for those with electromagnetic sensitivities. Noise and vibration can adversely affect some people with chemical and/or electromagnetic sensitivities and trigger seizures in susceptible individuals.

### **General Solutions**

Measures taken to improve indoor environmental quality, such as reducing air pollutants, noise and electromagnetic fields in buildings, will increase their accessibility for people with asthma and chemical and/or electromagnetic sensitivities, as well as provide a more healthful environment for all building occupants.

While “green” and “environmentally-friendly” practices and products for construction and maintenance of buildings sometimes provide more healthful indoor environments and improves access for those with asthma and multiple chemical sensitivities, this is not always the case. The U.S. EPA notes that there is growing concern that standards being promoted by the green building movement, such as Green Seal and Green Guard standards, are not sufficiently protective of health (1).

For example, some measures recommended to promote energy and water conservation -- such as reducing outdoor air supplied and/or reducing time of HVAC usage, using motion sensors that can create electromagnetic fields, using waterless urinals that require continuous chemical treatments, recommending cold water for cleaning, and promoting the use of alcohol hand wipes instead of hand washing – can cause or lead to increased indoor pollution and less healthful and accessible environments.

In addition, “greener cleaners” often promote the use of citrus- and/or pine-based products, which can react with even low levels of oxidants, such as ozone, to produce hazardous byproducts, as well as make buildings inaccessible for many people with chemical sensitivities. The addition of either synthetic or natural fragrances to cleaning and other products is also problematic for chemically sensitive individuals.

Other common green building recommendations, such as building on brownfields, using tuck-under parking, and putting heliports or gardens on roofs can also lead to diminished indoor air quality and create barriers for people with chemical sensitivities.

Lastly, the green building community has yet to provide guidance on the issue of electromagnetic fields.

## **BARRIERS & ISSUES**

### **Fragrances**

The presence of perfume, cologne, scented cleaners and other scented products contributes to poor indoor air quality and is one of the major access barriers for people with asthma and multiple chemical sensitivities.

“Fragrances” are chemical compounds added to a product to give it a scent. There are approximately 3000 chemicals used in the manufacture of fragrances. Most of these chemicals are synthetic and derived from petroleum. Chemicals found in fragrance formulations include toluene, alcohols, formaldehyde, styrene, benzene, limonene, phthalates, and musk. An individual fragrance formula may contain over 100 chemicals, but their identity is protected as a trade secret. Fragrances do not have to be tested for safety before they are put on the market (2).

Exposure to fragrances can trigger asthma attacks and migraine headaches, and aggravate sinus conditions. In those who are chemically sensitive, fragrance exposures can also cause irregular heartbeat, memory loss, confusion, fatigue, and neurological, vascular, and other problems. In addition, some fragrance chemicals are implicated in causing cancer and/or damaging the liver, kidneys, and central nervous system. Fragrance chemicals can enter the body via inhalation, skin absorption, or nasal passageways.

According to a 1986 U.S. House of Representatives Report:

*"In 1986, the National Academy of Sciences targeted fragrances as one of the six categories of chemicals that should be given high priority for neurotoxicity testing. The other groups include insecticides, heavy metals, solvents, food additives and certain air pollutants. The report states that 95 percent of chemicals used in fragrances are synthetic compounds derived from petroleum. They include benzene derivatives, aldehydes, and many other known toxics and sensitizers, which are capable of causing cancer, birth defects, central nervous system disorders and allergic reactions "* (3)

If a product label lists “fragrance” as an ingredient on the back of the label, it contains added fragrance, even if the front label says the product is “unscented” or “fragrance-free”. If “fragrance” is not listed as an ingredient, it may still contain fragrance chemicals or contain natural fragrances.

The main sources of fragrances in buildings are from 1) fragrance-emitting devices (FEDS), sprays, and deodorizers, 2) other scented cleaning and maintenance products, 3) perfume; cologne; essential oils; and scented skin and hair products, cosmetics, and other personal care products, 4) clothing that has been laundered with scented detergents, fabric softeners, or dryer sheets, and 5) potpourri, incense and scented candles (even when incense or scented candles are not burning). Sometimes fragrance is added to and dispersed by a building’s ventilation system.

### **Pesticides**

Pesticides are hazardous chemicals designed to kill or repel insects, plants, and other pests. The term pesticide applies to insecticides, herbicides (weed-killers), fungicides, rodenticides, disinfectants, and other substances used to control pests. Many pesticides contain volatile and/or semi-volatile chemicals that contribute to poor indoor air and environmental quality (IAQ/IEQ).

A pesticide product consists of the active ingredient(s) and “inert” ingredients. Active ingredients are the chemicals that kill or repel the pest. The rest of the product is composed of “inert” ingredients, which often comprise over 95% of the pesticide product. “Inert” ingredients are commonly solvents and may be as, or more, toxic than the active ingredient(s).

Individuals exposed to pesticides are at risk for both acute and chronic health effects (4, 5, 6, 7). Pesticide exposures can exacerbate asthma and cause nausea, headaches, rashes, dizziness, fatigue and memory loss. Many pesticides are also linked with causing cancer, birth defects, neurological and reproductive disorders, and the onset and exacerbation of chemical sensitivities. Pesticide exposure can occur long after its application because pesticide products are often designed to be persistent in the environment.

For people who are chemically sensitive, exposure to even minute amounts of pesticides from, for example, pesticide drift from neighborhood lawn treatments, driving on a road where herbicides have been sprayed weeks earlier, or being in a building that was treated with pesticides even several years earlier, can cause severe, sometimes, life-threatening and/or prolonged illness (8). Thus the presence of pesticides is one of the greatest access barriers for people with chemical sensitivities.

The use of pesticides can be eliminated or significantly reduced through implementation of Integrated Pest Management (IPM) programs. IPM is a program of prevention, monitoring, record-keeping, and control that eliminates or drastically reduces the use of pesticides. The focus of IPM is to prevent pest problems by reducing or eliminating sources of pest food, water, and shelter and by maintaining healthy lawns and landscapes. The first approach to controlling a pest outbreak is to improve sanitation, make structural repairs (such as fixing leaky pipes and caulking cracks), and using physical or mechanical controls such as screens, traps and mechanical weed cutters. A least hazardous chemical is used only when other strategies have failed.

IPM strategies are being increasingly implemented in schools, parks, government facilities, and hospitals nationwide. One needs to be aware, however, that the term IPM is sometimes inappropriately used for pest management programs that use or recommend the use of significant amounts of pesticides.

### **Cleaning Products & Disinfectants**

Many toxic chemicals are found in janitorial cleaning supplies used in industrial and commercial facilities. They often emit volatile organic compounds (VOC's) (9), contribute to poor indoor air quality (IAQ), and create access barriers for people with asthma, allergies, and/or chemical sensitivities. Some of these chemicals are associated with human health effects, including cancer, damage to major organs, interference with normal reproduction and development, and even death. (10).

Even “greener cleaners” may contain volatile substances, like citrus or pine, that can cause adverse health effects in building occupants.

There is a wide range of cleaning and maintenance products that include, but are not limited to, air fresheners, deodorizers, bathroom and tile cleaners, dusting aids, engine and other degreasers, lubricants, fabric protectants, floor polishes and waxes, furniture polish, general purpose cleaners, glass cleaners, laundry products, oven cleaners, carpet and upholstery cleaners, graffiti remover, and floor strippers. One of the most hazardous cleaning operations for workers and building occupants is the stripping and refinishing of floors.

Some cleaning products also contain disinfectants. The U.S. EPA notes that one major concern from a health standpoint is the increased incorporation of antimicrobial agents and fragrances in cleaners and air fresheners marketed to reduce indoor air contamination (1).

Many commonly used disinfectant or sanitizer products contain chlorine, phenol, quaternary ammonium compounds, and isopropyl and other alcohols. These produce hazardous fumes and present access barriers for people with chemical sensitivities.

### **Electromagnetic Fields**

For people who are electromagnetically sensitive, the presence of cell phones and towers, portable telephones, computers, fluorescent lighting, unshielded transformers and wiring, battery re-chargers, wireless devices, security and scanning equipment, microwave ovens, electric ranges and numerous other electrical appliances can make a building inaccessible.

The National Institute for Occupational Safety and Health (NIOSH) notes that scientific studies have raised questions about the possible health effects of EMF's. NIOSH recommends the following measures for those wanting to reduce EMF exposure – informing workers and employers about possible hazards of magnetic fields, increasing workers' distance from EMF sources, using low-EMF designs wherever possible (e.g., for layout of office power supplies), and reducing EMF exposure times (11).

### **Renovation/Remodeling/Furniture**

Many new building materials, such as paints, adhesives, wallboard, carpet, and insulation, as well as upholstered furniture, particleboard cabinets, and other furnishings emit hazardous volatile organic compounds (VOC's), contribute to poor indoor air quality (IAQ) and create significant access barriers for people with asthma and/or chemical sensitivities. These materials often outgas and are problematic for prolonged periods of time.

### **Smoke & Combustion**

Many people with asthma and most people with chemical sensitivities are made sick by exposure to: 1) smoke, such as that from tobacco, fireplaces, candles, incense, and barbeques, and other outdoor fires, 2) vehicle and other engine exhaust, especially exhaust from vehicles using diesel or oxygenated fuel, and 3) combustion appliances burning kerosene, propane, or natural gas (natural gas usually being better tolerated than kerosene or propane). If combustion appliances are used, they should be directly vented to the outdoors. Electrical appliances are preferred by people with chemical sensitivities.

### **Noise & Vibration**

Noise and vibration from HVAC systems, vacuums, pumps, helicopters and other sources can trigger severe symptoms, including seizures, in susceptible individuals.

### **Synergistic Effects of Indoor Air Pollutants**

Indoor air is a "chemical soup" made up of a variety of chemicals emitted by building materials, cleaning products, pesticides, personal care and consumer products, emissions from building equipment and activities, etc. While individual chemicals may be hazardous, combinations of chemicals can be even more hazardous through additive or synergistic effects. Synergistic effects

occur when the health impacts of a chemical combination is greater than the sum of the impacts of the individual chemicals.

### **Indoor Air Chemistry**

In indoor air, chemicals can react with one another to form other compounds that are more hazardous than the original chemicals. Increasing evidence has shown that ozone and hydroxyl radicals formed by other oxidants can react with alkenes (such as limonene found in citrus and fragrance formulations, as well as terpenes emitted by many wood products) to generate secondary pollutants, including formaldehyde, as well as hydroxy radicals that can react with organics to form other potentially toxic air pollutants. The toxicity of many of these secondary pollutants is well-established while for others it has yet to be evaluated (12, 13, 14, 15, 16). These reactions can be limited by employing carbon-based filters in locations where outdoor ozone concentrations commonly approach or exceed the National Ambient Air Quality Standards (NAAQS) promulgated by the U.S. EPA.

### **Persistence of Indoor Air Pollutants**

Many porous building materials and furnishings, such as carpeting, couches, drapes, and wallboard, absorb cleaning chemicals, fragrances, pesticides, and other air pollutants. Chemicals adsorb to virtually all indoor surfaces but more strongly to rough rather than smooth surfaces. These processes are known as the “sink effect”. These chemicals can be re-emitted into the air for long periods of time leading to prolonged air pollution. For example, it is not uncommon for a building to retain the odor of a fragrance-emitting device (FED) months after it has been removed. Similarly, residual tobacco smoke can still be detected in buildings long after a no-smoking policy is implemented. Air pollutants clear more readily from buildings that contain a higher percentage of hard impermeable surfaces.

## **RECOMMENDED ACTIONS FOR FACILITY MANAGERS AND OPERATIONS & MAINTENANCE STAFF**

The O & M Committee identified *pesticides* (indoors & outdoors), *fragrances* (especially fragrance-emitting devices/FEDS, air fresheners, and deodorizers), and volatile *cleaners* (including citrus & pine) as the biggest access barriers for people with chemical sensitivities related to operations and maintenance of a building. Cell phone use was identified as a significant barrier for people with electromagnetic sensitivities.

The Committee developed recommendations for making buildings more accessible for people with chemical and/or electromagnetic sensitivities in the areas of pest control, cleaning & disinfecting, mechanical / HVAC, landscape maintenance, and enclosure maintenance. They are listed in bullet form in the Appendix and summarized in the body of the report below.

In addition, recommendations are given for renovation, remodeling, and furnishings and for adoption of policies on smoking, fragrances, cell phone use, notification of building activities, and vehicle idling.

The Committee recognizes that the list of recommendations is long and that few buildings will be able to implement all of them. The recommendations are the ideal goal towards which to strive. Any steps taken to reduce the levels of the problematic substances or conditions listed above will improve access for people with chemical and/or electromagnetic sensitivities and create a healthier building.

Some of the recommendations will not apply to certain types of buildings or geographic areas. The recommendations are given in sufficient detail to help those who need to address a specific issue. Resources from which to obtain more information or guidance are also provided in the Appendix and at the end of the document in Additional Resources.

### **Recommendations for Pest Control**

Adopt an Integrated Pest Management (IPM) program for building interiors and grounds as described in “Healthy Hospitals, Controlling Pests Without Harmful Pesticides” (17). The Los Angeles Unified School District also has an exemplary plan for an IPM program (18).

IPM is a program of prevention, monitoring, record-keeping, and control that eliminates or drastically reduces the use of pesticides. The focus of IPM is to prevent pest problems by reducing or eliminating sources of pest food, water, and shelter and by maintaining healthy lawns (19) and landscapes.

The first approach in controlling a pest outbreak is to improve sanitation, make structural repairs (such as fixing leaky pipes and caulking cracks), and using physical or mechanical controls such as screens, traps, vacuums, and mechanical weed cutters. Increased sanitation measures include more frequent trash removal, restricting eating to designated areas, securing trash container lids, and steam cleaning trash containers. The IPM approach uses knowledge of a pest’s biology, habitat, and needs to time specific interventions to prevent and control pests. A least hazardous chemical is used only when other strategies have failed.

Pesticide use is discouraged in a true IPM program. If pesticides are used indoors or outdoors, however, the following precautions should be taken -- notification of applications (even for “spot” or crack & crevice treatments) should be given through posting of signs (before, during, and after applications) and by other means to building occupants, especially those on a pesticide notification

registry (20), applications should only be made by a licensed applicator, applications should not be made inside buildings by spraying, fogging, bombing, or tenting, and applications should not be made in occupied areas or areas that may become occupied during the 24 hours (at a minimum) following an application. In buildings that are constantly occupied, pesticide applications should be made when they are least occupied. It is recommended that pesticides be applied when there is the longest time before the area will be re-occupied, such as at the beginning of a weekend or vacation period.

The Committee recommends that certain pesticides, such as organophosphates, carbamates, pyrethroids, and other neurotoxic insecticides; 2,4-D, other phenoxy herbicides, and glyphosate; and fungicides such as mancozeb, chlorothalonil, and maneb, never be used.

### **Recommendations for Cleaning & Disinfecting**

Use fragrance-free, low-VOC cleaning products. Do not use fragrance-emitting devices (FEDS), plug-ins, or sprays; urinal or toilet blocks; or other deodorizer/re-odorizer products. Reduce odors by increasing cleaning and ventilation and/or using baking soda or zeolite to absorb odors. Do not use products containing paradichlorobenzene (21) or naphthalene, which are common ingredients in FEDS.

Do not use cleaner/disinfectant combination products. Avoid or limit the use of products containing chlorine, ammonia, quaternary ammonium, phenol, isopropyl and other alcohols, formaldehyde, and other petroleum distillates. Do not use citrus- or pine-based products. Hydrogen peroxide-based products are the preferred disinfectants, but still should be used with caution and care. Use hot water for cleaning to reduce the need for soaps, detergents, and disinfectants.

Use disinfectants only in areas and at strengths (i.e., levels of disinfection) required by law. Check with local health department to obtain details of all legal requirements. Clean surfaces thoroughly before disinfecting. Leave disinfectants in place for the correct amount of time before wiping surfaces clean.

Audit cleaning chemicals currently in use and develop a plan to replace with safer alternatives.

Vacuum frequently and thoroughly using vacuums with HEPA filters and strong suction. If carpets must be cleaned, use steam or least toxic all-purpose cleaner or carpet cleaner that does not contain petroleum solvents. Spot clean whenever possible. Clean stains while they are fresh to avoid the need for aggressive cleaning later. Dust hard surfaces with a lint-free cloth, or with water only.

Spray cleaning products on to cloths rather than on to surfaces or into the air. Dry all washed surfaces with a dry cloth or mop to reduce chemical residue and chance of mold growth. Minimize the use of floor waxes and buffing.

Ventilate well when using cleaning products. Post signs during cleaning. Make cleaning schedule available to employees or others upon request.

Schedule heavy cleaning, repairs and maintenance during low or no-occupancy periods whenever possible.

Prohibit occupant usage of cleaning chemicals except as authorized. Establish a list of least toxic, low-VOC cleaning products (and/or provide them to employees) which they can use to clean computers, erase felt pen writing on white board, and perform other similar activities.

In decorative building fountains, use the minimum amount of chlorine necessary for disinfection, avoid the use of bromine, use closed ozone water treatment systems to the maximum extent possible, and make use of newer, less-toxic disinfecting technologies as they become available.

Avoid the use of wall-mounted devices, similar to fragrance-emitting devices (FEDS), that operate automatically or by pushing a button to dispense deodorizers, disinfectants, and pesticides.

### **Recommendations for Mechanical Equipment / HVAC**

Adhere to a strict maintenance schedule for HVAC equipment and make sure it is working properly. Use the highest efficiency filters compatible with current HVAC system, and if necessary, consider retrofitting the system to increase filtration capabilities. Maintain relative humidity between 30% and 50%.

Use non-chemical methods to maintain HVAC ducts free of particulate matter, dust, and debris, such as physical removal or use of vacuums. Do not use the HVAC system to disperse fragrances or other materials.

Seal return air openings into HVAC system during remodeling and exhaust directly to the outdoors, by temporarily removing window glazing if necessary.

Use demand controlled ventilation (DCV) that provides liberal amounts of air flow and outdoor air ventilation. Before a building is re-occupied in the morning or after weekends, flush with at least three complete outdoor air exchanges.

Create door and window-opening protocol to maintain proper pressure relationships and air flow in the building. Educate and provide protocol to staff and other building occupants. Policy should include provision that allows chemically sensitive and other individuals to open windows on a temporary or regular basis, as needed because of a health condition. Windows should also be permitted to be opened by occupants when the HVAC system is not working or shut off, such as may occur during nights and weekends.

Make maximum use of economizer cycle. Avoid energy conservation practices that reduce intake of outside air below minimum requirements.

Avoid or minimize the use of humidifiers in the building's HVAC system. Prohibit the use of personal humidifiers except when an occupant has a medical need for one. Maintain the cleanliness of all humidifier equipment and use the minimum amount of water treatment chemicals necessary to control dissolved solids and pH and prevent antimicrobial contamination. Do not allow the use of portable air "cleaners" that emit ozone.

Repair plumbing with least toxic, low-VOC materials. Use snakes or other mechanical methods to clear clogged drains. Use bacterial enzymes to prevent drain clogs. Inspect floor and other drains, especially those that are infrequently used, to ensure there is water in the P-traps, thereby avoiding sewer gas backup. Treat grease traps daily with bacterial enzymes.

### **Recommendations for Landscape Maintenance**

Maintain lawns and gardens organically. Use integrated pest management (IPM) to eliminate or minimize the use of herbicides, fungicides, insecticides, and other pesticides. Maintain soil health. Avoid the use of synthetic fertilizers.

Pull, mow, or use mechanical weed cutters to remove weeds. Vinegar can be used to kill weeds along fence lines and other hard to reach places.

Avoid dust-blowing equipment like leaf blowers. Sweeping, raking, and use of vacuums are the preferred methods for removing debris.

Avoid diesel-powered and 2-cycle engine equipment. Use electric lawn and landscape equipment whenever possible.

Use rock, gravel, flat stones, or pavers for mulch, and/or use tytar landscape barrier to suppress weeds. Avoid organic mulches, like cocoa beans, peat moss, wood chips, and bark, especially near operable windows and doors of buildings. These mulches usually emit volatile fumes and may produce or harbor mold.

Avoid the use of CCA wood or wood chips because they contain arsenic and other toxic chemicals which can leach into the environment. Do not use railroad ties because they contain creosote.

Apply pesticide, fertilizers, and lime only when there is little or no wind and apply them in a manner that prevents drift. Post signs and provide advance notification to building occupants before starting these applications.

Use least toxic, low-VOC paints, stains, and finishes on outside equipment, like benches, poles, decks, and porches.

### **Recommendations for Enclosure Maintenance**

It is important to properly maintain the building envelop in order to prevent mold problems and block pest entry.

Routinely inspect and clean roof and gutters to make sure they are draining properly. Promptly repair roof or plumbing leaks. Regularly inspect walls and foundations, especially all utility entrance seals (e.g., phone, water, electric, and cable) for cracks and repair promptly if found. Insulate cold pipes to prevent condensation.

Promptly remove wet ceiling tiles and wall panels.

Remove excess water from carpeting damaged by clean water and quickly dry it to avoid mold buildup. Do not use disinfectants or moldicides (other than hydrogen peroxide-based ones). Instead, utilize a steam extraction carpet cleaning system with a hydrogen peroxide-based cleaner/disinfectant. Inspect carpet after it is completely dried to ensure there is no mold or mildew. Those with asthma or chemical sensitivities should be removed from areas where there is wet carpeting. Remove carpeting if it has been wet longer than 24 hours.

Immediately remove and do not re-use any wet carpeting that has been contaminated with sewer water, heavy dirt and soils, or toxic chemicals.

Seal rusted surfaces with a least toxic low VOC sealant to minimize emissions of airborne particles.

### **Recommendations for Renovation/Remodeling/Furnishings**

It is recommended that buildings and furnishings be well maintained to reduce the need for renovation and remodeling. Chemically sensitive individuals often tolerate older building materials and furnishings better than new ones because older materials have usually outgassed and emit lower levels of VOCs.

If renovation and remodeling is done, however, efforts should be made to limit activities to select areas, rather than being done on a wide scale. They should be performed when the areas are unoccupied (or the least occupied in buildings that are in constant use).

If new materials and finishes are applied (especially wet-applied products such as paints, sealants, caulks, and adhesives), maximum outdoor air ventilation with no recirculation should be employed during and for a reasonable period of time after the application.

When possible, new furnishings should be thoroughly aired out before being brought into the occupied space.

## **GENERAL RECOMMENDATIONS**

### **Indoor Air & Environmental Quality Program**

The O & M Committee recommends that facilities adopt an Indoor Air & Environmental Quality Program (IAQ/IEQ) to promote practices that prevent or reduce the contamination of indoor air, thereby contributing to a safe, healthy, productive and comfortable environment for building occupants. Benefits of good IAQ/IEQ may include improved health of occupants, decrease in the spread of infectious disease, protection of susceptible populations, increased productivity of occupants, improved relationships/fewer complaints, reduction in potential building closures (due to unhealthful conditions), less deterioration of buildings and equipment, reduced maintenance costs, and decreased liability and risk (22).

An IAQ/IEQ Program should include the maintenance of a log that records building problems and health complaints reported by building occupants.

### **Policies**

The O & M committee recommends the following policies be adopted in commercial and public buildings:

#### **No Smoking Policy**

It is recommended that smoking be prohibited inside buildings. Smoking should be restricted to designated outdoor smoking areas that are 100 feet from paths of travel, entryways, operable windows, and air intakes.

#### **Fragrance-Free Policy**

It is recommended that a fragrance-free policy include prohibition of fragrance-emitting devices (FEDS) and sprays; use of fragrance-free maintenance, laundry, paper and other products; restrictions on perfume, cologne, and other scented personal care products used by employees, visitors, and other occupants; and prohibitions on use of potpourri and burning incense and scented candles.

An important first step is educating staff and others about the need for and benefits of reducing or eliminating the use of fragranced products.

### **Resources**

No Scents Makes Sense brochure, Lung Association of New Brunswick:  
<http://www.nb.lung.ca/pdf/NoScentsMakeSense.pdf>

Guidelines on Wearing Scented Products and We Share the Air posters, University of Waterloo, Ontario, Canada, [www.safetyoffice.uwaterloo.ca/hspm/hspmm\\_intro/safety\\_manual\\_index.htm](http://www.safetyoffice.uwaterloo.ca/hspm/hspmm_intro/safety_manual_index.htm), (under 12. Hygiene).

See “*Steps for Implementing a Scent-free Policy in the Workplace*” in Additional Resources.

#### **Cell Phone Use Policy**

It is recommended that cell phone use be prohibited in areas of a building when requested by an electromagnetically sensitive individual who needs to work or visit that area. Also, see information on use of a Cleaner Air Symbol in the Designated Cleaner Air Room report.

### **Notification Policy**

It is recommended that facilities adopt a posting and notification policy to notify staff, visitors, and other building occupants of pesticide applications, cleaning and maintenance activities, renovation and construction, and other activities that may produce hazardous fumes or dust.

### **Vehicle Idling Policy**

It is recommended that facilities limit or prohibit idling of vehicles, especially diesel vehicles, near entryways, loading docks, operable windows, and air intakes (23).

### **Recommendations for Future Actions**

1. The O & M Committee recommends that the U.S. Access Board sponsor a meeting with stakeholders, including architects, building owners and managers, government officials, scientists, advocates, sensitive and vulnerable individuals, and others to evaluate the recommendations of this report (Operations & Maintenance). This meeting should provide a forum for increasing awareness of the report, facilitating dialogue among stakeholders, assessing the feasibility of the recommendations, and identifying ways to advance the recommendations.

2. The recommendations on cleaning products and practices in this report are based on information that is currently available. The O & M committee found that much more information and research is needed to better define cleaning products and practices that are effective and that will best protect occupant health. Some of the data gaps or problems the Committee identified are lack of information on labels and Material Safety Data Sheets, lack of information on fragrance ingredients combined with incomplete information on their health effects, and safety questions about citrus- and pine-based cleaning products because, among other things, they react with ozone to produce hazardous byproducts.

We, therefore, recommend that the U.S. Access Board and/or NIBS, in conjunction with U.S. EPA and other stakeholders, sponsor a workshop to examine existing information on cleaning products and practices, identify those products and practices that have the least adverse impact on indoor environmental quality and occupant health (including impacts on sensitive and vulnerable individuals), develop best practices, and determine research needs.

## REFERENCES

- 1) Program Needs for Indoor Environments Research (PNIER), U.S. EPA, 402-B-05-001, March 2005, [www.epa.gov/iaq/pubs/pnier.pdf](http://www.epa.gov/iaq/pubs/pnier.pdf)
- 2) Bridges, B, Fragrance: emerging health and environmental concerns, *Flavour and Fragrance Journal* 2002; 17: 361-371, <http://www3.interscience.wiley.com/cgi-bin/fulltext/93514043/PDFSTART>
- 3) Neurotoxins: At Home and the Workplace, Report by the Committee on Science and Technology, U.S. House of Representatives, Sept. 16, 1986, Report 99-827.
- 4) National Strategies for Health Care Providers: Pesticide Initiative, The National Environmental Education & Training Foundation (NEETF), [www.neetf.org/health/providers/index.shtml](http://www.neetf.org/health/providers/index.shtml), and U.S. EPA, [www.epa.gov/pesticides/safety/healthcare/healthcare.htm](http://www.epa.gov/pesticides/safety/healthcare/healthcare.htm), Implementation Plan, 2002.
- 5) Recognition and Management of Pesticide Poisonings, Fifth Edition, EPA 735-R-98-003, <http://www.epa.gov/pesticides/safety/healthcare/handbook/handbook.htm>
- 6) (Contains information on acute health effects of pesticides, but does not cover the range of effects experienced by people with pesticide or chemical sensitivities).
- 7) Sanborn M, et. al, Pesticides Literature Review, The Ontario College of Family Physicians, April 23, 2004, <http://www.ocfp.on.ca/local/files/Communications/Current%20Issues/Pesticides/Final%20Paper%2023APR2004.pdf>
- 8) Solomon, G, Pesticides and Human Health, A Resource for Health Care Professionals, Physicians for Social Responsibility and Californians for Pesticide Reform, 2000, [www.psrla.org/pesthealth.htm](http://www.psrla.org/pesthealth.htm)
- 9) McCampbell A, Pesticide Sensitivities, pp. 606-609, in *Encyclopedia of Pest Management*, Pimentel D, Ed., New York: Marcel Dekker, 2002.
- 10) Initial Statement of Reasons for Proposed Amendments to the California Aerosol Coating Products, Antiperspirants and Deodorants, and Consumer Products Regulation, Test Method 310, and Airborne Toxic Control Measure for Para-dichlorobenzene Solid Air Fresheners and Toilet/Urinal Care Products, Volume I: Executive Summary, Air Resources Board, State of California, [www.arb.ca.gov/regact/conprod/execsum.pdf](http://www.arb.ca.gov/regact/conprod/execsum.pdf)
- 11) Cleaning for Health: Products and Practices for a Safer Indoor Environment, INFORM, 2002, Chapters 1-5, <http://www.informinc.org/cleanforhealth.php>
- 12) EMFs in the Workplace, NIOSH Fact Sheet, DHHS (NIOSH) Publication No. 96-129, [www.cdc.gov/niosh/emf2.html](http://www.cdc.gov/niosh/emf2.html)
- 13) Nazaroff WW, Weschler CJ, Cleaning products and air fresheners: exposure to primary and secondary air pollutants, *Atmospheric Environment* 38 (2004) 2841-2865.
- 14) Nojgaard JK, Christensen KB, Wolkoff P, The effect on human eye blink frequency of exposure to limonene oxidation products and methacrolein, *Toxicology Letters* 156 (2005) 241-251.

- 15) Weschler CJ, Reactions Among Indoor Pollutants: What's New, Paper #291, Proceedings of the Annual Meeting of the Air and Waste Management Association, Orlando, FL, June, 2001.
- 16) Weschler, CJ, Ozone in Indoor Environments: Concentration and Chemistry, *Indoor Air* 2000;10: 269-288.
- 17) Weschler, CJ, Chemical Transformations of Indoor Pollutants: Effects on Indoor Air Quality, In Proceedings of Indoor Climate of Buildings 2004, D. Petras, Ed., Slovak University of Technology, Bratislava, 2004, pp. 1-8.
- 18) Healthy Hospitals, Controlling Pests Without Harmful Pesticides, a report by Beyond Pesticides and Health Care Without Harm, 2003, <http://www.noharm.org/> (<http://www.noharm.org/details.cfm?ID=864&type=document>) and <http://www.beyondpesticides.org/> ([http://www.beyondpesticides.org/hospitals/Healthy\\_Hospitals\\_Report.pdf](http://www.beyondpesticides.org/hospitals/Healthy_Hospitals_Report.pdf))
- 19) Los Angeles Unified School District, Integrated Pest Management Policy, [www.laschools.org/employee/mo/ipm/docs/ipmpolicyretype.pdf](http://www.laschools.org/employee/mo/ipm/docs/ipmpolicyretype.pdf), and Integrated Pest Management Procedures Manual, written by Bill Currie of International Pest Management Institute, October, 2000, <http://www.laschools.org/employee/mo/ipm/docs/ipm-procedures-manual.pdf>
- 20) Healthy Lawn, Healthy Environment, Caring for Your Lawn in an Environmentally Friendly Way, U.S. EPA, 735-K-04-001, September 2004, <http://www.epa.gov/oppfead1/Publications/lawncare.pdf>
- 21) New Jersey Pesticide Control Regulations, New Jersey Administrative Code Title 7 Chapter 30, Subchapters 1-12, [www.nj.gov/dep/enforcement/pcp/pcp-regs.htm](http://www.nj.gov/dep/enforcement/pcp/pcp-regs.htm) and New Jersey School Integrated Pest Management (IPM) Program, Laws and Regulations Supplement, Pesticide Control Regulations, NJAC 7:30-13, Integrated Pest Management in Schools, [www.nj.gov/dep/enforcement/pcp/ipm-laws2.htm](http://www.nj.gov/dep/enforcement/pcp/ipm-laws2.htm)
- 22) Health Risk and Needs Assessment for the Airborne Toxic Control Measure for Para-Dichlorobenzene Solid Air Fresheners and Toilet/Urinal Care Products, Air Resources Board, State of California, [www.arb.ca.gov/regact/conprod/ch7.pdf](http://www.arb.ca.gov/regact/conprod/ch7.pdf)
- 23) Texas Voluntary Indoor Air Quality Guidelines for Government Buildings, Texas Department of Health, January 2003, [http://www.tdh.state.tx.us/beh/iaq/Gov\\_Bld\\_Gd.htm](http://www.tdh.state.tx.us/beh/iaq/Gov_Bld_Gd.htm)
- 24) New Jersey Requirements for Diesel-Powered Motor Vehicles, N.J.A.C. 7:27-14, <http://www.state.nj.us/dep/aqm/sub14v2001-10-01.htm>

## **APPENDIX - DETAILED RECOMMENDATIONS**

### **Detailed Recommendations for Pest Control**

#### ***Use Integrated Pest Management:***

Use integrated pest management (IPM) – a program of pest prevention, monitoring, record-keeping, and control that eliminates or drastically reduces the use of pesticides.

Follow recommendations for integrated pest management (IPM) in "Healthy Hospitals, Controlling Pests Without Harmful Pesticides". The Los Angeles Unified School District also has an exemplary plan for an IPM Program.

Eliminate the use of chemical pesticides or minimize their use to the greatest possible extent.

Pest management program should be part of an overall Indoor Air & Environmental Quality (IAQ/IEQ) program.

Designate an IPM coordinator.

When contracting for IPM services, give clear instructions on the type of service requested, including which, if any, pesticides are acceptable for use under specific conditions.

Eliminate all scheduled or routine use of pesticides. Use chemical pesticides only as a last resort when non-chemical methods have failed to control a pest problem.

Use organic methods to maintain lawns and landscape vegetation.

Do not use fertilizers that contain herbicides (e.g., "weed and feed" products).

Do not use herbicides to kill grass, shrubs, or other unwanted vegetation prior to removal or replacement.

If control methods are needed, preference should be given to physical (e.g., barriers), mechanical (e.g., mouse traps, pulling weeds, vacuuming, fly swatters, hosing insects off plants), and cultural (e.g., improved soil health, proper watering and pruning) controls, using bio-controls (e.g., natural predator insects) if those methods fail, and only using chemical pesticides as a last resort.

#### ***Prevent Pests:***

Emphasize pest prevention through non-chemical means.

To avoid creating conditions attractive to pests, clean thoroughly, promptly fix building cracks and plumbing leaks, restrict eating to designated areas, and promptly dispose of waste.

Adopt and adhere to strict maintenance schedules to determine and repair points of possible pest entry, such as torn screens, cracks and holes in walls, and damaged or improperly placed door seals and sweeps.

Initiate additional housekeeping routines to reduce the chances of pest infestation, including more frequent trash removal, securing trash container lids, and steam cleaning trash containers.

Locate trash cans and dumpsters, compactors, and recycling areas away from the building.

Maintain healthy lawns and landscape vegetation to increase resistance to pests.

To maximize health of lawns, develop healthy soils, mow often and with sharp blades, reduce thatch, and water deeply but not too often.

Maintain soil health. Avoid the use of synthetic fertilizers.

Prevent mosquitoes from breeding by draining stagnant water from bird baths, swimming pool covers, buckets, tires and other areas where water may be collecting. Drill holes in bottom of recycling bins that must be kept outside. Check rain gutters to ensure they are draining properly.

Discourage the introduction or presence of indoor plants because they attract pests, encourage pesticide use, and often promote mold growth.

If indoor plants are present, minimize mold growth by being careful not to over water, loosening the top layer of soil every week, and not keeping plants in wicker baskets. Do not use synthetic fertilizers or pesticides on indoor plants.

Change the water in flower vases frequently.

***Pesticides:***

**USE PESTICIDES ONLY AS A LAST RESORT WHEN NON-CHEMICAL METHODS HAVE FAILED TO CONTROL A PEST PROBLEM**

Use the least toxic pesticide in the least amount necessary to accomplish the job. Spot treatments are preferred.

Least hazardous pest management materials include:

- Boric acid and disodium octoborate tetrahydrate;
- Soybean oil and corn gluten meal;
- Diatomaceous earth;
- Nonvolatile insect and rodent baits in tamper-resistant containers or for use in crack and crevices;
- Microbe-based insecticides (such as *Bacillus thuringiensis*, B.t.);
- Botanical insecticides that do not contain synthetic pyrethroids or toxic synergists;
- Biological control agents, such as parasites and predators; and
- Soap-based products.

[Note that due to individual variations in sensitivities, some people with allergies, asthma, or chemical sensitivities may not tolerate one or more of the above least hazardous materials.]

Least hazardous physical pest management methods include the use of liquid nitrogen for cold treatment of termites.

Pesticide applications should only be made by a licensed pest control applicator.

The O & M Committee recommends that certain pesticides, such as organophosphates, carbamates, pyrethroids, and other neurotoxic insecticides; 2,4-D, other phenoxy herbicides, and glyphosate; and fungicides such as mancozeb, chlorothalonil, and maneb, never be used.

Do not apply pesticides to buildings by fogging, bombing, or tenting or by space, broadcast, or baseboard spraying.

Do not apply pesticides in occupied areas or areas that may become occupied during the 24 hours (at a minimum) following an application. In buildings that are constantly occupied, pesticide applications should be made when they are least occupied. It is recommended that pesticides be applied when there is the longest time before the area will be re-occupied, such as at the beginning of a weekend or vacation period.

Minimize contamination of the HVAC system by sealing all inlets and outlets to the area where pesticides are applied. When the seals are removed, ventilate the area with 100% outside air with no recirculation at least until the building is re-occupied.

No application of pesticides should be made along paths of travel or in the vicinity of entrances, windows, or outside air intakes.

Do not use pesticides that contain added fragrance.

Ensure proper training of all personnel working with pesticides.

Prohibit other staff and building occupants from using pesticide products.

In the event of a scheduled structural or lawn care pesticide application (including spot or crack & crevice treatments), provide pre-notification and post signage in appropriate disability formats before, during, and after the application.

Signage for pesticide applications should include the name of the pesticide product applied and EPA registration number, date and time of application, name of the applicator, and the name and number of contact person from whom to obtain more information. For examples of notification requirements, see Healthy Hospitals report (17) and New Jersey regulations (20) under References.

Require that pest control applicators provide the building manager or designated agent copies of Material Safety Data Sheet(s) and product label(s) for all pesticides used inside the building or on facility grounds. These documents should be provided to building occupants and the public upon request. Note, however, that neither the MSDS or product label provide complete information on product ingredients or their potential health effects.

Maintain a voluntary registry of persons at increased risk of injury or harm from pesticide exposures who wish to receive individual notification prior to pesticide applications (or notified after an emergency application).

Reasonable accommodation to programs, services, and employment needs to be readily available to people whose disabilities require that they avoid exposures to pesticides.

Maintain secured separate storage for pesticides and limit access to authorized personnel only.

Store any pesticide and disinfectant products away from food, laundry areas, paper product storage, areas occupied by children, and HVAC air intakes.

Maintain separate equipment, including mixing containers, for use with pesticides. Avoid cross contamination with equipment used for cleaning and other maintenance activities.

Establish a reporting procedure and encourage individuals who are experiencing adverse health effects from a pesticide exposure to report the incident to the building manager and the U. S. Environmental Protection Agency. See EPA Pesticide Health Incident Reporting, <http://www.epa.gov/pesticides/health/reporting.htm>

## **Resources**

IPM for Schools: A How-to Manual, EPA 909-B-97-001, March 1997,

<http://www.epa.gov/pesticides/ipm/schoolipm/>

Pest Prevention: Maintenance Practices and Facility Design by Sewell Simmons, California School IPM, California Department of Pesticide Regulation,

[http://www.cdpr.ca.gov/cfdocs/apps/schoolipm/managing\\_pests/71\\_pest\\_prevention.cfm?crumbs\\_list=1,34](http://www.cdpr.ca.gov/cfdocs/apps/schoolipm/managing_pests/71_pest_prevention.cfm?crumbs_list=1,34)

School Integrated Pest Management Program, California Department of Pesticide Regulation, [www.cdpr.ca.gov/cfdocs/apps/schoolipm/main.cfm](http://www.cdpr.ca.gov/cfdocs/apps/schoolipm/main.cfm)

Responsible Pest Management: Best Practices and Alternatives, Canada

<http://www.pestinfo.ca/main/ns/22/doc/23/lang/EN>

Second National Report on Human Exposure to Environmental Chemicals, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services, 2003,

[www.cdc.gov/exposurereport/2nd](http://www.cdc.gov/exposurereport/2nd)

ExToxNet (Extension Toxicology Network) Pesticide Information Profiles, Cornell University, <http://pmep.cce.cornell.edu/profiles/extoxnet/> (Does not include information on all health impacts experienced by people with pesticide/chemical sensitivities)

The Safety Source for Pest Management: A National Directory of Least-Toxic Service Providers, [www.beyondpesticides.org/safetysource](http://www.beyondpesticides.org/safetysource)

Beyond Pesticides  
701 E Street, SE, Suite 200, Washington DC 20003  
202-543-5450

[info@beyondpesticides.org](mailto:info@beyondpesticides.org)

[www.beyondpesticides.org](http://www.beyondpesticides.org)

Bio-Integral Resource Center  
P. O. Box 7414, Berkeley CA 94707  
510-524-2567

[birc@igc.org](mailto:birc@igc.org)

[www.birc.org](http://www.birc.org)

Californians for Pesticide Reform  
49 Powell Street, #530, San Francisco, CA 94102  
415-981-3939

[pests@igc.org](mailto:pests@igc.org)

[www.pesticidereform.org](http://www.pesticidereform.org)

International Pest Management Institute  
P. O. Box 474, Ash Fork AZ 86320  
928-637-2378

Bill Currie, Director  
[bugebill@earthlink.net](mailto:bugebill@earthlink.net)

IPM Institute of North America  
1914 Rowley Avenue, Madison WI 53705  
608-232-1528

[ipmworks@ipminstitute.org](mailto:ipmworks@ipminstitute.org)

[www.ipminstitute.org](http://www.ipminstitute.org)

National Center for Environmental Health Strategies

1100 Rural Avenue, Voorhees NJ 08043  
856-429-5358

[ncehs@ncehs.org](mailto:ncehs@ncehs.org)

[www.ncehs.org](http://www.ncehs.org)

Northwest Coalition for Alternatives to Pesticides  
P.O. Box 1393, Eugene OR 97440-1393  
541-344-5044

[info@pesticide.org](mailto:info@pesticide.org)

[www.pesticide.org](http://www.pesticide.org)

Pesticide Action Network North America  
49 Powell Street, Suite 500, San Francisco CA  
94102

415-981-1771

[panna@panna.org](mailto:panna@panna.org)

[www.panna.org](http://www.panna.org), [www.pesticideinfo.org](http://www.pesticideinfo.org)

U.S. Environmental Protection Agency  
Office of Pesticide Programs  
Ariel Rios Building  
1200 Pennsylvania Ave., NW, Mail Code 3213A  
Washington, DC 20460  
202-260-2090

[www.epa.gov/pesticides](http://www.epa.gov/pesticides)

National Pesticide Information Center  
Cooperative effort between Oregon State  
University and U.S. EPA  
333 Weniger, Corvallis OR 97331  
800-858-7378

[npic@ace.orst.edu](mailto:npic@ace.orst.edu)

<http://npic.orst.edu>

(Good site for basic pesticide information, but does not include full range of possible health effects experienced by people with pesticide or chemical sensitivities)

## **Detailed Recommendations for Cleaning & Disinfecting**

Do not use fragrance-emitting devices (FEDS), plug-ins, or sprays; urinal or toilet blocks; or other deodorizer/re-odorizer products.

To reduce odors, increase cleaning and ventilation and/or use baking soda or zeolite to absorb odors.

Do not use products containing paradichlorobenzene or naphthalene (common ingredients in FEDS).

Avoid or limit the use of products containing chlorine, ammonia, quaternary ammonium, phenol, isopropyl and other alcohols, formaldehyde, and other petroleum distillates.

Discourage the use of alcohol-based hand washes.

Do not use products that contain or have a fragrance.

Do not use citrus- or pine-based products.

Use vegetable-based surfactants rather than petroleum-based ones. Do not use citrus- or pine-based solvents.

Cleaning and disinfecting programs should be part of an overall Indoor Air & Environmental Quality (IAQ/IEQ) program.

Establish an audit of all cleaning chemicals currently in use. Develop a priority list and plan to establish alternatives for chemicals and cleaning methods.

Raise awareness among building maintenance staff and occupants that "green" and "environmentally friendly" products are not necessarily good for occupant health.

Minimize the number of cleaning and disinfecting products used.

Perform cleaning maintenance on an as needed basis – use spot or area cleaning rather than broad-based cleaning.

Clean stains while they are fresh to avoid need for aggressive cleaning later.

Choose cleaning products and disinfectants that emit the lowest levels of volatile fumes.

Dust with a dry lint-free cloth, or with water only. Avoid or minimize the use of polish dusting products.

Avoid perfumed and/or chemically-treated cleaning products and supplies, such as cleaning rags, vacuum bags, trash bags, tissue, toilet paper, and hand soaps.

Increase scrubbing and other mechanical methods of cleaning to reduce the need for chemicals.

Inspect areas to insure there has been proper cleaning using visual inspection, white cloth, or ultraviolet light.

Do not use cleaner/disinfectant combination products.

Hot water should be available for hand washing and cleaning.

Whenever possible, clean with hot water to reduce the amount of soap, detergent, and disinfectant that must be used.

Spray cleaning products on to cloths rather than on to surfaces or into the air.

If carpets must be cleaned, use steam or least-toxic all-purpose cleaner or carpet cleaner that does not contain petroleum solvents. Spot clean whenever possible.

Adopt fast-drying methods for carpet cleaning, 4 hours maximum. Steam cleaning + highest extraction + higher dry air flow = fast drying.

Dry all washed surfaces and floors with a dry cloth or mop to minimize chemical residues and reduce the chance of mold growth.

Use vacuums with HEPA (High Efficiency Particulate Attenuation) filters and strong suction. Vacuum frequently and thoroughly.

Minimize the use of floor waxes and buffing, and if done, notify employees and the public.

Order cleaning products for use with pumps rather than spray or aerosol dispensers to minimize chemical contamination of the air and HVAC system.

Take control of your own dispensing to ensure proper measurements. Establish minimal dosing for applications. When chemical has multiple uses, dispense separately for each use. A good dispensing program can save 25% to 40% in chemical consumption and costs.

Educate staff that mixing cleaning chemicals is dangerous because it can create new compounds that are more toxic than the original products.

Initiate protocol to authorize, supervise, and provide safe areas to mix authorized chemicals.

Store cleaning chemicals securely, separated from paper, cloth, or other absorbent materials.

Post signs during cleaning activities. Make cleaning schedule available to employees or others upon request.

Schedule heavy cleaning, repairs and maintenance during low or no-occupancy periods whenever possible.

Maintain strict protocol for training employees who use hazardous products or materials.  
Maintain an active list of those authorized to perform those duties.

Restrict cleaning to authorized personnel only.

Prohibit occupant usage of cleaning chemicals except as authorized. Establish a list of least toxic, low-VOC cleaning products (and/or provide them to employees) which they can use to clean computers, erase felt pen writing on white board, and perform other similar activities.

Use micro vacuums for cleaning electronic equipment. Do not use solvent cleaners.

Increase air intake to a building to dilute cleaning products present in indoor air, especially during major cleaning activities such as cleaning of carpet, walls, etc.

Provide a well-ventilated room with exhaust fans in which to service computers and other portable equipment whenever toxic chemicals are involved in the repair process.

Develop protocol to dispose of cleaning solutions safely.

Reduce tracked-in dirt by using mats and grills in entryways. Where appropriate, exhaust air between separated doorway entrances.

Replace wet entrance mats and dry wet floors and carpeting as soon as possible.

Utilize only those floor mats that do not emit odors/fumes or particles.

Reasonable accommodation to programs, services, and employment needs to be readily available to people whose disabilities require that they avoid exposures to cleaning, disinfecting, and maintenance chemicals.

Waterless urinals should be maintained using products containing bacterial enzymes that biodegrade urea.

### ***Disinfectants***

Eliminate combined cleaner/disinfectant products.

Use disinfectants only when and where necessary. This includes:

- 1) Knowing what organisms need to be reduced/disinfected. Disinfectants are formulated to target certain organisms or combination of organisms. It is important to use the right product in the right place.
- 2) Knowing what surfaces do (or do not) need to be disinfected, and how often.
- 3) Cleaning surfaces thoroughly before disinfecting. Disinfectants can only be effective through contact. A layer of surface grime is likely to prevent sufficient contact.
- 4) Using proper disinfectant mixing and cleaning procedures. This includes leaving disinfectants in place for the correct amount of time before wiping surfaces clean.

Limit or avoid the use of disinfectant or cleaning products containing chlorine, quaternary ammonium, phenol, and isopropyl and other alcohols.

Hydrogen peroxide-based disinfectants are preferred, but should be used judiciously with caution and care.

Use disinfectants only in areas and at strengths (i.e., levels of disinfection) required by law. Check with local health department to obtain details of all legal requirements.

Restrict or eliminate the use of alcohol-based hand washes.

Do not use hand soaps containing triclosan or other disinfectants.

### **Resources**

See Addendum B for more information on Cleaning

### **Detailed Recommendations for Mechanical Equipment & HVAC Systems**

If a building has poor indoor air quality, investigate the extent to which outdoor air contaminants are contributing to the problem.

In areas where poor outdoor air is a problem, use the highest efficiency filters compatible with current HVAC system, and if necessary, consider retrofitting system to increase filtration capabilities.

Use demand controlled ventilation (DCV) that utilize sensors in occupied spaces to determine when ventilation should be increased due to increased occupancy or other loads. Be wary of using motion sensors that can create significant electromagnetic fields.

Provide liberal amounts of ventilation. It is better to have more ventilation than necessary rather than too little.

Where there is an adjoining parking garage or busy roadway, or nearby heliport, anticipate the need to decrease air exchange and ventilation in buildings prior to and during “rush hours” or times of usage, respectively. During periods of decreased outdoor air ventilation, increase recirculation and filtration of recirculated air.

Adhere to a strict maintenance plan for all HVAC equipment to make sure it is working properly. This will reduce the chance of air contamination, maintain optimal efficiency, and minimize noise and vibration.

Create door and window-opening protocol to maintain proper pressure relationships and air flow in the building. Educate and provide protocol to staff and other building occupants. Policy should include provision that allows chemically sensitive and other individuals to open windows on a temporary or regular basis, as needed because of a health condition. Windows should also be permitted to be opened by occupants when the HVAC system is not working or shut off, such as may occur during nights and weekends. Policy should address emergency situations in which opening windows could exacerbate the crisis.

Maintain HVAC ducts free of particulate matter, dust, and debris. Use non-chemical methods, such as physical removal or use of vacuums.

Do not use HVAC system to disperse fragrances or other chemicals.

Before a building is re-occupied (e.g., in the mornings or after weekends), flush with at least three complete outdoor air exchanges.

Make maximum use of economizer cycle. Avoid energy conservation practices that reduce intake of outside air below minimum requirements.

Make sure the supply and return air diffusers, grills, and registers are working correctly.

Test for stagnant air areas where furniture, wall partitions, or equipment may be blocking air movement. Use ribbons or dry ice rather than smoke to study air flow patterns.

Maintain relative humidity between 30 and 50%.

Avoid or minimize the use of humidifiers in the buildings HVAC system. Maintain the cleanliness of all humidifier equipment and use the minimum amount of water treatment chemicals necessary to prevent antimicrobial contamination and to control dissolved solids and pH.

Prohibit the use of personal humidifiers except where there is a medical need.

Isolate and contain construction chemicals and particulate matter from HVAC system by covering registers and diffusers and using negative-pressure air systems.

Seal return air openings into HVAC system during remodeling and exhaust directly to the outdoors, by temporarily removing window glazing if necessary.

Quickly evacuate a building if the HVAC system becomes contaminated with a solvent, pesticide, toxic gas, or other harmful chemical at a level that can cause adverse health impacts in occupants, including sensitive and more vulnerable individuals.

Eliminate storage of toxic and/or volatile chemicals near HVAC intakes.

Do not allow the use of portable air “cleaners” that emit ozone.

Repair plumbing with least toxic, low-VOC materials.

To clear clogged drains, use mechanical methods such as snakes, or steam cleaning.

Utilize bacterial enzymes to prevent drain clogs, instead of using acids, solvents and alkalines which deteriorate pipes and necessitate repairs.

Inspect floor and other drains, especially those that are infrequently used, to ensure there is water in the P-traps, thereby avoiding sewer gas backup in the building.

Treat grease traps daily with preventive dose of bacterial enzymes, to avoid the need to use strong chemical cleaners if they become clogged.

In decorative fountains, use the minimum amount of chlorine necessary for disinfection, avoid the use of bromine, use closed ozone water treatment systems to the maximum extent possible, and make use of newer, less-toxic disinfecting technologies as they become available.

### **Resources**

EPA, Indoor Air Quality Building Education and Assessment Guidance (I-BEAM) Software package, can be downloaded for free from EPA website at [http://www.epa.gov/iaq/largebldgs/ibeam\\_page.htm](http://www.epa.gov/iaq/largebldgs/ibeam_page.htm), or can be obtained on CD from IAQ Clearinghouse at 1-800-438-4318 or via e-mail at [iaqinfo@aol.com](mailto:iaqinfo@aol.com) (ask for EPA 402-C-01-001).

See references regarding HVAC in Building Design & Construction report

### **Detailed Recommendations for Landscape Maintenance**

Use integrated pest management (IPM) to eliminate or minimize the use of herbicides, fungicides, insecticides, and other pesticides. (See recommendations for Pest Control).

Maintain lawn and gardens organically.

Maintain soil health.

Avoid the use of synthetic fertilizer.

Do not use fertilizer products that contain herbicides (e.g., “weed and feed” products).

Maintain healthy lawns and landscape vegetation to increase resistance to pests.

To maximize health of lawns, develop healthy soils, mow often and with sharp blades, reduce thatch, and water deeply but not too often.

Pull, mow, or use mechanical weed cutter to control weeds. Vinegar can be used to kill weeds along fence lines or other hard to reach areas.

Avoid dust-blowing equipment, such as leaf blowers. Sweeping, raking, and use of a vacuum are the preferred methods for removing debris.

If string or other mechanical weed cutter is used, attempt to minimize dispersal of dust, dirt, and debris.

Avoid diesel-powered or 2-cycle engine equipment, use electric lawn equipment instead.

Close windows during grass cutting, or prior to pesticide, fertilizer, or lime applications, or use of gas-powered equipment or vehicles on building grounds.

Use least toxic low-VOC paints, stains and finishes on outside equipment, including benches, poles, decks, and porches, as is recommended for interior and exterior of buildings (see recommendations in Building Products & Materials report).

Use rock, gravel, flat stones, or pavers for mulch and/or use tytar landscape barrier to suppress weeds. Avoid organic mulches (e.g., cocoa beans, peat moss, wood chips, bark), especially near windows and doors of buildings. These mulches emit volatile fumes and may harbor mold.

Avoid the use of CCA wood or wood chips because they contain arsenic and other toxic chemicals which can leach into the environment.

Do not use railroad ties because they contain creosote.

Remove plants that are chronically ill and/or frequently attract insect pests.

When replacing plants or redesigning landscape, follow recommendations in Building Construction & Design report.

Apply pesticide, fertilizers, and lime only when there is little or no wind present and in a manner that prevents drift.

Provide prenotification by posting signs prior to pesticide, synthetic fertilizer, or lime applications.

### **Resources**

Allergy-Free Gardening, Thomas Leo Ogren, [www.allergyfree-gardening.com](http://www.allergyfree-gardening.com)

### **Detailed Recommendations for Enclosure Maintenance**

Routinely inspect and clean roof and gutters to make sure they are draining properly.

Promptly repair roof or plumbing leaks.

Regularly inspect walls and foundations, especially all utility entrance seals (e.g., phone, water, electric, cable) for cracks and repair promptly if found.

Insulate cold pipes to prevent condensation.

Promptly remove wet ceiling tiles and wall panels.

Seal rusted surfaces to minimize emissions of airborne particulates using least toxic low-VOC sealant.

Include proper seal of the building in commissioning and re-commissioning programs for the building.

Remove excess water from carpeting damaged by clean water and quickly dry it to avoid mold buildup. Do not use disinfectants or moldicides (other than hydrogen peroxide-based ones). Instead, utilize a steam extraction carpet cleaning system with a hydrogen peroxide-based cleaner/disinfectant. Inspect carpet after it is completely dried to ensure there is no mold or mildew. Those with asthma or chemical sensitivities should be removed from areas where there is wet carpeting. Remove carpeting if it has been wet longer than 24 hours.

Immediately remove and do not re-use any wet carpeting that has been contaminated with sewer water, heavy dirt and soils, or toxic chemicals.

Seal rusted surfaces with a least toxic low VOC sealant to minimize emissions of airborne particles.

Include proper seal of the building in commissioning and re-commissioning programs for the building.

### **Resources**

Treschel, Hans, Ed. *Moisture Control in Buildings*. West Conshohocken, PA: American Society for Testing and Materials. 1992.

## **COMMITTEE**

### **Active**

Chair – Hal Levin, Building Ecology Research Group

Mary Lamielle, National Center for Environmental Health Strategies

Ann McCampbell, Multiple Chemical Sensitivities Task Force of New Mexico

Susan Molloy, National Coalition for the Chemically Injured

Charlie Reid, Hamilton County Board of Health, Ohio

Toni Temple, Ohio Network for the Chemically Injured

### **Contributing**

Terry Brennan, Camroden Associates

Dave Rupp, Cabinet King, Inc.

## **ADDITIONAL RESOURCES**

### **General Guidance for Building Cleaning Programs**

**By Charlie Reid**, Member Hamilton County General Health District Board of Directors 1995-Present, Independent Consultant 1983 - Present.

#### **Outdoor Air Intakes & Building Pressurization**

The outside air intakes for positively pressurized buildings have a history of poor location. Many public buildings with utility or service entrances and loading docks have the outside air intake louvers near pollution sources that allow exhaust fumes from trucks to be drawn into the building. Some high-rise office buildings place air intakes in the path of drift from cooling towers on roofs, where contaminants such as bacteria that have caused Legionnaires' disease can enter the ventilation system. Air intakes of other rooftop installations have entrained roof sealants that are emitted into the air. Still others have entrained emissions from plumbing vent stacks resulting in sewer gas entrainment. Roosting birds can also be a source of contaminants that are entrained in outdoor air supply streams.

Outdoor air intakes are often poorly maintained and the areas are dirty. Getting good intake air - either by shielding or relocating intakes or by fine particle filtration eliminates the many contaminants from outside, as well as avoiding the added burden to cleaning inside. Mechanical rooms and nearby areas may also be the location for chemical storage and janitors' closets for many buildings. Mixing chemicals there sends vapors into the ventilation systems of the building. These are cleaning issues that affect indoor air quality.

Since most positively pressurized buildings do not provide for door or window ventilation, all cleaning activities create polluted air until gases and particles are diluted and removed by outside air supply and exhaust. Some older buildings, where the outdoor air supply rates are grandfathered into the energy saving criteria established in the era of President Carter and the 1970's oil embargo, have special problems with indoor air quality. They generally have lower levels of outside air ventilation and, thus, lower levels of dilution.

#### **First Reduce Soil and Dirt:**

Put emphasis on entryways. Reduce tracking in of outside soils and other particulate matter to make inside areas less difficult to clean. Mats, entryway grids, and special ventilation of vestibules reduces intake of soil and dust.

Evaluate high traffic patterns for use of removable matting that can be cleaned away from personnel in order to reduce the overall general cleaning required for carpet.

Limit eating to designated areas that can be cleaned by wiping and light mopping.

Quickly identify and clean spills and stains to eliminate the need for harsher treatments later.

Increase the light wipe and cleaning of hard floors to lessen the required stripping and finishing required. Much of this can be done with water or very light dilutions of an all-purpose cleaner.

Caution on use of the wrong mop is important because residual chemicals on an unrinsed mop can start stripping the finish from the floor, which then requires more frequent refinishing.

Employ better vacuums. Use HEPA (High Efficiency Particulate Attenuation) filtered vacuums with continuous suction. Higher suction not only reduces the amount of soil in buildings, it substantially reduces both hard floor and carpet cleaning. The removal rate makes the cost of high quality equipment worth the investment. The machines are larger, harder to manipulate, and because they have more suction, do not move as fast across the floor. Using a HEPA vacuum following a typical upright vacuum can make a visible difference in the brighter color of a carpet as the floor wand passes over a surface. Ground-in dirt is substantially reduced as is the need to clean the carpet.

Building occupants should be prohibited from having and using cleaning chemicals.

### **Selection of cleaning methods/general rules:**

Chemicals are used to make water work better in cleaning. Chemicals add surface wetting agents, soil reduction and rinsing agents, evaporative qualities, and at times mild coating to prevent re-deposition of soils or the re-appearance of soils. The lower the soil level, the less water needs help to clean.

Higher temperature water dissolves better, cuts greasy soils, and requires less agitation. Increased agitation requires less chemical action to cut into soils.

Wiping and general rinsing after cleaning eliminate the need for many rinsing additives. Most all-purpose cleaners, window cleaners, and other hard surface cleaners have an alternative available in vegetable-based surfactant chemistry. Using many of the alternative products can eliminate alcohol, which lingers in the air long after use. Many of these products can be used in higher dilutions and thus less product is required.

Wiping needs to replace spraying. Many companies have gone to dispensing systems that fill spray bottles. Spraying not only diffuses a solution into the air as well as on the surface, it generally wastes product by over-wetting a surface - thus the need for adding evaporative alcohol to the product. By wetting a wipe lightly and applying to a surface, the excess from spraying does not require the additional labor to work off the hard surface, which saves labor.

Water can be used in general dusting of non-wood surfaces, as can lint-free wipes for most surfaces. Spray devices can be used to dispense into a wipe and this is the most efficient application method.

There is no cleaning need for fragrances and they all need to be eliminated.

There are products on the market which are advertised as deodorizers/re-odorizers that have four times the level of quaternary ammonia as a disinfectant. They are not listed as a disinfectant because they are purportedly for cleaning and reodorizing. This is not uncommon in the labeling of janitorial products.

Fragrances are leading culprits in accessibility problems related to indoor air quality.

Detergent with warm or hot water disinfects as well as disinfectant cleaners most of the time. For quality assurance, use of an ultraviolet light detects bacterial growth and areas which are evading cleaning. In problem areas that are frequently not reached – as behind toilets, around urinals, and beneath the nozzle of soap dispensers - personnel need to be trained and instructed to thoroughly clean the affected area.

Peroxides (as stabilized additives) are capable of disinfecting in more critical areas. Bathrooms, food service areas, and dining areas all follow this general guideline.

Dispensers are most often provided by the companies that sell chemicals. They install the dispensers and set the dilutions. Use of dispensers when building ownership or management is in control of the dispensers is appropriate. Supervisory control over dilutions is essential.

Carpet cleaning often results in off-gassing of toxic solvents for days and even weeks. Use of steam, non-petroleum based cleaners - even in some cases peroxides - and fast drying has proven essential to reducing the impact of cleaning.

Carpets are typically treated with numerous products, including insecticides, sealants, and optical brighteners. No matter what method is used to clean it, e.g., washing, dry-cleaning, or steam cleaning, all cause the release of the built-in chemistry of the carpet.

While it is a general rule to dry carpet in less than 24 hours to reduce the chance for mold growth, optimal drying time is less than 4 hours. This may require selecting less humid days to do the work. It may require increased airflow in the building. It may require blowers and heating to the affected area. It may require higher, more efficient extraction after chemical application. Faster drying shortens the time for the air to recover from the cleaning.

Hard floor finishing is often a process that results in off-gassing for weeks. It is recommended that the work be completed during unoccupied or low occupancy times for the building, using higher air flows for drying, and maintaining maximum dilution with outside air until off-gassing is complete.

Frequent inspections of floors and refinishing only the areas necessary reduces chemical usage and impact. Scheduled finishing may not be the best practice. Using an “inspect and finish as necessary” program allows for limited work to preserve the floors while reducing labor requirements and chemical usage.

Some gel strippers may have lower off-gassing levels and should be evaluated for potential usage. Experiment with strippers to find the lowest effective concentration to achieve the work. Refinishing material as well as strippers should be managed carefully by dispensing in proper amounts to ensure proper usage and to avoid over-usage.

Carpet de-spotting can be accomplished by using mild detergent and baking soda. This old remedy can remove many stains, particularly when fresh. Using the mixture in hot water (120 degrees) and rubbing inward from the outside of the stain can remove many without the use of strong chemicals.

Bathroom fixtures, urinal, and toilets are subject to staining. Where possible, peroxide-based cleaners are preferable. Baking soda provides a mild cleaner-abrasive capability. Use of acids in

difficult circumstances may be necessary. When this is done, the bathroom should be completely ventilated before reopening it for use.

A continuous audit of building practices, education of building personnel, and control of chemical usages by occupants will go a long way in reducing the adverse chemical impacts associated with cleaning. Safer alternative products exist for almost all cleaning needs. Cleaning protocols do not need to change much and can be phased into a building's existing program. While one may look for one practice to save the day, there is no magic bullet. Only one change in cleaning will leave others to create problems. A comprehensive approach is necessary and can be implemented step by step.

### **Checklist Guidance**

Building managers can use the following list of questions as a guide to assess their office building cleaning efforts and to determine where to start transitioning cleaning activities. The checklist does not actually tell a building manager how to set up a cleaning program, but it serves as a starting point for educating everyone involved in a safer air cleaning program—managers, occupants, and janitors—about what they need to do to make it a successful program.

### **Building Considerations**

- How are various areas within the building used? Determine which require the most cleaning, and why (e.g., public restrooms, kitchen areas). What are the hours of use and are there preferred times to clean when personnel are not present?
- Where do people eat (e.g., individual offices throughout the building, designated areas)?
- Are there any special considerations related to the building itself (e.g., is it an historical building that has special preservation requirements or security issues)?
- Do any office furnishings have special cleaning requirements (e.g., thick carpets, antique furniture)?
- Are there any known at-risk populations who may be more adversely affected by the use of some chemicals (e.g., children, people with asthma, allergies or chemical sensitivities, and pregnant women)?
- Does the building have an adequate ventilation system to circulate air throughout the building?
- Does the building have any plumbing or moisture problems?
- Is there a method in place to keep dirt from entering the building (e.g., mats at the front door, double-door entryways)?

### Cleaning Checklist

<b>PROCEDURE</b>	<b>FREQUENCY</b>	<b>PRODUCT BRAND</b> (indicate whether it is purchased in concentrate or ready-to-use form)	<b>MONTHLY PRODUCT USEAGE</b>	<b>CLEANING PROCEDURE</b>
Clean furniture				
Clean walls				
Clean bathrooms				
Disinfection – Bathroom				
Disinfection – General				
Clean washroom fixtures				
Carpet spot removal				
Carpet cleaning				
Gum removal				
Concrete cleaning				
Graffiti removal				
Glass cleaning				
Metal cleaning				
Hard floor – routine cleaning				
Floor stripping				
Floor refinishing				
Other all purpose cleaning				

### **Adequacy of Current Cleaning Program**

- What are issues of concern to management, cleaning personnel, and building occupants? Conduct interviews with all stakeholders rather than on a representative basis.
- Review the log of tenant complaints over the last year. What are the items that come up consistently?
- How is the quality of cleaning currently being evaluated/measured? How often are inspections performed? Are there trends in the problems that are identified?

### **Cleaning Materials Usage**

- List the janitorial products that are currently in use for each of the following categories and identify how often the cleaning task is performed and how much of the product is used per month.
- Are there any reasons to change the procedure or frequency for these cleaning applications? In what manner can chemicals be eliminated or reduced? Seek methods to eliminate usage, reduce usage, and change products to those better for air quality.

### **Selecting Chemicals**

In selecting chemicals for cleaning, there can be considerable confusion. “Green,” “environmentally safe” and various other claims as to the safety of cleaning products do not provide adequate guidance for determining which products do not adversely affect air quality. Below is a list of some terms with which a buyer of chemical products needs to become familiar. The list also includes comments and discussion of alternatives to potentially hazardous chemicals.

Bio-Degradable: The product will break down in the environment over time into supposedly harmless materials. This does not mean the product is safe for the environment, including soil, water, or air.

Chlorine-free: Contains no chlorine, a toxic chemical responsible for substantial problems in air quality as well as more poisonings each year than any other chemical. Oxygen bleaches, the chlorine-free alternatives for bleaching action, are less stable than chlorine bleaches, but much has been done to stabilize oxygen bleaches in the past few years. Do not use concentrated hydrogen peroxide in pure form for disinfection because its application to a flammable surface can cause it to ignite. For scouring, use of baking soda, borax and scrub pads provides additional cleaning capacity. Using a compound containing stabilized peroxide is useful for bleaching.

Natural: Implies the product does not contain synthetic ingredients. Since the use of this term is unregulated and the claim can only be verified by checking with the manufacturer, do not rely upon it for any selection criteria. And since naturally-occurring substances can also be harmful, this term does not have meaning with respect to air quality.

Neutral pH: The product is neither alkaline, nor acidic. These are most useful for products that require handling or mixing or are intended for application to bare skin. Even if a product has a neutral pH, it may have been refined from petroleum and other hydrocarbons and emit volatile fumes. For better air quality, it is often preferable to use a non-petroleum *alkaline* product rather than a solvent or petroleum-based *neutral* product. Very acidic or alkaline products that become airborne can cause irritation and even severe damage to skin, eyes, and lungs.

Non-Toxic: Supposedly only a very large amount will cause damage. Since this term is unregulated in its use, it has little meaning. Fewer than 5% of all cleaning compounds have been tested for safety. A few manufacturers test for skin irritation or ingestion effects. Since a product

can impact air quality and affect people with a large range of sensitivities, a product claiming to be non-toxic may still cause adverse health effects.

Oxygenated: Helps whiten and brighten by releasing oxygen which breaks up stains, and eliminates mildew and mold. See Chlorine above. Oxygenated products, such as those containing hydrogen peroxide, can be as effective as chlorine when used in proper doses and according to safety instructions.

Phosphate-free: Generally meaningless term. Phosphates are allowed by law only in certain automatic dish detergents. Not a criterion for most purchases.

Surfactant: This is the active ingredient in most detergent cleaners, such as all-purpose cleaners, floor cleaners, dish detergents, fabric softeners, and hard surface cleaners. Most often they are created from petroleum and are neutral in pH. Surfactants are used to alter the surface properties of the surface being cleaned. This can make the surface more penetrable, easier to rinse, and less able to be adhered to and more repellent of dirt. Numerous surfactants have been used as reducing agents to dissolve heavy greases and soils. Surfactants are now available in non-petroleum-based (vegetable) forms and the newer surfactants offer interesting new chemistry for air quality. In general they have higher flash points. The vegetable-based surfactants rarely have alcohol or other solvents. They can easily be wiped on and off and do not require evaporative assistance, such as adding alcohol and ether to most window cleaners.

Deodorizer/Re-odorizer: This group of products may contain higher concentrations of quaternary ammonia than disinfectants. They also frequently contain strong fragrances and/or masking agents that diminish the sense of smell. Paradichlorobenzene and naphthalene are common ingredients in fragrance-emitting devices. Deodorizer products are often used in public bathrooms found in restaurants, motels, theaters, subways, trains, airports, airplanes, and other public facilities. The use of deodorizer/re-odorizer products can be avoided by increasing ventilation/air flow and thoroughly cleaning with mildly alkaline non-surfactant detergents followed by the use of disinfectants, preferably peroxide-based ones. Inspection by ultraviolet light is recommended after all intensive cleaning to verify that surfaces have been adequately cleaned

Fragrance: This is an air pollutant that is intended to give the false impression that air is clean. Truly clean air has no smell. Fragrance formulas can contain benzene, toluene, styrene, and formaldehyde, along with other ingredients. Fragrance chemicals can enter the body through the lungs, skin, and nasal passageways. They can affect the brain and nervous system in a matter of seconds, either by their presence in the brain or via stimulation of olfactory nerves. Avoid all products that list fragrance as an ingredient or have a fragrant odor. Be aware that even if "fragrance" is not listed as an ingredient, fragrance chemicals may have been added to a product for another purpose, or claimed to be added for another purpose - such as an anti-microbial stabilizer, blending agent, or enhancer.

Solvent: Water is a solvent. Using alcohol, petroleum, and coal tar-based solvents for floor refinishing, metal cleaning, stain removal, and graffiti control is commonplace. To preserve air quality, use water as a solvent whenever possible. Use petroleum-based solvents only as a last resort. Non-water-based solvents should be used in controlled programs, with substantial increased ventilation, pre-notification of building occupants, use during low building occupancy, and retesting of air to make sure it is clear before a space is re-occupied. The use of many solvent products, such as spot stain-removers, can be eliminated by promptly cleaning stains, using mild

detergent and baking soda with a gentle rubbing action and working in from the outside perimeter of the stain.

Vinegar: An acidic fluid usable for basic surface cleaning, window cleaning, and bathroom fixture wiping. The mild acidic properties provide the ability to remove hard water spots and cut soap films. Note that while vinegar is considered a less-toxic cleaner, some chemically sensitive individuals may react adversely to it.

### **Getting Started**

Eliminating fragranced products is perhaps the quickest and easiest step to improving air quality.

Eliminate air fresheners and fragrance-emitting devices. Do not use urinal or toilet deodorizer blocks which contain paradichlorobenzene, naphthalene, solvents or fragrances. Substitute vegetable-based surfactants combined with microbe-based urea reducing properties. Choose non-fragranced cleaners, hand soaps, and lotions. Choose basic paper items that do not contain fragrances. Do not use cleaner/disinfectant combination products. Disinfectants should be used after a surface is clean for optimal deep cleaning, which should be done on an as needed basis. Inspect cleaned areas using ultraviolet light to verify that the surface has been adequately cleaned. Concentrate heaviest cleaning on essential areas. This will control odor.

Find and remove room deodorizers and dispensing devices. Establish a policy restricting occupant usage of fragrance-emitting plug-ins.

Inventory all current products. Discontinue any product that has fragrance as an ingredient or has a strong odor – such as cleaners containing pine, tea tree oil, orange, lemon, or citrus.

### **Using Above Chart on Cleaning Materials Usage**

Select products used most frequently. This is most often an all-purpose cleaner, a window cleaner, and disinfectant cleaner or straight disinfectant.

Most of these products are overused. In addition, suitable substitutes can almost always be found that have less impact on air quality.

Experiment with dosages to find the minimum amount of cleaning product that will accomplish the job. This is best done after selecting a new vegetable surfactant-based all-purpose cleaner, window cleaner, or oxygen-based disinfectant for bathrooms. Control dispensers to make sure that the minimum dosages necessary are dispensed.

Make increased use of mechanical/physical methods of cleaning to reduce chemical usage.

Vacuuming: Vacuuming extracts soil at a rate of barely 60% when done with typical upright vacuum systems found today. Carpets tend to absorb particles from the air as well as tracked-in grease and other contaminants. Using a stronger vacuum system with continuous suction (non-pumping action) combined with a slower motion increases the extraction rate to above 85%. Keeping vacuumed dirt and fumes from escaping from the vacuum and re-contaminating a room requires strong filtration. HEPA systems work well to remove particulate matter, but care needs to be taken to insure there are no air leaks around the filter. An activated charcoal impregnated membrane will absorb and trap gasses.

A strong vacuuming program that includes daily and thorough vacuuming is the first guard against the need for frequent carpet cleaning. Secondly, evaluate traffic patterns and use throw rugs and entry mats to protect carpeting in heavily trafficked areas that quickly become dirty. Only clean spots or small areas of carpet that require cleaning. Clean carpet on an “as-needed” basis rather than on a regular schedule.

For widespread carpet cleaning, employ extraction methods using steam; mild cleaners that do not contain fragrances or solvents; or peroxide-based cleaners and fast four hour drying to reduce impacts on air quality and chances of mold growth.

Dusting: Wipe surfaces for dusting with lint-free cloths or damp clean rags. This is usually as effective as using chemical dusting products.

Mopping & Buffing: Damp mop hard floors using soft water in high traffic areas. Wipe with a dry mop on return pattern. Frequent mopping protects the floors and reduces the need for buffing and refinishing. Buff floors during off hours using the minimum amount of product necessary to refinish the floor.

Floor Refinishing: Refinish floors based on need rather than a fixed schedule. Keep service records that include the date and area where floor was refinished and the products used. Mandate that only the minimum amount of product necessary to accomplish the job will be used. Provide personnel with information on tracking and the goal of chemical reduction. All stripping and refinishing needs to be done during non-occupancy periods with substantial increases in outside air flow.

### **Keep Track**

Using a computer, create an ongoing tracking system on reductions in the amount and number of chemicals used, changes in chemicals used, and eliminations of chemicals. This overall program needs to be continuously evaluated and communicated to building owners, managers, and occupants.

## Steps for Implementing a Scent-Free Policy in the Workplace

(Adapted from the Canadian Centre for Occupational Health and Safety)

### What steps should I take when implementing a scent-free policy in the workplace?

The situation may arise and create the need for a scent-free policy. As with most workplace policies, be sure to consider the following:

- Conduct an assessment or survey of the employees to determine the extent of the problem. Collect opinions and suggestions at the same time to help you develop a policy appropriate to your workplace.
- Designate one key person to oversee the project and its development. If you work at a large company, it may be better to create a committee with members representing all groups (employees, unions, management).
- Involve the health and safety committee, and get management commitment from the beginning.
- Set and stick to deadlines for creating a draft policy, a review of the policy, and for implementation.
- Be sure that all employees have been fully informed of the policy and that they know what they have to do before the policy becomes effective.
- Educate the employees. You may choose to include brochures or flyers in payroll envelopes, publish articles in company newsletter, or give presentations. In any case, the goal is to inform all employees of the health concerns related to scents and why the policy is needed.
- Address any concerns the employees raise openly and honestly. Reinforce the idea that this policy is being implemented as a result of medical concerns - not merely because of a dislike for a certain smell.
- Make it clear that the policy applies to everyone (including visitors, patients, etc).
- Search local legislation for any supporting documentation.
- Do not limit the scent free policy to perfumes and colognes. Many cleaning and personal care products also have scents.
- Post a list of "approved" unscented products and where they are available locally.
- Review all MSDSs for the products currently used and for those you are considering using. Make sure that the ingredients are acceptable. Remember that some products which claim to be scent-free may be using additional chemicals to mask smells instead of truly being "unscented".
- Conduct trials in limited areas before purchasing large quantities of a product.
- Post notices that waxing, shampooing, painting, or spraying (etc.) will be conducted one week beforehand so that affected personnel can make arrangements or have their duties modified during that time.
- Put the policy statement notice on all appointment cards, stationery, room booking notices, employment postings, etc.
- Decide on wording for 'Scent Free' signs and where the signs will be posted.
- Let everyone know that the policy will be reviewed and can be changed because of experience or new knowledge.

### What is an example of a policy?

Policies should be based on the health concerns of employees - especially those who have sought medical help. Keep the policy short, but specific. The policy must also apply uniformly throughout the company.

<b>Sample: Scent-Free Policy</b>
<p><b>Policy:</b></p> <p>Due to the health concerns arising from exposure to scented products, ABC Company Inc. has instituted this policy to provide a scent-free environment for all employees and visitors.</p>
<p><b>Definitions:</b></p> <p>The use of scented products will not be allowed within the building at any time. In addition, all materials used for cleaning will be scent-free (where ever possible).</p> <p>A list of locally available scent-free products is available from the health and safety office.</p>
<p><b>Procedure:</b></p> <p>Employees will be informed of this policy through signs posted in buildings, the policy manual, promotional materials and will receive orientation and training.</p> <p>Visitors will be informed of this policy through signs and it will be explained to them by their host.</p> <p>Any violations of this policy will be handled through standard disciplinary procedures.</p> <p>This policy is effective on 01/01/01.</p>

**What should the 'posted notice' say?**

Signs should be posted near the entrances to company building(s). In addition, statements on business cards, letter head or promotional materials may be helpful if you receive a lot of visitors.

Examples include:

Some people who work at ABC Company report sensitivities to various chemical-based or scented products. We ask for everyone's cooperation in our efforts to accommodate their health concerns.

In response to health concerns, ABC Company has developed a Scent-Free Policy. Scented products such as hair spray, perfume, and deodorant can trigger reactions such as respiratory distress and headaches. Staff and visitors are asked to not use these products when reporting to this office.

ABC Company is a Scent-free environment. Please do not use scented products while at work.

**National Institute of Building Sciences (NIBS)  
Indoor Environmental Quality (IEQ) Project  
Designated Cleaner Air Rooms Committee**

**Table of Contents**

**Introduction and Overview**

**Promising Practices**

**Recommended Actions**

**Committee Recommendations**

**National Cleaner Air Signage**

**Background**

**Purpose**

**Proposed Language**

**Conditions of Use**

**Paths of Travel**

**Restrooms**

**Contact Information**

**Maintaining A Cleaner Air Record Log**

**Removal Of The Symbol**

**Temporary Use Of Cleaner Air Symbol**

**Further Explanation of the Criteria for Conditions of Use**

**No Smoking**

**Fragrance-Free**

**Pesticide-Free Indoors and Outdoors**

**Least Toxic/Risk Cleaning Products**

**No Recent Construction or Remodeling Including Carpet Installation**

**Cell Phones Turned Off**

**Ability to turn off or unplug computers and other electrical equipment by occupant or staff**

**Ability to turn off fluorescent lighting by occupant or staff**

**Ability to adjust temperature and air flow by occupant or staff, or the availability of operable window(s)**

**Recommendations for Accommodations**

**References**

**Resources for Access and Accommodations**

**Committee**

**Appendices**

**California Code Regulations**

**Southwest Community Health System Policy Guideline**

**MCS Nursing Protocol**

**INTRODUCTION AND OVERVIEW**

Individuals with multiple chemical and/or electromagnetic sensitivities have identified the availability of designated cleaner air rooms and paths of travel in public and commercial buildings as highly important for improving access. The Designated Cleaner Air Rooms Committee examined the rationale for having Designated Cleaner Air Rooms, the types of

buildings or occupancies that may be appropriate for having such rooms, the minimum criteria for such a designation, and who would benefit from having these rooms.

### **Promising Practices**

In November 2001 the State of California adopted a Cleaner Air Symbol and Conditions of Use in its building code to identify areas in publicly funded or leased facilities owned by the State of California that are accessible to and useable by people who are adversely impacted by airborne chemicals or particulate(s) and/or the use of certain electrical fixtures or devices.(1) The symbol can be used when minimum conditions established in the code are met. Use of the designation is voluntary.

A fact sheet on the California Cleaner Air Symbol and Criteria can be found at:

[http://www.documents.dgs.ca.gov/dsa/pubs/cleanerair\\_factsheet.pdf](http://www.documents.dgs.ca.gov/dsa/pubs/cleanerair_factsheet.pdf)

See *1117B.5.11 Cleaner air symbol* (page 109) of the California Code of Regulations for the code language: (see Appendix A)

[www.documents.dgs.ca.gov/dsa/pubs/regulations\\_02-16-05.pdf](http://www.documents.dgs.ca.gov/dsa/pubs/regulations_02-16-05.pdf)

### **Recommended Actions**

The Committee was charged with

- 1) reviewing the California symbol and criteria and investigating where it has been implemented, how it has worked, and what modifications and improvements, if any, are necessary to recommend broader usage;
- 2) developing and promoting a national Cleaner Air Symbol and Conditions of Use as appropriate; and
- 3) defining the scope of guidelines for creating an ideal zone (room and path of travel) hereafter referred to as a Clean Air Room in buildings for people with chemical and/or electromagnetic sensitivities.

During the project, the scope of work was expanded to include a brief discussion of accommodations for people with multiple chemical and/or electromagnetic sensitivities to address the needs of those individuals for whom a Cleaner Air Room would not provide adequate access or for those situations when such a designation would not be possible or feasible. Resources that address access and accommodations for people with multiple chemical and/or electromagnetic sensitivities at work, at school, at public meetings, and in hospitals are included at the end of this report.

### **Committee Recommendations**

- The Committee highly recommends that the Access Board and/or the National Institute of Building Sciences (NIBS) fund or seek funding for FY2006 to develop specifications for designing and constructing a Clean Air Room and Path of Travel, the ideal or model room. This project is a natural outgrowth of the work of the other three committees.
- The Committee proposes a Pilot Project for FY2006 to implement a national Cleaner Air Symbol, as promulgated by the State of California, and Conditions of Use, as modified in the National Cleaner Air Signage, Conditions of Use section below, in

select public and commercial buildings such as independent living centers, disability organizations, schools and other educational institutions, public meeting places, or other business or government entities. The Committee recommends that one or more committee members in conjunction with the Access Board and/or the National Institute of Building Sciences assist in its implementation, track its use, analyze how well it has worked, and determine whether modifications or improvements are necessary prior to recommending promotion nationally. This same group would also examine implementation of the California Signage which is expected to take place during the same time frame.

- The Committee recommends that the Access Board, or a committee created by the Board, identify, review, summarize, and publish best practices for accommodations for people with multiple chemical and/or electromagnetic sensitivities on the website. Such a project was previously proposed by Access Board officials and discussed with members of this Committee but was not part of the charge of the current project.

## **NATIONAL CLEANER AIR SIGNAGE**

### **Background:**

In November 2001 the State of California adopted the California Cleaner Air Symbol, California Building Code, Title 24, Parts 2 and 12, 1117B.5.11ff., which established a symbol and criteria for conditions of use to identify a room, facility, and paths of travel that are accessible to and useable by people who are adversely impacted by airborne chemicals or particulate(s) and/or the use of electrical fixtures and/or devices. Installation and use of the Cleaner Air Symbol is on a voluntary basis in state buildings. The Committee learned that the Cleaner Air Symbol has yet to be implemented in California although members of our group are aware of individuals in California and in other states who are using the symbol as a means of advocating for or obtaining individual access needs.

The California Cleaner Air Symbol and Conditions of Use were also proposed for adoption at the meeting of the Accredited Standards Committee A117 on Architectural Features and Site Design of Public Buildings and Residential Structures for Persons with Disabilities in December 2001.(2) The Cleaner Air Symbol received a favorable vote. It was later dropped prior to the issuance of the final standard in 2003: International Code Council, American National Standard-Accessible and Useable Buildings and Facilities, ICC/ANSI A117.1-2003. The Cleaner Air Symbol is expected to be reintroduced for consideration during a new standard cycle that will begin shortly. The Standard must be adopted by a state or locality to be enforceable.

The Committee also discussed the identification of state buildings in California that might qualify for the Cleaner Air Symbol either due to a building's unique ability to meet the implementation criteria, or the need to make public meeting rooms accessible for those with chemical and/or electromagnetic sensitivities. Committee members are also aware of the need to encourage residents of California who may need to access state buildings to seek to implement the Cleaner Air Symbol.

### **Purpose:**

To provide voluntary guidelines for a Cleaner Air Symbol that can be used nationally or adapted for state and local use.

### **Proposed Language:**

National Cleaner Air Symbol: The national symbol shall be the standard used to identify a room, facility, and paths of travel that are more accessible to and useable by people who are adversely impacted by airborne pollutants, such as those with chemical sensitivities, asthma, and other respiratory conditions, and/or people who are adversely impacted by electromagnetic fields from electrical fixtures and equipment such as those with electromagnetic sensitivities.

The Symbol will comply with the specifications as described in the California code.

When the Cleaner Air designation symbol is used, the following requirements must be met:

- The symbol and text, "Cleaner Air" is displayed within a minimum 6-inch square;
- The "Cleaner Air" text is located under the symbol, as shown
- The Cleaner Air Symbol is shown as either a negative or positive image.
- The symbol and text are posted in either black and white, or in Federal Blue and white. When blue is used, Federal Blue Color No. 15090, Federal Standard 595B, is used.
- There is at least a 70% color contrast between the backgrounds of the sign and the surface that it is mounted on.

### **Conditions of Use**

The Cleaner Air Symbol may be posted to identify the room and path of travel if there is verification that the room, facility, and path of travel to the room meet all of the Cleaner Air Requirements as indicated below:

- No Smoking
- Fragrance-Free
- Pesticide-Free (Indoors and Outdoors)
- Least Toxic/Risk Cleaning Products
- No Recent Construction or Remodeling Including Carpet Installation
- Cell phones turned off
- Ability to turn off or unplug computers and other electrical equipment by occupant or staff
- Ability to turn off fluorescent lighting by occupant or staff
- Ability to adjust temperature and air flow by occupant or staff, or the availability of operable window(s)

### **Paths of Travel**

Every effort should be made to make the Paths of Travel as accessible as possible for those with multiple chemical and/or electromagnetic sensitivities even though the paths of travel might not meet all of the criteria of the Cleaner Air Room. It is important that the Path of Travel from the building entrance to the Cleaner Air Room be as short as possible. The building entrance should also be fully accessible to those with mobility and other impairments.

### **Restrooms**

If possible, restrooms that are already fully accessible to those with mobility and other impairments should be designated for use by those individuals using the Cleaner Air Room. These restrooms should be located along the path of travel or as close as possible to the Cleaner Air Room. The restrooms should meet as many of the criteria as possible. The restrooms should prohibit smoking and be free of perfumes, fragranced products, air fresheners, deodorizers, and pesticides. Cleaning should be done with the same least toxic products used in the Cleaner Air Room. Cell phones should be turned off along the path of travel and in the restrooms.

**Contact Information** for the building/facilities manager or the designated agent responsible for maintaining and/or recording activity in the Cleaner Air Room should be posted at the Cleaner Air Room and at the accessible entrance, if possible, and be readily available to anyone seeking additional information by telephone, fax, e-mail, or mail.

### **Maintaining a Cleaner Air Record Log**

A log shall be maintained on site, accessible to the public either in person or by telephone, fax, e-mail, mail or other accessible means as requested. One or more individuals shall be designated to maintain the log. The log shall record any product or practice used in the designated Cleaner Air Room, the path of travel, and accessible restrooms, as well as scheduled activities that may impact the Cleaner Air designation. The log shall also include the product label and Material Safety Data Sheet(s), as available, for any products used. Note, however, that neither the MSDS nor the product label provides complete information on product ingredients or their potential health effects.

### **Removal of The Symbol**

If the path of travel, room and/or facility restrooms identified by the Cleaner Air Symbol should temporarily or permanently cease to meet the minimum conditions as set forth above, the Cleaner Air symbol shall be removed and shall not be replaced until the minimum conditions are again met.

### **Temporary Use of Cleaner Air Symbol**

The Cleaner Air Symbol may be used to identify a room, path of travel, and restrooms that meet the conditions of use on a temporary basis.

### **Further Explanation of the Criteria for Conditions of Use:**

**No Smoking:** Smoking is prohibited in the path of travel, Cleaner Air Room, and restrooms serving the room. To qualify as a Cleaner Air Room, the room, path of travel, restrooms and surrounding area must be free of tobacco residue. Those who smoke, or who have tobacco residue on their person, would be prohibited from using the room. Smoking should be restricted to outdoor, designated smoking areas that are at a minimum of 100 feet from paths of travel, entryways, operable windows, and air intakes. (See No Smoking Policy, Operations and Maintenance Report)

**Fragrance-Free:** Prohibit fragrance-emitting devices (FEDS), air fresheners, deodorizers, and similar products. Recommend that no fragranced, citrus-and/or pine-based products be used in cleaning or maintaining the room, path of travel, and restrooms. Any persons with perfume, cologne, aftershave, as well as fragranced personal care and laundry products, would be prohibited from using the room. (See Fragrance-Free Policy, Operations and Maintenance Report)

### **Pesticide-Free Indoors and Outdoors:**

Practice Integrated Pest Management. Use least hazardous pest management materials such as non-volatile baits, sticky traps, and boric acid with knowledge and input from those using the path of travel and Cleaner Air Room. The sign should be removed in the event of a least hazardous pesticide application for 24-48 hours because it is likely that the certified pest control applicator is in regular contact with chemical pesticides and could leave residue from clothing or equipment. In addition, some chemically sensitive individuals may be made sick by exposure to even least hazardous pesticides especially when they are first applied.

In the event of a chemical pesticide application made to the building or grounds, other than a least hazardous pesticide such as those listed above, remove the sign and consult with those who use the space and others regarding the length of time that the room would need to be closed to protect affected populations based on the product(s) used. (See Operations and Maintenance for least hazardous pest management materials and cautions in the event that a chemical pesticide application is considered for use in the Cleaner Air Room, Path of Travel, Restrooms, or the building or grounds.)

**Least Toxic/Risk Cleaning Products:**

Avoid or limit the use of products containing chlorine, ammonia, quaternary ammonium, phenol, isopropyl and other alcohols, formaldehyde, and other petroleum distillates. Do not use fragranced, citrus-and/or pine-based cleaning products as mentioned above. Consult those who plan to use the Cleaner Air Room and Path of Travel for cleaning product recommendations. Follow the recommendations of Operations and Maintenance Report for best practices.

**No Recent Construction or Remodeling Including Carpet Installation:**

Every effort should be made to avoid remodeling activities in the Cleaner Air Room, path of travel, and restrooms. Any remodeling activity would require removal of the signage. The length of time for removal should be determined by the type of activity, extent of the remodeling, and the products and materials selected for use. It is important to choose the least toxic, least problematic products and practices. Except for minimal touch up painting, for example, it would not be unusual to have the signage removal in effect for a period of 3- 6 months to a year or more depending on the nature and extent of the remodeling activity. Be sure to consult building occupants with existing health problems and those who are using the Cleaner Air Room for their input and to help determine when the Cleaner Air Room may again be safe for use. (See Products and Materials Report and Design and Construction Report for more information)

**Cell Phones Turned Off:**

Protect those with electromagnetic sensitivities and others who may be adversely affected by electrical equipment.

**Ability to turn off or unplug computers and other electrical equipment by occupant or staff:**

Protect those with electromagnetic sensitivities and others who may be adversely affected by computers and electrical equipment.

**Ability to turn off fluorescent lighting by occupant or staff:**

LEED (Leadership in Energy and Environmental Design) recommendations for new construction call for individual control of lighting.(3) Newer fluorescents that contain electronic rather than magnetic ballasts may be less problematic for some people with electromagnetic sensitivities because they do not produce a visible flicker or audible hum. They are also less prone to trigger seizures.

**Ability to adjust temperature and air flow by occupant or staff, or the availability of operable window(s):**

LEED recommendations for new construction include individual control of temperature and ventilation.(3) Opening an operable window may improve the air quality or air flow in a Cleaner Air Room and compensate for situations when individual control of temperature and air flow is not possible.

The text below is duplicated on the website

\*\*\*\*\*

## RECOMMENDATIONS FOR ACCOMMODATIONS

People with chemical and/or electromagnetic sensitivities can experience debilitating reactions from exposure to extremely low levels of common chemicals such as pesticides, cleaning products, fragrances, and remodeling activities, and from electromagnetic fields emitted by computers, cell phones, and other electrical equipment.

The severity of sensitivities varies among people with chemical and/or electromagnetic sensitivities. Some people can enter certain buildings with minor accommodations while others may be so severely impacted that they are unable to enter these same spaces without debilitating reactions. Furthermore tolerances to specific exposures can vary greatly from one individual to the next. Meanwhile some exposures, such as the application of certain pesticides or extensive remodeling, for example, may be devastating to all chemically sensitive people and make a building or facility inaccessible for a substantial period of time.

According to the Americans with Disabilities Act (ADA) and other disability laws, public and commercial buildings are required to provide reasonable accommodations for those disabled by chemical and/or electromagnetic sensitivities. These accommodations are best achieved on a case-by-case basis.

Reasonable accommodations for a chemically sensitive and/or electromagnetically sensitive individual can include providing a space or meeting area that addresses one or more of the Cleaner Air criteria, upon request, such as

- Remove fragrance-emitting devices (FEDS)
- Delay or postpone indoor or outdoor pesticide applications, carpet cleaning, or other cleaning or remodeling until after the meeting
- Provide room or meeting area near exterior door or with window(s) that can be opened
- Require cell phones and computers be turned off
- Provide incandescent lighting in lieu of fluorescent lighting
- Provide at least one nonsmoking, fragrance-free person per shift to provide services (e.g. nurse, police officer, security guard, clerk )

For individuals who are unable to use or meet in a building or facility, or who are too severely impacted by chemical and/or electromagnetic exposures to use a designated Cleaner Air Room, accommodations may include:

- Meet an individual at the door or outside to conduct business
- Allow a person to wait outside or in car until appointment
- Provide a means, such as a phone, intercom, bell, or buzzer to summon staff to an outside door for assistance
- Permit business to be conducted by phone, fax, mail, or e-mail rather than in person
- Allow participation in a meeting by speakerphone

**End duplicated text**

**SPECIAL ACKNOWLEDGEMENT:** The Committee extends a generous thank you to Sharon Toji, Access Communications, for designing the Cleaner Air Symbol and making it available for public use.

## REFERENCES

- 1) California Access Compliance Reference Manual, Division of the State Architecture, Chapter 11B Part 2 Title 24, California Code of Regulations 110 November 1, 2002.
- 2) American National Standards Institute (ANSI) Accredited Standards Committee A117, Committee on Architectural Features and Site Design of Public Buildings and Residential Structures for Persons with Disabilities, [www.iccsafe.org/cs/standards/a117/index.html](http://www.iccsafe.org/cs/standards/a117/index.html)
- 3) LEED Green Building Rating System for New Construction & Major Renovation, (LEED-NC), Version 2.1, US Green Building Council, pages 68 and 69. [www.usgbc.org](http://www.usgbc.org)  
LEED Controllability of Systems:  
6.1 Provide at least an average of one operable window and one lighting control zone per 200 SF for all regularly occupied areas within 15 feet of the perimeter wall.  
6.2 Provide controls for each individual for airflow, temperature and lighting for at least 50% of the non-perimeter, regularly occupied areas.

## RESOURCES FOR ACCESS AND ACCOMMODATIONS

Lamielle, M., Creating an Accessible Indoor Environment, Fact Sheet, National Center for Environmental Health Strategies, 2004.

Lamielle, M., Multiple Chemical Sensitivity and the Workplace, National Center for Environmental Health Strategies, 2004.

Temple, T., Healthier Hospitals, Ohio Network for the Chemically Injured, 1996.

Miller, CS, Ashford, NA, Multiple Chemical Intolerance and Indoor Air Quality. In Indoor Air Quality Handbook, Spengler, J, Samet J and McCarthy J, Eds., New York, McGraw-Hill, Inc., 2000.

Job Accommodations Network, a free service of the Office of Disability Employment Policy, U.S. Department of Labor, [www.jan.wvu.edu](http://www.jan.wvu.edu)

University of Minnesota, Disability Services, Internal Guidelines Regarding Multiple Chemical Sensitivity/Environmental Illness (MCS/EI), <http://ds.umn.edu/disabilities/MCSEIPolicy.html>

The Evergreen State College, policy on air quality, [www.evergreen.edu/policies/g-air.htm](http://www.evergreen.edu/policies/g-air.htm)

## COMMITTEE

### Active

Chair – Michael Mankin, Division of the California State Architect  
Libby Kelly, Council on Wireless Technology Impacts  
Mary Lamielle, National Center for Environmental Health Strategies  
Ann McCampbell, Multiple Chemical Sensitivities Task Force of New Mexico  
Susan Molloy, National Coalition for the Chemically Injured  
Toni Temple, Ohio Network for the Chemically Injured

### Contributing

Mark Jackson, Lennox Industries, Inc.  
R. Bruce McCreary, Snowflake, AZ

### Commenting

Dora McGregor, Salt Lake City, UT

## APPENDICES

**Appendix A - 1117B.5.11 Cleaner air symbol** (page 109) of the California Code of Regulations

*1117B.5.11 Cleaner air symbol. “STRICTLY FOR PUBLICLY FUNDED FACILITIES OR ANY FACILITIES LEASED OR RENTED BY STATE OF CALIFORNIA. NOT CONCESSIONAIRES”. This symbol shall be the standard used to identify a room, facility and paths of travel that are accessible to and usable by people who are adversely impacted by airborne chemicals or particulate(s) and/or the use of electrical fixtures and/or devices. When used, the symbol shall comply with Figure 11B-40.*

*1117B.5.11.1 Color and size of symbol. The symbol shall be used when the following minimum conditions are met. The symbol, which shall include the text “Cleaner Air” as shown, shall be displayed either as a negative or positive image within a square that is a minimum of 6 inches on each side. The symbol may be shown in black and white or in color. When color is used, it shall be Federal Blue (Color No. 15090 Federal Standard 595B) on white, or white on Federal Blue. There shall be at least a 70% color contrast between the background of the sign from the surface that it is mounted on.*

*Strictly for publicly funded public facilities or any facilities leased or rented by State of California. Not concessionaires.*

\* In 1117B.5.8.1 (Symbols of Accessibility) the title of this section is incorrectly worded, which is causing misunderstanding regarding proper standard reference. Change title to read ‘International Symbol of Accessibility.’ This will be submitted for correction in Rulemaking.  
CALIFORNIA ACCESS COMPLIANCE REFERENCE MANUAL . DIVISION OF THE  
STATE ARCHITECT

**1117B.5.11.2 Conditions of use.** *Use of the cleaner air symbol is voluntary. The cleaner air symbol shall be permitted for use to identify a path of travel, and a room or a facility when the following is met.*

- 1. Floor or wall coverings, floor or wall covering adhesives, carpets, formaldehyde-emitting particleboard cabinetry, cupboards or doors have not been installed or replaced in the previous 12 months.*
- 2. Incandescent lighting provided in lieu of fluorescent or halogen lighting, and electrical systems and equipment shall be operable by or on behalf of the occupant or user of the room, facility or path of travel.*
- 3. Heating, ventilation, air conditioning and their controls shall be operable by or on behalf of the occupant or user.*
- 4. To maintain "cleaner-air" designation only nonirritating, nontoxic products will be used in cleaning, maintenance, disinfection, pest management or for any minimal touch-ups that are essential for occupancy of the area. Deodorizers or Fragrance Emission Devices and Systems (FEDS) shall not be used in the designated area. Pest control practices for cleaner-air areas shall include the use of bait stations using boric acid, sticky traps and silicon caulk for sealing cracks and crevices. Areas shall be routinely monitored for pest problems. Additional nontoxic treatment methods, such as temperature extremes for termites, may be employed in the event of more urgent problems. These pest control practices shall not be used 48 hours prior to placement of the sign, and the facility shall be ventilated with outside air for a minimum of 24 hours following use or application.*
- 5. Signage shall be posted requesting occupants or users not to smoke or wear perfumes, colognes or scented personal care products. Fragranced products shall not be used in the designated cleaner-air room, facility or path of travel.*
- 6. A log shall be maintained on site, accessible to the public either in person or by telephone, e-mail, fax or other accessible means as requested. One or more individuals shall be designated to maintain the log. The log shall record any product or practice used in the cleaner-air designated room, facility or path of travel, as well as scheduled activities, that may impact the Cleaner-Air designation. The log shall also include the product label as well as the \*Material Safety Data Sheets (MSDS).*

**1117B.5.11.3 Removal of symbol.** *If the path of travel, room and/or facility identified by the cleaner air symbol should temporarily or permanently cease to meet the minimum conditions as set forth above, the cleaner air symbol shall be removed and shall not be replaced until the minimum conditions are again met.*

## **Appendix B – SOUTHWEST COMMUNITY HEALTH SYSTEM POLICY GUIDELINE**

Southwest General Health Center (SWGHC)

Middleburg Heights, OH

**EFFECTIVE DATE: July, 2002**

**Revision Dates:**

**POLICY 742**

**Page 1 of 7**

**POLICY NAME: MULTIPLE CHEMICAL SENSITIVITY SYNDROME (MCS)**

### **POLICY:**

Southwest General Health Center will provide guidelines to ensure optimal care of the patient experiencing Multiple Chemical Sensitivity (MCS) which is mutually established with the patient, family/significant other and health care team.

### **I. INTERPRETATION:**

Multiple Chemical Sensitivity (MCS), also referred to as environmental illness or chemical injury is a medical condition in which individuals develop symptoms from exposure to very low level of chemicals in the environment. The interdisciplinary team at SWGHC uses a collaborative process with the patient, physician, family/significant other and the health care associates to establish a safe environment, to promote healing and ensure comfort.

### **II. OBJECTIVES:**

An organizational approach to patient management with multiple chemical sensitivities includes:

- A. Method to ensure patient is placed in a safe environment.
- B. Method to facilitate identification of a MCS patient.
- C. Method to verify competency of all associates providing direct and supportive care to the patient with MCS
- D. Method to ensure patient's participation in developing their care plan.
- E. Method to ensure patient/their families/significant others are educated about the need to communicate about any special care required.

### **III. OVERSIGHT AND RESPONSIBILITY**

A coordinated organizational program to care for MCS patients will be developed by an interdisciplinary team. This committee will have the responsibility for assuring that all provisions of this policy are adhered to throughout the organization. The team will have representatives from:

- A. Medical Staff
- B. Nursing Services
- C. Central Sterile Supply
- D. Protection Services

SOUTHWEST GENERAL HEALTH CENTER  
STANDARD OF PRACTICE

PAGE 2 OF 7	MULTIPLE CHEMICAL SENSITIVITY SYNDROME	POLICY 742
----------------	--	---------------

- E. Nutritional Services
- F. Plant Operations
- G. Environmental Services
- H. SSA's
- I. Pharmacy
- J. Social Services
- K. Administration

**IV. SPECIFIC ROLES AND RESPONSIBILITIES OF INTERDISCIPLINARY TEAM**

- A. Medical Staff -Physician: Provides special instructions, treatments, diagnostic tests and medication orders. No treatments/medications should be administered to an MCS patient without prior approval of patient's private physician unless a life threatening emergency exists.
- B. Nursing Services  
Role and responsibilities:
  - 1. Identify the patient with MCS
  - 2. Provide a safe patient care environment.
  - 3. Develop an awareness, sensitivity and respect of patients' physical and emotional needs.
  - 4. Develop a plan of care on daily basis with minimum of one staff member per each shift to attend medical needs of the patient.
  - 5. Comply with the following when caring for the MCS patient:
    - a) be perfume and scent free (ie., no hair spray, no mousse gels, lotions, cigarette/smoking smells).
    - b) Do not use aerosol products (ie hair spray, deodorants). Non-scented, potassium salts, pump deodorant is acceptable. Baking soda (dry).
    - c) Do not wear new clothing which has not been laundered.
    - d) Do not wear clothing which has been freshly dry-cleaned.
    - e) Use only latex free gloves
    - f) Wash hands and apply gloves before entering the patient's room.
    - g) Be alert for any environmental triggers when following normal hospital procedures.
- C. Central Sterile: Provides and ensures the unit with
  - 1. Latex free products
  - 2. Adequate supply of sterile linens

SOUTHWEST GENERAL HEALTH CENTER  
STANDARD OF PRACTICE

PAGE	MULTIPLE CHEMICAL SENSITIVITY SYNDROME	POLICY
------	--	--------

3. Adequate supply of other medical core items (ie. Sponges, dressings, securing devices).
  4. Patient can provide their own linens if other methods are not satisfactory.
- D. Protection Services: Provides assistance from the vehicle to hospital in a safe manner. (Turn vehicle engines off)
- E. Nutritional Services: Recognizes different food sensitivities and follows certain guidelines to accommodate and meet individualized needs of the MCS patient.
- Special provisions may include but will not necessarily be limited to the following:
1. No processed foods of any kind including instant oatmeal, instant potatoes, and other prepackaged mixes, ie., gravies, sauces, and flavor packets as they may contain many additives.
  2. Use no dyes, preservatives, sulfites, artificial flavoring or MSG.
  3. Use no aerosol cooking sprays.
  4. Use no artificial sweeteners.
  5. Distilled water in glass containers to be provided by Nutrition Services, or patient may supply his/her own tolerated water for drinking.
  6. Serve beverages which have not been processed with chemicals.
  7. Nutrition Services will provide lactose free milk or a substitute such as soy or rice milk to those who require it.
  8. Rigidly follow physician's orders regarding food restrictions.
  9. Review food allergies within the food service to avoid allergic reactions.
  10. Permit patient to supply his/her own tolerated food products. Nursing will provide a proper storage area for them.
  11. Do not serve food or liquids in plastic or Styrofoam. Use only glass or ceramic dishes and cups which have been well rinsed to remove all traces of soap and chemical residues. Cellophane or plastic wrap packaging on room temperature food (i.e., crackers) is typically not a problem, however, caution must be used if toxic inks are used. Anything noticeably odorous can be a problem.
  12. Remove treated i.d. menu paper from the tray and replace tray liners that may have become wet during transport.
- F. Plant Operations: Plant Operations will not perform remodeling or painting within close proximity to MCS patient's room. These activities can be coordinated with the leadership of patient care area.

SOUTHWEST GENERAL HEALTH CENTER  
STANDARD OF PRACTICE

PAGE 4 OF 7	MULTIPLE CHEMICAL SENSITIVITY SYNDROME	POLICY 742
----------------	--	---------------

- G. Environmental Services: will perform terminal cleaning.
1. Refer to Environmental Services Policy for MCS room cleaning.
  2. Staff will check with the floor nurse before entering the patients room.
  3. Environmental Services will coordinate with the patient's nurse for cleaning of the patient's room or performing any special cleaning tasks in the general area (i.e., floor waxing or floor wax removal in the halls). Whenever there is a question of what may affect the health of an MCS patient, the floor nurse must be consulted.
  4. Scented products, air fresheners, deodorizers or other additives should not be placed in any vacuum cleaner bag used anywhere in the health center. Use only unscented vacuum cleaner bags.
  5. Do not use any other housekeeping products (garbage bags, paper towels, cleaning solutions) which contain fragrances or pesticides. These products should be stored in an area separate from disinfectants, soaps and other cleaning products. Do not store toilet paper, facial tissues or other patient items near fragranced or pesticide products.
- H. SSA's: Will perform daily cleaning of the patient's room by using the following guidelines.
1. SSA's must wear clean gowns and caps when cleaning the room of MCS patient when patient is in the room.
  2. Do not use any other housekeeping products (any plastic bags, paper towels, cleaning solutions which contain fragrances or pesticides). Do not use any air fresheners or deodorizers in patient's room.
  3. Dust with a clean cotton cloth moistened with only water.
  4. Use baking soda or Bon Ami cleanser for tubs, sinks and toilet.
  5. Remove trash at least twice daily. Do not use plastic liners.
  6. Do not leave patient trays in the room after meals.

SOUTHWEST GENERAL HEALTH CENTER  
STANDARD OF PRACTICE

PAGE 5 OF 7	MULTIPLE CHEMICAL SENSITIVITY SYNDROME	POLICY
----------------	--	--------

I. Pharmacy

Provides pharmaceutical care guidelines to patient, family and health care team members. The following guidelines are helpful in providing medications to patients with MCS:

1. Have patient bring medications to the hospital that he/she is currently using. If the physician desires the patient to continue using these medications, an order shall be written to state such.
2. Use glass bottles for IV solutions and any prescription medications that are to be administered intravenously.
3. Do not use any substitutions or generic drugs for medications ordered without patient or MD approval.
4. Be alert for standard ingredients MCS patients typically react to including but not limited to dyes, preservatives, artificial sweeteners and flavoring. Consider capsules instead of tablets.
5. Monitor medication by listing the patient's specific allergies on the patient's medication profiles.

J. Social Services

Provides psychological support and interventions, assists patient and family with community resources and discharge planning.

K. Administration

Provides support and assistance in developing a safe environment for MCS patient.

PROCEDURE:

- A. Admitting will adhere to the following to assist all health care center personnel in caring for the patient:
- 1) Flag patient's chart clearly and boldly with MCS under the allergies.
  - 2) Flag patient's chart to notify all other health center departments in advance of treating the patient so proper precautions can be made for necessary equipment and special supplies.
  - 3) Indicate "MCS" on patient's allergy band.

SOUTHWEST GENERAL HEALTH CENTER  
STANDARD OF PRACTICE

PAGE 6 OF 7	MULTIPLE CHEMICAL SENSITIVITY SYNDROME	POLICY 742
----------------	--	---------------

B. Emergency Department:

Will assist health care center personnel in diminishing any unnecessary discomfort and possible risks when MCS patient is brought into the Emergency Room. The following is initiated:

- 1) Immediately contact patient's physician for special instructions.
- 2) Immediately isolate patient from all other patients and visitors.
- 3) Place patient in an area which is not used to store any medical supplies or medications.
- 4) Keep a supply of sterile linens and gowns in the emergency room area.
- 5) Provide the least toxic pharmaceutical supplies and equipment.
- 6) Coordinate with all other health center departments to meet patients' needs.
- 7) Monitor the general environment the patient is placed in.

C. Patient's Room

Staff will implement numerous measures to prevent unnecessary exposure.

Prior to patient's occupancy:

- Contact Environmental Services for terminal cleaning of the room.
- Place new sharps container in the room
- Contact CSS for sterile linen.

During Patient's Occupancy:

- Patient should be isolated from other patients and their visitors at all times to prevent reactions to products these people are wearing or using.
- Place sign on patient's door stating: "Check at the nurses station before entering room".
- Keep patient's door closed at all times and if necessary provide a clean cloth to seal bottom of door from hall odors.
- Health care center personnel must wash their hands and apply hypo allergenic, non-latex gloves prior to entering the room of the MCS patient as these activities can trigger reactions in the patient.

SOUTHWEST GENERAL HEALTH CENTER  
STANDARD OF PRACTICE

PAGE 7 OF 7	MULTIPLE CHEMICAL SENSITIVITY SYNDROME	POLICY 742
----------------	--	---------------

- No live plants or flowers permitted in the patient's room (mold and pesticides trigger MCS reactions).
- No newspapers or treated paper permitted in patient's room. (3-part copy papers or chlorinated papers can be highly toxic and may affect breathing).

APPROVED:

---

Trilok C. Sharma, M.D.  
President, Medical Staff  
Southwest General Health Center

---

L. Jon Schurmeier,  
President  
Southwest General Health Center

**Appendix C – MULTIPLE CHEMICAL SENSITIVITY (MCS) PROTOCOL**  
 Southwest General Health Center (SWGHC)  
 Middleburg Heights, OH

INITIATED	DISCONTINUED
Date	Date
Time	Time
RN	RN

SOUTHWEST GENERAL HEALTH CENTER  
 NURSING SERVICES

**MULTIPLE CHEMICAL SENSITIVITY (MCS) PROTOCOL**

- PURPOSE:** To outline the management and nursing responsibilities caring for a patient experiencing multiple chemical sensitivity (MCS).
- LEVEL:** Independent
- SUPPORTIVE DATA:** MCS is an acquired chronic disorder characterized by recurrent symptoms occurring in response to low levels of exposure to multiple unrelated chemicals. The symptoms generally occur in one of four categories: central nervous system, circulatory, respiratory and mucous irritation or metabolic that would include enzymes, blood, kidneys, GI tract, etc.. Patient with a history of maladaptive reactions to chemicals found in perfumes pesticides, detergents, household cleaners, etc. may have or develop multiple chemical sensitivities. Approximately 75% of those affected are women, possibly due to endocrine disruption. People in their 30s and 40s are most strongly affected as well as children and others who are more susceptible to the effects of pesticides and products containing toxic chemicals. The population most strongly identified with this condition include: industrial workers, teachers, nurses, sick building occupants and those living in chemically contaminated communities. Refer to *Latex Sensitivity/Allergy Protocol* and *Hospital Policy #742 Multiple Chemical Sensitivity (MCS) Patient*.
- CONTENT:**
- Identify individuals at risk on admission in Emergency Room or Admitting.
  - Assign the patient to private room.
  - Contact CSR for free tote (or nursing supervisor during night shift).
  - Notify Environmental Services, Central Sterile, Pharmacy, Nutritional Services, and SSA of MCS patient admission.
  - Assess all patients on admission for allergies and maladaptive reactions.
  - Place green allergy band on patient; mark Multiple Chemical Sensitivity (MCS).
  - Place sign on patient’s door stating:
- Prior to Admission*
- Admission Assessment*

“Check at the nurses station before entering patient’s room.”

***Admission  
Assessment (cont’d)***

8. Enter Multiple Chemical Sensitivity on all the orders sent in Cerner in Comments Box.
9. Observe patient for following symptoms.
  - Fatigue
  - Memory loss
  - Depression
  - Nervousness
  - Lack of motivation
  - Visual problems
  - Hearing problems
  - Dizziness
  - Sleep disorders
  - Edema
  - Disorientation
  - Confusion
  - Irritability
  - Loss of logic sequencing ability
  - Loss of coordination
  - Hoarseness
  - SOB
  - Headache
  - Chest pain
  - Joint pain
  - Digestive difficulties
  - Sun or other rashes
  - Cold or heat sensitivity
  - Nausea
  - Tingling or numbness of extremities
  - Sinusitis
  - Pallor
  - Anemia
  - Salivation (usually from pesticides)

10. Refer to Latex Sensitivity/Allergy Protocol

***Patient Care***

11. Report signs and symptoms exhibited by patient to physician.
12. Obtain physician order for a special diet.
13. Encourage patient to select their own menu.
14. Allow patient to supply his/her own tolerated food products and dietary supplements.
15. Retain patients dietary requirements in the patient’s medical record for future reference.
16. Encourage use of personal respirator and other protection methods while in Health Care Center.

***Patient Safety***

17. Reinforce all hospital employees and visitors to check with patient’s nurse prior to entering patient’s room.
18. Maintain patient isolation from other patients and their visitors at all times.
19. Transport patient with R-95 mask or personal respirator.

***Patient Safety  
(cont'd)***

20. Refrain staff caring for patient from wearing perfumes, scented lotions, hair spray, deodorants or other scented products.
21. Educate hospital staff to wash their hands with unscented soap.
22. Apply hypo-allergenic, non-latex gloves prior to entering the room.
23. Instruct patient's family not to bring plants or flowers to the patient's room.
24. Restrict newspaper in patient's room.

***Patient Education***

25. Discuss with patient/family Multiple Chemical Sensitivity if newly diagnosed patient.
26. Reassure the patient with understanding of their chemically sensitive condition.
27. Refer patient to Social Services to provide list of Community Services.

***Documentation***

28. Document Multiple Chemical Sensitivity in the patient's medical record, in the front of the chart, medication record and computer system.
29. Record implementation/modification/discontinuation of protocols.
30. Document vital signs and assessment findings on appropriate flow sheet.
31. Document evaluative statement of the patient's response to interventions and lack of complications.

***Emergency  
Interventions***

32. If known, remove the offending object or person from patient's room.
33. If necessary, remove patient from room to fresh air outside the building.
34. Utilize charcoal and baking soda to absorb and remove odors from the room. Open windows if possible.
35. Refer to patient's personal emergency protocol for reducing and diluting chemical reactions (water, food, baking soda, tri-salts, etc.)

***Emergency  
Interventions  
(cont'd)***

36. Communicate and cooperate with the patient whenever possible as the patient generally knows what will help.

REFERENCES: Multiple Chemical Sensitivity Syndrome, September 1, 2000, American Academy of Fa.  
Mental Health Network, Editorial: April 2000.  
SWGHC Pharmacy  
Temple, Toni, Healthier Hospitals, 1996.

APPROVED: ICU QA 4/02; SC 05/02  
REVIEWED/  
REVISED: New 09/01, 3/02  
DISTRIBUTION: Generic

**National Institute of Building Sciences (NIBS)  
Indoor Environmental Quality (IEQ) Project  
Design & Construction Committee**

**Table of Contents**

**Introduction**

**Recommendations**

**Site and General Building Design**

**Enclosure**

**Plumbing, Mechanical and Electrical Equipment**

**Finishes and Furnishings**

**Construction Related Activities for Renovations**

**Occupancy**

**Commissioning**

**Exterior Landscaping**

**Appendices**

**Site Selection**

**Roof Gardens**

**Pest Prevention**

**Carpet**

**Use and Occupancy**

**Landscaping**

**References**

**Bibliography**

**Committee**

## **INTRODUCTION**

The Building Design & Construction Committee was charged with making recommendations for designing commercial and public buildings that would be more accessible for people with multiple chemical and/or electromagnetic sensitivities and provide healthier environments for all occupants.

The Committee found that major access barriers for chemically sensitive individuals are factors that contribute to poor air quality, such as pesticides, new carpets, tobacco smoke, inadequate ventilation, mold, certain building materials, and building activities that generate air pollutants. For electromagnetically sensitive individuals, access barriers include fluorescent lighting, unshielded transformers and wiring, security and scanning equipment and numerous other electrical appliances.

The recommendations that follow, therefore, focus on minimizing or eliminating these barriers through designing

- for pest prevention to reduce the need for or the use of pesticides,
- for preventing moisture and mold growth,
- for optimum ventilation via HVAC systems and operable windows,
- for exhausting air contaminants,
- for minimizing use of carpet and other flooring that emit volatiles, and
- for shielding occupants from electromagnetic fields.

Although many building materials can be problematic for chemically sensitive people, the Committee made minimal suggestions regarding product choices as this was the charge of the Building Products and Materials Committee.

### **Recommendations for Future Actions**

The Committee recommends that the Access Board, NIBS, or other entity create a Design Manual using the outline in this report. This Manual would provide more detailed guidance than is provided here.

The Committee acknowledges that while the scientific evidence may be inconclusive about whether ambient electromagnetic fields pose a substantial health risk to the general population, the presence of EMF is an access barrier for people who are electromagnetically sensitive. Therefore, the Committee recommends that measures be taken to reduce EMF whenever possible in order to increase access for these individuals as well as taking a precautionary approach to protecting the health of all.

## **RECOMMENDATIONS**

### **Site and General Building Design**

Select site to minimize potential exposure to air and soil pollutants and electromagnetic fields (EMF). (Appendix 1)

Visit the site on several occasions to assess site criteria.

Note microclimate: wind direction, sun exposure.

Avoid sites near wetlands/stagnant water, low lying areas; sites should be well above 100 year flood plain.

To minimize moisture infiltration at the foundation, avoid earth berm construction and provide positive drainage from building.

Avoid below-grade occupied space.

Avoid tuck-under parking and indoor parking.

Roof gardens should be avoided because soil and water can foster mold growth. (Appendix 2)

Arrange drop-offs, loading docks, helicopter pads, and other vehicular access points to eliminate or minimize exhaust fumes from entering building directly or being drawn into the HVAC system.

Avoid the use of indoor plants because they can attract pests, stimulate pesticide use, trigger allergies, and foster mold growth.

If smoking on site is permitted, dedicate an outdoor location that is remote from entries, main pedestrian paths and air intakes.

Group and isolate uses within a building that emit contaminants and could affect air quality.

High ceilings are preferred in order to dilute contaminants.

Avoid decorative indoor fountains.

### **Enclosure**

Design for a tight building envelope to maximize the performance of the HVAC system. Meet or exceed Energy Star leakage area (less than 1.25 s.i./100 sf. (Reference 1)

- Building should be able to be sealed off from exterior events that would raise outdoor pollutant levels such as, toxic spills, pesticide spraying, fires, traffic accidents, and rush hour traffic.

- Operable windows are preferred. Being able to open windows is an important access issue for chemically sensitive individuals and can be beneficial for other occupants in certain situations. Operable windows should be detailed to minimize air infiltration.

Design to prevent pest problems. (Appendix 3)

- Use inert pest resistant materials. When treatment of wood is required, treating with disodium octaborate tetrahydrate may be among the safer options.
- Incorporate pest barriers such as termite shields, window screens, and bird screens in construction details. Bird and bat droppings pose great IAQ risks.
- Some pesticides such as boric acid are considered environmentally safe. If used, granular or gel forms are preferred. Care should be taken to ensure that particles do not infiltrate interior habitable space.

Shield occupants from external sources of EMF. Windows with low e glazing, metal roof, and siding components may reduce certain interior EMF. (Reference 2)

Roof Design

- Pitched roofs are preferred, because they shed water quickly, clean the roof of pollutants and potential toxins, and are less prone to leakage.
- Inert roofing materials, such as coated metal or clay tile, are ideal. Note that galvanized metal presents a rust hazard and should be avoided.
- Flat roofs are not preferred. If used, membrane and high albedo (highly reflective to heat) type are recommended. Asphalt or modified bitumen built-up roofs are less preferable. (Reference 3)

Wall Design

- Use best design practices to prevent moisture and condensation within walls. Calculate dew points for each exterior wall (and roof) type to verify performance at each condition. Provide detail for all flashing and counter-flashing locations.

Foundation Design

- Provide under-slab vapor barriers, insulation, and damp-proofing to prevent moisture infiltration and condensation.

Protect stored building materials from water damage and mold growth.

Avoid use of water-damaged or mold-affected materials.

## **Plumbing, Mechanical and Electrical Equipment**

Properly insulate pipes to prevent condensation, especially within walls.

Use modeling software to determine airflow and to ensure isolation of pollutant sources and adequate ventilation.

Ventilate areas occupied by people with chemical sensitivities with goal of eliminating odors (ideally entire building). These ventilation rates meet or exceed all worldwide standards. (Reference 4)

Provide local control of temperature and airflow (ideally for every occupant). (Reference 5)

Utilize Displacement Air Distribution method to move pollutants away from occupants.

Dedicate building as Smoke-Free. (Reference 6)

Isolate mechanical equipment from occupied areas.

Provide direct exhaust from rooms and areas that have pollutant-generating sources or activities. These include but are not limited to: (see Appendix 5)

- Bathrooms (code requirement).
- Kitchens or office kitchenettes (this is in addition to code-required hoods or stove exhausts).
- Copy and print rooms.
- Computer rooms.

Ductwork

- Avoid insulation inside ductwork. Use external insulation wrap of non-friable (airborne particle creating) material.
- Oil coatings used in fabrication of sheet metal stock can affect air quality. Prior to installation, thoroughly clean ductwork with a low VOC product. Use methods that do not leave residue or cause oxidation. (Reference 7)

Prohibit the use of fragrances and disinfectants in air distribution systems.

Maintain relative humidity between 30%-50%.

Locate outside air louvers away from pollutant sources.

Filtration (Reference 8)

- Carbon and HEPA filters are preferred.
- Avoid ozone generating air-purification systems.
- Avoid electrostatic air cleaning due to ozone.

In renovation work, re-evaluate HVAC system performance to ensure that original design standards are met.

Shield occupants from internal EMF. Design electrical systems to minimize EMF. Maximum recommended magnetic field levels of 2.5 milligauss (preferably 1 milligauss in occupied areas) and as low as technically achievable in areas to be occupied by people with sensitivities.

## **Finishes and Furnishings**

Refer to Products and Materials Group report for specific recommendations on materials.

Floor Coverings

- Use inert materials wherever possible, such as, but not limited to:
  - Stone, tile, terra-cotta, brick, ceramic tiles,
  - Terrazzo,

- Sealed concrete.
- Minimize the use of carpeting. Note that carpet that meets Carpet and Rug Institute Green Label Plus standards can still be problematic for chemically sensitive people. (Appendix 4)
- Use carpet systems that allow for small area replacement, such as certain of the self-adhesive backing carpet squares.
- Avoid glue-down carpet installations or use low-VOC adhesives. (see Products & Materials Committee recommendations)
- Cork and linoleum may contain linseed oil and should be avoided. Rubber flooring can also pose problems for chemically sensitive individuals and should be avoided.
- Use low-or no VOC materials for all flooring. (Appendix 4)

### **Construction Related Activities for Renovations**

Provide advance notice to all occupants of any upcoming renovation work.

Post signs to alert occupants of renovation work.

Provide alternate accessible locations for affected individuals when occupied space will be rendered inaccessible due to the renovation.

Physically isolate renovation work areas from occupied portions of building.

Isolate the HVAC system from renovation work.

Implement a dust-control plan that identifies work methods and cleanup procedures.

Provide negative pressure in area of renovation work.

### **Occupancy**

Establish policies for renovation and chemical usage in lease agreements.

Designate a Smoke-Free building.

Leases should include language to ensure that occupant activity does not degrade original design standards and building performance.

Provide a list of areas and uses requiring separate exhaust air systems.

Designate areas free from use of cell phones, two-way radios, and wireless equipment.

### **Commissioning**

Develop a commissioning plan that includes the items listed above.

After construction or renovation provide a minimum flush-out period of two weeks prior to occupancy.

Re-commission buildings periodically. Building use shall be taken into account when determining the re-commissioning schedule.

## **Exterior Landscaping**

- Gardens (see Appendix 6)
  - Design gardens that can be maintained organically without pesticides.
  - Avoid plants with fragrances that may provoke allergies.
  - Exterior gardens and landscape should be free of all plantings that require pesticides, synthetic fertilizers, lime, or other chemical applications.
  - Use indigenous plant materials that are hardy, naturally pest-resistant, require minimal maintenance, and low water use.
  - Use xeriscaping principles.

## APPENDICES

### Appendix 1 - Site Selection: Potential Sources of Pollutants and EMF.

The Committee recognizes that few, if any, building sites are likely to be free of all the pollutant sources listed below. The recommendation is to minimize proximity to as many of these sources as possible in order to maximize outdoor environmental quality and hence indoor environmental quality.

Table A-1 Potential Sources of Pollutants and EMF

General (Air, Soil)	Engine Exhaust	Pesticides	Industrial/Commercial	EMF
Recognized area of poor air quality Smog Smoke (chimney, industrial, etc.)  Superfund Sites Brownfields Landfills Hazardous waste sites Compost sites Underground storage tanks  Floodplains Wetlands Filled-in wetlands  Military bases	Heavy traffic Highways Interstates Diesel exhaust Airports	Agriculture (unless organic) Golf courses Mosquito spraying Parks & Forests Roadside spraying Dairies Chicken & hog farms Other intensive livestock operations	Refineries Mines Chemical plants Cement plants Power plants Manufacturing Logging/Pulp mills Incinerators Sewage treatment plants Gas stations Dry cleaners Other commercial sources that emit air pollutants (See Appendix 5 on Use and Occupancy)	Substations Cell phone towers Radio towers Transponders Transformers High tension lines Electrical distribution lines Radar installations Military bases Airports Electrical Transportation Power-generating dams

### Appendix 2 - Roof Gardens

Roof gardens involve a range of potential issues related to moisture penetration and mold growth. Flat roofs are prone to pooling water and leaking. Foot traffic can cause or accelerate deterioration leading to leaking. Roof repair is more difficult under gardens. Plants may attract pests that subsequently encourage pesticide use. Planting soils can create dust. Plants can emit volatile fumes and pollen. Plants can drop leaves and fruit that rot and become moldy. Selected plants should be low allergen plants without strong fragrance (See Exterior Landscaping above). If used, roof gardens should be located away from air intakes, operable windows, and doors. Design should ensure that moisture will not penetrate the roof membrane or cause conditions of standing water.

## **Appendix 3 - Pest Prevention**

### **Exterior Design:**

Remove lights on or near building that may attract night-flying insects.

Maintain a plant-free zone of about 12 inches around buildings to discourage insects from entering.

Design weep-holes in window frames to prevent access by paper wasps. Design windows to prevent harborage and access for pests, without clear passageways to inside.

Correct structural features that provide opportunities for bird roosting and nesting.

Avoid locating decorative lattices over entrances to food services facilities that may inadvertently serve as bird roosts.

Install bird-proof barriers that are designed to prevent both pigeon and sparrow access to preferred nesting sites.

Design exterior light fixtures so that birds cannot roost or nest on or in them.

Fit eave roof tiles with bird stops (that will also exclude bats, bees and wasps).

Correct structural features that provide opportunities for rodent harborage and burrowing.

Screen or otherwise eliminate animal access under decks, porches, stairways. Seal porches and ramps to the building foundation with ¼-inch hardware cloth screen mesh to form a barrier to digging pests such as rats and skunks. This screen must extend 12 inches into the ground and must have a right-angled, 6 inches wide, outward extending shelf to prevent burrowing under the screen.

Screen ventilation louvers with ¼-inch hardware cloth screen mesh to exclude birds, rodents, cats, etc., (coordinate with mechanical requirements).

Maintain a 2-foot pea gravel strip around buildings to prevent rodent burrowing.

Use a 3" layer of sand barrier underneath slab construction. Use 1-3 mm particle size in place of unsifted sand to provide a permanent sand barrier to termites (both western subterranean and Formosan termites). This will prevent termites from penetrating cracks in slab construction.

For wood not in contact with the ground or concrete, use wood pre-soaked in disodium octoborate tetrahydrate.

### **Refuse and Recycling Areas:**

Place outdoor garbage containers, dumpsters, and compactors on hard, cleanable surfaces and away from building entrances (at least 50 feet from doorways). Design site with properly graded concrete or asphalt pads to help prevent rats from establishing burrows beneath them.

Design site with solid enclosure that extends all the way to the ground. Use metal or synthetic materials, as opposed to chain-link, wood, etc. to prevent rodents from gnawing and climbing the enclosure.

Design trash storage areas that can be closed off from the rest of the building.

Locate storage areas for boxes, paper supplies, and other materials in areas separate from where food or trash is stored. When stored together, these materials put food and shelter together, attracting pests.

## **Landscaped Areas**

Choose proven performers, plants known to do well in the intended planting area. Avoid plants with history of pest problems. Use resistant plant species and cultivars when available. Check with your university or cooperative extension service for recommendations.

Give preference to plants that shed a minimum of seeds and fruits, that may attract and support insects, rodents, and undesired birds.

Design with diversity. Include a wide variety of plants in the landscape to reduce the pest damage potential.

Provide a properly prepared site. Site selection is critical; the site must be compatible with the plants' requirements.

Design landscaped areas with flexibility to allow for campus additions, which may change drainage, exposure to sunlight, ventilation, or other plant requirements.

Avoid crowding of landscape plantings.

Group plantings with similar cultural requirements.

Install or retrofit fence lines and other turf or landscape borders with concrete mowing strips.

Avoid planting vegetation directly against buildings as this provides shelter and sheltered runways for rodents. For the same reason, avoid planting dense vegetation that completely covers the ground.

Do not plant vines which climb building walls, as these create runways for rodents and harborage for undesired bird species.

Plant trees away from buildings to prevent easy access to buildings for insects and rodents.

Give careful consideration to placement of deciduous trees. Leaves which accumulate along foundations provide harborage and sheltered runways for rodents.

## **Interior**

Food Preparation and Serving Areas (main kitchen, dining room, teachers' lounge, snack area, vending machines, and food storage rooms):

- Ensure that new kitchen appliances and fixtures are of pest-resistant design, i.e., open design, few or no hiding places for roaches, freestanding and on casters for easy, thorough cleaning.
- Provide space under and around appliances and equipment in kitchen areas to allow maximum ventilation and ease of (steam) cleaning.
- Use coving at floor-to-wall junctures to minimize build-up of debris and to facilitate cleaning.
- Slope floors in kitchen areas to provide good drainage after cleaning.
- Do not install pegboard in kitchens, animal rooms, or laboratories.
- Insure that all pipe insulation has a smooth surface and that there are no gaps between pieces.
- Refrigerate trash/recycling storage rooms.

### **Classrooms and Offices**

Ensure that new office and classroom furniture that is rarely moved (e.g., staff desks, bookcases, filing cabinets) is designed to permit complete cleaning under and around the furniture, or to allow ready movement for cleaning purposes.

Design or retrofit construction to provide adequate ventilation, preventing trapped moisture and condensation.

### **Storage Areas**

Equip area with self-closing doors.

### **Building Perimeter**

Seal all plumbing and electrical service entrances.

Keep doors closed tightly; equip doors with self-closures and door sweeps.

### **Appendix 4 - Carpet**

Stone, terra cotta, granite, marble, terrazzo, ceramic, brick, or sealed concrete flooring is best tolerated by individuals with chemical sensitivities. Wood flooring that has not been recently stripped or refinished is also often well tolerated by people with chemical sensitivities.

Carpet systems contain a myriad of chemicals in their fiber, dyes, backing, padding, bonding agents, adhesives, antimicrobials, flame retardants, and stain resistance, anti-static, and color fast agents. They also are reservoirs for tracked-in pesticides, dust, dust mites; foster mold growth; and absorb and remit volatile organic chemicals like fragrances and

paint fumes. In addition, many solvent-based agents used to clean carpets emit toxic fumes.

The Carpet and Rug Institute (CRI) has established a rating system and testing program (Green Label Plus) that may be used in lieu of the emissions testing criteria of California's Collaborative for High Performance School (CHPS) Section 01350 (See Products & Materials Committee).

Some people with chemical sensitivities have found that carpet squares with self-adhesive backing have been the best tolerated new carpeting. Others have reacted adversely to such products. More research is necessary to determine what factors in these carpets and/or which brands are best tolerated.

Older carpets are usually better tolerated by people with chemical sensitivities than new ones, as long as they have not become moldy.

Recommendations regarding carpeting (design, materials, and O&M issues):

- Minimize the use of carpeting.
- Use area rugs in place of carpeting whenever possible.
- Consider using self-adhesive carpet squares.
- Tack rather than glue down (unless using self-adhesive carpet).
- If glue down, use low or no VOC adhesive.
- Air out carpet for at least two weeks prior to installation.
- Exceed building flush-out of two weeks if possible.
- Reduce the need for and the frequency of carpet replacement through good maintenance (e.g., thorough vacuuming and frequent cleaning with low toxic products and procedures -- see recommendations by O&M).
- Minimize amount of carpet that is replaced, limit replacement to damaged areas. (A major advantage of carpet square systems is that smaller sections can be replaced).

## Appendix - 5 Use and Occupancy

Non industrial businesses/activities that may generate chemical pollutants include, but are not limited to:

Hair and Nail Salons	Dry Cleaners	Labs (eyeglasses, medical, etc.)
Spas	Laundromats	Dental offices
Restaurants	Nurseries (Plants)	Dialysis Centers
Grills & BBQ	Landscaping, Pest Control	

Furniture stores	Florists	
Woodworking and crafts shops	Candle/Soap/bath shops	
Art/Pottery studios	Pet Shops	
Auto Parts	Photo/Printing/Copy shops	
Taverns/Bars	Specialty foods stores	
Tobacco Shops	Leather goods stores	
Tattoo Parlors	Perfume shops or departments	

Areas that should be vented directly to the outside include: kitchens, labs, computer rooms, copy/fax areas, printer or blueprint rooms, storage areas for toxic materials, showers, locker rooms, and areas where animals are present.

### **Appendix 6 - Landscaping**

Use low allergen plants (See Ogren Plant Allergy Scale).

Plant female trees and shrubs (they do not produce pollen).

Avoid the use of plants that have strong fragrances, such as jasmine, lavender, peppermint, and roses.

Avoid or minimize lawn/turf areas to reduce mowing emissions and chemical usage.

Use low growing fine fescue, buffalo grass, or other turf grass which requires little or no mowing.

Use a wide variety of plant materials.

Group plants with similar water and cultural needs.

Do not crowd plants.

Leave gaps in groundcover to create less hospitable habitat for pests.

Plant deciduous shade trees on the south and west sides of buildings. The shade reduces interior temperatures and reduces A/C usage during summer months.

Use low or no VOC paints, stains and finishes on outside equipment including benches, poles, decks, and other outdoor equipment (See recommendations from Building Products & Materials group.)

Avoid organic mulches (cocoa beans, peat moss, bark, wood chips) as they emit volatile fumes and may harbor mold.

Avoid railroad ties as they contain creosote.

Utilize stone, clay, concrete, and other hard, non-volatile materials to create borders and frame gardens.

## REFERENCES

### Reference 1

ASHRAE Fundamentals Handbook, 2001, 25.19:

<http://www.infiltec.com/inf-larg.htm>

<http://www.argonair.com/pdf/Myth%20About%20Bldg%20Env.pdf>

### Reference 2

P.Levallois, et al., “Prevalence and Risk Factors of Self-Reported Hypersensitivity to Electromagnetic Fields in California” and “An Evaluation of the Possible Risks from Electric and Magnetic Fields (EMF) From Power Lines, Internal Wiring, Electrical Occupations and Appliances.”

<http://www.dhs.ca.gov/ps/deodc/ehib/emf/RiskEvaluation/Appendix3.pdf>

Case study for EMF control (Research Triangle)

[http://www.ncgreenbuilding.org/site/ncg/public/show\\_project.cfm?project\\_id=120](http://www.ncgreenbuilding.org/site/ncg/public/show_project.cfm?project_id=120)

*“EMF reduction: The team reviewed available literature on EMF and their threat to health and determined that while EMF radiation could be measured, its threat to humans had not yet been proven or disproved. Nevertheless, the team recommended adopting a philosophy of prudent avoidance toward EMF risks and undertook modifications of the building design to reduce occupant exposure. EMF radiation can be mitigated by distance and by shielding. Distance offers maximum protection and is “low-tech,” while the costs associated with shielding are high and the results are difficult to measure. Consequently, the design team chose to create “buffer zones” to reduce prolonged exposures in portions of the building that are occupied for long periods of time, such as the laboratories and offices. The largest sources of EMF were identified as the building’s transformers, the electrical rooms with their many cables, and the electrical conduit that was routed under the building atria. As a first step circulation and utility spaces were used to maximize the separation between a source and any potential receptors.”*

### Reference 3

Fumes from activities involving the installation and repair of modified bitumen roofs.

<http://environmentalchemistry.com/yogi/chemicals/cn/Asphalt%20fumes.html>

### Reference 4

Chapter 59, Indoor Air Quality Handbook CFD (Computational Fluid Dynamics) Method for indoor Air Quality Studies. Qingyan Chen, Leon Glicksman, MIT

#### **Reference 4**

Ventilation rate to remove odors falls between 14-50 (l\*s)/person or 28-100 cfm depending upon the type of odors to be removed. Ventilating to remove odor will exceed all requirements for Ventilation rates for human comfort.

(Levin, *Indoor Air Quality Handbook*, McGraw-Hill table 60.2)

ASHRAE 62.1-2004 Ventilation for Acceptable Indoor Air Quality

#### **Reference 5**

LEED™ 6.1, 6.2 Controllability of Systems

- Provide one operable window and one lighting control zone per 200sf of area within 15' of an exterior wall.
- Provide controls for each individual for airflow, temperature, & lighting

ASHRAE 55-1992 Addenda 1995 Thermal Environmental Conditions for Human Occupancy

Recommend maximum of 60% RH

ASHRAE 55-2004 Thermal Environmental Conditions for Human Occupancy

(based on satisfactory thermal comfort for 80% of people. 71d in winter, 76d in summer.)

#### **Reference 6**

LEED™ Prerequisite 2.0 ETS (Environmental Tobacco Smoke) control

[www.epa.gov/iaq/pubs/etsbro.html](http://www.epa.gov/iaq/pubs/etsbro.html)

#### **Reference 7**

LEED™ Credit 3.1 SMACNA (Sheet metal and air conditioning National Contractors Association) IAQ Guidelines for Occupied Buildings under Construction.

#### **Reference 8**

Air Filtration

<http://www.epa.gov/etv/centers/center10.html>

## **BIBLIOGRAPHY**

ANSI/ASHRAE Standard 62.1-2004, Ventilation for Acceptable Indoor Air Quality

ANSI/ASHRAE Standard 62.2-2004, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings

ALA Guidelines (American Lung Association)  
<http://www.healthhouse.org/build/Guidelines.asp>

ATSDR Toxicological Profiles Agency for Toxic Substances and Disease Registry  
<http://www.atsdr.cdc.gov>

California Office of Environmental Health Hazard Analysis  
[http://www.oehha.ca.gov/air/chronic\\_rels/index.html](http://www.oehha.ca.gov/air/chronic_rels/index.html)

Carpet  
<http://www.carpet-rug.org/index.cfm>  
[http://www.carpet-rug.org/drill\\_down\\_2.cfm?page=8&sub=3&requesttimeout=350](http://www.carpet-rug.org/drill_down_2.cfm?page=8&sub=3&requesttimeout=350)

*Diesel and Health in America: The Lingering Threat* [www.catf.us/goto/dieselhealth](http://www.catf.us/goto/dieselhealth)

## **EMF**

[http://www.cep.ca/reg\\_ontario/files/health\\_safety/emf\\_school\\_guidelines.pdf](http://www.cep.ca/reg_ontario/files/health_safety/emf_school_guidelines.pdf)

[http://vitatech.net/q\\_a.html](http://vitatech.net/q_a.html)

<http://www.emf-meter.com/emf-exposure-limits.htm>

Council on Wireless Technology Impacts: <http://www.energyfields.org>  
<http://www.asilo.com/aztap1>  
<http://www.emfservices.com/index.htm>  
[http://www.latitudes.org/articles/electrical\\_sensitivity\\_articles.html](http://www.latitudes.org/articles/electrical_sensitivity_articles.html)  
<http://www.FEB/Links.html>

[www.lessemf.com](http://www.lessemf.com)

"Electromagnetic Shielding: A Handbook Series on Electromagnetic Interference and Compatibility" Vol. 3. By Donald R.J. White and Michael Mardiguian, 1988.  
[http://www.amazon.com/exec/obidos/tg/detail/-/0944916031/ref=pd\\_ecc\\_rvi\\_1/002-9659512-8208838?%5Fencoding=UTF8&v=glance](http://www.amazon.com/exec/obidos/tg/detail/-/0944916031/ref=pd_ecc_rvi_1/002-9659512-8208838?%5Fencoding=UTF8&v=glance).

"Controlling Radiated Emissions by Design" By Michel Mardiguian, 1992.  
Available from the Electromagnetic Compatibility Lab, University of Missouri – Rollo,  
<http://www.emclab.umn.edu/emcbooks.html>

EDN's Designer's Guide to Electromagnetic Compatibility, by Daryl Gerke, P.E. and Bill Kimmel, P.E.

of Kimmell Gerke Associates, Ltd, St. Paul, MN

"EDN: The Design Magazine of the Electronics Industry" supplement, January 20, 1994.

Report by Lucinda Grant – World Health Organization (WHO) International Seminar and Working Group on EMF Hypersensitivity; October 25-27, 2004.

EPA Draft Guidance for Green Buildings: Eight Central Principles, Dave Mudarri

<http://www.housingzone.com/news2.asp?topicId=14531&docId=1:25891088>

*Greening Your Homes* series [www.clevelandgbc.org](http://www.clevelandgbc.org)

***Green Guide for Healthcare from Healthcare Without Harm***

<http://www.gghc.org/>

*Green Building: Project Planning & Cost Estimating* RS Means 2002

*Indoor Air Quality Handbook* McGraw-Hill 2003

*LEED Rating System for New Construction*\_USGBC 2002

*Myths About Building Envelopes*, 1999, Persily, NIST.

New Jersey Idling Regulations

<http://www.state.nj.us/dep/aqm/sub14v2001-10-01.htm>

*Pest Prevention Through Site Design* California Department of Pesticide Regulation

[http://www.cdpr.ca.gov/cfdocs/apps/schoolipm/managing\\_pests/71\\_pest\\_prevention](http://www.cdpr.ca.gov/cfdocs/apps/schoolipm/managing_pests/71_pest_prevention)

*Program Needs for Indoor Environments Research* (PNIER), U.S. EPA, 402-B-05-001,

March 2005, [www.epa.gov/iaq/pubs/pnier.pdf](http://www.epa.gov/iaq/pubs/pnier.pdf)

*Residential Environmental Guidelines*

Hugh L. Carey Battery Park City Authority

*Responding and Preventing Indoor Air Quality Problems in Schools*

Terry Brennan, Camroden Associates, Inc.

SMACNA “*IAQ Guideline for Occupied Buildings under Construction.*”

## **COMMITTEE**

### **Active**

Chair – Roger Morse, AIA, Morse-Zentner Associates

William S. Anderson, Architect

Mary Lamielle, National Center for Environmental Health Strategies

Ann McCampbell, Multiple Chemical Sensitivities Task Force of New Mexico

Susan Molloy, National Coalition for the Chemically Injured

Toni Temple, Ohio Network for the Chemically Injured

### **Contributing**

Terry Brennan, Camroden Associates

Jack Carman, *ASLA and Sustainable and Therapeutic Garden Group members for their input*

*Design for Exterior Landscaping Recommendations*

Jim LaRue, Healthy House Institute

David Rousseau, Archemy Consulting, Ltd.

Dave Rupp, Cabinet King, Inc.

### **Commenting**

Josh Roehm PE, Scheeser, Buckley Mayfield Engineers

**National Institute of Building Sciences (NIBS)  
Indoor Environmental Quality (IEQ) Project  
Building Products & Materials Committee**

**Table of Contents**

**Introduction**

**Overview – Design**

**Overview – Building Operations and Maintenance**

**CHPS Section 01350 Part 1.3B and 1.4D and GREENGUARD Allowable**

**Emission Levels**

**Formaldehyde**

**Adhesives and Sealants**

**Appliances**

**Ceilings**

**Composite Wood Products (plywood, particle board, OSB, paneling, etc.)**

**Fireproofing**

**Flooring and Floor Systems**

**Insulation**

**Paint**

**Textiles**

**Walls**

**Wallcovering**

**Conclusion & Recommendations**

**Committee**

**Introduction**

The goal of the NIBS – IEQ Products & Materials Committee was to develop procedures and guidelines to aid persons in making informed material selections in order to construct a building that will be accessible to persons with multiple chemical sensitivities (MCS) and/or electromagnetic sensitivities (EMS). The NIBS IEQ-Materials Committee has reviewed existing standards and guidance for materials selection in building construction. The group has determined that certain features of the existing standards offer a reasonable starting point for the selection of building materials, and in some respects can offer a more accessible environment to persons with MCS and/or EMS. These existing standards are designed to create healthier indoor air quality by making appropriate building material selections, among other things. Though the existing standards may not result in material selections that will make a building accessible to the majority of persons with MCS and/or EMS, they will produce a healthier building, than one constructed without regard to these standards. Healthier buildings would be useable by people with other health conditions such as asthma and other respiratory conditions, allergies and migraine headaches.

The NIBS IEQ Materials Committee has attempted to take the best ideas or practices from the existing standards and guidelines to recommend material selections that will provide for healthier, more accessible buildings. If a designer follows the suggestions provided herein, it will result in a building that has the lowest chance of IEQ problems stemming from the materials and that has the best likelihood of being accessible to persons with MCS and/or EMS.

The standards reviewed by the Materials Group include:

- Collaborative for High Performance Schools (CHPS) Section 01350
- Green Guard Environmental Institute - Certification Standards for Low Emitting Products for the Indoor Environment
- Green Seal – Environmental Standards
- Green Guidelines for Healthcare – Materials and Resources
- Reducing Occupant Exposure to Volatile Organic Compounds (VOCs) from Office Building Construction Materials: Non-Binding Guidelines - California Department of Health Services

Two of the key elements involved in the materials selection process are a component content screening (what chemicals and compounds are known to be a part of the material) and an emissions testing protocol. Both the California Section 1350 Specification and the Green Guard Standards recommend emissions testing based on the ASTM Method ASTM standards D-5116-97 and D- 6670-01. The Committee believes that both of these elements must be involved in making appropriate building material selections.

### **Overview - Design**

The Products & Materials Committee believes that particular attention is critical during building design to assure that the needs of chemically and electromagnetically sensitive people are accommodated to the greatest extent possible. In general, this means selection of construction materials that are low-emitting or non-emitting and selection of finishes that do not absorb or react with chemicals emitted by other materials or products in the building. To begin to address some of the concerns of electromagnetically sensitive persons, areas of the building can be designed to have reduced electromagnetic fields. By making indoor environments that are safer for the most vulnerable among us, we can create indoor environments that are healthier for everyone, especially children.

Generally, this means selection of materials that are “hard” or non-porous where possible so that any chemicals that contact these materials are not retained in and re-emitted from them. Also, particular attention should be paid to selection of materials that will not require VOC-emitting chemicals later as part of maintenance. For instance, in designing building foundations and structures, particular attention should be paid to the need for preventing termite problems, since the pesticides commonly used to control termites can have a deleterious effect on humans, especially persons with multiple chemical sensitivities. So, even though the material itself might be low-emitting, the use of products meant to “preserve, protect, or maintain” the material selected might emit volatile fumes that degrade indoor environmental quality and result in a building that is not suitable for persons with MCS.

In addition, during building design particular attention must be paid to choice of electrical appliances, equipment and products that may produce higher than necessary electromagnetic fields. The NIBS-IEQ Materials Committee recognizes that there are selections that can be made during building design and construction that can provide a more healthful environment for persons with electromagnetic sensitivities. A few of these considerations are:

- Incorporation of a foil vapor barrier or other metal shielding feature into the walls around electric equipment can reduce certain electromagnetic fields.

- Wireless (“bluetooth” type) connections should be avoided, or areas of their use should be "contained" by using foil-backed drywall or other incorporation of a foil or metal barrier.
- New construction should use twisted metal clad wiring and/or twisted wire placed in metal conduit.
- Fiber optic connectivity is preferred for computer networks communication because these data lines may be run without concern for stray emissions.

## **Overview – Building Operations and Maintenance**

Vigilance is required to assure that materials brought into the building throughout the course of its life are consistent with the standards provided herein, and are consistent with the design intent of the building.

For example, the Products & Materials Committee realizes that building operations and maintenance products might introduce materials that are not consistent with the initial design for an accessible, healthy building.

Building managers must also pay close attention to materials brought into the building environment by tenants or others to assure that these materials are consistent with provision of an accessible, healthy building for persons with multiple chemical sensitivities, electromagnetic sensitivities, and/or other health disorders. For instance, a tenant may bring furniture in that does not meet the design criteria presented in this document, and these materials could have detrimental effects on air quality within the entire building, depending on the design of the HVAC system. In addition, the chemicals and compounds used for maintenance can degrade environmental quality and seriously affect persons with multiple chemical sensitivities. Other products that can have detrimental effects on IEQ and/or certain individuals include paints and other finishes, carpeting, appliances and other electrical equipment, and others.

## **CHPS Section 01350 Part 1.3B and 1.4D and GREENGUARD Allowable Emission Levels**

The NIBS – IEQ Products & Materials Committee believes that the CHPS Indoor Air Quality Emissions Testing Standards and the Green Guard Allowable Emission Levels offer tested and reviewed approaches to material and product selection for buildings. Given the range of guidance and standards available for material selection, these two standards provide the most widely accepted processes for making material selections to construct buildings that are healthier for the general public. It should be noted that the NIBS –IEQ Products & Materials Committee does not believe that either of these standards offers an entirely acceptable solution for persons with MCS and EMS. However, they provide a starting point in making material selections, and they provide the best available guidance on component screening and materials emission limits. Making materials selections that meet either the CHPS or the Green Guard allowable emission levels should be considered an absolute minimum requirement in creating a building or environment that is accessible to persons with MCS and EMS. No designer or other person making material selections should choose any materials that do not at least meet these standards. Even then, the other considerations discussed herein should be a part of the selection process to provide the best

opportunity that the building will provide an environment accessible to persons with MCS and EMS.

The Green Guard Certification Standards list allowable emissions for a range of building products. A designer or other individual making a material selection must investigate product literature, for the material under consideration, to determine if the product meets at least the Green Guard standards. The Green Guard web site lists products that have been tested and have met their standards. However, it is possible that a product manufacturer has not submitted their product for certification to either Green Guard or CHPS. In this case, the person making a material selection must seek any published emissions testing data and product component data available from the manufacturer. Some manufacturers publish data on emissions from their products, and other manufacturers are moving quickly to provide such data. If such data is not currently published, the manufacturer must have the product or material tested in accordance with the testing regimen specified in the Green Guard or CHPS 01350 Certification Standards.

The CHPS Section 01350 protocols and the Green Guard Certification for IAQ data require the same chamber testing. The CHPS protocols and calculations go further than the Green Guard Certification Standards in that the designer is required to take published emissions rates and perform calculations based on the amount of material to be installed in the building and the zones and air handling capabilities of the HVAC systems in those zones. Also, the allowable emission level for formaldehyde is lower in the CHPS standard than the Green Guard standard. See the discussion below for more information on formaldehyde.

For both standards, all building materials are required to be tested in dynamic environmental chambers following ASTM standards D-5116-97 and D-6670-01, the U.S. Environmental Protection Agency's testing protocol for furniture and the State of Washington's protocol for interior furnishings and construction materials. Products are measured for emission levels according to the parameters set forth in the ASTM Standard for emissions testing.

California - Practice for Testing of VOC's from Building Materials Using Small Chambers

<http://www.dhs.ca.gov/ps/deodc/ehlb/iaq/VOCS/Practice.htm>

The allowable emission levels of both standards can be found by clicking on the links below. In some cases, the Green Guard standards may appear to have lower standards for emissions of some VOCs than the CHPS Section 1350 standards. However, the person selecting materials for the building must bear in mind that the CHPS standard requires a detailed calculation for the building, the amount of material to be installed and the air change rate of the HVAC systems. Green Guard emissions standards are based on a "standard" model of a building, and a "standard" exchange rate of fresh air in the building.

CHPS Section 01350 [http://www.chps.net/manual/documents/Sec\\_01350.doc](http://www.chps.net/manual/documents/Sec_01350.doc)

CHPS Compliant Materials Table [http://www.chps.net/manual/lem\\_table.htm](http://www.chps.net/manual/lem_table.htm)

Green Guard Allowable Emission Levels

<http://www.greenguard.org/DesktopDefault.aspx?tabindex=3&tabid=16>

Green Guard Certified Product Guide

<http://www.greenguard.org/DesktopDefault.aspx?tabindex=1&tabid=12>

### **Additional Resources**

California Department of Health Services IAQ Program Voluntary Guidelines for Reducing Occupant Exposure to VOCs

[http://www.dhs.ca.gov/iaq/VOCS/VOC\\_guidelines\\_1996.html](http://www.dhs.ca.gov/iaq/VOCS/VOC_guidelines_1996.html)

California Materials Emissions Study

<http://www.ciwmb.ca.gov/Publications/default.asp?pubid=1027>

U.S. EPA Indoor Environment Program web site -- VOCs

<http://www.epa.gov/iaq/voc.html>

## **Formaldehyde**

Formaldehyde is widely used by industry to manufacture building materials and numerous consumer products. It is also a by-product of combustion and certain other natural processes. Formaldehyde, by itself or in combination with other chemicals, serves a number of purposes in manufactured products. For example, it is used to add permanent-press qualities to clothing and draperies, as a component of glues and adhesives, and as a preservative in some paints and coating products.

In building materials, the most significant sources of formaldehyde are likely to be pressed wood products made using adhesives that contain urea-formaldehyde (UF) resins. Pressed wood products include: particleboard (used as sub-flooring and shelving and in cabinetry and furniture); hardwood-veneer plywood paneling (used for decorative wall covering and used in cabinets and furniture); and medium density fiberboard (used for drawer fronts, cabinets, and furniture tops). Medium density fiberboard contains a higher resin-to-wood ratio than any other UF pressed wood product and is generally recognized as being the highest formaldehyde-emitting pressed wood product.

Other pressed wood products, such as softwood plywood and flake or oriented strandboard, are produced for exterior construction use and contain the dark, or red/black-colored phenol-formaldehyde (PF) resin. Although formaldehyde is present in both types of resins, pressed woods that contain PF resin generally emit formaldehyde at considerably lower rates than those containing UF resin.

The NIBS – IEQ Products & Materials Committee is concerned about human exposure to formaldehyde, especially for individuals with multiple chemical sensitivities. The widespread use of formaldehyde, its known health effects, and the hyper-sensitivities of certain individuals create this concern. It may not be possible to make material selections that are completely free of formaldehyde, but where possible, the individual making material selections should make every effort to avoid products manufactured with formaldehyde. New soy-based adhesives are coming on to the market to replace formaldehyde resins used in many manufactured wood products. It may soon be possible to choose alternative products that are not formulated with this volatile organic compound (VOC).

The California Office of Environmental Health Hazard Assessment has determined that the lowest, reasonably achievable level of formaldehyde (because it is equal to ambient air

concentrations) is 33 (milligrams per cubic meter)  $\text{ug}/\text{m}^3$ , or 23 (parts per billion) ppb. Thus, the CHPS 01350 standard requires that a material must not emit a level of formaldehyde that results in a concentration of  $\frac{1}{2}$  of this level, or  $16 \text{ ug}/\text{m}^3$  (11 ppb). This limit is lower than the allowable emission level of the Green Guard standard. The NIBS – IEQ Products & Materials Committee believes that the  $16 \text{ ug}/\text{m}^3$  (11 ppb) level is a minimum requirement for formaldehyde emissions from building materials.

***Following is a list of typical building materials and some considerations for selection. Note that the considerations listed below are in addition to the recommended emissions standards from CHPS 1350 and Green Guard.***

### **Adhesives and Sealants**

One objective of the IEQ-Products & Materials Committee is to reduce the quantity of indoor air contaminants created by adhesives and sealants that are potentially irritating and/or harmful to occupants of buildings. The use of VOC-emitting adhesives and/or sealants should be minimized to the greatest extent possible in order to create an accessible, comfortable environment for the greatest numbers of people.

The designer should specify application of only the minimum amounts of these materials necessary for satisfactory completion of each installation task. Additionally, the designer should select products that have the lowest possible VOC emissions, according to the emissions testing information provided, while still meeting other performance requirements. Caution should be exercised when interpreting adhesive emission data because such data are usually provided without the associated installed products (e.g., flooring materials) and emissions from installed assemblies may differ from manufacturers' reported adhesive emission rates. If possible, adhesives that contain formaldehyde should be avoided.

The Committee also recommends that paints and finishes be selected that do not contain biocides.

In any building where adhesive use is necessary, it is a good practice to ensure that maximum ventilation is supplied during and after application of these products.

### **Appliances**

Appliances can emit volatile fumes as well as create electromagnetic fields.

Electromagnetic fields and radiofrequencies can jeopardize the functioning and safe access of electromagnetically sensitive individuals. Examples of indoor appliances which can provoke health problems include:

- cell and portable telephones,
- fluorescent lights,
- unshielded transformers and wiring,
- battery re-chargers,

- wireless devices including computers and personal communication services (“PCS”),
- security and scanning equipment,
- numerous common work place and household electronic appliances.

Many electrical appliances and equipment can be improved to varying degrees by appropriate shielding, and/or by being located in areas remote from vulnerable individuals.

It is not recommended that such equipment be eliminated from the built environment, but that exposure of vulnerable individuals to such equipment be voluntary or easily avoidable.

## **Ceilings**

Of particular concern to the NIBS-IEQ Products & Materials Committee are T-bar suspended ceilings used as return air plenums in buildings, because both sides of the panels come in contact with indoor air. In addition, penetrations for sprinklers, alarms, and smoke detectors may significantly increase the area exposed to emissions. Temperatures near ceiling surfaces and in return air plenums are usually higher than those in occupied zones and, as a result, increased emissions from ceiling materials may occur. The individual selecting ceiling materials should carefully consider the acoustic, fire, and aesthetic requirements for each space prior to material selection. Nonporous materials are now available that combine aesthetic, acoustical, and fire code requirements.

Ceiling materials that contain organic materials present the possibility of mold contamination if the ceiling system becomes wet. Porous ceilings and ceiling finishes can also act as receptors for toxins and VOCs that are brought into the building and later re-emit them. Many ceiling tile products are made using urea formaldehyde. No products using urea formaldehyde should be allowed.

## **Composite Wood Products (plywood, particle board, OSB, paneling, etc.)**

Because they emit formaldehyde and other VOCs, use of composite wood products should be minimized, if not eliminated. If it is absolutely necessary to use such products, the designer should select materials that meet the specified building criteria and are the lowest emitting products available according to emissions testing data. Formaldehyde emissions are of particular concern in composite wood products. Note that VOC-emitting wood preservatives may be used in some of these products. There are a number of manufacturers that are replacing formaldehyde adhesives in composite wood products with non-emitting adhesives and the Committee recommends using these alternative products whenever possible.

## **Fireproofing**

The use of fireproofing chemicals should be minimized when possible. Spray-on fireproofing can cause indoor air quality problems when chemical components are released into the air as a result of mechanical damage, air erosion, or deterioration of the binder. Also because spray-on materials have large, porous surface areas, they can act as sinks for adsorption and re-emittance of VOCs. If possible, seal the surface of spray-on fireproofing to reduce adsorption of VOCs. Ensure that the sealer: (a) will not change fire characteristics of the original fireproofing material; and (b) is not a high-VOC emitter. Also seal any

penetrations of surfaces sprayed with fireproofing material to prevent damage of the material in the vicinity of penetrations.

## **Flooring and Floor Systems**

The NIBS-IEQ Products & Materials committee recommends use of flooring products that are low or non-emitting and are non-porous. Consideration should also be given to maintenance products that will be necessary for the type of flooring selected. For instance, stripping and refinishing of wood flooring introduces hazardous chemicals into the air and are intolerable for persons with multiple chemical sensitivities. When selecting a floor system, the type of adhesives used with the flooring system must also be considered.

Stone, terra cotta, granite, marble, terrazzo, ceramic, brick, or sealed concrete flooring are best tolerated by individuals with chemical sensitivities, and provide a healthy, comfortable environment for the greatest number of people.

Wood flooring that has not been recently stripped or refinished and older vinyl flooring is also often well tolerated by people with chemical sensitivities.

Rubber, linoleum, and cork flooring are not recommended.

The Resilient Floor Covering Institute (RFCI) has recently introduced a new certification program for low emitting flooring products called the FloorScore™ program. The FloorScore program is a building materials emissions testing program that requires both independent laboratory testing and third-party certification to show compliance with CCHPS 01350 VOC emissions limits and includes certified site audit and documented control system requirements. The third-party certifier, Scientific Certification Systems, Inc. (SCS), not only reviews the results of the product VOC emissions report but also reviews raw material inputs and manufacturing processes to ensure that a product is consistently manufactured. SCS conducts site audits of manufacturing plants to ensure a quality management plan exists for continuing compliance of the product as defined in SCS-EC-10-2004 Environmental Certification Program – Indoor Air Quality Performance.

Resilient Floor Covering Institute – “Floor Score” Program

[http://www.rfci.com/int\\_FloorScore.htm](http://www.rfci.com/int_FloorScore.htm)

Floor Score List of Certified Products

[http://www.rfci.com/int\\_FS-ProdCert.htm](http://www.rfci.com/int_FS-ProdCert.htm)

Carpet systems contain a myriad of chemicals in their fiber, dyes, backing, padding, bonding agents, adhesives, antimicrobials, flame retardants, and stain resistance, anti-static, and color fast agents. They are reservoirs for tracked-in pesticides, dust, dust mites; foster mold growth; and absorb and re-emit volatile organic chemicals like fragrances and paint fumes. In addition, many solvent-based agents used to clean carpets emit toxic fumes.

The Carpet and Rug Institute (CRI) has established a rating system that involves emission testing that is based on CHPS Section 01350, and includes additional requirements. Carpets labeled with the CRI Green Label Plus are expected to have lower emissions than most

carpets. However, even carpets emitting low levels of volatile organic chemicals (VOC's) can cause adverse health effects in certain individuals.

CRI Green Label Plus link

[http://www.carpet-rug.org/drill\\_down\\_2.cfm?page=8&sub=3&requesttimeout=350](http://www.carpet-rug.org/drill_down_2.cfm?page=8&sub=3&requesttimeout=350)

Some people with multiple chemical sensitivities have found that carpet squares with self-adhesive backing have been the best tolerated new carpeting. Others have reacted adversely to such products. More research is necessary to determine what factors in these carpets and/or which brands are best tolerated.

Older carpets are usually better tolerated by people with chemical sensitivities than new ones, as long as they have not become moldy.

Recommendations regarding carpeting (design, materials, and O&M issues):

1. Minimize the use of carpeting
2. Use area rugs in place of carpeting whenever possible
3. Consider using self-adhesive carpet squares
4. Tack rather than glue down (unless using self-adhesive carpet)
5. If glue down, use low or no VOC adhesive
6. Air out carpet for at least two weeks prior to installation
7. Ventilate building with 100% outside (or fresh) air for as long as possible after installation
8. Reduce the frequency of carpet replacement by maintaining them well (e.g., vacuum thoroughly and frequently and clean with low toxic products and procedures – (see recommendations by Operations & Maintenance Committee).
9. Minimize amount of carpet that is replaced, limit replacement to damaged areas (an advantage of carpet square systems is that smaller sections can be more easily replaced).

## **Insulation**

The NIBS-IEQ Products & Materials committee realizes that insulation is an essential component in building systems to assure a comfortable environment. Insulation and insulating materials are generally hidden or covered, however emissions can still be encountered by building occupants. The Committee believes that polystyrene foam insulation is best tolerated by persons with multiple chemical sensitivities. Other insulating products, such as fiberglass, cellulose, or cotton/polyester blend insulating products may produce particulates, harbor mold, or emit problematic volatile fumes, depending on the product and the manufacturing techniques used.

The Committee has particular concerns about interior lined ductwork, due to the insulation's ability to collect and trap chemical contaminants, dusts, microbes and fungi, as well as emissions from the adhesives used to secure the insulation. It is recommended that no interior-lined ductwork be used in the construction of buildings meant to be accessible to persons with MCS.

Lastly, insulation used anywhere in buildings must not contain urea-formaldehyde resins.

## **Paint**

The NIBS-IEQ Products & Materials Committee determined that for some individuals, 100% acrylic paint and paints containing low-VOC emissions can be acceptable. Paints containing styrene-butadiene latex combinations, enamels, strippers and paint thinners are all problematic and should be avoided or their use minimized.

For some individuals, well-hardened enamel paint, baked-on enamel finish, or porcelainized steel provide optimum safety. These products provide a hard, durable surface that can be easily cleaned using non-toxic products.

Paints with biocides or biocide additives (mold/mildew resistant) should not be selected.

## **Textiles**

The NIBS-IEQ Products & Materials committee recommends sparing or no use of textiles in buildings. Though it may be possible to introduce textiles with no emissions, textiles provide a porous medium to trap chemical contaminants, dusts and microbes that can create an unhealthy environment. In addition, the dry cleaning and laundering of textiles pose additional problems due to the cleaning products.

## **Walls**

Gypsum wallboard: Gypsum may be reasonably inert and extremely low in VOC emissions. However, additives used to produce mold-proof gypsum wallboard (i.e., "green board"), fire-resistant gypsum wallboard, or to improve the workability of the slurry during manufacture may include compounds that emit VOCs. Careful product selection and review of emissions testing data is necessary to assure that appropriate materials are chosen. Recycled paper covering both sides of gypsum wallboard may contain chemicals from previous uses, and additives or chemicals used in the production of the paper itself. Note that VOC emissions from gypsum wallboard can sometimes be significantly reduced by "painting" or laminating the surfaces. The more impervious the coating or covering, the greater will be the reduction in VOC emissions from gypsum wallboard. However, VOC emissions from surface treatment materials must be considered.

Gypsum wallboard can act as a sink for other VOCs in indoor air. Avoid exposing unpainted gypsum wallboard to indoor environments where emissions from other VOC sources exist. Taping and topping compounds can contain considerable quantities of VOCs, so emissions testing data for these products are also critically important. Use ventilation and heat to accelerate the drying process of these materials. Protect wallboard from exposure to contaminants and excessive moisture prior to installation.

Where possible, select material to reduce the need for paints, wallcoverings, or porous wall finishes in buildings. Most commercial structures are built using metal studs, a good selection for persons with MCS. Wood studs can emit terpenes and pinenes

## **Wallcovering**

Wallpapers may contain vinyl, plasticizers, styrene-butadiene latex combinations and other chemicals that can seal and trap moisture between the wallpaper and the wall fostering mold growth. The water-based pastes and glues used to adhere the wallpaper to the wall may

contain mold retardants and pesticides. Adhesives can emit volatile fumes. For these reasons we recommend that wallpapers not be used.

## **Conclusion & Recommendations**

In order to minimize the level of air pollutants emitted from building materials and create healthier indoor environments, the NIBS Products & Materials Committee recommends that inert, non-porous materials be used to the greatest extent possible. This will increase access for the greatest number of chemically sensitive individuals. Choosing appliances and other equipment that create the lowest level of electromagnetic fields will increase access for those with electromagnetic sensitivities.

If materials are used that emit volatile fumes, the Committee recommends that these materials meet or exceed the CHPS Indoor Air Quality Emissions Testing Standards or Green Guard Allowable Emission Levels, as well as contain no formaldehyde or biocides. The Committee also recommends that, whenever possible, products and materials be aired out (preferably outside or in a separate well-ventilated space) for two weeks prior to being installed in a building.

While the Committee acknowledges that the CHPS Indoor Air Quality Emissions Testing Standards and Green Guard Allowable Emission Levels are the best current standards for selecting building materials that create healthier buildings, the Committee is concerned that these standards may not sufficiently protect the health of building occupants, especially those with chemical sensitivities and other vulnerable individuals.

Therefore, the Committee supports:

- 1) Creation of more stringent emission standards and development of a wider range of less volatile and less hazardous building materials, especially in the areas of resilient flooring and carpeting.
- 2) Full disclosure of product ingredients (on product labels or available upon request) to enable builders to make more informed decisions regarding selection of building materials.
- 3) Consulting with chemically and electromagnetically sensitive individuals or organizations, especially employees and others who frequently use a building, prior to making final decisions regarding product selection.

## **Committee Members**

### **Active**

Chair – Brent Kynoch, Kynoch Environmental Management, Inc.  
Mary Lamielle, National Center for Environmental Health Strategies  
Ann McCampbell, Multiple Chemical Sensitivities Task Force of New Mexico  
Susan Molloy, National Coalition for the Chemically Injured  
Toni Temple, Ohio Network for the Chemically Injured

## **Contributors**

Terry Brennan, Camroden Associates  
Dave Rupp, Cabinet King, Inc.

**Commentor**

Mike Preston, Burt Hill Kosar and Rittelman Associates



# American Academy of Environmental Medicine

---

## Executive Committee

### American Academy of Environmental Medicine Recommendations Regarding Electromagnetic and Radiofrequency Exposure

#### President

Physicians of the American Academy of Environmental Medicine recognize that patients are being adversely impacted by electromagnetic frequency (EMF) and radiofrequency (RF) fields and are becoming more electromagnetically sensitive.

#### President-Elect

The AAEM recommends that physicians consider patients' total electromagnetic exposure in their diagnosis and treatment, as well as recognition that electromagnetic and radiofrequency field exposure may be an underlying cause of a patient's disease process.

#### Secretary

Based on double-blinded, placebo controlled research in humans,<sup>1</sup> medical conditions and disabilities that would more than likely benefit from avoiding electromagnetic and radiofrequency exposure include, but are not limited to:

#### Treasurer

- Neurological conditions such as paresthesias, somnolence, cephalgia, dizziness, unconsciousness, depression
- Musculoskeletal effects including pain, muscle tightness, spasm, fibrillation
- Heart disease and vascular effects including arrhythmia, tachycardia, flushing, edema

#### Immediate Past President

#### Advisor

- Pulmonary conditions including chest tightness, dyspnea, decreased pulmonary function
- Gastrointestinal conditions including nausea, belching
- Ocular (burning)
- Oral (pressure in ears, tooth pain)
- Dermal (itching, burning, pain)
- Autonomic nervous system dysfunction (dysautonomia).

#### Board of Directors

Based on numerous studies showing harmful biological effects from EMF and RF exposure, medical conditions and disabilities that would more than likely benefit from avoiding exposure include, but are not limited to:

#### Continuing Medical Education

- Neurodegenerative diseases (Parkinson's Disease, Alzheimer's Disease, and Amyotrophic Lateral Sclerosis).<sup>2-6</sup>
- Neurological conditions (Headaches, depression, sleep disruption, fatigue, dizziness, tremors, autonomic nervous system dysfunction, decreased memory, attention deficit disorder, anxiety, visual disruption).<sup>7-10</sup>
- Fetal abnormalities and pregnancy.<sup>11,12</sup>
- Genetic defects and cancer.<sup>2,3,13-19</sup>
- Liver disease and genitourinary disease.<sup>12,20</sup>

#### Executive Director

Because Smart Meters produce Radiofrequency emissions, it is recommended that patients with the above conditions and disabilities be accommodated to protect their health. The AAEM recommends: that no Smart Meters be on these patients' homes, that Smart Meters be removed within a reasonable distance of patients' homes depending on the patients' perception and/or symptoms, and that no collection meters be placed near patients' homes depending on patients' perception and/or symptoms.

Submitted by: Amy L. Dean, DO and William J. Rea, MD

Approved July 12, 2012 by the Executive Committee of the American Academy of Environmental Medicine

### **Bibliography**

1. Rea WJ, Pan Y, Fenyves EJ, et al. Electromagnetic field sensitivity. *Journal of Bioelectricity*. 1991; 10(1 &2): 243-256.
2. Xu S, Zhou Z, Zhang L, et al. Exposure to 1800 MHz radiofrequency radiation induces oxidative damage to mitochondrial DNA in primary cultured neurons. *Brain Research*. 2010; 1311: 189-196.
3. Zhao T, Zou S, Knapp P. Exposure to cell phone radiation up-regulates apoptosis genes in primary cultures of neurons and astrocytes. *Neurosci Lett*. 2007; 412(1): 34-38.
4. Nittby H, Brun A, Eberhardt J, et al. Increased blood-brain barrier permeability in mammalian brain 7 days after exposure to the radiation from a GSM-900 mobile phone. *Pathophysiology*. 2009; 16: 103-112.
5. Awad SM, Hassan NS. Health Risks of electromagnetic radiation from mobile phone on brain of rats. *J. Appl. Sci. Res*. 2008; 4(12): 1994-2000.
6. Leszczynski D, Joenvaara S. Non-thermal activation of the hsp27/p38MAPK stress pathway by mobile phone radiation in human endothelial cells: Molecular mechanism for cancer - and blood-brain barrier - related effects. *Differentiation*. 2002; 70: 120-129.
7. Santini R, Santini P, Danze JM, et al. Study of the health of people living in the vicinity of mobile phone base stations: 1. Influences of distance and sex. *Pathol Biol*. 2002; 50: 369-373.
8. Abdel-Rassoul G, Abou El-Fateh O, Abou Salem M, et al. Neurobehavioral effects among inhabitants around mobile phone base stations. *Neurotox*. 2007; 28(2): 434-440.
9. Hutter HP, Moshammer H, Wallner P, Kundi M. Subjective symptoms, sleeping problems, and cognitive performance in subjects living near mobile phone base stations. *Occup. Environ. Med*. 2006; 63: 307-313.

10. Kolodynski AA, Kolodynska VV. Motor and psychological functions of school children living in the area of the Skrunda Radio Location Station in Latvia. *Sci. Total Environ.* 1996; 180: 87-93.
11. Magras IN, Xenos TD. RF radiation-induced changes in the prenatal development of mice. *Bioelectromagnetics.* 1997; 18:455-461.
12. Ingole IV, Ghosh SK. Cell phone radiation and developing tissues in chick embryo - a light microscopic study of kidneys. *J. Anat. Soc. India.* 2006; 55(2): 19-23.
13. Phillips JL, Singh NP, Lai H. Electromagnetic fields and DNA damage. *Pathophysiology.* 2009; 16: 79-88.
14. Ruediger HW. Genotoxic effects of radiofrequency electromagnetic fields. *Pathophysiology.* 2009; 16(2): 89-102.
15. Lee S, Johnson D, Dunbar K. 2.45 GHz radiofrequency fields alter gene expression on cultured human cells. *FEBS Letters.* 2005; 579: 4829-4836.
16. Demisia G, Vlastos D, Matthopoulos DP. Effect of 910-MHz electromagnetic field on rat bone marrow. *The Scientific World Journal.* 2004; 4(S2): 48-54.
17. Lai H, Singh NP. Magnetic-field-induced DNA strand breaks in brain cells of the rat. *Environmental Health Perspectives.* 2004; 112(6): 687-694. Available from: <http://ehp03.niehs.nih.gov/article/info:doi/10.1289/ehp.6355>
18. Mashevich M, Foldman D, Kesar, et al. Exposure of human peripheral blood lymphocytes to electromagnetic fields associated with cellular phones leads to chromosomal instability. *Bioelectromagnetics.* 2003; 24: 82-90.
19. Ban R, Grosse Y, Lauby-Secretan B, et al. Carcinogenicity of radiofrequency electromagnetic fields. *The Lancet Oncology.* 2011; 12(7): 624-626. Available from: [http://www.thelancet.com/journals/lanonc/article/PIIS1470-2045\(11\)70147-4/fulltext?\\_eventId=login](http://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(11)70147-4/fulltext?_eventId=login)
20. Lubec G, Wolf C, Bartosch B. Amino acid isomerisation and microwave exposure. *Lancet.* 1989; 334: 1392-1393.



## American Academy of Environmental Medicine

6505 E Central • Ste 296 • Wichita, KS 67206

Tel: (316) 684-5500 • Fax: (316) 684-5709

[www.aaemonline.org](http://www.aaemonline.org)

### Executive Committee

August 30, 2013

#### President

Amy L. Dean, D.O., FAAEM  
1955 Pauline Blvd Ste 100D  
Ann Arbor, MI 48103

Office of the Secretary  
Federal Communications Commission  
445 12<sup>th</sup> Street, SW  
Washington, D.C. 20554

#### President-Elect

Janette Hope, M.D., FAAEM  
304 W Los Olivos  
Santa Barbara, CA 93105

#### Secretary

Jennifer Armstrong, M.D., FAAEM  
3364 Carling Ave.  
Ottawa, Ontario, Canada

#### Treasurer

Richard G. Jaeckle, M.D., FAAEM  
8220 Walnut Hill Ln Ste 404  
Dallas, TX 75231

#### Immediate Past President

A.L. Barrier, M.D., FAAO-HNS

#### Advisor

William J. Rea, M.D., FAAEM  
Gary R. Oberg, M.D., FAAEM

#### Board of Directors

Craig Bass, M.D.  
Robin Bernhoft, M.D., FAAEM  
Martha Grout, M.D., MD(H)  
W. Alan Ingram, M.D.  
Derek Lang, D.O.  
Allan D. Lieberman, M.D., FAAEM  
Lisa Nagy, M.D.  
Kalpana D. Patel, M.D., FAAEM

#### Continuing Medical Education

Chair  
James W. Willoughby, II, D.O.  
24 Main St.  
Liberty, MO 64068

#### Assistant-Chair

Wm. Alan Ingram, M.D.  
18015 Oak St Ste B  
Omaha, NE 68130

Re: ET Docket No. 13-84

Dear Federal Communications Commission Commissioners:

The American Academy of Environmental Medicine is writing to request that the FCC review radiofrequency (RF) exposure limits (reference is made to the FCC's NOI sections 48, 51, 52, 53, 56, 60, 65 and 69), recognize non-thermal effects of RF exposure (NOI sections 66 and 69), and lower limits of RF exposure to protect the public from the adverse health effects of radiofrequency emissions (NOI sections 48, 52, 54, 65 and 71).

Founded in 1965 as a non-profit medical association, the AAEM is an international association of physicians and scientists who study and treat the effects of the environment on human health. With an elite membership of highly trained physicians and clinicians, AAEM is committed to education, public awareness and research regarding Environmental Medicine.

It became clear to AAEM physicians that by the mid 1990's patients were experiencing adverse health reactions and disease as a result of exposure to electromagnetic fields. In the last five years with the advent of wireless devices, there has been an exponential increase in the number of patients with radiofrequency induced disease and hypersensitivity.

Numerous peer reviewed, published studies correlate radiofrequency exposure with a wide range of health conditions and diseases. (NOI sections 54, 59, 60 and 65) These include neurological and neurodegenerative diseases such as Parkinson's Disease, ALS, paresthesias, dizziness, headaches and sleep disruption as well as cardiac, gastrointestinal and immune disease, cancer, developmental and reproductive disorders, and electromagnetic sensitivity. The World Health Organization has classified RF emissions as a group 2 B carcinogen. This research is reviewed and cited in the following attached documents: *AAEM Electromagnetic and Radiofrequency Fields Effect on Human Health* and *AAEM Recommendations Regarding Electromagnetic and Radiofrequency Exposure*.

The scientific literature proves that non-thermal adverse effects of RF exposure exist and negatively impact health and physiology. New guidelines based on measurements of non-thermal effects and lowering limits of exposure are needed and critical to protect public health.

In fact, electromagnetic sensitivity and the health effects of low level RF exposure have already been acknowledged by the federal government. In 2002, the Architectural and Transportation Barriers Compliance Board stated:

*“The Board recognizes...electromagnetic sensitivities may be considered disabilities under the ADA if they so severely impair the neurological, respiratory or other functions on an individual that it substantially limits one or more of the individual’s major life activities”*

Additionally, in 2005, the National Institute of Building Sciences, an organization established by the U.S. Congress in 1974, issued an Indoor Environmental Quality Report which concluded:

*“For people who are electromagnetically sensitive, the presence of cell phones and towers, portable telephones, computers,... wireless devices, security and scanning equipment, microwave ovens, electric ranges and numerous other electrical appliances can make a building inaccessible.”*

By recognizing electromagnetic sensitivity, the federal government and affiliated organizations are clearly acknowledging the existence of non-thermal effects. The AAEM urges the FCC to recognize that non-thermal effects of RF exposure exist and cause symptoms and disease. (NOI sections 66 and 69) The AAEM also requests that the FCC base guidelines of RF exposure on measurements of non-thermal effects and lower the limits of RF exposure to protect the health of the public. (NOI sections 48, 52, 54, 65 and 71)

Sincerely ,

A handwritten signature in black ink, appearing to read "Amy L. Dean, DO.", with a stylized flourish at the end.

Amy L. Dean, DO, FAAEM, DABEM, DAOBIM  
President



# Federal Register

---

Tuesday,  
September 3, 2002

---

## Part II

### **Architectural and Transportation Barriers Compliance Board**

---

**36 CFR Parts 1190 and 1191**

**Americans With Disabilities Act (ADA)  
Accessibility Guidelines for Buildings and  
Facilities; Final Rule**

**Americans With Disabilities Act (ADA)  
Accessibility Guidelines for Buildings and  
Facilities; Architectural Barriers Act (ABA)  
Accessibility Guidelines; Recreation  
Facilities; Supplemental Notice of  
Proposed Rulemaking**

**ARCHITECTURAL AND  
TRANSPORTATION BARRIERS  
COMPLIANCE BOARD**

**36 CFR Part 1191**

[Docket No. 98–5]

RIN 3014–AA16

**Americans With Disabilities Act (ADA)  
Accessibility Guidelines for Buildings  
and Facilities; Recreation Facilities**

**AGENCY:** Architectural and  
Transportation Barriers Compliance  
Board.

**ACTION:** Final rule.

**SUMMARY:** The Architectural and Transportation Barriers Compliance Board (Access Board) is issuing final accessibility guidelines to serve as the basis for standards to be adopted by the Department of Justice for new construction and alterations of recreation facilities covered by the Americans with Disabilities Act (ADA). The guidelines include scoping and technical provisions for amusement rides, boating facilities, fishing piers and platforms, golf courses, miniature golf, sports facilities, and swimming pools and spas. The guidelines will ensure that newly constructed and altered recreation facilities meet the requirements of the ADA and are readily accessible to and usable by individuals with disabilities.

**DATES:** The guidelines are effective October 3, 2002. The incorporation by reference of certain publications listed in the guidelines is approved by the Director of the Federal Register as of October 3, 2002.

**FOR FURTHER INFORMATION CONTACT:** Peggy Greenwell, Office of Technical and Information Services, Architectural and Transportation Barriers Compliance Board, 1331 F Street, NW., suite 1000, Washington, DC 20004–1111. Telephone number (202) 272–0017 (Voice); (202) 272–0082 (TTY). E-mail address: [greenwell@access-board.gov](mailto:greenwell@access-board.gov).

**SUPPLEMENTARY INFORMATION:**

**Availability of Copies and Electronic Access**

Single copies of this publication may be obtained at no cost by calling the Access Board's automated publications order line (202) 272–0080, by pressing 2 on the telephone keypad, then 1, and requesting publication S–43 (Recreation Facilities Final Rule). Persons using a TTY should call (202) 272–0082. Please record a name, address, telephone number and request publication S–43. This document is available in alternate formats upon request. Persons who want

a copy in an alternate format should specify the type of format (cassette tape, Braille, large print, or ASCII disk). This document is also available on the Board's Internet site (<http://www.access-board.gov/recreation/final.htm>).

**Background**

The Americans with Disabilities Act recognizes and protects the civil rights of people with disabilities.<sup>1</sup> Titles II and III of the ADA require, among other things, that newly constructed and altered State and local government facilities, places of public accommodation, and commercial facilities be readily accessible to and usable by individuals with disabilities. Recreation facilities are among the types of facilities covered by titles II and III of the ADA.

The ADA designates the Access Board as the agency responsible for developing minimum accessibility guidelines to ensure that new construction and alterations of facilities covered by titles II and III of the ADA are readily accessible to and usable by individuals with disabilities.<sup>2</sup> The Access Board initially issued the Americans with Disabilities Act Accessibility Guidelines (ADAAG) in 1991.<sup>3</sup> Current ADAAG contains general scoping and technical provisions (ADAAG 1 to 4) that apply to all types of facilities, and special application sections (ADAAG 5 to 12) that include additional scoping and technical provisions for certain types of facilities.<sup>4</sup> As discussed in more detail below, this final rule will amend section 4, and create a new section 15 (Recreation Facilities).

The Department of Justice is responsible for issuing regulations to

implement titles II and III of the ADA. The regulations issued by the Department of Justice must include accessibility standards for newly constructed and altered facilities covered by titles II and III of the ADA. The standards must be consistent with the minimum accessibility guidelines issued by the Access Board. The Department of Justice has adopted ADAAG as the Standard for Accessible Design for title III of the ADA.<sup>5</sup>

This final rule amends ADAAG by adding a new special application section for amusement rides, boating facilities, fishing piers and platforms, golf courses, miniature golf, sports facilities, and swimming pools and spas. This rulemaking has had a long history. In 1993, the Access Board established an advisory committee of 27 members to make recommendations on guidelines for recreation facilities. The Recreation Access Advisory Committee met from July 1993 to May 1994 and submitted a report to the Board, "Recommendations for Accessibility Guidelines: Recreational Facilities and Outdoor Developed Areas". After receiving the committee's report, the Board published it as an advance notice of proposed rulemaking (59 FR 48542, September 21, 1994). Over 600 comments were received on the report and questions asked in the advance notice. To obtain additional information for this rulemaking, the Board also sponsored research on access to swimming pools in 1995; held informational meetings and conducted site visits on access to miniature golf facilities in September 1996; and held informational meetings and conducted site visits on accessible amusement rides in December 1999 and March and April 2000.

A notice of proposed rulemaking (NPRM) was published in the **Federal Register** on July 9, 1999. (64 FR 37326, July 9, 1999). The comment period was originally scheduled to close on November 8, 1999, but was extended until December 8, 1999 to allow more time for the public to submit comments. These comments were submitted electronically, in writing, and as oral testimony received during two public hearings held in Dallas, TX (August 26,

<sup>1</sup> See 42 U.S.C. 12101 *et seq.* (<http://www.usdoj.gov/crt/ada/pubs/ada.txt>).

<sup>2</sup> The Access Board is an independent Federal agency established by section 502 of the Rehabilitation Act whose primary mission is to promote accessibility for individuals with disabilities. The Access Board consists of 25 members. Thirteen are appointed by the President from among the public, a majority of whom are required to be individuals with disabilities. The other twelve are heads of the following Federal agencies or their designees whose positions are Executive Level IV or above: The Departments of Health and Human Services, Education, Transportation, Housing and Urban Development, Labor, Interior, Defense, Justice, Veterans Affairs, and Commerce; General Services Administration; and United States Postal Service.

<sup>3</sup> See 36 CFR part 1191, Appendix A (<http://www.access-board.gov/adaag/html/adaag.html>).

<sup>4</sup> The special application sections cover the following facilities: restaurants and cafeterias (ADAAG 5); medical care facilities (ADAAG 6); business, mercantile and civic (ADAAG 7); libraries (ADAAG 8); transient lodging (ADAAG 9); transportation facilities (ADAAG 10); judicial, legislative, and regulatory facilities (ADAAG 11); and detention and correctional facilities (ADAAG 12). ADAAG 13 is reserved for housing and ADAAG 14 is reserved for public rights-of-way.

<sup>5</sup> See 28 CFR part 36, Appendix A (<http://www.usdoj.gov/crt/ada/reg3a.html>). The Department of Justice standards currently include ADAAG 1 to 10. State and local governments currently have the option of using ADAAG or an earlier standard, the Uniform Federal Accessibility Standards (UFAS), when constructing or altering facilities under the Department of Justice regulations for title II of the ADA. See 28 CFR 35.151(c) (<http://www.usdoj.gov/crt/ada/reg2/html>). The Department of Justice has issued a notice of proposed rulemaking to eliminate this option. 59 FR 31808 (June 20, 1994).

1999) and Boston, MA (November 17, 1999). Over 200 people attended these hearings and approximately 54 people provided testimony. The Board received approximately 300 comments during the public comment period.

The Access Board created an ad hoc committee of Board members to review the comments received on the proposed rule. The ad hoc committee discussed significant issues associated with the comments and made recommendations to the full Board for the final rule. In an effort to provide the public with more opportunities for input into the provisions for the final rule, on July 21, 2000 the Board published a summary of the ad hoc committee's recommendations and put the summary in the rulemaking docket for public review (65 FR 4533, July 21, 2000). The comment period on the summary closed on September 19, 2000. Approximately 70 comments were received during the public comment period. Afterwards, the Board held informational meetings on the summary in Washington, DC (August 21–22, 2000) and San Francisco, CA (September 6–7, 2000).

#### General Issues

##### *Incorporating the Final Rule on Recreation Facilities Into Future Revisions to ADAAG*

A complete review of ADAAG has been underway for several years. ADAAG was first published on July 26, 1991. The Board is committed to ensuring that ADAAG continues to reflect technological developments and is improved in terms of usability. Efforts also include coordination with changes in national standards and model code organizations and reconciling differences between ADAAG and national consensus standards, where possible. The Board published a notice of proposed rulemaking on November 16, 1999 with proposed revisions to ADAAG. The Board plans to issue final changes to ADAAG in the near future.

The Board is issuing the final guidelines for recreation facilities prior to the publication of the final ADAAG revision. The Board then plans to incorporate these final guidelines into the final revisions to ADAAG. To effectively incorporate these guidelines into the new format, some minor formatting changes will be made. For instance, the revised ADAAG will include a new format and numbering system. This rule will need to be formatted to fit that system. Some of the provisions will also be modified slightly to avoid redundancy. No substantive changes to the text are planned. Once incorporated, the Board will develop a

guide to assist users with the new ADAAG.

The incorporation of the final recreation guidelines into the revised ADAAG will enhance the usability of the accessibility guidelines for architects, designers, manufacturers, operators and others using ADAAG. For example, accessibility guidelines for accessible parking spaces, toilet rooms, amusement rides, swimming pools, and exercise facilities will be combined into one document. Other improvements in the format of ADAAG will reduce redundancy through the use of basic technical provisions known as "building blocks," which will provide consistent dimensions for clear spaces, turning spaces, and knee and toe clearances for elements. These basic technical provisions will apply unless otherwise modified in the section containing accessibility guidelines for recreation facilities. For example, handrail requirements for sloped entries into swimming pools modify the requirements otherwise required in the ramp provisions (ADAAG 4.8.5).

##### *Multiple Chemical Sensitivities and Electromagnetic Sensitivities*

Individuals with multiple chemical sensitivities and electromagnetic sensitivities submitted a substantial number of written comments and attended the public information meetings on the draft final rule. They reported that chemicals used in recreation facilities, such as chlorine used in swimming pools and spas, and pesticides and synthetic fertilizers used on golf courses, are barriers that deny them access to those facilities. They requested the Board to include provisions in the final rule to make recreation facilities accessible for them.

The Board recognizes that multiple chemical sensitivities and electromagnetic sensitivities may be considered disabilities under the ADA if they so severely impair the neurological, respiratory or other functions of an individual that it substantially limits one or more of the individual's major life activities. The Board plans to closely examine the needs of this population, and undertake activities that address accessibility issues for these individuals.

The Board plans to develop technical assistance materials on best practices for accommodating individuals with multiple chemical sensitivities and electromagnetic sensitivities. The Board also plans to sponsor a project on indoor environmental quality. In this project, the Board will bring together building owners, architects, building product manufacturers, model code and

standard-setting organizations, individuals with multiple chemical sensitivities and electromagnetic sensitivities, and other individuals. This group will examine building design and construction issues that affect the indoor environment, and develop an action plan that can be used to reduce the level of chemicals and electromagnetic fields in the built environment.

Neither the proposed rule nor the draft final rule included provisions for multiple chemical sensitivities or electromagnetic sensitivities. The Board believes these issues require a thorough examination and public review before they are addressed through rulemaking. The Board does not address these issues in the final rule.

##### *Existing Recreation Facilities*

The Board received a significant number of comments related to the impact of these accessibility guidelines on existing facilities. Some commenters interpreted the proposed rule and the draft final rule to require all existing recreation facilities or elements of these facilities to be modified to meet the new accessibility guidelines. They expressed concern that the guidelines would have a significant economic impact on existing recreation facilities.

To clarify, ADAAG and the final accessibility guidelines for recreation facilities apply to newly designed or newly constructed buildings and facilities and to existing facilities when they are altered. ADAAG and the Department of Justice regulations address whether a change to a building or facility is considered an alteration. The publication of this final rule does not require that all existing facilities be modified to meet these guidelines. State and local governments who provide recreation facilities have a separate obligation under title II of the ADA to provide program accessibility which may require the removal of architectural barriers in existing facilities. See 28 CFR 35.150 (<http://www.usdoj.gov/crt/ada/reg2.html>). Private entities who own, lease (or lease to), or operate recreation facilities have a separate obligation under title III of the ADA to remove architectural barriers in existing facilities where it is readily achievable (*i.e.*, easily accomplishable and able to be carried out without much difficulty or expense). See 28 CFR 36.304 (<http://www.usdoj.gov/crt/ada/reg3a.html>).

Federal tax credits and deductions are available to private entities for architectural barrier removal in existing facilities. Federal funds also are available through the Community Development Block Grant Program to

remove architectural barriers in existing facilities. State and local governments may use Community Development Block Grant funds to remove architectural barriers in publicly and privately operated facilities. Entities requesting guidance on their obligations for existing facilities should contact the Department of Justice.

#### *Equivalent Facilitation*

Commenters addressing various sections of the recreation rule indicated the need for flexibility in designing and constructing accessible recreation facilities and elements. Commenters wanted to ensure that alternative designs would be permitted for providing accessibility with some of the unique elements and facilities addressed in this rule. Specific concerns were raised in comments related to accessible amusement rides and miniature golf courses.

The Board recognizes that many of the facilities and elements addressed in this rule are unique and supports the need for flexibility in making them accessible. Section 2.2 of ADAAG currently permits "departures from particular technical and scoping requirements of this guideline by the use of other designs and technologies \* \* \* where the alternative designs and technologies used will provide substantially equivalent or greater access to and usability of the facility." This provision applies to all facilities and elements addressed by ADAAG, including recreation facilities.

#### *Section-by-Section Analysis*

This section of the preamble contains a concise summary of the final rule and an analysis of the comments the Board received on each section. The final rule amends several existing sections of ADAAG and adds a new special application section. Section 4 of ADAAG has been amended to include provisions addressing miscellaneous sports facilities and elements as explained below.

#### *Miscellaneous Sports Facilities and Elements*

The accessibility guidelines for recreation facilities are primarily set forth in Section 15. Several changes, however, were also required within ADAAG section 4 to adequately address some of the unique sports facilities and elements.

#### *Section 3.5 Definitions "Area of Sport Activity"*

An area of sport activity is defined as "that portion of a room or space where the play or practice of a sport occurs."

The term is defined in order to clarify the requirements for connecting an accessible route with this type of space. The term is used broadly to define spaces where the play or practice of a sport occurs. It includes, but is not limited to, field sports such as softball, football, lacrosse, baseball, and soccer; court sports such as tennis, racquetball, and volleyball; and other sports such as gymnastics.

*Comment.* A few commenters suggested that further clarification would be helpful in the use of the term "sport" and "practice" of a sport.

*Response.* Providing an exhaustive list of sports is not practical, since it may inadvertently omit a sport, or fail to recognize an emerging sport of the future. The "area of sport activity" will vary from sport to sport. Exceptions to technical provisions in ADAAG 4.1.2 (3) and (4) and 4.1.3 (2) and (3) clarify that accessibility is not required in the "area of sport activity." This is consistent with the recommendations of the Recreation Access Advisory Committee and supports access to each "area of sport activity," while not affecting the nature of the sport.

#### *Section 4.1.1(5)(b) General Exceptions*

The following recreation facilities or portions of recreation facilities are exempt from accessibility requirements: Raised structures used for refereeing, judging, or scoring a sport; water slides; animal containment areas not for public use; and raised boxing rings and wrestling rings.

*Comment.* The proposed rule exempted structures used solely for refereeing a sport. A commenter questioned whether structures used for "judging" or "scoring" a sport would also be considered exempt.

*Response.* The exception has been modified in the final rule to include the term "judging" and "scoring." The Board considers the structures used for these activities to be consistent with the intent of this exception.

*Comment.* The proposed rule did not include any specific requirements for access to water slides. Question 4 in the proposed rule requested comments on this issue. Most of the commenters did not support providing access to the top of water slides. A few commenters suggested that access be required to the top of smaller water slides with an exemption for larger slides.

*Response.* An exception has been added in the final rule exempting water slides, including the structure supporting the water slide, from the guidelines. Providing access to water slides would require extensive ramping or elevators which would make the

slides cost prohibitive. Designers and operators are encouraged to provide access to smaller water slides, where possible. Recent designs for "leisure pools" have incorporated an accessible route to the top of water slides using the different elevations on a site. These designs provide increased access for individuals with disabilities.

*Comment.* The proposed rule did not specifically address access to "life guard stands." A few commenters recommended that structures such as life guard stands be addressed.

*Response.* ADAAG 4.1.1(5)(b) specifically exempts life guard stands and was added during a rulemaking for State and local government facilities (63 FR 2000, January 13, 1998).

*Comment.* The proposed rule included exceptions to technical provisions for accessible routes in animal containment areas. The International Association of Amusement Parks and Attractions expressed concern about general requirements for accessibility in animal containment areas that are not open to the public and are specifically limited to animal handlers.

*Response.* An exception has been added in the final rule to clarify that accessibility is not required to animal containment areas that are not for "public use." Where animal containment areas are open to public use such as petting farms, the provisions of ADAAG 4.3 apply. Several exceptions to the provisions of ADAAG 4.3 in animal containment areas are also included in the final rule.

*Comment.* The proposed rule exempted raised boxing rings from accessibility. A few commenters suggested that raised wrestling rings be added to this exception.

*Response.* The exception has been modified in the final rule to add wrestling rings to the exemption.

#### *Section 4.1.2(2)(b) and 4.1.3(1)(b) Accessible Routes for Court Sports*

These sections are amended to require an accessible route complying with ADAAG 4.3 to directly connect both sides of the court in court sports.

*Comment.* The proposed rule required an accessible route to connect both sides of the court in court sports. The American Institute of Architects (AIA) was concerned that an accessible route connecting the two sides of a court may not be a direct route and could require one to go around a multitude of courts to get to the other side of the court where a sport requires changing sides. This is especially critical in sports such as tennis, where changing sides of the court is part of the game.

*Response.* The accessible route must be a direct route from one side of the court to the other side. Requiring players on one side of the court to traverse through or around another court to get to the other side is not permitted.

*Section 4.1.2(3) and 4.1.3(2)  
Protruding Objects in Areas of Sport Activity*

Areas of sport activity are exempt from the requirements of ADAAG 4.4 (Protruding Objects).

No substantive comments were received and no changes have been made for the final rule.

*Section 4.1.2 (4) and 4.1.3(3) Ground Surfaces in Areas of Sport Activity and Animal Containment Areas*

Two exceptions are added to these sections which require ground surfaces along accessible routes and in accessible spaces to comply with ADAAG 4.5. ADAAG 4.5 requires ground and floor surfaces along accessible routes to be stable, firm, and slip resistant. ADAAG 4.5 also addresses changes in level (ADAAG 4.5.2), carpet (ADAAG 4.5.3), and gratings ADAAG (4.5.4). Exception 1 exempts areas of sport activity from all requirements of ADAAG 4.5. Exception 2 exempts animal containment areas designed and constructed for public use from the requirements of ADAAG 4.5.2 and from providing a stable, firm, and slip resistant ground or floor surface.

*Comment.* The proposed rule required an accessible route to connect to each area of sport activity. A commenter questioned the feasibility of this requirement when connecting multiple sand volleyball courts on a beach.

*Response.* The final rule requires an accessible route to each area of sport activity in newly constructed facilities. For example, where a new sports field is planned with multiple fields, an accessible route is required to each field.

With respect to sand volleyball courts located at beaches, the Board plans to more specifically address the accessible route requirement in a future rulemaking on outdoor facilities, including trails, picnic and camping facilities, and beaches. It is expected that this future rule will address accessible routes on beaches, including their location to various elements on a beach.

*Comment.* The proposed rule exempted animal containment areas for hooved animals from the requirements of a stable, firm, and slip resistant surface. Commenters questioned why the exception was limited to "hooved" animal containment areas. Others suggested that other provisions such as

ADAAG 4.5.2 (Changes in Level) not apply within these areas.

*Response.* This exception has been amended in the final rule to include all animal containment areas and is not limited to those for "hooved" animals. The Board agrees that there often are areas where many different types of animals are contained and are not limited solely to hooved animals. Exemption from the requirements to ADAAG 4.5.2 (Changes in Level) has also been included since absorbent surfaces used to ensure the care and health of animals may conflict with this provision. As previously discussed, an exception has been added to ADAAG 4.1.1(5)(b) to clarify that accessibility is not required in animal containment areas that are not for public use.

*Section 4.1.3(5) Exception 4(f)  
Platform Lifts for Team or Player Seating Areas*

An exception is added to this section permitting the use of a platform lift in new construction as a means of providing access to team or player seating areas serving areas of sport activity.

*Comment.* The proposed rule did not include an option to use a platform lift in new construction to provide access to team or player seating areas. The AIA and several architects representing a firm that specializes in sports facilities commented that platform lifts should be an option. They were particularly concerned about providing access to dugouts and other recessed team player seating areas in major league stadiums. They believed that providing a ramp parallel to the playing field presents a dangerous tripping and falling hazard for players attempting to field foul balls. Other groups representing persons with disabilities commended the Board for not allowing platform lifts in this environment in new construction. Among other issues, they cited the problems associated with relying on a mechanical device to provide access in newly constructed buildings and facilities.

*Response.* The final rule includes an option to use a platform lift as part of an accessible route connecting team or player seating areas. While the Board includes this as an option in new construction, it is recommended that where possible, ramps be utilized. This will reduce reliance for persons with disabilities on a mechanical device when providing access. Several minor league stadiums have incorporated a ramp into their design in recent years. It is the Board's understanding that there have been no reported incidents of accidents related to the ramps.

Information on major league stadiums is not available since ramps have not been incorporated into their designs.

*Section 4.1.3(12)(c) Lockers*

This section is amended to require that where lockers are provided, at least 5 percent, but not less than one, of each type of locker, must comply with ADAAG 4.25.

No substantive comments were received and no changes have been made for the final rule.

*Section 4.1.3(13) Controls and Operating Mechanisms for Exercise Equipment and Machines*

An exception is added to this section to exempt exercise machines from the requirements of ADAAG 4.27 (Controls and Operating Mechanisms).

No substantive comments were received and no changes have been made for the final rule.

*Section 4.1.3(19)(c) Team or Player Seating Areas*

This section is amended to require that where team or player seating areas contain fixed seats and serve an accessible area of sport activity, the seating area must contain the number of wheelchair spaces required by ADAAG 4.1.3(19)(a), but not less than one space. Wheelchair spaces must comply with ADAAG 4.33.2, 4.33.3, 4.33.4, and 4.33.5.

An accessible route is required to connect to the team player seating areas. An accessible route is also required to connect to the area of sport activity which is defined as "that portion of a room or space where the practice or play of a sport occurs." For the most part, the requirement is intended to provide access to the boundary of where the sport is played. In some cases, this will provide for a "level" entry to the area of sport activity such as a softball field or football field. In other cases, there may be changes in level and non-accessible surfaces. The Board recognizes that the accessible route requirement may, in some cases, not ensure access directly onto the area of sport activity. Where possible, designers are encouraged to provide for a smooth transition to the area of sport activity. This requirement is not intended to change the nature of the sport to provide access.

*Comment.* The AIA questioned how wheelchair spaces in team or player seating areas could meet the requirements of ADAAG 4.33.3. ADAAG 4.33.3 requires, among other things, that the wheelchair spaces provide a choice of admission prices or lines of sight

comparable to those afforded members of the general public.

*Response.* An exception has been added in the final rule exempting the wheelchair spaces in team or player seating areas from requirements related to choice of admission price or lines of sight comparable to those for members of the general public. Section 4.1.3(19)(c) is intended to ensure that at least one wheelchair space is provided in team or player seating areas. This can easily be accomplished through clear space adjacent to a fixed bench, for example. Bench seating will also serve as companion seating. Where designers and operators are planning facilities to serve a variety of wheelchair sports, it is recommended that the minimum be exceeded to more adequately accommodate wheelchair sports team.

Exception 2 is added to clarify that the requirements for accessible team or player seating does not apply to bowling lanes that are not required to be on an accessible route. Section 15.7.3 requires 5 percent, but not less than one, of each type of bowling lane to be served by an accessible route. Only those team or player seating areas that serve the bowling lanes required to be on an accessible route must have accessible team or player seating.

*Comment.* The proposed rule included an exception to ADAAG 4.1.3(19) for assembly seating in amusement facilities. The exception permitted use of a transfer seat complying with 15.1.4 where the motion of the seats is an integral part of the amusement experience. A few commenters questioned why this was permitted and recommended that wheelchair spaces be designed so as to provide the same general experience or effects as other seats.

*Response.* This exception has been deleted in the final rule. The Board is aware of amusement facilities where the various effects provided within the wheelchair space. Many of the effects, such as misting or smoke, may be easy to incorporate into the wheelchair space. Others effects, such as aggressive seat motion, may be extremely difficult to incorporate and may possibly be unsafe. The Board expects that designers will provide the same effects for the wheelchair space as other seats, to the extent possible. An appendix note also recommends that providing companion seats with removable armrests will provide an option for persons using wheelchairs to transfer into the seat in these venues, if desired.

#### *Section 4.1.3(21) Dressing, Fitting, or Locker Rooms*

This section requires that where dressing, fitting, or locker rooms are provided, the rooms must comply with ADAAG 4.35. An exception permits 5 percent, but not less than one, of the rooms to be accessible when they are provided in a cluster.

No substantive comments were received and no changes have been made for the final rule.

#### *Section 4.1.3(22) Saunas and Steam Rooms*

This section requires where saunas and steam rooms are provided, the rooms must comply with ADAAG 4.36. An exception permits 5 percent, but not less than one, of the rooms to be accessible when they are provided in a cluster.

No substantive comments were received and no changes have been made for the final rule.

#### *Section 4.35 Dressing, Fitting, and Locker Rooms*

##### *Section 4.35.1 General*

This section requires dressing, fitting, and locker rooms required to be accessible by ADAAG 4.1 to comply with ADAAG 4.35 and to be on an accessible route.

No substantive comments were received and no changes have been made for the final rule.

##### *Section 4.35.4 Benches in Accessible Dressing Rooms, Fitting Rooms, and Locker Rooms*

This section requires benches complying with ADAAG 4.37 in accessible dressing, fitting, and locker rooms.

No substantive comments were received and no changes have been made for the final rule.

#### *Section 4.36 Saunas and Steam Rooms*

##### *Section 4.36.1 General*

This section requires saunas and steam rooms required to be accessible by ADAAG 4.1 to comply with ADAAG 4.36.

*Comment.* Several commenters questioned whether an operator would be required to provide a heat resistant wheelchair in accessible saunas and steam rooms.

*Response.* The provision of heat resistant chairs is an operational issue and outside the jurisdiction of the Board. Questions regarding the operational issues related to the use of accessible facilities and elements will be addressed by the Department of Justice

when it adopts accessibility standards for recreation facilities.

##### *Section 4.36.2 Wheelchair Turning Space*

This section requires wheelchair turning space complying with ADAAG 4.2.3 to be provided within a sauna or steam room. An exception permits the wheelchair turning space to be obstructed by readily removable seats.

*Comment.* The proposed rule permitted the maneuvering space to be "temporarily" obstructed by readily removable seats. Commenters questioned what would be considered "temporary".

*Response.* The term "temporarily" has been deleted in the final rule. The intent of the provision is to permit a seat or bench to be located within the required maneuvering space within a room, provided that it can be readily removed. The focus of the exception is on the seat being "readily removable" to enable persons using wheelchairs to avail themselves of smaller saunas and steam rooms.

##### *Section 4.36.3 Sauna and Steam Room Bench*

This section requires that where seating is provided in a sauna or steam room, at least one bench complying with ADAAG 4.37 must be provided. An exception permits the clear floor space required by ADAAG 4.37.1 to be obstructed by readily removable seats.

*Comment.* The proposed rule permitted readily removable seats to "temporarily" obstruct the clear floor space and commenters questioned what would be considered "temporary".

*Response.* As discussed above, the term "temporarily" has been deleted in the final rule.

##### *Section 4.36.4 Door Swing*

This section requires that doors shall not swing into any part of the clear floor space required at an accessible bench.

No substantive comments were received and no changes have been made for the final rule.

#### *Section 4.37 Benches*

##### *Section 4.37.1 General*

Benches required to be accessible by 4.1 must comply with 4.37. No substantive comments were received and no changes have been made for the final rule.

##### *Section 4.37.2 Clear Floor or Ground Space*

This section requires clear floor or ground space complying with ADAAG 4.2.4 to be provided and be positioned for a parallel approach to a short end of

a bench seat. An exception permits the clear floor or ground space required by 4.37.2 to be obstructed by readily removable seats in saunas and steam rooms.

No substantive comments were received and no changes have been made to this provision in the final rule.

#### Section 4.37.3 Size

The final rule requires benches to be fixed and have seats that are 20 inches minimum to 24 inches maximum in depth and 42 inches minimum in length.

*Comment.* A few comments questioned whether a portable bench would meet the requirements for accessible benches.

*Response.* This provision has been modified in the final rule to include the term "fixed".

#### Section 4.37.4 Back Support

This section requires benches to have back support that is 42 inches minimum in length and that extends from a point 2 inches maximum above the seat to a point 18 inches minimum above the bench.

*Comment.* The proposed rule included the requirement for back support under ADAAG 4.37.2 (Size). Commenters expressed confusion over the requirements for back support for benches and some questioned whether back support was required.

*Response.* Back support is required for an accessible bench in a sauna or steam room, or a dressing room. To clarify this requirement, the technical provisions that were part of ADAAG 4.37.2 in the proposed rule have been included in a separate provision, ADAAG 4.37.3, in the final rule.

#### Section 4.37.5 Seat Height

This section requires benches to be 17 inches minimum to 19 inches maximum above the floor or ground.

No substantive comments were received and no changes have been made for the final rule.

#### Section 4.37.6 Structural Strength

This section requires that benches be strong enough to withstand a vertical or horizontal force of 250 pounds applied at any point on the seat, fastener, mounting device, or supporting structure.

No substantive comments were received and no changes have been made for the final rule.

#### Section 4.37.7 Wet Locations

This section requires that where installed in wet locations, the surface of benches must be slip-resistant and shall not accumulate water.

No substantive comments were received and no changes have been made for the final rule.

#### Section 10.5 Boat and Ferry Docks

This section is deleted in the final rule.

*Comment.* The proposed rule applied the accessibility guidelines for recreational boating facilities to boat and ferry docks located at transportation facilities, covered by ADAAG Section 10. This section of the proposed rule received little comment.

*Response.* The Board is concerned that those involved in the design and construction of boat and ferry docks may not have been fully aware of the proposed rule and therefore may not have evaluated its impact on such facilities. In addition, through the proposed rule, the Board sought information to establish access provisions for gangways based on the size of vessels using floating piers. Few commenters responded to the question, and none provided the type of information the Board was seeking.

The Board is not addressing commercial boat and ferry docks at transportation facilities at this time. In the future, the Board will consider whether such transportation facilities should be treated differently than recreational boating facilities covered by 15.2. As a result, ADAAG 10.5 has been deleted.

#### Section 15 Recreation Facilities

Section 15 has been added to ADAAG and contains accessibility guidelines for amusement rides, boating facilities, fishing piers and platforms, golf courses, miniature golf courses, exercise equipment and machines, bowling lanes, shooting facilities, and swimming pools and spas. Unless otherwise modified in section 4 or specifically addressed in 15, all other ADAAG provisions apply. For example, special technical provisions have not been included in section 15 for toilet rooms or for accessible parking. In this case, other appropriate provisions in ADAAG 4.22 and ADAAG 4.6 apply. The accessibility guidelines for play areas, which were issued on October 18, 2000 (65 FR 62498) are reprinted in Section 15.

*Comment.* A few commenters suggested that the term "recreation facilities" be defined. They suggested that the lack of definition leaves some doubt about how to apply the provisions in this section. They questioned whether locker rooms for a professional sports team, for example, would be considered a "recreation facility".

*Response.* Recreation facilities is not defined in the final rule. The term is used generally to address the types of elements and facilities covered by this section. The term is inclusive and applies to buildings and facilities designed and constructed for recreation, as well as elements and spaces located in a facility. For example, section 15.7.1 would apply to exercise equipment and machines located in an office building as a part of employee health club. Also, these provisions would apply to locker rooms for professional and other sports teams.

#### Section 15.1 Amusement Rides

Significant comment on amusement ride accessibility was received on the proposed rule. The proposed rule would have required that one wheelchair space and one transfer seat be provided for each 100 seats on new amusement rides and proposed technical provisions for the wheelchair spaces and transfer seats. The majority of comments were from amusement park operators, and amusement ride manufacturers and designers. The Board also received comments from groups representing persons with disabilities.

Overall, commenters did not support the provisions in the proposed rule for access to amusement rides. The commenters stated that the proposed rule lacked flexibility, making it impossible for most rides to comply with the guidelines given the uniqueness of this industry. They also raised concern about the lack of available manufactured rides that would meet the proposed provisions. Most rides are manufactured outside the United States where there is an absence of accessibility requirements. The ride manufacturers in the United States indicated significant hardship on their businesses to retool to meet some of the proposed technical provisions. Amusement park operators interpreted the proposed rule to require operators to modify manufactured rides. Most indicated that they were either unwilling or unable to modify a ride in a way that would differ from the manufacturer's specifications because they were not willing to accept the liability associated with modifying the ride or did not have sufficient engineering expertise to do so.

Additionally, several groups representing persons with disabilities expressed concern that some rides, such as walk through attractions and fun houses, would be exempt along with rides in traveling carnivals. They wanted the accessibility guidelines to encourage ride manufacturers to make all rides accessible. The Eastern

Paralyzed Veterans Association (EPVA) wanted the number of accessible amusement rides to be doubled from the proposed rule.

Because of these comments, the Board held several information meetings with representatives from the amusement industry and others to gather additional information. Site visits were also made to several amusement parks to better understand the issues raised. The information gained from these meetings and site visits have shaped the amusement ride section of the final rule.

Based on this information, the final rule differs significantly from the proposed rule. The final rule makes major changes in the number of accessible spaces per ride and in the options for providing access. It also includes different requirements for wheelchair spaces and for ride seats designed for individuals to transfer from their wheelchair or other mobility device. The final rule provides the flexibility requested by commenters in this unique environment, while still providing a high level of accessibility to persons with disabilities.

Since this is the first time national accessibility guidelines have been established for amusement rides, the Board intends to monitor the implementation of these guidelines. As with other accessibility guidelines developed by the Board, future updates and revisions are planned to ensure that the guidelines reflect new designs and technology.

### Section 3.5 Definitions

Three terms are defined for amusement rides.

An "amusement ride" is a system that moves persons through a fixed course within a defined area for the purpose of amusement. Editorial changes are made in the final rule to be consistent with terms used within the amusement industry.

*Comment.* A few commenters questioned whether this section would apply to a ski lift, tram, or a gondola. Trams and gondolas are provided at some amusement parks.

*Response.* Section 15.1 is not intended to apply to ski lifts, trams, or gondolas. These devices are designed primarily for the purpose of transporting people from one point to another. While a ride on a ski lift or tram may be enjoyable, it is not designed primarily for the "purpose of amusement". Trams and similar vehicles are already addressed in the ADA Accessibility Guidelines for Transportation Vehicles (Vehicle Guidelines). See 36 CFR 1192.179.

An "amusement ride seat" is defined as a seat that is built-in or mechanically fastened to an amusement ride intended to be occupied by one or more passengers. This is a new term which has been added to the final rule.

"Amusement ride seats" are referenced in several of the technical provisions.

*Comment.* The proposed rule did not include the term "amusement ride seat." Several commenters including those representing the International Association of Amusement Parks and Attractions (IAAPA) questioned the differences between the transfer seat and the amusement ride seat in the proposed rule. Questions were also raised about the application of the guidelines to rides without seats or those designed with a variety of riding postures, such as toboggan style.

*Response.* A definition for amusement ride seats is added to the final rule. The Board intends the guidelines to apply to amusement rides with seats. Specific technical provisions included in this section address clear floor or ground space and maneuvering space requirements for amusement ride seats where transfer access is provided. Technical provisions focus on ensuring that people can transfer from their wheelchairs or mobility aids to the ride seats. With respect to the various riding postures, the Board intends these guidelines to apply to those amusement rides with ride seats, including toboggan style, but not to those amusement rides where the rider is expected to be in the prone position or standing. In these cases, however, an accessible route complying with ADAAG 4.3 is required to the load and unload area.

A "transfer device" is defined as equipment designed to facilitate the transfer of a person from a wheelchair or other mobility device to and from an amusement ride seat. Several new scoping and technical provisions included in the final rule specify a "transfer device." An appendix note provides additional information on available transfer devices, including ways to provide equipment that will provide for a safe and independent transfer from a wheelchair or other mobility device.

### Section 15.1.1 General

Newly designed or newly constructed and altered amusement rides are required to comply with 15.1.1. Four exceptions are included in the final rule. Under Exception 1, portable or mobile amusement rides are not covered by the guidelines. Exceptions 2, 3, and 4 clarify that amusement rides that are controlled or operated by the rider; amusement rides designed primarily for

children, where children are assisted on and off the ride by an adult; and amusement rides without amusement ride seats are only required to comply with 15.1.4 and 15.1.5, which requires an accessible route to and maneuvering space in the load and unload areas.

*Comment.* Amusement park operators requested clarification regarding how the guidelines apply to existing rides.

*Response.* As previously mentioned, the final rule is significantly different from the proposed rule. The term "new" is included in 15.1.1 to clarify that this section applies to "new" rides and not to existing rides. The Department of Justice has the rulemaking authority to address existing rides.

A custom manufactured ride is new upon its "first use", which is the first time amusement park patrons take the ride. With respect to amusement rides purchased from other entities, "new" refers to the first permanent installation of a ride, whether the ride is used "off the shelf" or is modified before it is installed. The application of these guidelines to existing amusement rides that are altered is discussed elsewhere in this preamble. The final rule provides operators with the requested flexibility. Providing opportunities for access for persons with disabilities may be accomplished under the final rule without modifying the ride itself.

*Comment.* The preamble of the proposed rule explained that the guidelines applied to permanent amusement rides with fixed seats that are set up for a long duration and are not regularly assembled and disassembled. Amusement rides set up for short periods of time such as rides that are part of traveling carnivals, State and county fairs, festivals, and other special events are not addressed by these guidelines. The majority of amusement ride manufacturers supported this approach and considered it appropriate given the uniqueness of these rides. However, the commenters were concerned that the proposed rule did not specifically exempt temporary rides. Others suggested that a time frame be attached to this concept of "temporary" to clarify specifically what is meant. They suggested a 90 day or less time frame be used to define how long such rides can operate at the same location. Several groups representing persons with disabilities believed that temporary rides should also be accessible. They believed that manufacturers should be encouraged to make temporary rides as accessible as permanent rides.

*Response.* Exception 1 is added to specify that mobile or portable amusement rides are not covered by

15.1. The Department of Justice is authorized to determine the applicable requirement for these rides.

While mobile rides are not specifically addressed by these guidelines, other ADA requirements including general nondiscrimination obligations, program accessibility, and barrier removal provisions of the ADA apply to covered entities operating mobile or portable amusement rides. Mobile amusement rides are subject to a variety of site conditions that affect the load and unload areas. Because the rides are transported over the road, their size and weight is also restricted. This can limit the size available for the load and unload areas along with the accessible route to the ride.

Ride operators and manufacturers are encouraged to apply the provisions of this section to mobile amusement rides, where possible. Mobile rides are available that provide roll-on access and others may be close to providing transfer access with some minor adaptations in the load and unload areas. The Board will, upon request, work with interested manufacturers to provide guidance on providing either roll-on access or transfer access for someone using a wheelchair or mobility device.

#### *Exception 2*

*Comment.* The proposed rule excluded from the definition of amusement rides, those rides which are controlled or operated by the rider such as bumper cars and go-carts. A few commenters suggested that these types of rides also be addressed by this section. Several commenters requested guidance on whether making a ride turn faster or shake faster would be considered "control".

*Response.* An exception has been added to the final rule for rides that are controlled by the rider requiring such rides to only provide an accessible route to the ride and maneuvering space in the load and unload areas. The Board plans to gather additional information for making these rides accessible for potential rulemaking in the future. In the interim, designers and operators may use the applicable provisions in ADAAG and this final rule as a guide in providing access.

With respect to the issue of control, the exception is not intended to apply to those rides where patrons may affect some incidental movements of the ride, but otherwise have no control.

#### *Exception 3*

*Comment.* The proposed rule did not distinguish between those rides designed for adults and those designed

for young children, also known as "kiddie rides." Many amusement park operators and ride manufacturers commented that "kiddie rides" should be exempt from compliance with the provisions of 15.1.1. Most indicated that size restrictions will prohibit compliance with several of the provisions.

*Response.* Because of their size restrictions, an exception has been added to the final rule for "kiddie" rides requiring such rides to only provide an accessible route to and maneuvering space in the load and unload area. The requirement for an accessible route will provide access for adults and family members assisting children on and off these rides. An amusement industry definition for "kiddie rides" includes rides designed for children up to the age of 12. The Board does not support an exemption for rides designed for children up to age 12. Rather, the exception is limited to those rides designed "primarily" for children, where children are assisted on and off the ride by an adult. The Board intends that this exception be limited to those rides designed for children and not for the occasional adult user.

#### *Exception 4*

*Comment.* Some commenters interpreted the proposed rule to apply to amusement rides without seats.

*Response.* Section 15.1 of the proposed rule limited the application of this section to rides "containing fixed seats". Exception 4 is added in the final rule to further clarify that 15.1 does not apply to amusement rides without ride seats. Amusement rides without seats are required to be served by an accessible route and connect to accessible load and unload areas.

#### *Section 15.1.2 Alterations to Amusement Rides*

Section 15.1 applies to amusement rides that are altered. This section clarifies that a modification to an existing amusement ride is an alteration if one or more of the following conditions apply: (1) The amusement ride's structural or operation characteristics are changed to the extent that the ride's performance differs from that specified by the manufacturer or the original design criteria; or (2) the load and unload area of the amusement ride is newly designed and constructed.

*Comment.* The majority of commenters questioned how the proposed rule applied to existing amusement rides. Many commenters believed that the guidelines require that all existing amusement rides be accessible. Others inquired about the

requirements for existing rides that are modified and the type of modification that would trigger the alteration provisions.

*Response.* The final rule addresses alterations to existing amusement rides. See the discussion at the beginning of this preamble for further information on ADA obligations for existing amusement rides.

Where an existing amusement ride is modified in a way that does not change the ride's structural or operational characteristics to the extent that the ride's performance differs from that specified by the manufacturer's or original design criteria, the amusement ride is not required to comply with 15.1.1. Routine maintenance, painting, and changing of story boards are examples of activities that do not constitute an alteration.

As with other elements or facilities subject to the alterations provisions in ADAAG, "technical infeasibility" applies to alterations of amusement rides. In this case, compliance with the technical provisions is required except where the nature of the existing ride makes it virtually impossible to comply fully. In these circumstances, the alteration should provide the maximum accessibility feasible.

*Comment.* Commenters requested clarification regarding how the guidelines apply where amusement rides are moved.

*Response.* In response to this question, a provision has been added that requires a ride to be accessible when a new load and unload area is designed and constructed for the ride. This provision applies where a ride is moved either within a park or to another park and a new load and unload area is designed and constructed. The ride must comply with 15.1.1. Operators have a choice of providing either a wheelchair space, ride a seat designed for transfer, or a transfer device. In most cases with an existing amusement ride, providing a transfer device may be the most appropriate. This option does not require modification to the ride. Where an amusement ride is moved and the load and unload area is not modified, the provisions of 15.1.1 do not apply. In this case, the on-going obligations of "readily achievable barrier removal" or "program accessibility" will apply.

#### *Section 15.1.3 Number Required*

This section requires each amusement ride to provide at least one wheelchair space complying with 15.1.7, or at least one amusement ride seat designed for transfer complying with 15.1.8, or at least one transfer device complying with 15.1.9.

*Comment.* The proposed rule required one wheelchair space per 100 fixed seats and one transfer seat per 100 fixed seats to be provided on each amusement ride. An exception permitted two transfer seats in lieu of a wheelchair space where a wheelchair space is not operationally or structurally feasible. Significant comment was received on this provision during the comment period. Amusement park operators stated that the number of accessible spaces (both wheelchair and transfer seats) was too high. Several amusement park operators cited safety concerns with respect to evacuation where more than one wheelchair user may be on a ride at one time. Others expressed concern about lengthening the load and unload time. Groups representing persons with disabilities were concerned that the number of wheelchair spaces and transfer seats in the proposed rule was too low. The Eastern Paralyzed Veterans Association (EPVA) wanted the number doubled from the proposed rule, potentially requiring two wheelchair spaces and two transfer seats per ride.

*Response.* The final rule requires that each ride provide: (1) A wheelchair space, or (2) a ride seat designed for transfer, or (3) a device to facilitate the transfer of a person in a wheelchair from the load or unload area to a ride seat. This represents a decrease in the number of accessible spaces from the proposed rule and is no longer dependent on the number of seats per ride. Designers and operators have the choice of deciding which of the three types of access is appropriate for a given ride. Where a manufactured ride does not permit space for a wheelchair, for example, a ride seat designed for transfer or a transfer device may be provided to help an individual transfer into the ride seat.

The Board is aware of amusement rides in certain parks that currently exceed this minimum and provide more than one wheelchair space on a given ride. In these cases, more persons with disabilities and their families are able to ride at the same time. Amusement park operators are encouraged to exceed the minimum with their new rides.

#### Section 15.1.4 Accessible Route

This section requires that, when in the load and unload position, amusement rides with wheelchair spaces, or ride seats designed for transfer, or transfer devices, must be served by an accessible route complying with ADAAG 4.3. Any part of an accessible route serving amusement rides with a slope greater than 1:20 is considered a ramp and must comply

with ADAAG 4.8. The accessible route is required only to the wheelchair space or transfer loading station, and not to all stations. This route can deviate from the main route in order to access the particular station designated.

Three new exceptions to 15.1.4 are provided in the final rule. Exception 1 exempts ramps from the maximum slope specified in ADAAG 4.8.2, where compliance with 4.8.2 is structurally or operationally infeasible, provided that the slope of the ramp may not exceed 1:8. Exception 2 exempts the requirements for handrails on the accessible route where compliance is structurally or operationally infeasible. Exception 3 permits that use of limited-use/limited-application elevators and platform lifts complying with ADAAG 4.11 to be part of an accessible route serving the load and unload area.

*Comment.* The proposed rule required an accessible route to connect the portion of the load and unload area serving each accessible amusement ride and to provide a maneuvering space with a slope not greater than 1:48. Commenters questioned whether the 1:48 slope applied to the accessible route on the ride and the appropriateness of this requirement for those rides where a transfer seat was provided.

*Response.* The requirements for an accessible route are maintained in the final rule, but are modified to clarify that at least one accessible route requirement applies when the ride is in the load and unload position. The requirement for a maneuvering space is moved to 15.1.4, which addresses the load and unload areas. The provision also clarifies that where the running slope serving the amusement ride or transfer devices is greater than 1:20, the provisions of ADAAG 4.8 apply.

*Comment.* Operators expressed concerns with the requirements of ADAAG 4.8 with respect to the maximum slope (1:12) and the maximum rise (30 inches) for the accessible route. They described rides where space limitations will prohibit long ramps and where fundamental changes to amusement rides would be necessary to comply with ADAAG 4.8.2.

*Response.* An exception is added in the final rule that exempts the accessible route serving accessible rides from the maximum slope specified in ADAAG 4.8.2, provided that the slope may not exceed 1:8. The exemption only applies where compliance with ADAAG 4.8.2 is "structurally or operationally" infeasible. The exception for structural or operational limitations is limited to that portion of the accessible route connecting the load and unload areas

with the amusement ride. There is no exception for other portions of the accessible route, such as the queue line leading to the load and unload areas.

*Comment.* Ride operators and designers also stated that the requirement for handrails was not practical on the portion of the accessible route connecting the load and unload areas and the ride. They again cited space limitations especially where ramps are integrated into the ride and folded out of the way when the ride is in use.

*Response.* An exception from the requirement for handrails is added in the final rule. Similar to exception 2, this exception is limited to circumstances where compliance with the handrail requirement is structurally or operationally infeasible.

*Comment.* The proposed rule did not include a provision permitting the use of a limited-use/limited-application elevator or a platform lift as a part of the accessible route in providing access to load and unload areas. The American Institute of Architects (AIA) and others in the amusement industry recommended their use in connecting these areas, especially in connecting elevated load and unload areas and those that cross tracks.

*Response.* An exception is provided in the final rule permitting the use of limited-use/limited-application elevators and platform lifts complying with ADAAG 4.11. The Board has included this option in the final rule to address some of the unique designs and elevated loading areas used within an amusement park. Where platform lifts are used, they must comply with ADAAG 4.11. Future revisions to ADAAG will include technical provisions for limited-use/limited-application elevators. At that time, appropriate provisions will be referenced for these elevators. Currently available design and safety standards should be applied in the interim.

*Comment.* Some commenters questioned whether moving turnstiles and walkways can serve as part of an accessible route connecting amusement rides.

*Response.* The Board has not specifically addressed moving turnstiles and walkways, since they are always capable of stopping or slowing to accommodate guests needing additional time. At this time there is not sufficient information to suggest a consistent safe speed for use for all persons with disabilities. Some individuals will be able to maneuver within the speed and time provided on the moving walkway or turnstile, while others will need additional time. Operators may need to

adjust the speed accordingly to reasonably accommodate guests with disabilities.

#### *Section 15.1.5 Load and Unload Areas*

This section requires load and unload areas serving amusement rides required to comply with 15.1 to provide a maneuvering space complying with ADAAG 4.2.3. The maneuvering space must have a slope not steeper than 1:48. The maneuvering space is permitted to overlap the accessible route and the required clear floor spaces.

No substantive comment was received and no changes have been made for the final rule.

#### *Section 15.1.6 Signage*

This section requires signage to be provided at the entrance of the queue or waiting line for each amusement ride to identify the type of access provided (e.g., wheelchair access or transfer access). Where an accessible unload area also serves as the accessible load area, signage must be provided at the entrance to the queue or waiting line indicating the location of the accessible load and unload area. This is important to avoid unnecessary backtracking when patrons begin the process of waiting in line for a particular ride. No substantive comments were received and no changes have been made to this provision in the final rule.

#### *Section 15.1.7 Amusement Rides With Wheelchair Spaces*

This section contains technical provisions for amusement rides with wheelchair spaces.

*Comment.* Several amusement ride designers and manufacturers raised concerns about technical provisions for wheelchair spaces on amusement rides. Most commenters believed that the space required was too large and boxy, and would significantly limit the number of amusement rides that could incorporate such a space. Some recommended that knee and toe clearances be incorporated into the space. In general, designers and operators requested more flexibility with wheelchair spaces on amusement rides.

*Response.* The Board has significantly modified the requirements for wheelchair spaces on amusement rides. The final rule includes changes which address the commenters concerns, while still requiring a minimum space that would serve most mobility devices on an amusement ride. The Board recommends that where possible, designers and manufacturers exceed the minimum space. Providing additional space will greatly enhance the ease in

loading and unloading and accommodate a greater variety of mobility devices.

#### *Section 15.1.7.1 Floor and Ground Surface*

This section contains technical provisions for floor or ground surface of wheelchair spaces.

*Comment.* The proposed rule required wheelchair spaces to comply with several provisions of ADAAG 4.5 (4.5.1, 4.5.3, 4.5.4). Commenters expressed some confusion over these references and sought clarification.

*Response.* Rather than referencing ADAAG 4.5, the final rule incorporates these provisions into 15.1.7.1 for clarity. Other editorial changes are also made within this section.

##### *Section 15.1.7.1.1 Slope*

This section requires the floor or ground surface of wheelchair spaces to have a maximum slope of 1:48 when in the load and unload position and to be firm and stable.

*Comment.* Commenters questioned the appropriateness of requiring the clear space to be level when the amusement ride is in motion.

*Response.* The section is modified to clarify that the maximum 1:48 slope is only required when the amusement ride is in the load and unload position.

##### *Section 15.1.7.1.2 Gaps*

This section requires floors of amusement rides with wheelchair spaces and floors of load and unload areas to be coordinated so that when the amusement rides are at rest in the load and unload position, the vertical difference between the floors must be within plus or minus  $\frac{5}{8}$  inches and the horizontal gap should be no greater than 3 inches under normal passenger load conditions. An exception permits that where it is not operationally or structurally feasible to meet the horizontal or vertical difference requirements, ramps, bridge plates, or similar devices complying with the applicable requirements of 36 CFR 1192.83(c) (the Board's vehicle accessibility guidelines) must be provided.

*Comment.* No substantive comment was received on this section. Several representatives from the amusement industry, however, recommended that the Board reference an ASTM Standard Practice for the Design and Manufacture of Amusement Rides and Devices where ramps, bridge plates, lifts, or similar devices are used.

*Response.* The Board carefully examined the suggested ASTM Standard Practice and determined that it was

designed as a safety standard rather than a standard that provides guidance on the minimum access requirements for ramps, bridge plates, lifts, and similar devices. Operators and manufacturers are not precluded from also following the standards in the ASTM Standard Practice for the operation of these elements. The applicable requirements of 36 CFR 1192.83(c) (ADA Accessibility Guidelines for Transportation Vehicles—Light Rail Vehicles and Systems—Mobility Aid Accessibility) are available on the Board's Web site at [www.access-board.gov/transit/html/vguide.htm#LRVM](http://www.access-board.gov/transit/html/vguide.htm#LRVM).

#### *Section 15.1.7.2 Clearances*

This section requires clearances for wheelchair spaces to comply with 15.1.7.2. Three new exceptions are added. Exception 1 permits securement devices, where provided, to overlap the required clearances of the wheelchair space. Exception 2 permits the wheelchair space to be mechanically or manually repositioned. Exception 3 permits departure from the requirements of ADAAG 4.4.2 (Head Room) for the wheelchair space.

*Comment.* The proposed rule did not specifically address securement devices in wheelchair spaces. Commenters questioned whether securement devices could be located within the minimum clear space requirements for wheelchair spaces on amusement rides. They noted that while the proposed rule did not specifically address or require these devices, many operators have provided them where wheelchair spaces are provided on amusement rides.

*Response.* The final rule adds an exception to 15.1.7.2 to permit securement devices to overlap required clearances for wheelchair spaces on amusement rides. However, the final rule does not require securement devices. The decision about whether securement devices are needed is left up to the designer or manufacturer. Where provided, these devices may overlap the required clearances for wheelchair spaces.

*Comment.* As previously discussed, the Board received a significant number of comments from representatives in the amusement industry on the need for more flexibility. Several operators of large parks demonstrated ways that wheelchair spaces were provided on rides through the use of a turntable. This permits the space to be orientated for a forward approach and later turned to be in line with the direction of the motion of the amusement ride. Commenters did not consider repositioning to be an option under the proposed rule.

*Response.* Exception 2 has been added to the final rule and permits the wheelchair space on an amusement ride to be either manually or mechanically repositioned.

*Comment.* A few amusement park designers raised concern about the head clearance requirements of ADAAG 4.4 (Protruding Objects) for the wheelchair space located on an amusement ride. Amusement rides are often designed to move through confined spaces in order to enhance the amusement experience. Since most of these rides are designed for seated patrons, designers requested exemption from this requirement.

*Response.* Exception 3 is added in the final rule and exempts wheelchair spaces on rides from ADAAG 4.4.2 (Head Room). This exception applies to circulation space and clear space requirements on the ride. It does not apply to circulation areas and accessible routes in the queue line or the load and unload areas.

#### *Section 15.1.7.2.1 Width and Length*

This section requires wheelchair spaces to have a width of 30 inches minimum and a length of 48 inches minimum measured 9 inches minimum above the ground or floor surface.

*Comment.* The proposed rule required the wheelchair space to be a minimum of 36 inches in width. This width was based on the minimum 30 inch width needed for a stationary wheelchair with the additional 6 inches necessary for repositioning in confined spaces which allows space for the front casters of a wheelchair to turn and move when backing up. Designers expressed significant concern over the 36 minimum width and questioned why it was necessary where the space is reached in a forward direction. They further cited designs where the space is manually or mechanically repositioned and therefore should not require further maneuvering. Some commenters also suggested that the depth of the clear space could be 48 inches in all cases.

*Response.* The minimum width of the wheelchair space is reduced to 30 inches in the final rule. While the Board has decreased the minimum width, it recommends that designers and manufacturers exceed the minimum where possible to allow for increased maneuvering space.

#### *Section 15.1.7.2.2 Wheelchair Spaces—Side Entry*

This section requires that where the wheelchair space can be entered only from the side, the ride must be designed to permit sufficient maneuvering space for individuals using a wheelchair or

mobility device to enter and exit the ride.

*Comment.* A few commenters questioned what the minimum space requirements would be for a ride entered from the side. They questioned whether a 32 inch side opening leading to a 30 inch wide by 48 inch long space would be sufficient.

*Response.* Section 15.1.7.2.2 is added to address rides with side entries. A center opening of 32 inches combined with a minimum space of 30 inches wide and 48 inches long is not adequate space for maneuvering. Designers must consider the position of the opening in relation to the minimum space. In some cases, additional clear space and larger openings will be necessary to allow for maneuvering a wheelchair on the ride. An appendix note is included to provide further guidance.

#### *Section 15.1.7.2.3 Protrusions in Wheelchair Space*

This section permits protrusions in the wheelchair spaces on amusement rides. Objects are permitted to protrude a distance of 6 inches maximum along the front of the wheelchair space where located 9 inches minimum and 27 inches maximum above the wheelchair space. Objects are also permitted to protrude a distance of 25 inches maximum along the front of the wheelchair space where located more than 27 inches above the wheelchair space.

*Comment.* As previously noted, amusement ride designers and operators commented that the wheelchair space clearances in the proposed rule were too restrictive and did not permit knee and toe clearances. They suggested that the clearances could be reduced without compromising the minimum space requirements.

*Response.* The final rule permits protrusions in the wheelchair space on amusement rides.

#### *Section 15.1.7.3 Openings*

This section requires that where openings are provided to access wheelchair spaces on amusement rides, the entry must provide a 32 inch minimum clear opening.

*Comment.* The proposed rule did not specify a minimum opening space where wheelchair spaces are provided on amusement rides. Commenters requested guidance on this dimension.

*Response.* A provision is added in the final rule to address the minimum width of openings where wheelchair spaces are provided on an amusement ride. This is consistent with minimum width requirements for doors and other

passageways that are part of an accessible route.

#### *Section 15.1.7.4 Approach*

This section requires one side of the wheelchair space to adjoin an accessible route.

No substantive comment was received on this provision.

#### *Section 15.1.7.5 Companion Seats*

This section requires that where the interior of an amusement ride is greater than 53 inches in width, seating is provided for more than one rider, and the wheelchair is not required to be centered within the amusement ride, a companion seat must be provided for each wheelchair space.

*Comment.* The proposed rule required companion seating where seating for more than one rider is provided. Ride manufacturers commented that providing companion seating may not be possible on rides where the center of gravity is critical to its operation. They noted that providing space for an individual seated in a wheelchair and a seated companion may increase and change the weight distribution on a ride. They supported a provision with limits that are linked to the minimum width of the ride, whether or not seating is provided for more than one rider, and whether the wheelchair space is centered on the ride.

*Response.* This section is modified in the final rule to address the concerns raised. Consistent with the proposed rule, companion seating is required only where seating is provided for more than one rider. Additionally, companion seating is required only where the interior of an amusement ride is greater than 53 inches in width and the wheelchair is not required to be centered within the amusement ride.

#### *Section 15.1.7.5.1 Shoulder-to-Shoulder Seating*

This section requires that where an amusement ride provides shoulder-to-shoulder seating, companion seats must be shoulder-to-shoulder with the adjacent wheelchair space.

*Comment.* Commenters suggested that in some circumstances, shoulder-to-shoulder seating may not be possible. They cited examples of water rides where the rider's center of gravity is critical. Adding two riders side by side can alter the balance of the ride.

*Response.* An exception is added in the final rule that shoulder-to-shoulder companion seating is required only to the maximum extent feasible, where compliance is not operationally or structurally feasible.

### *Section 15.1.8 Amusement Ride Seats Designed for Transfer*

This section requires that amusement rides with ride seats designed for transfer must comply with 15.1.8 when positioned for loading and unloading.

*Comment.* Significant comment was received on the technical provisions addressing transfer seats. Some interpreted the proposed rule to require a "special seat" in addition to other ride seats. Others believed that the technical provisions did not provide sufficient flexibility, especially given the diversity of rides and ride seats.

*Response.* The final rule requires that each ride provide: (1) A wheelchair space, or (2) an amusement ride seat designed for transfer, or (3) a system to facilitate the transfer of a person in a wheelchair from the load or unload area to a ride seat. Where ride seats are designed for transfer, this section applies. For the most part, the technical provisions for space and other features are applied to both the ride seat and the transfer device since both elements are designed for an individual to transfer from their wheelchair or mobility device to an element. A ride seat designed for transfer is usually a seat that is a permanent part of the ride itself.

#### *Section 15.1.8.1 Clear Floor Space*

This section requires clear floor space complying with ADAAG 4.2.4 to be provided in the load and unload area adjacent to amusement ride seats designed for transfer.

*Comment.* The proposed rule required the clear floor space to comply with ADAAG 4.2.4 and be positioned with the longer dimension parallel to the unobstructed side of the transfer seat. The space was also required to be located within 3 inches maximum of the transfer seat. Commenters supported the basic clear floor space requirement of 30 inches by 48 inches. Several commenters however, believed that the requirements for the orientation of the clear space were too stringent for two reasons. First, the orientation required in the proposed rule was potentially limited to a side transfer. Many individuals choose to transfer using a diagonal or front approach. Second, they were concerned about the variety of amusement rides and load and unload areas. They recommended that the orientation of the clear space with respect to its location to the ride seat be left up to the designer.

*Response.* The final rule requires a 30 inch wide by 48 inch deep clear space to be adjacent to the ride seat designed for transfer. The position of the clear space is not specified in the final rule.

Designers will decide its location based on what is best suited for transfer on a particular ride.

#### *Section 15.1.8.2 Transfer Height*

This section requires the height of ride transfer seats to be located 14 inches minimum to 24 inches maximum measured above the load and unload surface.

*Comment.* The proposed rule required the transfer seat to be between 17 and 19 inches based on other elements within ADAAG where individuals using wheelchairs and other mobility devices are expected to transfer. Commenters requested the range to be greater.

*Response.* The final rule provides a greater range in the height of the ride seat designed for transfer. Providing a greater range in this height should reduce reliance on transfer devices and have the effect of decreasing the number of transfers to get from one's wheelchair or mobility device to a ride seat. The Board recognizes that amusement rides have unique designs. The increase in the transfer height range is limited to amusement rides because of their unique designs. The goal is to provide designs that afford the least amount of transfers for the least amount of distance. The Board recognizes that providing a greater range in the transfer height may make transfers more difficult for some people with disabilities. Based on this concern, and the fact that the transfer height for amusement rides is new, the Board will closely monitor how well the range provides access to amusement rides. Where possible, designers are encouraged to locate the transfer seat between 17 inches and 19 inches above the load and unload surface.

#### *Section 15.1.8.3 Transfer Entry*

This section requires that where openings are provided to transfer to amusement ride seats, the space must be designed to provide clearance for transfer from a wheelchair or other mobility device to the amusement ride seat.

*Comment.* The proposed rule required the transfer entry on the amusement ride to be a minimum of 36 inches wide. The entry was also required to be positioned parallel and adjacent to the longer dimension of the clear floor space. Amusement ride designers and manufacturers commented that the 36 inch width was excessive and believed that few rides, if any, could comply with this dimension. They further explained that openings are generally kept to a minimum since the sides of the ride often serve as a part of the restraint or securement system for the ride.

*Response.* Due to the large variance of amusement rides and the potential interference with the securement system, the final rule requires a space to be designed to provide clearance for transfer from a wheelchair or mobility device to the amusement ride seat. Specific dimensions for the opening are not provided in the final rule.

#### *Section 15.1.8.4 Wheelchair Storage Space*

This section requires wheelchair storage spaces complying with ADAAG 4.2.4 to be provided in or adjacent to unload areas for each required amusement ride seat designed for transfer. The space must not overlap any required means of egress or accessible route.

*Comment.* Some commenters interpreted the provision to require some type of constructed storage space.

*Response.* Clear space is needed in the load and unload areas for individuals to leave their wheelchairs when they transfer onto amusement rides. ADAAG 4.2.4 specifies a minimum 30 inch by 48 inch space for a stationary wheelchair. For safety reasons, the space must not overlap any required means of egress or accessible route. This provision does not require a constructed element for storage, only a space. Most current designs used for load and unload areas will include sufficient space to comply with this provision.

#### *Section 15.1.9 Transfer Devices for Use With Amusement Rides*

This section requires that transfer devices for use with amusement rides must comply with 15.1.9 when positioned for loading and unloading.

*Comment.* As previously discussed, significant comment was received on the technical provisions addressing transfer seats. Some interpreted the proposed rule to require a "special seat" in addition to other ride seats. Others believed that the technical provisions did not provide sufficient flexibility, especially given the diversity of rides and ride seats.

*Response.* The final rule requires that each ride provide: (1) A wheelchair space, or (2) an amusement ride seat designed for transfer, or (3) a system to facilitate transfer of a person in a wheelchair from the load or unload area to a ride seat. This section applies where transfer devices are used to provide access to an amusement ride seat. A transfer device can be provided as an integral part of the ride, or as a permanent or temporary part of the facility. Significant flexibility is provided for ride designers or park

operators to develop these transfer devices. Transfer devices may include lifts, ramps, transfer platforms and steps, or other similar systems and do not require modification to manufactured rides. Information is provided in the appendix to assist operators in selecting from different types of transfer devices.

#### Section 15.1.9.1 Clear Floor Space

This section requires clear floor space complying with ADAAG 4.2.4 to be provided in the load and unload area adjacent to transfer devices.

Consistent with the clear space requirement for ride seats designed for transfer, the position of the clear space adjacent to the transfer devices is not specified in the final rule. Designers will decide its location based on what is best suited for transfer on a particular transfer device.

#### Section 15.1.9.2 Transfer Height

This section requires the height of transfer device seats to be located 14 inches minimum to 24 inches maximum measured above the load and unload surface.

The Board has applied the same range established for amusement ride seats designed for transfer to transfer devices. As previously stated, the goal is to provide designs that afford the least amount of transfers for the least amount of distance.

Where possible, designers are encouraged to locate the transfer device between 17 inches and 19 inches above the load and unload surface. Further guidance related to maximum heights for vertical movements when transferring within a transfer device is provided in the appendix.

#### Section 15.1.9.3 Wheelchair Storage Space

This section requires wheelchair storage spaces complying with ADAAG 4.2.4 to be provided in or adjacent to unload areas for each required transfer device and must not overlap any required means of egress or accessible route.

*Comment.* Some commenters interpreted the provision to require some type of constructed storage space.

*Response.* Clear space is needed in the load and unload areas for individuals to leave their wheelchairs when they transfer onto transfer devices. ADAAG 4.2.4 specifies a minimum 30 inch by 48 inch space for a stationary wheelchair. For safety reasons, the space must not overlap any required means of egress or accessible route. This provision does not require a constructed element for storage, only a

space. Most current designs used for load and unload areas will include sufficient space to comply with this provision.

#### Other Issues

##### Accessible Routes in Temporary Places of Amusement

*Comment.* The proposed rule requested comment on providing accessible routes on sites used for fairs, carnivals, and other temporary places of amusement. Usually a site such as a field or parking lot may be used for a short period of time for temporary places of amusement.

*Response.* The Board received few comments on this issue. The final rule does not include any provisions for accessible routes in temporary places of amusement. The Department of Justice has the authority to address this issue. Given the diversity of sites and complexity of agreements involved when using sites on a temporary basis, one set of guidelines is not practical. State and local government entities covered by title II may not, in determining the site or location of a facility, make selections that have the effect of excluding individuals with disabilities (28 CFR 35.130(b)(4)). Where a site is altered by installing some type of surface, that surface must be stable, firm, and slip resistant and meet other requirements in ADAAG 4.3 for the accessible route. Temporary structures are covered by ADAAG 4.1.1(4) and are required to comply with ADAAG. As with other alterations, "technical infeasibility" permits departure from technical provisions where existing physical or site constraints prohibit modification or addition of elements, spaces, or features.

#### Section 15.2 Boating Facilities

##### Section 3.5 Definitions

This section defines five terms for boating facilities.

A "boat launch ramp" is a sloped surface designed for launching and retrieving trailered boats and other water craft to and from a body of water.

A "boat slip" is that portion of a pier, main pier, finger pier, or float where a boat is moored for the purpose of berthing, embarking, or disembarking.

A "boarding pier" is a portion of a pier where a boat is temporarily secured for purposes of embarking and disembarking.

A "gangway" is a variable-sloped pedestrian walkway linking a fixed structure or land with a floating structure. This definition does not apply to gangways which connect to vessels.

A "transition plate" is a sloping pedestrian walking surface located at the end(s) of a gangway.

*Comment.* The proposed rule included definitions for boat launch ramp, boat slip, design high point, and gangway. Commenters recommended rewording these definitions. Commenters also recommended that additional definitions be added, such as handrail, landings, pier, main pier, finger pier, boarding pier, fixed and floating piers, mooring space, transient slips, and transition plate.

*Response.* The final rule provides five definitions. Definitions for boat launch ramp, boat slip, and gangway, have been retained but have been changed to improve clarity. Definitions for boarding pier and transition plate have been added, and the definition for design high point has been removed. Additional terms suggested by commenters were not added since they were not used in the technical or scoping provisions of the boating section.

##### Section 15.2.1 General

This section requires newly designed or newly constructed and altered boating facilities to comply with 15.2.

*Comment.* Some commenters did not want the rule to apply to each boating facility. They noted that designers and facility managers needed flexibility to provide reasonable accommodations in an environment which may contain extreme physical conditions. Several commenters requested that where two or more boating facilities are located within 10 miles of each other, only one facility should be accessible. Other commenters assumed that all existing facilities would have to immediately conform to the final rule.

*Response.* These guidelines apply to each newly designed or newly constructed boating facilities. Altered facilities must conform to the guidelines to the degree required by ADAAG 4.1.6. Where an existing facility is not being altered, the guidelines do not require that alterations be performed.

*Comment.* Commenters requested clarification on the term "recreational boating facility."

*Response.* This section primarily applies to piers and docks typically found at marinas where recreational boats are moored for embarking and disembarking occupants, but will apply in other non-marina settings. Where a vessel is primarily used for recreation, generally piers and docks designed and constructed to provide mooring and other services for such vessels would be covered by this section. Recreational boats range in size from small canoes to

large sailboats and power boats. The final rule is not intended to cover piers used solely by ferries or other commercial vessels, such as freighters, ocean supply vessels, and commercial fishing vessels.

Boating facilities covered by this final rule vary in size. Some contain as few as one boat slip (for example, a small campground with a short non-demarcated pier) and others are large enough to contain several thousand boat slips (for example, a large marina with many boat basins). Some have piers and boat launch ramps, while others only have piers. A boating facility may only contain a single launch ramp with no boarding pier or may contain multiple launch ramps with multiple boarding piers. In some cases, a site (such as a State park with a large lake) may contain more than one boating facility. In other cases, several boating facilities may be located in the same waterfront area, each operated by different operators.

#### Section 15.2.2 Accessible Route

This section requires that accessible routes, including gangways that are part of an accessible route, comply with ADAAG 4.3. ADAAG 4.1.2(2) requires that at least one accessible route connect accessible buildings, facilities, elements, and spaces on the same site. Therefore, an accessible route must connect accessible boat slips with other accessible elements on the same site. Eight exceptions, discussed below, have been added which modify the accessible route requirements as they relate to connecting floating piers.

No exceptions have been provided for accessing fixed piers. Therefore, accessible routes serving fixed piers must meet all the requirements of ADAAG 4.3.

#### Exception 1 Alterations to Existing Gangways

Exception 1 permits the replacement and alteration of existing gangways or series of gangways without triggering an increase in the length of the gangways, unless required by ADAAG 4.1.6(2).

*Comment.* Commenters noted that for maintenance or safety reasons, gangways are sometimes replaced or altered without any other changes being made to the floating piers and land based features located at the ends of the gangways. Under ADAAG's requirements for alterations, a replaced gangway would have to meet the requirements of section 15.2.2. The primary difficulty typically involves meeting slope requirements, rather than meeting handrail and transition plate requirements. In many cases,

compliance with section 15.2.2 would require longer gangways to be installed. To install a longer gangway, changes to adjacent structures may be needed and such changes could also lead to reductions in the number of boat slips available. Available water sheet may also prevent lengthening of the gangways in an existing boating facility.

*Response.* The final rule includes an exception that does not require an increase in the length of the gangway, where gangways are replaced or altered. However, under ADAAG 4.1.6(2), alterations to areas containing primary functions may require existing gangways and adjacent structures to be brought into conformance with section 15.2.2. ADAAG 4.1.6(2) provides that, when an area containing a primary function is altered, an accessible path of travel must be provided to the altered area unless the cost and scope of the alterations to provide an accessible path of travel is disproportionate to the overall alterations as determined under criteria established by the Department of Justice. The Department of Justice regulations for title III of the ADA deem alterations to provide an accessible path of travel to be disproportionate when the cost exceeds 20 percent of the cost of the overall alterations.<sup>6</sup>

#### Exceptions 2 and 3 Maximum Gangway Rise and Slope

Exception 2 permits gangways or series of gangways to exceed the maximum rise specified in ADAAG 4.8.2. Exception 3 permits gangways to exceed the maximum slope specified in ADAAG 4.8.2, where the total length of the gangways serving as part of a required accessible route is at least 80 feet.

*Comment.* One of the most difficult issues relating to accessibility in floating boating facilities is gangway slopes. The proposed rule permitted gangway slopes to exceed a maximum slope of 1:12 at such times as when the distance between the design high point and water level exceeded a specific value depending on the size of the pier. In addition, the proposed rule exempted gangways from the maximum rise in ADAAG 4.8.2.

Over 60 organizations and individuals responded to the above proposals. Most indicated that they did not support the provisions. The comments raised concerns about how to calculate the pier square footage and what was considered a "pier." Some asked whether levees, boardwalks, or retaining walls are fixed piers and how to measure the square

footage. Others asked about private operators using floating piers and leasing space at a city pier. They questioned whether the square footage of the city pier is included in the calculations for determining access to the privately owned floating pier. One commenter noted that facility size determinations based on square footage may tend to drive entities to reduce pier widths which could compromise safety and stability.

A few commenters questioned how the design high point was selected. They questioned whether this point was the 100 year flood line, mean high tide, extreme high tide, ordinary high water, or high pool water line. One commenter noted that what is a safe and practical upper limit is not constant and easily determined.

Some commenters were concerned that facilities located where water level fluctuations are over 40 feet, would end up with no access or only limited access. A number of commenters suggested that a maximum gangway slope be established for most conditions, if not all conditions. Recommended slope maximums ranged from 5 percent to 15 percent.

At least 10 commenters noted that the requirements should ideally be site specific because of the varying logistical problems and differing geographic conditions at locations where water level fluctuations range from a few inches to over 100 feet. These commenters said that the table in the proposed rule would create hardships for existing facilities where space limitations are present, by requiring reductions in boat slip counts and by discouraging operators from upgrading their facilities. A number of commenters recommended that accessible gangways only be required where they serve 100 or more boat slips.

Using recommendations made by a number of commenters and combined with an effort to reduce the complexity of the final rule, the Board published a summary of a draft final rule for comment. In this draft, the Board indicated that the slope of a gangway would be permitted to exceed the maximum slope of 1:12 where the linear feet of mooring space along the perimeter of the piers at a facility was less than 1,000 feet (approximately 20–30 slips) and the water fluctuation was more than one foot. The provision, which was a general exception from the maximum slope requirement, was intended to provide regulatory relief for smaller boating facilities where an extensive gangway system may be cost prohibitive. Linear feet of mooring space was used instead of the square footage

<sup>6</sup> See 28 CFR 36.403(f)(1) (<http://www.usdoj.gov/crt/ada/reg3a.html>).

of a facility to more effectively measure the size of usable space where boats can dock rather than other spaces at a boating facility.

The draft final rule also required that where the linear feet of mooring spaces along the perimeter of the piers at a facility was less than 3,000 feet (approximately 50–70 slips) and the water fluctuation was more than 5 feet, the maximum gangway slope would be permitted to be 1:8 maximum. This exception allowed for a steeper slope than generally provided in ADAAG.

Lastly, the draft final rule stated that where the water fluctuation was more than 10 feet, gangways would be permitted to exceed the maximum slope of 1:12. Providing complying gangway slopes where the water fluctuation exceeds 10 feet requires extensive gangway systems and supporting facilities. It was noted in the draft final rule that although the gangway slope was permitted to be any slope, the gangway was not allowed to consist of stairs, since stairs are not permitted to be part of an accessible route.

During two public information meetings and from written comment received on the summary of the draft final rule, commenters generally supported simplifying the rule. Some expressed concerns about allowing a 1:8 slope on gangways, and others objected to using linear feet to determine the size of smaller facilities. A few commenters noted that the maximum feasible length of a gangway is between 60 and 70 feet. These commenters indicated that providing longer gangways, or providing two or more shorter gangways as part of a gangway and ramp system, dramatically increased the costs, complexity, and maintenance of the structure. Some commenters pointed out that because gangways often depart from a landside connection which is positioned at least 3 to 4 feet above high water, a 120-foot gangway provided to handle a 10-foot water level change actually needs to be at least 156 to 168 feet long (or a series of gangways and ramps with the same aggregate length).

*Response.* It is recognized that many factors which vary throughout the country add to the complications of providing larger gangway and ramp systems to handle greater changes in water fluctuation and elevation. Factors include water level changes, distance of gangway departure points above high water marks, available water sheet to construct within, location of shipping channels into which piers and gangways cannot project, wind load on floating structures as they get bigger, types of mooring systems, dead and live loads of gangways and the size of floating

facilities to support them, currents, boat wakes, and the ability to remove floating structures when bodies of water freeze over. In the proposed rule, the Board attempted to define the level of access based on the size of a facility (*i.e.*, pier square footage). Comments noted that many other factors besides facility size, play a role in determining what is feasible. Because factors vary throughout the country and could vary between adjacent sites and adjacent facilities, selecting one factor or a list of factors to measure for determining appropriate gangway slope is not feasible.

In an effort to provide a simplified rule and establish a starting point for determining gangway access, the final rule focuses on a maximum feasible gangway length. In response to the draft final rule, a recommendation was developed by the California Department of Boating and Waterways, Oregon State Marine Board, Clean Harbor Action, and Revitalize Our Waterways (and supported by over 20 other commenters). This recommendation showed that it would be feasible in new construction to provide up to 80-foot gangways. From this comment (which also contained recommendations for different gangway slopes for varying changes in elevation), the Board developed the final rule which is based only on gangway length. Exception 3 requires that an entity either (1) provide a gangway (or series of gangways) at least 80 feet in total length, or (2) provide a gangway (or series of gangways) which does not exceed a maximum slope of 1:12. The final rule also retains the exception permitting gangways to be any length without a landing. As these exceptions only apply to gangways, ramps constructed on floating piers and ramps providing access to landside connections of gangways are not permitted to use these exceptions. Since the final rule does not use water level change as a mechanism for determining gangway accessibility, the definition for design high point was removed. The appendix includes the following two examples.

*Example 1.* Boat slips which are required to be accessible are provided at a floating pier. The vertical distance an accessible route must travel to the pier when the water is at its lowest level is 6 feet, although the water level only fluctuates 3 feet. To comply with exceptions 2 and 3, at least one design solution would provide a gangway at least 72.25 feet long which ensures the slope does not exceed 1:12.

*Example 2.* A gangway is provided to a floating pier which is required to be on an accessible route. The vertical distance is 10 feet between the elevation where the gangway departs the landside connection and

the elevation of the pier surface at the lowest water level. Exceptions 2 and 3, which modify 4.8.2, permit the gangway to be at least 80 feet long. Another design solution would be to have two 40-foot continuous gangways joined together at a float, where the float (as the water level falls) will stop dropping at an elevation five feet below the landside connection.

*Comment.* A number of commenters expressed concern that steeper gangway slopes and the absence of level landings every 30 feet created barriers for persons with disabilities. Some commenters also noted that State and local governments should be held to a higher standard than private entities.

*Response.* As water levels rise and fall, gangway slopes also rise and fall. In some areas, there will be times that a gangway slope is less than 1:20 and at other times it will be greater than 1:12. The Board has attempted to balance the needs of persons with disabilities with the cost of providing access in an environment that can vary dramatically throughout the country. The Board also decided against providing different requirements for boating facilities operated by State and local government or private entities. As this is the first time Federal accessibility guidelines have been developed to address these types of facilities, the Board plans to closely monitor how well the guidelines provide access and what new technologies are developed to provide equivalent or better access.

*Comment.* A few commenters representing passenger vessel owners were concerned that the gangway provisions would also apply to gangways serving passenger vessels.

*Response.* The gangway provisions of this rulemaking only apply to gangways which access floating piers from the land or fixed structures. The Board is working on a separate rulemaking which will address passenger vessel access. A statement has been added to the gangway definition indicating that the definition does not apply to gangways which connect to vessels.

#### *Exception 4 Small Boating Facilities With Less Than 25 Boat Slips*

Exception 4 permits gangways to exceed the maximum slope specified in ADAAG 4.8.2, where a facility contains less than 25 boat slips and where the total length of the gangway, or series of gangways, serving as part of a required accessible route is at least 30 feet.

*Comment.* Commenters were concerned about how the gangway requirements would impact smaller facilities.

*Response.* The proposed rule and the draft final rule lessened the impact on

smaller boating facilities based on pier square footage or linear feet. Most commenters recommended using number of boat slips. Since the final rule does not address piers used by transportation vessels covered by ADAAG 10.5, which are more likely to contain a limited number of very large slips, basing the exception on boat slip numbers is appropriate.

#### *Exception 5 Transition Plates*

Exception 5 permits transition plates to be located at the ends of gangways instead of the landings specified by ADAAG 4.8.4.

*Comment.* The proposed rule permitted gangways to have transition plates at the top and bottom. Comments ranged from noting the need for a definition, setting out maximum lengths and slopes, and having them meet gangway requirements.

*Response.* In the final rule, a definition for transition plate has been added to ADAAG 3.5. Where transition plates are part of an accessible route, the transition plates must comply with ADAAG 4.3, unless one of the exceptions in 15.2.2 applies. For example, ADAAG 4.3.7 and 4.8.2 would prohibit transition plates from having a slope greater than 1:12. Where the requirements of ADAAG 4.8 apply (because the slope is greater than 1:20), the transition plates must have landings complying with ADAAG 4.8.4 at the non-gangway end.

#### *Exception 6 Handrail Extensions*

Exception 6 does not require handrail extensions, where gangways and transition plates connect and both are required to have handrails. In addition, the exception provides that where handrail extensions are provided on gangways or transition plates, the extensions are not required to be parallel with the ground or floor surface.

*Comment.* The proposed rule did not require handrail extensions on gangways or landings where they connect to transition plates and did not require handrail extensions at transitions plates. Although some commenters supported the exception, others noted that handrail extensions were needed, particularly on gangways when the transition plate had no handrail. Commenters also noted the difficulty in complying with ADAAG 4.8.5, which requires handrail extensions to be parallel with the ground or floor surface. As gangway slopes change, handrails extensions at the end of gangways and transition plates are no longer parallel. Other commenters requested that transition plates always have handrails and

questioned whether gangway handrails had to be connected or continuous with landing handrails.

*Response.* The exception has been rewritten to address most of the concerns raised. The determination of whether a transition plate is required to have a handrail will be triggered by the requirements of ADAAG 4.3.7 and 4.8.5. Regarding connections to landing handrails, gangways required to comply with ADAAG 4.8.5 are required to have continuous handrails on both sides. When gangway handrail extensions are required, subject to exception 5 exclusions, the extensions would overhang landings and transition plates 12 inches minimum. ADAAG contains no requirement that these extensions connect handrails which might be provided on landings or guardrails which also may be provided.

#### *Exception 7 Cross Slope*

Exception 7 permits the cross slope of gangways, transition plates, and floating piers that are part of an accessible route to be 2 percent maximum measured in the static position.

*Comment.* Commenters representing State recreational boating agencies expressed concern about constructing floating piers and gangways which must conform to a 2 percent maximum cross slope 100 percent of the time in all weather and water conditions.

*Response.* Exception 7 was added to address this concern by specifying that the maximum cross slope is measured in the static condition. Gangways and piers which are part of an accessible route are expected to be designed and constructed to meet the 2 percent maximum cross slope. Once they are placed in the water, measurements absent live loads are to be made from a static condition without motion or wave action. Where floating piers are grounded out due to low water conditions, the slope requirements would not apply to such floating piers and associated gangways and transition plates.

#### *Exception 8 Limited-Use/Limited-Application Elevators and Platform Lifts*

Exception 8 permits limited-use/limited-application elevators or platform lifts complying with ADAAG 4.11 to be used in lieu of gangways complying with ADAAG 4.3.

*Comment.* One commenter pointed out that other methods, such as platform lifts and elevators should be used to provide access to a floating pier. Another commenter noted that a product, similar to a platform lift, had been developed for accessing floating piers. They believed that the final rule

should encourage technological developments in this area.

*Response.* ADAAG 4.3 and 15.2 allow accessible routes to consist of elevators, ramps, and (when accessing floating piers) gangways. However, under ADAAG 4.1.3(5), Exception 4, the use of a platform lift to access a pier (floating or fixed) would be prohibited in new construction. In alterations to existing facilities, this restriction does not apply. (See ADAAG 4.1.6(3)(g) regarding platform lift usage in alterations.) Exception 8 was added to allow more flexibility in providing access to floating piers and to encourage the development of other methods of access using mechanical means. This exception modifies the requirements of ADAAG 4.1.3(5) and allows the use of platform lifts and limited-use/limited-application elevators in new construction as part of an accessible route connecting floating piers.

#### *Section 15.2.3 Boat Slips: Minimum Number*

This section requires that where boat slips are provided, accessible boat slips complying with section 15.2.5 must be provided in accordance with Table 15.2.3. Boarding piers at boat launch ramps are not counted for this purpose. Where the number of boat slips is not identified, each 40 feet of boat slip edge provided along the perimeter of the pier shall be counted as one boat slip for purposes of this section.

*Comment.* The proposed rule required that where boat slips are provided, at least 3 percent of all boat slips, but not less than one boat slip, be accessible. Comments varied between supporting a range from 1 percent to 4 percent. Some comments recommended that the number of accessible boat slips be the same as the number of required accessible vehicle parking spaces. One commenter recommended that one of each type of slip be accessible. A facility operator noted that at large facilities, a 3 percent scoping provision would require more accessible boat slips than a similar number of vehicle parking spaces. Several commenters questioned whether the need for accessible slips was as high as the need for accessible parking.

*Response.* The Board is not convinced that the scoping for accessible boat slips needs to be the same as the scoping for accessible vehicle parking spaces and is concerned that the proposed 3 percent would require more accessible slips in larger facilities than a similar number of parking spaces. The final rule modifies the scoping by reducing the percentage of accessible boat slips in larger facilities. A table is added to the final

rule to show the required number of accessible boat slips. The table starts with 3 percent and reduces down to 1 percent as the number of boat slips increase. For example, a 100-slip marina would need 3 accessible slips, and a 1,450-slip marina would need 17 accessible slips. Since this is the first time Federal guidelines have addressed the minimum number of accessible boat slips, the Board plans to closely monitor how the numbers meet the needs of individuals with disabilities.

*Comment.* The proposed rule also required that where the number of slips cannot be identified, each 40 feet of mooring space provided along the perimeter of a pier be counted as one boat slip for the purpose of applying this section. Most commenters supported the requirement. A few commenters noted that most recreational boats are less than 40 feet in length and recommended a number less than 40 feet.

*Response.* Although most recreational boats are less than 40 feet, the final rule seeks to increase the likelihood that accessible slips at non-demarcated piers are long enough to accommodate most types of common recreational boats. For this reason, the final rule has retained using 40 feet as the distance for determining the number of slips at piers where slips are not demarcated. (See section 15.2.4.1 regarding lengths of boarding piers at launch ramps.) The following two examples are included in the appendix.

*Example 1.* A site contains a new boating facility which consists of a single 60-foot pier. Boats are only moored parallel with the pier on both sides to allow occupants to embark or disembark. Since the number of slips cannot be identified, section 15.2.3 requires each 40 feet of boat slip edge to be counted as one slip for purposes of determining the number of slips available and determines the number required to be accessible. The 120 feet of boat slip edge at the pier would equate with 3 boat slips.

Table 15.2.3 would require 1 slip to be accessible and comply with 15.2.5. Section 15.2.5 (excluding the exceptions within the section) requires a clear pier space 60 inches wide minimum extending the length of the slip. In this example, because the pier is at least 40 feet long, the accessible slip must contain a clear pier space at least 40 feet long which has a minimum width of 60 inches.

*Example 2.* A new boating facility consisting of a single pier 25 feet long and 3 feet wide is being planned for a site. The design intends to allow boats to moor and occupants to embark and disembark on both sides, and at one end. As the number of boat slips cannot be identified, applying section 15.2.3 would translate to 53 feet of boat slip edge at the pier. This equates with two slips. Table 15.2.5 would require 1 slip to be accessible. To comply with 15.2.5 (excluding

the exceptions within the section), the width of the pier must be increased to 60 inches. Neither (15.2.3 nor 15.2.5) requires the pier length to be increased to 40 feet.

*Comment.* The proposed rule counted boat launch ramp boarding piers as boat slips for determining the number of accessible slips required at a facility. The proposed rule also required at least one additional accessible boat slip to be provided adjacent to accessible launch ramps, where boarding piers were provided. Some commenters thought that this requirement would cause confusion. A few commenters questioned whether boat slips should be provided on boarding piers because boat slips are rented, leased or purchased, but boarding piers are used in a short-term manner. A number of commenters believed the provision required that launch ramps must have boarding piers.

*Response.* To avoid confusion, the final rule addresses scoping requirements for launch ramp boarding piers separately from boat slips. A definition has been added to ADAAG 3.5 for boarding piers.

*Comment.* Many commenters expressed concern that accessible slips had to be reserved only for persons with disabilities similar to how vehicle parking spaces are reserved.

*Response.* Accessible boat slips are not "reserved" for persons with disabilities in the same manner as accessible vehicle parking spaces. Rather, accessible boat slip use is comparable to accessible hotel rooms. The Department of Justice is responsible for addressing operational issues relating to the use of accessible facilities and elements. The Department of Justice currently advises that hotels should hold accessible rooms for persons with disabilities until all other rooms are filled. At that point, accessible rooms can be open for general use on a first come, first serve basis. This information has also been included in the appendix.

#### Section 15.2.3.1 Dispersion

This section requires that accessible boat slips be dispersed throughout the various types provided. It does not require an increase in the minimum number of boat slips required to be accessible.

*Comment.* Commenters expressed concern about how many accessible gangways would be required due to this dispersion requirement. Commenters noted that some facilities have several floating piers, each connected by an individual gangway. If accessible slips must be placed on more than one pier (due to the dispersion requirement), more than one accessible gangway system would be required.

*Response.* This provision does not prohibit accessible boat slips from being grouped at one or more piers, where such grouping does not reduce the number of type of slips that are required to be accessible. In cases where relocation of types of accessible boat slips to one pier is not possible, this dispersion provision will require more than one conforming gangway system.

*Comment.* Commenters requested more information on the different "types" of boat slips.

*Response.* Features to be considered in determining types of boat slips include the size of the boat slips, whether there are single berths or double berths, shallow water or deep water, transient, longer-term lease, covered or uncovered, and whether slips are equipped with features such as telephone, water, electricity, and cable connections. Because the term "boat slip" is intended to cover any pier area where passengers or occupants embark or disembark, unless classified as a launch ramp boarding pier, other piers not typically thought of as containing "boat slips" are covered by this dispersion requirement. Therefore, for example, a fuel pier used on a short term basis may contain boat slips, and this type of slip would be included in determining compliance with section 15.2.3.1. This information has also been included in the appendix.

*Comment.* The proposed rule required that accessible boat slips be located nearest to the amenities provided in the boating facility. Some commenters noted that adding this requirement to the dispersion provision increased the difficulty in providing accessible slips in existing facilities. It also tended to require more accessible gangways even in new construction. Commenters also questioned how to identify an amenity and if it is desirable to be located nearest an amenity. For example, being located near the toilet room might be desirable for one person but not for someone sensitive to noise and odors. Likewise, having an accessible slip located nearest the fuel pier may be beneficial for one person and not desired by others. One commenter noted that at existing facilities, corner slips are already accessible, but may not be closest to amenities.

*Response.* The "amenities" section has been removed from the final rule, because the rule intends to allow accessible boat slips to be grouped on one or more piers. In addition, the provision was removed due to comments which questioned whether being closest to an amenity is desirable.

### Section 15.2.4 Boarding Piers at Boat Launch Ramps

This section requires where boarding piers are provided at boat launch ramps, at least 5 percent, but not less than one, of the boarding piers must comply with 15.2.4 and be served by an accessible route complying with ADAAG 4.3.

Exception 1 permits accessible routes serving floating boarding piers to use the exceptions in section 15.2.2.

Exception 2 permits gangways to exceed the maximum slope and rise specified by ADAAG 4.8.2, where the total length of the gangways serving as part of a required accessible route is greater than 30 feet. Lastly, exception 3 indicates that where the accessible route serving a floating boarding pier or skid pier is located within a boat launch ramp, ADAAG 4.8 does not apply to the portion located within the boat launch ramp.

*Comment.* As noted above, some commenters thought that the proposed rule required that an accessible slip or boarding pier had to be provided at boat launch ramps.

*Response.* The proposed rule did not require that accessible boarding piers be provided at every facility with a launch ramp. Where boarding piers are provided, the proposed rule required that at least one accessible boat slip be provided adjacent to the launch ramp to ensure that at least one boarding pier complied with the pier clearance requirements. By using the term "boat slip", the Board did not intend to ensure that a rented, leased, or purchased mooring space would be available at the launch ramp, as some commenters concluded.

*Comment.* The proposed rule required that where boat launch ramps are provided with boarding piers, at least one accessible slip be provided adjacent to a boat launch ramp. A few commenters suggested that 50 percent, but not less than one boarding pier, be accessible.

*Response.* The final rule requires 5 percent, but not less than one, of boarding piers to be accessible. Most facilities with launch ramps only have one or two launch ramps. Compliance with this provision would translate to 100 percent or 50 percent access, assuming each launch ramp had its own boarding pier. Since some facilities have more than 20 launch ramps, the provision is consistent with how ADAAG addresses some conditions where multiple features are provided for the same use.

*Comment.* Some commenters were concerned that to serve an accessible floating boarding pier, the accessible

route would have to run down the launch ramp and would require the slope of the launch ramp to be 1:12 maximum. Such a slope would dramatically effect the ability to launch and retrieve trailered boats. A few commenters noted that in designs using a string of boarding piers connected together, as water levels decline, the boarding piers end up resting on the launch ramp surface. Therefore, they would match the slope of the launch ramp which is generally steeper than 1:8. In such a design, some piers actually function as gangways for a period of time.

In another design, a stationary boarding pier (also known as a skid pier) rests on the launch ramp surface, but is repositioned as water levels rise and fall. This design also allows the skid pier to be easily removed where the body of water becomes ice bound and deicing equipment is not practical. An example of a fixed boarding pier was provided which showed two levels connected by handrail equipped ramps. During high water, boaters used the upper level while the lower level and the ramp connecting it were covered by water. At low water, the lower level is used.

One commenter noted the value floating boarding piers provide for persons with disabilities when accessing a boat since the pier remains at a set height above the water. A few pointed out that accessible routes serving boarding piers were not required to run down the launch ramp but could be provided alongside the ramp. Another commenter noted that constructing switchback ramps or any other structure within the area near the shoreline was subject to more environmental limitations and was a problem particularly for providing access at existing launch ramps. Several commenters pointed out that at launch ramps, handrails and guardrails on some gangways (primarily on short gangways) are not provided because they interfere with boat lines as boats are launched or retrieved. One commenter mentioned that providing accessible boarding piers was not a problem, but providing the accessible route to it was a problem. The commenter noted that if the requirements were too difficult, entities would stop providing boarding piers.

*Response.* Anecdotal information indicates that boarding piers are not provided at all launch ramps. For example, the Michigan Department of Natural Resources reported that of their over 900 boating access sites, approximately half are provided with boarding piers (also known as courtesy

piers or docks). Since boarding piers may improve the ability for persons with disabilities to embark and disembark boats at launch ramps, the final rule seeks to not discourage entities from providing them. The Board has identified two areas of concern.

The first concern relates to accessing floating boarding piers. Boarding piers, when provided, tend to be quite small as compared to the square footage of piers used as boat slips. Many boating facilities consist of only one or two launch ramps and maybe a boarding pier, and contain no other boating structures. Providing access to floating boarding piers are subject to many of the same factors as providing access to floating piers which contain boat slips. In the final rule, the Board added exception 1 to section 15.2.4. This exception allows launch ramp boarding piers to use specified exceptions contained in section 15.2.2.

Exception 4 in section 15.2.2 allows boating facilities with less than 25 slips to have shorter gangways. To provide a similar small facility exception for boarding piers, exception 2 was added to 15.2.4. The exception exempts gangways accessing floating boarding piers at launch ramps from complying with the maximum slope requirements of ADAAG 4.8.2 where the gangways are at least 30 feet in length.

The Board's second area of concern focused on the effect of the accessible route requirements on a launch ramp, where the connection to a boarding pier is located within a launch ramp. As noted in the comments, the issue is not only the running slope requirement of an accessible route, but also includes the handrail, landing, and maximum rise requirements.

To address this concern, the Board added exception 3 to this section of the final rule. This exception provides that the requirements of ADAAG 4.8 do not apply to accessible routes located within launch ramps which serve floating boarding piers or skid piers also located within launch ramps. Although ADAAG 4.8 does not apply, other requirements of ADAAG 4.3 are applicable. For example, an accessible route with a minimum width of 36 inches must serve the boarding pier. Large "V" shaped groves which are typically provided to increase tire traction would not be allowed by ADAAG 4.3.6 (which references ADAAG 4.5) within the accessible route. Cross slopes requirements of ADAAG 4.3.7 remain 1:50 maximum. It is noted that ADAAG 4.3 does not require the entire launch ramp to meet these requirements, but does apply them to the 36 inch wide minimum accessible

route which shares the launch ramp surface and connects to the boarding pier and accessible elements on the boarding pier. Exception 3 only exempts the ramp requirements contained in ADAAG 4.8, such as maximum slope, maximum rise, handrails, and level landings. The following two examples are included in the appendix.

*Example 1.* A chain of floats are provided on a launch ramp to be used as a boarding pier which is required to be accessible by 15.2.4. At high water, the entire chain is floating and a transition plate connects the first float to the surface of the launch ramp. As the water level decreases, segments of the chain end up resting on the launch ramp surface, matching the slope of the launch ramp. As water levels drop, segments function also as gangways because one end of a segment is resting on the launch ramp surface and the other end is connecting to another floating segment in the chain.

Under ADAAG 4.1.2(2), an accessible route must serve the last float because it would function as the boarding pier at the lowest water level, before it possibly grounded out. Under exception 3, because the entire chain of floats is part of the accessible route, each float is not required to comply with ADAAG 4.8, but must meet all other requirements in ADAAG 4.3, unless exempted by exception 1. In this example, because the entire chain also functions as a boarding pier, the entire chain must comply with the requirements of 15.2.5, including the 60 inch minimum clear pier width provision.

*Example 2.* A non-floating boarding pier supported by piles divides a launching area into two launch ramps and is required to be accessible. Under ADAAG 4.1.2(2), an accessible route must connect the boarding pier with other accessible buildings, facilities, elements, and spaces on the site. Although the boarding pier is located within a launch ramp, because the pier is not a floating pier or a skid pier, none of the exceptions in 15.2.4 apply. To comply with ADAAG 4.3, either the accessible route must run down the launch ramp or the fixed boarding pier could be relocated to the side of the two launch ramps. The second option leaves the slope of the launch ramps unchanged, because the accessible route runs outside the launch ramps.

*Comment.* A few commenters questioned how the accessible route required by ADAAG 4.1.2 should connect a launch ramp which does not have a boarding pier.

*Response.* In the Recreation Access Advisory Committee, Boating and Fishing Facilities subcommittee report, the subcommittee recommended that the accessible route run to the crown of the launch ramp. In response to the ANPRM, commenters questioned how the "crown" would be determined. Because a precise spot at the launch ramp could not be identified to which the accessible route connects, neither the proposed rule nor the final rule

addresses this issue. As the final rule does not intend to change the slope of launch ramps, the accessible route required by ADAAG 4.1.2 is required to connect the launch ramp, but the specific point of connection is not set out.

#### *Section 15.2.4.1 Boarding Pier Clearances*

This section requires that at boarding piers, the entire length of the piers required to be accessible by section 15.2.4, must comply with section 15.2.5.

*Comment.* Some commenters questioned if the proposed rule required a minimum length of 40 feet for the accessible boarding piers.

*Response.* Neither the proposed rule, nor the final rule establishes a minimum length for accessible boarding piers. The accessible boarding pier would have a length which is at least equal to other boarding piers provided at the facility. Where only one boarding pier is provided, it would have a length equal to what would have been provided if no access requirements applied. The entire length of accessible boarding piers would be required to comply with the same technical provisions that apply to accessible boat slips. For example, at a launch ramp, if a 20-foot long accessible boarding pier is provided, the entire 20 feet must comply with the pier clearance requirements in section 15.2.5. Likewise, if a 60-foot long accessible boarding pier is provided, the pier clearance requirements in section 15.2.5 would apply to the entire 60 feet. An advisory note has been added to the appendix which provides similar information regarding lengths of boarding piers.

#### *Section 15.2.5 Accessible Boat Slips*

This section sets out requirements for accessible boat slips. Section 15.2.5.2 specifically addresses cleats and other boat securement devices.

##### *Section 15.2.5.1 Clearances*

This section requires that accessible boat slips be served by clear pier space 60 inches wide minimum and at least as long as the accessible boat slips. Additionally, every 10 feet maximum of linear pier edge serving the accessible boat slips must contain at least one continuous clear opening 60 inches minimum in width. The provision is unchanged from the proposed rule, although three exceptions have been added.

##### *Exception 1 Reduced Width*

Exception 1 allows the width of the clear pier space to be 36 inches minimum for a length of 24 inches

maximum, provided that multiple 36 inch wide segments are separated by segments that are 60 inches wide and 60 inches long.

*Comment.* Some commenters requested piers to be 72 to 96 inches wide to improve safety for persons who use wheelchairs. Others commenters were satisfied with the 60 inch minimum width but wanted the ability to reduce the width down to 36 inches in places to get around objects like supporting piles located within the clear pier space. One commenter requested, in response to the draft final rule, a reduced width because environmental agencies are making it harder to install finger piers wider than 4 feet.

*Response.* The 60 inch minimum width is consistent with the width required at access aisles for standard accessible parking spaces and was supported in the Recreation Access Advisory Committee, Boating and Fishing Facilities subcommittee report. Because the final rule allows obstructions to be located around the edge of the finger piers where 60 inch openings are available, unlike vehicle access aisles, it is not necessary for the entire pier to have a 60 inches clear width. Exception 1 allows reductions in the width of the pier clearance. The exception was included in the draft final rule and received little comment. An advisory note has been added to the appendix which recommends that clear pier spaces be wider than 60 inches, particularly on floating piers which are less stable, to improve the safety for persons with disabilities.

*Comment.* A number of commenters recommended that instead of the 60 inch clear width running the length of the slip, only one 60 inch by 60 inch space be required at the accessible boat slip. This space could be placed either alongside the slip or at the head of the slip on the main pier. These commenters also recommended that where finger piers at the facility are longer than 20 feet, a second 60 inch by 60 inch space should be provided at the slip.

*Response.* As recreational boats vary in shape, size, and layout, it cannot easily be known where persons with disabilities would embark or disembark a boat. By requiring the clear pier space along the entire length of the slip, access options between the boat and the pier are improved. Although the final rule does not require the entire edge of the clear pier space to be unobstructed, by extending the clear pier space the length of the slip, the number of 60 inch continuous clear openings increases which further improves access between the boat and the pier.

### Exception 2 Edge Protection

Exception 2 permits edge protection 4 inches high maximum and 2 inches deep maximum at the continuous clear openings.

*Comment.* The proposed rule required that every 120 inches maximum of linear pier edge serving the accessible boat slips contain at least one continuous clear opening 60 inches minimum. A few commenters noted that the provision would not allow edge protection to be placed within the opening.

*Response.* In response to the ANPRM, commenters had mixed views on the use of edge protection. Some maintained that edge protection was necessary to protect persons who use wheelchairs from falling off the pier edges. Others maintained that edge protection created a tripping hazard as persons moved between a pier and boat. The proposed rule did not address edge protection at piers but did prohibit its installation at the continuous clear openings at the accessible slips. The Board has not taken a position on whether edge protection should be provided at piers, but has provided exception 2 so as not to prohibit its use at the continuous clear openings. Maximum dimensions are provided to control the size of the edge protection so as not to block the clear openings.

### Exception 3 Alterations to Existing Facilities

Exception 3 provides that in alterations to existing facilities, the clear pier space can be located perpendicular to the boat slip and extend the width of the boat slip. This exception is available only if the facility has at least one boat slip complying with section 15.2.5 and where further compliance with 15.2.5 would result in a reduction in the number of boat slips available or result in a reduction in the widths of existing slips.

*Comment.* Some commenters disagreed with requiring clear pier spaces alongside accessible boat slips where finger piers are not provided within the facility. Others noted that at existing facilities, increasing finger pier widths, on which pier clearances would be provided, may reduce the number of slips available.

*Response.* Although commenters at the two information meetings on the draft final rule indicated that more recreational boats are designed to be boarded from the stern, many recreational boats still provide for side boarding. To maximize the options for persons with disabilities to board, the requirement that the clear pier space

extend the length of the accessible boat slip in newly constructed facilities has not been modified. However, exception 3 has been added to the final rule to reduce the impact of this provision on existing facilities.

### Section 15.2.5.2 Cleats and Other Boat Securement Devices

This section clarifies that cleats and other boat securement devices are not required to comply with ADAAG 4.27.3.

*Comment.* A few commenters noted that at accessible boat slips, controls and operating mechanisms (such as power receptacles, and water and sewage connections) should comply with ADAAG 4.27.

*Response.* Although section 15.2 contains requirements for recreational boating facilities, other requirements in ADAAG 4.1 still apply. Therefore, ADAAG 4.1.3(13) would require controls and operating mechanisms, such as electrical and water connections, at accessible boat slips to comply with ADAAG 4.27. However, because mooring features used to secure a boat, when raised, exert higher load pressures at the point of pier attachment, the danger of failure increases, particularly on floating piers. For this reason, section 15.2.5.2 was added which states that the reach range requirements of ADAAG 4.27.3 do not apply to boat securement devices.

### Section 15.3 Fishing Piers and Platforms

#### Section 15.3.1 General

This section requires that newly designed or newly constructed and altered fishing piers and platforms comply with section 15.3.

*Comment.* Commenters questioned how the guidelines would apply to places that people may fish from, but were not constructed for fishing (e.g., a breakwater jetty, a bridge, or a flood control dam).

*Response.* Structures that have been designed and constructed for purposes other than fishing, even though persons may use the structure for fishing, are not required to comply with this section. However, piers and platforms that are newly designed or constructed and altered for the specific purpose of fishing are required to comply with this section.

#### Section 15.3.2 Accessible Route

This section requires that accessible routes, including gangways that are part of accessible routes serving fishing piers and platforms comply with ADAAG 4.3. Exception 1 permits the accessible route, serving floating fishing piers and platforms to use exceptions 1, 2, 5, 6, 7,

and 8 in section 15.2.2. Exception 2 provides that where the total length of the gangway or series of gangways serving as part of a accessible route is at least 30 feet, the maximum slope specified by ADAAG 4.8.2 does not apply to the gangways.

*Comment.* The proposed rule required the accessible route connecting to floating fishing piers and platforms to comply with the provisions for accessible routes at boating facilities. This section received only a few comments. One commenter recommended that the square footage values in the proposed rule be reduced for application to floating fishing piers. Another commenter noted that such a requirement would discourage entities from providing fishing piers.

*Response.* The final rule references exceptions 1, 2, 5, 6, 7 and 8 of 15.2.2 (Boating Facilities) for floating fishing piers and platforms. Exception 4 in section 15.2.2 allows boating facilities with less than 25 slips to have shorter gangways. To provide a similar small facility exception for floating fishing piers, exception 2 was added to section 15.3.2 and is based on a similar exception in section 15.2.4 which applies to floating boarding piers. The following example is included in the appendix.

*Example.* To provide access to an accessible floating fishing pier, a gangway is used. The vertical distance is 60 inches between the elevation that the gangway departs the landside connection and the elevation of the pier surface at the lowest water level. Exception 2 permits the use of a gangway at least 30 feet long, or a series of connecting gangways with a total length of at least 30 feet. The length of transition plates would not be included in determining if the gangway(s) meet the requirements of the exception.

*Comment.* One designer questioned whether the proposed rule prohibited gangways which comply with ADAAG 4.8.

*Response.* ADAAG 4.1.2(2) requires at least one accessible route complying with ADAAG 4.3 to connect accessible buildings, facilities, elements, and spaces that are on a site. ADAAG 4.3.7 requires an accessible route with a running slope greater than 1:20 to comply with the ramp requirements of ADAAG 4.8. Although the final rule contains exceptions which modify the requirements of ADAAG 4.8, the use of these exceptions is not mandatory. Designers are encouraged to provide greater access for gangways and exceed the minimums contained in the exceptions and the minimum requirements of ADAAG 4.8.

### Section 15.3.3 Railings

This section requires that where railings, guards, or handrails are provided, they must comply with 15.3.3.

#### Section 15.3.3.1 Edge Protection

This provision requires edge protection that extends 2 inches minimum above the ground or deck surface. An exception provides that where the railing, guardrail, or handrail is 34 inches or less above the ground or deck surface, edge protection is not required if the deck surface extends 12 inches minimum beyond the inside face of the railing. The toe clearance must be 9 inches minimum above the ground or deck surface beyond the railing and be 30 inches minimum wide.

*Comment.* The proposed rule did not permit other options for edge protection on floating fishing piers and platforms. Commenters provided designs of fishing stations incorporating an extended deck past the rail or guard that enable a person using a wheelchair or mobility device the opportunity for toe clearance beyond the face of the railing or guard. They felt that this design should be permitted and encouraged the Board to incorporate into the final rule.

*Response.* The proposed rule required edge protection where railings are provided and did not provide the flexibility designers of fishing piers and platform requested. An exception has been added to the final rule to permit more flexibility in providing a variety of designs that promote increased levels of accessibility to anglers with disabilities.

#### Section 15.3.3.2 Height

This section requires at least 25 percent of the railings to be a maximum of 34 inches above the ground or deck surface.

The Board sought comment on the height of lowered guards and what steps have been taken to ensure that their use was permitted under applicable building codes and standards. Additionally, in light of concerns that have been raised about safety issues related to lower guards, the Board also sought information on experiences designers or operators have had where guards on floating fishing piers and platforms have been lowered to accommodate individuals using wheelchairs and other mobility devices while fishing.

*Comment.* Many commenters supported the use of lowered rails or guards to provide persons using wheelchairs or other mobility devices the opportunity to fish. Commenters gave examples of providing lowered

rails or guards for many years, in many different applications, with no reported safety or injury problems. Commenters provided descriptions of unique and innovative designs of fishing stations constructed for use by persons with disabilities.

*Response.* The final rule retains the requirement that, where provided, 25 percent of the railing must be at a lowered height. Current designs, provided by commenters, supported a maximum height of the lowered rail or guard to be at 34 inches above the ground or deck surface. The height requirement for 25 percent of the rail has been changed in the final rule to 34 inches maximum above the ground or deck surface.

*Comment.* Some commenters believed that the Occupational Safety and Health Administration (OSHA) standards apply to recreational fishing piers and platforms. The OSHA standards apply to places where employment is performed and prescribe a 42 inch high railing along open sides of platforms located 4 feet or more above the floor. 29 CFR 1910.5 and 1910.23 (c) and (e). Other commenters believed that recreational fishing piers and platforms are covered by State and local building codes, which typically prescribe 42 inch high guards along open sides of platforms located more than 30 inches above the floor. These commenters were concerned that requiring at least 25 percent of railings to be a maximum 34 inches high conflicts with the OSHA standards, and State and local building codes.

*Response.* Recreational fishing piers and platforms are subject to OSHA safety standards only if they are places of work. In some cases there may be both workers and recreational users on a pier. In those cases, OSHA standards would apply, and the pier would be exempted from the height requirements in the final rule, as discussed below.

The International Code Council has advised the Board that recreational fishing piers and platforms are not covered by model building codes unless they are an integral part of a building that is regulated by the adopting State or local authority. To avoid potential conflicts, an exception has been added to the final rule that permits a higher guard to be provided along a recreational fishing pier or platform where the guard complies with the International Building Code (IBC) (2000 edition) requirements for height (not less than 42 inches high) and opening limitations (4 inch diameter sphere cannot pass through any opening up to a height of 34 inches; and 8 inch diameter sphere cannot pass through

any opening from a height of 34 inches to 42 inches). This exception can be used if a recreational fishing pier or platform is covered by a State or local building code; or if a design professional believes that a specific location warrants enhanced safety measures; or if an employer provides a 42 inch high railing to comply with OSHA standards.

#### Section 15.3.3.3 Dispersion

This section requires that lowered railings be dispersed throughout a fishing pier or platform.

*Comment.* A commenter requested guidance on the criteria used to determine dispersion.

*Response.* Anglers who stand can fish from any part of a pier or platform and can change location depending on the fishing or water conditions. Where railings, guards, and handrails have been installed on fishing piers and platforms, the height of the railings interfere with fishing and block vision for persons who use wheelchairs and other mobility devices. This provision requires that where railings are provided, the dispersion of the lowered railings provide similar choices to fish from a variety of locations. The distribution of lower railings could include locations of different water depths with some that provide shading or are close to shore, and could take into account the tides or water fluctuations.

#### Section 15.3.4 Clear Floor or Ground Space

This section requires that at least one clear floor or ground space complying with ADAAG 4.2.4 be provided where the lowered railing height is located. Where no railings are provided, at least one clear floor or ground space complying with ADAAG 4.2.4 must be provided. No substantive comments were received and no changes were made to this provision for the final rule.

#### Section 15.3.5 Maneuvering Space

This section requires that at least one maneuvering space complying with ADAAG 4.2.3 be provided on a fishing pier or platform. The maneuvering space is permitted to overlap the accessible route and the clear floor space required by 15.3.4. No substantive comments were received and no changes were made to this provision for the final rule.

#### Golf

#### Section 3.5 Definitions

Two terms used in this section are added to ADAAG 3.5 (Definitions).

A "golf car passage" is defined as a continuous passage on which a

motorized golf car, also known as a golf cart, can operate. Designers and operators sometimes use the term "golf car path" to identify what the Board is defining as a "golf car passage." Because the term "golf car path" may connote a prepared surface, the term was not used. While a golf car passage must be usable by golf cars, it does not necessarily need to have a prepared surface.

A "teeing ground" is the starting place for a hole to be played. This definition is consistent with the United States Golf Association definition, which describes a teeing ground as a rectangular area two club-lengths in depth, with the front and sides defined by the outside limits of two tee-markers.

#### Section 15.4.1 General

This section requires newly designed or newly constructed and altered golf courses, driving ranges, practice putting greens, and practice teeing grounds to comply with 15.4.

#### Section 15.4.2 Accessible Route—Golf Courses

This section requires an accessible route to be 48 inches wide minimum, or 60 inches minimum if handrails are provided, to connect accessible elements and spaces located within the boundary of a golf course. Additionally, an accessible route must connect the golf car rental area, bag drop areas, practice putting greens, accessible practice teeing grounds, course toilet rooms, and course weather shelters.

Exception 1 permits the use of a golf car passage complying with section 15.4.7 in lieu of all or part of an accessible route. This exception does not apply to the required accessible route complying with 4.3 when connecting elements and amenities outside of the boundary of the golf course (*i.e.*, accessible vehicle parking spaces with the golf course clubhouse entrance). Exception 2 provides that handrails are not required on accessible routes within the boundary of a golf course. It is hazardous for handrails to be located through a green, or on teeing grounds, because of the danger of golf balls ricocheting off rails. Since course elements could be accessible from golf car passages in lieu of an accessible route, handrails would be of little utility along these routes.

The guidelines recognize that providing an accessible route may be impractical on a golf course for several reasons. First, the route of play for a golfer is dependent on where the ball lands and is therefore unpredictable. Secondly, there is an assumption that on many courses, golfers use a golf car to move throughout the course. Finally,

requiring an accessible route throughout a course could alter the slopes within some courses and eliminate some of the challenge of the game. The guidelines permit accessible elements and spaces within the boundary of the course and areas used for practice putting or driving and other course amenities outside the boundary of the course to be connected through either an accessible route or a golf car passage.

The 48 inch minimum width for the accessible route is necessary to ensure passage of a golf car on either the accessible route or the golf car passage. This is important where the accessible route is used to connect the golf car rental area, bag drop areas, practice putting greens, accessible practice teeing grounds, course toilet rooms, and course weather shelters. These are areas outside the boundary of the golf course, but are areas where an individual using an adapted golf car may travel. A golf car passage may not be substituted for other accessible routes, required by ADAAG 4.1.2, located outside the boundary of the course. The following example is included in the appendix.

*Example.* An accessible route connecting an accessible parking space to the entrance of a golf course clubhouse is not covered by this provision permitting a golf car passage in lieu of an accessible route required by 4.1.2.

*Comment.* The proposed rule sought comment on the option of using a golf car passage in lieu of an accessible route for smaller courses (*i.e.*, 3 or 6 holes).

*Response.* Commenters supported the use of the golf car passage on smaller courses. The final rule provides golf course designers and operators the opportunity to choose between providing either a golf car passage or an accessible route for all courses regardless of size.

*Comment.* Commenters questioned who would be responsible for providing single rider adaptive golf cars. Additionally, commenters questioned if a course could establish criteria for restricting use due to terrain conditions. Others wanted to know if there are plans to create regulations or guidelines for accessible golf cars. Persons with disabilities supported the use of adaptive or single rider golf cars and gave examples of experiences at courses currently permitting or providing access via golf cars to courses.

*Response.* The Board develops and maintains accessibility guidelines for the built environment. It is outside the jurisdiction of the Board to address the operational and procedural requirements of a golf course. Operational and procedural issues are

within the jurisdiction of the Department of Justice.

*Comment.* The requirements for an accessible route or golf car passage seek to provide access for players with disabilities to either practice or play the game of golf. The Board requested comments on how access should be provided for spectators during golf tournaments and competitions. Commenters provided examples and experiences of current accessibility practices encountered at many levels of tournaments and supported allowing the tournament committees to select holes (teeing areas, fairways, and putting greens) to provide accommodations and transportation to the selected areas throughout the golf course and surrounding areas.

*Response.* No additional requirements have been included in the final rule for spectators with disabilities attending tournaments or competitions. Facilities hosting tournaments or competitions must comply with all the other requirements of the ADA, including the general obligation to provide an equal opportunity to individuals with disabilities to enjoy the services provided. Additionally, ADAAG requires temporary facilities used during tournaments or competitions to provide access to assembly seating areas, portable restroom facilities, concessions, and all other available amenities. Access to these temporary facilities on a golf course may be achieved through either an accessible route or golf car passage.

#### Section 15.4.3 Accessible Routes—Driving Ranges

This section provides that an accessible route must connect accessible teeing stations at driving ranges with accessible parking spaces and must be 48 inches minimum in width. Where handrails are provided, the accessible route must be a minimum of 60 inches in width. An exception has also been added which permits a golf car passage to be used at driving ranges instead of an accessible route.

*Comment.* The proposed rule did not specifically address the accessible route provided at driving ranges. A commenter stated that a person who plays from a golf car would need to practice driving a golf ball from the same position and stance used when playing the game.

*Response.* The final rule requires both a stand alone driving range and a driving range located at a golf course to provide an accessible route that is 48 inches wide minimum or 60 inches minimum where handrails are provided,

to connect the accessible parking spaces to required accessible teeing stations.

#### Section 15.4.4 Teeing Grounds

This section requires teeing grounds to comply with section 15.4.4.

##### Section 15.4.4.1 Number Required

This section requires that where one or two teeing grounds are provided for a hole, one teeing ground must be accessible. Where three or more teeing grounds are provided for a hole, at least two teeing grounds serving a hole must be accessible.

*Comment.* The proposed rule required that if two teeing grounds were provided both must be accessible. Course designers and operators expressed concerns that if only two teeing grounds are provided at a hole requiring both to be accessible was too restrictive.

*Response.* The final rule has been revised to require two teeing grounds to be accessible when three or more teeing grounds are provided for a hole. The Board believes that requiring two teeing grounds to be accessible when three or more are provided will provide persons with disabilities with an option to play from different tees appropriate to their skill level and also provide course operators and designers with the flexibility they requested.

##### Section 15.4.4.2 Forward Teeing Ground

This section requires the forward teeing ground to be accessible. The forward teeing ground need not be accessible in alterations of existing courses when terrain makes compliance infeasible.

*Comment.* The proposed rule sought comment on the number of accessible teeing grounds that should be required for each hole and, if more than one accessible teeing ground is provided, whether it should be the forward tee. Commenters supported the option to play from different teeing grounds appropriate to player skill levels if multiple teeing grounds are provided per hole. Additionally, golfers with disabilities overwhelmingly supported requiring the forward teeing ground to be accessible regardless of the number of teeing grounds provided.

*Response.* The final rule provides a choice of teeing grounds for golfers with disabilities when three or more teeing grounds are provided per hole and also provides flexibility to course designers and operators. The final rule also requires that the forward teeing ground be the accessible tee regardless of the number of teeing grounds provided per hole.

*Comment.* The proposed rule did not provide an exception for alterations of existing teeing grounds from making the forward tee accessible. Commenters stated that requiring access to the forward teeing ground in alterations to existing courses may be too restrictive.

*Response.* Some teeing grounds on existing courses may be located on steep slopes and it may not be possible to provide a golf car passage to the forward teeing ground. The final rule exempts the forward teeing ground from being accessible in alterations where compliance is not feasible due to terrain.

##### Section 15.4.4.3 Teeing Grounds

This section requires accessible teeing grounds to be designed and constructed to allow a golf car to enter and exit the teeing ground.

*Comment.* The proposed rule required teeing grounds to provide a minimum clear area 10 feet by 10 feet with a surface slope not exceeding 1:48 in all directions. Course designers and operators stated that current designs of teeing grounds provide a clear area of at least 10 feet by 10 feet. Additionally, they expressed concern about maintaining a slope no greater than 1:48, and noted that settling of the soil and drainage problems occur with such a minimal slope. Others questioned how the slope of the teeing ground should be measured.

*Response.* Current design and construction practices for teeing grounds provide the needed space for golf car passages. Designers currently limit the slope of the teeing grounds to provide a level surface from which golfers tee off. The maximum slopes and minimum size requirements have been deleted from the final rule. The final rule requires teeing grounds to be designed and constructed to allow a golf car to enter and exit the teeing ground.

##### Section 15.4.5 Teeing Stations at Driving Ranges and Practice Teeing Grounds

This section requires that where teeing stations or practice teeing grounds are provided, at least 5 percent, but not less than one, of the practice teeing grounds must be accessible. This provision applies to practice facilities adjacent to a golf course, in addition to stand-alone facilities. No substantive comments were received and no changes have been made for the final rule.

##### Section 15.4.6 Weather Shelters

This section requires weather shelters that are provided on a golf course to be designed and constructed to allow a golf

car to enter and exit and have a clear floor or ground space 60 inches by 96 inches. This space will allow a golf car to be driven directly into a weather shelter. No substantive comments were received and no changes have been made for the final rule.

##### Section 15.4.7 Golf Car Passage

This section requires openings at least 60 inches wide to be provided at intervals, not exceeding 75 yards, where curbs or other man-made barriers are provided along a golf car passage that would prohibit a golf car from entering a fairway.

*Comment.* The proposed rule required the 60 inch openings at intervals of 75 yards of golf car passage. Course designers and operators expressed concern that requiring openings at a fixed distance of 75 yards would be too restrictive and would not allow enough flexibility for natural characteristics of the course, hazard placement, and erosion control.

*Response.* The final rule requires the openings at intervals not to exceed 75 yards. These openings will provide access to the course at reasonable intervals, enabling a golfer using a golf car to play the game without extended travel distances and time requirements and also provide the flexibility the course designer and course operator need.

##### Section 15.4.7.1 Width

This section requires a golf car passage to be 48 inches wide minimum.

*Comment.* Commenters supported limited technical requirements for golf car passages. Currently there are no standards that govern the design or construction of golf car passages. Commenters felt that additional requirements would restrict designers and have the potential of altering the game.

*Response.* The 48 inch minimum dimension for a golf car passage is based on the standard width of gasoline or electric powered golf cars. The golf car passage may at times coincide with the golf car path, however, it is not required to include a prepared surface. The golf car passage is a continuous passage on which a motorized golf car can operate. No additional technical provisions for golf car passages have been included in the final rule.

##### Section 15.4.8 Putting Greens

This section requires space to allow a golf car to enter and exit the green.

*Comment.* Substantial comment was received on requiring putting greens and fairways to be accessible to golfers using adaptive single rider golf cars. Course

operators are concerned that allowing golf cars access to the green will cause damage to the greens and potentially cause holes to be closed for extended periods of time. Golfers with disabilities, organizations supporting golfers with disabilities, and golf car manufacturers provided information on current courses that allow for golf car passage on putting greens which showed little or no damage to the putting green surface.

*Response.* Single rider golf cars adapted for golfers with disabilities are available from about a dozen companies. These golf cars are generally designed to be "greens friendly" and have low ground pressure that is evenly distributed on all four tires. Some manufacturers report that the ground pressure of these golf cars is less than the ground pressure of a typically standing person and cause no turf damage even in wet conditions.

*Comment.* Course operators also raised operational issues such as whether they are required to make single rider adapted golf cars available for rental and whether they can restrict the use of golf cars on fairways and greens for certain weather or agronomic conditions.

*Response.* These issues go beyond the Board's jurisdiction and the requirements in this final rule. The Board anticipates that the Department of Justice will answer these operational issues when it amends its ADA regulations to incorporate the recreation facilities guidelines as standards.

### Section 15.5 Miniature Golf

#### Section 15.5.1 General

This section requires newly designed or newly constructed and altered miniature golf courses to comply with section 15.5.

#### Section 15.5.2 Accessible Holes

This section requires at least 50 percent of all holes to be accessible and that the accessible holes be consecutive. With the reduction in the minimum number of accessible holes on a miniature golf course, the Board wants to provide a more socially integrated golfing experience for people using wheelchairs or other mobility devices. An exception also permits one break in the sequence of consecutive accessible holes, provided that the last hole on the miniature golf course is the last hole in the sequence. This exception is provided to allow some flexibility in the layout and design of a miniature golf course.

*Comment.* Significant comment was received from miniature golf course

owners and operators regarding the number of holes required to be accessible. The proposed rule required each hole on a miniature golf course to be accessible, with an exception for 50 percent of elevated holes. Commenters were asked to give the Board guidance on differentiating between level and elevated holes. Few comments were received on definition alternatives. Some owners and operators believed that the requirement for all holes to be accessible would significantly impact course design to the extent that the experience may be "fundamentally altered." Others cited space limitations, concerns about slowing the game down, and having the effect of "compromising the challenge of the game."

*Response.* The Board has significantly reduced the number of holes required to be accessible in newly constructed miniature golf courses to 50 percent of all holes.

*Comment.* During the comment period following the draft final rule, the Miniature Golf Association recommended that instead of making 50 percent of the holes accessible, miniature golf facilities should have the option of providing tools, equipment, or assistive devices to provide access. They specifically requested that assistive devices such as electric carts be permitted as an alternative to an accessible route. Several other commenters opposed the reduction in the number of accessible holes, expressing concerns about limiting the game for persons with disabilities to only half of the holes.

*Response.* The Board has maintained the requirement that a minimum of 50 percent of all holes in new construction be accessible. The final rule does not recognize the alternative use of assistive devices for providing access in new construction. Designing miniature golf course holes so electric carts can safely maneuver through the holes is likely to have as great or greater impacts than designing an accessible route. Requiring individuals with disabilities to use electric carts on miniature golf courses is also inconsistent with other provisions of the ADA which require goods, services, and facilities to be afforded in the most integrated setting appropriate.

Given the diversity of layouts and designs of miniature golf courses, the final rule does not distinguish between courses with elevated holes or those with largely level holes. The 50 percent reduction represents a compromise given the concerns presented. Other considerations relate to the accessible route connecting accessible holes. The Board has established this reduction to

give relief where courses are designed on small parcels of land with existing terrain limitations. It is recommended that all holes on a miniature golf course be made accessible where space limitations and existing steep terrain are not present.

#### Section 15.5.3 Accessible Route

This section requires that the accessible route must connect the course entrance with the first accessible hole and the start of play area on each accessible hole. Since accessible holes must be consecutive, this section also requires the course to be configured to allow exit from the last accessible hole to the course exit or entrance. The course must be designed so as not to require an individual to back track through other holes to exit or move around the course. Where the accessible route is located on the playing surface of the accessible hole, five exceptions are permitted and are discussed below.

*Comment.* Miniature golf course operators were concerned that the surface commonly used on miniature golf course holes would not meet the requirements for accessible carpet. Their concerns were centered around the thickness of the surface. ADAAG 4.5.3 includes a requirement that the maximum pile thickness must be no more than 1/2 inch and be securely attached with a firm cushion, pad, or backing. Exposed edges must be fastened to floor surfaces and must have trim along the entire length of the exposed edge.

*Response.* The Board has added Exception 1 which exempts carpet used on miniature golf course holes from the provisions of ADAAG 4.5.3. Surfaces provided as a part of an accessible route, whether on or off the playing surface, must comply with ADAAG 4.5.2. ADAAG 4.5.2 requires the surface to be "stable, firm, and slip resistant."

*Comment.* Commenters raised concern about the use of readily removable curbs permitted in the proposed rule. Operators were concerned that their removable qualities would tempt younger players to use them inappropriately. Persons with disabilities questioned who would actually move the curbs and how problems related to their use would be addressed.

*Response.* The final rule does not allow the use of "readily removable curbs". This option was included to allow for passage on and off the course while containing the ball while in play. As an alternative, Exception 2 has been added which permits a 1 inch curb for an opening distance of 32 inches where the accessible route intersects the

playing surface of a hole. This permits passage of wheelchairs while containing the ball within the hole.

*Comment.* The proposed rule permitted a maximum slope of 1:4 for a 4 inch rise where the accessible route is located on the playing surface. A few commenters questioned how close together a designer could locate these steeply sloped surfaces. They were concerned about the appropriateness where these steep slopes existed for long distances without areas to rest.

*Response.* Exception 3 permits a slope of 1:4 maximum for a 4 inch rise where the accessible route is located on the playing surface of a hole. Exception 4 specifically addresses the issue of landings where sloped surfaces are provided. This exception permits the landings to be 48 inches long with slopes no greater than 1:20. ADAAG 4.8.4(3) requires landings to be 48 inches by 60 inches minimum, where ramps change direction. Providing a separation or break from the steeper slopes is necessary for individuals with disabilities to safely maneuver on the hole.

Exception 5 states that where the accessible route is located on the playing surface of a hole, handrails are not required.

#### *Section 15.5.3.2 Accessible Route—Adjacent to the Playing Surface*

Where the accessible route is located adjacent to the playing surface, the requirements of 4.3 apply. This provision clarifies that the accessible route may be located on the playing surface of the accessible hole or adjacent to the hole.

#### *Section 15.5.4 Start of Play Areas*

This section requires start of play areas required to comply with 15.5.2 to have a slope not steeper than 1:48 and to be 48 inches minimum by 60 inches minimum.

*Comment.* The proposed rule required the minimum space for the start of play area to be 60 inches by 60 inches. Commenters questioned the need for this space and recommended a reduction where possible especially where space limitations exist. Questions were also raised regarding the appropriateness of overlapping the accessible route with the start of play area.

*Response.* The final rule reduces the space required since the start of play area will usually not require a person using a wheelchair or mobility aid to make a complete turn. Rather, space is necessary for positioning to take the first shot of the hole. Consistent with ADAAG, unless otherwise specified, the accessible route and the clear space

required at the start of play area are permitted to overlap.

#### *Section 15.5.5 Golf Club Reach Range*

This section requires all areas within accessible holes where golf balls rest to be within 36 inches maximum of an accessible route having a maximum slope of 1:20.

*Comment.* The proposed rule required that all level areas within accessible holes where golf balls rest be within 27 inches maximum of an accessible route. A few commenters questioned the appropriateness of the 27 inch dimension. They recommended an increase to include a broader range of skill levels and golf club lengths.

*Response.* The distance from the level areas has been increased to 36 inches to balance the impact on course design and incorporate the reach of a typical adult size golf club. This is a maximum distance from the accessible route which may be located either on the hole or adjacent to the hole. Where possible, designers should locate the accessible route as close as possible to the level areas on the course. This will improve the ability to reach the golf ball for a variety of users.

#### *Section 15.7 Exercise Equipment and Machines, Bowling Lanes, and Shooting Facilities*

##### *Section 15.7.1 General*

This section requires all newly designed or newly constructed and altered exercise equipment and machines, bowling lanes, and shooting facilities to comply with section 15.7.

##### *Section 15.7.2 Exercise Equipment and Machines*

This section requires at least one of each type of exercise equipment and machines to be provided with clear floor space complying with ADAAG 4.2.4 and be served by an accessible route. Clear floor space must be positioned for transfer or for use by an individual seated in a wheelchair. Clear floor spaces for more than one piece of equipment are permitted to overlap. Permitting clear spaces to overlap should reduce the space requirements within an exercise or health club facility.

*Comment.* The American Hotel and Lodging Association commented that the requirement for clear space at exercise equipment and machines created a burden for the lodging industry. Similar comments were also received from the International Health, Racquet, and Sport Club Association, who indicated that space limitations present in existing facilities will prohibit compliance with this provision.

*Response.* These guidelines apply only to newly constructed and altered buildings and facilities. Where exercise equipment and machines are altered or added to a facility, the provisions of 15.7.1 apply to those pieces that are altered or added. In the case of altered exercise equipment or machines, the provisions of ADAAG 4.1.6(1)(j) related to “technical infeasibility” will also apply. ADAAG 4.1.6(1)(j) permits departure from the technical provisions where existing physical or site constraints prohibit full compliance. Space limitations may prohibit full compliance with 15.7.2. In this case, designers and operators must comply to the “maximum extent feasible”.

Requirements for existing buildings and facilities are addressed in the Department of Justice regulations and are subject to the requirements for “readily achievable barrier removal” where the facility is covered by title III of the ADA. Facilities covered by title II of the ADA are subject to the requirements for “program accessibility”. See discussion in the background section of this preamble.

An appendix note is added to provide guidance on exercise equipment and machine layout to maximize space.

*Comment.* A few commenters requested guidance on what is intended with respect to “types” of exercise equipment and machines. Others suggested that the Board should not require access to exercise machines or equipment that require the user to stand such as tread mills or stair climbers.

*Response.* The final rule is not limited to exercise equipment or machines that do not require standing. Access to the various pieces of exercise equipment serves individuals who use mobility aids such as scooters and wheelchairs. Individuals with ambulatory disabilities including those using walkers, canes, and crutches will also benefit from an accessible route and clear floor space next to a treadmill or stationary bike or other exercise equipment. An appendix note provides guidance on the different types of exercise equipment and machines. It also suggests that owners and operators consider including exercise equipment and machines within their facilities that provide for upper body cardiovascular exercise. This will add to the diversity of exercise options for everyone.

With respect to the issue of “type”, a stationary bicycle would be considered one type. A rowing machine would also be considered a type. While both provide a cardiovascular exercise, they are considered two different types for purposes of these guidelines. In terms of strength training machines, a bench

press machine is considered a different type than a biceps curl machine. The requirement for providing access to each type is intended to cover the variety of strength training machines. Where operators provide a biceps curl machine and free weights, both are required to meet the provisions in this section, even though an individual may be able to work on their biceps through both types of equipment. Where the exercise equipment and machines are only different in that different manufacturers provide them, only one of each type of machine is required to meet these guidelines. For example, where two bench press machines are provided and each is manufactured by a different company, only one is required to comply.

#### Section 15.7.3 Bowling Lanes

This section requires that where bowling lanes are provided, at least 5 percent, but not less than one lane of each type must be accessible.

*Comment.* The Bowlers Proprietors Association expressed concern about requiring 5 percent of bowling lanes to be accessible. Their comments focused on the difficulty of providing ramps to gain access to bowling lanes within existing facilities. They also questioned how to apply the 5 percent minimum requirement where a bowling facility has multiple lanes.

*Response.* As previously indicated, these guidelines apply to newly constructed and altered facilities. When a bowling facility is altered, the provisions of 15.7.2 will apply to the lane that is undergoing an alteration and does not require all other lanes to be modified unless required by ADAAG 4.1.6 (Path of Travel). Other obligations related to existing facilities covered by titles II and III of the ADA are addressed in the Department of Justice regulations.

Where the required number of accessible elements to be provided is determined by calculations of ratios or percentages and remainders or fractions result, the next greater whole number of such elements should be provided. For example, if 18 lanes of one type are provided, one lane would be required to be accessible in new construction. If 24 bowling lanes of one type are provided in new construction, a minimum of two accessible bowling lanes would be required in new construction.

*Comment.* The Bowlers Proprietors Association also expressed concern about the number of accessible bowling lanes required in those facilities where different types of bowling is provided. They were also concerned about facilities that provide both ten pin and duck pin bowling. They believed that a

5 percent requirement for both types was excessive and recommended that the requirement be limited to the type that is dominant within a given facility. Further, the Bowlers Proprietors Association questioned what made a bowling lane accessible.

*Response.* In facilities where both ten pin and duck pin bowling are provided, the 5 percent requirement for each type will typically result in one of each type of lane being accessible.

The final rule does not include any further technical provisions for bowling lanes required to be accessible. Like other areas of sport activity, the requirement is for an accessible route to connect to the area of sport activity, in this case, the bowling lane. Specific exemptions to ADAAG 4.4 (protruding objects) and 4.5 (surfacing requirements) are applied within the area of sport activity. Therefore, bowling lanes which are necessarily waxed to allow the ball to travel, are not required to be slip resistant.

#### Section 15.7.4 Shooting Facilities

This section requires that where fixed firing positions are provided at a site, at least 5 percent, but not less than one, of each type of firing position must be accessible.

*Comment.* A few commenters questioned why the Board did not require an accessible route to the target areas as well as the fixed firing positions. Commenters also questioned the application of this section to trap and skeet facilities where the facilities are not entirely fixed. Others questioned what factors should be considered in determining the different types of firing positions.

*Response.* The Board has not included a requirement for an accessible route to the target areas since targets are often moveable, making it difficult to locate the accessible route effectively. There is also difficulty in defining what is considered the "target" area. Where facilities contain a combination of fixed and non-fixed elements, operators should consider the general nondiscrimination requirements of the ADA. Direction on these and other issues related to the use of shooting facilities should be obtained from the Department of Justice. Factors to be considered in determining the types of fixed firing positions include whether covering and lighting is provided, and which shooting events the fixed firing position is intended to support.

#### Section 15.7.4.1 Fixed Firing Positions

This section requires that accessible fixed firing positions contain a 60 inch diameter space and have a slope not

steeper than 1:48. No substantive comments were received and no changes have been made to this provision in the final rule.

#### Section 15.8 Swimming Pools, Wading Pools, and Spas

##### Section 3.5 Definitions

The final rule provides a definition for a catch pool which is defined as a pool used as a terminus for water slide flumes.

*Comment.* The proposed rule did not define the term catch pool. Commenters requested that catch pools be exempt since access is not required for water slides.

*Response.* The term "catch pool" is added to the final rule since it is used in an exception in the final rule. Exception 3 to section 15.8.1 exempts catch pools from complying with the requirements of this section, provided that an accessible route connects to the catch pool edge.

##### Section 15.8.1 General

This section requires newly designed or newly constructed and altered swimming pools, wading pools, and spas to comply with 15.8. An exception has been added to the final rule that provides that an accessible route is not required to serve raised diving boards or diving platforms provided that an accessible route is provided to the base of the raised diving board or platform.

##### Section 15.8.2 Swimming Pools

This section requires that at least two means of entry be provided for each public or common use swimming pool. A sloped entry or lift must be one of the primary means of access. The secondary means of access could include a pool lift, sloped entry, transfer wall, transfer system, or pool stairs.

*Comment.* The proposed rule permitted a moveable floor as a secondary means of entry. Commenters stated that even though moveable floors may have some practical applications they do not provide independent access and often place a person with a disability on display while the pool is evacuated and the floor raised to provide access. Additionally, commenters raised concerns regarding the removal of handrails and other means of egress prior to lifting the pool floor.

*Response.* The option of using a moveable floor as a secondary means of accessible entry in public or common use swimming pools has been deleted from the final rule.

The Board has also deleted the requirement that the second means of access not duplicate the first means of

access in larger pools in the final rule. This should give designers additional flexibility in choosing between the various means of access. An appendix note recommends that where two means of access into the water are provided, different means are recommended.

*Exception 1 Small Pools With Less Than 300 Linear Feet of Pool Wall*

Exception 1 permits public or common use swimming pools with less than 300 linear feet of pool wall to only provide one accessible means of entry by either a swimming pool lift or a sloped entry.

*Comment.* A commenter suggested that Exception 1 should be modified to refer to pool wall that is available for entry into the pool. They explained that pool walls at diving areas and pool decks where there is no available pool entry because of landscaping or adjacent structures should not be counted when determining the number of accessible means of entry required.

*Response.* Exception 1 is intended to provide small pools with relief from providing more than one accessible means of entry. It was not intended for large pools that could limit the locations of entry with landscaping or other structures from requiring additional accessible means of entry.

*Exception 2 Pools Where Access Is Limited to One Area*

Exception 2 has been added to the final rule and permits wave action pools, leisure rivers, sand bottom pools, and other pools where user access is limited to only one area, to provide one accessible means of entry by either a swimming pool lift, sloped entry, or a transfer system.

*Comment.* Commenters from speciality pool operators and leisure river designers expressed concerns for safety, where there is wave action or moving water, when providing additional accessible means of entry in these unique water environments. Wave action pools typically provide a large area of zero grade entry, where everyone enters the water. Providing an accessible means of entry along the high walls could be very dangerous. Leisure rivers are constructed to provide a safe area where staff can assist individuals into the current at one location to control access to and from the moving water.

*Response.* In response to the safety concerns provided by designers and operators of these moving water experiences, only one accessible means of entry is required in the final rule, when user access is limited to one area.

*Exception 3 Catch Pools*

Exception 3 exempts catch pools from these requirements, provided that an accessible route connects to the catch pool edge.

*Comment.* The proposed rule did not include any specific requirements for access to water slides. Comments on the proposed rule and the draft final rule supported not requiring access to the top of water slides.

*Response.* An exception has been added to the final rule exempting water slides from accessibility. See ADAAG 4.1.1 (5) (b) (v). To be consistent with the water slide exception, the final rule also exempts the catch pool at the discharge area of a water slide from providing an accessible means of entry or exit from the catch pool, provided that an accessible route connects to the catch pool edge.

*Section 15.8.3 Wading Pools*

This section requires at least one accessible means of entry into each wading pool. The means of entry must be a sloped entry.

*Comment.* The proposed rule required the means of entry into wading pools to be either a sloped entry, transfer wall, or a transfer system. The proposed rule also sought comment on the appropriateness of providing a transfer wall or other transfer system as a means of access into a wading pool. Several commenters expressed concern about the potential dangers to children that may use the transfer walls or systems inappropriately for play or diving.

*Response.* The final rule limits the accessible means of entry into a wading pool to a sloped entry only. Examination of the different means of access into wading pools found zero grade entry to be the most appropriate and currently most provided means of entry.

*Section 15.8.4 Spas*

This section requires at least one accessible means of entry into spas. The means of entry must be a pool lift, transfer wall, or transfer system. An exception allows for five percent, but not less than one spa, where spas are provided in a cluster, to be accessible. No substantive comment was received and no changes have been made to this section in the final rule.

*Section 15.8.5 Pool Lifts*

This section provides the technical requirements for pool lifts.

*Section 15.8.5.1 Pool Lift Location*

This provision requires pool lifts to be located where the water level does not exceed 48 inches.

*Comment.* The proposed rule did not specify the location of a pool lift. Commenters with disabilities and individuals who work in environments where people with disabilities use pool lifts expressed concern that pool lifts may be placed in areas where the water depth would not permit assistance in the water if needed. Comments on the draft final rule supported the requirement for a pool lift to be located in a water depth of 48 inches or less whenever possible. Commenters also gave examples of when the location of a pool lift should be allowed in an area where the water depth is greater than 48 inches.

*Response.* The final rule requires a pool lift to be located where the water level does not exceed 48 inches. Two exceptions have been added to the final rule in response to comments received. Exception 1 permits the use of pool lifts at any location where the entire pool has a depth greater than 48 inches. Exception 2 permits pools with multiple pool lift locations to provide at least one where the water depth does not exceed 48 inches.

*Section 15.8.5.2 Seat Location*

This section requires the centerline of the seat, when in the raised position, to be located over the deck and 16 inches minimum from the edge of the pool. Additionally, the deck surface between the centerline of the seat and the pool edge must not have a slope greater than 1:48.

*Comment.* The proposed rule required the centerline of the seat, when in the raised position, to be located over the deck and 20 inches minimum from the pool edge. Comments from lift manufacturers expressed concern about the 20 inch minimum distance. They elaborated on the difficulties associated with providing a lift that places the user away from the pivot point of the lift a distance of 20 inches. Additionally, they commented that aquatic lifts with the centerline of the seat at least 20 inches away from the pool edge may not clear the footrest over the curbing or pool edge provided on some pools.

*Response.* Based on the concerns of commenters, the distance measured from the centerline of the lift seat to the edge of the pool has been reduced from 20 inches to 16 inches minimum. The location of the seat in relation to the edge of the pool is especially important to facilitate safe transfers. The Board is concerned about locating the seat either over the water or too close to the deck edge for safety reasons. This provision has been modified to address design limitations and incorporate the

maximum distance from the pool edge to ensure safety.

#### *Section 15.8.5.3 Clear Deck Space*

This section requires a clear deck space on the side of the seat opposite the water and parallel with the seat. The space is required to be 36 inches wide minimum and to extend forward 48 inches minimum from a line located 12 inches behind the rear edge of the seat. The clear space is specified in relationship to the seat to allow unobstructed space for either side or diagonal transfer. Additionally, the clear deck space must have a slope not greater than 1:48.

*Comment.* The proposed rule required the clear deck space to be a minimum of 30 inches wide. Commenters requested additional space to permit greater flexibility for transfer position preferences and the varied abilities of persons requiring the use of a pool lift. Commenters expressed a preference that the clear deck space should be required to provide a level surface from which to transfer from a mobility device to the lift seat.

*Response.* The final rule increases the clear deck space required on the side of the seat opposite the water to be a width of 36 inches minimum and that the clear deck space provide a surface with a slope not greater than 1:48. The additional space will facilitate the maneuvering that may be needed by a person using a mobility device preparing for a transfer to the seat of a pool lift.

#### *Section 15.8.5.4 Seat Height*

This section requires the height of a lift seat to be designed to allow a stop at 16 inches minimum to 19 inches maximum measured from the deck to the top of the seat surface when the seat is in the raised (load) position.

*Comment.* The proposed rule required the height of the lift seat to be 16 inches minimum to 18 inches maximum. Commenters requested a greater range of seat heights to transfer to or from when the lift is in the up position. They suggested a seat height that could accommodate the needs of users of all ages and abilities would be more beneficial.

*Response.* Information obtained from the Board sponsored research project supported the height requirement of a lift seat while in the upper load position to be at a height between 16 and 18 inches from the deck surface. In response to the comments received, the final rule departs slightly from the proposed rule, by permitting the lift seat to make a stop at the 16 to 19 inch height above the deck surface. The lift

could provide additional stops at various heights provided that a stop is provided between 16 and 19 inches above the surface of the deck.

#### *Section 15.8.5.5 Seat Width*

This section requires a lift seat to be 16 inches wide minimum. No substantive comment was received and no changes have been made to this section in the final rule.

*Comment.* The proposed rule sought information on the different types of seats that are available on pool lifts and whether a specific type should be required in the final rule. Commenters did not provide a consensus on either the type of pool lift seat or the type of materials preferred by pool lift users.

*Response.* The final rule does not specify the type of material or the type of seat to be provided by a pool lift. Persons with disabilities involved in the Board sponsored research project expressed interest in all types of seats. An appendix note provides additional information on pool lift seats.

#### *Section 15.8.5.6 Footrests and Armrests*

This section requires footrests to be provided and that they move in conjunction with the seat. Additionally, this provision requires that, if provided, the armrest opposite the water be removable or fold clear of the seat when the seat is in the raised (load) position.

*Comment.* The proposed rule requested information on the appropriateness of requiring armrests on pool lifts and on their size and location. Commenters supported requirements based on their own personal needs with no consistent guidance on the location or size of armrests on a pool lift. One commenter questioned the appropriateness of providing a footrest on a lift for entry into a spa due to the water depth in some smaller spas.

*Response.* An exception has been added that provides that footrests are not required on pool lifts that provide an accessible means of entry into a spa. An appendix note encourages the use of a footrest in larger spas where possible and some type of retractable leg support is recommended for pool lifts used in all spas.

#### *Section 15.8.5.7 Operation*

This section requires that a pool lift be capable of unassisted operation from both the deck and water levels. This section also requires that controls and operating mechanisms be unobstructed when a lift is in use and comply with ADAAG 4.27.4. That section requires that operating controls not require tight grasping, pinching, or twisting of the

wrist or more than 5 pounds of pressure to operate.

*Comment.* The proposed rule required that the lift controls and operating mechanisms may not require continuous manual pressure for operation. Commenters with disabilities supported the requirement of unassisted operation from both the deck and water levels. They reported the difficulty in finding the responsible person when lifts require assistance, especially in environments where pools are not routinely staffed. Commenters expressed concerns about getting out of the water, if assistance is required, especially where the pool is not staffed. Someone could be stranded in the water for extended periods of time awaiting assistance. Commenters suggested that pool lifts that require continuous manual pressure give the user greater control of their descent into the water and ascent back to the deck. Concern was expressed by a manufacturer of pool lifts that providing unassisted operation encourages individuals to swim alone and the potential dangers of causing injury are greatly increased when using an automatic lift without assistance.

*Response.* A large percentage of the respondents in the Board sponsored research project noted the importance of using a lift without assistance. Pool facility staff also indicated the importance of a device or design that could be used without pool staff assistance. While this provision requires the lift to be independently operable it does not preclude assistance from being provided. The final rule removes the requirement that pool lifts may not require continuous manual pressure for operation.

*Comment.* A few commenters expressed safety concerns where pool lifts are provided in pools that are unattended.

*Response.* Pool lifts have been commercially available for over 20 years. While the Board recognizes that inappropriate use of pool lifts may result in accident or injury, the Board is not aware of any incidents of injury or accidents involving pool lifts. The Board is also not aware of any evidence that shows that pool lifts are any less safe than other components of a pool facility, such as other means of pool entry, when they are used inappropriately. Manufacturers are also incorporating features which are intended to discourage inappropriate use, such as fold-up seats and covers.

#### *Section 15.8.5.8 Submerged Depth*

This section requires that a pool lift be designed so that the seat will

submerge to a water depth of 18 inches minimum. This depth is necessary to ensure buoyancy for the person on the lift seat once in the water. No substantive comment was received and no changes have been made to this section for the final rule.

#### *Section 15.8.5.9 Lifting Capacity*

This section requires that single person pool lifts provide a minimum weight capacity of 300 pounds. Lifts also must be capable of sustaining a static load of at least one and a half times the rated load.

*Comment.* The proposed rule required pool lifts to provide a minimum weight capacity of 300 pounds and be capable of sustaining a static load of at least three times the rated load. Several pool lift manufacturers supported the minimum weight requirement of 300 pounds. They questioned requiring a static load of three times the weight limit. They believed it was too excessive and would eliminate viable lifts from being provided. A commenter suggested that the static load requirement reference an international standard for lifts that require a static load of 1.6 times the weight capacity.

*Response.* The static load requirement has been reduced to one and a half times the weight capacity requirement.

#### *Section 15.8.6 Sloped Entries*

This section provides technical requirements for sloped entries designed to provide access into the water. Due to the similarities of this type of entry with ramps used in other buildings and facilities, existing ADAAG requirements have been referenced accordingly.

##### *Section 15.8.6.1 Sloped Entries*

This section requires sloped entries to comply with ADAAG 4.3 (Accessible Route), except for slip resistance.

*Comment.* Commenters questioned the ability of providing a slip resistant surface on a sloped entry that is under water.

*Response.* The final rule provides an exception for sloped entries from being slip resistant.

##### *Section 15.8.6.2 Submerged Depth*

This section requires sloped entries to extend to a depth of 24 to 30 inches below the stationary water level. This section also requires that where landings are required by ADAAG 4.8, at least one landing must be located between 24 and 30 inches below the stationary water level. Since wading pools are typically less than 24 to 30 inches deep, an exception provides that sloped entries are only required to

extend to the deepest part of a wading pool. No substantive comment was received and no changes have been made to this section in the final rule.

##### *Section 15.8.6.3 Handrails*

This section requires handrails that comply with ADAAG 4.8.5 on both sides of all sloped entries. The clear width between handrails must be between 33 and 38 inches. Exception 1 does not require handrail extensions to be provided at the bottom of a landing serving a sloped entry. Exception 2 does not require the clear width between handrails where a sloped entry is provided for wave action pools, leisure rivers, sand bottom pools, and other pools where user access is limited to one area. Exception 3 exempts sloped entries in wading pools from providing handrails.

*Comment.* The proposed rule did not specifically address handrails in wading pools. Commenters expressed great concern about the potential dangers from children using handrails to play on or jump into the shallow water or the risk to other children in the wading pool.

*Response.* The Board is concerned about the potential dangers to children using handrails inappropriately. Exception 3 has been added to the final rule exempting wading pools from providing handrails.

#### *Section 15.8.7 Transfer Walls*

This section provides technical requirements for transfer walls.

##### *Section 15.8.7.1 Clear Deck Space*

This section requires clear deck space of 60 inches by 60 inches minimum with a slope not steeper than 1:48 to be provided at the base of a transfer wall. Where one grab bar is provided on a transfer wall, the clear deck space must be centered on the grab bar. This allows sufficient space for a transfer on either side of the grab bar. Where two grab bars are provided, the clear deck space must be centered on the clearance between the grab bars. No substantive comment was received and no changes have been made to this section for the final rule.

##### *Section 15.8.7.2 Height*

This section requires the height of transfer walls to be 16 to 19 inches measured from the deck below. The height requirement is consistent with pool lift seat heights and similarly addresses the needs of some children. The maximum height above the deck has been changed to 19 inches to be consistent with other transfer heights in ADAAG.

##### *Section 15.8.7.3 Wall Depth and Length*

This section requires the depth of a transfer wall to be 12 to 16 inches. As a minimum, the 12 inch depth of the transfer wall provides adequate space for a person to comfortably sit on the surface of the wall. The wall depth is limited to 16 inches maximum so that users are not required to traverse the wall to transfer to the water. The length of the transfer wall must be 60 inches minimum and must be centered on the clear deck space.

##### *Section 15.8.7.4 Surface*

This section requires that the surface of a transfer wall must not be sharp and must have rounded edges. Commenters overwhelmingly supported this section and no changes have been made to this section for the final rule.

##### *Section 15.8.7.5 Grab Bars*

This section requires at least one grab bar to be provided on a transfer wall. Grab bars are required to be perpendicular to the pool wall and extend the full depth of the wall. The top of the gripping surface must be 4 to 6 inches above the wall. Where two grab bars are provided, clearance between grab bars must be 24 inches minimum. Where one grab bar is provided, clearance must be 24 inches minimum on both sides of the grab bar. Grab bars must comply with ADAAG 4.26.

*Comment.* The proposed rule required the top of the gripping surface to be a maximum of 4 inches above the wall. Commenters expressed concern that 4 inches maximum above the wall surface, after factoring in the diameter of the grab bar, would not provide sufficient gripping space for persons transferring.

*Response.* The final rule provides a range from 4 to 6 inches above the wall to the top of the gripping surface. The range will provide greater flexibility and incorporate the diameter of the grab bar in providing users of all ages and abilities with an appropriate gripping surface.

##### *Section 15.8.8 Transfer Systems*

This section provides technical requirements for transfer systems used as a means of access into the water. A transfer system consists of a transfer platform, combined with a series of transfer steps that descend into the water. Users must transfer from their wheelchair or mobility device to the transfer platform and continue transferring from step to step.

#### *Section 15.8.8.1 Transfer Platform*

This section requires a transfer platform to be 19 inches deep by 24 inches wide. Transfer platforms must be provided at the head of each transfer system. No substantive comment was received and no changes have been made to this section for the final rule.

#### *Section 15.8.8.2 Clear Deck Space*

This section requires a clear deck space of 60 by 60 inches minimum with a slope not steeper than 1:48 at the base of the transfer platform. A level unobstructed space at the base of the transfer platform, centered along the 24 inch side, is necessary to facilitate a transfer from a wheelchair or mobility device. No substantive comment was received and no changes have been made to this section for the final rule.

#### *Section 15.8.8.3 Height*

This section requires the height of transfer platforms to be 16 to 19 inches measured from the deck. No substantive comment was received and no changes have been made to this section for the final rule.

#### *Section 15.8.8.4 Transfer Steps*

This section requires transfer steps to be 8 inches maximum in height. It also requires that transfer steps extend to a water depth of 18 inches minimum.

*Comment.* The proposed rule required transfer steps to be 7 inches maximum in height. Commenters questioned the inconsistencies between the transfer step height of 8 inches required on a play area transfer step (15.6.5.2.2) to that provided in an aquatic setting.

*Response.* The final rule has been changed to require an 8 inch maximum step height in aquatic settings to be consistent with the play areas transfer step (15.6.5.2.2). An appendix note has been included recommending the height of the transfer step be minimized whenever possible.

#### *Section 15.8.8.5 Surface*

This section requires that the surface of a transfer system must not be sharp and provide rounded edges. Similar to other transfer surfaces, this is necessary to reduce the potential for injury. No substantive comment was received and no changes have been made to this section in the final rule.

#### *Section 15.8.8.6 Size*

This section requires each transfer step to have a tread depth of 14 to 17 inches and a minimum tread width of 24 inches.

*Comment.* The proposed rule required a range for the transfer step depth from 12 to 17 inches and a tread width of 22

inches minimum. Commenters pointed out the inconsistencies between the size of the transfer step in the play areas final rule (15.6.5.2.1) and for swimming pools.

*Response.* In an effort to provide uniformity between the play areas transfer steps and those located at swimming pools, the final rule modifies the transfer step to incorporate a range of 14 to 17 inches in depth and a minimum width of 24 inches.

#### *Section 15.8.8.7 Grab Bars*

This section requires one grab bar to be provided on each step and the transfer platform, or a continuous grab bar serving each transfer step and the transfer platform. Where provided on each step, the top of the gripping surface must be 4 to 6 inches above each step. Where a continuous grab bar is provided, the top of the gripping surface must be 4 to 6 inches above the step nosing. Grab bars must comply with ADAAG 4.26 and be located on at least one side of the transfer system. The grab bar located at the transfer platform must not obstruct transfer.

*Comment.* As previously discussed in section 15.8.7.5, the proposed rule required the top of the gripping surface to be 4 inches above the wall.

Commenters expressed concern that 4 inches above the wall surface, after factoring in the diameter of the grab bar, would not provide sufficient space for persons transferring.

*Response.* The final rule requires the top of the gripping surface to be 4 to 6 inches above the wall. It is believed that the range will provide greater flexibility to users of all ages and abilities with an appropriate gripping surface.

#### *Section 15.8.9 Pool Stairs*

This section provides technical requirements for pool stairs used as a means of entry and exit to the water.

##### *Section 15.8.9.1 Pool Stairs*

This section requires pool stairs to comply with ADAAG 4.9 (Stairs), except as modified. ADAAG 4.9 has been referenced since stairs in pools are used in a similar manner as stairs elsewhere. No substantive comment was received and no changes have been made to this section in the final rule.

##### *Section 15.8.9.2 Handrails*

This section requires the width between handrails to be 20 to 24 inches. To reduce the potential for underwater protrusions, handrail extensions are not required at the bottom landing serving a pool stair.

*Comment.* The proposed rule required a 22 inch maximum width between

handrails on pool stairs. Commenters expressed concern that a maximum distance of 22 inches may be too close for people that are large in size. Commenters with mobility impairments supported the handrail distance of 22 inches for providing the needed support while entering a pool by stairs.

*Response.* The final rule increases the maximum width between handrails to 24 inches. Separating the handrails more than 24 inches apart would make them too far apart for a larger class of people that require the support on pool stairs.

#### *Section 15.8.10 Water Play Components*

This section requires that where water play components are provided, the provisions of 15.6 (Play Areas) and ADAAG 4.3 apply, except where modified by this section.

*Comment.* The proposed rule sought comment on specific features within aquatic recreation facilities where it may be technically infeasible in new construction to comply with the proposed requirements in 15.8. Manufacturers and designers of water play components expressed concerns about having to provide ramp access to elevated play structures in standing water. Many of these components are at considerable distances from the top of the water surface and ramping would be very challenging and costly.

Commenters with disabilities or individuals representing individuals with disabilities expressed a great desire to have access to these unique water experiences.

*Response.* The final rule requires that where water play components are provided, they must comply with 15.6 (Play Areas) and ADAAG 4.3, except as modified or otherwise provided in this section. The final rule is responsive to manufacturers and designers by providing an exception to providing ramp access, while providing persons with disabilities the opportunity to enjoy this unique family oriented water experience with their family and friends. Exception 1 exempts accessible routes, clear floor spaces, and maneuvering spaces that are submerged from the requirements for cross slope, running slope, and surface. Exception 2 permits transfer systems to be used in lieu of ramps to connect elevated play components.

#### **Regulatory Process Matters**

##### *Executive Order 12866: Regulatory Planning and Review*

This final rule is a significant regulatory action under Executive Order

12866 and has been reviewed by the Office of Management and Budget. The Board has assessed the benefits and costs of the rule. The assessment has been placed in the public docket and is available for inspection. The assessment is also available on the Board's Internet site (<http://www.access-board.gov>). The assessment is summarized below:

#### Benefits

The benefits of the final rule are not quantifiable, but are significant and are consistent with the President's New Freedom Initiative. The primary benefit is the fulfillment of civil rights realized by individuals with disabilities. There are 52.5 million Americans with disabilities. Almost one in five adults has some type of disability. Among individuals 15 years old and over, 25 million have difficulty walking or using stairs. The final guidelines will result in newly constructed and altered recreation facilities that are accessible to individuals with disabilities and will enable them to participate in a wide range of recreational opportunities. Individuals with disabilities can also realize significant health benefits by participating in the range of recreational opportunities made accessible as a result of the final guidelines.

#### Costs

For each type of facility addressed by the final rule, the assessment estimates the number of existing facilities and new facilities constructed annually, identifies the requirements that have cost impacts for new construction and alterations, estimates the unit costs per facility, and calculates the total annual compliance costs. The number of small entities is reported as a percentage of the facilities. To estimate cost impacts, the assessment relies on assumptions where sufficient data is not available. The assumptions are based on interviews with professionals in the affected industries and are disclosed in the assessment. The assumptions cannot be validated and may not reflect the real world. The assumptions may result in under or overestimating the impacts of the final rule. The relevant data for each facility type is presented below.

#### Amusement Rides

*Existing Facilities:* 377 amusement parks.

*New Construction:* 4 new amusement parks per year.

*Small Entities:* 81 percent of amusement parks.

*New Amusement Rides:* 343 new rides per year; 68 will be platform type rides with stepped entrances.

*New Construction Impacts:* New platform type rides with stepped entrances will need a ramp (\$4,000 to \$6,700 unit cost) or a platform lift (\$12,000 to \$15,000 unit cost) to provide an accessible route to the load and unload area; and additional space (\$1,175 unit cost) in the load and unload area to provide wheelchair turning space and wheelchair storage space if a ride seat designed for transfer or transfer device is provided. For purposes of estimating the costs of providing access to new rides, the assessment assumes that a transfer device (\$5,000 unit cost) would be provided for all new rides. New rides will need a sign (\$100 unit cost) at the entrance of the queue or waiting line indicating the type of access provided (e.g., wheelchair access or transfer access).

*Alterations Impacts:* Minimal.

*Total Annual Compliance Costs:* \$2.5 million.

#### Boating Facilities

*Existing Facilities:* 12,000 marinas; no data on boat launch ramps.

*New Construction:* 240 new marinas per year.

*Alterations:* 600 existing marinas per year.

*Small Entities:* 99 percent of marinas.

*New Construction Impacts:* Gangways that are part of an accessible route will need to provide a 1:12 maximum slope or a gangway at least 80 feet long. The unit cost will be site specific. The assessment assumes unit costs will range from \$15,000 to \$35,000 where the maximum vertical level change is more than 2.5 feet, but less than 10 feet; and \$33,000 to \$45,000 where the maximum vertical level change is more than 10 feet. The impacts on new accessible boat slips and new accessible boarding piers at new boat launch ramps will be minimal.

*Alterations Impacts:* Alterations to existing boat slips are a primary function area and may trigger provision of an accessible route, unless the additional cost is disproportionate to the overall costs of the alterations or compliance is technically infeasible. The impacts on altered boat slips will be minimal.

*Total Annual Compliance Costs:* \$10.8 million to \$18.0 million.

#### Fishing Piers and Platforms

*Existing Facilities:* No data.

*New Construction:* No data.

*Small Entities:* No data.

*New Construction Impacts:* Minimal.

*Alterations Impacts:* Minimal.

*Total Annual Compliance Costs:* Minimal

#### Golf Courses

*Existing Facilities:* 17,108 golf courses.

*New Construction:* 377 to 524 new golf courses per year.

*Small Entities:* 99 percent of golf courses.

*New Construction Impacts:* Minimal.

*Alterations Impacts:* Minimal.

*Total Annual Compliance Costs:* Minimal.

#### Miniature Golf Courses

*Existing Facilities:* 7,500 to 10,000 miniature golf courses.

*New Construction:* 150 new custom design and 170 new modular miniature golf courses per year.

*Small Entities:* 100 percent of miniature golf courses.

*New Construction Impacts:* The assessment discusses potential impacts on new custom design courses (low profile courses, challenge courses, and adventure style courses) and new modular courses (indoor courses and outdoor courses). The impacts on new custom design low profile courses will be minimal. For purposes of estimating the costs for making at least 50 percent of the holes on the other custom design courses accessible, the assessment assumes a 10 percent increase in construction costs for new challenge type courses, and a 25 percent increase for new adventure style courses. New indoor modular courses may need to lease additional space to provide an accessible route for at least 50 percent of the holes, and new outdoor modular courses that are not recessed in the ground will have to provide an accessible route for at least 50 percent of the holes. The assessment assumes the additional cost for new modular courses will \$5,000 per course.

*Alterations Impacts:* Minimal.

*Total Annual Compliance Costs:* \$5.4 million.

#### Exercise Equipment, Bowling Lanes, and Shooting Facilities

*Existing Facilities:* 17,531 physical fitness facilities; 5,500 bowling centers; and 10,000 shooting facilities. No data on other facilities that provide exercise equipment.

*New Construction:* 800 to 1,000 new physical fitness facilities; 25 new bowling centers; and 100 new shooting facilities per year.

*Small Entities:* 99 percent of physical fitness facilities; and 100 percent of bowling centers and shooting facilities.

*New Construction Impacts:* Minimal.

*Alterations Impacts:* Minimal.

*Total Annual Compliance Costs:* Minimal.

## Swimming Pools, Wading Pools, and Spas

*Existing Facilities:* 124,577 pools; no data on spas.

*New Construction:* 1,245 new pools per year; 565 new spas per year. The assessment assumes 715 new pools per year have less than 300 linear feet of pool wall and will need at least one means of accessible entry into the pool.

*Small Entities:* Ranges from 15 percent for private hospitals to 100 percent for camps and recreational vehicle parks.

*New Construction Impacts:* For new pools with less than 300 linear feet of pool wall, the assessment assumes that a pool lift will be provided (\$4,000 unit cost). For pools with 300 linear feet or more of pool wall, the assessment assumes 250 of these new pools per year will provide an accessible means of entry in the absence of the final rule and will add a pool lift (\$4,000 unit cost). The assessment assumes the other new pools with 300 linear feet or more of pool wall will provide a pool lift (\$4,000 unit cost) and pool stairs (\$2,500 unit cost). The impacts on wading pools will be minimal. The assessment assumes new spas will provide a pool lift (\$4,000 unit cost).

*Alterations Impacts:* Minimal.

*Total Annual Compliance Costs:* \$8.0 million.

### Regulatory Flexibility Act

The final regulatory flexibility analysis has been performed in conjunction with the assessment of the benefits and costs of the final rule required by Executive Order 12866 and the preparation of the preamble for the final rule. The analysis is summarized below.

#### Need for and Objectives of Guidelines

The Access Board is required to issue accessibility guidelines under the Americans with Disabilities Act (ADA) to ensure that new construction and alterations of facilities covered by the law are readily accessible to and usable by individuals with disabilities. Recreation facilities are among the facilities covered by the ADA. Recreation facilities have unique features that are not adequately addressed by the Americans with Disabilities Act Accessibility Guidelines (ADAAG). The final rule will amend ADAAG to provide supplemental guidelines for making recreation facilities accessible.

#### Significant Issues Raised During Public Comment Period

The significant comments raised during the public comment period are

summarized in the preamble to the final rule, along with the Access Board's assessment of the comments and the reason for selecting the alternative adopted in the final rule. The alternatives considered in the proposed rule and the final rule, and changes made from the proposed rule for each type of recreation facility are presented in the assessment of the benefits and costs of the final rule required by Executive Order 12866.

#### Numbers of Small Entities Affected by Final Rule

The numbers of small entities affected by the final rule are reported under the summary of the assessment of the benefits and costs of the final rule required by Executive Order 12866.

#### Reporting and Recordkeeping Requirements

There are no reporting and recordkeeping requirements.

#### Steps Taken To Minimize Significant Economic Impact on Small Entities

The Access Board has taken steps to minimize the significant economic impact on small entities for each of the different types of recreation facilities addressed in the final rule. These steps are listed below.

- *Amusement Rides*—The final rule allows designers and operators of new amusement rides the choice of providing at least one wheelchair space, or an amusement ride seat designed for transfer, or a transfer device. The final rule limits application of the guidelines to existing rides that are altered. The final rule also allows designers and operators greater flexibility in applying ADAAG to amusement rides.

- *Boating Facilities*—The final rule permits gangways that are part of an accessible route to exceed the 1:12 maximum slope requirement for ramps where the total length of the gangways is at least 80 feet (30 feet for smaller facilities with fewer than 25 boat slips). The final rule reduces the number of boat slips required to be accessible in new construction, and modifies the requirements for accessible boat slips in alterations so no more than one boat slip is lost. The final rule also allows designers and operators greater flexibility in applying ADAAG to boating facilities.

- *Fishing Piers and Platforms*—The final rule permits gangways that are part of an accessible route to exceed the maximum 1:12 requirement for ramps where the total length of the gangways is at least 30 feet. The final rule also exempts guards that comply with certain sections of the International

Building Code from the maximum 34 inch height requirement.

- *Golf Courses*—The final rule permits a golf car passage to be provided on golf courses and driving ranges, instead of an accessible route.

- *Miniature Golf Courses*—The final rule requires at least 50 percent of holes on miniature golf courses to be accessible, and permits one break in the sequence of accessible holes provided the last hole in the sequence is the last hole on the course. The final rule also allows designers and operators greater flexibility in applying ADAAG to miniature golf courses.

- *Swimming Pools, Wading Pools, and Spas*—The final rule permits small pools with less than 300 linear feet of pool wall to provide at least one means of access into the water, and permits water play components to use transfer systems to connect elevated water play components.

#### Technical Assistance

The Access Board will provide technical assistance materials to help small entities understand the accessibility guidelines for recreation facilities. The Access Board also operates a toll-free technical assistance service to answer questions from the public about the guidelines.

#### Executive Order 13132: Federalism

The final rule adheres to the fundamental federalism principles and policy making criteria in Executive Order 13132. The final rule implements Federal civil rights legislation that was enacted pursuant to the Congress' authority to enforce the fourteenth amendment and to regulate commerce. Ensuring the civil rights of groups who have experienced irrational discrimination has long been recognized as a national issue and a proper function of the Federal government. The ADA was enacted "to provide a clear and comprehensive national mandate for the elimination of discrimination against individuals with disabilities \* \* \* and to ensure that the Federal government plays a central role in enforcing the standards established in this chapter on behalf of individuals with disabilities." 42 U.S.C. 12101(b)(1) and (3). The ADA recognizes the authority of State and local governments to enact and enforce laws that "provide greater or equal protection for the rights of individuals with disabilities than are afforded by this chapter." 42 U.S.C. 12201(b). The final rule establishes minimum guidelines. States and local governments can adopt accessibility standards that provide individuals with

disabilities equal or greater access to recreation facilities.

The Access Board has consulted with State and local governments throughout the rulemaking process. The National Recreation and Park Association, States Organization for Boating Access, New Jersey Department of Community Affairs, San Francisco Department of Public Works, and the Hawaii Disability and Communication Access Board represented the interests of State and local governments on the Recreation Access Advisory Committee. State and local governments participated in the public hearings and information meetings held on the NPRM and the draft final rule, and submitted more than 70 comments. Most of the comments were centered on boating facilities. The California Department of Boating and Waterways, Oregon State Marine Board, and Michigan Department of Natural Resources were actively involved in providing information and alternative proposals for consideration during the rulemaking. Approximately 30 other State and local governments joined in supporting the

various proposals submitted by those States.

*Unfunded Mandates Reform Act*

The Unfunded Mandates Reform Act does not apply to proposed or final rules that enforce constitutional rights of individuals or enforce any statutory rights that prohibit discrimination on the basis of race, color, sex, national origin, age, handicap, or disability. Since the final rule is issued under the authority of the Americans with Disabilities Act, an assessment of the rule's effects on State, local, and tribal governments, and the private sector is not required by the Unfunded Mandates Reform Act.

**List of Subjects in 36 CFR Part 1191**

Buildings and facilities, Civil rights, Incorporation by reference, Individuals with disabilities, Transportation.

**Thurman M. Davis, Sr.,**

*Chair, Architectural and Transportation Barriers Compliance Board.*

For the reasons stated in the preamble, part 1191 of title 36 of the Code of Federal Regulations is amended as follows:

**PART 1191—AMERICANS WITH DISABILITIES ACT (ADA) ACCESSIBILITY GUIDELINES FOR BUILDINGS AND FACILITIES**

1. The authority citation for 36 CFR Part 1191 continues to read as follows:

**Authority:** 42 U.S.C. 12204.

2. Appendix A to Part 1191 is amended as follows:

a. By revising the title page and pages i, ii, 1A, 2, 3, 4, 4A, 5 through 11, 58A, and 76 through 81 as set forth below.

b. By removing the blank page following the title page.

c. By adding pages 4B, 11A, 58B, and 82 through 96 as set forth below.

d. In the appendix to Appendix A by revising pages A1, A1A, A16, and A22 through A25 and adding pages A1B, A16A, and A26 through A32 as set forth below.

The additions and revisions read as follows:

**Appendix A to Part 1191—Americans With Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities**

BILLING CODE 8150-01-P

# **Americans with Disabilities Act (ADA)**

## **Accessibility Guidelines for Buildings and Facilities**

**U.S. Architectural and Transportation Barriers  
Compliance Board (Access Board)  
1331 F Street, N.W., Suite 1000  
Washington, D.C. 20004-1111  
(202) 272-0080  
(202) 272-0082 TTY  
(202) 272-0081 FAX**

**ADA ACCESSIBILITY GUIDELINES  
FOR BUILDINGS AND FACILITIES  
TABLE OF CONTENTS**

<b>1. PURPOSE</b>	<b>1</b>
<b>2. GENERAL</b>	<b>1</b>
2.1 Provisions for Adults and Children	1
2.2 Equivalent Facilitation	1
2.3 Incorporation by Reference	1A
<b>3. MISCELLANEOUS INSTRUCTIONS AND DEFINITIONS</b>	<b>2</b>
3.1 Graphic Conventions	2
3.2 Dimensional Tolerances	2
3.3 Notes	2
3.4 General Terminology	2
3.5 Definitions	2
<b>4. ACCESSIBLE ELEMENTS AND SPACES: SCOPE AND TECHNICAL REQUIREMENTS</b>	<b>5</b>
4.1 Minimum Requirements	5
4.1.1 Application	5
4.1.2 Accessible Sites and Exterior Facilities: New Construction	6
4.1.3 Accessible Buildings: New Construction	7
4.1.4 (Reserved)	11A
4.1.5 Accessible Buildings: Additions	11A
4.1.6 Accessible Buildings: Alterations	12
4.1.7 Accessible Buildings: Historic Preservation	14
4.2 Space Allowance and Reach Ranges	14A
4.3 Accessible Route	15
4.4 Protruding Objects	21
4.5 Ground and Floor Surfaces	22
4.6 Parking and Passenger Loading Zones	24
4.7 Curb Ramps	26
4.8 Ramps	27
4.9 Stairs	30
4.10 Elevators	30
4.11 Platform Lifts (Wheelchair Lifts)	36
4.12 Windows	36
4.13 Doors	36
4.14 Entrances	40
4.15 Drinking Fountains and Water Coolers	40

4.16	Water Closets . . . . .	40
4.17	Toilet Stalls . . . . .	41A
4.18	Urinals . . . . .	44
4.19	Lavatories and Mirrors . . . . .	44A
4.20	Bathtubs . . . . .	45
4.21	Shower Stalls . . . . .	45
4.22	Toilet Rooms . . . . .	45
4.23	Bathrooms, Bathing Facilities, and Shower Rooms . . . . .	48
4.24	Sinks . . . . .	49
4.25	Storage . . . . .	49
4.26	Handrails, Grab Bars, and Tub and Shower Seats . . . . .	50
4.27	Controls and Operating Mechanisms . . . . .	51
4.28	Alarms . . . . .	52
4.29	Detectable Warnings . . . . .	53
4.30	Signage . . . . .	53
4.31	Telephones . . . . .	54
4.32	Fixed or Built-in Seating and Tables . . . . .	56
4.33	Assembly Areas . . . . .	56
4.34	Automated Teller Machines . . . . .	58
4.35	Dressing, Fitting, and Locker Rooms . . . . .	58A
4.36	Saunas and Steam Rooms . . . . .	58A
4.37	Benches . . . . .	58A
<b>5.</b>	<b>RESTAURANTS AND CAFETERIAS . . . . .</b>	<b>59</b>
<b>6.</b>	<b>MEDICAL CARE FACILITIES . . . . .</b>	<b>60</b>
<b>7.</b>	<b>BUSINESS, MERCANTILE AND CIVIC . . . . .</b>	<b>61</b>
<b>8.</b>	<b>LIBRARIES . . . . .</b>	<b>62</b>
<b>9.</b>	<b>ACCESSIBLE TRANSIENT LODGING . . . . .</b>	<b>63</b>
<b>10.</b>	<b>TRANSPORTATION FACILITIES . . . . .</b>	<b>67</b>
<b>11.</b>	<b>JUDICIAL, LEGISLATIVE AND REGULATORY FACILITIES . . . . .</b>	<b>72</b>
<b>12.</b>	<b>DETENTION AND CORRECTIONAL FACILITIES . . . . .</b>	<b>74</b>
<b>13.</b>	<b>RESIDENTIAL HOUSING (Reserved) . . . . .</b>	<b>76</b>
<b>14.</b>	<b>PUBLIC RIGHTS-OF-WAY (Reserved) . . . . .</b>	<b>76</b>
<b>15.</b>	<b>RECREATION FACILITIES . . . . .</b>	<b>76</b>
	<b>APPENDIX . . . . .</b>	<b>A1</b>

## 2.3 Incorporation by Reference

### 2.3 Incorporation by Reference.

**2.3.1 General.** The publications listed in 2.3.2 are incorporated by reference in this document. The Director of the Federal Register has approved these materials for incorporation by reference in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies of the referenced publications may be inspected at the Architectural and Transportation Barriers Compliance Board, 1331 F Street, NW., Suite 1000, Washington, DC; at the Department of Justice, Civil Rights Division, Disability Rights Section, 1425 New York Avenue, NW., Washington, DC; or at the Office of the Federal Register, 800 North Capitol Street, NW., Suite 700, Washington, DC.

**2.3.2 Referenced Publications.** The specific edition of the publications listed below are referenced in this document. Where differences occur between this document and the referenced publications, this document applies.

**2.3.2.1 American Society for Testing and Materials (ASTM) Standards.** Copies of the referenced publications may be obtained from the American Society for Testing and Materials, 100 Bar Harbor Drive, West Conshohocken, Pennsylvania 19428 (<http://www.astm.org>).

ASTM F 1292-99 Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment (see 15.6.7.2 Ground Surfaces, Use Zones).

ASTM F 1487-98 Standard Consumer Safety Performance Specification for Playground Equipment for Public Use (see 3.5 Definitions, Use Zone).

ASTM F 1951-99 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment (see 15.6.7.1 Ground Surfaces, Accessibility).

**2.3.2.2 International Code Council (ICC) Codes.** Copies of the referenced publications may be obtained from the International Code Council, 5203 Leesburg Pike, Suite 600, Falls Church, VA 22041-3401 (<http://www.intlcode.org>).

International Building Code 2000 (see 15.3.3.2 Height).

### 3.0 Miscellaneous Instructions and Definitions

## 3. MISCELLANEOUS INSTRUCTIONS AND DEFINITIONS.

**3.1 Graphic Conventions.** Graphic conventions are shown in Table 1. Dimensions that are not marked minimum or maximum are absolute, unless otherwise indicated in the text or captions.

**3.2 Dimensional Tolerances.** All dimensions are subject to conventional building industry tolerances for field conditions.

**3.3 Notes.** The text of these guidelines does not contain notes or footnotes. Additional information, explanations, and advisory materials are located in the Appendix.

### 3.4 General Terminology.

comply with. Meet one or more specifications of *these guidelines*.

if, if ... then. Denotes a specification that applies only when the conditions described are present.

may. Denotes an option or alternative.

shall. Denotes a mandatory specification or requirement.

should. Denotes an advisory specification or recommendation.

### 3.5 Definitions.

**Access Aisle.** An accessible pedestrian space between elements, such as parking spaces, seating, and desks, that provides clearances appropriate for use of the elements.

**Accessible.** Describes a site, building, facility, or portion thereof that complies with *these guidelines*.

**Accessible Element.** An *element* specified by *these guidelines* (for example, telephone, controls, and the like).

**Accessible Route.** A continuous unobstructed path connecting all accessible elements and spaces of a building or facility. Interior accessible routes may include corridors, floors, ramps, elevators, lifts, and clear floor space at fixtures. Exterior accessible routes may include parking access aisles, curb ramps, *crosswalks at vehicular ways*, walks, ramps, and lifts.

**Accessible Space.** Space that complies with *these guidelines*.

**Adaptability.** The ability of certain building spaces and elements, such as kitchen counters, sinks, and grab bars, to be added or altered so as to accommodate the needs of *individuals with or without disabilities* or to accommodate the needs of persons with different types or degrees of disability.

**Addition.** *An expansion, extension, or increase in the gross floor area of a building or facility.*

**Administrative Authority.** A governmental agency that adopts or enforces regulations and *guidelines* for the design, construction, or *alteration* of buildings and facilities.

**Alteration.** *An alteration is a change to a building or facility that affects or could affect the usability of the building or facility or part thereof. Alterations include, but are not limited to, remodeling, renovation, rehabilitation, reconstruction, historic restoration, resurfacing of circulation paths or vehicular ways, changes or rearrangement of the structural parts or elements, and changes or rearrangement in the plan configuration of walls and full-height partitions. Normal maintenance, reroofing, painting or wallpapering, or changes to mechanical and electrical systems are not alterations unless they affect the usability of the building or facility.*

**Amusement Attraction.** *Any facility, or portion of a facility, located within an amusement park or theme park which provides amusement without*

*the use of an amusement device. Examples include, but are not limited to, fun houses, barrels, and other attractions without seats.*

**Amusement Ride.** *A system that moves persons through a fixed course within a defined area for the purpose of amusement.*

**Amusement Ride Seat.** *A seat that is built-in or mechanically fastened to an amusement ride intended to be occupied by one or more passengers.*

**Area of Rescue Assistance.** *An area, which has direct access to an exit, where people who are unable to use stairs may remain temporarily in safety to await further instructions or assistance during emergency evacuation.*

**Area of Sport Activity.** *That portion of a room or space where the play or practice of a sport occurs.*

**Assembly Area.** *A room or space accommodating a group of individuals for recreational, educational, political, social, civic, or amusement purposes, or for the consumption of food and drink.*

**Automatic Door.** *A door equipped with a power-operated mechanism and controls that open and close the door automatically upon receipt of a momentary actuating signal. The switch that begins the automatic cycle may be a photoelectric device, floor mat, or manual switch (see power-assisted door).*

**Boarding Pier.** *A portion of a pier where a boat is temporarily secured for the purpose of embarking or disembarking.*

**Boat Launch Ramp.** *A sloped surface designed for launching and retrieving trailered boats and other water craft to and from a body of water.*

**Boat Slip.** *That portion of a pier, main pier, finger pier, or float where a boat is moored for the purpose of berthing, embarking, or disembarking.*

**Building.** *Any structure used and intended for supporting or sheltering any use or occupancy.*

**Catch Pool.** *A pool or designated section of a pool used as a terminus for water slide flumes.*

**Circulation Path.** *An exterior or interior way of passage from one place to another for pedestrians, including, but not limited to, walks, hallways, courtyards, stairways, and stair landings.*

**Clear.** *Unobstructed.*

**Clear Floor Space.** *The minimum unobstructed floor or ground space required to accommodate a single, stationary wheelchair and occupant.*

**Closed Circuit Telephone.** *A telephone with dedicated line(s) such as a house phone, courtesy phone or phone that must be used to gain entrance to a facility.*

**Common Use.** *Refers to those interior and exterior rooms, spaces, or elements that are made available for the use of a restricted group of people (for example, occupants of a homeless shelter, the occupants of an office building, or the guests of such occupants).*

**Cross Slope.** *The slope that is perpendicular to the direction of travel (see running slope).*

**Curb Ramp.** *A short ramp cutting through a curb or built up to it.*

**Detectable Warning.** *A standardized surface feature built in or applied to walking surfaces or other elements to warn visually impaired people of hazards on a circulation path.*

**Egress, Means of.** *A continuous and unobstructed way of exit travel from any point in a building or facility to a public way. A means of egress comprises vertical and horizontal travel and may include intervening room spaces, doorways, hallways, corridors, passageways, balconies, ramps, stairs, enclosures, lobbies, horizontal exits, courts and yards. An accessible means of egress is one that complies with these guidelines and does not include stairs, steps, or escalators. Areas of rescue assistance or evacuation elevators*

### 3.5 Definitions

may be included as part of accessible means of egress.

**Element.** *An architectural or mechanical component of a building, facility, space, or site, e.g., telephone, curb ramp, door, drinking fountain, seating, or water closet.*

**Elevated Play Component.** *A play component that is approached above or below grade and that is part of a composite play structure consisting of two or more play components attached or functionally linked to create an integrated unit providing more than one play activity.*

**Entrance.** *Any access point to a building or portion of a building or facility used for the purpose of entering. An entrance includes the approach walk, the vertical access leading to the entrance platform, the entrance platform itself, vestibules if provided, the entry door(s) or gate(s) and the hardware of the entry door(s) or gate(s).*

**Facility.** *All or any portion of buildings, structures, site improvements, complexes, equipment, roads, walks, passageways, parking lots, or other real or personal property located on a site.*

**Gangway.** *A variable-sloped pedestrian walkway that links a fixed structure or land with a floating structure. Gangways which connect to vessels are not included.*

**Golf Car Passage.** *A continuous passage on which a motorized golf car can operate.*

**Ground Floor.** *Any occupiable floor less than one story above or below grade with direct access to grade. A building or facility always has at least one ground floor and may have more than one ground floor as where a split level entrance has been provided or where a building is built into a hillside.*

**Ground Level Play Component.** *A play component that is approached and exited at the ground level.*

**Mezzanine or Mezzanine Floor.** *That portion of a story which is an intermediate floor level placed within the story and having occupiable space above and below its floor.*

**Marked Crossing.** *A crosswalk or other identified path intended for pedestrian use in crossing a vehicular way.*

**Multifamily Dwelling.** *Any building containing more than two dwelling units.*

**Occupiable.** *A room or enclosed space designed for human occupancy in which individuals congregate for amusement, educational or similar purposes, or in which occupants are engaged at labor, and which is equipped with means of egress, light, and ventilation.*

**Operable Part.** *A part of a piece of equipment or appliance used to insert or withdraw objects, or to activate, deactivate, or adjust the equipment or appliance (for example, coin slot, push button, handle).*

**Path of Travel.** (Reserved).

**Play Area.** *A portion of a site containing play components designed and constructed for children.*

**Play Component.** *An element intended to generate specific opportunities for play, socialization, or learning. Play components may be manufactured or natural, and may be stand alone or part of a composite play structure.*

**Power-assisted Door.** *A door used for human passage with a mechanism that helps to open the door, or relieves the opening resistance of a door, upon the activation of a switch or a continued force applied to the door itself.*

**Private Facility.** *A place of public accommodation or a commercial facility subject to title III of the ADA and 28 CFR part 36 or a transportation facility subject to title III of the ADA and 49 CFR 37.45.*

**Public Facility.** *A facility or portion of a facility constructed by, on behalf of, or for the use of a public entity subject to title II of the ADA and 28 CFR part 35 or to title II of the ADA and 49 CFR 37.41 or 37.43.*

**Public Use.** Describes interior or exterior rooms or spaces that are made available to the general public. Public use may be provided at a building or facility that is privately or publicly owned.

**Ramp.** A walking surface which has a running slope greater than 1:20.

**Running Slope.** The slope that is parallel to the direction of travel (see cross slope).

**Service Entrance.** An entrance intended primarily for delivery of goods or services.

**Signage.** *Displayed* verbal, symbolic, *tactile*, and pictorial information.

**Site.** A parcel of land bounded by a property line or a designated portion of a public right-of-way.

**Site Improvement.** Landscaping, paving for pedestrian and vehicular ways, outdoor lighting, recreational facilities, and the like, added to a site.

**Sleeping Accommodations.** Rooms in which people sleep; for example, dormitory and hotel or motel guest rooms or suites.

**Soft Contained Play Structure.** *A play structure made up of one or more components where the user enters a fully enclosed play environment that utilizes pliable materials (e.g., plastic, netting, fabric).*

**Space.** *A definable area, e.g., room, toilet room, hall, assembly area, entrance, storage room, alcove, courtyard, or lobby.*

**Story.** *That portion of a building included between the upper surface of a floor and upper surface of the floor or roof next above. If such portion of a building does not include occupiable space, it is not considered a story for purposes of these guidelines. There may be more than one*

*floor level within a story as in the case of a mezzanine or mezzanines.*

**Structural Frame.** The structural frame shall be considered to be the columns and the girders, beams, trusses and spandrels having direct connections to the columns and all other members which are essential to the stability of the building as a whole.

**TDD.** *(Telecommunication Devices for the Deaf). See text telephone.*

**TTY (Tele-Typewriter).** *See text telephone.*

**Tactile.** Describes an object that can be perceived using the sense of touch.

**Technically Infeasible.** *See 4.1.6(1)(j) EXCEPTION.*

**Teeing Ground.** *In golf, the starting place for the hole to be played.*

**Text Telephone (TTY).** *Machinery or equipment that employs interactive text based communications through the transmission of coded signals across the standard telephone network. Text telephones can include, for example, devices known as TDDs (telecommunication display devices or telecommunication devices for deaf persons) or computers with special modems. Text telephones are also called TTYs, an abbreviation for tele-typewriter.*

**Transient Lodging.\*** *A building, facility, or portion thereof, excluding inpatient medical care facilities and residential facilities, that contains sleeping accommodations. Transient lodging may include, but is not limited to, resorts, group homes, hotels, motels, and dormitories.*

**Transfer Device.** *Equipment designed to facilitate the transfer of a person from a wheelchair or other mobility device to and from an amusement ride seat.*

**Transition Plate.** *A sloping pedestrian walking surface located at the end(s) of a gangway.*

### 3.5 Definitions

**Use Zone.** *The ground level area beneath and immediately adjacent to a play structure or equipment that is designated by ASTM F 1487 Standard Consumer Safety Performance Specification for Playground Equipment for Public Use (incorporated by reference, see 2.3.2) for unrestricted circulation around the equipment and on whose surface it is predicted that a user would land when falling from or exiting the equipment.*

**Vehicular Way.** A route intended for vehicular traffic, such as a street, driveway, or parking lot.

**Walk.** An exterior pathway with a prepared surface intended for pedestrian use, including general pedestrian areas such as plazas and courts.

## 4.0 Accessible Elements and Spaces: Scope and Technical Requirements

Note: Sections 4.1.1 through 4.1.7 are different from ANSI A117.1 in their entirety and are printed in standard type (ANSI A117.1 does not include scoping provisions).

### **4. ACCESSIBLE ELEMENTS AND SPACES: SCOPE AND TECHNICAL REQUIREMENTS.**

#### **4.1 Minimum Requirements**

##### **4.1.1\* Application.**

(1) General. All areas of newly designed or newly constructed buildings and facilities and altered portions of existing buildings and facilities shall comply with section 4, unless otherwise provided in this section or as modified in a special application section.

(2) Application Based on Building Use. Special application sections provide additional requirements based on building use. When a building or facility contains more than one use covered by a special application section, each portion shall comply with the requirements for that use.

(3)\* Areas Used Only by Employees as Work Areas. Areas that are used only as work areas shall be designed and constructed so that individuals with disabilities can approach, enter, and exit the areas. These guidelines do not require that any areas used only as work areas be constructed to permit maneuvering within the work area or be constructed or equipped (i.e., with racks or shelves) to be accessible.

(4) Temporary Structures. These guidelines cover temporary buildings or facilities as well as permanent facilities. Temporary buildings and facilities are not of permanent construction but are extensively used or are essential for public use for a period of time. Examples of temporary buildings or facilities covered by these guidelines include, but are not limited to: reviewing stands, temporary classrooms, bleacher areas, exhibit

areas, temporary banking facilities, temporary health screening services, or temporary safe pedestrian passageways around a construction site. Structures, sites and equipment directly associated with the actual processes of construction, such as scaffolding, bridging, materials hoists, or construction trailers are not included.

##### (5) General Exceptions.

(a) In new construction, a person or entity is not required to meet fully the requirements of these guidelines where that person or entity can demonstrate that it is structurally impracticable to do so. Full compliance will be considered structurally impracticable only in those rare circumstances when the unique characteristics of terrain prevent the incorporation of accessibility features. If full compliance with the requirements of these guidelines is structurally impracticable, a person or entity shall comply with the requirements to the extent it is not structurally impracticable. Any portion of the building or facility which can be made accessible shall comply to the extent that it is not structurally impracticable.

##### (b) Accessibility is not required to or in:

(i) raised areas used primarily for purposes of security or life or fire safety, including, but not limited to, observation or lookout galleries, prison guard towers, fire towers, or fixed life guard stands;

(ii) non-occupiable spaces accessed only by ladders, catwalks, crawl spaces, very narrow passageways, tunnels, or freight (non-passenger) elevators, and frequented only by service personnel for maintenance, repair, or occasional monitoring of equipment; such spaces may include, but are not limited to, elevator pits, elevator penthouses, piping or equipment catwalks, water or sewage treatment pump rooms and stations, electric substations and transformer vaults, and highway and tunnel utility facilities;

(iii) single occupant structures accessed only by a passageway that is below grade or that is

**4.1.2 Accessible Sites and Exterior Facilities: New Construction**

elevated above standard curb height, including, but not limited to, toll booths accessed from underground tunnels;

(iv) raised structures used solely for refereeing, judging, or scoring a sport;

(v) water slides;

(vi) animal containment areas that are not for public use; or

(vii) raised boxing or wrestling rings.

**4.1.2 Accessible Sites and Exterior Facilities: New Construction.** An accessible site shall meet the following minimum requirements:

(1) At least one accessible route complying with 4.3 shall be provided within the boundary of the site from public transportation stops, accessible parking spaces, passenger loading zones if provided, and public streets or sidewalks, to an accessible building entrance.

(2) (a) At least one accessible route complying with 4.3 shall connect accessible buildings, accessible facilities, accessible elements, and accessible spaces that are on the same site.

(b)\* Court Sports: An accessible route complying with 4.3 shall directly connect both sides of the court in court sports.

(3) All objects that protrude from surfaces or posts into circulation paths shall comply with 4.4.

EXCEPTION: The requirements of 4.4 shall not apply within an area of sport activity.

(4) Ground surfaces along accessible routes and in accessible spaces shall comply with 4.5.

EXCEPTION 1\*: The requirements of 4.5 shall not apply within an area of sport activity.

EXCEPTION 2\*: Animal containment areas designed and constructed for public use shall not be required to provide stable, firm, and slip resistant ground and floor surfaces and shall not be required to comply with 4.5.2.

(5) (a) If parking spaces are provided for self-parking by employees or visitors, or both, then accessible spaces complying with 4.6 shall be provided in each such parking area in conformance with the table below. Spaces required by the table need not be provided in the particular lot. They may be provided in a different location if equivalent or greater accessibility, in terms of distance from an accessible entrance, cost and convenience is ensured.

TOTAL PARKING IN LOT	REQUIRED MINIMUM NUMBER OF ACCESSIBLE SPACES
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8
401 to 500	9
501 to 1000	2 percent of total
1001 and over	20 plus 1 for each 100 over 1000

Except as provided in (b), access aisles adjacent to accessible spaces shall be 60 in (1525 mm) wide minimum.

(b) One in every eight accessible spaces, but not less than one, shall be served by an access aisle 96 in (2440 mm) wide minimum and shall be designated "van accessible" as required by 4.6.4. The vertical clearance at such spaces shall comply with 4.6.5. All such spaces may be grouped on one level of a parking structure.

EXCEPTION: Provision of all required parking spaces in conformance with "Universal Parking Design" (see appendix A4.6.3) is permitted.

(c) If passenger loading zones are provided, then at least one passenger loading zone shall comply with 4.6.6.

(d) At facilities providing medical care and other services for persons with mobility

### 4.1.3 Accessible Buildings: New Construction

impairments, parking spaces complying with 4.6 shall be provided in accordance with 4.1.2(5)(a) except as follows:

(i) Outpatient units and facilities: 10 percent of the total number of parking spaces provided serving each such outpatient unit or facility;

(ii) Units and facilities that specialize in treatment or services for persons with mobility impairments: 20 percent of the total number of parking spaces provided serving each such unit or facility.

(e)\* Valet parking: Valet parking facilities shall provide a passenger loading zone complying with 4.6.6 located on an accessible route to the entrance of the facility. Paragraphs 5(a), 5(b), and 5(d) of this section do not apply to valet parking facilities.

(6) If toilet facilities are provided on a site, then each such public or common use toilet facility shall comply with 4.22. If bathing facilities are provided on a site, then each such public or common use bathing facility shall comply with 4.23.

For single user portable toilet or bathing units clustered at a single location, at least five percent but no less than one toilet unit or bathing unit complying with 4.22 or 4.23 shall be installed at each cluster whenever typical inaccessible units are provided. Accessible units shall be identified by the International Symbol of Accessibility.

EXCEPTION: Portable toilet units at construction sites used exclusively by construction personnel are not required to comply with 4.1.2(6).

(7) Building Signage. Signs which designate permanent rooms and spaces shall comply with 4.30.1, 4.30.4, 4.30.5 and 4.30.6. Other signs which provide direction to, or information about, functional spaces of the building shall comply with 4.30.1, 4.30.2, 4.30.3, and 4.30.5. Elements and spaces of accessible facilities which shall be identified by the International Symbol of

Accessibility and which shall comply with 4.30.7 are:

(a) Parking spaces designated as reserved for individuals with disabilities;

(b) Accessible passenger loading zones;

(c) Accessible entrances when not all are accessible (inaccessible entrances shall have directional signage to indicate the route to the nearest accessible entrance);

(d) Accessible toilet and bathing facilities when not all are accessible.

**4.1.3 Accessible Buildings: New Construction.** Accessible buildings and facilities shall meet the following minimum requirements:

(1) (a) At least one accessible route complying with 4.3 shall connect accessible building or facility entrances with all accessible spaces and elements within the building or facility.

(b)\* Court Sports: An accessible route complying with 4.3 shall directly connect both sides of the court in court sports.

(2) All objects that overhang or protrude into circulation paths shall comply with 4.4.

EXCEPTION: The requirements of 4.4 shall not apply within an area of sport activity.

(3) Ground and floor surfaces along accessible routes and in accessible rooms and spaces shall comply with 4.5.

EXCEPTION 1\*: The requirements of 4.5 shall not apply within an area of sport activity.

EXCEPTION 2\*: Animal containment areas designed and constructed for public use shall not be required to provide stable, firm, and slip resistant ground and floor surfaces and shall not be required to comply with 4.5.2.

(4) Interior and exterior stairs connecting levels that are not connected by an elevator, ramp, or

### 4.1.3 Accessible Buildings: New Construction

other accessible means of vertical access shall comply with 4.9.

(5)\* One passenger elevator complying with 4.10 shall serve each level, including mezzanines, in all multi-story buildings and facilities unless exempted below. If more than one elevator is provided, each passenger elevator shall comply with 4.10.

EXCEPTION 1: Elevators are not required in:

(a) private facilities that are less than three stories or that have less than 3000 square feet per story unless the building is a shopping center, a shopping mall, or the professional office of a health care provider, or another type of facility as determined by the Attorney General; or

(b) public facilities that are less than three stories and that are not open to the general public if the story above or below the accessible ground floor houses no more than five persons and is less than 500 square feet. Examples may include, but are not limited to, drawbridge towers and boat traffic towers, lock and dam control stations, and train dispatching towers.

The elevator exemptions set forth in paragraphs (a) and (b) do not obviate or limit in any way the obligation to comply with the other accessibility requirements established in section 4.1.3. For example, floors above or below the accessible ground floor must meet the requirements of this section except for elevator service. If toilet or bathing facilities are provided on a level not served by an elevator, then toilet or bathing facilities must be provided on the accessible ground floor. In new construction, if a building or facility is eligible for exemption but a passenger elevator is nonetheless planned, that elevator shall meet the requirements of 4.10 and shall serve each level in the building. A passenger elevator that provides service from a garage to only one level of a building or facility is not required to serve other levels.

EXCEPTION 2: Elevator pits, elevator penthouses, mechanical rooms, piping or equipment catwalks are exempted from this requirement.

EXCEPTION 3: Accessible ramps complying with 4.8 may be used in lieu of an elevator.

EXCEPTION 4: Platform lifts (wheelchair lifts) complying with 4.11 of this guideline and applicable State or local codes may be used in lieu of an elevator only under the following conditions:

(a) To provide an accessible route to a performing area in an assembly occupancy.

(b) To comply with the wheelchair viewing position line-of-sight and dispersion requirements of 4.33.3.

(c) To provide access to incidental occupiable spaces and rooms which are not open to the general public and which house no more than five persons, including but not limited to equipment control rooms and projection booths.

(d) To provide access where existing site constraints or other constraints make use of a ramp or an elevator infeasible.

(e) To provide access to raised judges' benches, clerks' stations, speakers' platforms, jury boxes and witness stands or to depressed areas such as the well of a court.

(f)\* To provide access to player seating areas serving an area of sport activity.

EXCEPTION 5: Elevators located in air traffic control towers are not required to serve the cab and the floor immediately below the cab.

(6) Windows: (Reserved).

(7) Doors:

(a) At each accessible entrance to a building or facility, at least one door shall comply with 4.13.

(b) Within a building or facility, at least one door at each accessible space shall comply with 4.13.

(c) Each door that is an element of an accessible route shall comply with 4.13.

### 4.1.3 Accessible Buildings: New Construction

(d) Each door required by 4.3.10, Egress, shall comply with 4.13.

(8)\* The requirements in (a) and (b) below shall be satisfied independently:

(a)(i) At least 50 percent of all public entrances (excluding those in (b) below) shall comply with 4.14. At least one must be a ground floor entrance. Public entrances are any entrances that are not loading or service entrances.

(ii) Accessible public entrances must be provided in a number at least equivalent to the number of exits required by the applicable building or fire codes. (This paragraph does not require an increase in the total number of public entrances planned for a facility.)

(iii) An accessible public entrance must be provided to each tenancy in a facility (for example, individual stores in a strip shopping center).

(iv) In detention and correctional facilities subject to section 12, public entrances that are secured shall be accessible as required by 12.2.1.

One entrance may be considered as meeting more than one of the requirements in (a). Where feasible, accessible public entrances shall be the entrances used by the majority of people visiting or working in the building.

(b)(i) In addition, if direct access is provided for pedestrians from an enclosed parking garage to the building, at least one direct entrance from the garage to the building must be accessible.

(ii) If access is provided for pedestrians from a pedestrian tunnel or elevated walkway, one entrance to the building from each tunnel or walkway must be accessible.

(iii) In judicial, legislative, and regulatory facilities subject to section 11, restricted and secured entrances shall be accessible in the number required by 11.1.1.

One entrance may be considered as meeting more than one of the requirements in (b).

Because entrances also serve as emergency exits whose proximity to all parts of buildings and facilities is essential, it is preferable that all entrances be accessible.

(c) If the only entrance to a building, or tenancy in a facility, is a service entrance, that entrance shall be accessible.

(d) Entrances which are not accessible shall have directional signage complying with 4.30.1, 4.30.2, 4.30.3, and 4.30.5, which indicates the location of the nearest accessible entrance.

(9)\* In buildings or facilities, or portions of buildings or facilities, required to be accessible, accessible means of egress shall be provided in the same number as required for exits by local building/life safety regulations. Where a required exit from an occupiable level above or below a level of accessible exit discharge is not accessible, an area of rescue assistance shall be provided on each such level (in a number equal to that of inaccessible required exits). Areas of rescue assistance shall comply with 4.3.11. A horizontal exit, meeting the requirements of local building/life safety regulations, shall satisfy the requirement for an area of rescue assistance.

EXCEPTION: Areas of rescue assistance are not required in buildings or facilities having a supervised automatic sprinkler system.

(10)\* Drinking Fountains:

(a) Where only one drinking fountain is provided on a floor there shall be a drinking fountain which is accessible to individuals who use wheelchairs in accordance with 4.15 and one accessible to those who have difficulty bending or stooping. (This can be accommodated by the use of a "hi-lo" fountain; by providing one fountain accessible to those who use wheelchairs and one fountain at a standard height convenient for those who have difficulty bending; by providing a fountain accessible under 4.15 and a water cooler; or by such other means as would achieve the required accessibility for each group on each floor.)

**4.1.3 Accessible Buildings: New Construction**

(b) Where more than one drinking fountain or water cooler is provided on a floor, 50% of those provided shall comply with 4.15 and shall be on an accessible route.

(11) Toilet Facilities: If toilet rooms are provided, then each public and common use toilet room shall comply with 4.22. Other toilet rooms provided for the use of occupants of specific spaces (i.e., a private toilet room for the occupant of a private office) shall be adaptable. If bathing rooms are provided, then each public and common use bathroom shall comply with 4.23. Accessible toilet rooms and bathing facilities shall be on an accessible route.

(12) Storage, Shelving and Display Units:

(a) If fixed or built-in storage facilities such as cabinets, shelves, closets, and drawers are provided in accessible spaces, at least one of each type provided shall contain storage space complying with 4.25. Additional storage may be provided outside of the dimensions required by 4.25.

(b) Shelves or display units allowing self-service by customers in mercantile occupancies shall be located on an accessible route complying with 4.3. Requirements for accessible reach range do not apply.

(c)\* Where lockers are provided in accessible spaces, at least 5 percent, but not less than one, of each type of locker shall comply with 4.25.

(13) Controls and operating mechanisms in accessible spaces, along accessible routes, or as parts of accessible elements (for example, light switches and dispenser controls) shall comply with 4.27.

EXCEPTION: The requirements of 4.27 shall not apply to exercise machines.

(14) If emergency warning systems are provided, then they shall include both audible alarms and visual alarms complying with 4.28. Sleeping accommodations required to comply with 9.3 shall have an alarm system complying

with 4.28. Emergency warning systems in medical care facilities may be modified to suit standard health care alarm design practice.

(15) Detectable warnings shall be provided at locations as specified in 4.29.

(16) Building Signage:

(a) Signs which designate permanent rooms and spaces shall comply with 4.30.1, 4.30.4, 4.30.5 and 4.30.6.

(b) Other signs which provide direction to or information about functional spaces of the building shall comply with 4.30.1, 4.30.2, 4.30.3, and 4.30.5.

EXCEPTION: Building directories, menus, and all other signs which are temporary are not required to comply.

(17) Public Telephones:

(a) If public pay telephones, public closed circuit telephones, or other public telephones are provided, then they shall comply with 4.31.2 through 4.31.8 to the extent required by the following table:

<b>Number of each type of telephone provided on each floor</b>	<b>Number of telephones required to comply with 4.31.2 through 4.31.8<sup>1</sup></b>
--	---

1 or more single unit	1 per floor
1 bank <sup>2</sup>	1 per floor
2 or more banks <sup>2</sup>	1 per bank. Accessible unit may be installed as a single unit in proximity (either visible or with signage) to the bank. At least one public telephone per floor shall meet the requirements for a forward reach telephone <sup>3</sup>

<sup>1</sup> Additional public telephones may be installed at any height. Unless otherwise specified, accessible

**4.1.3 Accessible Buildings: New Construction**

telephones may be either forward or side reach telephones.

<sup>2</sup> A bank consists of two or more adjacent public telephones, often installed as a unit.

<sup>3</sup> EXCEPTION: For exterior installations only, if dial tone first service is available, then a side reach telephone may be installed instead of the required forward reach telephone.

(b)\* All telephones required to be accessible and complying with 4.31.2 through 4.31.8 shall be equipped with a volume control. In addition, 25 percent, but never less than one, of all other public telephones provided shall be equipped with a volume control and shall be dispersed among all types of public telephones, including closed circuit telephones, throughout the building or facility. Signage complying with applicable provisions of 4.30.7 shall be provided.

(c) The following shall be provided in accordance with 4.31.9:

(i) If four or more public pay telephones (including both interior and exterior telephones) are provided at a site of a private facility, and at least one is in an interior location, then at least one interior public text telephone (TTY) shall be provided. If an interior public pay telephone is provided in a public use area in a building of a public facility, at least one interior public text telephone (TTY) shall be provided in the building in a public use area.

(ii) If an interior public pay telephone is provided in a private facility that is a stadium or arena, a convention center, a hotel with a convention center, or a covered mall, at least one interior public text telephone (TTY) shall be provided in the facility. In stadiums, arenas and convention centers which are public facilities, at least one public text telephone (TTY) shall be provided on each floor level having at least one interior public pay telephone.

(iii) If a public pay telephone is located in or adjacent to a hospital emergency room, hospital recovery room, or hospital waiting room,

one public text telephone (TTY) shall be provided at each such location.

(iv) If an interior public pay telephone is provided in the secured area of a detention or correctional facility subject to section 12, then at least one public text telephone (TTY) shall also be provided in at least one secured area. Secured areas are those areas used only by detainees or inmates and security personnel.

(d) Where a bank of telephones in the interior of a building consists of three or more public pay telephones, at least one public pay telephone in each such bank shall be equipped with a shelf and outlet in compliance with 4.31.9(2).

EXCEPTION: This requirement does not apply to the secured areas of detention or correctional facilities where shelves and outlets are prohibited for purposes of security or safety.

(18) If fixed or built-in seating or tables (including, but not limited to, study carrels and student laboratory stations), are provided in accessible public or common use areas, at least five percent (5%), but not less than one, of the fixed or built-in seating areas or tables shall comply with 4.32. An accessible route shall lead to and through such fixed or built-in seating areas, or tables.

(19)\* Assembly Areas:

(a) In places of assembly with fixed seating accessible wheelchair locations shall comply with 4.33.2, 4.33.3, and 4.33.4 and shall be provided consistent with the following table:

<b>Capacity of Seating in Assembly Areas</b>	<b>Number of Required Wheelchair Locations</b>
4 to 25	1
26 to 50	2
51 to 300	4
301 to 500	6
over 500	6 plus 1 additional space for each total seating capacity increase of 100

#### 4.1.5 Accessible Buildings: Additions

In addition, one percent, but not less than one, of all fixed seats shall be aisle seats with no armrests on the aisle side, or removable or folding armrests on the aisle side. Each such seat shall be identified by a sign or marker. Signage notifying patrons of the availability of such seats shall be posted at the ticket office. Aisle seats are not required to comply with 4.33.4.

(b) This paragraph applies to assembly areas where audible communications are integral to the use of the space (e.g., concert and lecture halls, playhouses and movie theaters, meeting rooms, etc.). Such assembly areas, if (1) they accommodate at least 50 persons, or if they have audio-amplification systems, and (2) they have fixed seating, shall have a permanently installed assistive listening system complying with 4.33. For other assembly areas, a permanently installed assistive listening system, or an adequate number of electrical outlets or other supplementary wiring necessary to support a portable assistive listening system shall be provided. The minimum number of receivers to be provided shall be equal to 4 percent of the total number of seats, but in no case less than two. Signage complying with applicable provisions of 4.30 shall be installed to notify patrons of the availability of a listening system.

(c) Where a team or player seating area contains fixed seats and serves an area of sport activity, the seating area shall contain the number of wheelchair spaces required by 4.1.3(19)(a), but not less than one wheelchair space. Wheelchair spaces shall comply with 4.33.2, 4.33.3, 4.33.4, and 4.33.5.

EXCEPTION 1: Wheelchair spaces in team or player seating areas shall not be required to provide a choice of admission price or lines of sight comparable to those for members of the general public.

EXCEPTION 2: This provision shall not apply to team or player seating areas serving bowling lanes not required to be accessible by 15.7.2.

(20) Where automated teller machines (ATMs) are provided, each ATM shall comply with the

requirements of 4.34 except where two or more are provided at a location, then only one must comply.

EXCEPTION: Drive-up-only automated teller machines are not required to comply with 4.27.2, 4.27.3 and 4.34.3.

(21) Where dressing, fitting, or locker rooms are provided, the rooms shall comply with 4.35.

EXCEPTION: Where dressing, fitting, or locker rooms are provided in a cluster, at least 5 percent, but not less than one, of the rooms for each type of use in each cluster shall comply with 4.35.

(22) Where saunas or steam rooms are provided, the rooms shall comply with 4.36.

EXCEPTION: Where saunas or steam rooms are provided in a cluster, at least 5 percent, but not less than one, of the rooms for each type of use in each cluster shall comply with 4.36.

#### 4.1.4 (Reserved)

**4.1.5 Accessible Buildings: Additions.** Each addition to an existing building or facility shall be regarded as an alteration. Each space or element added to the existing building or facility shall comply with the applicable provisions of 4.1.1 to 4.1.3, Minimum Requirements (for New Construction) and the applicable technical specifications of section 4 and the special application sections. Each addition that affects or could affect the usability of an area containing a primary function shall comply with 4.1.6(2).

## 4.35 Dressing, Fitting, and Locker Rooms

**4.34.5 Equipment for Persons with Vision Impairments.** Instructions and all information for use shall be made accessible to and independently usable by persons with vision impairments.

### 4.35 Dressing, Fitting, and Locker Rooms.

**4.35.1 General.** Dressing, fitting, and locker rooms required to be accessible by 4.1 shall comply with 4.35 and shall be on an accessible route.

**4.35.2 Clear Floor Space.** A clear floor space allowing a person using a wheelchair to make a 180-degree turn shall be provided in every accessible dressing room entered through a swinging or sliding door. No door shall swing into any part of the turning space. Turning space shall not be required in a private dressing room entered through a curtained opening at least 32 in (815 mm) wide if clear floor space complying with section 4.2 renders the dressing room usable by a person using a wheelchair.

**4.35.3 Doors.** All doors to accessible dressing rooms shall be in compliance with section 4.13.

**4.35.4 Bench.** A bench complying with 4.37 shall be provided within the room.

**4.35.5 Mirror.** Where mirrors are provided in dressing rooms of the same use, then in an accessible dressing room, a full-length mirror, measuring at least 18 in wide by 54 in high (460 mm by 1370 mm), shall be mounted in a position affording a view to a person on the bench as well as to a person in a standing position.

### 4.36 Saunas and Steam Rooms.

**4.36.1 General.** Saunas and steam rooms required to be accessible by 4.1 shall comply with 4.36.

**4.36.2\* Wheelchair Turning Space.** A wheelchair turning space complying with 4.2.3 shall be provided within the room.

*EXCEPTION:* Wheelchair turning space shall be permitted to be obstructed by readily removable seats.

**4.36.3 Sauna and Steam Room Bench.** Where seating is provided, at least one bench shall be provided and shall comply with 4.37.

**4.36.4 Door Swing.** Doors shall not swing into any part of the clear floor or ground space required at a bench complying with 4.37.

### 4.37 Benches.

**4.37.1 General.** Benches required to be accessible by 4.1 shall comply with 4.37.

**4.37.2 Clear Floor or Ground Space.** Clear floor or ground space complying with 4.2.4 shall be provided and shall be positioned for parallel approach to a short end of a bench seat.

*EXCEPTION:* Clear floor or ground space required by 4.37.2 shall be permitted to be obstructed by readily removable seats in saunas and steam rooms.

**4.37.3\* Size.** Benches shall be fixed and shall have seats that are 20 inches (510 mm) minimum to 24 inches (610 mm) maximum in depth and 42 inches (1065 mm) minimum in length (see Fig. 47).

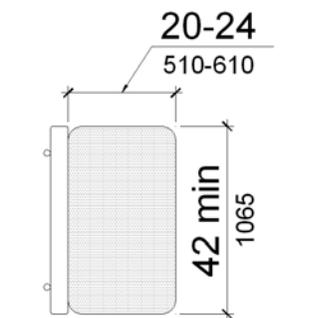


Fig. 47  
Size of Bench

## 4.37 Benches

**4.37.4 Back Support.** Benches shall have back support that is 42 inches (1065 mm) minimum in length and that extends from a point 2 inches (51 mm) maximum above the seat to a point 18 inches (455 mm) minimum above the seat (see Fig. 48).

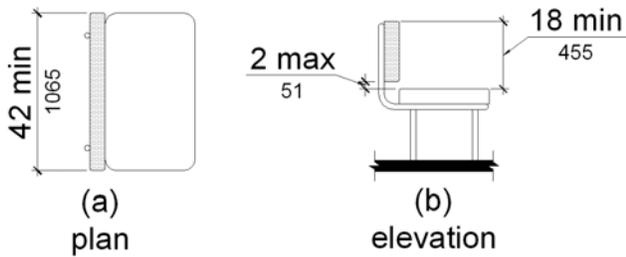


Fig. 48  
Bench Back Support

**4.37.5 Seat Height.** Bench seats shall be 17 inches (430 mm) minimum to 19 inches (485 mm) maximum above the floor or ground.

**4.37.6 Structural Strength.** Allowable stresses shall not be exceeded for materials used when a vertical or horizontal force of 250 lbs. (1112 N) is applied at any point on the seat, fastener, mounting device, or supporting structure.

**4.37.7 Wet Locations.** The surface of benches installed in wet locations shall be slip-resistant and shall not accumulate water.

**12.6 Visible Alarms and Telephones**

back support (e.g., attachment to wall). The structural strength of the bench attachments shall comply with 4.26.3.

(7) Storage. Fixed or built-in storage facilities, such as cabinets, shelves, closets, and drawers, shall contain storage space complying with 4.25.

(8) Controls. All controls intended for operation by inmates shall comply with 4.27.

(9) Accommodations for persons with hearing impairments required by 12.4.3 and complying with 12.6 shall be provided in accessible cells or rooms.

**12.6 Visible Alarms and Telephones.** Where audible emergency warning systems are provided to serve the occupants of holding or housing cells or rooms, visual alarms complying with 4.28.4 shall be provided. Where permanently installed telephones are provided within holding or housing cells or rooms, they shall have volume controls complying with 4.31.5.

EXCEPTION: Visual alarms are not required where inmates or detainees are not allowed independent means of egress.

<b>13.</b>	<b>RESIDENTIAL HOUSING. (Reserved).</b>
------------	---

<b>14.</b>	<b>PUBLIC RIGHTS-OF-WAY. (Reserved).</b>
------------	--

<b>15.</b>	<b>RECREATION FACILITIES.</b>
------------	-------------------------------

Newly designed or newly constructed and altered recreation facilities shall comply with the applicable requirements of section 4 and the special application sections, except as modified or otherwise provided in this section.

**15.1\* Amusement Rides.**

**15.1.1 General.** Newly designed or newly constructed and altered amusement rides shall comply with 15.1.

EXCEPTION 1\*: Mobile or portable amusement rides shall not be required to comply with 15.1.

EXCEPTION 2\*: Amusement rides which are controlled or operated by the rider shall be required to comply only with 15.1.4 and 15.1.5.

EXCEPTION 3\*: Amusement rides designed primarily for children, where children are assisted on and off the ride by an adult, shall be required to comply only with 15.1.4 and 15.1.5.

EXCEPTION 4: Amusement rides without amusement ride seats shall be required to comply only with 15.1.4 and 15.1.5.

**15.1.2\* Alterations to Amusement Rides.** A modification to an existing amusement ride is an alteration subject to 15.1 if one or more of the following conditions apply:

(1) The amusement ride's structural or operational characteristics are changed to the extent that the ride's performance differs from that specified by the manufacturer or the original design criteria; or

(2) The load and unload area of the amusement ride is newly designed and constructed.

**15.1.3 Number Required.** Each amusement ride shall provide at least one wheelchair space complying with 15.1.7, or at least one amusement ride seat designed for transfer complying with 15.1.8, or at least one transfer device complying with 15.1.9.

**15.1.4\* Accessible Route.** When in the load and unload position, amusement rides required to comply with 15.1 shall be served by an accessible route complying with 4.3. Any part of an accessible route serving amusement rides with a slope greater than 1:20 shall be considered a ramp and shall comply with 4.8.

EXCEPTION 1: The maximum slope specified in 4.8.2 shall not apply in the load and unload areas or on the amusement ride where compliance is structurally or operationally infeasible, provided that the slope of the ramp shall not exceed 1:8.

EXCEPTION 2: Handrails shall not be required in the load and unload areas or on the amusement ride where compliance is structurally or operationally infeasible.

EXCEPTION 3: Limited-use/limited-application elevators and platform lifts complying with 4.1.1 shall be permitted to be part of an accessible route serving the load and unload area.

**15.1.5 Load and Unload Areas.** Load and unload areas serving amusement rides required to comply with 15.1 shall provide a maneuvering space complying with 4.2.3. The maneuvering space shall have a slope not steeper than 1:48.

**15.1.6 Signage.** Signage shall be provided at the entrance of the queue or waiting line for each amusement ride to identify the type of access provided. Where an accessible unload area also serves as the accessible load area, signage shall be provided at the entrance to the queue or waiting line indicating the location of the accessible load and unload area.

**15.1.7 Amusement Rides with Wheelchair Spaces.** Amusement rides with wheelchair spaces shall comply with 15.1.7.

**15.1.7.1 Floor or Ground Surface.** The floor or ground surface of wheelchair spaces shall comply with 15.1.7.1.

**15.1.7.1.1 Slope.** The floor or ground surface of wheelchair spaces shall have a slope not steeper than 1:48 when in the load and unload position and shall be stable and firm.

**15.1.7.1.2\* Gaps.** Floors of amusement rides with wheelchair spaces and floors of load and unload areas shall be coordinated so that, when the amusement rides are at rest in the load and unload position, the vertical difference between the floors shall be within plus or minus 5/8 inches

(16 mm) and the horizontal gap shall be no greater than 3 inches (75 mm) under normal passenger load conditions.

EXCEPTION: Where compliance is not operationally or structurally feasible, ramps, bridge plates, or similar devices complying with the applicable requirements of 36 CFR 1192.83(c) shall be provided.

**15.1.7.2 Clearances.** Clearances for wheelchair spaces shall comply with 15.1.7.2.

EXCEPTION 1: Where provided, securement devices shall be permitted to overlap required clearances.

EXCEPTION 2: Wheelchair spaces shall be permitted to be mechanically or manually repositioned.

EXCEPTION 3\*: Wheelchair spaces shall not be required to comply with 4.4.2.

**15.1.7.2.1 Width and Length.** Wheelchair spaces shall provide a clear width of 30 inches (760 mm) minimum and a clear length of 48 inches (1220 mm) minimum measured to 9 inches (230 mm) minimum above the floor surface.

**15.1.7.2.2\* Wheelchair Spaces - Side Entry.** Where the wheelchair space can be entered only from the side, the ride shall be designed to permit sufficient maneuvering space for individuals using a wheelchair or mobility device to enter and exit the ride.

**15.1.7.2.3 Protrusions in Wheelchair Spaces.** Objects are permitted to protrude a distance of 6 inches (150 mm) maximum along the front of the wheelchair space where located 9 inches (230 mm) minimum and 27 inches (685 mm) maximum above the floor or ground surface of the wheelchair space. Objects are permitted to protrude a distance of 25 inches (635 mm) maximum along the front of the wheelchair space, where located more than 27 inches (685 mm) above the floor or ground surface of the wheelchair space (see Fig. 58).

## 15.1 Amusement Rides

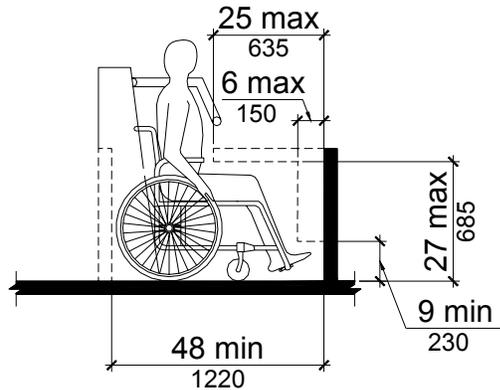


Fig. 58  
Protrusions in Wheelchair Spaces

**15.1.7.3 Openings.** Where openings are provided to access wheelchair spaces on amusement rides, the entry shall provide a 32 inch (815 mm) minimum clear opening.

**15.1.7.4 Approach.** One side of the wheelchair space shall adjoin an accessible route.

**15.1.7.5 Companion Seats.** Where the interior width of the amusement ride is greater than 53 inches (1346 mm), seating is provided for more than one rider, and the wheelchair is not required to be centered within the amusement ride, a companion seat shall be provided for each wheelchair space.

**15.1.7.5.1 Shoulder-to-Shoulder Seating.** Where an amusement ride provides shoulder-to-shoulder seating, companion seats shall be shoulder-to-shoulder with the adjacent wheelchair space.

EXCEPTION: Where shoulder-to-shoulder companion seating is not operationally or structurally feasible, compliance with this provision shall be required to the maximum extent feasible.

**15.1.8\* Amusement Ride Seats Designed for Transfer.** Amusement ride seats designed for transfer shall comply with 15.1.8 when positioned for loading and unloading.

**15.1.8.1 Clear Floor or Ground Space.** Clear floor or ground space complying with 4.2.4 shall be provided in the load and unload area adjacent to the amusement ride seats designed for transfer.

**15.1.8.2 Transfer Height.** The height of the amusement ride seats shall be 14 inches (355 mm) minimum to 24 inches (610mm) maximum measured above the load and unload surface.

**15.1.8.3 Transfer Entry.** Where openings are provided to transfer to amusement ride seats, the space shall be designed to provide clearance for transfer from a wheelchair or mobility device to the amusement ride seat.

**15.1.8.4 Wheelchair Storage Space.** Wheelchair storage spaces complying with 4.2.4 shall be provided in or adjacent to unload areas for each required amusement ride seat designed for transfer and shall not overlap any required means of egress or accessible route.

**15.1.9\* Transfer Devices for Use with Amusement Rides.** Transfer devices for use with amusement rides shall comply with 15.1.9 when positioned for loading and unloading.

**15.1.9.1 Clear Floor or Ground Space.** Clear floor or ground space complying with 4.2.4 shall be provided in the load and unload area adjacent to the transfer devices.

**15.1.9.2 Transfer Height.** The height of the transfer device seats shall be 14 inches (355 mm) minimum to 24 inches (610 mm) maximum measured above the load and unload surface.

**15.1.9.3 Wheelchair Storage Space.** Wheelchair storage spaces complying with 4.2.4 shall be provided in or adjacent to unload areas for each required transfer device and shall not overlap any required means of egress or accessible route.

**15.2 Boating Facilities.**

**15.2.1 General.** Newly designed or newly constructed and altered boating facilities shall comply with 15.2.

**15.2.2\* Accessible Route.** Accessible routes, including gangways that are part of accessible routes, shall comply with 4.3.

EXCEPTION 1: Where an existing gangway or series of gangways is replaced or altered, an increase in the length of the gangway is not required to comply with 15.2.2, unless required by 4.1.6(2).

EXCEPTION 2: The maximum rise specified in 4.8.2 shall not apply to gangways.

EXCEPTION 3: Where the total length of the gangway or series of gangways serving as part of a required accessible route is at least 80 feet (24 m), the maximum slope specified in 4.8.2 shall not apply to the gangways.

EXCEPTION 4: In facilities containing fewer than 25 boat slips and where the total length of the gangways or series of gangways serving as part of a required accessible route is at least 30 feet (9140 mm), the maximum slope specified in 4.8.2 shall not apply to the gangways.

EXCEPTION 5: Where gangways connect to transition plates, landings specified by 4.8.4 shall not be required.

EXCEPTION 6: Where gangways and transition plates connect and are required to have handrails, handrail extensions specified by 4.8.5 shall not be required. Where handrail extensions are provided on gangways or transition plates, such extensions are not required to be parallel with the ground or floor surface.

EXCEPTION 7: The cross slope of gangways, transition plates, and floating piers that are part of an accessible route shall be 1:50 maximum measured in the static position.

EXCEPTION 8: Limited-use/limited-application elevators or platform lifts complying with 4.11 shall be permitted in lieu of gangways complying with 4.3.

**15.2.3\* Boat Slips: Minimum Number.** Where boat slips are provided, boat slips complying with 15.2.5 shall be provided in accordance with Table 15.2.3. Where the number of boat slips is not identified, each 40 feet (12 m) of boat slip edge provided along the perimeter of the pier shall be counted as one boat slip for the purpose of this section.

**Table 15.2.3**

Total Boat Slips in Facility	Minimum Number of Required Accessible Boat Slips
1 to 25	1
26 to 50	2
51 to 100	3
101 to 150	4
151 to 300	5
301 to 400	6
401 to 500	7
501 to 600	8
601 to 700	9
701 to 800	10
801 to 900	11
901 to 1000	12
1001 and over	12 plus 1 for each 100 or fraction thereof over 1000

**15.2.3.1\* Dispersion.** Accessible boat slips shall be dispersed throughout the various types of slips provided. This provision does not require an increase in the minimum number of boat slips required to be accessible.

**15.2.4\* Boarding Piers at Boat Launch Ramps.** Where boarding piers are provided at boat launch ramps, at least 5 percent, but not less than one of the boarding piers shall comply with 15.2.4 and shall be served by an accessible route complying with 4.3.

## 15.2 Boating Facilities

EXCEPTION 1: Accessible routes serving floating boarding piers shall be permitted to use exceptions 1, 2, 5, 6, 7, and 8 in 15.2.2.

EXCEPTION 2: Where the total length of the gangway or series of gangways serving as part of a required accessible route is at least 30 feet (9140 mm), the maximum slope specified by 4.8.2 shall not apply to the gangways.

EXCEPTION 3: Where the accessible route serving a floating boarding pier or skid pier is located within a boat launch ramp, the portion of the accessible route located within the boat launch ramp shall not be required to comply with 4.8.

**15.2.4.1\* Boarding Pier Clearances.** The entire length of the piers shall comply with 15.2.5.

**15.2.5\* Accessible Boat Slips.** Accessible boat slips shall comply with 15.2.5.

**15.2.5.1 Clearances.** Accessible boat slips shall be served by clear pier space 60 inches (1525 mm) wide minimum and at least as long as the accessible boat slips. Every 10 feet (3050 mm) maximum of linear pier edge serving the accessible boat slips shall contain at least one continuous clear opening 60 inches (1525 mm) minimum in width (see Fig. 59).

EXCEPTION 1: The width of the clear pier space shall be permitted to be 36 inches (915 mm) minimum for a length of 24 inches (610 mm) maximum, provided that multiple 36 inch (915 mm) wide segments are separated by segments that are 60 inches (1525 mm) minimum clear in width and 60 inches (1525 mm) minimum clear in length (see Fig. 60).

EXCEPTION 2: Edge protection 4 inches (100 mm) high maximum and 2 inches (51 mm) deep maximum shall be permitted at the continuous clear openings (see Fig. 61).

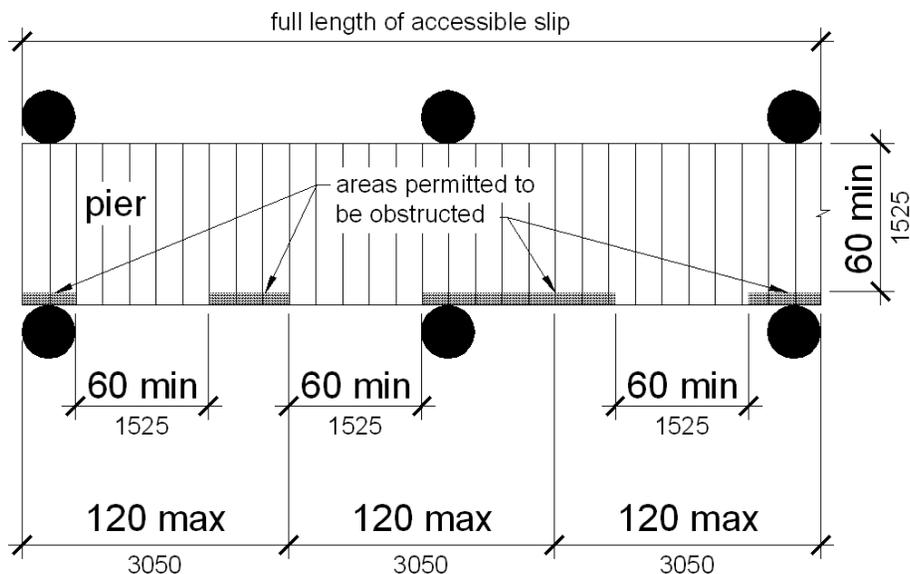


Fig. 59  
Pier Clearances

**EXCEPTION 3\*:** In alterations to existing facilities, clear pier space shall be permitted to be located perpendicular to the boat slip and shall extend the width of the boat slip, where the facility has at least one boat slip complying with 15.2.5, and further compliance with 15.2.5 would result in a reduction in the number of boat slips available or result in a reduction of the widths of existing slips.

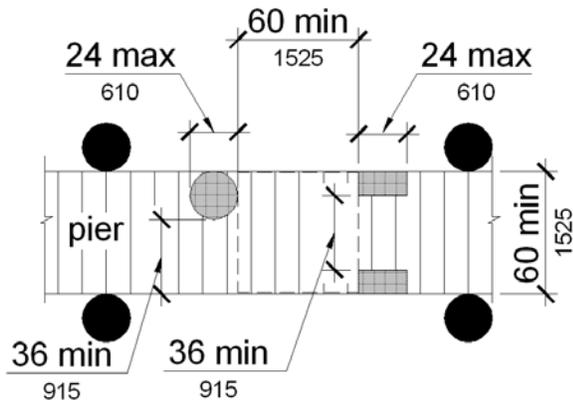


Fig. 60  
Pier Clear Space Reduction

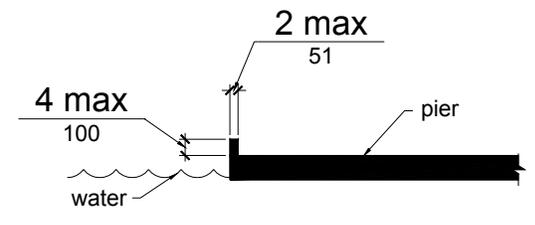


Fig. 61  
Edge Protection at Pier

**15.2.5.2 Cleats and Other Boat Securement Devices.** Cleats and other boat securement devices shall not be required to comply with 4.27.3.

**15.3 Fishing Piers and Platforms.**

**15.3.1 General.** Newly designed or newly constructed and altered fishing piers and platforms shall comply with 15.3.

**15.3.2 Accessible Route.** Accessible routes, including gangways that are part of accessible routes, serving fishing piers and platforms shall comply with 4.3.

**EXCEPTION 1:** Accessible routes serving floating fishing piers and platforms shall be permitted to use exceptions 1, 2, 5, 6, 7, and 8 in 15.2.2.

**EXCEPTION 2\*:** Where the total length of the gangway or series of gangways serving as part of a required accessible route is at least 30 feet (9140 mm), the maximum slope specified by 4.8.2 shall not apply to the gangways.

**15.3.3 Railings.** Where railings, guards, or handrails are provided, they shall comply with 15.3.3.

**15.3.3.1\* Edge Protection.** Edge protection shall be provided and shall extend 2 inches (51 mm) minimum above the ground or deck surface.

**EXCEPTION:** Where the railing, guard, or handrail is 34 inches (865 mm) or less above the ground or deck surface, edge protection shall not be required if the deck surface extends 12 inches (305 mm) minimum beyond the inside face of the railing. Toe clearance shall be 9 inches (230 mm) minimum above the ground or deck surface beyond the railing. Toe clearance shall be 30 inches (760 mm) minimum wide (see Fig. 62).

**15.3.3.2 Height.** At least 25 percent of the railings, guards, or handrails shall be 34 inches (865 mm) maximum above the ground or deck surface.

**EXCEPTION:** This provision shall not apply to that portion of a fishing pier or platform where a guard which complies with sections 1003.2.12.1 (Height) and 1003.2.12.2 (Opening limitations) of the International Building Code (incorporated by reference, see 2.3.2) is provided.

## 15.4 Golf

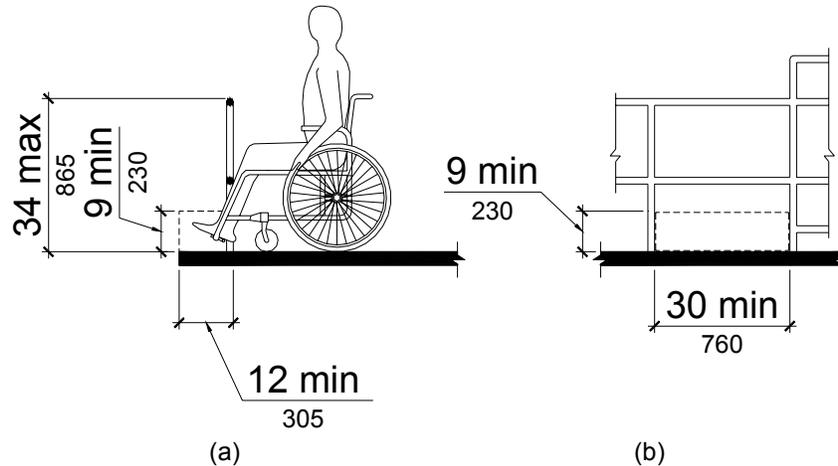


Fig. 62  
Edge Protection at Fishing Piers

**15.3.3.3\* Dispersion.** Railings required to comply with 15.3.3.2 shall be dispersed throughout a fishing pier or platform.

**15.3.4 Clear Floor or Ground Space.** At least one clear floor or ground space complying with 4.2.4 shall be provided where the railing height required by 15.3.3.2 is located. Where no railings are provided, at least one clear floor or ground space complying with 4.2.4 shall be provided.

**15.3.5 Maneuvering Space.** At least one maneuvering space complying with 4.2.3 shall be provided on the fishing pier or platform.

### 15.4 Golf.

**15.4.1 General.** Newly designed or newly constructed and altered golf courses, driving ranges, practice putting greens, and practice teeing grounds shall comply with 15.4.

**15.4.2\* Accessible Route - Golf Course.** An accessible route shall connect accessible elements and spaces within the boundary of the golf course.

In addition, an accessible route shall connect the golf car rental area, bag drop areas, practice putting greens, accessible practice teeing grounds, course toilet rooms, and course weather shelters. The accessible route required by this section shall be 48 inches (1220 mm) minimum wide. Where handrails are provided, the accessible route shall be 60 inches (1525 mm) minimum wide.

**EXCEPTION 1:** A golf car passage complying with 15.4.7 shall be permitted in lieu of all or part of an accessible route required by 15.4.2.

**EXCEPTION 2:** The handrail requirements of 4.8.5 shall not apply to an accessible route located within the boundary of a golf course.

**15.4.3\* Accessible Route - Driving Ranges.** An accessible route shall connect accessible teeing stations at driving ranges with accessible parking spaces and shall be 48 inches (1220 mm) wide minimum. Where handrails are provided, the accessible route shall be 60 inches (1525 mm) wide minimum.

EXCEPTION: A golf car passage complying with 15.4.7 shall be permitted in lieu of all or part of an accessible route required by 15.4.3.

**15.4.4 Teeing Grounds.** Teeing grounds shall comply with 15.4.4.

**15.4.4.1 Number Required.** Where one or two teeing grounds are provided for a hole, at least one teeing ground serving the hole shall comply with 15.4.4.3. Where three or more teeing grounds are provided for a hole, at least two teeing grounds shall comply with 15.4.4.3.

**15.4.4.2 Forward Teeing Ground.** The forward teeing ground shall be accessible.

EXCEPTION: In alterations, the forward teeing ground shall not be required to be accessible where compliance is not feasible due to terrain.

**15.4.4.3 Teeing Grounds.** Teeing grounds required by 15.4.4.1 and 15.4.4.2 shall be designed and constructed so that a golf car can enter and exit the teeing ground.

**15.4.5 Teeing Stations at Driving Ranges and Practice Teeing Grounds.** Where teeing stations or practice teeing grounds are provided, at least 5 percent of the practice teeing stations or practice teeing grounds, but not less than one, shall comply with 15.4.4.3.

**15.4.6 Weather Shelters.** Where weather shelters are provided on a golf course, each weather shelter shall have a clear floor or ground space 60 inches (1525 mm) minimum by 96 inches (2440 mm) minimum and shall be designed and constructed so that a golf car can enter and exit.

**15.4.7 Golf Car Passage.** Where curbs or other constructed barriers are provided along a golf car passage to prohibit golf cars from entering a fairway, openings at least 60 inches (1525 mm) wide shall be provided at intervals not to exceed 75 yds (69 m).

**15.4.7.1 Width.** The golf car passage shall be 48 inches (1220 mm) minimum wide.

**15.4.8 Putting Greens.** Each putting green shall be designed and constructed so that a golf car can enter and exit the putting green.

**15.5\* Miniature Golf.**

**15.5.1 General.** Newly designed or newly constructed and altered miniature golf courses shall comply with 15.5.

**15.5.2 Accessible Holes.** At least fifty percent of holes on a miniature golf course shall comply with 15.5.3 through 15.5.5 and shall be consecutive.

EXCEPTION: One break in the sequence of consecutive accessible holes shall be permitted, provided that the last hole on a miniature golf course is the last hole in the sequence.

**15.5.3\* Accessible Route.** An accessible route complying with 4.3 shall connect the course entrance with the first accessible hole and the start of play area on each accessible hole. The course shall be configured to allow exit from the last accessible hole to the course exit or entrance and shall not require travel back through other holes.

**15.5.3.1 Accessible Route - Located On the Playing Surface.** Where the accessible route is located on the playing surface of the accessible hole, exceptions 1-5 shall be permitted.

EXCEPTION 1: Where carpet is provided, the requirements of 4.5.3 shall not apply.

EXCEPTION 2: Where the accessible route intersects the playing surface of a hole, a 1 inch (26 mm) maximum curb shall be permitted for a width of 32 inches (815 mm) minimum.

EXCEPTION 3: A slope of 1:4 maximum for a 4 inch (100 mm) maximum rise shall be permitted.

EXCEPTION 4: Landings required by 4.8.4 shall be permitted to be 48 inches (1220 mm) in length minimum. Landing size required by 4.8.4(3) shall be permitted to be 48 inches (1220 mm) minimum by 60 inches (1525 mm) minimum.

## 15.6 Play Areas

Landing slopes shall be permitted to be 1:20 maximum.

EXCEPTION 5: Handrail requirements of 4.8.5 shall not apply.

**15.5.3.2 Accessible Route - Adjacent to the Playing Surface.** Where the accessible route is located adjacent to the playing surface, the requirements of 4.3 shall apply.

**15.5.4 Start of Play Areas.** Start of play areas at holes required to comply with 15.5.2 shall have a slope not steeper than 1:48 and shall be 48 inches (1220 mm) minimum by 60 inches (1525 mm) minimum.

**15.5.5\* Golf Club Reach Range.** All areas within accessible holes where golf balls rest shall be within 36 inches (915 mm) maximum of an accessible route having a maximum slope of 1:20 for 48 inches (1220 mm) in length (see Fig. 63).

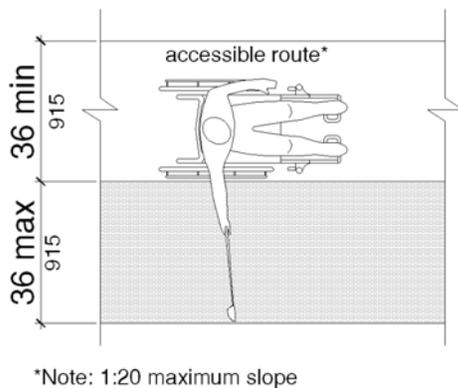


Fig. 63  
Golf Club Reach Range

### 15.6 Play Areas.

**15.6.1\* General.** Newly designed and newly constructed play areas for children ages 2 and over and altered portions of existing play areas shall comply with the applicable provisions of section 4, except as modified or otherwise provided by this section. Where separate play

areas are provided within a site for specified age groups, each play area shall comply with this section. Where play areas are designed or constructed in phases, this section shall be applied so that when each successive addition is completed, the entire play area complies with all the applicable provisions of this section.

EXCEPTION 1: Play areas located in family child care facilities where the proprietor actually resides shall not be required to comply with 15.6.

EXCEPTION 2: Where play components are relocated in existing play areas for the purpose of creating safe use zones, 15.6 shall not apply, provided that the ground surface is not changed or extended for more than one use zone.

EXCEPTION 3: Where play components are altered and the ground surface is not altered, the ground surface shall not be required to comply with 15.6.7, unless required by 4.1.6(2).

EXCEPTION 4: The provisions of 15.6.1 through 15.6.7 shall not apply to amusement attractions.

EXCEPTION 5: Compliance with 4.4 shall not be required within the boundary of the play area.

EXCEPTION 6: Stairs shall not be required to comply with 4.9.

### 15.6.2\* Ground Level Play Components.

Ground level play components shall be provided in the number and types required by 15.6.2.1 and 15.6.2.2. Ground level play components that are provided to comply with 15.6.2.1 shall be permitted to satisfy the number required by 15.6.2.2, provided that the minimum required types of play components are provided. Where more than one ground level play component required by 15.6.2.1 and 15.6.2.2 is provided, the play components shall be integrated in the play area.

**15.6.2.1 General.** Where ground level play components are provided, at least one of each type provided shall be located on an accessible route complying with 15.6.4 and shall comply with 15.6.6.

**15.6.2.2 Additional Number and Types.** Where elevated play components are provided, ground level play components shall be provided in accordance with Table 15.6.2.2. Ground level play components required by 15.6.2.2 shall be located on an accessible route complying with 15.6.4 and shall comply with 15.6.6.

EXCEPTION: If at least 50 percent of the elevated play components are connected by a ramp, and if at least 3 of the elevated play components connected by the ramp are different types of play components, 15.6.2.2 shall not apply.

**15.6.3\* Elevated Play Components.** Where elevated play components are provided, at least 50 percent shall be located on an accessible route complying with 15.6.4. Elevated play components connected by a ramp shall comply with 15.6.6.

**15.6.4\* Accessible Routes.** At least one accessible route complying with 4.3, as modified by 15.6.4, shall be provided.

EXCEPTION 1: Transfer systems complying with 15.6.5 shall be permitted to connect elevated play components, except where 20 or more elevated play components are provided, no more than 25 percent of the elevated play components shall be permitted to be connected by transfer systems.

EXCEPTION 2: Where transfer systems are provided, an elevated play component shall be permitted to connect to another elevated play component in lieu of an accessible route.

EXCEPTION 3: Platform lifts (wheelchair lifts) complying with 4.1.1 and applicable State or local codes shall be permitted to be used as part of an accessible route.

**Table 15.6.2.2 Number and Types of Ground Level Play Components Required to be on Accessible Route**

Number of Elevated Play Components Provided	Minimum Number of Ground Level Play Components Required to be on Accessible Route	Minimum Number of Different Types of Ground Level Play Components Required to be on Accessible Route
1	Not applicable	Not applicable
2 to 4	1	1
5 to 7	2	2
8 to 10	3	3
11 to 13	4	3
14 to 16	5	3
17 to 19	6	3
20 to 22	7	4
23 to 25	8	4
More than 25	8 plus 1 for each additional 3 over 25, or fraction thereof	5

## 15.6 Play Areas

**15.6.4.1 Location.** Accessible routes shall be located within the boundary of the play area and shall connect ground level play components as required by 15.6.2.1 and 15.6.2.2 and elevated play components as required by 15.6.3, including entry and exit points of the play components.

**15.6.4.2 Protrusions.** Objects shall not protrude into ground level accessible routes at or below 80 in (2030 mm) above the ground or floor surface.

**15.6.4.3 Clear Width.** The clear width of accessible routes within play areas shall comply with 15.6.4.3.

**15.6.4.3.1 Ground Level.** The clear width of accessible routes at ground level shall be 60 in (1525 mm) minimum.

EXCEPTION 1: In play areas less than 1,000 square feet, the clear width of accessible routes shall be permitted to be 44 in (1120 mm) minimum, provided that at least one turning space complying with 4.2.3 is provided where the restricted accessible route exceeds 30 feet (9.14 m) in length.

EXCEPTION 2: The clear width of accessible routes shall be permitted to be 36 in (915 mm) minimum for a distance of 60 in (1525 mm) maximum, provided that multiple reduced width segments are separated by segments that are 60 in (1525 mm) minimum in width and 60 in (1525 mm) minimum in length.

**15.6.4.3.2 Elevated.** The clear width of accessible routes connecting elevated play components shall be 36 in (915 mm).

EXCEPTION 1: The clear width of accessible routes connecting elevated play components shall be permitted to be reduced to 32 in (815 mm) minimum for a distance of 24 in (610 mm) maximum provided that reduced width segments are separated by segments that are 48 in (1220 mm) minimum in length and 36 in (915 mm) minimum in width.

EXCEPTION 2: The clear width of transfer systems connecting elevated play components

shall be permitted to be 24 in (610 mm) minimum.

**15.6.4.4 Ramp Slope and Rise.** Any part of an accessible route with a slope greater than 1:20 shall be considered a ramp and shall comply with 4.8, as modified by 15.6.4.4.

**15.6.4.4.1 Ground Level.** The maximum slope for ramps connecting ground level play components within the boundary of a play area shall be 1:16.

**15.6.4.4.2 Elevated.** Where a ramp connects elevated play components, the maximum rise of any ramp run shall be 12 in (305 mm).

**15.6.4.5 Handrails.** Where required on ramps, handrails shall comply with 4.8.5, as modified by 15.6.4.5.

EXCEPTION 1: Handrails shall not be required at ramps located within ground level use zones.

EXCEPTION 2: Handrail extensions shall not be required.

**15.6.4.5.1 Handrail Gripping Surface.** Handrails shall have a diameter or width of 0.95 in (24.1 mm) minimum to 1.55 in (39.4 mm) maximum, or the shape shall provide an equivalent gripping surface.

**15.6.4.5.2 Handrail Height.** The top of handrail gripping surfaces shall be 20 in (510 mm) minimum to 28 in (710 mm) maximum above the ramp surface.

**15.6.5\* Transfer Systems.** Where transfer systems are provided to connect elevated play components, the transfer systems shall comply with 15.6.5.

**15.6.5.1 Transfer Platforms.** Transfer platforms complying with 15.6.5.1 shall be provided where transfer is intended to be from a wheelchair or other mobility device (see Fig. 64).

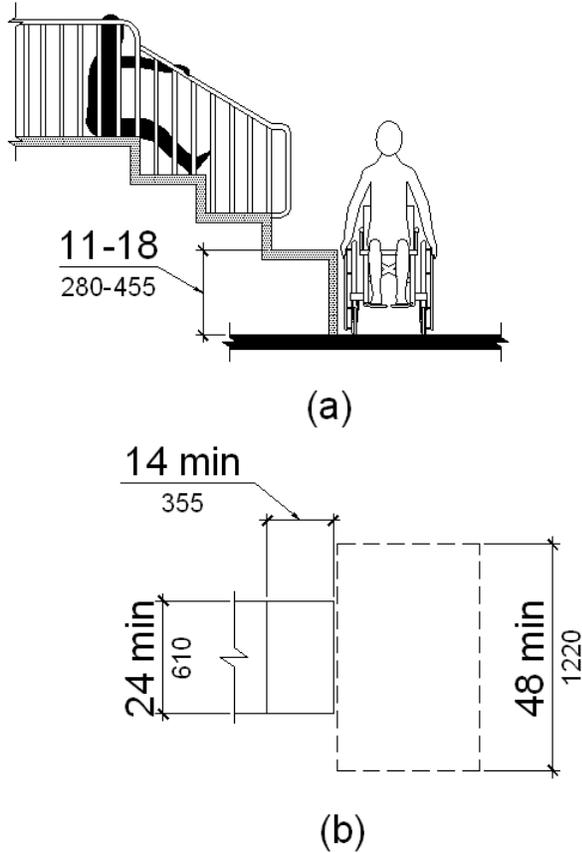


Fig. 64

**15.6.5.1.1 Size.** Platforms shall have a level surface 14 in (355 mm) minimum in depth and 24 in (610 mm) minimum in width.

**15.6.5.1.2 Height.** Platform surfaces shall be 11 in (280 mm) minimum to 18 in (455 mm) maximum above the ground or floor surface.

**15.6.5.1.3 Transfer Space.** A level space complying with 4.2.4 shall be centered on the 48 in (1220 mm) long dimension parallel to the 24 in (610 mm) minimum long unobstructed side of the transfer platform.

**15.6.5.1.4 Transfer Supports.** A means of support for transferring shall be provided.

**15.6.5.2 Transfer Steps.** Transfer steps complying with 15.6.5.2 shall be provided where movement is intended from a transfer platform to a level with elevated play components required to be located on an accessible route (see Fig. 65).

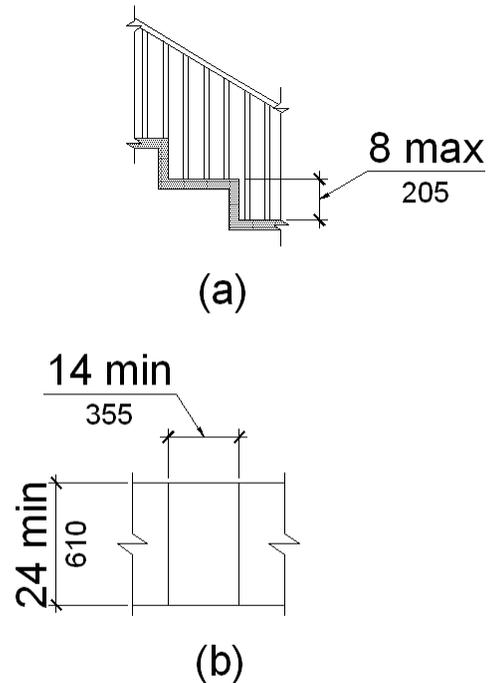


Fig. 65

**15.6.5.2.1 Size.** Transfer steps shall have a level surface 14 in (355 mm) minimum in depth and 24 in (610 mm) minimum in width.

**15.6.5.2.2 Height.** Each transfer step shall be 8 in (205 mm) maximum high.

**15.6.5.2.3 Transfer Supports.** A means of support for transferring shall be provided.

**15.6.6\* Play Components.** Ground level play components located on accessible routes and

## 15.7 Exercise Equipment and Machines

elevated play components connected by ramps shall comply with 15.6.6.

**15.6.6.1 Maneuvering Space.** Maneuvering space complying with 4.2.3 shall be provided on the same level as the play components. Maneuvering space shall have a slope not steeper than 1:48 in all directions. The maneuvering space required for a swing shall be located immediately adjacent to the swing.

**15.6.6.2 Clear Floor or Ground Space.** Clear floor or ground space shall be provided at the play components and shall be 30 in (760 mm) by 48 in (1220 mm) minimum. Clear floor or ground space shall have a slope not steeper than 1:48 in all directions.

**15.6.6.3 Play Tables: Height and Clearances.** Where play tables are provided, knee clearance 24 in (610 mm) high minimum, 17 in deep (430 mm) minimum, and 30 in (760 mm) wide minimum shall be provided. The tops of rims, curbs, or other obstructions shall be 31 in (785 mm) high maximum.

EXCEPTION: Play tables designed or constructed primarily for children ages 5 and under shall not be required to provide knee clearance if the clear floor or ground space required by 15.6.6.2 is arranged for a parallel approach and if the rim surface is 31 in (785 mm) high maximum.

**15.6.6.4 Entry Points and Seats: Height.** Where a play component requires transfer to the entry point or seat, the entry point or seat shall be 11 in (280 mm) minimum and 24 in (610 mm) maximum above the clear floor or ground space.

EXCEPTION: The entry point of a slide shall not be required to comply with 15.6.6.4.

**15.6.6.5 Transfer Supports.** Where a play component requires transfer to the entry point or seat, a means of support for transferring shall be provided.

**15.6.7\* Ground Surfaces.** Ground surfaces along accessible routes, clear floor or ground

spaces, and maneuvering spaces within play areas shall comply with 4.5.1 and 15.6.7.

**15.6.7.1 Accessibility.** Ground surfaces shall comply with ASTM F 1951 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment (incorporated by reference, see 2.3.2). Ground surfaces shall be inspected and maintained regularly and frequently to ensure continued compliance with ASTM F 1951.

**15.6.7.2 Use Zones.** If located within use zones, ground surfaces shall comply with ASTM F 1292 Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment (incorporated by reference, see 2.3.2).

**15.6.8 Soft Contained Play Structures.** Soft contained play structures shall comply with 15.6.8.

**15.6.8.1 Accessible Routes to Entry Points.** Where three or fewer entry points are provided, at least one entry point shall be located on an accessible route. Where four or more entry points are provided, at least two entry points shall be located on an accessible route. Accessible routes shall comply with 4.3.

EXCEPTION: Transfer systems complying with 15.6.5 or platform lifts (wheelchair lifts) complying with 4.1.1 and applicable State or local codes shall be permitted to be used as part of an accessible route.

### **15.7 Exercise Equipment and Machines, Bowling Lanes, and Shooting Facilities.**

**15.7.1 General.** Newly designed or newly constructed and altered exercise equipment and machines, bowling lanes, and shooting facilities shall comply with 15.7.

**15.7.2\* Exercise Equipment and Machines.** At least one of each type of exercise equipment and machines shall be provided with clear floor or ground space complying with 4.2.4 and shall be served by an accessible route. Clear floor or ground space shall be positioned for transfer or

## 15.8 Swimming Pools, Wading Pools, and Spas

for use by an individual seated in a wheelchair. Clear floor or ground spaces for more than one piece of equipment shall be permitted to overlap .

**15.7.3 Bowling Lanes.** Where bowling lanes are provided, at least 5 percent, but not less than one of each type of lane shall be served by an accessible route.

**15.7.4\* Shooting Facilities.** Where fixed firing positions are provided at a site, at least 5 percent, but not less than one, of each type of firing position shall comply with 15.7.4.1.

**15.7.4.1 Fixed Firing Position.** Fixed firing positions shall contain a 60 inch (1525 mm) diameter space and shall have a slope not steeper than 1:48.

### 15.8 Swimming Pools, Wading Pools, and Spas.

**15.8.1 General.** Newly designed or newly constructed and altered swimming pools, wading pools, and spas shall comply with 15.8.

EXCEPTION: An accessible route shall not be required to serve raised diving boards or diving platforms.

**15.8.2\* Swimming Pools.** At least two accessible means of entry shall be provided for each public use and common use swimming pool. The primary means of entry shall comply with 15.8.5 (Swimming Pool Lifts) or 15.8.6 (Sloped Entries). The secondary means of entry shall comply with one of the following: 15.8.5 (Swimming Pool Lifts), 15.8.6 (Sloped Entries), 15.8.7 (Transfer Walls), 15.8.8 (Transfer Systems), or 15.8.9 (Pool Stairs).

EXCEPTION 1\*: Where a swimming pool has less than 300 linear feet (91 m) of swimming pool wall, at least one accessible means of entry shall be provided and shall comply with 15.8.5 (Swimming Pool Lifts) or 15.8.6 (Sloped Entries).

EXCEPTION 2: Wave action pools, leisure rivers, sand bottom pools, and other pools where user access is limited to one area, shall provide at least one accessible means of entry that complies with

15.8.5 (Swimming Pool Lifts), 15.8.6 (Sloped Entries), or 15.8.8 (Transfer Systems).

EXCEPTION 3: Catch pools shall be required only to be served by an accessible route that connects to the pool edge.

**15.8.3 Wading Pools.** At least one accessible means of entry complying with 15.8.6 (Sloped Entries) shall be provided for each wading pool.

**15.8.4 Spas.** At least one accessible means of entry complying with 15.8.5 (Swimming Pool Lifts), 15.8.7 (Transfer Walls), or 15.8.8 (Transfer Systems) shall be provided for each spa.

EXCEPTION: Where spas are provided in a cluster, 5 percent, but not less than one, in each cluster shall be accessible.

**15.8.5\* Pool Lifts.** Pool lifts shall comply with 15.8.5.

**15.8.5.1 Pool Lift Location.** Pool lifts shall be located where the water level does not exceed 48 inches (1220 mm).

EXCEPTION 1: Where the entire pool depth is greater than 48 inches (1220 mm), 15.8.5.1 shall not apply.

EXCEPTION 2: Where multiple pool lift locations are provided, no more than one shall be required to be located in an area where the water level does not exceed 48 inches (1220 mm).

**15.8.5.2 Seat Location.** In the raised position, the centerline of the seat shall be located over the deck and 16 inches (405 mm) minimum from the edge of the pool. The deck surface between the centerline of the seat and the pool edge shall have a slope not greater than 1:48 (see Fig. 68).

## 15.8 Swimming Pools, Wading Pools, and Spas

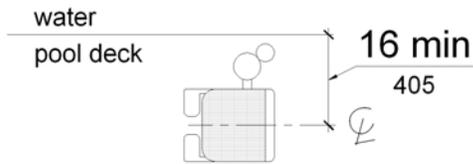


Fig. 68  
Pool Lift Seat Location

**15.8.5.3 Clear Deck Space.** On the side of the seat opposite the water, a clear deck space shall be provided parallel with the seat. The space shall be 36 inches (915 mm) wide minimum and shall extend forward 48 inches (1220 mm) minimum from a line located 12 inches (305 mm) behind the rear edge of the seat. The clear deck space shall have a slope not greater than 1:48 (see Fig. 69).

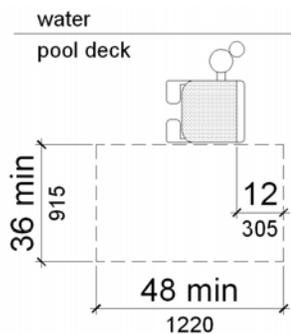


Fig. 69  
Clear Deck Space at Pool Lifts

**15.8.5.4 Seat Height.** The height of the lift seat shall be designed to allow a stop at 16 inches (405 mm) minimum to 19 inches (485 mm) maximum measured from the deck to the top of the seat

surface when in the raised (load) position (see Fig. 70).

**15.8.5.5 Seat Width.** The seat shall be 16 inches (405 mm) minimum wide.

**15.8.5.6\* Footrests and Armrests.** Footrests shall be provided and shall move with the seat. If provided, armrests positioned opposite the water shall be removable or shall fold clear of the seat when the seat is in the raised (load) position.

EXCEPTION: Footrests shall not be required on pool lifts provided in spas.

**15.8.5.7\* Operation.** The lift shall be capable of unassisted operation from both the deck and water levels. Controls and operating mechanisms shall be unobstructed when the lift is in use and shall comply with 4.27.4.

**15.8.5.8 Submerged Depth.** The lift shall be designed so that the seat will submerge to a water depth of 18 inches (455 mm) minimum below the stationary water level (see Fig. 71).

**15.8.5.9\* Lifting Capacity.** Single person pool lifts shall have a minimum weight capacity of 300 lbs. (136 kg) and be capable of sustaining a static load of at least one and a half times the rated load.

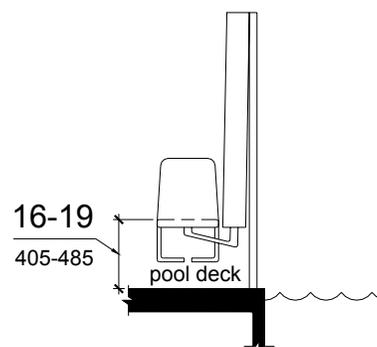


Fig. 70  
Pool Lift Seat Height

## 15.8 Swimming Pools, Wading Pools, and Spas

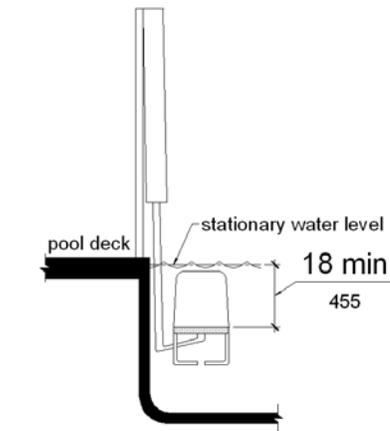


Fig 71  
Pool Lift Submerged Depth

**15.8.6 Sloped Entries.** Sloped entries designed to provide access into the water shall comply with 15.8.6.

**15.8.6.1\* Sloped Entries.** Sloped entries shall comply with 4.3, except as modified below.

EXCEPTION: Where sloped entries are provided, the surfaces shall not be required to be slip resistant.

**15.8.6.2 Submerged Depth.** Sloped entries shall extend to a depth of 24 inches (610 mm)

minimum to 30 inches (760 mm) maximum below the stationary water level. Where landings are required by 4.8, at least one landing shall be located 24 inches (610 mm) minimum to 30 inches (760 mm) maximum below the stationary water level (see Fig. 72).

EXCEPTION: In wading pools, the sloped entry and landings, if provided, shall extend to the deepest part of the wading pool.

**15.8.6.3\* Handrails.** Handrails shall be provided on both sides of the sloped entry and shall comply with 4.8.5. The clear width between handrails shall be 33 inches (840 mm) minimum and 38 inches (965 mm) maximum (see Fig. 73).

EXCEPTION 1: Handrail extensions specified by 4.8.5 shall not be required at the bottom landing serving a sloped entry.

EXCEPTION 2: Where a sloped entry is provided for wave action pools, leisure rivers, sand bottom pools, and other pools where user access is limited to one area, the required clear width between handrails shall not apply.

EXCEPTION 3: The handrail requirements of 4.8.5 and 15.8.6.3 shall not be required on sloped entries in wading pools.

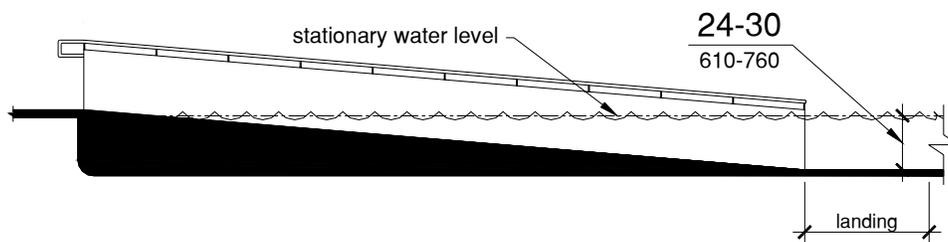


Fig. 72  
Sloped Entry Submerged Depth

## 15.8 Swimming Pools, Wading Pools, and Spas

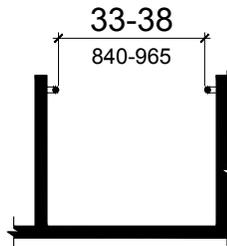


Fig. 73  
Sloped Entry Handrails

**15.8.7 Transfer Walls.** Transfer walls shall comply with 15.8.7.

**15.8.7.1 Clear Deck Space.** A clear deck space of 60 inches (1525 mm) minimum by 60 inches (1525 mm) minimum with a slope not steeper

than 1:48 shall be provided at the base of the transfer wall. Where one grab bar is provided, the clear deck space shall be centered on the grab bar. Where two grab bars are provided, the clear deck space shall be centered on the clearance between the grab bars (see Fig. 74).

**15.8.7.2 Height.** The height of the transfer wall shall be 16 inches (405 mm) minimum to 19 inches (485 mm) maximum measured from the deck (see Fig. 75).

**15.8.7.3 Wall Depth and Length.** The depth of the transfer wall shall be 12 inches (305 mm) minimum to 16 inches (405 mm) maximum. The length of the transfer wall shall be 60 inches (1525 mm) minimum and shall be centered on the clear deck space (see Fig. 76).

**15.8.7.4 Surface.** Surfaces of transfer walls shall not be sharp and shall have rounded edges.

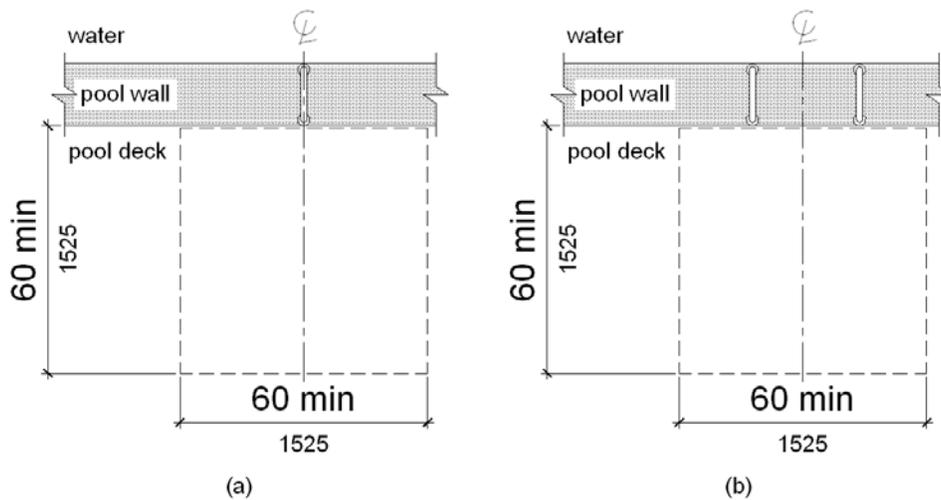


Fig. 74  
Clear Deck Space at Transfer Walls

**15.8 Swimming Pools, Wading Pools, and Spas**

**15.8.7.5 Grab Bars.** At least one grab bar shall be provided on the transfer wall. Grab bars shall be perpendicular to the pool wall and shall extend the full depth of the transfer wall. The top of the gripping surface shall be 4 inches (100 mm) minimum and 6 inches (150 mm) maximum above walls. Where one grab bar is provided, clearance shall be 24 inches (610 mm) minimum on both sides of the grab bar. Where two grab bars are provided, clearance between grab bars

shall be 24 inches (610 mm) minimum. Grab bars shall comply with 4.26 (see Fig. 77).

**15.8.8 Transfer Systems.** Transfer systems shall comply with 15.8.8.

**15.8.8.1 Transfer Platform.** A transfer platform 19 inches (485 mm) minimum clear depth by 24 inches (610 mm) minimum clear width shall be provided at the head of each transfer system (see Fig. 78).

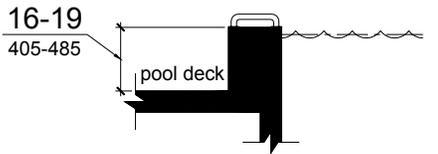


Fig. 75  
Transfer Wall Height

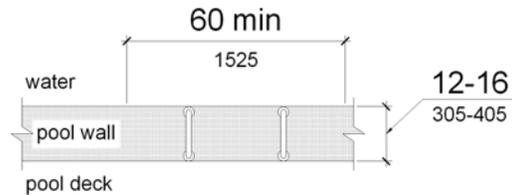


Fig. 76  
Transfer Wall Depth and Length

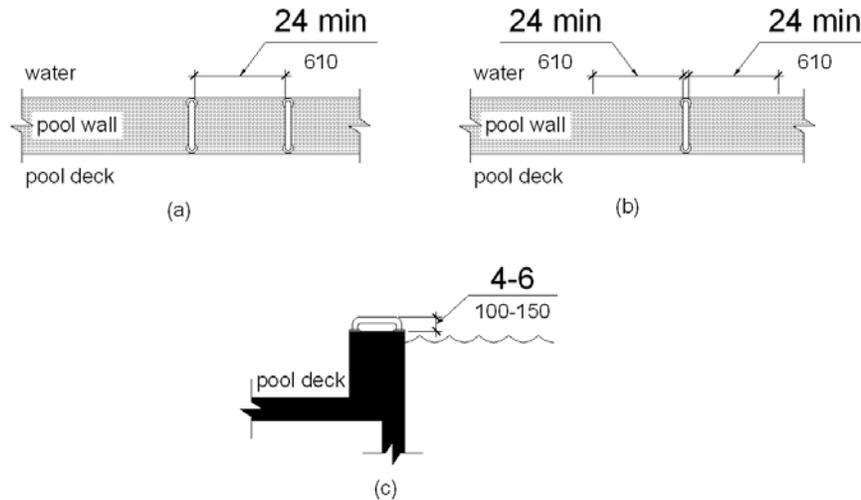
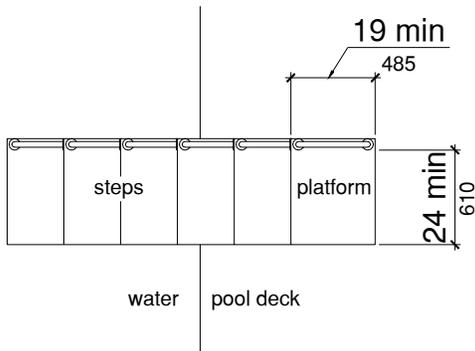


Fig. 77  
Grab Bars at Transfer Walls

**15.8 Swimming Pools, Wading Pools, and Spas**



**Fig. 78**  
Transfer System Platform

transfer platform surface and shall be centered along a 24 inch (610 mm) minimum unobstructed side of the transfer platform (see Fig. 79).

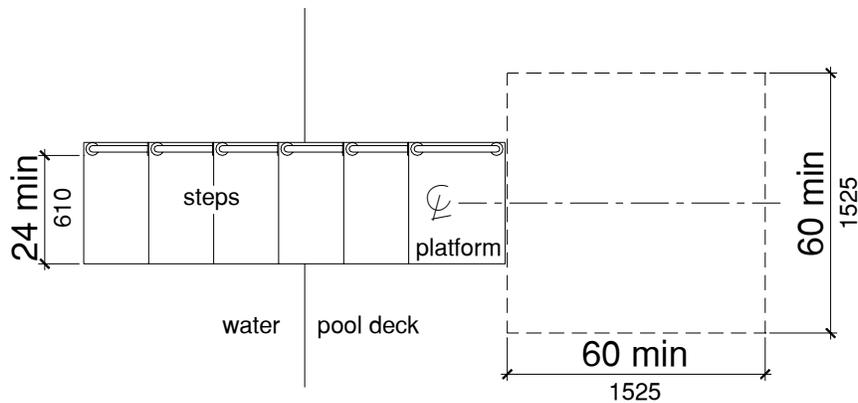
**15.8.8.3 Height.** The height of the transfer platform shall comply with 15.8.7.2.

**15.8.8.4\* Transfer Steps.** Transfer step height shall be 8 inches (205 mm) maximum. Transfer steps shall extend to a water depth of 18 inches (455 mm) minimum below the stationary water level (see Fig. 80).

**15.8.8.5 Surface.** The surface of the transfer system shall not be sharp and shall have rounded edges.

**15.8.8.6 Size.** Each transfer step shall have a tread clear depth of 14 inches (355 mm) minimum and 17 inches (430 mm) maximum and shall have a tread clear width of 24 inches (610 mm) minimum (see Fig. 81).

**15.8.8.2 Clear Deck Space.** A clear deck space of 60 inches (1525 mm) minimum by 60 inches (1525 mm) minimum with a slope not steeper than 1:48 shall be provided at the base of the

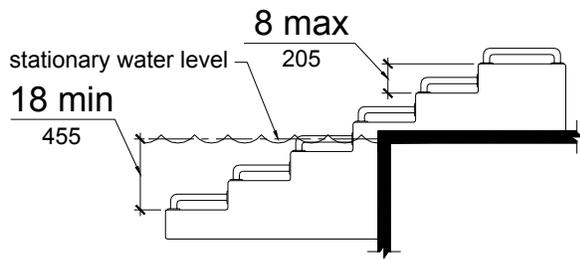


**Fig. 79**  
Clear Deck Space at Transfer Systems

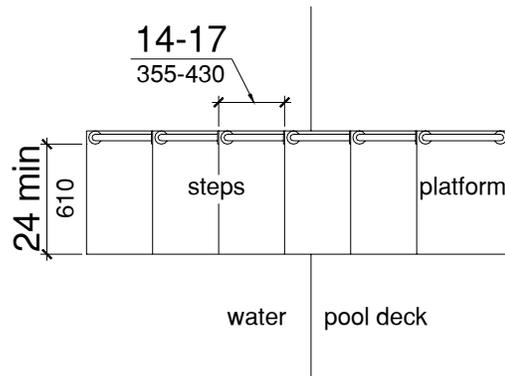
**15.8 Swimming Pools, Wading Pools, and Spas**

**15.8.8.7\* Grab Bars.** At least one grab bar on each transfer step and the transfer platform, or a continuous grab bar serving each transfer step and the transfer platform, shall be provided. Where provided, the top of the gripping surface shall be 4 inches (100 mm) minimum and 6 inches (150 mm) maximum above each step and transfer platform. Where a continuous grab bar is

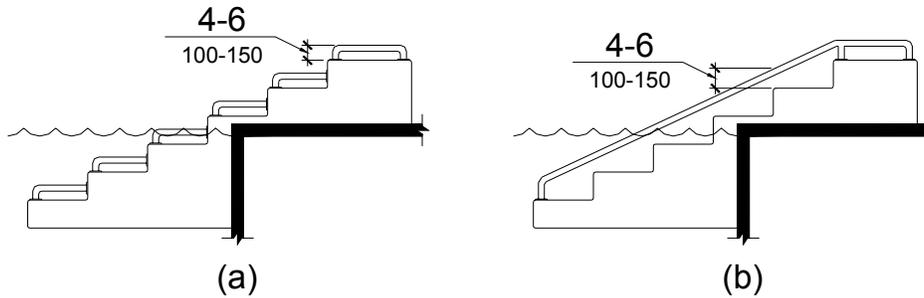
provided, the top of the gripping surface shall be 4 inches (100 mm) minimum and 6 inches (150 mm) maximum above the step nosing and transfer platform. Grab bars shall comply with 4.26 and be located on at least one side of the transfer system. The grab bar located at the transfer platform shall not obstruct transfer (see Fig. 82).



**Fig. 80**  
Transfer System Steps



**Fig. 81**  
Size of Transfer System Steps



**Fig. 82**  
Grab Bars at Transfer Systems

## 15.8 Swimming Pools, Wading Pools, and Spas

**15.8.9 Pool Stairs.** Pool stairs shall comply with 15.8.9.

**15.8.9.1 Pool Stairs.** Pool stairs shall comply with 4.9, except as modified below.

**15.8.9.2 Handrails.** The width between handrails shall be 20 inches (510 mm) minimum and 24 inches (610 mm) maximum. Handrail extensions required by 4.9.4 shall not be required at the bottom landing serving a pool stair.

**15.8.10\* Water Play Components.** Where water play components are provided, the provisions of 15.6 and 4.3 shall apply, except as modified or otherwise provided in this section.

EXCEPTION 1: Where the surface of the accessible route, clear floor or ground spaces and maneuvering spaces connecting play components is submerged, the provisions of 15.6 and 4.3 for cross slope, running slope, and surface shall not apply.

EXCEPTION 2: Transfer systems complying with 15.6.5 shall be permitted to be used in lieu of ramps to connect elevated play components.

## APPENDIX

This appendix contains materials of an advisory nature and provides additional information that should help the reader to understand the minimum requirements of the guidelines or to design buildings or facilities for greater accessibility. The paragraph numbers correspond to the sections or paragraphs of the guideline to which the material relates and are therefore not consecutive (for example, A4.2.1 contains additional information relevant to 4.2.1). Sections of the guidelines for which additional material appears in this appendix have been indicated by an asterisk. Nothing in this appendix shall in any way obviate any obligation to comply with the requirements of the guidelines itself.

### A2.0 General.

**A2.2 Equivalent Facilitation.** Specific examples of equivalent facilitation are found in the following sections:

4.1.6(3)(c)	Elevators in Alterations
4.31.9	Text Telephones
7.2	Sales and Service Counters, Teller Windows, Information Counters
9.1.4	Classes of Sleeping Accommodations
9.2.2(6)(d)	Requirements for Accessible Units, Sleeping Rooms, and Suites

### A3.0 Miscellaneous Instructions and Definitions.

#### A3.5 Definitions.

**Transient Lodging.** The Department of Justice's policy and rules further define what is covered as transient lodging.

#### A4.0 Accessible Elements and Spaces: Scope and Technical Requirements.

##### A4.1.1 Application.

**A4.1.1(3) Areas Used Only by Employees as Work Areas.** Where there are a series of individual work stations of the same type (e.g., laboratories, service counters, ticket booths), 5%, but not less

than one, of each type of work station should be constructed so that an individual with disabilities can maneuver within the work stations. Rooms housing individual offices in a typical office building must meet the requirements of the guidelines concerning doors, accessible routes, etc. but do not need to allow for maneuvering space around individual desks. Modifications required to permit maneuvering within the work area may be accomplished as a reasonable accommodation to individual employees with disabilities under Title I of the ADA.

Consideration should also be given to placing shelves in employee work areas at a convenient height for accessibility or installing commercially available shelving that is adjustable so that reasonable accommodations can be made in the future.

If work stations are made accessible they should comply with the applicable provisions of 4.2 through 4.35.

##### A4.1.2 Accessible Sites and Exterior Facilities: New Construction.

**A4.1.2(2)(b) Court Sports:** The accessible route must be direct and connect both sides of the court without requiring players on one side of the court to traverse through or around another court to get to the other side of the court.

**A4.1.2(4) Exception 1.** An accessible route is required to connect to the boundary of the area of sport activity. The term "area of sport activity" distinguishes that portion of a room or space where the play or practice of a sport occurs from adjacent areas. Examples of areas of sport activity include: basketball courts, baseball fields, running tracks, bowling lanes, skating rinks, and the area surrounding a piece of gymnastic equipment. While the size of an area of sport activity may vary from sport to sport, each includes only the space needed to play. The following example is provided for additional clarification.

*Example.* Boundary lines define the field where a football game is played. A safety border is also provided around the field. The game may

### A4.1.3 Accessible Buildings: New Construction

temporarily be played in the space between the boundary lines and the safety border when players are pushed out of bounds or momentum carries them forward while receiving a pass. In the game of football, the space between the boundary line and the safety border is used to play the game. This space and the football field are included in the area of sport activity.

**A4.1.2(4) Exception 2.** Public circulation routes where animals may also travel, such as in petting zoos and passageways alongside animal pens in State fairs, are not eligible for the exception.

**A4.1.2(5)(e)** Valet parking is not always usable by individuals with disabilities. For instance, an individual may use a type of vehicle controls that render the regular controls inoperable or the driver's seat in a van may be removed. In these situations, another person cannot park the vehicle. It is recommended that some self-parking spaces be provided at valet parking facilities for individuals whose vehicles cannot be parked by another person and that such spaces be located on an accessible route to the entrance of the facility.

#### **A4.1.3 Accessible Buildings: New Construction.**

**4.1.3(1)(b) Court Sports:** The accessible route must be direct and connect both sides of the court without requiring players on one side of the court to traverse through or around another court to get to the other side of the court.

**4.1.3(3) Exception 1.** An accessible route is required to connect to the boundary of the area of sport activity. The term "area of sport activity" distinguishes that portion of a room or space where the play or practice of a sport occurs from adjacent areas. Examples of areas of sport activity include: basketball courts, baseball fields, running tracks, bowling lanes, skating rinks, and the area surrounding a piece of fixed gymnastic equipment. While the size of an area of sport activity may vary from sport to sport, each includes only the space needed to play. The following example is provided for additional clarification.

*Example.* Boundary lines define the field where a football game is played. A safety border is also provided around the field. The game may temporarily be played in the space between the boundary lines and the safety border when players are pushed out of bounds or momentum carries them forward while receiving a pass. In the game of football, the space between the boundary line and the safety border is used to play the game. This space and the football field are included in the area of sport activity.

**4.1.3(3) Exception 2.** Public circulation routes where animals may also travel, such as in petting zoos and passageways alongside animal pens in State fairs, are not eligible for the exception.

**A4.1.3(5)** Only passenger elevators are covered by the accessibility provisions of 4.10. Materials and equipment hoists, freight elevators not intended for passenger use, dumbwaiters, and construction elevators are not covered by these guidelines. If a building is exempt from the elevator requirement, it is not necessary to provide a platform lift or other means of vertical access in lieu of an elevator.

Under Exception 4, platform lifts are allowed where existing conditions make it impractical to install a ramp or elevator. Such conditions generally occur where it is essential to provide access to small raised or lowered areas where space may not be available for a ramp. Examples include, but are not limited to, raised pharmacy platforms, commercial offices raised above a sales floor, or radio and news booths.

While the use of platform lifts is allowed, ramps are recommended to provide access to player seating areas serving an area of sport activity.

**A4.1.3(9)** Supervised automatic sprinkler systems have built in signals for monitoring features of the system such as the opening and closing of water control valves, the power supplies for needed pumps, water tank levels, and for indicating conditions that will impair the satisfactory operation of the sprinkler system. Because of these monitoring features, supervised automatic sprinkler systems have a high level of

### A4.1.3 Accessible Buildings: New Construction

satisfactory performance and response to fire conditions.

**A4.1.3(10)** If an odd number of drinking fountains is provided on a floor, the requirement in 4.1.3(10)(b) may be met by rounding down the odd number to an even number and calculating 50% of the even number. When more than one drinking fountain on a floor is required to comply with 4.15, those fountains should be dispersed to allow wheelchair users convenient access. For example, in a large facility such as a convention center that has water fountains at several locations on a floor, the accessible water fountains should be located so that wheelchair users do not have to travel a greater distance than other people to use a drinking fountain.

**A4.1.3(12)(c)** Different types of lockers may include full-size and half-size lockers, as well as those specifically designed for storage of various sports equipment.

#### A4.33.6 Placement of Listening Systems

within the seating area are provided. This will allow choice in viewing and price categories.

Building and life safety codes set minimum distances between rows of fixed seats with consideration of the number of seats in a row, the exit aisle width and arrangement, and the location of exit doors. "Continental" seating, with a greater number of seats per row and a commensurate increase in row spacing and exit doors, facilitates emergency egress for all people and increases ease of access to mid-row seats especially for people who walk with difficulty. Consideration of this positive attribute of "continental" seating should be included along with all other factors in the design of fixed seating areas.

Removable armrests are recommended on fixed companion seats provided in assembly areas in amusement facilities. This provides the option for an individual using a wheelchair or other mobility device to transfer into a seat where motion and other effects may be provided as part of the amusement experience.

**A4.33.6 Placement of Listening Systems.** A distance of 50 ft (15 m) allows a person to distinguish performers' facial expressions.

**A4.33.7 Types of Listening Systems.** An assistive listening system appropriate for an assembly area for a group of persons or where the specific individuals are not known in advance, such as a playhouse, lecture hall or movie theater, may be different from the system appropriate for a particular individual provided as an auxiliary aid or as part of a reasonable accommodation. The appropriate device for an individual is the type that individual can use, whereas the appropriate system for an assembly area will necessarily be geared toward the "average" or aggregate needs of various individuals. A listening system that can be used from any seat in a seating area is the most flexible way to meet this specification. Earphone jacks with variable volume controls can benefit only people who have slight hearing loss and do not help people who use hearing aids. At the present time, magnetic induction loops are the most feasible type of

listening system for people who use hearing aids equipped with "T- coils," but people without hearing aids or those with hearing aids not equipped with inductive pick-ups cannot use them without special receivers. Radio frequency systems can be extremely effective and inexpensive. People without hearing aids can use them, but people with hearing aids need a special receiver to use them as they are presently designed. If hearing aids had a jack to allow a bypass of microphones, then radio frequency systems would be suitable for people with and without hearing aids. The Department of Justice's regulations implementing titles II and III of the ADA require public entities and public accommodations to provide appropriate auxiliary aids and services to ensure effective communication. See 28 CFR 35.160, 28CFR 35.164, and 28 CFR 36.303. Where assistive listening systems are used to provide effective communication, the Department of Justice considers it essential that a portion of receivers be compatible with hearing aids.

Some listening systems may be subject to interference from other equipment and feedback from hearing aids of people who are using the systems. Such interference can be controlled by careful engineering design that anticipates feedback sources in the surrounding area.

Table A2, shows some of the advantages and disadvantages of different types of assistive listening systems. In addition, the Access Board has published a pamphlet on Assistive Listening Systems which lists demonstration centers across the country where technical assistance can be obtained in selecting and installing appropriate systems. The state of New York has also adopted a detailed technical specification which may be useful.

**A4.36.2 Saunas and Steam Rooms.** A 60-inch turning diameter space or a T-shaped space is required within the sauna or steam room. Removable benches or seats are permitted to obstruct the 60-inch or T-shaped space.

**A4.37.3 Benches.** Back support may be achieved through locating benches adjacent to walls or by other designs that will meet the minimum dimensions specified.

**A5.0 Restaurants and Cafeterias.**

**A5.1 General.** Dining counters (where there is no service) are typically found in small carry-out restaurants, bakeries, or coffee shops and may only be a narrow eating surface attached to a wall. This section requires that where such a dining counter is provided, a portion of the counter shall be at the required accessible height.

**A7.0 Business, Mercantile and Civic.**

**A7.2(3)(iii) Counter or Teller Windows with Partitions.** Methods of facilitating voice communication may include grilles, slats, talk-through baffles, and other devices mounted directly into the partition which users can speak directly into for effective communication. These methods are required to be designed or placed so that they are accessible to a person who is standing or seated. However, if the counter is only used by persons in a seated position, then a method of facilitating communication which is accessible to standing persons would not be necessary.

## A15.0 Recreation Facilities

### A15.0 Recreation Facilities.

Unless otherwise modified in Section 4 or specifically addressed in section 15, all other ADAAG provisions apply for the design and construction of recreation facilities and elements. The provisions in this section apply wherever these elements are provided. For example, office buildings may contain a room with exercise equipment and these sections therefore apply.

### A15.1 Amusement Rides.

These guidelines apply to newly designed or newly constructed amusement rides. A custom designed and constructed ride is new upon its "first use," which is the first time amusement park patrons take the ride. With respect to amusement rides purchased from other entities, "new" refers to the first permanent installation of the ride, whether it is used "off the shelf" or it is modified before it is installed. Where amusement rides are moved after several seasons to another area of the park or to another park, the ride would not be considered newly designed or newly constructed.

Amusement rides designed primarily for children, amusement rides that are controlled or operated by the rider, and amusement rides without seats, are not required to provide wheelchair spaces, transfer seats, or transfer systems, and need not meet the signage requirements in 15.1.6. The load and unload areas of these rides must, however, be on an accessible route and must provide maneuvering space under 15.1.4 and 15.1.5.

The scoping and technical provisions of the guidelines were developed to address common amusement rides. There will be other amusement attractions that have unique designs and features which are not adequately addressed by the guidelines. In those situations, the guidelines are to be applied to the extent possible.

An accessible route must be provided to these areas. Where an attraction or ride has unique features for which there are no applicable scoping provisions, then a reasonable number, but at least one, of the features must be located on an

accessible route. Where there are appropriate technical provisions, they must be applied to the elements that are covered by the scoping provisions. Where an attraction has unique designs for which the technical provisions are not appropriate, the operators of those attractions are still subject to all the other requirements of the ADA, including program accessibility, barrier removal and the general obligation to provide individuals with disabilities an equal opportunity to enjoy the goods and services provided by their facilities. An example of an amusement ride not specifically addressed by the guidelines includes "virtual reality" rides where the device does not move through a fixed course within a defined area.

**A15.1 Exception 1.** Mobile or temporary rides are those set up for short periods of time such as traveling carnivals, State and county fairs, and festivals. The amusement rides that are covered by section 15.1 are ones that are not regularly assembled and disassembled.

**A15.1 Exception 2.** The exception does not apply to those rides where patrons may cause the ride to make incidental movements, but where the patron otherwise has no control over the ride.

**A15.1 Exception 3.** The exception is limited to those rides designed "primarily" for children, where children are assisted on and off the ride by an adult. This exception is limited to those rides designed for children and not for the occasional adult user. An accessible route to and maneuvering space in the load and unload area will provide access for adults and family members assisting children on and off these rides.

### A15.1.2 Alterations to Amusement Rides.

Routine maintenance, painting, and changing of theme boards are examples of activities that do not constitute an alteration subject to section 15.1.2. Where existing amusement rides are moved and not altered, section 15.1 does not apply unless the load and unload area of the amusement ride is newly designed and constructed. If a load or unload area is altered, the alteration provisions of ADAAG 4.1.6 must be applied to the altered area.

**A15.1.4 Accessible Route.** Steeper slopes are permitted (not to exceed 1:8) where the accessible route connects to the amusement ride in the load and unload position. This is permitted only where compliance with 4.8.2 (maximum slope 1:12) is “structurally or operationally infeasible”. In most cases, this will be limited to areas where the accessible route leads directly to the amusement ride and where there are space limitations on the ride, not the queue line. Where possible, the least possible slope should be used on the accessible route that serves the amusement ride.

**A15.1.7.1.2 Amusement Rides with Wheelchair Spaces.** 36 CFR 1192.83(c) ADA Accessibility Guidelines for Transportation Vehicles - Light Rail Vehicles and Systems - Mobility Aid Accessibility is available at [www.access-board.gov/transit/html/vguide.htm#LRVM](http://www.access-board.gov/transit/html/vguide.htm#LRVM). It references provisions for bridge plates and ramps used for gaps between wheelchair spaces and floors of load and unload areas.

**A15.1.7.2 Exception 3.** This exception for protruding objects applies to the ride devices, not to circulation areas or accessible routes in the queue lines or the load and unload areas.

**A15.1.7.2.2 Wheelchair Spaces - Side Entry.** Under certain circumstances, a 32-inch clear opening will not provide sufficient width to accommodate a turn into an amusement ride. The amount of clear space needed within the ride, and the size and position of the opening are interrelated. Additional space for maneuvering and a wider door will be needed where a side opening is centered on the ride. For example, where a 42-inch opening is provided, a minimum clear space of 60 inches in length and 36 inches in depth is needed (see Fig. A9). This is necessary to ensure adequate space for maneuvering. For additional guidance refer to Figure 3 (Wheelchair Turning Space) and Figure 4 (Minimum Clear Floor Space for Wheelchairs) on minimum space requirements.

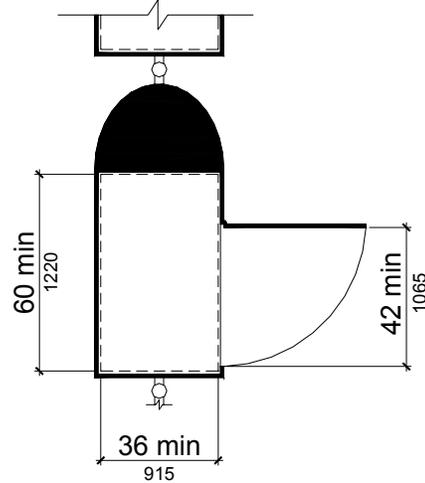


Fig. A9  
Wheelchair Spaces - Side Entry

**A15.1.8 Amusement Ride Seats Designed for Transfer.** There are many different ways that individuals transfer to and from their wheelchairs or mobility devices. The proximity of the clear floor or ground space next to an element and the height of the element one is transferring to are both critical for a safe and independent transfer. Providing additional clear floor or ground space both in front of and diagonally to the element will provide flexibility and increased usability for a more diverse population of individuals with disabilities. Ride seats designed for transfer should involve only one transfer. Where possible, designers are encouraged to locate the ride seat no higher than 17 to 19 inches above the load and unload surface. Where greater distances are required for transfers, consideration should be given to providing gripping surfaces, seat padding, and avoiding sharp or protruding objects in the path of transfer to better facilitate the transfer process.

**A15.1.9 Transfer Devices for Use with Amusement Rides.** Transfer devices for use with

## A15.2 Boating Facilities

amusement rides should permit individuals to make independent transfers to and from their wheelchairs or mobility devices. There are a variety of transfer devices available that could be adapted to provide access onto an amusement ride. Examples of devices that may provide for transfers include, but are not limited to, transfer systems (see 15.8.8), lifts, mechanized seats, and other custom designed systems. Operators and designers have flexibility in developing designs that will facilitate individuals to transfer onto amusement rides. These systems or devices should be designed to be reliable and sturdy. A transfer board, for example, would not be sufficient because it will not provide enough support or stability and may cause injury.

Designs which limit the number of transfers required from one's wheelchair or mobility device to the ride seat are encouraged. When using a transfer device to access an amusement ride, the least amount of transfers for the least amount of distance is desired. Where possible, designers are encouraged to locate the transfer device seat no higher than 17 to 19 inches above the load and unload surface. Where greater distances are required for transfers, consideration should be given to providing gripping surfaces, seat padding, and avoiding sharp or protruding objects in the path of transfer to better facilitate the transfer process. Where a series of transfers are required to reach the amusement ride seat, each vertical transfer should not exceed 8 inches.

As discussed with amusement rides seats designed for transfer, there are many different ways that individuals transfer to and from their wheelchairs or mobility devices. The proximity of the clear floor or ground space next to an element and the height of the element one is transferring to are both critical for a safe and independent transfer. Providing additional clear floor or ground space both in front of and diagonally to the element will provide flexibility and increased usability for a more diverse population of individuals with disabilities.

### A15.2 Boating Facilities.

**A15.2.2 Accessible Route.** The following two examples apply exceptions two and three.

Example 1. Boat slips which are required to be accessible are provided at a floating pier. The vertical distance an accessible route must travel to the pier when the water is at its lowest level is six feet, although the water level only fluctuates three feet. To comply with exceptions 2 and 3, at least one design solution would provide a gangway at least 72.25 feet long which ensures the slope does not exceed 1:12.

Example 2. A gangway is provided to a floating pier which is required to be on an accessible route. The vertical distance is 10 feet between the elevation where the gangway departs the landside connection and the elevation of the pier surface at the lowest water level. Exceptions 2 and 3, which modify 4.8.2, permit the gangway to be at least 80 feet long. Another design solution would be to have two 40-foot continuous gangways joined together at a float, where the float (as the water level falls) will stop dropping at an elevation five feet below the landside connection.

### A15.2.3 Boat Slips: Minimum Number.

Accessible boat slips are not "reserved" for persons with disabilities in the same manner as accessible vehicle parking spaces. Rather, accessible boat slip use is comparable to accessible hotel rooms. The Department of Justice is responsible for addressing operational issues relating to the use of accessible facilities and elements. The Department of Justice currently advises that hotels should hold accessible rooms for persons with disabilities until all other rooms are filled. At that point, accessible rooms can be open for general use on a first come, first serve basis.

The following two examples apply to a boating facility with a single non-demarcated pier.

Example 1. A site contains a new boating facility which consists of a single 60-foot pier. Boats are only moored parallel with the pier on both sides to allow occupants to embark or disembark.

Since the number of slips cannot be identified, section 15.2.3 requires each 40 feet of boat slip edge to be counted as one slip for purposes of determining the number of slips available and determines the number required to be accessible. The 120 feet of boat slip edge at the pier would equate with 3 boat slips. Table 15.2.3 would require 1 slip to be accessible and comply with 15.2.5. Section 15.2.5 (excluding the exceptions within the section) requires a clear pier space 60 inches wide minimum extending the length of the slip. In this example, because the pier is at least 40 feet long, the accessible slip must contain a clear pier space at least 40 feet long which has a minimum width of 60 inches.

**Example 2.** A new boating facility consisting of a single pier 25 feet long and 3 feet wide is being planned for a site. The design intends to allow boats to moor and occupants to embark and disembark on both sides, and at one end. As the number of boat slips cannot be identified, applying section 15.2.3 would translate to 53 feet of boat slip edge at the pier. This equates with two slips. Table 15.2.5 would require 1 slip to be accessible. To comply with 15.2.5 (excluding the exceptions within the section), the width of the pier must be increased to 60 inches. Neither 15.2.3 or 15.2.5 requires the pier length to be increased to 40 feet.

**A15.2.3.1 Dispersion.** Types of boat slips are based on the size of the boat slips; whether single berths or double berths, shallow water or deep water, transient or longer-term lease, covered or uncovered; and whether slips are equipped with features such as telephone, water, electricity and cable connections. The term “boat slip” is intended to cover any pier area where recreational boats embark or disembark, unless classified as a launch ramp boarding pier. For example, a fuel pier may contain boat slips, and this type of short term slip would be included in determining compliance with 15.2.3.1.

**A15.2.4 Boarding Piers at Boat Launch Ramps.** The following two examples apply to a boat launch ramp boarding pier.

**Example 1.** A chain of floats is provided on a launch ramp to be used as a boarding pier which is required to be accessible by 15.2.4. At high water, the entire chain is floating and a transition plate connects the first float to the surface of the launch ramp. As the water level decreases, segments of the chain end up resting on the launch ramp surface, matching the slope of the launch ramp. As water levels drop, segments function also as gangways because one end of a segment is resting on the launch ramp surface and the other end is connecting to another floating segment in the chain.

Under ADAAG 4.1.2(2), an accessible route must serve the last float because it would function as the boarding pier at the lowest water level. Under exception 3 in 15.2.4, each float is not required to comply with ADAAG 4.8, but must meet all other requirements in ADAAG 4.3, unless exempted by exception 1 in 15.2.4. In this example, because the entire chain also functions as a boarding pier, the entire chain must comply with the requirements of 15.2.5, including the 60-inch minimum clear pier width provision.

**Example 2.** A non-floating boarding pier supported by piles divides a launching area into two launch ramps and is required to be accessible. Under ADAAG 4.1.2(2), an accessible route must connect the boarding pier with other accessible buildings, facilities, elements, and spaces on the site. Although the boarding pier is located within a launch ramp, because the pier is not a floating pier or a skid pier, none of the exceptions in 15.2.4 apply. To comply with ADAAG 4.3, either the accessible route must run down the launch ramp or the fixed boarding pier could be relocated to the side of the two launch ramps. The second option leaves the slope of the launch ramps unchanged, because the accessible route runs outside the launch ramps.

**A15.2.4.1 Boarding Pier Clearances.** The guidelines do not establish a minimum length for accessible boarding piers at boat launch ramps. The accessible boarding pier would have a length which is at least equal to other boarding piers provided at the facility. If no other boarding pier

### A15.3 Fishing Piers and Platforms

is provided, the pier would have a length equal to what would have been provided if no access requirements applied. The entire length of accessible boarding piers would be required to comply with the same technical provisions that apply to accessible boat slips. For example, at a launch ramp, if a 20-foot long accessible boarding pier is provided, the entire 20 feet must comply with the pier clearance requirements in 15.2.5. Likewise, if a 60-foot long accessible boarding pier is provided, the pier clearance requirements in 15.2.5 would apply to the entire 60 feet.

**A15.2.5 Accessible Boat Slips.** Although the minimum width of the clear pier space is 60 inches, it is recommended that piers be wider than 60 inches to improve the safety for persons with disabilities, particularly on floating piers.

**A15.2.5.1 Clearances, Exception 3.** Where the conditions in exception 3 are satisfied, existing facilities are only required to have one accessible boat slip with a pier clearance which runs the length of the slip. All other accessible slips are allowed to have the required pier clearance at the head of the slip. Under this exception, at piers with perpendicular boat slips, the width of most “finger piers” will remain unchanged. However, where mooring systems for floating piers are replaced as part of pier alteration projects, an opportunity may exist for increasing accessibility. Piers may be reconfigured to allow an increase in the number of wider finger piers, and serve as accessible boat slips.

#### A15.3 Fishing Piers and Platforms.

**A15.3.3.1 Edge Protection.** Edge protection is required only where railings, guards, or handrails are provided on a fishing pier or platform. Edge protection will prevent wheelchairs or other mobility devices from slipping off the fishing pier or platform. Extending the deck of the fishing pier or platform 12 inches where the 34-inch high railing is provided is an alternative design, permitting individuals using a wheelchair or other mobility device to pull into a clear space and move beyond the face of the railing. In such a design, edge protection is not required.

**A15.3.2 Accessible Route, Exception 2.** For example, to provide access to an accessible floating fishing pier, a gangway is used. The vertical distance is 60 inches between the elevation that the gangway departs the landside connection and the elevation of the pier surface at the lowest water level. Exception 2 permits the use of a gangway at least 30 feet long, or a series of connecting gangways with a total length of at least 30 feet. The length of transition plates would not be included in determining if the gangway(s) meet the requirements of the exception.

**A15.3.3.3 Dispersion.** Portions of the railings that are lowered to provide fishing opportunities for persons with disabilities must be located in a variety of locations on the fishing pier or platform to give people a variety of locations to fish. Different fishing locations may provide varying water depths, shade (at certain times of the day), vegetation, and proximity to the shoreline or bank.

#### A15.4 Golf.

**A15.4.2 Accessible Routes.** The accessible route or golf car passage must serve accessible elements and spaces located within the boundary of a golf course. The 48-inch minimum width for the accessible route is necessary to ensure passage of a golf car on either the accessible route or the golf car passage. This is important where the accessible route is used to connect the golf car rental area, bag drop areas, practice putting greens, accessible practice teeing grounds, course toilet rooms, and course weather shelters. These are areas outside the boundary of the golf course, but are areas where an individual using an adapted golf car may travel. A golf car passage may not be substituted for other accessible routes, required by ADAAG 4.1.2, located outside the boundary of the course. For example, an accessible route connecting an accessible parking space to the entrance of a golf course clubhouse is not covered by this provision.

**A15.4.3 Accessible Route - Driving Ranges.** Both a stand alone driving range or a driving range next to a golf course must provide an

accessible route or golf car passage that connects accessible teeing stations with accessible parking spaces. The accessible route must be a minimum width of 48 inches; 60 inches if handrails are provided. The additional width permits the use of a golf car on the accessible route. Providing a golf car passage will permit a person that uses a golf car to practice driving a golf ball from the same position and stance used when playing the game. Additionally, the space required for a person using a golf car to enter and exit the teeing stations required to be accessible should be considered.

**A15.5 Miniature Golf.**

Where possible, providing access to all holes on a miniature golf course is recommended. If a course is designed with the minimum 50 percent accessible holes, designers or operators are encouraged to select holes which provide for an equivalent experience to the maximum extent possible. Accessible holes are required to be consecutive with one break permitted, if the last hole on the course is in the sequence.

**A15.5.3 Accessible Route.** Where only the minimum 50 percent of the holes are accessible, an accessible route from the last accessible hole to the course exit or entrance must not require travel back through other holes. In some cases, this may require an additional route. Other options include increasing the number of accessible holes in a way that limits the distance needed to connect the last accessible hole with the course exit or entrance. In any case, careful consideration to the layout of the course will be important to minimize space impacts.

The 1-inch curb for a 32-inch minimum opening can be located in an area where the ball is less likely to ricochet. Where the accessible route on the hole is provided, steeper slopes are permitted for a limited distance. A landing or level area must separate each of these steeper sloping segments. This will provide a resting area between the steeper segments.

**A15.5.5 Golf Club Reach Range.** Accessible holes on a miniature golf course may be provided with an accessible route leading through the hole

or with the accessible route next to the hole. Where the accessible route is provided adjacent to the hole, the route must be located within the golf club reach range. This allows individuals sufficient space and reach to play the game outside of the hole. Where possible, the distance between the level areas and the accessible route should be as close as possible, affording more opportunities for play.

**A15.6 Play Areas.**

**A15.6.1 General.** This section is to be applied during the design, construction, and alteration of play areas for children ages 2 and over. Play areas are the portion of a site where play components are provided. This section does not apply to other portions of a site where elements such as sports fields, picnic areas, or other gathering areas are provided. Those areas are addressed by other sections of ADAAG. Play areas may be located on exterior sites or within a building. Where separate play areas are provided within a site for children in specified age groups (e.g., preschool (ages 2 to 5) and school age (ages 5 to 12)), each play area must comply with this section. Where play areas are provided for the same age group on a site but are geographically separated (e.g., one is located next to a picnic area and another is located next to a softball field), they are considered separate play areas and each play area must comply with this section.

**A15.6.2 Ground Level Play Components.** A ground level play component is a play component approached and exited at the ground level. Examples of ground level play components include spring rockers, swings, diggers, and stand alone slides. When distinguishing between the different types of ground level play components, consider the general experience provided by the play component. Examples of different types of experiences include, but are not limited to, rocking, swinging, climbing, spinning, and sliding. A spiral slide may provide a slightly different experience from a straight slide, but sliding is the general experience and therefore a spiral slide is not considered a different type of play component than a straight slide.

## A15.6 Play Areas

The number of ground level play components is not dependent on the number of children who can play on the play component. A large seesaw designed to accommodate ten children at once is considered one ground level play component.

Where a large play area includes two or more composite play structures designed for the same age group, the total number of elevated play components on all the composite play structures must be added to determine the additional number and types of ground level play components that must be provided on an accessible route, and the type of accessible route (e.g., ramps or transfer systems) that must be provided to the elevated play components.

Ground level play components accessed by children with disabilities must be integrated in the play area. Designers should consider the optimal layout of ground level play components accessed by children with disabilities to foster interaction and socialization among all children. Grouping all ground level play components accessed by children with disabilities in one location is not considered integrated.

**A15.6.3 Elevated Play Components.** Elevated play components are approached above or below grade and are part of a composite play structure. A double or triple slide that is part of a composite play structure is one elevated play component. For purposes of this section, ramps, transfer systems, steps, decks, and roofs are not considered elevated play components. These elements are generally used to link other elements on a composite play structure. Although socialization and pretend play can occur on these elements, they are not primarily intended for play. Some play components that are attached to a composite play structure can be approached or exited at the ground level or above grade from a platform or deck. For example, a climber attached to a composite play structure can be approached or exited at the ground level or above grade from a platform or deck on a composite play structure. Play components that are attached to a composite play structure and can be approached from a platform or deck (e.g.,

climbers and overhead play components), are considered elevated play components. These play components are not considered ground level play components also, and do not count toward the requirements in 15.6.2 regarding the number of ground level play components that must be located on an accessible route.

**A15.6.4 Accessible Routes.** Accessible routes within the boundary of the play area must comply with 15.6.4. Accessible routes connecting the play area to parking, drinking fountains, and other elements on a site must comply with 4.3. Accessible routes provide children who use wheelchairs or other mobility devices the opportunity to access play components. Accessible routes should coincide with the general circulation path used within the play area. Careful placement and consideration of the layout of accessible routes will enhance the ability of children with disabilities to socialize and interact with other children.

Where possible, designers and operators are encouraged to provide wider ground level accessible routes within the play area or consider designing the entire ground surface to be accessible. Providing more accessible spaces will enhance the integration of all children within the play area and provide access to more play components. A maximum slope of 1:16 is required for ground level ramps; however, a lesser slope will enhance access for those children who have difficulty negotiating the 1:16 maximum slope. Handrails are not required on ramps located within ground level use zones.

Where a stand alone slide is provided, an accessible route must connect the base of the stairs at the entry point, and the exit point of the slide. A ramp or transfer system to the top of the slide is not required. Where a sand box is provided, an accessible route must connect to the border of the sand box. Accessibility to the sand box would be enhanced by providing a transfer system into the sand or by providing a raised sand table with knee clearance complying with 15.6.6.3.

Elevated accessible routes must connect the entry and exit points of at least 50 percent of elevated play components. Ramps are preferred over transfer systems since not all children who use wheelchairs or other mobility devices may be able to use or may choose not to use transfer systems. Where ramps connect elevated play components, the maximum rise of any ramp run is limited to 12 inches. Where possible, designers and operators are encouraged to provide ramps with a lesser slope than the 1:12 maximum. Berms or sculpted dirt may be used to provide elevation and may be part of an accessible route to composite play structures.

Platform lifts complying with 4.11 and applicable State and local codes are permitted as a part of an accessible route. Because lifts must be independently operable, operators should carefully consider the appropriateness of their use in unsupervised settings.

**A15.6.5 Transfer Systems.** Transfer systems are a means of accessing composite play structures. Transfer systems generally include a transfer platform and a series of transfer steps. Children who use wheelchairs or other mobility devices transfer from their wheelchair or mobility devices onto the transfer platform and lift themselves up or down the transfer steps and scoot along the decks or platforms to access elevated play components. Some children may be unable or may choose not to use transfer systems. Where transfer systems are provided, consideration should be given to the distance between the transfer system and the elevated play components. Moving between a transfer platform and a series of transfer steps requires extensive exertion for some children. Designers should minimize the distance between the points where a

child transfers from a wheelchair or mobility device and where the elevated play components are located. Where elevated play components are used to connect to another elevated play component in lieu of an accessible route, careful consideration should be used in the selection of the play components used for this purpose. Transfer supports are required on transfer platforms and transfer steps to assist children when transferring. Some examples of supports include a rope loop, a loop type handle, a slot in the edge of a flat horizontal or vertical member, poles or bars, or D rings on the corner posts.

**A15.6.6 Play Components.** Clear floor or ground spaces, maneuvering spaces, and accessible routes may overlap within play areas. A specific location has not been designated for the clear floor or ground spaces or maneuvering spaces, except swings, because each play component may require that the spaces be placed in a unique location. Where play components include a seat or entry point, designs that provide for an unobstructed transfer from a wheelchair or other mobility device are recommended. This will enhance the ability of children with disabilities to independently use the play component.

When designing play components with manipulative or interactive features, consider appropriate reach ranges for children seated in wheelchairs. The following table provides guidance on reach ranges for children seated in wheelchairs. These dimensions apply to either forward or side reaches. The reach ranges are appropriate for use with those play components that children seated in wheelchairs may access and reach. Where transfer systems provide access to elevated play components, the reach ranges are not appropriate.

**Children's Reach Ranges**

<b>Forward or Side Reach</b>	<b>Ages 3 and 4</b>	<b>Ages 5 through 8</b>	<b>Ages 9 through 12</b>
<b>High (maximum)</b>	36 in (915 mm)	40 in (1015 mm)	44 in (1120 mm)
<b>Low (minimum)</b>	20 in (510 mm)	18 in (455 mm)	16 in (405 mm)

## A15.7 Exercise Equipment and Machines

Where a climber is located on a ground level accessible route, some of the climbing rings should be within the reach ranges. A careful balance of providing access to play components but not eliminating the challenge and nature of the activity is encouraged.

**A15.6.7 Ground Surfaces.** Ground surfaces along clear floor or ground spaces, maneuvering spaces, and accessible routes must comply with the ASTM F 1951 Standard Specification for Determination of Accessibility to Surface Systems Under and Around Playground Equipment. The ASTM F 1951 standard is available from the American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, telephone (610) 832-9585. The ASTM F 1951 standard may be ordered online from ASTM (<http://www.astm.org>). The ASTM F 1951 standard determines the accessibility of a surface by measuring the work required to propel a wheelchair across the surface. The standard includes tests of effort for both straight ahead and turning movement, using a force wheel on a rehabilitation wheelchair as the measuring device. To meet the standard, the force required must be less than that required to propel the wheelchair up a ramp with a 1:14 slope. When evaluating ground surfaces, operators should request information about compliance with the ASTM F 1951 standard.

Ground surfaces must be inspected and maintained regularly and frequently to ensure continued compliance with the ASTM F 1951 standard. The type of surface material selected and play area use levels will determine the frequency of inspection and maintenance activities.

When using a combination of surface materials, careful design is necessary to provide appropriate transitions between the surfaces. Where a rubber surface is installed on top of asphalt to provide impact attenuation, the edges of the rubber surface may create a change in level between the adjoining ground surfaces. Where the change in level is greater than ½ inch, a sloped surface with a maximum slope of 1:12 must be provided.

Products are commercially available that provide a 1:12 slope at transitions. Transitions are also necessary where the combination of surface materials include loose fill products. Where edging is used to prevent the loose surface from moving onto the firmer surface, the edging may create a tripping hazard. Where possible, the transition should be designed to allow for a smooth and gradual transition between the two surfaces.

### **A15.7 Exercise Equipment and Machines, Bowling Lanes, and Shooting Facilities.**

#### **A15.7.2 Exercise Equipment and Machines.**

Fitness facilities often provide a range of choices of exercise equipment. At least one of each type of exercise equipment and machine must be served by an accessible route. Most strength training equipment and machines are considered different types. For example, a bench press machine is considered a different type than a biceps curl machine. The requirement for providing access to each type is intended to cover the variety of strength training machines. Where operators provide a biceps curl machine and free weights, both are required to meet the provisions in this section, even though an individual may be able to work on their biceps through both types of equipment. Where the exercise equipment and machines provided are only different in that different manufacturers provide them, only one of each type of machine is required to meet these guidelines. For example, where two bench press machines are provided and each is manufactured by a different company, only one is required to comply.

Similarly, there are many types of cardiovascular exercise machines, such as stationary bicycles, rowing machines, stair climbers, and treadmills. Each machine provides a cardiovascular exercise and is considered a different type for purposes of these guidelines.

One clear floor or ground space is permitted to be shared between two pieces of exercise equipment. Designers should carefully consider layout

## A15.8 Swimming Pools, Wading Pools, and Spas

options to maximize space such as connecting ends of the row and center aisle spaces.

The position of the clear floor space may vary greatly depending on the use of the equipment or machine. For example, to make a shoulder press accessible, clear floor space next to the seat would be appropriate to allow for transfer. Clear floor space for a bench press machine designed for use by an individual seated in a wheelchair, however, will most likely be centered on the operating mechanisms.

Designers and operators are encouraged to select exercise equipment and machines that provide fitness opportunities for persons with lower body extremity disabilities. Upper body exercise equipment and machines that offer either cardiovascular or strength training will enhance fitness opportunities for persons with disabilities from a wheelchair or mobility device. Examples include: equipment or machines that provide arm ergometry, free weights, and weighted pulley systems that are usable from a wheelchair or mobility device.

**A15.7.4. Shooting Facilities.** Examples of different types of firing positions include, but are not limited to: positions having different admission prices, positions with or without weather covering or lighting, and positions supporting different shooting events such as argon, muzzle loading rifle, small bore rifle, high power rifle, bull's eye pistol, action pistol, silhouette, trap, skeet, and archery (bow and crossbow).

### **A15.8 Swimming Pools, Wading Pools, and Spas.**

**A15.8.2 Swimming Pools.** Where more than one means of access is provided into the water, it is recommended that the means be different. Providing different means of access will better serve the varying needs of people with disabilities in getting into and out of a swimming pool. It is also recommended that where two or more means of access are provided, they not be provided in the same location in the pool. Different locations will

provide increased options for entry and exit, especially in larger pools.

**A15.8.2 Swimming Pools, Exception 1.** Pool walls at diving areas and areas along pool walls where there is no pool entry because of landscaping or adjacent structures should be counted when determining the number of accessible means of entry required.

**A15.8.5 Pool Lifts.** There are a variety of seats available on pool lifts ranging from sling seats to those that are preformed or molded. Pool lift seats with backs will enable a larger population of persons with disabilities to use the lift. Pool lift seats that consist of materials that resist corrosion and provide a firm base to transfer will be usable by a wider range of people with disabilities. Additional options such as armrests, head rests, seat belts, and leg support will enhance accessibility and better accommodate people with a wide range of disabilities.

**A15.8.5.6 Footrests and Armrests.** Footrests are encouraged on lifts used in larger spas, where the foot well water depth is 34 inches or greater. Providing footrests, especially ones that support the entire foot, will facilitate safe and independent transfers by a larger population of persons with disabilities.

**A15.8.5.7 Operation.** Pool lifts must be capable of unassisted operation from both the deck and water levels. This will permit a person to call the pool lift when the pool lift is in the opposite position. It is extremely important for a person who is swimming alone to be able to call the pool lift when it is in the up position so he or she will not be stranded in the water for extended periods of time awaiting assistance. The requirement for a pool lift to be independently operable does not preclude assistance from being provided.

**A15.8.5.9 Lifting Capacity.** Single person pool lifts must be capable of supporting a minimum weight of 300 pounds and sustaining a static load of at least one and a half times the rated load. Pool lifts should be provided that meet the needs of the population it is serving. Providing a pool lift

## A15.8 Swimming Pools, Wading Pools and Spas

with a weight capacity greater than 300 pounds may be advisable.

**A15.8.6.1 Sloped Entries.** Personal wheelchairs and mobility devices may not be appropriate for submerging in water. Some may have batteries, motors, and electrical systems that when submerged in water may cause damage to the personal mobility device or wheelchair or may contaminate the pool water. Providing an aquatic wheelchair made of non-corrosive materials and designed for access into the water will protect the water from contamination and avoid damage to personal wheelchairs or other mobility aids.

**A15.8.6.3 Handrails.** Handrails on both sides of a sloped entry provides stability to both persons with mobility impairments and persons using wheelchairs. For safety reasons, a single handrail is permitted on sloped entries provided at wave action pools, leisure rivers, sand bottom pools, and other pools where user access is limited to one area.

**A15.8.8.4 Transfer Steps.** Where possible, the height of the transfer step should be as minimal as possible. This will decrease the distance an individual is required to lift up or move down to reach the next step to gain access.

**A15.8.8.7 Grab Bars.** Pool operators have the choice of providing a grab bar on one side of each step and transfer platform or a continuous grab bar on one side serving each transfer step and the transfer platform. If provided on each step, the top of the gripping surface must be 4 to 6 inches above each step. Where a continuous grab bar is provided, the top of the gripping surface must be 4 to 6 inches above the step nosing. Each type has its advantages. A continuous handrail allows the person that is transferring to maintain a constant grip on the handrail while moving up or down the transfer steps. Grab bars provided on each step provide the gripping surface parallel to each step rather than on a diagonal.

**A15.8.10 Water Play Components.** Personal wheelchairs and mobility devices may not be appropriate for submerging in water when accessing play components located in water.

Some may have batteries, motors, and electrical systems that when submerged in water may cause damage to the personal mobility device or wheelchair or may contaminate the water. Providing an aquatic wheelchair made of non-corrosive materials and designed for access into the water will protect the water from contamination and avoid damage to personal wheelchairs.

# IEQ Indoor Environmental Quality

A project of the National Institute of Building Sciences (NIBS) with funding support from The Architectural and Transportation Barriers Compliance Board (Access Board)



© 2005, National Institute of Building Sciences. All rights reserved.

<b>Table of Contents</b>	<b>Page</b>
<b>Introduction</b>	<b>4</b>
<b>Summary Recommendations</b>	<b>5</b>
<b>Steering Committee</b>	<b>6</b>
<b>Operations &amp; Maintenance</b>	<b>7</b>
<b>Introduction and Overview</b>	<b>8</b>
<b>Barriers &amp; Issues</b>	<b>9</b>
Fragrances	
Pesticides	
Cleaning Products & Disinfectants	
Electromagnetic Fields	
Renovation/Remodeling/Furniture	
Smoke & Combustion	
Noise & Vibration	
Synergistic Effects of Indoor Air Pollutants	
Indoor Air Chemistry	
Persistence of Indoor Air Pollutants	
<b>Recommended Actions for Facility Managers and O&amp;M Staff</b>	<b>13</b>
Pest Control	
Cleaning & Disinfecting	
Mechanical Equipment / HVAC	
Landscape Maintenance	
Enclosure Maintenance	
Renovation/Remodeling/Furnishings	
<b>General Recommendations</b>	<b>18</b>
Indoor Air & Environmental Quality Programs	
Policies (Smoking, Fragrance, Cell phone, Notification, Vehicle idling)	
Recommendations for Future Actions	
<b>References</b>	<b>20</b>
<b>Appendices - Detailed Recommendations</b>	
Pest Control / Resources	<b>22</b>
Cleaning & Disinfecting / Resources	<b>27</b>

<b>Mechanical Equipment / Resources</b>	<b>30</b>
<b>Landscape Maintenance / Resources</b>	<b>32</b>
<b>Enclosure Maintenance / Resources</b>	<b>33</b>
<b>Committee and other contributors to the report</b>	<b>34</b>
<b>Additional Resources</b>	
<b>General Guidance for Building Cleaning Programs</b>	<b>35</b>
<b>Steps for Implementing a Scent-free Policy in the Workplace</b>	<b>44</b>
<b>Designated Cleaner Air Rooms</b>	
<b>Introduction and Overview</b>	<b>46</b>
<b>Promising Practices</b>	
<b>Recommended Actions</b>	
<b>Committee Recommendations</b>	
<b>National Cleaner Air Signage</b>	<b>48</b>
<b>Background</b>	
<b>Purpose</b>	
<b>Proposed Language</b>	
<b>Conditions of Use</b>	
<b>Paths of Travel</b>	<b>49</b>
<b>Restrooms</b>	
<b>Contact Information</b>	
<b>Maintaining A Cleaner Air Record Log</b>	
<b>Removal Of The Symbol</b>	
<b>Temporary Use Of Cleaner Air Symbol</b>	
<b>Further Explanation of the Criteria for Conditions of Use</b>	<b>50</b>
<b>No Smoking</b>	
<b>Fragrance-Free</b>	
<b>Pesticide-Free Indoors and Outdoors</b>	
<b>Least Toxic/Risk Cleaning Products</b>	
<b>No Recent Construction or Remodeling Including Carpet Installation</b>	
<b>Cell Phones Turned Off</b>	
<b>Ability to turn off or unplug computers and other electrical equipment by occupant or staff</b>	
<b>Ability to turn off fluorescent lighting by occupant or staff</b>	
<b>Ability to adjust temperature and air flow by occupant or staff, or the availability of operable window(s)</b>	
<b>Recommendations for Accommodations</b>	<b>52</b>
<b>References</b>	<b>53</b>
<b>Resources for Access and Accommodations</b>	<b>53</b>
<b>Committee</b>	<b>54</b>
<b>Appendices</b>	
<b>California Code Regulations</b>	<b>54</b>
<b>Southwest Community Health System Policy Guideline</b>	<b>56</b>
<b>MCS Nursing Protocol</b>	<b>63</b>

<b>Design &amp; Construction</b>	<b>67</b>
<b>Introduction</b>	<b>68</b>
<b>Recommendations</b>	<b>69</b>
<b>Site and General Building Design</b>	
Enclosure	
Plumbing, Mechanical and Electrical Equipment	
Finishes and Furnishings	
Construction Related Activities for Renovations	
Occupancy	
Commissioning	
Exterior Landscaping	
<b>Appendices</b>	<b>74</b>
Site Selection	
Roof Gardens	
Pest Prevention	
Carpet	
Use and Occupancy	
Landscaping	
<b>References</b>	<b>81</b>
<b>Bibliography</b>	<b>83</b>
<b>Committee</b>	<b>85</b>
<b>Building Products &amp; Materials</b>	<b>86</b>
<b>Introduction</b>	<b>86</b>
Overview – Design	<b>87</b>
Overview – Building Operations and Maintenance	<b>88</b>
CHPS Section 01350 Part 1.3B and 1.4D and GREENGUARD Allowable	
Emission Levels	
Formaldehyde	<b>88</b>
Adhesives and Sealants	<b>91</b>
Appliances	<b>91</b>
Ceilings	<b>92</b>
Composite Wood Products (plywood, particle board, OSB, paneling, etc.)	
Fireproofing	<b>92</b>
Flooring and Floor Systems	<b>93</b>
Insulation	<b>94</b>
Paint	<b>95</b>
Textiles	<b>95</b>
Walls	<b>95</b>
Wallcovering	<b>95</b>
Conclusion & Recommendations	<b>96</b>
Committee	<b>96</b>

## Introduction

The Architectural and Transportation Barriers Compliance Board (Access Board) is an independent federal agency devoted to accessibility for people with disabilities. The Access Board is responsible for developing and maintaining accessibility guidelines to ensure that newly constructed and altered buildings and facilities covered by the Americans with Disabilities Act and the Architectural Barriers Act are accessible to and usable by people with disabilities. In November 1999, the Access Board issued a proposed rule to revise and update its accessibility guidelines. During the public comment period on the proposed rule, the Access Board received approximately 600 comments from individuals with multiple chemical sensitivities (MCS) and electromagnetic sensitivities (EMS). They reported that chemicals released from products and materials used in construction, renovation, and maintenance of buildings, electromagnetic fields, and inadequate ventilation are barriers that deny them access to most buildings.

Americans spend about 90 percent of their time indoors, where concentrations of air pollutants are often much higher than those outside. According to the U.S. EPA Healthy Buildings, Healthy People: A Vision for the 21st Century, [www.epa.gov/iaq/hbhp/hbhptoc.html](http://www.epa.gov/iaq/hbhp/hbhptoc.html) "Known health effects of indoor pollutants include asthma; cancer; developmental defects and delays, including effects on vision, hearing, growth, intelligence, and learning; and effects on the cardiovascular system (heart and lungs). Pollutants found in the indoor environment may also contribute to other health effects, including those of the reproductive and immune systems." (p. 4). The report further notes that "Most chemicals in commercial use have not been tested for possible health effects. (p. 8).

There are a significant number of people who are sensitive to chemicals and electromagnetic fields. Surveys conducted by the California and New Mexico Departments of Health and by medical researchers in North Carolina found 16 to 33 percent of the people interviewed reported that they are unusually sensitive to chemicals, and in the California and New Mexico health departments' surveys 2 percent to 6 percent reported that they have been diagnosed as having multiple chemical sensitivities. C. Miller and N. Ashford, "Multiple Chemical Intolerance and Indoor Air Quality," in *Indoor Air Quality Handbook* Chapter 27.8 (McGraw-Hill 2001). Another California Department of Health Services survey has found that 3 percent of the people interviewed reported that they are unusually sensitive to electric appliances or power lines. P. LeVallois, et al., "Prevalence and Risk Factors of Self-Reported Hypersensitivity to Electromagnetic Fields in California," in California EMF Program, "An Evaluation of the Possible Risks From Electric and Magnetic Fields (EMFs From Power Lines, Internal Wiring, Electrical Occupations and Appliances, Draft 3 for Public Comment, April 2001" Appendix 3 (<http://www.dhs.ca.gov/ehib/emf/RiskEvaluation/riskeval.html>).

Individuals with multiple chemical sensitivities and electromagnetic sensitivities, who submitted written comments and/or attended the public information meetings on the draft final rule, requested that the Access Board include provisions in the final rule to make buildings and facilities accessible for them.

The Board has not included such provisions in their rules, but they have taken the commentary very seriously and acted upon it. As stated in the Background for its Final Rule **Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Recreation Facilities:** <http://www.access-board.gov/recreation/final.htm>

"The Board recognizes that multiple chemical sensitivities and electromagnetic sensitivities may be considered disabilities under the ADA if they so severely impair the neurological, respiratory or other functions of an individual that it substantially limits one or more of the

individual's major life activities. The Board plans to closely examine the needs of this population, and undertake activities that address accessibility issues for these individuals.

The Board plans to develop technical assistance materials on best practices for accommodating individuals with multiple chemical sensitivities and electromagnetic sensitivities. The Board also plans to sponsor a project on indoor environmental quality. In this project, the Board will bring together building owners, architects, building product manufacturers, model code and standard-setting organizations, individuals with multiple chemical sensitivities and electromagnetic sensitivities, and other individuals. This group will examine building design and construction issues that affect the indoor environment, and develop an action plan that can be used to reduce the level of chemicals and electromagnetic fields in the built environment.”

This report and the recommendations included within are a direct outgrowth from that public comment process. The Access Board contracted with the National Institute of Building Sciences (NIBS) to establish this Indoor Environmental Quality Project as a first step in implementing that action plan.

A broad and distinguished Steering Committee was established and met in January 2004 in Bethesda, Maryland, to review the project objectives. Subsequently four task teams (committees) were established to address specific issues in buildings related to Operations & Maintenance, Cleaner Air Rooms, Design and Construction, and Products and Materials. The following reports from these four committees offer recommendations for improving IEQ in buildings. They also list valuable resources and references to allow readers to investigate the pertinent issues in greater depth. The focus of the project was on commercial and public buildings, but many of the issues addressed and recommendations offered are applicable in residential settings.

Many volunteers worked diligently to create the recommendations in this report. These individuals are listed in the separate committee sections of the report, but special thanks go to the committee chairs: respectively Hal Levin, Building Ecology Research Group; Michael Mankin, California Division of the State Architect; Roger Morse, Morse-Zentner Associates; and Brent Kynoch, Kynoch Environmental Management, Inc. Lastly, an enormous debt of gratitude is owed to four amazing individuals who made significant contributions to the work of all four committees: Mary Lamielle, National Center for Environmental Health Strategies; Ann McCampbell, MD, Multiple Chemical Sensitivities Task Force of New Mexico; Susan Molloy, National Coalition for the Chemically Injured; and Toni Temple, Ohio Network for the Chemically Injured.

The overall objectives of this project were to establish a collaborative process among a range of stakeholders to recommend practical, implementable actions to both improve access to buildings for people with MCS and EMS while at the same time raising the bar and improving indoor environmental quality to create healthier buildings for the entire population.

This IEQ project supports and helps achieve the goals of the Healthy Buildings, Healthy People project, which acknowledges that "We will create indoor environments that are healthier for everyone by making indoor environments safer for the most vulnerable among us, especially children." (p.17)

## **Summary Recommendations**

The recommendations in this report are only a first step toward the action plan envisioned by the Access Board.

The NIBS IEQ committee offers several recommendations for further action. It is recommended that a follow-on project organize and convene one, or more, workshops to deliberate the issues and recommendations in this report. It is also recommended that a project be organized to develop a single guidelines document. Such guidelines would be built on refinement and coordination of the recommendations of the Design & Construction and Products & Materials committees in this report. This same, or a separate project, should develop new building code provisions to accelerate the implementation of improved IEQ. Lastly, it is recommended that a project be organized to develop guidelines for the design of an “ideal space” for people with MCS and EMS. The recommended follow-up projects should involve collaborative effort and funding from a range of organizations across the building community; e.g., American Institute of Architects (AIA), Associated General Contractors of America (AGC), Building Owners & Managers Association International (BOMA), American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Environmental Protection Agency (EPA), and, of course, the Access Board.

### **Steering Committee**

Nicolas Ashford, Massachusetts Institute of Technology

Kathy Barcus, Clarke Construction Company, Inc.

Marilyn Golden, Disability Rights Education and Defense Fund (DREDF)

Harry Gordon, Burt Hill Kosar and Rittelmann Associates

Mark Jackson, Lennox Industries, Inc.

Brent Kynoch, Kynoch Environmental Management, Inc.

Mary Lamielle, National Center for Environmental Health Strategies

Ann McCampbell, Multiple Chemical Sensitivities Task Force of New Mexico

Claudia Miller, University of Texas Health Sciences Center - San Antonio

Susan Molloy, National Coalition for the Chemically Injured

Roger Morse, Morse Zentner Associates

Larry Perry, Building Owners and Managers Association

Bruce Small, Building Inspections

Toni Temple, Ohio Network for the Chemically Injured

James Wasley, University of Wisconsin-Milwaukee

James Raggio, Access Board

Alexander Shaw, National Institute of Building Sciences

**National Institute of Building Sciences (NIBS)  
Indoor Environmental Quality (IEQ) Project  
Operations & Maintenance Committee**

**May 26, 2005**

**Table of Contents**

**Introduction and Overview**

**Barriers & Issues**

**Fragrances**

**Pesticides**

**Cleaning Products & Disinfectants**

**Electromagnetic Fields**

**Renovation/Remodeling/Furniture**

**Smoke & Combustion**

**Noise & Vibration**

**Synergistic Effects of Indoor Air Pollutants**

**Indoor Air Chemistry**

**Persistence of Indoor Air Pollutants**

**Recommended Actions for Facility Managers and Operations & Maintenance Staff**

**Pest Control**

**Cleaning & Disinfecting**

**Mechanical Equipment / HVAC**

**Landscape Maintenance**

**Enclosure Maintenance**

**Renovation/Remodeling/Furnishings**

**General Recommendations**

**Indoor Air & Environmental Quality Programs**

**Policies (Smoking, Fragrance, Cell phone, Notification, Vehicle idling)**

**Recommendations for Future Actions**

**References**

**Appendices - Detailed Recommendations**

**Pest Control / Resources**

**Cleaning & Disinfecting / Resources**

**Mechanical Equipment / Resources**

**Landscape Maintenance / Resources**

**Enclosure Maintenance / Resources**

**Committee and other contributors to the report**

**Additional Resources**

**General Guidance for Building Cleaning Programs**

**Steps for Implementing a Scent-free Policy in the Workplace**

## **INTRODUCTION AND OVERVIEW**

### **Problem Summary**

The operation and maintenance of commercial and public buildings can affect their accessibility for people with asthma and multiple chemical and/or electromagnetic sensitivities. The presence of many products or conditions involved in cleaning, maintaining, using, and operating buildings often contributes to poor indoor environmental quality and are access barriers for these individuals.

Problematic substances include, but are not limited to, pesticides, fragrances, disinfectants, many cleaners and new building materials and furnishings, and smoke and other engine exhaust. Inadequate ventilation of a building further contributes to poor indoor environmental quality.

The presence of electromagnetic fields from office equipment and other sources is a barrier for those with electromagnetic sensitivities. Noise and vibration can adversely affect some people with chemical and/or electromagnetic sensitivities and trigger seizures in susceptible individuals.

### **General Solutions**

Measures taken to improve indoor environmental quality, such as reducing air pollutants, noise and electromagnetic fields in buildings, will increase their accessibility for people with asthma and chemical and/or electromagnetic sensitivities, as well as provide a more healthful environment for all building occupants.

While “green” and “environmentally-friendly” practices and products for construction and maintenance of buildings sometimes provide more healthful indoor environments and improves access for those with asthma and multiple chemical sensitivities, this is not always the case. The U.S. EPA notes that there is growing concern that standards being promoted by the green building movement, such as Green Seal and Green Guard standards, are not sufficiently protective of health (1).

For example, some measures recommended to promote energy and water conservation -- such as reducing outdoor air supplied and/or reducing time of HVAC usage, using motion sensors that can create electromagnetic fields, using waterless urinals that require continuous chemical treatments, recommending cold water for cleaning, and promoting the use of alcohol hand wipes instead of hand washing – can cause or lead to increased indoor pollution and less healthful and accessible environments.

In addition, “greener cleaners” often promote the use of citrus- and/or pine-based products, which can react with even low levels of oxidants, such as ozone, to produce hazardous byproducts, as well as make buildings inaccessible for many people with chemical sensitivities. The addition of either synthetic or natural fragrances to cleaning and other products is also problematic for chemically sensitive individuals.

Other common green building recommendations, such as building on brownfields, using tuck-under parking, and putting heliports or gardens on roofs can also lead to diminished indoor air quality and create barriers for people with chemical sensitivities.

Lastly, the green building community has yet to provide guidance on the issue of electromagnetic fields.

## **BARRIERS & ISSUES**

### **Fragrances**

The presence of perfume, cologne, scented cleaners and other scented products contributes to poor indoor air quality and is one of the major access barriers for people with asthma and multiple chemical sensitivities.

“Fragrances” are chemical compounds added to a product to give it a scent. There are approximately 3000 chemicals used in the manufacture of fragrances. Most of these chemicals are synthetic and derived from petroleum. Chemicals found in fragrance formulations include toluene, alcohols, formaldehyde, styrene, benzene, limonene, phthalates, and musk. An individual fragrance formula may contain over 100 chemicals, but their identity is protected as a trade secret. Fragrances do not have to be tested for safety before they are put on the market (2).

Exposure to fragrances can trigger asthma attacks and migraine headaches, and aggravate sinus conditions. In those who are chemically sensitive, fragrance exposures can also cause irregular heartbeat, memory loss, confusion, fatigue, and neurological, vascular, and other problems. In addition, some fragrance chemicals are implicated in causing cancer and/or damaging the liver, kidneys, and central nervous system. Fragrance chemicals can enter the body via inhalation, skin absorption, or nasal passageways.

According to a 1986 U.S. House of Representatives Report:

*"In 1986, the National Academy of Sciences targeted fragrances as one of the six categories of chemicals that should be given high priority for neurotoxicity testing. The other groups include insecticides, heavy metals, solvents, food additives and certain air pollutants. The report states that 95 percent of chemicals used in fragrances are synthetic compounds derived from petroleum. They include benzene derivatives, aldehydes, and many other known toxics and sensitizers, which are capable of causing cancer, birth defects, central nervous system disorders and allergic reactions "* (3)

If a product label lists “fragrance” as an ingredient on the back of the label, it contains added fragrance, even if the front label says the product is “unscented” or “fragrance-free”. If “fragrance” is not listed as an ingredient, it may still contain fragrance chemicals or contain natural fragrances.

The main sources of fragrances in buildings are from 1) fragrance-emitting devices (FEDS), sprays, and deodorizers, 2) other scented cleaning and maintenance products, 3) perfume; cologne; essential oils; and scented skin and hair products, cosmetics, and other personal care products, 4) clothing that has been laundered with scented detergents, fabric softeners, or dryer sheets, and 5) potpourri, incense and scented candles (even when incense or scented candles are not burning). Sometimes fragrance is added to and dispersed by a building’s ventilation system.

### **Pesticides**

Pesticides are hazardous chemicals designed to kill or repel insects, plants, and other pests. The term pesticide applies to insecticides, herbicides (weed-killers), fungicides, rodenticides, disinfectants, and other substances used to control pests. Many pesticides contain volatile and/or semi-volatile chemicals that contribute to poor indoor air and environmental quality (IAQ/IEQ).

A pesticide product consists of the active ingredient(s) and “inert” ingredients. Active ingredients are the chemicals that kill or repel the pest. The rest of the product is composed of “inert” ingredients, which often comprise over 95% of the pesticide product. “Inert” ingredients are commonly solvents and may be as, or more, toxic than the active ingredient(s).

Individuals exposed to pesticides are at risk for both acute and chronic health effects (4, 5, 6, 7). Pesticide exposures can exacerbate asthma and cause nausea, headaches, rashes, dizziness, fatigue and memory loss. Many pesticides are also linked with causing cancer, birth defects, neurological and reproductive disorders, and the onset and exacerbation of chemical sensitivities. Pesticide exposure can occur long after its application because pesticide products are often designed to be persistent in the environment.

For people who are chemically sensitive, exposure to even minute amounts of pesticides from, for example, pesticide drift from neighborhood lawn treatments, driving on a road where herbicides have been sprayed weeks earlier, or being in a building that was treated with pesticides even several years earlier, can cause severe, sometimes, life-threatening and/or prolonged illness (8). Thus the presence of pesticides is one of the greatest access barriers for people with chemical sensitivities.

The use of pesticides can be eliminated or significantly reduced through implementation of Integrated Pest Management (IPM) programs. IPM is a program of prevention, monitoring, record-keeping, and control that eliminates or drastically reduces the use of pesticides. The focus of IPM is to prevent pest problems by reducing or eliminating sources of pest food, water, and shelter and by maintaining healthy lawns and landscapes. The first approach to controlling a pest outbreak is to improve sanitation, make structural repairs (such as fixing leaky pipes and caulking cracks), and using physical or mechanical controls such as screens, traps and mechanical weed cutters. A least hazardous chemical is used only when other strategies have failed.

IPM strategies are being increasingly implemented in schools, parks, government facilities, and hospitals nationwide. One needs to be aware, however, that the term IPM is sometimes inappropriately used for pest management programs that use or recommend the use of significant amounts of pesticides.

### **Cleaning Products & Disinfectants**

Many toxic chemicals are found in janitorial cleaning supplies used in industrial and commercial facilities. They often emit volatile organic compounds (VOC's) (9), contribute to poor indoor air quality (IAQ), and create access barriers for people with asthma, allergies, and/or chemical sensitivities. Some of these chemicals are associated with human health effects, including cancer, damage to major organs, interference with normal reproduction and development, and even death. (10).

Even “greener cleaners” may contain volatile substances, like citrus or pine, that can cause adverse health effects in building occupants.

There is a wide range of cleaning and maintenance products that include, but are not limited to, air fresheners, deodorizers, bathroom and tile cleaners, dusting aids, engine and other degreasers, lubricants, fabric protectants, floor polishes and waxes, furniture polish, general purpose cleaners, glass cleaners, laundry products, oven cleaners, carpet and upholstery cleaners, graffiti remover, and floor strippers. One of the most hazardous cleaning operations for workers and building occupants is the stripping and refinishing of floors.

Some cleaning products also contain disinfectants. The U.S. EPA notes that one major concern from a health standpoint is the increased incorporation of antimicrobial agents and fragrances in cleaners and air fresheners marketed to reduce indoor air contamination (1).

Many commonly used disinfectant or sanitizer products contain chlorine, phenol, quaternary ammonium compounds, and isopropyl and other alcohols. These produce hazardous fumes and present access barriers for people with chemical sensitivities.

### **Electromagnetic Fields**

For people who are electromagnetically sensitive, the presence of cell phones and towers, portable telephones, computers, fluorescent lighting, unshielded transformers and wiring, battery re-chargers, wireless devices, security and scanning equipment, microwave ovens, electric ranges and numerous other electrical appliances can make a building inaccessible.

The National Institute for Occupational Safety and Health (NIOSH) notes that scientific studies have raised questions about the possible health effects of EMF's. NIOSH recommends the following measures for those wanting to reduce EMF exposure – informing workers and employers about possible hazards of magnetic fields, increasing workers' distance from EMF sources, using low-EMF designs wherever possible (e.g., for layout of office power supplies), and reducing EMF exposure times (11).

### **Renovation/Remodeling/Furniture**

Many new building materials, such as paints, adhesives, wallboard, carpet, and insulation, as well as upholstered furniture, particleboard cabinets, and other furnishings emit hazardous volatile organic compounds (VOC's), contribute to poor indoor air quality (IAQ) and create significant access barriers for people with asthma and/or chemical sensitivities. These materials often outgas and are problematic for prolonged periods of time.

### **Smoke & Combustion**

Many people with asthma and most people with chemical sensitivities are made sick by exposure to: 1) smoke, such as that from tobacco, fireplaces, candles, incense, and barbeques, and other outdoor fires, 2) vehicle and other engine exhaust, especially exhaust from vehicles using diesel or oxygenated fuel, and 3) combustion appliances burning kerosene, propane, or natural gas (natural gas usually being better tolerated than kerosene or propane). If combustion appliances are used, they should be directly vented to the outdoors. Electrical appliances are preferred by people with chemical sensitivities.

### **Noise & Vibration**

Noise and vibration from HVAC systems, vacuums, pumps, helicopters and other sources can trigger severe symptoms, including seizures, in susceptible individuals.

### **Synergistic Effects of Indoor Air Pollutants**

Indoor air is a "chemical soup" made up of a variety of chemicals emitted by building materials, cleaning products, pesticides, personal care and consumer products, emissions from building equipment and activities, etc. While individual chemicals may be hazardous, combinations of chemicals can be even more hazardous through additive or synergistic effects. Synergistic effects

occur when the health impacts of a chemical combination is greater than the sum of the impacts of the individual chemicals.

### **Indoor Air Chemistry**

In indoor air, chemicals can react with one another to form other compounds that are more hazardous than the original chemicals. Increasing evidence has shown that ozone and hydroxyl radicals formed by other oxidants can react with alkenes (such as limonene found in citrus and fragrance formulations, as well as terpenes emitted by many wood products) to generate secondary pollutants, including formaldehyde, as well as hydroxy radicals that can react with organics to form other potentially toxic air pollutants. The toxicity of many of these secondary pollutants is well-established while for others it has yet to be evaluated (12, 13, 14, 15, 16). These reactions can be limited by employing carbon-based filters in locations where outdoor ozone concentrations commonly approach or exceed the National Ambient Air Quality Standards (NAAQS) promulgated by the U.S. EPA.

### **Persistence of Indoor Air Pollutants**

Many porous building materials and furnishings, such as carpeting, couches, drapes, and wallboard, absorb cleaning chemicals, fragrances, pesticides, and other air pollutants. Chemicals adsorb to virtually all indoor surfaces but more strongly to rough rather than smooth surfaces. These processes are known as the “sink effect”. These chemicals can be re-emitted into the air for long periods of time leading to prolonged air pollution. For example, it is not uncommon for a building to retain the odor of a fragrance-emitting device (FED) months after it has been removed. Similarly, residual tobacco smoke can still be detected in buildings long after a no-smoking policy is implemented. Air pollutants clear more readily from buildings that contain a higher percentage of hard impermeable surfaces.

## **RECOMMENDED ACTIONS FOR FACILITY MANAGERS AND OPERATIONS & MAINTENANCE STAFF**

The O & M Committee identified *pesticides* (indoors & outdoors), *fragrances* (especially fragrance-emitting devices/FEDS, air fresheners, and deodorizers), and volatile *cleaners* (including citrus & pine) as the biggest access barriers for people with chemical sensitivities related to operations and maintenance of a building. Cell phone use was identified as a significant barrier for people with electromagnetic sensitivities.

The Committee developed recommendations for making buildings more accessible for people with chemical and/or electromagnetic sensitivities in the areas of pest control, cleaning & disinfecting, mechanical / HVAC, landscape maintenance, and enclosure maintenance. They are listed in bullet form in the Appendix and summarized in the body of the report below.

In addition, recommendations are given for renovation, remodeling, and furnishings and for adoption of policies on smoking, fragrances, cell phone use, notification of building activities, and vehicle idling.

The Committee recognizes that the list of recommendations is long and that few buildings will be able to implement all of them. The recommendations are the ideal goal towards which to strive. Any steps taken to reduce the levels of the problematic substances or conditions listed above will improve access for people with chemical and/or electromagnetic sensitivities and create a healthier building.

Some of the recommendations will not apply to certain types of buildings or geographic areas. The recommendations are given in sufficient detail to help those who need to address a specific issue. Resources from which to obtain more information or guidance are also provided in the Appendix and at the end of the document in Additional Resources.

### **Recommendations for Pest Control**

Adopt an Integrated Pest Management (IPM) program for building interiors and grounds as described in “Healthy Hospitals, Controlling Pests Without Harmful Pesticides” (17). The Los Angeles Unified School District also has an exemplary plan for an IPM program (18).

IPM is a program of prevention, monitoring, record-keeping, and control that eliminates or drastically reduces the use of pesticides. The focus of IPM is to prevent pest problems by reducing or eliminating sources of pest food, water, and shelter and by maintaining healthy lawns (19) and landscapes.

The first approach in controlling a pest outbreak is to improve sanitation, make structural repairs (such as fixing leaky pipes and caulking cracks), and using physical or mechanical controls such as screens, traps, vacuums, and mechanical weed cutters. Increased sanitation measures include more frequent trash removal, restricting eating to designated areas, securing trash container lids, and steam cleaning trash containers. The IPM approach uses knowledge of a pest’s biology, habitat, and needs to time specific interventions to prevent and control pests. A least hazardous chemical is used only when other strategies have failed.

Pesticide use is discouraged in a true IPM program. If pesticides are used indoors or outdoors, however, the following precautions should be taken -- notification of applications (even for “spot” or crack & crevice treatments) should be given through posting of signs (before, during, and after applications) and by other means to building occupants, especially those on a pesticide notification

registry (20), applications should only be made by a licensed applicator, applications should not be made inside buildings by spraying, fogging, bombing, or tenting, and applications should not be made in occupied areas or areas that may become occupied during the 24 hours (at a minimum) following an application. In buildings that are constantly occupied, pesticide applications should be made when they are least occupied. It is recommended that pesticides be applied when there is the longest time before the area will be re-occupied, such as at the beginning of a weekend or vacation period.

The Committee recommends that certain pesticides, such as organophosphates, carbamates, pyrethroids, and other neurotoxic insecticides; 2,4-D, other phenoxy herbicides, and glyphosate; and fungicides such as mancozeb, chlorothalonil, and maneb, never be used.

### **Recommendations for Cleaning & Disinfecting**

Use fragrance-free, low-VOC cleaning products. Do not use fragrance-emitting devices (FEDS), plug-ins, or sprays; urinal or toilet blocks; or other deodorizer/re-odorizer products. Reduce odors by increasing cleaning and ventilation and/or using baking soda or zeolite to absorb odors. Do not use products containing paradichlorobenzene (21) or naphthalene, which are common ingredients in FEDS.

Do not use cleaner/disinfectant combination products. Avoid or limit the use of products containing chlorine, ammonia, quaternary ammonium, phenol, isopropyl and other alcohols, formaldehyde, and other petroleum distillates. Do not use citrus- or pine-based products. Hydrogen peroxide-based products are the preferred disinfectants, but still should be used with caution and care. Use hot water for cleaning to reduce the need for soaps, detergents, and disinfectants.

Use disinfectants only in areas and at strengths (i.e., levels of disinfection) required by law. Check with local health department to obtain details of all legal requirements. Clean surfaces thoroughly before disinfecting. Leave disinfectants in place for the correct amount of time before wiping surfaces clean.

Audit cleaning chemicals currently in use and develop a plan to replace with safer alternatives.

Vacuum frequently and thoroughly using vacuums with HEPA filters and strong suction. If carpets must be cleaned, use steam or least toxic all-purpose cleaner or carpet cleaner that does not contain petroleum solvents. Spot clean whenever possible. Clean stains while they are fresh to avoid the need for aggressive cleaning later. Dust hard surfaces with a lint-free cloth, or with water only.

Spray cleaning products on to cloths rather than on to surfaces or into the air. Dry all washed surfaces with a dry cloth or mop to reduce chemical residue and chance of mold growth. Minimize the use of floor waxes and buffing.

Ventilate well when using cleaning products. Post signs during cleaning. Make cleaning schedule available to employees or others upon request.

Schedule heavy cleaning, repairs and maintenance during low or no-occupancy periods whenever possible.

Prohibit occupant usage of cleaning chemicals except as authorized. Establish a list of least toxic, low-VOC cleaning products (and/or provide them to employees) which they can use to clean computers, erase felt pen writing on white board, and perform other similar activities.

In decorative building fountains, use the minimum amount of chlorine necessary for disinfection, avoid the use of bromine, use closed ozone water treatment systems to the maximum extent possible, and make use of newer, less-toxic disinfecting technologies as they become available.

Avoid the use of wall-mounted devices, similar to fragrance-emitting devices (FEDS), that operate automatically or by pushing a button to dispense deodorizers, disinfectants, and pesticides.

### **Recommendations for Mechanical Equipment / HVAC**

Adhere to a strict maintenance schedule for HVAC equipment and make sure it is working properly. Use the highest efficiency filters compatible with current HVAC system, and if necessary, consider retrofitting the system to increase filtration capabilities. Maintain relative humidity between 30% and 50%.

Use non-chemical methods to maintain HVAC ducts free of particulate matter, dust, and debris, such as physical removal or use of vacuums. Do not use the HVAC system to disperse fragrances or other materials.

Seal return air openings into HVAC system during remodeling and exhaust directly to the outdoors, by temporarily removing window glazing if necessary.

Use demand controlled ventilation (DCV) that provides liberal amounts of air flow and outdoor air ventilation. Before a building is re-occupied in the morning or after weekends, flush with at least three complete outdoor air exchanges.

Create door and window-opening protocol to maintain proper pressure relationships and air flow in the building. Educate and provide protocol to staff and other building occupants. Policy should include provision that allows chemically sensitive and other individuals to open windows on a temporary or regular basis, as needed because of a health condition. Windows should also be permitted to be opened by occupants when the HVAC system is not working or shut off, such as may occur during nights and weekends.

Make maximum use of economizer cycle. Avoid energy conservation practices that reduce intake of outside air below minimum requirements.

Avoid or minimize the use of humidifiers in the building's HVAC system. Prohibit the use of personal humidifiers except when an occupant has a medical need for one. Maintain the cleanliness of all humidifier equipment and use the minimum amount of water treatment chemicals necessary to control dissolved solids and pH and prevent antimicrobial contamination. Do not allow the use of portable air "cleaners" that emit ozone.

Repair plumbing with least toxic, low-VOC materials. Use snakes or other mechanical methods to clear clogged drains. Use bacterial enzymes to prevent drain clogs. Inspect floor and other drains, especially those that are infrequently used, to ensure there is water in the P-traps, thereby avoiding sewer gas backup. Treat grease traps daily with bacterial enzymes.

### **Recommendations for Landscape Maintenance**

Maintain lawns and gardens organically. Use integrated pest management (IPM) to eliminate or minimize the use of herbicides, fungicides, insecticides, and other pesticides. Maintain soil health. Avoid the use of synthetic fertilizers.

Pull, mow, or use mechanical weed cutters to remove weeds. Vinegar can be used to kill weeds along fence lines and other hard to reach places.

Avoid dust-blowing equipment like leaf blowers. Sweeping, raking, and use of vacuums are the preferred methods for removing debris.

Avoid diesel-powered and 2-cycle engine equipment. Use electric lawn and landscape equipment whenever possible.

Use rock, gravel, flat stones, or pavers for mulch, and/or use tytar landscape barrier to suppress weeds. Avoid organic mulches, like cocoa beans, peat moss, wood chips, and bark, especially near operable windows and doors of buildings. These mulches usually emit volatile fumes and may produce or harbor mold.

Avoid the use of CCA wood or wood chips because they contain arsenic and other toxic chemicals which can leach into the environment. Do not use railroad ties because they contain creosote.

Apply pesticide, fertilizers, and lime only when there is little or no wind and apply them in a manner that prevents drift. Post signs and provide advance notification to building occupants before starting these applications.

Use least toxic, low-VOC paints, stains, and finishes on outside equipment, like benches, poles, decks, and porches.

### **Recommendations for Enclosure Maintenance**

It is important to properly maintain the building envelop in order to prevent mold problems and block pest entry.

Routinely inspect and clean roof and gutters to make sure they are draining properly. Promptly repair roof or plumbing leaks. Regularly inspect walls and foundations, especially all utility entrance seals (e.g., phone, water, electric, and cable) for cracks and repair promptly if found. Insulate cold pipes to prevent condensation.

Promptly remove wet ceiling tiles and wall panels.

Remove excess water from carpeting damaged by clean water and quickly dry it to avoid mold buildup. Do not use disinfectants or moldicides (other than hydrogen peroxide-based ones). Instead, utilize a steam extraction carpet cleaning system with a hydrogen peroxide-based cleaner/disinfectant. Inspect carpet after it is completely dried to ensure there is no mold or mildew. Those with asthma or chemical sensitivities should be removed from areas where there is wet carpeting. Remove carpeting if it has been wet longer than 24 hours.

Immediately remove and do not re-use any wet carpeting that has been contaminated with sewer water, heavy dirt and soils, or toxic chemicals.

Seal rusted surfaces with a least toxic low VOC sealant to minimize emissions of airborne particles.

### **Recommendations for Renovation/Remodeling/Furnishings**

It is recommended that buildings and furnishings be well maintained to reduce the need for renovation and remodeling. Chemically sensitive individuals often tolerate older building materials and furnishings better than new ones because older materials have usually outgassed and emit lower levels of VOCs.

If renovation and remodeling is done, however, efforts should be made to limit activities to select areas, rather than being done on a wide scale. They should be performed when the areas are unoccupied (or the least occupied in buildings that are in constant use).

If new materials and finishes are applied (especially wet-applied products such as paints, sealants, caulks, and adhesives), maximum outdoor air ventilation with no recirculation should be employed during and for a reasonable period of time after the application.

When possible, new furnishings should be thoroughly aired out before being brought into the occupied space.

## **GENERAL RECOMMENDATIONS**

### **Indoor Air & Environmental Quality Program**

The O & M Committee recommends that facilities adopt an Indoor Air & Environmental Quality Program (IAQ/IEQ) to promote practices that prevent or reduce the contamination of indoor air, thereby contributing to a safe, healthy, productive and comfortable environment for building occupants. Benefits of good IAQ/IEQ may include improved health of occupants, decrease in the spread of infectious disease, protection of susceptible populations, increased productivity of occupants, improved relationships/fewer complaints, reduction in potential building closures (due to unhealthful conditions), less deterioration of buildings and equipment, reduced maintenance costs, and decreased liability and risk (22).

An IAQ/IEQ Program should include the maintenance of a log that records building problems and health complaints reported by building occupants.

### **Policies**

The O & M committee recommends the following policies be adopted in commercial and public buildings:

#### **No Smoking Policy**

It is recommended that smoking be prohibited inside buildings. Smoking should be restricted to designated outdoor smoking areas that are 100 feet from paths of travel, entryways, operable windows, and air intakes.

#### **Fragrance-Free Policy**

It is recommended that a fragrance-free policy include prohibition of fragrance-emitting devices (FEDS) and sprays; use of fragrance-free maintenance, laundry, paper and other products; restrictions on perfume, cologne, and other scented personal care products used by employees, visitors, and other occupants; and prohibitions on use of potpourri and burning incense and scented candles.

An important first step is educating staff and others about the need for and benefits of reducing or eliminating the use of fragranced products.

### **Resources**

No Scents Makes Sense brochure, Lung Association of New Brunswick:  
<http://www.nb.lung.ca/pdf/NoScentsMakeSense.pdf>

Guidelines on Wearing Scented Products and We Share the Air posters, University of Waterloo, Ontario, Canada, [www.safetyoffice.uwaterloo.ca/hspm/hspmm\\_intro/safety\\_manual\\_index.htm](http://www.safetyoffice.uwaterloo.ca/hspm/hspmm_intro/safety_manual_index.htm), (under 12. Hygiene).

See “*Steps for Implementing a Scent-free Policy in the Workplace*” in Additional Resources.

#### **Cell Phone Use Policy**

It is recommended that cell phone use be prohibited in areas of a building when requested by an electromagnetically sensitive individual who needs to work or visit that area. Also, see information on use of a Cleaner Air Symbol in the Designated Cleaner Air Room report.

### **Notification Policy**

It is recommended that facilities adopt a posting and notification policy to notify staff, visitors, and other building occupants of pesticide applications, cleaning and maintenance activities, renovation and construction, and other activities that may produce hazardous fumes or dust.

### **Vehicle Idling Policy**

It is recommended that facilities limit or prohibit idling of vehicles, especially diesel vehicles, near entryways, loading docks, operable windows, and air intakes (23).

### **Recommendations for Future Actions**

1. The O & M Committee recommends that the U.S. Access Board sponsor a meeting with stakeholders, including architects, building owners and managers, government officials, scientists, advocates, sensitive and vulnerable individuals, and others to evaluate the recommendations of this report (Operations & Maintenance). This meeting should provide a forum for increasing awareness of the report, facilitating dialogue among stakeholders, assessing the feasibility of the recommendations, and identifying ways to advance the recommendations.

2. The recommendations on cleaning products and practices in this report are based on information that is currently available. The O & M committee found that much more information and research is needed to better define cleaning products and practices that are effective and that will best protect occupant health. Some of the data gaps or problems the Committee identified are lack of information on labels and Material Safety Data Sheets, lack of information on fragrance ingredients combined with incomplete information on their health effects, and safety questions about citrus- and pine-based cleaning products because, among other things, they react with ozone to produce hazardous byproducts.

We, therefore, recommend that the U.S. Access Board and/or NIBS, in conjunction with U.S. EPA and other stakeholders, sponsor a workshop to examine existing information on cleaning products and practices, identify those products and practices that have the least adverse impact on indoor environmental quality and occupant health (including impacts on sensitive and vulnerable individuals), develop best practices, and determine research needs.

## REFERENCES

- 1) Program Needs for Indoor Environments Research (PNIER), U.S. EPA, 402-B-05-001, March 2005, [www.epa.gov/iaq/pubs/pnier.pdf](http://www.epa.gov/iaq/pubs/pnier.pdf)
- 2) Bridges, B, Fragrance: emerging health and environmental concerns, *Flavour and Fragrance Journal* 2002; 17: 361-371, <http://www3.interscience.wiley.com/cgi-bin/fulltext/93514043/PDFSTART>
- 3) Neurotoxins: At Home and the Workplace, Report by the Committee on Science and Technology, U.S. House of Representatives, Sept. 16, 1986, Report 99-827.
- 4) National Strategies for Health Care Providers: Pesticide Initiative, The National Environmental Education & Training Foundation (NEETF), [www.neetf.org/health/providers/index.shtml](http://www.neetf.org/health/providers/index.shtml), and U.S. EPA, [www.epa.gov/pesticides/safety/healthcare/healthcare.htm](http://www.epa.gov/pesticides/safety/healthcare/healthcare.htm), Implementation Plan, 2002.
- 5) Recognition and Management of Pesticide Poisonings, Fifth Edition, EPA 735-R-98-003, <http://www.epa.gov/pesticides/safety/healthcare/handbook/handbook.htm>
- 6) (Contains information on acute health effects of pesticides, but does not cover the range of effects experienced by people with pesticide or chemical sensitivities).
- 7) Sanborn M, et. al, Pesticides Literature Review, The Ontario College of Family Physicians, April 23, 2004, <http://www.ocfp.on.ca/local/files/Communications/Current%20Issues/Pesticides/Final%20Paper%2023APR2004.pdf>
- 8) Solomon, G, Pesticides and Human Health, A Resource for Health Care Professionals, Physicians for Social Responsibility and Californians for Pesticide Reform, 2000, [www.psrla.org/pesthealth.htm](http://www.psrla.org/pesthealth.htm)
- 9) McCampbell A, Pesticide Sensitivities, pp. 606-609, in *Encyclopedia of Pest Management*, Pimentel D, Ed., New York: Marcel Dekker, 2002.
- 10) Initial Statement of Reasons for Proposed Amendments to the California Aerosol Coating Products, Antiperspirants and Deodorants, and Consumer Products Regulation, Test Method 310, and Airborne Toxic Control Measure for Para-dichlorobenzene Solid Air Fresheners and Toilet/Urinal Care Products, Volume I: Executive Summary, Air Resources Board, State of California, [www.arb.ca.gov/regact/conprod/execsum.pdf](http://www.arb.ca.gov/regact/conprod/execsum.pdf)
- 11) Cleaning for Health: Products and Practices for a Safer Indoor Environment, INFORM, 2002, Chapters 1-5, <http://www.informinc.org/cleanforhealth.php>
- 12) EMFs in the Workplace, NIOSH Fact Sheet, DHHS (NIOSH) Publication No. 96-129, [www.cdc.gov/niosh/emf2.html](http://www.cdc.gov/niosh/emf2.html)
- 13) Nazaroff WW, Weschler CJ, Cleaning products and air fresheners: exposure to primary and secondary air pollutants, *Atmospheric Environment* 38 (2004) 2841-2865.
- 14) Nojgaard JK, Christensen KB, Wolkoff P, The effect on human eye blink frequency of exposure to limonene oxidation products and methacrolein, *Toxicology Letters* 156 (2005) 241-251.

- 15) Weschler CJ, Reactions Among Indoor Pollutants: What's New, Paper #291, Proceedings of the Annual Meeting of the Air and Waste Management Association, Orlando, FL, June, 2001.
- 16) Weschler, CJ, Ozone in Indoor Environments: Concentration and Chemistry, *Indoor Air* 2000;10: 269-288.
- 17) Weschler, CJ, Chemical Transformations of Indoor Pollutants: Effects on Indoor Air Quality, In Proceedings of Indoor Climate of Buildings 2004, D. Petras, Ed., Slovak University of Technology, Bratislava, 2004, pp. 1-8.
- 18) Healthy Hospitals, Controlling Pests Without Harmful Pesticides, a report by Beyond Pesticides and Health Care Without Harm, 2003, <http://www.noharm.org/> (<http://www.noharm.org/details.cfm?ID=864&type=document>) and <http://www.beyondpesticides.org/> ([http://www.beyondpesticides.org/hospitals/Healthy\\_Hospitals\\_Report.pdf](http://www.beyondpesticides.org/hospitals/Healthy_Hospitals_Report.pdf))
- 19) Los Angeles Unified School District, Integrated Pest Management Policy, [www.laschools.org/employee/mo/ipm/docs/ipmpolicyretype.pdf](http://www.laschools.org/employee/mo/ipm/docs/ipmpolicyretype.pdf), and Integrated Pest Management Procedures Manual, written by Bill Currie of International Pest Management Institute, October, 2000, <http://www.laschools.org/employee/mo/ipm/docs/ipm-procedures-manual.pdf>
- 20) Healthy Lawn, Healthy Environment, Caring for Your Lawn in an Environmentally Friendly Way, U.S. EPA, 735-K-04-001, September 2004, <http://www.epa.gov/oppfead1/Publications/lawncare.pdf>
- 21) New Jersey Pesticide Control Regulations, New Jersey Administrative Code Title 7 Chapter 30, Subchapters 1-12, [www.nj.gov/dep/enforcement/pcp/pcp-regs.htm](http://www.nj.gov/dep/enforcement/pcp/pcp-regs.htm) and New Jersey School Integrated Pest Management (IPM) Program, Laws and Regulations Supplement, Pesticide Control Regulations, NJAC 7:30-13, Integrated Pest Management in Schools, [www.nj.gov/dep/enforcement/pcp/ipm-laws2.htm](http://www.nj.gov/dep/enforcement/pcp/ipm-laws2.htm)
- 22) Health Risk and Needs Assessment for the Airborne Toxic Control Measure for Para-Dichlorobenzene Solid Air Fresheners and Toilet/Urinal Care Products, Air Resources Board, State of California, [www.arb.ca.gov/regact/conprod/ch7.pdf](http://www.arb.ca.gov/regact/conprod/ch7.pdf)
- 23) Texas Voluntary Indoor Air Quality Guidelines for Government Buildings, Texas Department of Health, January 2003, [http://www.tdh.state.tx.us/beh/iaq/Gov\\_Bld\\_Gd.htm](http://www.tdh.state.tx.us/beh/iaq/Gov_Bld_Gd.htm)
- 24) New Jersey Requirements for Diesel-Powered Motor Vehicles, N.J.A.C. 7:27-14, <http://www.state.nj.us/dep/aqm/sub14v2001-10-01.htm>

## **APPENDIX - DETAILED RECOMMENDATIONS**

### **Detailed Recommendations for Pest Control**

#### ***Use Integrated Pest Management:***

Use integrated pest management (IPM) – a program of pest prevention, monitoring, record-keeping, and control that eliminates or drastically reduces the use of pesticides.

Follow recommendations for integrated pest management (IPM) in "Healthy Hospitals, Controlling Pests Without Harmful Pesticides". The Los Angeles Unified School District also has an exemplary plan for an IPM Program.

Eliminate the use of chemical pesticides or minimize their use to the greatest possible extent.

Pest management program should be part of an overall Indoor Air & Environmental Quality (IAQ/IEQ) program.

Designate an IPM coordinator.

When contracting for IPM services, give clear instructions on the type of service requested, including which, if any, pesticides are acceptable for use under specific conditions.

Eliminate all scheduled or routine use of pesticides. Use chemical pesticides only as a last resort when non-chemical methods have failed to control a pest problem.

Use organic methods to maintain lawns and landscape vegetation.

Do not use fertilizers that contain herbicides (e.g., "weed and feed" products).

Do not use herbicides to kill grass, shrubs, or other unwanted vegetation prior to removal or replacement.

If control methods are needed, preference should be given to physical (e.g., barriers), mechanical (e.g., mouse traps, pulling weeds, vacuuming, fly swatters, hosing insects off plants), and cultural (e.g., improved soil health, proper watering and pruning) controls, using bio-controls (e.g., natural predator insects) if those methods fail, and only using chemical pesticides as a last resort.

#### ***Prevent Pests:***

Emphasize pest prevention through non-chemical means.

To avoid creating conditions attractive to pests, clean thoroughly, promptly fix building cracks and plumbing leaks, restrict eating to designated areas, and promptly dispose of waste.

Adopt and adhere to strict maintenance schedules to determine and repair points of possible pest entry, such as torn screens, cracks and holes in walls, and damaged or improperly placed door seals and sweeps.

Initiate additional housekeeping routines to reduce the chances of pest infestation, including more frequent trash removal, securing trash container lids, and steam cleaning trash containers.

Locate trash cans and dumpsters, compactors, and recycling areas away from the building.

Maintain healthy lawns and landscape vegetation to increase resistance to pests.

To maximize health of lawns, develop healthy soils, mow often and with sharp blades, reduce thatch, and water deeply but not too often.

Maintain soil health. Avoid the use of synthetic fertilizers.

Prevent mosquitoes from breeding by draining stagnant water from bird baths, swimming pool covers, buckets, tires and other areas where water may be collecting. Drill holes in bottom of recycling bins that must be kept outside. Check rain gutters to ensure they are draining properly.

Discourage the introduction or presence of indoor plants because they attract pests, encourage pesticide use, and often promote mold growth.

If indoor plants are present, minimize mold growth by being careful not to over water, loosening the top layer of soil every week, and not keeping plants in wicker baskets. Do not use synthetic fertilizers or pesticides on indoor plants.

Change the water in flower vases frequently.

***Pesticides:***

**USE PESTICIDES ONLY AS A LAST RESORT WHEN NON-CHEMICAL METHODS HAVE FAILED TO CONTROL A PEST PROBLEM**

Use the least toxic pesticide in the least amount necessary to accomplish the job. Spot treatments are preferred.

Least hazardous pest management materials include:

- Boric acid and disodium octoborate tetrahydrate;
- Soybean oil and corn gluten meal;
- Diatomaceous earth;
- Nonvolatile insect and rodent baits in tamper-resistant containers or for use in crack and crevices;
- Microbe-based insecticides (such as *Bacillus thuringiensis*, B.t.);
- Botanical insecticides that do not contain synthetic pyrethroids or toxic synergists;
- Biological control agents, such as parasites and predators; and
- Soap-based products.

[Note that due to individual variations in sensitivities, some people with allergies, asthma, or chemical sensitivities may not tolerate one or more of the above least hazardous materials.]

Least hazardous physical pest management methods include the use of liquid nitrogen for cold treatment of termites.

Pesticide applications should only be made by a licensed pest control applicator.

The O & M Committee recommends that certain pesticides, such as organophosphates, carbamates, pyrethroids, and other neurotoxic insecticides; 2,4-D, other phenoxy herbicides, and glyphosate; and fungicides such as mancozeb, chlorothalonil, and maneb, never be used.

Do not apply pesticides to buildings by fogging, bombing, or tenting or by space, broadcast, or baseboard spraying.

Do not apply pesticides in occupied areas or areas that may become occupied during the 24 hours (at a minimum) following an application. In buildings that are constantly occupied, pesticide applications should be made when they are least occupied. It is recommended that pesticides be applied when there is the longest time before the area will be re-occupied, such as at the beginning of a weekend or vacation period.

Minimize contamination of the HVAC system by sealing all inlets and outlets to the area where pesticides are applied. When the seals are removed, ventilate the area with 100% outside air with no recirculation at least until the building is re-occupied.

No application of pesticides should be made along paths of travel or in the vicinity of entrances, windows, or outside air intakes.

Do not use pesticides that contain added fragrance.

Ensure proper training of all personnel working with pesticides.

Prohibit other staff and building occupants from using pesticide products.

In the event of a scheduled structural or lawn care pesticide application (including spot or crack & crevice treatments), provide pre-notification and post signage in appropriate disability formats before, during, and after the application.

Signage for pesticide applications should include the name of the pesticide product applied and EPA registration number, date and time of application, name of the applicator, and the name and number of contact person from whom to obtain more information. For examples of notification requirements, see Healthy Hospitals report (17) and New Jersey regulations (20) under References.

Require that pest control applicators provide the building manager or designated agent copies of Material Safety Data Sheet(s) and product label(s) for all pesticides used inside the building or on facility grounds. These documents should be provided to building occupants and the public upon request. Note, however, that neither the MSDS or product label provide complete information on product ingredients or their potential health effects.

Maintain a voluntary registry of persons at increased risk of injury or harm from pesticide exposures who wish to receive individual notification prior to pesticide applications (or notified after an emergency application).

Reasonable accommodation to programs, services, and employment needs to be readily available to people whose disabilities require that they avoid exposures to pesticides.

Maintain secured separate storage for pesticides and limit access to authorized personnel only.

Store any pesticide and disinfectant products away from food, laundry areas, paper product storage, areas occupied by children, and HVAC air intakes.

Maintain separate equipment, including mixing containers, for use with pesticides. Avoid cross contamination with equipment used for cleaning and other maintenance activities.

Establish a reporting procedure and encourage individuals who are experiencing adverse health effects from a pesticide exposure to report the incident to the building manager and the U. S. Environmental Protection Agency. See EPA Pesticide Health Incident Reporting, <http://www.epa.gov/pesticides/health/reporting.htm>

## **Resources**

IPM for Schools: A How-to Manual, EPA 909-B-97-001, March 1997,

<http://www.epa.gov/pesticides/ipm/schoolipm/>

Pest Prevention: Maintenance Practices and Facility Design by Sewell Simmons, California School IPM, California Department of Pesticide Regulation,

[http://www.cdpr.ca.gov/cfdocs/apps/schoolipm/managing\\_pests/71\\_pest\\_prevention.cfm?crumbs\\_list=1,34](http://www.cdpr.ca.gov/cfdocs/apps/schoolipm/managing_pests/71_pest_prevention.cfm?crumbs_list=1,34)

School Integrated Pest Management Program, California Department of Pesticide Regulation, [www.cdpr.ca.gov/cfdocs/apps/schoolipm/main.cfm](http://www.cdpr.ca.gov/cfdocs/apps/schoolipm/main.cfm)

Responsible Pest Management: Best Practices and Alternatives, Canada

<http://www.pestinfo.ca/main/ns/22/doc/23/lang/EN>

Second National Report on Human Exposure to Environmental Chemicals, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services, 2003,

[www.cdc.gov/exposurereport/2nd](http://www.cdc.gov/exposurereport/2nd)

ExToxNet (Extension Toxicology Network) Pesticide Information Profiles, Cornell University, <http://pmep.cce.cornell.edu/profiles/extoxnet/> (Does not include information on all health impacts experienced by people with pesticide/chemical sensitivities)

The Safety Source for Pest Management: A National Directory of Least-Toxic Service Providers, [www.beyondpesticides.org/safetysource](http://www.beyondpesticides.org/safetysource)

Beyond Pesticides  
701 E Street, SE, Suite 200, Washington DC 20003  
202-543-5450

[info@beyondpesticides.org](mailto:info@beyondpesticides.org)

[www.beyondpesticides.org](http://www.beyondpesticides.org)

Bio-Integral Resource Center  
P. O. Box 7414, Berkeley CA 94707  
510-524-2567

[birc@igc.org](mailto:birc@igc.org)

[www.birc.org](http://www.birc.org)

Californians for Pesticide Reform  
49 Powell Street, #530, San Francisco, CA 94102  
415-981-3939

[pests@igc.org](mailto:pests@igc.org)

[www.pesticidereform.org](http://www.pesticidereform.org)

International Pest Management Institute  
P. O. Box 474, Ash Fork AZ 86320  
928-637-2378

Bill Currie, Director  
[bugebill@earthlink.net](mailto:bugebill@earthlink.net)

IPM Institute of North America  
1914 Rowley Avenue, Madison WI 53705  
608-232-1528

[ipmworks@ipminstitute.org](mailto:ipmworks@ipminstitute.org)

[www.ipminstitute.org](http://www.ipminstitute.org)

National Center for Environmental Health Strategies

1100 Rural Avenue, Voorhees NJ 08043  
856-429-5358

[ncehs@ncehs.org](mailto:ncehs@ncehs.org)

[www.ncehs.org](http://www.ncehs.org)

Northwest Coalition for Alternatives to Pesticides  
P.O. Box 1393, Eugene OR 97440-1393  
541-344-5044

[info@pesticide.org](mailto:info@pesticide.org)

[www.pesticide.org](http://www.pesticide.org)

Pesticide Action Network North America  
49 Powell Street, Suite 500, San Francisco CA  
94102

415-981-1771

[panna@panna.org](mailto:panna@panna.org)

[www.panna.org](http://www.panna.org), [www.pesticideinfo.org](http://www.pesticideinfo.org)

U.S. Environmental Protection Agency  
Office of Pesticide Programs  
Ariel Rios Building  
1200 Pennsylvania Ave., NW, Mail Code 3213A  
Washington, DC 20460  
202-260-2090

[www.epa.gov/pesticides](http://www.epa.gov/pesticides)

National Pesticide Information Center  
Cooperative effort between Oregon State  
University and U.S. EPA  
333 Weniger, Corvallis OR 97331  
800-858-7378

[npic@ace.orst.edu](mailto:npic@ace.orst.edu)

<http://npic.orst.edu>

(Good site for basic pesticide information, but does not include full range of possible health effects experienced by people with pesticide or chemical sensitivities)

## **Detailed Recommendations for Cleaning & Disinfecting**

Do not use fragrance-emitting devices (FEDS), plug-ins, or sprays; urinal or toilet blocks; or other deodorizer/re-odorizer products.

To reduce odors, increase cleaning and ventilation and/or use baking soda or zeolite to absorb odors.

Do not use products containing paradichlorobenzene or naphthalene (common ingredients in FEDS).

Avoid or limit the use of products containing chlorine, ammonia, quaternary ammonium, phenol, isopropyl and other alcohols, formaldehyde, and other petroleum distillates.

Discourage the use of alcohol-based hand washes.

Do not use products that contain or have a fragrance.

Do not use citrus- or pine-based products.

Use vegetable-based surfactants rather than petroleum-based ones. Do not use citrus- or pine-based solvents.

Cleaning and disinfecting programs should be part of an overall Indoor Air & Environmental Quality (IAQ/IEQ) program.

Establish an audit of all cleaning chemicals currently in use. Develop a priority list and plan to establish alternatives for chemicals and cleaning methods.

Raise awareness among building maintenance staff and occupants that "green" and "environmentally friendly" products are not necessarily good for occupant health.

Minimize the number of cleaning and disinfecting products used.

Perform cleaning maintenance on an as needed basis – use spot or area cleaning rather than broad-based cleaning.

Clean stains while they are fresh to avoid need for aggressive cleaning later.

Choose cleaning products and disinfectants that emit the lowest levels of volatile fumes.

Dust with a dry lint-free cloth, or with water only. Avoid or minimize the use of polish dusting products.

Avoid perfumed and/or chemically-treated cleaning products and supplies, such as cleaning rags, vacuum bags, trash bags, tissue, toilet paper, and hand soaps.

Increase scrubbing and other mechanical methods of cleaning to reduce the need for chemicals.

Inspect areas to insure there has been proper cleaning using visual inspection, white cloth, or ultraviolet light.

Do not use cleaner/disinfectant combination products.

Hot water should be available for hand washing and cleaning.

Whenever possible, clean with hot water to reduce the amount of soap, detergent, and disinfectant that must be used.

Spray cleaning products on to cloths rather than on to surfaces or into the air.

If carpets must be cleaned, use steam or least-toxic all-purpose cleaner or carpet cleaner that does not contain petroleum solvents. Spot clean whenever possible.

Adopt fast-drying methods for carpet cleaning, 4 hours maximum. Steam cleaning + highest extraction + higher dry air flow = fast drying.

Dry all washed surfaces and floors with a dry cloth or mop to minimize chemical residues and reduce the chance of mold growth.

Use vacuums with HEPA (High Efficiency Particulate Attenuation) filters and strong suction. Vacuum frequently and thoroughly.

Minimize the use of floor waxes and buffing, and if done, notify employees and the public.

Order cleaning products for use with pumps rather than spray or aerosol dispensers to minimize chemical contamination of the air and HVAC system.

Take control of your own dispensing to ensure proper measurements. Establish minimal dosing for applications. When chemical has multiple uses, dispense separately for each use. A good dispensing program can save 25% to 40% in chemical consumption and costs.

Educate staff that mixing cleaning chemicals is dangerous because it can create new compounds that are more toxic than the original products.

Initiate protocol to authorize, supervise, and provide safe areas to mix authorized chemicals.

Store cleaning chemicals securely, separated from paper, cloth, or other absorbent materials.

Post signs during cleaning activities. Make cleaning schedule available to employees or others upon request.

Schedule heavy cleaning, repairs and maintenance during low or no-occupancy periods whenever possible.

Maintain strict protocol for training employees who use hazardous products or materials.  
Maintain an active list of those authorized to perform those duties.

Restrict cleaning to authorized personnel only.

Prohibit occupant usage of cleaning chemicals except as authorized. Establish a list of least toxic, low-VOC cleaning products (and/or provide them to employees) which they can use to clean computers, erase felt pen writing on white board, and perform other similar activities.

Use micro vacuums for cleaning electronic equipment. Do not use solvent cleaners.

Increase air intake to a building to dilute cleaning products present in indoor air, especially during major cleaning activities such as cleaning of carpet, walls, etc.

Provide a well-ventilated room with exhaust fans in which to service computers and other portable equipment whenever toxic chemicals are involved in the repair process.

Develop protocol to dispose of cleaning solutions safely.

Reduce tracked-in dirt by using mats and grills in entryways. Where appropriate, exhaust air between separated doorway entrances.

Replace wet entrance mats and dry wet floors and carpeting as soon as possible.

Utilize only those floor mats that do not emit odors/fumes or particles.

Reasonable accommodation to programs, services, and employment needs to be readily available to people whose disabilities require that they avoid exposures to cleaning, disinfecting, and maintenance chemicals.

Waterless urinals should be maintained using products containing bacterial enzymes that biodegrade urea.

### ***Disinfectants***

Eliminate combined cleaner/disinfectant products.

Use disinfectants only when and where necessary. This includes:

- 1) Knowing what organisms need to be reduced/disinfected. Disinfectants are formulated to target certain organisms or combination of organisms. It is important to use the right product in the right place.
- 2) Knowing what surfaces do (or do not) need to be disinfected, and how often.
- 3) Cleaning surfaces thoroughly before disinfecting. Disinfectants can only be effective through contact. A layer of surface grime is likely to prevent sufficient contact.
- 4) Using proper disinfectant mixing and cleaning procedures. This includes leaving disinfectants in place for the correct amount of time before wiping surfaces clean.

Limit or avoid the use of disinfectant or cleaning products containing chlorine, quaternary ammonium, phenol, and isopropyl and other alcohols.

Hydrogen peroxide-based disinfectants are preferred, but should be used judiciously with caution and care.

Use disinfectants only in areas and at strengths (i.e., levels of disinfection) required by law. Check with local health department to obtain details of all legal requirements.

Restrict or eliminate the use of alcohol-based hand washes.

Do not use hand soaps containing triclosan or other disinfectants.

### **Resources**

See Addendum B for more information on Cleaning

### **Detailed Recommendations for Mechanical Equipment & HVAC Systems**

If a building has poor indoor air quality, investigate the extent to which outdoor air contaminants are contributing to the problem.

In areas where poor outdoor air is a problem, use the highest efficiency filters compatible with current HVAC system, and if necessary, consider retrofitting system to increase filtration capabilities.

Use demand controlled ventilation (DCV) that utilize sensors in occupied spaces to determine when ventilation should be increased due to increased occupancy or other loads. Be wary of using motion sensors that can create significant electromagnetic fields.

Provide liberal amounts of ventilation. It is better to have more ventilation than necessary rather than too little.

Where there is an adjoining parking garage or busy roadway, or nearby heliport, anticipate the need to decrease air exchange and ventilation in buildings prior to and during “rush hours” or times of usage, respectively. During periods of decreased outdoor air ventilation, increase recirculation and filtration of recirculated air.

Adhere to a strict maintenance plan for all HVAC equipment to make sure it is working properly. This will reduce the chance of air contamination, maintain optimal efficiency, and minimize noise and vibration.

Create door and window-opening protocol to maintain proper pressure relationships and air flow in the building. Educate and provide protocol to staff and other building occupants. Policy should include provision that allows chemically sensitive and other individuals to open windows on a temporary or regular basis, as needed because of a health condition. Windows should also be permitted to be opened by occupants when the HVAC system is not working or shut off, such as may occur during nights and weekends. Policy should address emergency situations in which opening windows could exacerbate the crisis.

Maintain HVAC ducts free of particulate matter, dust, and debris. Use non-chemical methods, such as physical removal or use of vacuums.

Do not use HVAC system to disperse fragrances or other chemicals.

Before a building is re-occupied (e.g., in the mornings or after weekends), flush with at least three complete outdoor air exchanges.

Make maximum use of economizer cycle. Avoid energy conservation practices that reduce intake of outside air below minimum requirements.

Make sure the supply and return air diffusers, grills, and registers are working correctly.

Test for stagnant air areas where furniture, wall partitions, or equipment may be blocking air movement. Use ribbons or dry ice rather than smoke to study air flow patterns.

Maintain relative humidity between 30 and 50%.

Avoid or minimize the use of humidifiers in the buildings HVAC system. Maintain the cleanliness of all humidifier equipment and use the minimum amount of water treatment chemicals necessary to prevent antimicrobial contamination and to control dissolved solids and pH.

Prohibit the use of personal humidifiers except where there is a medical need.

Isolate and contain construction chemicals and particulate matter from HVAC system by covering registers and diffusers and using negative-pressure air systems.

Seal return air openings into HVAC system during remodeling and exhaust directly to the outdoors, by temporarily removing window glazing if necessary.

Quickly evacuate a building if the HVAC system becomes contaminated with a solvent, pesticide, toxic gas, or other harmful chemical at a level that can cause adverse health impacts in occupants, including sensitive and more vulnerable individuals.

Eliminate storage of toxic and/or volatile chemicals near HVAC intakes.

Do not allow the use of portable air “cleaners” that emit ozone.

Repair plumbing with least toxic, low-VOC materials.

To clear clogged drains, use mechanical methods such as snakes, or steam cleaning.

Utilize bacterial enzymes to prevent drain clogs, instead of using acids, solvents and alkalines which deteriorate pipes and necessitate repairs.

Inspect floor and other drains, especially those that are infrequently used, to ensure there is water in the P-traps, thereby avoiding sewer gas backup in the building.

Treat grease traps daily with preventive dose of bacterial enzymes, to avoid the need to use strong chemical cleaners if they become clogged.

In decorative fountains, use the minimum amount of chlorine necessary for disinfection, avoid the use of bromine, use closed ozone water treatment systems to the maximum extent possible, and make use of newer, less-toxic disinfecting technologies as they become available.

### **Resources**

EPA, Indoor Air Quality Building Education and Assessment Guidance (I-BEAM) Software package, can be downloaded for free from EPA website at [http://www.epa.gov/iaq/largebldgs/ibeam\\_page.htm](http://www.epa.gov/iaq/largebldgs/ibeam_page.htm), or can be obtained on CD from IAQ Clearinghouse at 1-800-438-4318 or via e-mail at [iaqinfo@aol.com](mailto:iaqinfo@aol.com) (ask for EPA 402-C-01-001).

See references regarding HVAC in Building Design & Construction report

### **Detailed Recommendations for Landscape Maintenance**

Use integrated pest management (IPM) to eliminate or minimize the use of herbicides, fungicides, insecticides, and other pesticides. (See recommendations for Pest Control).

Maintain lawn and gardens organically.

Maintain soil health.

Avoid the use of synthetic fertilizer.

Do not use fertilizer products that contain herbicides (e.g., “weed and feed” products).

Maintain healthy lawns and landscape vegetation to increase resistance to pests.

To maximize health of lawns, develop healthy soils, mow often and with sharp blades, reduce thatch, and water deeply but not too often.

Pull, mow, or use mechanical weed cutter to control weeds. Vinegar can be used to kill weeds along fence lines or other hard to reach areas.

Avoid dust-blowing equipment, such as leaf blowers. Sweeping, raking, and use of a vacuum are the preferred methods for removing debris.

If string or other mechanical weed cutter is used, attempt to minimize dispersal of dust, dirt, and debris.

Avoid diesel-powered or 2-cycle engine equipment, use electric lawn equipment instead.

Close windows during grass cutting, or prior to pesticide, fertilizer, or lime applications, or use of gas-powered equipment or vehicles on building grounds.

Use least toxic low-VOC paints, stains and finishes on outside equipment, including benches, poles, decks, and porches, as is recommended for interior and exterior of buildings (see recommendations in Building Products & Materials report).

Use rock, gravel, flat stones, or pavers for mulch and/or use tytar landscape barrier to suppress weeds. Avoid organic mulches (e.g., cocoa beans, peat moss, wood chips, bark), especially near windows and doors of buildings. These mulches emit volatile fumes and may harbor mold.

Avoid the use of CCA wood or wood chips because they contain arsenic and other toxic chemicals which can leach into the environment.

Do not use railroad ties because they contain creosote.

Remove plants that are chronically ill and/or frequently attract insect pests.

When replacing plants or redesigning landscape, follow recommendations in Building Construction & Design report.

Apply pesticide, fertilizers, and lime only when there is little or no wind present and in a manner that prevents drift.

Provide prenotification by posting signs prior to pesticide, synthetic fertilizer, or lime applications.

### **Resources**

Allergy-Free Gardening, Thomas Leo Ogren, [www.allergyfree-gardening.com](http://www.allergyfree-gardening.com)

### **Detailed Recommendations for Enclosure Maintenance**

Routinely inspect and clean roof and gutters to make sure they are draining properly.

Promptly repair roof or plumbing leaks.

Regularly inspect walls and foundations, especially all utility entrance seals (e.g., phone, water, electric, cable) for cracks and repair promptly if found.

Insulate cold pipes to prevent condensation.

Promptly remove wet ceiling tiles and wall panels.

Seal rusted surfaces to minimize emissions of airborne particulates using least toxic low-VOC sealant.

Include proper seal of the building in commissioning and re-commissioning programs for the building.

Remove excess water from carpeting damaged by clean water and quickly dry it to avoid mold buildup. Do not use disinfectants or moldicides (other than hydrogen peroxide-based ones). Instead, utilize a steam extraction carpet cleaning system with a hydrogen peroxide-based cleaner/disinfectant. Inspect carpet after it is completely dried to ensure there is no mold or mildew. Those with asthma or chemical sensitivities should be removed from areas where there is wet carpeting. Remove carpeting if it has been wet longer than 24 hours.

Immediately remove and do not re-use any wet carpeting that has been contaminated with sewer water, heavy dirt and soils, or toxic chemicals.

Seal rusted surfaces with a least toxic low VOC sealant to minimize emissions of airborne particles.

Include proper seal of the building in commissioning and re-commissioning programs for the building.

### **Resources**

Treschel, Hans, Ed. *Moisture Control in Buildings*. West Conshohocken, PA: American Society for Testing and Materials. 1992.

## **COMMITTEE**

### **Active**

Chair – Hal Levin, Building Ecology Research Group

Mary Lamielle, National Center for Environmental Health Strategies

Ann McCampbell, Multiple Chemical Sensitivities Task Force of New Mexico

Susan Molloy, National Coalition for the Chemically Injured

Charlie Reid, Hamilton County Board of Health, Ohio

Toni Temple, Ohio Network for the Chemically Injured

### **Contributing**

Terry Brennan, Camroden Associates

Dave Rupp, Cabinet King, Inc.

## **ADDITIONAL RESOURCES**

### **General Guidance for Building Cleaning Programs**

**By Charlie Reid**, Member Hamilton County General Health District Board of Directors 1995-Present, Independent Consultant 1983 - Present.

#### **Outdoor Air Intakes & Building Pressurization**

The outside air intakes for positively pressurized buildings have a history of poor location. Many public buildings with utility or service entrances and loading docks have the outside air intake louvers near pollution sources that allow exhaust fumes from trucks to be drawn into the building. Some high-rise office buildings place air intakes in the path of drift from cooling towers on roofs, where contaminants such as bacteria that have caused Legionnaires' disease can enter the ventilation system. Air intakes of other rooftop installations have entrained roof sealants that are emitted into the air. Still others have entrained emissions from plumbing vent stacks resulting in sewer gas entrainment. Roosting birds can also be a source of contaminants that are entrained in outdoor air supply streams.

Outdoor air intakes are often poorly maintained and the areas are dirty. Getting good intake air - either by shielding or relocating intakes or by fine particle filtration eliminates the many contaminants from outside, as well as avoiding the added burden to cleaning inside. Mechanical rooms and nearby areas may also be the location for chemical storage and janitors' closets for many buildings. Mixing chemicals there sends vapors into the ventilation systems of the building. These are cleaning issues that affect indoor air quality.

Since most positively pressurized buildings do not provide for door or window ventilation, all cleaning activities create polluted air until gases and particles are diluted and removed by outside air supply and exhaust. Some older buildings, where the outdoor air supply rates are grandfathered into the energy saving criteria established in the era of President Carter and the 1970's oil embargo, have special problems with indoor air quality. They generally have lower levels of outside air ventilation and, thus, lower levels of dilution.

#### **First Reduce Soil and Dirt:**

Put emphasis on entryways. Reduce tracking in of outside soils and other particulate matter to make inside areas less difficult to clean. Mats, entryway grids, and special ventilation of vestibules reduces intake of soil and dust.

Evaluate high traffic patterns for use of removable matting that can be cleaned away from personnel in order to reduce the overall general cleaning required for carpet.

Limit eating to designated areas that can be cleaned by wiping and light mopping.

Quickly identify and clean spills and stains to eliminate the need for harsher treatments later.

Increase the light wipe and cleaning of hard floors to lessen the required stripping and finishing required. Much of this can be done with water or very light dilutions of an all-purpose cleaner.

Caution on use of the wrong mop is important because residual chemicals on an unrinsed mop can start stripping the finish from the floor, which then requires more frequent refinishing.

Employ better vacuums. Use HEPA (High Efficiency Particulate Attenuation) filtered vacuums with continuous suction. Higher suction not only reduces the amount of soil in buildings, it substantially reduces both hard floor and carpet cleaning. The removal rate makes the cost of high quality equipment worth the investment. The machines are larger, harder to manipulate, and because they have more suction, do not move as fast across the floor. Using a HEPA vacuum following a typical upright vacuum can make a visible difference in the brighter color of a carpet as the floor wand passes over a surface. Ground-in dirt is substantially reduced as is the need to clean the carpet.

Building occupants should be prohibited from having and using cleaning chemicals.

### **Selection of cleaning methods/general rules:**

Chemicals are used to make water work better in cleaning. Chemicals add surface wetting agents, soil reduction and rinsing agents, evaporative qualities, and at times mild coating to prevent re-deposition of soils or the re-appearance of soils. The lower the soil level, the less water needs help to clean.

Higher temperature water dissolves better, cuts greasy soils, and requires less agitation. Increased agitation requires less chemical action to cut into soils.

Wiping and general rinsing after cleaning eliminate the need for many rinsing additives. Most all-purpose cleaners, window cleaners, and other hard surface cleaners have an alternative available in vegetable-based surfactant chemistry. Using many of the alternative products can eliminate alcohol, which lingers in the air long after use. Many of these products can be used in higher dilutions and thus less product is required.

Wiping needs to replace spraying. Many companies have gone to dispensing systems that fill spray bottles. Spraying not only diffuses a solution into the air as well as on the surface, it generally wastes product by over-wetting a surface - thus the need for adding evaporative alcohol to the product. By wetting a wipe lightly and applying to a surface, the excess from spraying does not require the additional labor to work off the hard surface, which saves labor.

Water can be used in general dusting of non-wood surfaces, as can lint-free wipes for most surfaces. Spray devices can be used to dispense into a wipe and this is the most efficient application method.

There is no cleaning need for fragrances and they all need to be eliminated.

There are products on the market which are advertised as deodorizers/re-odorizers that have four times the level of quaternary ammonia as a disinfectant. They are not listed as a disinfectant because they are purportedly for cleaning and reodorizing. This is not uncommon in the labeling of janitorial products.

Fragrances are leading culprits in accessibility problems related to indoor air quality.

Detergent with warm or hot water disinfects as well as disinfectant cleaners most of the time. For quality assurance, use of an ultraviolet light detects bacterial growth and areas which are evading cleaning. In problem areas that are frequently not reached – as behind toilets, around urinals, and beneath the nozzle of soap dispensers - personnel need to be trained and instructed to thoroughly clean the affected area.

Peroxides (as stabilized additives) are capable of disinfecting in more critical areas. Bathrooms, food service areas, and dining areas all follow this general guideline.

Dispensers are most often provided by the companies that sell chemicals. They install the dispensers and set the dilutions. Use of dispensers when building ownership or management is in control of the dispensers is appropriate. Supervisory control over dilutions is essential.

Carpet cleaning often results in off-gassing of toxic solvents for days and even weeks. Use of steam, non-petroleum based cleaners - even in some cases peroxides - and fast drying has proven essential to reducing the impact of cleaning.

Carpets are typically treated with numerous products, including insecticides, sealants, and optical brighteners. No matter what method is used to clean it, e.g., washing, dry-cleaning, or steam cleaning, all cause the release of the built-in chemistry of the carpet.

While it is a general rule to dry carpet in less than 24 hours to reduce the chance for mold growth, optimal drying time is less than 4 hours. This may require selecting less humid days to do the work. It may require increased airflow in the building. It may require blowers and heating to the affected area. It may require higher, more efficient extraction after chemical application. Faster drying shortens the time for the air to recover from the cleaning.

Hard floor finishing is often a process that results in off-gassing for weeks. It is recommended that the work be completed during unoccupied or low occupancy times for the building, using higher air flows for drying, and maintaining maximum dilution with outside air until off-gassing is complete.

Frequent inspections of floors and refinishing only the areas necessary reduces chemical usage and impact. Scheduled finishing may not be the best practice. Using an “inspect and finish as necessary” program allows for limited work to preserve the floors while reducing labor requirements and chemical usage.

Some gel strippers may have lower off-gassing levels and should be evaluated for potential usage. Experiment with strippers to find the lowest effective concentration to achieve the work. Refinishing material as well as strippers should be managed carefully by dispensing in proper amounts to ensure proper usage and to avoid over-usage.

Carpet de-spotting can be accomplished by using mild detergent and baking soda. This old remedy can remove many stains, particularly when fresh. Using the mixture in hot water (120 degrees) and rubbing inward from the outside of the stain can remove many without the use of strong chemicals.

Bathroom fixtures, urinal, and toilets are subject to staining. Where possible, peroxide-based cleaners are preferable. Baking soda provides a mild cleaner-abrasive capability. Use of acids in

difficult circumstances may be necessary. When this is done, the bathroom should be completely ventilated before reopening it for use.

A continuous audit of building practices, education of building personnel, and control of chemical usages by occupants will go a long way in reducing the adverse chemical impacts associated with cleaning. Safer alternative products exist for almost all cleaning needs. Cleaning protocols do not need to change much and can be phased into a building's existing program. While one may look for one practice to save the day, there is no magic bullet. Only one change in cleaning will leave others to create problems. A comprehensive approach is necessary and can be implemented step by step.

### **Checklist Guidance**

Building managers can use the following list of questions as a guide to assess their office building cleaning efforts and to determine where to start transitioning cleaning activities. The checklist does not actually tell a building manager how to set up a cleaning program, but it serves as a starting point for educating everyone involved in a safer air cleaning program—managers, occupants, and janitors—about what they need to do to make it a successful program.

### **Building Considerations**

- How are various areas within the building used? Determine which require the most cleaning, and why (e.g., public restrooms, kitchen areas). What are the hours of use and are there preferred times to clean when personnel are not present?
- Where do people eat (e.g., individual offices throughout the building, designated areas)?
- Are there any special considerations related to the building itself (e.g., is it an historical building that has special preservation requirements or security issues)?
- Do any office furnishings have special cleaning requirements (e.g., thick carpets, antique furniture)?
- Are there any known at-risk populations who may be more adversely affected by the use of some chemicals (e.g., children, people with asthma, allergies or chemical sensitivities, and pregnant women)?
- Does the building have an adequate ventilation system to circulate air throughout the building?
- Does the building have any plumbing or moisture problems?
- Is there a method in place to keep dirt from entering the building (e.g., mats at the front door, double-door entryways)?

### Cleaning Checklist

<b>PROCEDURE</b>	<b>FREQUENCY</b>	<b>PRODUCT BRAND</b> (indicate whether it is purchased in concentrate or ready-to-use form)	<b>MONTHLY PRODUCT USEAGE</b>	<b>CLEANING PROCEDURE</b>
Clean furniture				
Clean walls				
Clean bathrooms				
Disinfection – Bathroom				
Disinfection – General				
Clean washroom fixtures				
Carpet spot removal				
Carpet cleaning				
Gum removal				
Concrete cleaning				
Graffiti removal				
Glass cleaning				
Metal cleaning				
Hard floor – routine cleaning				
Floor stripping				
Floor refinishing				
Other all purpose cleaning				

### **Adequacy of Current Cleaning Program**

- What are issues of concern to management, cleaning personnel, and building occupants? Conduct interviews with all stakeholders rather than on a representative basis.
- Review the log of tenant complaints over the last year. What are the items that come up consistently?
- How is the quality of cleaning currently being evaluated/measured? How often are inspections performed? Are there trends in the problems that are identified?

### **Cleaning Materials Usage**

- List the janitorial products that are currently in use for each of the following categories and identify how often the cleaning task is performed and how much of the product is used per month.
- Are there any reasons to change the procedure or frequency for these cleaning applications? In what manner can chemicals be eliminated or reduced? Seek methods to eliminate usage, reduce usage, and change products to those better for air quality.

### **Selecting Chemicals**

In selecting chemicals for cleaning, there can be considerable confusion. “Green,” “environmentally safe” and various other claims as to the safety of cleaning products do not provide adequate guidance for determining which products do not adversely affect air quality. Below is a list of some terms with which a buyer of chemical products needs to become familiar. The list also includes comments and discussion of alternatives to potentially hazardous chemicals.

Bio-Degradable: The product will break down in the environment over time into supposedly harmless materials. This does not mean the product is safe for the environment, including soil, water, or air.

Chlorine-free: Contains no chlorine, a toxic chemical responsible for substantial problems in air quality as well as more poisonings each year than any other chemical. Oxygen bleaches, the chlorine-free alternatives for bleaching action, are less stable than chlorine bleaches, but much has been done to stabilize oxygen bleaches in the past few years. Do not use concentrated hydrogen peroxide in pure form for disinfection because its application to a flammable surface can cause it to ignite. For scouring, use of baking soda, borax and scrub pads provides additional cleaning capacity. Using a compound containing stabilized peroxide is useful for bleaching.

Natural: Implies the product does not contain synthetic ingredients. Since the use of this term is unregulated and the claim can only be verified by checking with the manufacturer, do not rely upon it for any selection criteria. And since naturally-occurring substances can also be harmful, this term does not have meaning with respect to air quality.

Neutral pH: The product is neither alkaline, nor acidic. These are most useful for products that require handling or mixing or are intended for application to bare skin. Even if a product has a neutral pH, it may have been refined from petroleum and other hydrocarbons and emit volatile fumes. For better air quality, it is often preferable to use a non-petroleum *alkaline* product rather than a solvent or petroleum-based *neutral* product. Very acidic or alkaline products that become airborne can cause irritation and even severe damage to skin, eyes, and lungs.

Non-Toxic: Supposedly only a very large amount will cause damage. Since this term is unregulated in its use, it has little meaning. Fewer than 5% of all cleaning compounds have been tested for safety. A few manufacturers test for skin irritation or ingestion effects. Since a product

can impact air quality and affect people with a large range of sensitivities, a product claiming to be non-toxic may still cause adverse health effects.

Oxygenated: Helps whiten and brighten by releasing oxygen which breaks up stains, and eliminates mildew and mold. See Chlorine above. Oxygenated products, such as those containing hydrogen peroxide, can be as effective as chlorine when used in proper doses and according to safety instructions.

Phosphate-free: Generally meaningless term. Phosphates are allowed by law only in certain automatic dish detergents. Not a criterion for most purchases.

Surfactant: This is the active ingredient in most detergent cleaners, such as all-purpose cleaners, floor cleaners, dish detergents, fabric softeners, and hard surface cleaners. Most often they are created from petroleum and are neutral in pH. Surfactants are used to alter the surface properties of the surface being cleaned. This can make the surface more penetrable, easier to rinse, and less able to be adhered to and more repellent of dirt. Numerous surfactants have been used as reducing agents to dissolve heavy greases and soils. Surfactants are now available in non-petroleum-based (vegetable) forms and the newer surfactants offer interesting new chemistry for air quality. In general they have higher flash points. The vegetable-based surfactants rarely have alcohol or other solvents. They can easily be wiped on and off and do not require evaporative assistance, such as adding alcohol and ether to most window cleaners.

Deodorizer/Re-odorizer: This group of products may contain higher concentrations of quaternary ammonia than disinfectants. They also frequently contain strong fragrances and/or masking agents that diminish the sense of smell. Paradichlorobenzene and naphthalene are common ingredients in fragrance-emitting devices. Deodorizer products are often used in public bathrooms found in restaurants, motels, theaters, subways, trains, airports, airplanes, and other public facilities. The use of deodorizer/re-odorizer products can be avoided by increasing ventilation/air flow and thoroughly cleaning with mildly alkaline non-surfactant detergents followed by the use of disinfectants, preferably peroxide-based ones. Inspection by ultraviolet light is recommended after all intensive cleaning to verify that surfaces have been adequately cleaned

Fragrance: This is an air pollutant that is intended to give the false impression that air is clean. Truly clean air has no smell. Fragrance formulas can contain benzene, toluene, styrene, and formaldehyde, along with other ingredients. Fragrance chemicals can enter the body through the lungs, skin, and nasal passageways. They can affect the brain and nervous system in a matter of seconds, either by their presence in the brain or via stimulation of olfactory nerves. Avoid all products that list fragrance as an ingredient or have a fragrant odor. Be aware that even if "fragrance" is not listed as an ingredient, fragrance chemicals may have been added to a product for another purpose, or claimed to be added for another purpose - such as an anti-microbial stabilizer, blending agent, or enhancer.

Solvent: Water is a solvent. Using alcohol, petroleum, and coal tar-based solvents for floor refinishing, metal cleaning, stain removal, and graffiti control is commonplace. To preserve air quality, use water as a solvent whenever possible. Use petroleum-based solvents only as a last resort. Non-water-based solvents should be used in controlled programs, with substantial increased ventilation, pre-notification of building occupants, use during low building occupancy, and retesting of air to make sure it is clear before a space is re-occupied. The use of many solvent products, such as spot stain-removers, can be eliminated by promptly cleaning stains, using mild

detergent and baking soda with a gentle rubbing action and working in from the outside perimeter of the stain.

Vinegar: An acidic fluid usable for basic surface cleaning, window cleaning, and bathroom fixture wiping. The mild acidic properties provide the ability to remove hard water spots and cut soap films. Note that while vinegar is considered a less-toxic cleaner, some chemically sensitive individuals may react adversely to it.

### **Getting Started**

Eliminating fragranced products is perhaps the quickest and easiest step to improving air quality.

Eliminate air fresheners and fragrance-emitting devices. Do not use urinal or toilet deodorizer blocks which contain paradichlorobenzene, naphthalene, solvents or fragrances. Substitute vegetable-based surfactants combined with microbe-based urea reducing properties. Choose non-fragranced cleaners, hand soaps, and lotions. Choose basic paper items that do not contain fragrances. Do not use cleaner/disinfectant combination products. Disinfectants should be used after a surface is clean for optimal deep cleaning, which should be done on an as needed basis. Inspect cleaned areas using ultraviolet light to verify that the surface has been adequately cleaned. Concentrate heaviest cleaning on essential areas. This will control odor.

Find and remove room deodorizers and dispensing devices. Establish a policy restricting occupant usage of fragrance-emitting plug-ins.

Inventory all current products. Discontinue any product that has fragrance as an ingredient or has a strong odor – such as cleaners containing pine, tea tree oil, orange, lemon, or citrus.

### **Using Above Chart on Cleaning Materials Usage**

Select products used most frequently. This is most often an all-purpose cleaner, a window cleaner, and disinfectant cleaner or straight disinfectant.

Most of these products are overused. In addition, suitable substitutes can almost always be found that have less impact on air quality.

Experiment with dosages to find the minimum amount of cleaning product that will accomplish the job. This is best done after selecting a new vegetable surfactant-based all-purpose cleaner, window cleaner, or oxygen-based disinfectant for bathrooms. Control dispensers to make sure that the minimum dosages necessary are dispensed.

Make increased use of mechanical/physical methods of cleaning to reduce chemical usage.

Vacuuming: Vacuuming extracts soil at a rate of barely 60% when done with typical upright vacuum systems found today. Carpets tend to absorb particles from the air as well as tracked-in grease and other contaminants. Using a stronger vacuum system with continuous suction (non-pumping action) combined with a slower motion increases the extraction rate to above 85%. Keeping vacuumed dirt and fumes from escaping from the vacuum and re-contaminating a room requires strong filtration. HEPA systems work well to remove particulate matter, but care needs to be taken to insure there are no air leaks around the filter. An activated charcoal impregnated membrane will absorb and trap gasses.

A strong vacuuming program that includes daily and thorough vacuuming is the first guard against the need for frequent carpet cleaning. Secondly, evaluate traffic patterns and use throw rugs and entry mats to protect carpeting in heavily trafficked areas that quickly become dirty. Only clean spots or small areas of carpet that require cleaning. Clean carpet on an “as-needed” basis rather than on a regular schedule.

For widespread carpet cleaning, employ extraction methods using steam; mild cleaners that do not contain fragrances or solvents; or peroxide-based cleaners and fast four hour drying to reduce impacts on air quality and chances of mold growth.

Dusting: Wipe surfaces for dusting with lint-free cloths or damp clean rags. This is usually as effective as using chemical dusting products.

Mopping & Buffing: Damp mop hard floors using soft water in high traffic areas. Wipe with a dry mop on return pattern. Frequent mopping protects the floors and reduces the need for buffing and refinishing. Buff floors during off hours using the minimum amount of product necessary to refinish the floor.

Floor Refinishing: Refinish floors based on need rather than a fixed schedule. Keep service records that include the date and area where floor was refinished and the products used. Mandate that only the minimum amount of product necessary to accomplish the job will be used. Provide personnel with information on tracking and the goal of chemical reduction. All stripping and refinishing needs to be done during non-occupancy periods with substantial increases in outside air flow.

### **Keep Track**

Using a computer, create an ongoing tracking system on reductions in the amount and number of chemicals used, changes in chemicals used, and eliminations of chemicals. This overall program needs to be continuously evaluated and communicated to building owners, managers, and occupants.

## **Steps for Implementing a Scent-Free Policy in the Workplace**

(Adapted from the Canadian Centre for Occupational Health and Safety)

### **What steps should I take when implementing a scent-free policy in the workplace?**

The situation may arise and create the need for a scent-free policy. As with most workplace policies, be sure to consider the following:

- Conduct an assessment or survey of the employees to determine the extent of the problem. Collect opinions and suggestions at the same time to help you develop a policy appropriate to your workplace.
- Designate one key person to oversee the project and its development. If you work at a large company, it may be better to create a committee with members representing all groups (employees, unions, management).
- Involve the health and safety committee, and get management commitment from the beginning.
- Set and stick to deadlines for creating a draft policy, a review of the policy, and for implementation.
- Be sure that all employees have been fully informed of the policy and that they know what they have to do before the policy becomes effective.
- Educate the employees. You may choose to include brochures or flyers in payroll envelopes, publish articles in company newsletter, or give presentations. In any case, the goal is to inform all employees of the health concerns related to scents and why the policy is needed.
- Address any concerns the employees raise openly and honestly. Reinforce the idea that this policy is being implemented as a result of medical concerns - not merely because of a dislike for a certain smell.
- Make it clear that the policy applies to everyone (including visitors, patients, etc).
- Search local legislation for any supporting documentation.
- Do not limit the scent free policy to perfumes and colognes. Many cleaning and personal care products also have scents.
- Post a list of "approved" unscented products and where they are available locally.
- Review all MSDSs for the products currently used and for those you are considering using. Make sure that the ingredients are acceptable. Remember that some products which claim to be scent-free may be using additional chemicals to mask smells instead of truly being "unscented".
- Conduct trials in limited areas before purchasing large quantities of a product.
- Post notices that waxing, shampooing, painting, or spraying (etc.) will be conducted one week beforehand so that affected personnel can make arrangements or have their duties modified during that time.
- Put the policy statement notice on all appointment cards, stationery, room booking notices, employment postings, etc.
- Decide on wording for 'Scent Free' signs and where the signs will be posted.
- Let everyone know that the policy will be reviewed and can be changed because of experience or new knowledge.

### **What is an example of a policy?**

Policies should be based on the health concerns of employees - especially those who have sought medical help. Keep the policy short, but specific. The policy must also apply uniformly throughout the company.

<b>Sample: Scent-Free Policy</b>
<p><b>Policy:</b></p> <p>Due to the health concerns arising from exposure to scented products, ABC Company Inc. has instituted this policy to provide a scent-free environment for all employees and visitors.</p>
<p><b>Definitions:</b></p> <p>The use of scented products will not be allowed within the building at any time. In addition, all materials used for cleaning will be scent-free (where ever possible).</p> <p>A list of locally available scent-free products is available from the health and safety office.</p>
<p><b>Procedure:</b></p> <p>Employees will be informed of this policy through signs posted in buildings, the policy manual, promotional materials and will receive orientation and training.</p> <p>Visitors will be informed of this policy through signs and it will be explained to them by their host.</p> <p>Any violations of this policy will be handled through standard disciplinary procedures.</p> <p>This policy is effective on 01/01/01.</p>

**What should the 'posted notice' say?**

Signs should be posted near the entrances to company building(s). In addition, statements on business cards, letter head or promotional materials may be helpful if you receive a lot of visitors.

Examples include:

Some people who work at ABC Company report sensitivities to various chemical-based or scented products. We ask for everyone's cooperation in our efforts to accommodate their health concerns.

In response to health concerns, ABC Company has developed a Scent-Free Policy. Scented products such as hair spray, perfume, and deodorant can trigger reactions such as respiratory distress and headaches. Staff and visitors are asked to not use these products when reporting to this office.

ABC Company is a Scent-free environment. Please do not use scented products while at work.

**National Institute of Building Sciences (NIBS)  
Indoor Environmental Quality (IEQ) Project  
Designated Cleaner Air Rooms Committee**

**Table of Contents**

**Introduction and Overview**

**Promising Practices**

**Recommended Actions**

**Committee Recommendations**

**National Cleaner Air Signage**

**Background**

**Purpose**

**Proposed Language**

**Conditions of Use**

**Paths of Travel**

**Restrooms**

**Contact Information**

**Maintaining A Cleaner Air Record Log**

**Removal Of The Symbol**

**Temporary Use Of Cleaner Air Symbol**

**Further Explanation of the Criteria for Conditions of Use**

**No Smoking**

**Fragrance-Free**

**Pesticide-Free Indoors and Outdoors**

**Least Toxic/Risk Cleaning Products**

**No Recent Construction or Remodeling Including Carpet Installation**

**Cell Phones Turned Off**

**Ability to turn off or unplug computers and other electrical equipment by occupant or staff**

**Ability to turn off fluorescent lighting by occupant or staff**

**Ability to adjust temperature and air flow by occupant or staff, or the availability of operable window(s)**

**Recommendations for Accommodations**

**References**

**Resources for Access and Accommodations**

**Committee**

**Appendices**

**California Code Regulations**

**Southwest Community Health System Policy Guideline**

**MCS Nursing Protocol**

**INTRODUCTION AND OVERVIEW**

Individuals with multiple chemical and/or electromagnetic sensitivities have identified the availability of designated cleaner air rooms and paths of travel in public and commercial buildings as highly important for improving access. The Designated Cleaner Air Rooms Committee examined the rationale for having Designated Cleaner Air Rooms, the types of

buildings or occupancies that may be appropriate for having such rooms, the minimum criteria for such a designation, and who would benefit from having these rooms.

### **Promising Practices**

In November 2001 the State of California adopted a Cleaner Air Symbol and Conditions of Use in its building code to identify areas in publicly funded or leased facilities owned by the State of California that are accessible to and useable by people who are adversely impacted by airborne chemicals or particulate(s) and/or the use of certain electrical fixtures or devices.(1) The symbol can be used when minimum conditions established in the code are met. Use of the designation is voluntary.

A fact sheet on the California Cleaner Air Symbol and Criteria can be found at:

[http://www.documents.dgs.ca.gov/dsa/pubs/cleanerair\\_factsheet.pdf](http://www.documents.dgs.ca.gov/dsa/pubs/cleanerair_factsheet.pdf)

See *1117B.5.11 Cleaner air symbol* (page 109) of the California Code of Regulations for the code language: (see Appendix A)

[www.documents.dgs.ca.gov/dsa/pubs/regulations\\_02-16-05.pdf](http://www.documents.dgs.ca.gov/dsa/pubs/regulations_02-16-05.pdf)

### **Recommended Actions**

The Committee was charged with

- 1) reviewing the California symbol and criteria and investigating where it has been implemented, how it has worked, and what modifications and improvements, if any, are necessary to recommend broader usage;
- 2) developing and promoting a national Cleaner Air Symbol and Conditions of Use as appropriate; and
- 3) defining the scope of guidelines for creating an ideal zone (room and path of travel) hereafter referred to as a Clean Air Room in buildings for people with chemical and/or electromagnetic sensitivities.

During the project, the scope of work was expanded to include a brief discussion of accommodations for people with multiple chemical and/or electromagnetic sensitivities to address the needs of those individuals for whom a Cleaner Air Room would not provide adequate access or for those situations when such a designation would not be possible or feasible. Resources that address access and accommodations for people with multiple chemical and/or electromagnetic sensitivities at work, at school, at public meetings, and in hospitals are included at the end of this report.

### **Committee Recommendations**

- The Committee highly recommends that the Access Board and/or the National Institute of Building Sciences (NIBS) fund or seek funding for FY2006 to develop specifications for designing and constructing a Clean Air Room and Path of Travel, the ideal or model room. This project is a natural outgrowth of the work of the other three committees.
- The Committee proposes a Pilot Project for FY2006 to implement a national Cleaner Air Symbol, as promulgated by the State of California, and Conditions of Use, as modified in the National Cleaner Air Signage, Conditions of Use section below, in

select public and commercial buildings such as independent living centers, disability organizations, schools and other educational institutions, public meeting places, or other business or government entities. The Committee recommends that one or more committee members in conjunction with the Access Board and/or the National Institute of Building Sciences assist in its implementation, track its use, analyze how well it has worked, and determine whether modifications or improvements are necessary prior to recommending promotion nationally. This same group would also examine implementation of the California Signage which is expected to take place during the same time frame.

- The Committee recommends that the Access Board, or a committee created by the Board, identify, review, summarize, and publish best practices for accommodations for people with multiple chemical and/or electromagnetic sensitivities on the website. Such a project was previously proposed by Access Board officials and discussed with members of this Committee but was not part of the charge of the current project.

## **NATIONAL CLEANER AIR SIGNAGE**

### **Background:**

In November 2001 the State of California adopted the California Cleaner Air Symbol, California Building Code, Title 24, Parts 2 and 12, 1117B.5.11ff., which established a symbol and criteria for conditions of use to identify a room, facility, and paths of travel that are accessible to and useable by people who are adversely impacted by airborne chemicals or particulate(s) and/or the use of electrical fixtures and/or devices. Installation and use of the Cleaner Air Symbol is on a voluntary basis in state buildings. The Committee learned that the Cleaner Air Symbol has yet to be implemented in California although members of our group are aware of individuals in California and in other states who are using the symbol as a means of advocating for or obtaining individual access needs.

The California Cleaner Air Symbol and Conditions of Use were also proposed for adoption at the meeting of the Accredited Standards Committee A117 on Architectural Features and Site Design of Public Buildings and Residential Structures for Persons with Disabilities in December 2001.(2) The Cleaner Air Symbol received a favorable vote. It was later dropped prior to the issuance of the final standard in 2003: International Code Council, American National Standard-Accessible and Useable Buildings and Facilities, ICC/ANSI A117.1-2003. The Cleaner Air Symbol is expected to be reintroduced for consideration during a new standard cycle that will begin shortly. The Standard must be adopted by a state or locality to be enforceable.

The Committee also discussed the identification of state buildings in California that might qualify for the Cleaner Air Symbol either due to a building's unique ability to meet the implementation criteria, or the need to make public meeting rooms accessible for those with chemical and/or electromagnetic sensitivities. Committee members are also aware of the need to encourage residents of California who may need to access state buildings to seek to implement the Cleaner Air Symbol.

### **Purpose:**

To provide voluntary guidelines for a Cleaner Air Symbol that can be used nationally or adapted for state and local use.

### **Proposed Language:**

National Cleaner Air Symbol: The national symbol shall be the standard used to identify a room, facility, and paths of travel that are more accessible to and useable by people who are adversely impacted by airborne pollutants, such as those with chemical sensitivities, asthma, and other respiratory conditions, and/or people who are adversely impacted by electromagnetic fields from electrical fixtures and equipment such as those with electromagnetic sensitivities.

The Symbol will comply with the specifications as described in the California code.

When the Cleaner Air designation symbol is used, the following requirements must be met:

- The symbol and text, "Cleaner Air" is displayed within a minimum 6-inch square;
- The "Cleaner Air" text is located under the symbol, as shown
- The Cleaner Air Symbol is shown as either a negative or positive image.
- The symbol and text are posted in either black and white, or in Federal Blue and white. When blue is used, Federal Blue Color No. 15090, Federal Standard 595B, is used.
- There is at least a 70% color contrast between the backgrounds of the sign and the surface that it is mounted on.

### **Conditions of Use**

The Cleaner Air Symbol may be posted to identify the room and path of travel if there is verification that the room, facility, and path of travel to the room meet all of the Cleaner Air Requirements as indicated below:

- No Smoking
- Fragrance-Free
- Pesticide-Free (Indoors and Outdoors)
- Least Toxic/Risk Cleaning Products
- No Recent Construction or Remodeling Including Carpet Installation
- Cell phones turned off
- Ability to turn off or unplug computers and other electrical equipment by occupant or staff
- Ability to turn off fluorescent lighting by occupant or staff
- Ability to adjust temperature and air flow by occupant or staff, or the availability of operable window(s)

### **Paths of Travel**

Every effort should be made to make the Paths of Travel as accessible as possible for those with multiple chemical and/or electromagnetic sensitivities even though the paths of travel might not meet all of the criteria of the Cleaner Air Room. It is important that the Path of Travel from the building entrance to the Cleaner Air Room be as short as possible. The building entrance should also be fully accessible to those with mobility and other impairments.

### **Restrooms**

If possible, restrooms that are already fully accessible to those with mobility and other impairments should be designated for use by those individuals using the Cleaner Air Room. These restrooms should be located along the path of travel or as close as possible to the Cleaner Air Room. The restrooms should meet as many of the criteria as possible. The restrooms should prohibit smoking and be free of perfumes, fragranced products, air fresheners, deodorizers, and pesticides. Cleaning should be done with the same least toxic products used in the Cleaner Air Room. Cell phones should be turned off along the path of travel and in the restrooms.

**Contact Information** for the building/facilities manager or the designated agent responsible for maintaining and/or recording activity in the Cleaner Air Room should be posted at the Cleaner Air Room and at the accessible entrance, if possible, and be readily available to anyone seeking additional information by telephone, fax, e-mail, or mail.

### **Maintaining a Cleaner Air Record Log**

A log shall be maintained on site, accessible to the public either in person or by telephone, fax, e-mail, mail or other accessible means as requested. One or more individuals shall be designated to maintain the log. The log shall record any product or practice used in the designated Cleaner Air Room, the path of travel, and accessible restrooms, as well as scheduled activities that may impact the Cleaner Air designation. The log shall also include the product label and Material Safety Data Sheet(s), as available, for any products used. Note, however, that neither the MSDS nor the product label provides complete information on product ingredients or their potential health effects.

### **Removal of The Symbol**

If the path of travel, room and/or facility restrooms identified by the Cleaner Air Symbol should temporarily or permanently cease to meet the minimum conditions as set forth above, the Cleaner Air symbol shall be removed and shall not be replaced until the minimum conditions are again met.

### **Temporary Use of Cleaner Air Symbol**

The Cleaner Air Symbol may be used to identify a room, path of travel, and restrooms that meet the conditions of use on a temporary basis.

### **Further Explanation of the Criteria for Conditions of Use:**

**No Smoking:** Smoking is prohibited in the path of travel, Cleaner Air Room, and restrooms serving the room. To qualify as a Cleaner Air Room, the room, path of travel, restrooms and surrounding area must be free of tobacco residue. Those who smoke, or who have tobacco residue on their person, would be prohibited from using the room. Smoking should be restricted to outdoor, designated smoking areas that are at a minimum of 100 feet from paths of travel, entryways, operable windows, and air intakes. (See No Smoking Policy, Operations and Maintenance Report)

**Fragrance-Free:** Prohibit fragrance-emitting devices (FEDS), air fresheners, deodorizers, and similar products. Recommend that no fragranced, citrus-and/or pine-based products be used in cleaning or maintaining the room, path of travel, and restrooms. Any persons with perfume, cologne, aftershave, as well as fragranced personal care and laundry products, would be prohibited from using the room. (See Fragrance-Free Policy, Operations and Maintenance Report)

### **Pesticide-Free Indoors and Outdoors:**

Practice Integrated Pest Management. Use least hazardous pest management materials such as non-volatile baits, sticky traps, and boric acid with knowledge and input from those using the path of travel and Cleaner Air Room. The sign should be removed in the event of a least hazardous pesticide application for 24-48 hours because it is likely that the certified pest control applicator is in regular contact with chemical pesticides and could leave residue from clothing or equipment. In addition, some chemically sensitive individuals may be made sick by exposure to even least hazardous pesticides especially when they are first applied.

In the event of a chemical pesticide application made to the building or grounds, other than a least hazardous pesticide such as those listed above, remove the sign and consult with those who use the space and others regarding the length of time that the room would need to be closed to protect affected populations based on the product(s) used. (See Operations and Maintenance for least hazardous pest management materials and cautions in the event that a chemical pesticide application is considered for use in the Cleaner Air Room, Path of Travel, Restrooms, or the building or grounds.)

**Least Toxic/Risk Cleaning Products:**

Avoid or limit the use of products containing chlorine, ammonia, quaternary ammonium, phenol, isopropyl and other alcohols, formaldehyde, and other petroleum distillates. Do not use fragranced, citrus-and/or pine-based cleaning products as mentioned above. Consult those who plan to use the Cleaner Air Room and Path of Travel for cleaning product recommendations. Follow the recommendations of Operations and Maintenance Report for best practices.

**No Recent Construction or Remodeling Including Carpet Installation:**

Every effort should be made to avoid remodeling activities in the Cleaner Air Room, path of travel, and restrooms. Any remodeling activity would require removal of the signage. The length of time for removal should be determined by the type of activity, extent of the remodeling, and the products and materials selected for use. It is important to choose the least toxic, least problematic products and practices. Except for minimal touch up painting, for example, it would not be unusual to have the signage removal in effect for a period of 3- 6 months to a year or more depending on the nature and extent of the remodeling activity. Be sure to consult building occupants with existing health problems and those who are using the Cleaner Air Room for their input and to help determine when the Cleaner Air Room may again be safe for use. (See Products and Materials Report and Design and Construction Report for more information)

**Cell Phones Turned Off:**

Protect those with electromagnetic sensitivities and others who may be adversely affected by electrical equipment.

**Ability to turn off or unplug computers and other electrical equipment by occupant or staff:**

Protect those with electromagnetic sensitivities and others who may be adversely affected by computers and electrical equipment.

**Ability to turn off fluorescent lighting by occupant or staff:**

LEED (Leadership in Energy and Environmental Design) recommendations for new construction call for individual control of lighting.(3) Newer fluorescents that contain electronic rather than magnetic ballasts may be less problematic for some people with electromagnetic sensitivities because they do not produce a visible flicker or audible hum. They are also less prone to trigger seizures.

**Ability to adjust temperature and air flow by occupant or staff, or the availability of operable window(s):**

LEED recommendations for new construction include individual control of temperature and ventilation.(3) Opening an operable window may improve the air quality or air flow in a Cleaner Air Room and compensate for situations when individual control of temperature and air flow is not possible.

The text below is duplicated on the website

\*\*\*\*\*

## RECOMMENDATIONS FOR ACCOMMODATIONS

People with chemical and/or electromagnetic sensitivities can experience debilitating reactions from exposure to extremely low levels of common chemicals such as pesticides, cleaning products, fragrances, and remodeling activities, and from electromagnetic fields emitted by computers, cell phones, and other electrical equipment.

The severity of sensitivities varies among people with chemical and/or electromagnetic sensitivities. Some people can enter certain buildings with minor accommodations while others may be so severely impacted that they are unable to enter these same spaces without debilitating reactions. Furthermore tolerances to specific exposures can vary greatly from one individual to the next. Meanwhile some exposures, such as the application of certain pesticides or extensive remodeling, for example, may be devastating to all chemically sensitive people and make a building or facility inaccessible for a substantial period of time.

According to the Americans with Disabilities Act (ADA) and other disability laws, public and commercial buildings are required to provide reasonable accommodations for those disabled by chemical and/or electromagnetic sensitivities. These accommodations are best achieved on a case-by-case basis.

Reasonable accommodations for a chemically sensitive and/or electromagnetically sensitive individual can include providing a space or meeting area that addresses one or more of the Cleaner Air criteria, upon request, such as

- Remove fragrance-emitting devices (FEDS)
- Delay or postpone indoor or outdoor pesticide applications, carpet cleaning, or other cleaning or remodeling until after the meeting
- Provide room or meeting area near exterior door or with window(s) that can be opened
- Require cell phones and computers be turned off
- Provide incandescent lighting in lieu of fluorescent lighting
- Provide at least one nonsmoking, fragrance-free person per shift to provide services (e.g. nurse, police officer, security guard, clerk )

For individuals who are unable to use or meet in a building or facility, or who are too severely impacted by chemical and/or electromagnetic exposures to use a designated Cleaner Air Room, accommodations may include:

- Meet an individual at the door or outside to conduct business
- Allow a person to wait outside or in car until appointment
- Provide a means, such as a phone, intercom, bell, or buzzer to summon staff to an outside door for assistance
- Permit business to be conducted by phone, fax, mail, or e-mail rather than in person
- Allow participation in a meeting by speakerphone

**End duplicated text**

**SPECIAL ACKNOWLEDGEMENT:** The Committee extends a generous thank you to Sharon Toji, Access Communications, for designing the Cleaner Air Symbol and making it available for public use.

## REFERENCES

- 1) California Access Compliance Reference Manual, Division of the State Architecture, Chapter 11B Part 2 Title 24, California Code of Regulations 110 November 1, 2002.
- 2) American National Standards Institute (ANSI) Accredited Standards Committee A117, Committee on Architectural Features and Site Design of Public Buildings and Residential Structures for Persons with Disabilities, [www.iccsafe.org/cs/standards/a117/index.html](http://www.iccsafe.org/cs/standards/a117/index.html)
- 3) LEED Green Building Rating System for New Construction & Major Renovation, (LEED-NC), Version 2.1, US Green Building Council, pages 68 and 69. [www.usgbc.org](http://www.usgbc.org)  
LEED Controllability of Systems:  
6.1 Provide at least an average of one operable window and one lighting control zone per 200 SF for all regularly occupied areas within 15 feet of the perimeter wall.  
6.2 Provide controls for each individual for airflow, temperature and lighting for at least 50% of the non-perimeter, regularly occupied areas.

## RESOURCES FOR ACCESS AND ACCOMMODATIONS

Lamielle, M., Creating an Accessible Indoor Environment, Fact Sheet, National Center for Environmental Health Strategies, 2004.

Lamielle, M., Multiple Chemical Sensitivity and the Workplace, National Center for Environmental Health Strategies, 2004.

Temple, T., Healthier Hospitals, Ohio Network for the Chemically Injured, 1996.

Miller, CS, Ashford, NA, Multiple Chemical Intolerance and Indoor Air Quality. In Indoor Air Quality Handbook, Spengler, J, Samet J and McCarthy J, Eds., New York, McGraw-Hill, Inc., 2000.

Job Accommodations Network, a free service of the Office of Disability Employment Policy, U.S. Department of Labor, [www.jan.wvu.edu](http://www.jan.wvu.edu)

University of Minnesota, Disability Services, Internal Guidelines Regarding Multiple Chemical Sensitivity/Environmental Illness (MCS/EI), <http://ds.umn.edu/disabilities/MCSEIPolicy.html>

The Evergreen State College, policy on air quality, [www.evergreen.edu/policies/g-air.htm](http://www.evergreen.edu/policies/g-air.htm)

## COMMITTEE

### Active

Chair – Michael Mankin, Division of the California State Architect  
Libby Kelly, Council on Wireless Technology Impacts  
Mary Lamielle, National Center for Environmental Health Strategies  
Ann McCampbell, Multiple Chemical Sensitivities Task Force of New Mexico  
Susan Molloy, National Coalition for the Chemically Injured  
Toni Temple, Ohio Network for the Chemically Injured

### Contributing

Mark Jackson, Lennox Industries, Inc.  
R. Bruce McCreary, Snowflake, AZ

### Commenting

Dora McGregor, Salt Lake City, UT

## APPENDICES

**Appendix A - 1117B.5.11 Cleaner air symbol** (page 109) of the California Code of Regulations

*1117B.5.11 Cleaner air symbol. “STRICTLY FOR PUBLICLY FUNDED FACILITIES OR ANY FACILITIES LEASED OR RENTED BY STATE OF CALIFORNIA. NOT CONCESSIONAIRES”. This symbol shall be the standard used to identify a room, facility and paths of travel that are accessible to and usable by people who are adversely impacted by airborne chemicals or particulate(s) and/or the use of electrical fixtures and/or devices. When used, the symbol shall comply with Figure 11B-40.*

*1117B.5.11.1 Color and size of symbol. The symbol shall be used when the following minimum conditions are met. The symbol, which shall include the text “Cleaner Air” as shown, shall be displayed either as a negative or positive image within a square that is a minimum of 6 inches on each side. The symbol may be shown in black and white or in color. When color is used, it shall be Federal Blue (Color No. 15090 Federal Standard 595B) on white, or white on Federal Blue. There shall be at least a 70% color contrast between the background of the sign from the surface that it is mounted on.*

*Strictly for publicly funded public facilities or any facilities leased or rented by State of California. Not concessionaires.*

\* In 1117B.5.8.1 (Symbols of Accessibility) the title of this section is incorrectly worded, which is causing misunderstanding regarding proper standard reference. Change title to read ‘International Symbol of Accessibility.’ This will be submitted for correction in Rulemaking.  
CALIFORNIA ACCESS COMPLIANCE REFERENCE MANUAL . DIVISION OF THE  
STATE ARCHITECT

**1117B.5.11.2 Conditions of use.** *Use of the cleaner air symbol is voluntary. The cleaner air symbol shall be permitted for use to identify a path of travel, and a room or a facility when the following is met.*

- 1. Floor or wall coverings, floor or wall covering adhesives, carpets, formaldehyde-emitting particleboard cabinetry, cupboards or doors have not been installed or replaced in the previous 12 months.*
- 2. Incandescent lighting provided in lieu of fluorescent or halogen lighting, and electrical systems and equipment shall be operable by or on behalf of the occupant or user of the room, facility or path of travel.*
- 3. Heating, ventilation, air conditioning and their controls shall be operable by or on behalf of the occupant or user.*
- 4. To maintain "cleaner-air" designation only nonirritating, nontoxic products will be used in cleaning, maintenance, disinfection, pest management or for any minimal touch-ups that are essential for occupancy of the area. Deodorizers or Fragrance Emission Devices and Systems (FEDS) shall not be used in the designated area. Pest control practices for cleaner-air areas shall include the use of bait stations using boric acid, sticky traps and silicon caulk for sealing cracks and crevices. Areas shall be routinely monitored for pest problems. Additional nontoxic treatment methods, such as temperature extremes for termites, may be employed in the event of more urgent problems. These pest control practices shall not be used 48 hours prior to placement of the sign, and the facility shall be ventilated with outside air for a minimum of 24 hours following use or application.*
- 5. Signage shall be posted requesting occupants or users not to smoke or wear perfumes, colognes or scented personal care products. Fragranced products shall not be used in the designated cleaner-air room, facility or path of travel.*
- 6. A log shall be maintained on site, accessible to the public either in person or by telephone, e-mail, fax or other accessible means as requested. One or more individuals shall be designated to maintain the log. The log shall record any product or practice used in the cleaner-air designated room, facility or path of travel, as well as scheduled activities, that may impact the Cleaner-Air designation. The log shall also include the product label as well as the \*Material Safety Data Sheets (MSDS).*

**1117B.5.11.3 Removal of symbol.** *If the path of travel, room and/or facility identified by the cleaner air symbol should temporarily or permanently cease to meet the minimum conditions as set forth above, the cleaner air symbol shall be removed and shall not be replaced until the minimum conditions are again met.*

**Appendix B – SOUTHWEST COMMUNITY HEALTH SYSTEM POLICY GUIDELINE**  
Southwest General Health Center (SWGHC)  
Middleburg Heights, OH

**EFFECTIVE DATE: July, 2002**

**POLICY 742**

**Revision Dates:**

**Page 1 of 7**

**POLICY NAME: MULTIPLE CHEMICAL SENSITIVITY SYNDROME (MCS)**

**POLICY:**

Southwest General Health Center will provide guidelines to ensure optimal care of the patient experiencing Multiple Chemical Sensitivity (MCS) which is mutually established with the patient, family/significant other and health care team.

**I. INTERPRETATION:**

Multiple Chemical Sensitivity (MCS), also referred to as environmental illness or chemical injury is a medical condition in which individuals develop symptoms from exposure to very low level of chemicals in the environment. The interdisciplinary team at SWGHC uses a collaborative process with the patient, physician, family/significant other and the health care associates to establish a safe environment, to promote healing and ensure comfort.

**II. OBJECTIVES:**

An organizational approach to patient management with multiple chemical sensitivities includes:

- A. Method to ensure patient is placed in a safe environment.
- B. Method to facilitate identification of a MCS patient.
- C. Method to verify competency of all associates providing direct and supportive care to the patient with MCS
- D. Method to ensure patient's participation in developing their care plan.
- E. Method to ensure patient/their families/significant others are educated about the need to communicate about any special care required.

**III. OVERSIGHT AND RESPONSIBILITY**

A coordinated organizational program to care for MCS patients will be developed by an interdisciplinary team. This committee will have the responsibility for assuring that all provisions of this policy are adhered to throughout the organization. The team will have representatives from:

- A. Medical Staff
- B. Nursing Services
- C. Central Sterile Supply
- D. Protection Services

SOUTHWEST GENERAL HEALTH CENTER  
STANDARD OF PRACTICE

PAGE 2 OF 7	MULTIPLE CHEMICAL SENSITIVITY SYNDROME	POLICY 742
----------------	--	---------------

- E. Nutritional Services
- F. Plant Operations
- G. Environmental Services
- H. SSA's
- I. Pharmacy
- J. Social Services
- K. Administration

**IV. SPECIFIC ROLES AND RESPONSIBILITIES OF INTERDISCIPLINARY TEAM**

- A. Medical Staff -Physician: Provides special instructions, treatments, diagnostic tests and medication orders. No treatments/medications should be administered to an MCS patient without prior approval of patient's private physician unless a life threatening emergency exists.
- B. Nursing Services  
Role and responsibilities:
  - 1. Identify the patient with MCS
  - 2. Provide a safe patient care environment.
  - 3. Develop an awareness, sensitivity and respect of patients' physical and emotional needs.
  - 4. Develop a plan of care on daily basis with minimum of one staff member per each shift to attend medical needs of the patient.
  - 5. Comply with the following when caring for the MCS patient:
    - a) be perfume and scent free (ie., no hair spray, no mousse gels, lotions, cigarette/smoking smells).
    - b) Do not use aerosol products (ie hair spray, deodorants). Non-scented, potassium salts, pump deodorant is acceptable. Baking soda (dry).
    - c) Do not wear new clothing which has not been laundered.
    - d) Do not wear clothing which has been freshly dry-cleaned.
    - e) Use only latex free gloves
    - f) Wash hands and apply gloves before entering the patient's room.
    - g) Be alert for any environmental triggers when following normal hospital procedures.
- C. Central Sterile: Provides and ensures the unit with
  - 1. Latex free products
  - 2. Adequate supply of sterile linens

SOUTHWEST GENERAL HEALTH CENTER  
STANDARD OF PRACTICE

PAGE	MULTIPLE CHEMICAL SENSITIVITY SYNDROME	POLICY
------	--	--------

3. Adequate supply of other medical core items (ie. Sponges, dressings, securing devices).
4. Patient can provide their own linens if other methods are not satisfactory.

D. Protection Services: Provides assistance from the vehicle to hospital in a safe manner. (Turn vehicle engines off)

E. Nutritional Services: Recognizes different food sensitivities and follows certain guidelines to accommodate and meet individualized needs of the MCS patient.

Special provisions may include but will not necessarily be limited to the following:

1. No processed foods of any kind including instant oatmeal, instant potatoes, and other

prepackaged mixes, ie., gravies, sauces, and flavor packets as they may contain many

additives.

2. Use no dyes, preservatives, sulfites, artificial flavoring or MSG.
3. Use no aerosol cooking sprays.
4. Use no artificial sweeteners.
5. Distilled water in glass containers to be provided by Nutrition Services, or patient may supply his/her own tolerated water for drinking.
6. Serve beverages which have not been processed with chemicals.
7. Nutrition Services will provide lactose free milk or a substitute such as soy or rice milk to those who require it.
8. Rigidly follow physician's orders regarding food restrictions.
9. Review food allergies within the food service to avoid allergic reactions.
10. Permit patient to supply his/her own tolerated food products. Nursing will provide a proper storage area for them.
11. Do not serve food or liquids in plastic or Styrofoam. Use only glass or ceramic dishes and cups which have been well rinsed to remove all traces of soap and chemical residues. Cellophane or plastic wrap packaging on room temperature food (i.e., crackers) is typically not a problem, however, caution must be used if toxic inks are used. Anything noticeably odorous can be a problem.
12. Remove treated i.d. menu paper from the tray and replace tray liners that may have become wet during transport.

F. Plant Operations: Plant Operations will not perform remodeling or painting within close proximity to MCS patient's room. These activities can be coordinated with the leadership of patient care area.

SOUTHWEST GENERAL HEALTH CENTER  
STANDARD OF PRACTICE

PAGE 4 OF 7	MULTIPLE CHEMICAL SENSITIVITY SYNDROME	POLICY 742
----------------	--	---------------

- G. Environmental Services: will perform terminal cleaning.
1. Refer to Environmental Services Policy for MCS room cleaning.
  2. Staff will check with the floor nurse before entering the patients room.
  3. Environmental Services will coordinate with the patient's nurse for cleaning of the patient's room or performing any special cleaning tasks in the general area (i.e., floor waxing or floor wax removal in the halls). Whenever there is a question of what may affect the health of an MCS patient, the floor nurse must be consulted.
  4. Scented products, air fresheners, deodorizers or other additives should not be placed in any vacuum cleaner bag used anywhere in the health center. Use only unscented vacuum cleaner bags.
  5. Do not use any other housekeeping products (garbage bags, paper towels, cleaning solutions) which contain fragrances or pesticides. These products should be stored in an area separate from disinfectants, soaps and other cleaning products. Do not store toilet paper, facial tissues or other patient items near fragranced or pesticide products.
- H. SSA's: Will perform daily cleaning of the patient's room by using the following guidelines.
1. SSA's must wear clean gowns and caps when cleaning the room of MCS patient when patient is in the room.
  2. Do not use any other housekeeping products (any plastic bags, paper towels, cleaning solutions which contain fragrances or pesticides). Do not use any air fresheners or deodorizers in patient's room.
  3. Dust with a clean cotton cloth moistened with only water.
  4. Use baking soda or Bon Ami cleanser for tubs, sinks and toilet.
  5. Remove trash at least twice daily. Do not use plastic liners.
  6. Do not leave patient trays in the room after meals.

SOUTHWEST GENERAL HEALTH CENTER  
STANDARD OF PRACTICE

PAGE 5 OF 7	MULTIPLE CHEMICAL SENSITIVITY SYNDROME	POLICY
----------------	--	--------

I. Pharmacy

Provides pharmaceutical care guidelines to patient, family and health care team members. The following guidelines are helpful in providing medications to patients with MCS:

1. Have patient bring medications to the hospital that he/she is currently using. If the physician desires the patient to continue using these medications, an order shall be written to state such.
2. Use glass bottles for IV solutions and any prescription medications that are to be administered intravenously.
3. Do not use any substitutions or generic drugs for medications ordered without patient or MD approval.
4. Be alert for standard ingredients MCS patients typically react to including but not limited to dyes, preservatives, artificial sweeteners and flavoring. Consider capsules instead of tablets.
5. Monitor medication by listing the patient's specific allergies on the patient's medication profiles.

J. Social Services

Provides psychological support and interventions, assists patient and family with community resources and discharge planning.

K. Administration

Provides support and assistance in developing a safe environment for MCS patient.

PROCEDURE:

- A. Admitting will adhere to the following to assist all health care center personnel in caring for the patient:
- 1) Flag patient's chart clearly and boldly with MCS under the allergies.
  - 2) Flag patient's chart to notify all other health center departments in advance of treating the patient so proper precautions can be made for necessary equipment and special supplies.
  - 3) Indicate "MCS" on patient's allergy band.

SOUTHWEST GENERAL HEALTH CENTER  
STANDARD OF PRACTICE

PAGE 6 OF 7	MULTIPLE CHEMICAL SENSITIVITY SYNDROME	POLICY 742
----------------	--	---------------

B. Emergency Department:

Will assist health care center personnel in diminishing any unnecessary discomfort and possible risks when MCS patient is brought into the Emergency Room. The following is initiated:

- 1) Immediately contact patient's physician for special instructions.
- 2) Immediately isolate patient from all other patients and visitors.
- 3) Place patient in an area which is not used to store any medical supplies or medications.
- 4) Keep a supply of sterile linens and gowns in the emergency room area.
- 5) Provide the least toxic pharmaceutical supplies and equipment.
- 6) Coordinate with all other health center departments to meet patients' needs.
- 7) Monitor the general environment the patient is placed in.

C. Patient's Room

Staff will implement numerous measures to prevent unnecessary exposure.

Prior to patient's occupancy:

- Contact Environmental Services for terminal cleaning of the room.
- Place new sharps container in the room
- Contact CSS for sterile linen.

During Patient's Occupancy:

- Patient should be isolated from other patients and their visitors at all times to prevent reactions to products these people are wearing or using.
- Place sign on patient's door stating: "Check at the nurses station before entering room".
- Keep patient's door closed at all times and if necessary provide a clean cloth to seal bottom of door from hall odors.
- Health care center personnel must wash their hands and apply hypo allergenic, non-latex gloves prior to entering the room of the MCS patient as these activities can trigger reactions in the patient.

SOUTHWEST GENERAL HEALTH CENTER  
STANDARD OF PRACTICE

PAGE 7 OF 7	MULTIPLE CHEMICAL SENSITIVITY SYNDROME	POLICY 742
----------------	--	---------------

- No live plants or flowers permitted in the patient's room (mold and pesticides trigger MCS reactions).
- No newspapers or treated paper permitted in patient's room. (3-part copy papers or chlorinated papers can be highly toxic and may affect breathing).

APPROVED:

---

Trilok C. Sharma, M.D.  
President, Medical Staff  
Southwest General Health Center

---

L. Jon Schurmeier,  
President  
Southwest General Health Center

**Appendix C – MULTIPLE CHEMICAL SENSITIVITY (MCS) PROTOCOL**  
 Southwest General Health Center (SWGHC)  
 Middleburg Heights, OH

INITIATED	DISCONTINUED
Date	Date
Time	Time
RN	RN

SOUTHWEST GENERAL HEALTH CENTER  
 NURSING SERVICES

**MULTIPLE CHEMICAL SENSITIVITY (MCS) PROTOCOL**

- PURPOSE:** To outline the management and nursing responsibilities caring for a patient experiencing multiple chemical sensitivity (MCS).
- LEVEL:** Independent
- SUPPORTIVE DATA:** MCS is an acquired chronic disorder characterized by recurrent symptoms occurring in response to low levels of exposure to multiple unrelated chemicals. The symptoms generally occur in one of four categories: central nervous system, circulatory, respiratory and mucous irritation or metabolic that would include enzymes, blood, kidneys, GI tract, etc.. Patient with a history of maladaptive reactions to chemicals found in perfumes pesticides, detergents, household cleaners, etc. may have or develop multiple chemical sensitivities. Approximately 75% of those affected are women, possibly due to endocrine disruption. People in their 30s and 40s are most strongly affected as well as children and others who are more susceptible to the effects of pesticides and products containing toxic chemicals. The population most strongly identified with this condition include: industrial workers, teachers, nurses, sick building occupants and those living in chemically contaminated communities. Refer to *Latex Sensitivity/Allergy Protocol* and *Hospital Policy #742 Multiple Chemical Sensitivity (MCS) Patient*.
- CONTENT:**
1. Identify individuals at risk on admission in Emergency Room or Admitting.
  - Prior to Admission* 2. Assign the patient to private room.
  3. Contact CSR for free tote (or nursing supervisor during night shift).
  4. Notify Environmental Services, Central Sterile, Pharmacy, Nutritional Services, and SSA of MCS patient admission.
  - Admission Assessment* 5. Assess all patients on admission for allergies and maladaptive reactions.
  6. Place green allergy band on patient; mark Multiple Chemical Sensitivity (MCS).
  7. Place sign on patient’s door stating:

“Check at the nurses station before entering patient’s room.”

***Admission  
Assessment (cont’d)***

8. Enter Multiple Chemical Sensitivity on all the orders sent in Cerner in Comments Box.
9. Observe patient for following symptoms.
  - Fatigue
  - Memory loss
  - Depression
  - Nervousness
  - Lack of motivation
  - Visual problems
  - Hearing problems
  - Dizziness
  - Sleep disorders
  - Edema
  - Disorientation
  - Confusion
  - Irritability
  - Loss of logic sequencing ability
  - Loss of coordination
  - Hoarseness
  - SOB
  - Headache
  - Chest pain
  - Joint pain
  - Digestive difficulties
  - Sun or other rashes
  - Cold or heat sensitivity
  - Nausea
  - Tingling or numbness of extremities
  - Sinusitis
  - Pallor
  - Anemia
  - Salivation (usually from pesticides)

10. Refer to Latex Sensitivity/Allergy Protocol

***Patient Care***

11. Report signs and symptoms exhibited by patient to physician.
12. Obtain physician order for a special diet.
13. Encourage patient to select their own menu.
14. Allow patient to supply his/her own tolerated food products and dietary supplements.
15. Retain patients dietary requirements in the patient’s medical record for future reference.
16. Encourage use of personal respirator and other protection methods while in Health Care Center.

***Patient Safety***

17. Reinforce all hospital employees and visitors to check with patient’s nurse prior to entering patient’s room.
18. Maintain patient isolation from other patients and their visitors at all times.
19. Transport patient with R-95 mask or personal respirator.

***Patient Safety  
(cont'd)***

20. Refrain staff caring for patient from wearing perfumes, scented lotions, hair spray, deodorants or other scented products.
21. Educate hospital staff to wash their hands with unscented soap.
22. Apply hypo-allergenic, non-latex gloves prior to entering the room.
23. Instruct patient's family not to bring plants or flowers to the patient's room.
24. Restrict newspaper in patient's room.

***Patient Education***

25. Discuss with patient/family Multiple Chemical Sensitivity if newly diagnosed patient.
26. Reassure the patient with understanding of their chemically sensitive condition.
27. Refer patient to Social Services to provide list of Community Services.

***Documentation***

28. Document Multiple Chemical Sensitivity in the patient's medical record, in the front of the chart, medication record and computer system.
29. Record implementation/modification/discontinuation of protocols.
30. Document vital signs and assessment findings on appropriate flow sheet.
31. Document evaluative statement of the patient's response to interventions and lack of complications.

***Emergency  
Interventions***

32. If known, remove the offending object or person from patient's room.
33. If necessary, remove patient from room to fresh air outside the building.
34. Utilize charcoal and baking soda to absorb and remove odors from the room. Open windows if possible.
35. Refer to patient's personal emergency protocol for reducing and diluting chemical reactions (water, food, baking soda, tri-salts, etc.)

***Emergency  
Interventions  
(cont'd)***

36. Communicate and cooperate with the patient whenever possible as the patient generally knows what will help.

REFERENCES: Multiple Chemical Sensitivity Syndrome, September 1, 2000, American Academy of Fa.  
Mental Health Network, Editorial: April 2000.  
SWGHC Pharmacy  
Temple, Toni, Healthier Hospitals, 1996.

APPROVED: ICU QA 4/02; SC 05/02  
REVIEWED/  
REVISED: New 09/01, 3/02  
DISTRIBUTION: Generic

**National Institute of Building Sciences (NIBS)  
Indoor Environmental Quality (IEQ) Project  
Design & Construction Committee**

**Table of Contents**

**Introduction**

**Recommendations**

**Site and General Building Design**

**Enclosure**

**Plumbing, Mechanical and Electrical Equipment**

**Finishes and Furnishings**

**Construction Related Activities for Renovations**

**Occupancy**

**Commissioning**

**Exterior Landscaping**

**Appendices**

**Site Selection**

**Roof Gardens**

**Pest Prevention**

**Carpet**

**Use and Occupancy**

**Landscaping**

**References**

**Bibliography**

**Committee**

## **INTRODUCTION**

The Building Design & Construction Committee was charged with making recommendations for designing commercial and public buildings that would be more accessible for people with multiple chemical and/or electromagnetic sensitivities and provide healthier environments for all occupants.

The Committee found that major access barriers for chemically sensitive individuals are factors that contribute to poor air quality, such as pesticides, new carpets, tobacco smoke, inadequate ventilation, mold, certain building materials, and building activities that generate air pollutants. For electromagnetically sensitive individuals, access barriers include fluorescent lighting, unshielded transformers and wiring, security and scanning equipment and numerous other electrical appliances.

The recommendations that follow, therefore, focus on minimizing or eliminating these barriers through designing

- for pest prevention to reduce the need for or the use of pesticides,
- for preventing moisture and mold growth,
- for optimum ventilation via HVAC systems and operable windows,
- for exhausting air contaminants,
- for minimizing use of carpet and other flooring that emit volatiles, and
- for shielding occupants from electromagnetic fields.

Although many building materials can be problematic for chemically sensitive people, the Committee made minimal suggestions regarding product choices as this was the charge of the Building Products and Materials Committee.

### **Recommendations for Future Actions**

The Committee recommends that the Access Board, NIBS, or other entity create a Design Manual using the outline in this report. This Manual would provide more detailed guidance than is provided here.

The Committee acknowledges that while the scientific evidence may be inconclusive about whether ambient electromagnetic fields pose a substantial health risk to the general population, the presence of EMF is an access barrier for people who are electromagnetically sensitive. Therefore, the Committee recommends that measures be taken to reduce EMF whenever possible in order to increase access for these individuals as well as taking a precautionary approach to protecting the health of all.

## **RECOMMENDATIONS**

### **Site and General Building Design**

Select site to minimize potential exposure to air and soil pollutants and electromagnetic fields (EMF). (Appendix 1)

Visit the site on several occasions to assess site criteria.

Note microclimate: wind direction, sun exposure.

Avoid sites near wetlands/stagnant water, low lying areas; sites should be well above 100 year flood plain.

To minimize moisture infiltration at the foundation, avoid earth berm construction and provide positive drainage from building.

Avoid below-grade occupied space.

Avoid tuck-under parking and indoor parking.

Roof gardens should be avoided because soil and water can foster mold growth. (Appendix 2)

Arrange drop-offs, loading docks, helicopter pads, and other vehicular access points to eliminate or minimize exhaust fumes from entering building directly or being drawn into the HVAC system.

Avoid the use of indoor plants because they can attract pests, stimulate pesticide use, trigger allergies, and foster mold growth.

If smoking on site is permitted, dedicate an outdoor location that is remote from entries, main pedestrian paths and air intakes.

Group and isolate uses within a building that emit contaminants and could affect air quality.

High ceilings are preferred in order to dilute contaminants.

Avoid decorative indoor fountains.

### **Enclosure**

Design for a tight building envelope to maximize the performance of the HVAC system. Meet or exceed Energy Star leakage area (less than 1.25 s.i./100 sf. (Reference 1)

- Building should be able to be sealed off from exterior events that would raise outdoor pollutant levels such as, toxic spills, pesticide spraying, fires, traffic accidents, and rush hour traffic.

- Operable windows are preferred. Being able to open windows is an important access issue for chemically sensitive individuals and can be beneficial for other occupants in certain situations. Operable windows should be detailed to minimize air infiltration.

Design to prevent pest problems. (Appendix 3)

- Use inert pest resistant materials. When treatment of wood is required, treating with disodium octaborate tetrahydrate may be among the safer options.
- Incorporate pest barriers such as termite shields, window screens, and bird screens in construction details. Bird and bat droppings pose great IAQ risks.
- Some pesticides such as boric acid are considered environmentally safe. If used, granular or gel forms are preferred. Care should be taken to ensure that particles do not infiltrate interior habitable space.

Shield occupants from external sources of EMF. Windows with low e glazing, metal roof, and siding components may reduce certain interior EMF. (Reference 2)

Roof Design

- Pitched roofs are preferred, because they shed water quickly, clean the roof of pollutants and potential toxins, and are less prone to leakage.
- Inert roofing materials, such as coated metal or clay tile, are ideal. Note that galvanized metal presents a rust hazard and should be avoided.
- Flat roofs are not preferred. If used, membrane and high albedo (highly reflective to heat) type are recommended. Asphalt or modified bitumen built-up roofs are less preferable. (Reference 3)

Wall Design

- Use best design practices to prevent moisture and condensation within walls. Calculate dew points for each exterior wall (and roof) type to verify performance at each condition. Provide detail for all flashing and counter-flashing locations.

Foundation Design

- Provide under-slab vapor barriers, insulation, and damp-proofing to prevent moisture infiltration and condensation.

Protect stored building materials from water damage and mold growth.

Avoid use of water-damaged or mold-affected materials.

## **Plumbing, Mechanical and Electrical Equipment**

Properly insulate pipes to prevent condensation, especially within walls.

Use modeling software to determine airflow and to ensure isolation of pollutant sources and adequate ventilation.

Ventilate areas occupied by people with chemical sensitivities with goal of eliminating odors (ideally entire building). These ventilation rates meet or exceed all worldwide standards. (Reference 4)

Provide local control of temperature and airflow (ideally for every occupant). (Reference 5)

Utilize Displacement Air Distribution method to move pollutants away from occupants.

Dedicate building as Smoke-Free. (Reference 6)

Isolate mechanical equipment from occupied areas.

Provide direct exhaust from rooms and areas that have pollutant-generating sources or activities. These include but are not limited to: (see Appendix 5)

- Bathrooms (code requirement).
- Kitchens or office kitchenettes (this is in addition to code-required hoods or stove exhausts).
- Copy and print rooms.
- Computer rooms.

Ductwork

- Avoid insulation inside ductwork. Use external insulation wrap of non-friable (airborne particle creating) material.
- Oil coatings used in fabrication of sheet metal stock can affect air quality. Prior to installation, thoroughly clean ductwork with a low VOC product. Use methods that do not leave residue or cause oxidation. (Reference 7)

Prohibit the use of fragrances and disinfectants in air distribution systems.

Maintain relative humidity between 30%-50%.

Locate outside air louvers away from pollutant sources.

Filtration (Reference 8)

- Carbon and HEPA filters are preferred.
- Avoid ozone generating air-purification systems.
- Avoid electrostatic air cleaning due to ozone.

In renovation work, re-evaluate HVAC system performance to ensure that original design standards are met.

Shield occupants from internal EMF. Design electrical systems to minimize EMF. Maximum recommended magnetic field levels of 2.5 milligauss (preferably 1 milligauss in occupied areas) and as low as technically achievable in areas to be occupied by people with sensitivities.

## **Finishes and Furnishings**

Refer to Products and Materials Group report for specific recommendations on materials.

Floor Coverings

- Use inert materials wherever possible, such as, but not limited to:
  - Stone, tile, terra-cotta, brick, ceramic tiles,
  - Terrazzo,

- Sealed concrete.
- Minimize the use of carpeting. Note that carpet that meets Carpet and Rug Institute Green Label Plus standards can still be problematic for chemically sensitive people. (Appendix 4)
- Use carpet systems that allow for small area replacement, such as certain of the self-adhesive backing carpet squares.
- Avoid glue-down carpet installations or use low-VOC adhesives. (see Products & Materials Committee recommendations)
- Cork and linoleum may contain linseed oil and should be avoided. Rubber flooring can also pose problems for chemically sensitive individuals and should be avoided.
- Use low-or no VOC materials for all flooring. (Appendix 4)

### **Construction Related Activities for Renovations**

Provide advance notice to all occupants of any upcoming renovation work.

Post signs to alert occupants of renovation work.

Provide alternate accessible locations for affected individuals when occupied space will be rendered inaccessible due to the renovation.

Physically isolate renovation work areas from occupied portions of building.

Isolate the HVAC system from renovation work.

Implement a dust-control plan that identifies work methods and cleanup procedures.

Provide negative pressure in area of renovation work.

### **Occupancy**

Establish policies for renovation and chemical usage in lease agreements.

Designate a Smoke-Free building.

Leases should include language to ensure that occupant activity does not degrade original design standards and building performance.

Provide a list of areas and uses requiring separate exhaust air systems.

Designate areas free from use of cell phones, two-way radios, and wireless equipment.

### **Commissioning**

Develop a commissioning plan that includes the items listed above.

After construction or renovation provide a minimum flush-out period of two weeks prior to occupancy.

Re-commission buildings periodically. Building use shall be taken into account when determining the re-commissioning schedule.

## **Exterior Landscaping**

- Gardens (see Appendix 6)
  - Design gardens that can be maintained organically without pesticides.
  - Avoid plants with fragrances that may provoke allergies.
  - Exterior gardens and landscape should be free of all plantings that require pesticides, synthetic fertilizers, lime, or other chemical applications.
  - Use indigenous plant materials that are hardy, naturally pest-resistant, require minimal maintenance, and low water use.
  - Use xeriscaping principles.

## APPENDICES

### Appendix 1 - Site Selection: Potential Sources of Pollutants and EMF.

The Committee recognizes that few, if any, building sites are likely to be free of all the pollutant sources listed below. The recommendation is to minimize proximity to as many of these sources as possible in order to maximize outdoor environmental quality and hence indoor environmental quality.

Table A-1 Potential Sources of Pollutants and EMF

General (Air, Soil)	Engine Exhaust	Pesticides	Industrial/Commercial	EMF
Recognized area of poor air quality Smog Smoke (chimney, industrial, etc.)  Superfund Sites Brownfields Landfills Hazardous waste sites Compost sites Underground storage tanks  Floodplains Wetlands Filled-in wetlands  Military bases	Heavy traffic Highways Interstates Diesel exhaust Airports	Agriculture (unless organic) Golf courses Mosquito spraying Parks & Forests Roadside spraying Dairies Chicken & hog farms Other intensive livestock operations	Refineries Mines Chemical plants Cement plants Power plants Manufacturing Logging/Pulp mills Incinerators Sewage treatment plants Gas stations Dry cleaners Other commercial sources that emit air pollutants (See Appendix 5 on Use and Occupancy)	Substations Cell phone towers Radio towers Transponders Transformers High tension lines Electrical distribution lines Radar installations Military bases Airports Electrical Transportation Power-generating dams

### Appendix 2 - Roof Gardens

Roof gardens involve a range of potential issues related to moisture penetration and mold growth. Flat roofs are prone to pooling water and leaking. Foot traffic can cause or accelerate deterioration leading to leaking. Roof repair is more difficult under gardens. Plants may attract pests that subsequently encourage pesticide use. Planting soils can create dust. Plants can emit volatile fumes and pollen. Plants can drop leaves and fruit that rot and become moldy. Selected plants should be low allergen plants without strong fragrance (See Exterior Landscaping above). If used, roof gardens should be located away from air intakes, operable windows, and doors. Design should ensure that moisture will not penetrate the roof membrane or cause conditions of standing water.

## **Appendix 3 - Pest Prevention**

### **Exterior Design:**

Remove lights on or near building that may attract night-flying insects.

Maintain a plant-free zone of about 12 inches around buildings to discourage insects from entering.

Design weep-holes in window frames to prevent access by paper wasps. Design windows to prevent harborage and access for pests, without clear passageways to inside.

Correct structural features that provide opportunities for bird roosting and nesting.

Avoid locating decorative lattices over entrances to food services facilities that may inadvertently serve as bird roosts.

Install bird-proof barriers that are designed to prevent both pigeon and sparrow access to preferred nesting sites.

Design exterior light fixtures so that birds cannot roost or nest on or in them.

Fit eave roof tiles with bird stops (that will also exclude bats, bees and wasps).

Correct structural features that provide opportunities for rodent harborage and burrowing.

Screen or otherwise eliminate animal access under decks, porches, stairways. Seal porches and ramps to the building foundation with ¼-inch hardware cloth screen mesh to form a barrier to digging pests such as rats and skunks. This screen must extend 12 inches into the ground and must have a right-angled, 6 inches wide, outward extending shelf to prevent burrowing under the screen.

Screen ventilation louvers with ¼-inch hardware cloth screen mesh to exclude birds, rodents, cats, etc., (coordinate with mechanical requirements).

Maintain a 2-foot pea gravel strip around buildings to prevent rodent burrowing.

Use a 3" layer of sand barrier underneath slab construction. Use 1-3 mm particle size in place of unsifted sand to provide a permanent sand barrier to termites (both western subterranean and Formosan termites). This will prevent termites from penetrating cracks in slab construction.

For wood not in contact with the ground or concrete, use wood pre-soaked in disodium octoborate tetrahydrate.

### **Refuse and Recycling Areas:**

Place outdoor garbage containers, dumpsters, and compactors on hard, cleanable surfaces and away from building entrances (at least 50 feet from doorways). Design site with properly graded concrete or asphalt pads to help prevent rats from establishing burrows beneath them.

Design site with solid enclosure that extends all the way to the ground. Use metal or synthetic materials, as opposed to chain-link, wood, etc. to prevent rodents from gnawing and climbing the enclosure.

Design trash storage areas that can be closed off from the rest of the building.

Locate storage areas for boxes, paper supplies, and other materials in areas separate from where food or trash is stored. When stored together, these materials put food and shelter together, attracting pests.

## **Landscaped Areas**

Choose proven performers, plants known to do well in the intended planting area. Avoid plants with history of pest problems. Use resistant plant species and cultivars when available. Check with your university or cooperative extension service for recommendations.

Give preference to plants that shed a minimum of seeds and fruits, that may attract and support insects, rodents, and undesired birds.

Design with diversity. Include a wide variety of plants in the landscape to reduce the pest damage potential.

Provide a properly prepared site. Site selection is critical; the site must be compatible with the plants' requirements.

Design landscaped areas with flexibility to allow for campus additions, which may change drainage, exposure to sunlight, ventilation, or other plant requirements.

Avoid crowding of landscape plantings.

Group plantings with similar cultural requirements.

Install or retrofit fence lines and other turf or landscape borders with concrete mowing strips.

Avoid planting vegetation directly against buildings as this provides shelter and sheltered runways for rodents. For the same reason, avoid planting dense vegetation that completely covers the ground.

Do not plant vines which climb building walls, as these create runways for rodents and harborage for undesired bird species.

Plant trees away from buildings to prevent easy access to buildings for insects and rodents.

Give careful consideration to placement of deciduous trees. Leaves which accumulate along foundations provide harborage and sheltered runways for rodents.

## **Interior**

Food Preparation and Serving Areas (main kitchen, dining room, teachers' lounge, snack area, vending machines, and food storage rooms):

- Ensure that new kitchen appliances and fixtures are of pest-resistant design, i.e., open design, few or no hiding places for roaches, freestanding and on casters for easy, thorough cleaning.
- Provide space under and around appliances and equipment in kitchen areas to allow maximum ventilation and ease of (steam) cleaning.
- Use coving at floor-to-wall junctures to minimize build-up of debris and to facilitate cleaning.
- Slope floors in kitchen areas to provide good drainage after cleaning.
- Do not install pegboard in kitchens, animal rooms, or laboratories.
- Insure that all pipe insulation has a smooth surface and that there are no gaps between pieces.
- Refrigerate trash/recycling storage rooms.

### **Classrooms and Offices**

Ensure that new office and classroom furniture that is rarely moved (e.g., staff desks, bookcases, filing cabinets) is designed to permit complete cleaning under and around the furniture, or to allow ready movement for cleaning purposes.

Design or retrofit construction to provide adequate ventilation, preventing trapped moisture and condensation.

### **Storage Areas**

Equip area with self-closing doors.

### **Building Perimeter**

Seal all plumbing and electrical service entrances.

Keep doors closed tightly; equip doors with self-closures and door sweeps.

### **Appendix 4 - Carpet**

Stone, terra cotta, granite, marble, terrazzo, ceramic, brick, or sealed concrete flooring is best tolerated by individuals with chemical sensitivities. Wood flooring that has not been recently stripped or refinished is also often well tolerated by people with chemical sensitivities.

Carpet systems contain a myriad of chemicals in their fiber, dyes, backing, padding, bonding agents, adhesives, antimicrobials, flame retardants, and stain resistance, anti-static, and color fast agents. They also are reservoirs for tracked-in pesticides, dust, dust mites; foster mold growth; and absorb and remit volatile organic chemicals like fragrances and

paint fumes. In addition, many solvent-based agents used to clean carpets emit toxic fumes.

The Carpet and Rug Institute (CRI) has established a rating system and testing program (Green Label Plus) that may be used in lieu of the emissions testing criteria of California's Collaborative for High Performance School (CHPS) Section 01350 (See Products & Materials Committee).

Some people with chemical sensitivities have found that carpet squares with self-adhesive backing have been the best tolerated new carpeting. Others have reacted adversely to such products. More research is necessary to determine what factors in these carpets and/or which brands are best tolerated.

Older carpets are usually better tolerated by people with chemical sensitivities than new ones, as long as they have not become moldy.

Recommendations regarding carpeting (design, materials, and O&M issues):

- Minimize the use of carpeting.
- Use area rugs in place of carpeting whenever possible.
- Consider using self-adhesive carpet squares.
- Tack rather than glue down (unless using self-adhesive carpet).
- If glue down, use low or no VOC adhesive.
- Air out carpet for at least two weeks prior to installation.
- Exceed building flush-out of two weeks if possible.
- Reduce the need for and the frequency of carpet replacement through good maintenance (e.g., thorough vacuuming and frequent cleaning with low toxic products and procedures -- see recommendations by O&M).
- Minimize amount of carpet that is replaced, limit replacement to damaged areas. (A major advantage of carpet square systems is that smaller sections can be replaced).

## Appendix - 5 Use and Occupancy

Non industrial businesses/activities that may generate chemical pollutants include, but are not limited to:

Hair and Nail Salons	Dry Cleaners	Labs (eyeglasses, medical, etc.)
Spas	Laundromats	Dental offices
Restaurants	Nurseries (Plants)	Dialysis Centers
Grills & BBQ	Landscaping, Pest Control	

Furniture stores	Florists	
Woodworking and crafts shops	Candle/Soap/bath shops	
Art/Pottery studios	Pet Shops	
Auto Parts	Photo/Printing/Copy shops	
Taverns/Bars	Specialty foods stores	
Tobacco Shops	Leather goods stores	
Tattoo Parlors	Perfume shops or departments	

Areas that should be vented directly to the outside include: kitchens, labs, computer rooms, copy/fax areas, printer or blueprint rooms, storage areas for toxic materials, showers, locker rooms, and areas where animals are present.

### **Appendix 6 - Landscaping**

Use low allergen plants (See Ogren Plant Allergy Scale).

Plant female trees and shrubs (they do not produce pollen).

Avoid the use of plants that have strong fragrances, such as jasmine, lavender, peppermint, and roses.

Avoid or minimize lawn/turf areas to reduce mowing emissions and chemical usage.

Use low growing fine fescue, buffalo grass, or other turf grass which requires little or no mowing.

Use a wide variety of plant materials.

Group plants with similar water and cultural needs.

Do not crowd plants.

Leave gaps in groundcover to create less hospitable habitat for pests.

Plant deciduous shade trees on the south and west sides of buildings. The shade reduces interior temperatures and reduces A/C usage during summer months.

Use low or no VOC paints, stains and finishes on outside equipment including benches, poles, decks, and other outdoor equipment (See recommendations from Building Products & Materials group.)

Avoid organic mulches (cocoa beans, peat moss, bark, wood chips) as they emit volatile fumes and may harbor mold.

Avoid railroad ties as they contain creosote.

Utilize stone, clay, concrete, and other hard, non-volatile materials to create borders and frame gardens.

## REFERENCES

### Reference 1

ASHRAE Fundamentals Handbook, 2001, 25.19:

<http://www.infiltec.com/inf-larg.htm>

<http://www.argonair.com/pdf/Myth%20About%20Bldg%20Env.pdf>

### Reference 2

P.Levallois, et al., “Prevalence and Risk Factors of Self-Reported Hypersensitivity to Electromagnetic Fields in California” and “An Evaluation of the Possible Risks from Electric and Magnetic Fields (EMF) From Power Lines, Internal Wiring, Electrical Occupations and Appliances.”

<http://www.dhs.ca.gov/ps/deodc/ehib/emf/RiskEvaluation/Appendix3.pdf>

Case study for EMF control (Research Triangle)

[http://www.ncgreenbuilding.org/site/ncg/public/show\\_project.cfm?project\\_id=120](http://www.ncgreenbuilding.org/site/ncg/public/show_project.cfm?project_id=120)

*“EMF reduction: The team reviewed available literature on EMF and their threat to health and determined that while EMF radiation could be measured, its threat to humans had not yet been proven or disproved. Nevertheless, the team recommended adopting a philosophy of prudent avoidance toward EMF risks and undertook modifications of the building design to reduce occupant exposure. EMF radiation can be mitigated by distance and by shielding. Distance offers maximum protection and is “low-tech,” while the costs associated with shielding are high and the results are difficult to measure. Consequently, the design team chose to create “buffer zones” to reduce prolonged exposures in portions of the building that are occupied for long periods of time, such as the laboratories and offices. The largest sources of EMF were identified as the building’s transformers, the electrical rooms with their many cables, and the electrical conduit that was routed under the building atria. As a first step circulation and utility spaces were used to maximize the separation between a source and any potential receptors.”*

### Reference 3

Fumes from activities involving the installation and repair of modified bitumen roofs.

<http://environmentalchemistry.com/yogi/chemicals/cn/Asphalt%20fumes.html>

### Reference 4

Chapter 59, Indoor Air Quality Handbook CFD (Computational Fluid Dynamics) Method for indoor Air Quality Studies. Qingyan Chen, Leon Glicksman, MIT

#### **Reference 4**

Ventilation rate to remove odors falls between 14-50 (l\*s)/person or 28-100 cfm depending upon the type of odors to be removed. Ventilating to remove odor will exceed all requirements for Ventilation rates for human comfort.

(Levin, *Indoor Air Quality Handbook*, McGraw-Hill table 60.2)

ASHRAE 62.1-2004 Ventilation for Acceptable Indoor Air Quality

#### **Reference 5**

LEED™ 6.1, 6.2 Controllability of Systems

- Provide one operable window and one lighting control zone per 200sf of area within 15' of an exterior wall.
- Provide controls for each individual for airflow, temperature, & lighting

ASHRAE 55-1992 Addenda 1995 Thermal Environmental Conditions for Human Occupancy

Recommend maximum of 60% RH

ASHRAE 55-2004 Thermal Environmental Conditions for Human Occupancy

(based on satisfactory thermal comfort for 80% of people. 71d in winter, 76d in summer.)

#### **Reference 6**

LEED™ Prerequisite 2.0 ETS (Environmental Tobacco Smoke) control

[www.epa.gov/iaq/pubs/etsbro.html](http://www.epa.gov/iaq/pubs/etsbro.html)

#### **Reference 7**

LEED™ Credit 3.1 SMACNA (Sheet metal and air conditioning National Contractors Association) IAQ Guidelines for Occupied Buildings under Construction.

#### **Reference 8**

Air Filtration

<http://www.epa.gov/etv/centers/center10.html>

## **BIBLIOGRAPHY**

ANSI/ASHRAE Standard 62.1-2004, Ventilation for Acceptable Indoor Air Quality

ANSI/ASHRAE Standard 62.2-2004, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings

ALA Guidelines (American Lung Association)  
<http://www.healthhouse.org/build/Guidelines.asp>

ATSDR Toxicological Profiles Agency for Toxic Substances and Disease Registry  
<http://www.atsdr.cdc.gov>

California Office of Environmental Health Hazard Analysis  
[http://www.oehha.ca.gov/air/chronic\\_rels/index.html](http://www.oehha.ca.gov/air/chronic_rels/index.html)

Carpet  
<http://www.carpet-rug.org/index.cfm>  
[http://www.carpet-rug.org/drill\\_down\\_2.cfm?page=8&sub=3&requesttimeout=350](http://www.carpet-rug.org/drill_down_2.cfm?page=8&sub=3&requesttimeout=350)

*Diesel and Health in America: The Lingering Threat* [www.catf.us/goto/dieselhealth](http://www.catf.us/goto/dieselhealth)

## **EMF**

[http://www.cep.ca/reg\\_ontario/files/health\\_safety/emf\\_school\\_guidelines.pdf](http://www.cep.ca/reg_ontario/files/health_safety/emf_school_guidelines.pdf)

[http://vitatech.net/q\\_a.html](http://vitatech.net/q_a.html)

<http://www.emf-meter.com/emf-exposure-limits.htm>

Council on Wireless Technology Impacts: <http://www.energyfields.org>  
<http://www.asilo.com/aztap1>  
<http://www.emfservices.com/index.htm>  
[http://www.latitudes.org/articles/electrical\\_sensitivity\\_articles.html](http://www.latitudes.org/articles/electrical_sensitivity_articles.html)  
<http://www.FEB/Links.html>

[www.lessemf.com](http://www.lessemf.com)

"Electromagnetic Shielding: A Handbook Series on Electromagnetic Interference and Compatibility" Vol. 3. By Donald R.J. White and Michael Mardiguian, 1988.  
[http://www.amazon.com/exec/obidos/tg/detail/-/0944916031/ref=pd\\_ecc\\_rvi\\_1/002-9659512-8208838?%5Fencoding=UTF8&v=glance](http://www.amazon.com/exec/obidos/tg/detail/-/0944916031/ref=pd_ecc_rvi_1/002-9659512-8208838?%5Fencoding=UTF8&v=glance).

"Controlling Radiated Emissions by Design" By Michel Mardiguian, 1992.  
Available from the Electromagnetic Compatibility Lab, University of Missouri – Rollo,  
<http://www.emclab.umn.edu/emcbooks.html>

EDN's Designer's Guide to Electromagnetic Compatibility, by Daryl Gerke, P.E. and Bill Kimmel, P.E.

of Kimmell Gerke Associates, Ltd, St. Paul, MN

"EDN: The Design Magazine of the Electronics Industry" supplement, January 20, 1994.

Report by Lucinda Grant – World Health Organization (WHO) International Seminar and Working Group on EMF Hypersensitivity; October 25-27, 2004.

EPA Draft Guidance for Green Buildings: Eight Central Principles, Dave Mudarri

<http://www.housingzone.com/news2.asp?topicId=14531&docId=l:25891088>

*Greening Your Homes* series [www.clevelandgbc.org](http://www.clevelandgbc.org)

***Green Guide for Healthcare from Healthcare Without Harm***

<http://www.gghc.org/>

*Green Building: Project Planning & Cost Estimating* RS Means 2002

*Indoor Air Quality Handbook* McGraw-Hill 2003

*LEED Rating System for New Construction*\_USGBC 2002

*Myths About Building Envelopes*, 1999, Persily, NIST.

New Jersey Idling Regulations

<http://www.state.nj.us/dep/aqm/sub14v2001-10-01.htm>

*Pest Prevention Through Site Design* California Department of Pesticide Regulation

[http://www.cdpr.ca.gov/cfdocs/apps/schoolipm/managing\\_pests/71\\_pest\\_prevention](http://www.cdpr.ca.gov/cfdocs/apps/schoolipm/managing_pests/71_pest_prevention)

*Program Needs for Indoor Environments Research* (PNIER), U.S. EPA, 402-B-05-001,

March 2005, [www.epa.gov/iaq/pubs/pnier.pdf](http://www.epa.gov/iaq/pubs/pnier.pdf)

*Residential Environmental Guidelines*

Hugh L. Carey Battery Park City Authority

*Responding and Preventing Indoor Air Quality Problems in Schools*

Terry Brennan, Camroden Associates, Inc.

SMACNA “*IAQ Guideline for Occupied Buildings under Construction.*”

## **COMMITTEE**

### **Active**

Chair – Roger Morse, AIA, Morse-Zentner Associates

William S. Anderson, Architect

Mary Lamielle, National Center for Environmental Health Strategies

Ann McCampbell, Multiple Chemical Sensitivities Task Force of New Mexico

Susan Molloy, National Coalition for the Chemically Injured

Toni Temple, Ohio Network for the Chemically Injured

### **Contributing**

Terry Brennan, Camroden Associates

Jack Carman, *ASLA and Sustainable and Therapeutic Garden Group members for their input*

*Design for Exterior Landscaping Recommendations*

Jim LaRue, Healthy House Institute

David Rousseau, Archemy Consulting, Ltd.

Dave Rupp, Cabinet King, Inc.

### **Commenting**

Josh Roehm PE, Scheeser, Buckley Mayfield Engineers

**National Institute of Building Sciences (NIBS)  
Indoor Environmental Quality (IEQ) Project  
Building Products & Materials Committee**

**Table of Contents**

**Introduction**

**Overview – Design**

**Overview – Building Operations and Maintenance**

**CHPS Section 01350 Part 1.3B and 1.4D and GREENGUARD Allowable**

**Emission Levels**

**Formaldehyde**

**Adhesives and Sealants**

**Appliances**

**Ceilings**

**Composite Wood Products (plywood, particle board, OSB, paneling, etc.)**

**Fireproofing**

**Flooring and Floor Systems**

**Insulation**

**Paint**

**Textiles**

**Walls**

**Wallcovering**

**Conclusion & Recommendations**

**Committee**

**Introduction**

The goal of the NIBS – IEQ Products & Materials Committee was to develop procedures and guidelines to aid persons in making informed material selections in order to construct a building that will be accessible to persons with multiple chemical sensitivities (MCS) and/or electromagnetic sensitivities (EMS). The NIBS IEQ-Materials Committee has reviewed existing standards and guidance for materials selection in building construction. The group has determined that certain features of the existing standards offer a reasonable starting point for the selection of building materials, and in some respects can offer a more accessible environment to persons with MCS and/or EMS. These existing standards are designed to create healthier indoor air quality by making appropriate building material selections, among other things. Though the existing standards may not result in material selections that will make a building accessible to the majority of persons with MCS and/or EMS, they will produce a healthier building, than one constructed without regard to these standards. Healthier buildings would be useable by people with other health conditions such as asthma and other respiratory conditions, allergies and migraine headaches.

The NIBS IEQ Materials Committee has attempted to take the best ideas or practices from the existing standards and guidelines to recommend material selections that will provide for healthier, more accessible buildings. If a designer follows the suggestions provided herein, it will result in a building that has the lowest chance of IEQ problems stemming from the materials and that has the best likelihood of being accessible to persons with MCS and/or EMS.

The standards reviewed by the Materials Group include:

- Collaborative for High Performance Schools (CHPS) Section 01350
- Green Guard Environmental Institute - Certification Standards for Low Emitting Products for the Indoor Environment
- Green Seal – Environmental Standards
- Green Guidelines for Healthcare – Materials and Resources
- Reducing Occupant Exposure to Volatile Organic Compounds (VOCs) from Office Building Construction Materials: Non-Binding Guidelines - California Department of Health Services

Two of the key elements involved in the materials selection process are a component content screening (what chemicals and compounds are known to be a part of the material) and an emissions testing protocol. Both the California Section 1350 Specification and the Green Guard Standards recommend emissions testing based on the ASTM Method ASTM standards D-5116-97 and D- 6670-01. The Committee believes that both of these elements must be involved in making appropriate building material selections.

### **Overview - Design**

The Products & Materials Committee believes that particular attention is critical during building design to assure that the needs of chemically and electromagnetically sensitive people are accommodated to the greatest extent possible. In general, this means selection of construction materials that are low-emitting or non-emitting and selection of finishes that do not absorb or react with chemicals emitted by other materials or products in the building. To begin to address some of the concerns of electromagnetically sensitive persons, areas of the building can be designed to have reduced electromagnetic fields. By making indoor environments that are safer for the most vulnerable among us, we can create indoor environments that are healthier for everyone, especially children.

Generally, this means selection of materials that are “hard” or non-porous where possible so that any chemicals that contact these materials are not retained in and re-emitted from them. Also, particular attention should be paid to selection of materials that will not require VOC-emitting chemicals later as part of maintenance. For instance, in designing building foundations and structures, particular attention should be paid to the need for preventing termite problems, since the pesticides commonly used to control termites can have a deleterious effect on humans, especially persons with multiple chemical sensitivities. So, even though the material itself might be low-emitting, the use of products meant to “preserve, protect, or maintain” the material selected might emit volatile fumes that degrade indoor environmental quality and result in a building that is not suitable for persons with MCS.

In addition, during building design particular attention must be paid to choice of electrical appliances, equipment and products that may produce higher than necessary electromagnetic fields. The NIBS-IEQ Materials Committee recognizes that there are selections that can be made during building design and construction that can provide a more healthful environment for persons with electromagnetic sensitivities. A few of these considerations are:

- Incorporation of a foil vapor barrier or other metal shielding feature into the walls around electric equipment can reduce certain electromagnetic fields.

- Wireless (“bluetooth” type) connections should be avoided, or areas of their use should be "contained" by using foil-backed drywall or other incorporation of a foil or metal barrier.
- New construction should use twisted metal clad wiring and/or twisted wire placed in metal conduit.
- Fiber optic connectivity is preferred for computer networks communication because these data lines may be run without concern for stray emissions.

## **Overview – Building Operations and Maintenance**

Vigilance is required to assure that materials brought into the building throughout the course of its life are consistent with the standards provided herein, and are consistent with the design intent of the building.

For example, the Products & Materials Committee realizes that building operations and maintenance products might introduce materials that are not consistent with the initial design for an accessible, healthy building.

Building managers must also pay close attention to materials brought into the building environment by tenants or others to assure that these materials are consistent with provision of an accessible, healthy building for persons with multiple chemical sensitivities, electromagnetic sensitivities, and/or other health disorders. For instance, a tenant may bring furniture in that does not meet the design criteria presented in this document, and these materials could have detrimental effects on air quality within the entire building, depending on the design of the HVAC system. In addition, the chemicals and compounds used for maintenance can degrade environmental quality and seriously affect persons with multiple chemical sensitivities. Other products that can have detrimental effects on IEQ and/or certain individuals include paints and other finishes, carpeting, appliances and other electrical equipment, and others.

## **CHPS Section 01350 Part 1.3B and 1.4D and GREENGUARD Allowable Emission Levels**

The NIBS – IEQ Products & Materials Committee believes that the CHPS Indoor Air Quality Emissions Testing Standards and the Green Guard Allowable Emission Levels offer tested and reviewed approaches to material and product selection for buildings. Given the range of guidance and standards available for material selection, these two standards provide the most widely accepted processes for making material selections to construct buildings that are healthier for the general public. It should be noted that the NIBS –IEQ Products & Materials Committee does not believe that either of these standards offers an entirely acceptable solution for persons with MCS and EMS. However, they provide a starting point in making material selections, and they provide the best available guidance on component screening and materials emission limits. Making materials selections that meet either the CHPS or the Green Guard allowable emission levels should be considered an absolute minimum requirement in creating a building or environment that is accessible to persons with MCS and EMS. No designer or other person making material selections should choose any materials that do not at least meet these standards. Even then, the other considerations discussed herein should be a part of the selection process to provide the best

opportunity that the building will provide an environment accessible to persons with MCS and EMS.

The Green Guard Certification Standards list allowable emissions for a range of building products. A designer or other individual making a material selection must investigate product literature, for the material under consideration, to determine if the product meets at least the Green Guard standards. The Green Guard web site lists products that have been tested and have met their standards. However, it is possible that a product manufacturer has not submitted their product for certification to either Green Guard or CHPS. In this case, the person making a material selection must seek any published emissions testing data and product component data available from the manufacturer. Some manufacturers publish data on emissions from their products, and other manufacturers are moving quickly to provide such data. If such data is not currently published, the manufacturer must have the product or material tested in accordance with the testing regimen specified in the Green Guard or CHPS 01350 Certification Standards.

The CHPS Section 01350 protocols and the Green Guard Certification for IAQ data require the same chamber testing. The CHPS protocols and calculations go further than the Green Guard Certification Standards in that the designer is required to take published emissions rates and perform calculations based on the amount of material to be installed in the building and the zones and air handling capabilities of the HVAC systems in those zones. Also, the allowable emission level for formaldehyde is lower in the CHPS standard than the Green Guard standard. See the discussion below for more information on formaldehyde.

For both standards, all building materials are required to be tested in dynamic environmental chambers following ASTM standards D-5116-97 and D-6670-01, the U.S. Environmental Protection Agency's testing protocol for furniture and the State of Washington's protocol for interior furnishings and construction materials. Products are measured for emission levels according to the parameters set forth in the ASTM Standard for emissions testing.

California - Practice for Testing of VOC's from Building Materials Using Small Chambers

<http://www.dhs.ca.gov/ps/deodc/ehlb/iaq/VOCS/Practice.htm>

The allowable emission levels of both standards can be found by clicking on the links below. In some cases, the Green Guard standards may appear to have lower standards for emissions of some VOCs than the CHPS Section 1350 standards. However, the person selecting materials for the building must bear in mind that the CHPS standard requires a detailed calculation for the building, the amount of material to be installed and the air change rate of the HVAC systems. Green Guard emissions standards are based on a "standard" model of a building, and a "standard" exchange rate of fresh air in the building.

CHPS Section 01350 [http://www.chps.net/manual/documents/Sec\\_01350.doc](http://www.chps.net/manual/documents/Sec_01350.doc)

CHPS Compliant Materials Table [http://www.chps.net/manual/lem\\_table.htm](http://www.chps.net/manual/lem_table.htm)

Green Guard Allowable Emission Levels

<http://www.greenguard.org/DesktopDefault.aspx?tabindex=3&tabid=16>

Green Guard Certified Product Guide

<http://www.greenguard.org/DesktopDefault.aspx?tabindex=1&tabid=12>

### **Additional Resources**

California Department of Health Services IAQ Program Voluntary Guidelines for Reducing Occupant Exposure to VOCs

[http://www.dhs.ca.gov/iaq/VOCS/VOC\\_guidelines\\_1996.html](http://www.dhs.ca.gov/iaq/VOCS/VOC_guidelines_1996.html)

California Materials Emissions Study

<http://www.ciwmb.ca.gov/Publications/default.asp?pubid=1027>

U.S. EPA Indoor Environment Program web site -- VOCs

<http://www.epa.gov/iaq/voc.html>

## **Formaldehyde**

Formaldehyde is widely used by industry to manufacture building materials and numerous consumer products. It is also a by-product of combustion and certain other natural processes. Formaldehyde, by itself or in combination with other chemicals, serves a number of purposes in manufactured products. For example, it is used to add permanent-press qualities to clothing and draperies, as a component of glues and adhesives, and as a preservative in some paints and coating products.

In building materials, the most significant sources of formaldehyde are likely to be pressed wood products made using adhesives that contain urea-formaldehyde (UF) resins. Pressed wood products include: particleboard (used as sub-flooring and shelving and in cabinetry and furniture); hardwood-veneer plywood paneling (used for decorative wall covering and used in cabinets and furniture); and medium density fiberboard (used for drawer fronts, cabinets, and furniture tops). Medium density fiberboard contains a higher resin-to-wood ratio than any other UF pressed wood product and is generally recognized as being the highest formaldehyde-emitting pressed wood product.

Other pressed wood products, such as softwood plywood and flake or oriented strandboard, are produced for exterior construction use and contain the dark, or red/black-colored phenol-formaldehyde (PF) resin. Although formaldehyde is present in both types of resins, pressed woods that contain PF resin generally emit formaldehyde at considerably lower rates than those containing UF resin.

The NIBS – IEQ Products & Materials Committee is concerned about human exposure to formaldehyde, especially for individuals with multiple chemical sensitivities. The widespread use of formaldehyde, its known health effects, and the hyper-sensitivities of certain individuals create this concern. It may not be possible to make material selections that are completely free of formaldehyde, but where possible, the individual making material selections should make every effort to avoid products manufactured with formaldehyde. New soy-based adhesives are coming on to the market to replace formaldehyde resins used in many manufactured wood products. It may soon be possible to choose alternative products that are not formulated with this volatile organic compound (VOC).

The California Office of Environmental Health Hazard Assessment has determined that the lowest, reasonably achievable level of formaldehyde (because it is equal to ambient air

concentrations) is 33 (milligrams per cubic meter)  $\text{ug}/\text{m}^3$ , or 23 (parts per billion) ppb. Thus, the CHPS 01350 standard requires that a material must not emit a level of formaldehyde that results in a concentration of  $\frac{1}{2}$  of this level, or  $16 \text{ ug}/\text{m}^3$  (11 ppb). This limit is lower than the allowable emission level of the Green Guard standard. The NIBS – IEQ Products & Materials Committee believes that the  $16 \text{ ug}/\text{m}^3$  (11 ppb) level is a minimum requirement for formaldehyde emissions from building materials.

***Following is a list of typical building materials and some considerations for selection. Note that the considerations listed below are in addition to the recommended emissions standards from CHPS 1350 and Green Guard.***

### **Adhesives and Sealants**

One objective of the IEQ-Products & Materials Committee is to reduce the quantity of indoor air contaminants created by adhesives and sealants that are potentially irritating and/or harmful to occupants of buildings. The use of VOC-emitting adhesives and/or sealants should be minimized to the greatest extent possible in order to create an accessible, comfortable environment for the greatest numbers of people.

The designer should specify application of only the minimum amounts of these materials necessary for satisfactory completion of each installation task. Additionally, the designer should select products that have the lowest possible VOC emissions, according to the emissions testing information provided, while still meeting other performance requirements. Caution should be exercised when interpreting adhesive emission data because such data are usually provided without the associated installed products (e.g., flooring materials) and emissions from installed assemblies may differ from manufacturers' reported adhesive emission rates. If possible, adhesives that contain formaldehyde should be avoided.

The Committee also recommends that paints and finishes be selected that do not contain biocides.

In any building where adhesive use is necessary, it is a good practice to ensure that maximum ventilation is supplied during and after application of these products.

### **Appliances**

Appliances can emit volatile fumes as well as create electromagnetic fields.

Electromagnetic fields and radiofrequencies can jeopardize the functioning and safe access of electromagnetically sensitive individuals. Examples of indoor appliances which can provoke health problems include:

- cell and portable telephones,
- fluorescent lights,
- unshielded transformers and wiring,
- battery re-chargers,

- wireless devices including computers and personal communication services (“PCS”),
- security and scanning equipment,
- numerous common work place and household electronic appliances.

Many electrical appliances and equipment can be improved to varying degrees by appropriate shielding, and/or by being located in areas remote from vulnerable individuals.

It is not recommended that such equipment be eliminated from the built environment, but that exposure of vulnerable individuals to such equipment be voluntary or easily avoidable.

## **Ceilings**

Of particular concern to the NIBS-IEQ Products & Materials Committee are T-bar suspended ceilings used as return air plenums in buildings, because both sides of the panels come in contact with indoor air. In addition, penetrations for sprinklers, alarms, and smoke detectors may significantly increase the area exposed to emissions. Temperatures near ceiling surfaces and in return air plenums are usually higher than those in occupied zones and, as a result, increased emissions from ceiling materials may occur. The individual selecting ceiling materials should carefully consider the acoustic, fire, and aesthetic requirements for each space prior to material selection. Nonporous materials are now available that combine aesthetic, acoustical, and fire code requirements.

Ceiling materials that contain organic materials present the possibility of mold contamination if the ceiling system becomes wet. Porous ceilings and ceiling finishes can also act as receptors for toxins and VOCs that are brought into the building and later re-emit them. Many ceiling tile products are made using urea formaldehyde. No products using urea formaldehyde should be allowed.

## **Composite Wood Products (plywood, particle board, OSB, paneling, etc.)**

Because they emit formaldehyde and other VOCs, use of composite wood products should be minimized, if not eliminated. If it is absolutely necessary to use such products, the designer should select materials that meet the specified building criteria and are the lowest emitting products available according to emissions testing data. Formaldehyde emissions are of particular concern in composite wood products. Note that VOC-emitting wood preservatives may be used in some of these products. There are a number of manufacturers that are replacing formaldehyde adhesives in composite wood products with non-emitting adhesives and the Committee recommends using these alternative products whenever possible.

## **Fireproofing**

The use of fireproofing chemicals should be minimized when possible. Spray-on fireproofing can cause indoor air quality problems when chemical components are released into the air as a result of mechanical damage, air erosion, or deterioration of the binder. Also because spray-on materials have large, porous surface areas, they can act as sinks for adsorption and re-emittance of VOCs. If possible, seal the surface of spray-on fireproofing to reduce adsorption of VOCs. Ensure that the sealer: (a) will not change fire characteristics of the original fireproofing material; and (b) is not a high-VOC emitter. Also seal any

penetrations of surfaces sprayed with fireproofing material to prevent damage of the material in the vicinity of penetrations.

## **Flooring and Floor Systems**

The NIBS-IEQ Products & Materials committee recommends use of flooring products that are low or non-emitting and are non-porous. Consideration should also be given to maintenance products that will be necessary for the type of flooring selected. For instance, stripping and refinishing of wood flooring introduces hazardous chemicals into the air and are intolerable for persons with multiple chemical sensitivities. When selecting a floor system, the type of adhesives used with the flooring system must also be considered.

Stone, terra cotta, granite, marble, terrazzo, ceramic, brick, or sealed concrete flooring are best tolerated by individuals with chemical sensitivities, and provide a healthy, comfortable environment for the greatest number of people.

Wood flooring that has not been recently stripped or refinished and older vinyl flooring is also often well tolerated by people with chemical sensitivities.

Rubber, linoleum, and cork flooring are not recommended.

The Resilient Floor Covering Institute (RFCI) has recently introduced a new certification program for low emitting flooring products called the FloorScore™ program. The FloorScore program is a building materials emissions testing program that requires both independent laboratory testing and third-party certification to show compliance with CCHPS 01350 VOC emissions limits and includes certified site audit and documented control system requirements. The third-party certifier, Scientific Certification Systems, Inc. (SCS), not only reviews the results of the product VOC emissions report but also reviews raw material inputs and manufacturing processes to ensure that a product is consistently manufactured. SCS conducts site audits of manufacturing plants to ensure a quality management plan exists for continuing compliance of the product as defined in SCS-EC-10-2004 Environmental Certification Program – Indoor Air Quality Performance.

Resilient Floor Covering Institute – “Floor Score” Program

[http://www.rfci.com/int\\_FloorScore.htm](http://www.rfci.com/int_FloorScore.htm)

Floor Score List of Certified Products

[http://www.rfci.com/int\\_FS-ProdCert.htm](http://www.rfci.com/int_FS-ProdCert.htm)

Carpet systems contain a myriad of chemicals in their fiber, dyes, backing, padding, bonding agents, adhesives, antimicrobials, flame retardants, and stain resistance, anti-static, and color fast agents. They are reservoirs for tracked-in pesticides, dust, dust mites; foster mold growth; and absorb and re-emit volatile organic chemicals like fragrances and paint fumes. In addition, many solvent-based agents used to clean carpets emit toxic fumes.

The Carpet and Rug Institute (CRI) has established a rating system that involves emission testing that is based on CHPS Section 01350, and includes additional requirements. Carpets labeled with the CRI Green Label Plus are expected to have lower emissions than most

carpets. However, even carpets emitting low levels of volatile organic chemicals (VOC's) can cause adverse health effects in certain individuals.

CRI Green Label Plus link

[http://www.carpet-rug.org/drill\\_down\\_2.cfm?page=8&sub=3&requesttimeout=350](http://www.carpet-rug.org/drill_down_2.cfm?page=8&sub=3&requesttimeout=350)

Some people with multiple chemical sensitivities have found that carpet squares with self-adhesive backing have been the best tolerated new carpeting. Others have reacted adversely to such products. More research is necessary to determine what factors in these carpets and/or which brands are best tolerated.

Older carpets are usually better tolerated by people with chemical sensitivities than new ones, as long as they have not become moldy.

Recommendations regarding carpeting (design, materials, and O&M issues):

1. Minimize the use of carpeting
2. Use area rugs in place of carpeting whenever possible
3. Consider using self-adhesive carpet squares
4. Tack rather than glue down (unless using self-adhesive carpet)
5. If glue down, use low or no VOC adhesive
6. Air out carpet for at least two weeks prior to installation
7. Ventilate building with 100% outside (or fresh) air for as long as possible after installation
8. Reduce the frequency of carpet replacement by maintaining them well (e.g., vacuum thoroughly and frequently and clean with low toxic products and procedures – (see recommendations by Operations & Maintenance Committee).
9. Minimize amount of carpet that is replaced, limit replacement to damaged areas (an advantage of carpet square systems is that smaller sections can be more easily replaced).

## **Insulation**

The NIBS-IEQ Products & Materials committee realizes that insulation is an essential component in building systems to assure a comfortable environment. Insulation and insulating materials are generally hidden or covered, however emissions can still be encountered by building occupants. The Committee believes that polystyrene foam insulation is best tolerated by persons with multiple chemical sensitivities. Other insulating products, such as fiberglass, cellulose, or cotton/polyester blend insulating products may produce particulates, harbor mold, or emit problematic volatile fumes, depending on the product and the manufacturing techniques used.

The Committee has particular concerns about interior lined ductwork, due to the insulation's ability to collect and trap chemical contaminants, dusts, microbes and fungi, as well as emissions from the adhesives used to secure the insulation. It is recommended that no interior-lined ductwork be used in the construction of buildings meant to be accessible to persons with MCS.

Lastly, insulation used anywhere in buildings must not contain urea-formaldehyde resins.

## **Paint**

The NIBS-IEQ Products & Materials Committee determined that for some individuals, 100% acrylic paint and paints containing low-VOC emissions can be acceptable. Paints containing styrene-butadiene latex combinations, enamels, strippers and paint thinners are all problematic and should be avoided or their use minimized.

For some individuals, well-hardened enamel paint, baked-on enamel finish, or porcelainized steel provide optimum safety. These products provide a hard, durable surface that can be easily cleaned using non-toxic products.

Paints with biocides or biocide additives (mold/mildew resistant) should not be selected.

## **Textiles**

The NIBS-IEQ Products & Materials committee recommends sparing or no use of textiles in buildings. Though it may be possible to introduce textiles with no emissions, textiles provide a porous medium to trap chemical contaminants, dusts and microbes that can create an unhealthy environment. In addition, the dry cleaning and laundering of textiles pose additional problems due to the cleaning products.

## **Walls**

Gypsum wallboard: Gypsum may be reasonably inert and extremely low in VOC emissions. However, additives used to produce mold-proof gypsum wallboard (i.e., "green board"), fire-resistant gypsum wallboard, or to improve the workability of the slurry during manufacture may include compounds that emit VOCs. Careful product selection and review of emissions testing data is necessary to assure that appropriate materials are chosen. Recycled paper covering both sides of gypsum wallboard may contain chemicals from previous uses, and additives or chemicals used in the production of the paper itself. Note that VOC emissions from gypsum wallboard can sometimes be significantly reduced by "painting" or laminating the surfaces. The more impervious the coating or covering, the greater will be the reduction in VOC emissions from gypsum wallboard. However, VOC emissions from surface treatment materials must be considered.

Gypsum wallboard can act as a sink for other VOCs in indoor air. Avoid exposing unpainted gypsum wallboard to indoor environments where emissions from other VOC sources exist. Taping and topping compounds can contain considerable quantities of VOCs, so emissions testing data for these products are also critically important. Use ventilation and heat to accelerate the drying process of these materials. Protect wallboard from exposure to contaminants and excessive moisture prior to installation.

Where possible, select material to reduce the need for paints, wallcoverings, or porous wall finishes in buildings. Most commercial structures are built using metal studs, a good selection for persons with MCS. Wood studs can emit terpenes and pinenes

## **Wallcovering**

Wallpapers may contain vinyl, plasticizers, styrene-butadiene latex combinations and other chemicals that can seal and trap moisture between the wallpaper and the wall fostering mold growth. The water-based pastes and glues used to adhere the wallpaper to the wall may

contain mold retardants and pesticides. Adhesives can emit volatile fumes. For these reasons we recommend that wallpapers not be used.

## **Conclusion & Recommendations**

In order to minimize the level of air pollutants emitted from building materials and create healthier indoor environments, the NIBS Products & Materials Committee recommends that inert, non-porous materials be used to the greatest extent possible. This will increase access for the greatest number of chemically sensitive individuals. Choosing appliances and other equipment that create the lowest level of electromagnetic fields will increase access for those with electromagnetic sensitivities.

If materials are used that emit volatile fumes, the Committee recommends that these materials meet or exceed the CHPS Indoor Air Quality Emissions Testing Standards or Green Guard Allowable Emission Levels, as well as contain no formaldehyde or biocides. The Committee also recommends that, whenever possible, products and materials be aired out (preferably outside or in a separate well-ventilated space) for two weeks prior to being installed in a building.

While the Committee acknowledges that the CHPS Indoor Air Quality Emissions Testing Standards and Green Guard Allowable Emission Levels are the best current standards for selecting building materials that create healthier buildings, the Committee is concerned that these standards may not sufficiently protect the health of building occupants, especially those with chemical sensitivities and other vulnerable individuals.

Therefore, the Committee supports:

- 1) Creation of more stringent emission standards and development of a wider range of less volatile and less hazardous building materials, especially in the areas of resilient flooring and carpeting.
- 2) Full disclosure of product ingredients (on product labels or available upon request) to enable builders to make more informed decisions regarding selection of building materials.
- 3) Consulting with chemically and electromagnetically sensitive individuals or organizations, especially employees and others who frequently use a building, prior to making final decisions regarding product selection.

## **Committee Members**

### **Active**

Chair – Brent Kynoch, Kynoch Environmental Management, Inc.  
Mary Lamielle, National Center for Environmental Health Strategies  
Ann McCampbell, Multiple Chemical Sensitivities Task Force of New Mexico  
Susan Molloy, National Coalition for the Chemically Injured  
Toni Temple, Ohio Network for the Chemically Injured

## **Contributors**

Terry Brennan, Camroden Associates  
Dave Rupp, Cabinet King, Inc.

**Commentor**

Mike Preston, Burt Hill Kosar and Rittelman Associates

<http://www.takebackyourpower.net/news/2013/02/24/smart-water-meters-installed-where-have-the-birds-gone/>

## **“Smart” water meters installed – so where have the birds gone?**

24 February 2013 at 3:39pm

### **Are smart meters chasing away birds from Rolling Hills?**

**Since the installation of smart water meters last month, the birds have disappeared from the rolling hills neighbourhood.**

*by Brian Beckley, Renton Reporter, 22 Feb 2013*

source: [www.rentonreporter.com/news/192319761.html](http://www.rentonreporter.com/news/192319761.html)

Paul Ouellette has been feeding birds in the Rolling Hills neighborhood for several years and said since the city installed smart water meters he has not had to buy bird feed for the multiple feeders in his yard.

Paul Ouellette has lived in the Rolling Hills neighborhood for decades and since his retirement he has spent a lot of time in his backyard, which contains several bird feeders.

Normally at this time of year, his backyard is filled with birds; finches, chickadees and even hummingbirds.

“It’s very nice to see them flying around the yard all the time,” he said.

But this year is different. This year an eerie silence has settled over Ouellette’s yard – and his entire neighborhood.

“The birds are gone,” he said this past week. “Our feeders are still full.”

Ouellette said some people tell him it’s the hawks or that this winter has been foggy and that’s thrown off the birds.

But Ouellette, a retired civil engineer, isn’t buying it. He’s seen winters like this before and there have been birds.

“If you feed the birds, you know when they’re (usually around),” he said.

But there is a difference in the neighborhood this winter.

Beginning in mid-December, the city began installing new smart-water meters on homes all throughout Rolling Hills. The meters send information to the city four times a day to help monitor water usage without having to send workers to check individual meters. By mid-January, the entire Rolling Hills North neighborhood had been equipped with the new meters.

And the birds were gone.

“Right after the meter was installed . . . I was noticing my bird feeders weren’t going down,” Ouellette said.

In the past Ouellette said he was spending about \$30 a month on bird seed.

Now?

“I haven’t bought any for two months,” he said.

Ouellette began asking his neighbors if they’d experienced anything similar.

Bruce Chase, who lives down the street from Ouellette, said he and his wife also noticed something strange this year.

“Ever since they’ve installed that smart meter, we have not seen a bird,” Chase said. “They’re just gone.”

Chase’s house sits along a greenbelt in the neighborhood and he said he and his wife specifically noticed the lack of hummingbirds at their feeders. Usually, they’d get three or four birds every hour stopping by for a quick meal.

“Now we’re lucky to see one a day,” he said.

Ouellette has taken his concerns to the city, including an appearance at the Feb. 11 City Council meeting, asking the council to look into the continued use of smart meters through out the city.

The city’s meters work by sending out a one-minute, 900 MHZ pulse of information every four hours. While that doesn’t seem like a lot, only one meter can send the information at a time so each meter in a neighborhood has to wait its turn to send the information to the controller, located in Rolling Hills on a water tower.

Because of this, there is almost a constant wave of the pulse streaming out from an area.

“It’s constantly doing it,” Ouellette said.

While there is much information and misinformation on the effects of the high-frequency pulse on the health of humans, there is little research into the effect on small wildlife such as birds. The meters operate at a frequency similar to cell phones and other portable communications devices and while some minor health effects have been reported, such as problems sleeping or dizziness or nausea, the meters are generally considered safe for humans. Ouellette said he thinks the city’s meters may be different somehow, as the power and gas meters in the neighborhood were also fitted with smart meters last year and they did not seem to have an effect on the neighborhood’s wildlife.

But since the city’s have gone on, he and Chase both said the change was obvious and immediate.

“Normally you can walk into a neighborhood and hear birds,” Chase said. “Here there’s nothing. And at this time of the year, it should be getting noisier.”

Ouellette said his research on the Internet has shown similar issues elsewhere, on small animals such as squirrels – which are also missing from the neighborhood these days, he said – and bees.

“I don’t know what the impact is,” Ouellette said. “I want the City of Renton to do some research.”

According to Utility Engineering Supervisor-Water Abdoul Gafour, the city has no information at this time on the effects of the meters on wildlife. Gafour said the city is looking into the matter further for discussion at the Utilities Committee meeting on Monday. The issue was added to the committee’s agenda after Ouellette spoke to the council.

Toby Ross, science officer for the Seattle Audubon Society also said he had not heard of this issue prior to getting a call recently from Ouellette.

Ross said there was “very little research” into the matter and is also checking with other local experts.

Ross also stressed that there could be many other reasons for missing birds, though he did not rule out the meters.

“It could just be a coincidence,” Ross said.

And while it might be a coincidence, Ouellette and his neighbors are concerned it might be the harbinger of a bigger problem.

Like the canary miners used to take into a coal mine to warn them if toxic gases were building up, Ouellette worries that once again our feathered friends are giving us a warning.

“The birds are indicators of a potential problem,” he said.

The Utilities Commission will meet at 4 p.m. Monday in the Council Committee Room, 7th floor of City Hall, Renton WA. A briefing on smart meter installation is on the scheduled agenda.

# **Cardiac Effects of Natural and Artificial EMR:**

**Dr Neil Cherry  
Associate Professor of Environmental Health**

**16<sup>th</sup> December 2002**

**Neil.Cherry@ecan.govt.nz**

**© Dr Neil Cherry 2002-2005**

**Human Sciences Department  
P.O. Box 84  
Lincoln University  
Canterbury, New Zealand**

## Cardiac Effects of Natural and Artificial EMR:

Dr Neil Cherry  
Lincoln University  
Canterbury, New Zealand

16/12/02

[Neil.Cherry@ecan.govt.nz](mailto:Neil.Cherry@ecan.govt.nz)

### Abstract:

The heart is a muscular organ whose regular coordinated contraction, called a heart beat, is regulated by an electrical pulse that initiates a cascade of calcium ions that carry the message into all the heart cells to initiate the contraction of the heart beat. Therefore it is biologically plausible that natural and artificial electromagnetic fields will interfere with the heart activity. It has been shown that external ELF fields cause altered calcium-concentrations in neurons and heart cells. Altered blood pressure is associated with the Schumann Resonance signal, along with its modulation of human heart disease and mortality rates in a homeostatic manner. Electrical and electronic workers, radio/TV workers are shown to have increased risks of heart disease and mortality. We all live in electromagnetic fields which act to contribute to increase the rate of cardiac disease and death. A new high risk factor is the usage of a cellphone. Cellphones have been shown to interfere with electronic pacemakers. Therefore it is very reasonable that they will interfere with biological pacemakers, that is, our hearts. The use of a cellphone is associated with significant increase of blood pressure. This is a symptom of hypertension and shows that there is a cardiac risk factor. This risk factor is strongly confirmed in the context of the Schumann Resonance signal effects, electrical workers effects and altered cardiac functions in radio, TV and radar exposed workers.

### Introduction:

A primary principle of Environmental Health is a necessity to understand how the natural system works before we can appreciate and understand how artificial signals and chemicals can alter the natural functions and cause human health effects. Muscular contraction and relaxation is regulated by the motor neuron system for skeletal muscles. Electrical signals come from the brain through a particular circuit, through the spine, to the motor neurons in the particular muscular system. This signal initiates a coordinated alteration of the calcium ion cell messengers which alters the contraction or relaxation of those muscles.

Heart muscle cells are very similar to the skeletal muscle cells, Alberts et al. (1994). Muscle contraction is initiated by a sudden rise in cytosolic calcium ions ( $\text{Ca}^{2+}$ ). For the skeletal muscle force-generating molecular interaction takes place only when a signal passes to the skeletal muscle from its motor nerve. The signal from the nerve triggers an action potential in the muscle cell plasma membrane, and this electrical excitation spreads rapidly into a series of membranous folds, the transverse tubules that extend inward from the plasma membrane around each myofibril. A signal is then laid across a small gap to the sarcoplasmic reticulum, Figure 1.

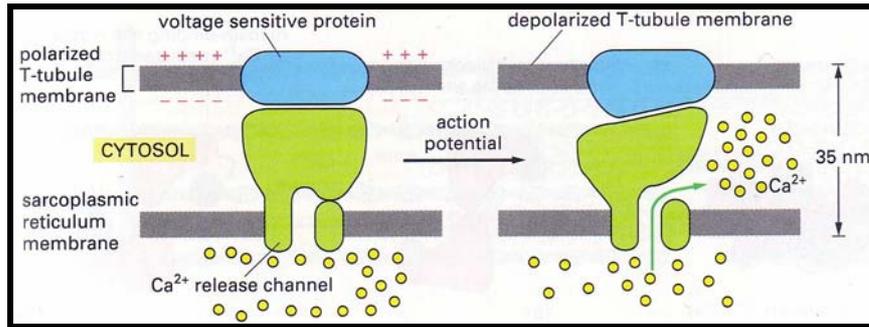


Figure 1: Schematic diagram showing how a calcium ion release channel in the sarcoplasmic reticulum membrane is thought to be opened by a voltage-sensitive transmembrane protein in the adjacent T-tubule membrane, Alberts et al. (1994).

When you see how electrical signals and ions have so many important roles in cells, controlling muscles and hearts, and many other bodily functions, through the electrical signals in the brain that are sent from the brain to the central nervous system and the motor neuron system, the opened understanding is that external electromagnetic fields can interfere with the body's systems. Certain organs such as the brain, the central nervous system and the heart, are very reliant on the electromagnetic signals and all the body's cells use many electromagnetic signals for their natural functions.

One of the earliest electromagnetic fields biological effects found and which is now well-established, is the calcium-ion efflux and influx of the cell membranes induced by extremely low-frequency (ELF) electromagnetic fields typically in the similar range of the brain EEG system frequencies. Another of the brain's most active frequencies is the alpha rhythm including 16 Hz. Dr Ross Adey's team showed that brain cells have been very strong in efflux and influx  $\text{Ca}^{2+}$  changes when exposed to 16 Hz fields and modulated RF/MW radiation Figure 2.

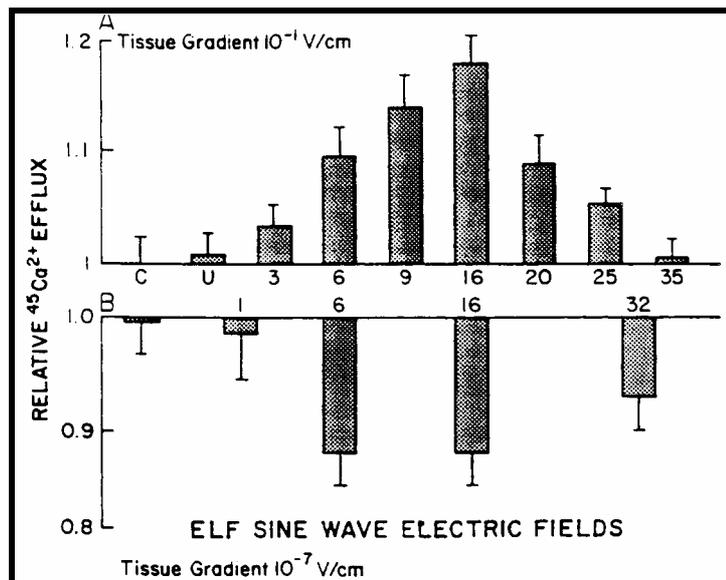


Figure 2: Relative  $\text{Ca}^{2+}$  efflux from an ELF modulated 147 MHz signal and (B) influx from the same external field strength (56V/m) but solely an ELF field, Adey (1988).

Figure 2 also indicated the strength of the induced fields in the tissue which for the RF field is 0.1V/m, a million times higher than the ELF field,  $10^{-7}$ V/m. This I call the “EMR Spectrum Principle” because it is well-established that the higher the carrier frequency the higher the induced tissue electric gradient and induced tissue current strength. This means that biological and health effects of RF/MW exposures will be found to be much higher from much lower intensities than from ELF fields.

Dr Adey was basing his insights on a fascination with discovering how neurological tissue operated and how it was altered in extremely low level RF/MW and ELF fields. The current world leader in  $\text{Ca}^{2+}$  efflux research is Dr Carl Blackman of the U.S.E.P.A. Blackman has replicated and significantly extended the studies carried out by Dr Adey's group and other groups. Dr Blackman has produced over 20 peer-reviewed publications in this area, including several major reviews.

Blackman et al. (1989) identified multiple power density windows for  $\text{Ca}^{2+}$  efflux, using a 50 MHz carrier modulated at 16 Hz. Their results, using units of  $\text{mW}/\text{cm}^2$ , are summarized as follows:

No change	0.75	2.30	4.50	5.85	7.08		8.19	8.66	10.6	14.7
Enhanced efflux		1.75	3.85	5.57	6.82	7.65	7.77		8.82	

The intensity window data was considered as an example of non-linear dynamics because there appears to be no progressive decline in the magnitude of the effects at low exposure intensities. This data is consistent with a fractal process with a non-integer dimension which is approximately 1.4, Blackman et al. (1989).

The lowest published RF intensity that has been documented to produce significant  $\text{Ca}^{2+}$  efflux is 0.00015 W/kg from Schwartz et al. (1990). They used frog hearts, exposed for 30 mins, to a 16Hz modulated 240 MHz RF signal. This has an exposure intensity of about  $0.4\mu\text{W}/\text{cm}^2$ .

Hearts use natural electric pulses to produce heart-beats. An electric pulse produces a cascade of calcium ions that cause the heart muscle to contract. The Electrocardiogram (ECG) is used to monitor heart activity and can detect heart disease through the altered electrical signals. Hence it is biologically plausible that electric signals, that are shown to interfere with artificial pacemakers, can also interfere with the natural heart-beat. This has been shown in several studies in relation to reduction of the heart rate variability (HRV). This is a known risk factor for heart disease.

Another important biophysics principal is the resonance interaction process. When an external frequency matches a natural internal frequency there is a very strong interaction from the process of resonance.

With the modern widespread use of mobile phones which expose the user's ear to much higher intensities of microwaves than radar repair workers usually receive, there is a real concern that the use of the phones and the close relation of cell site base stations near homes, cause possible or actual health effects. This review report has established that electromagnetic fields and radiation are plausibly changing non-thermal biological effects, and that resonant interactions are plausible because of the natural frequencies of the electromagnetic fields in the body. Therefore the evidence

is that natural global electromagnetic fields are associated with cardiac health effects. When the evidence of cardiac effects in electrical and electronic workers is considered, along with the evidence from radio frequency and microwave exposures for workers and military personnel, then it is found in epidemiological studies that they will also have elevated cardiac disease and mortality rates.

This review will include health effects found in physiotherapists whose work involved exposures to short waves and microwaves used for diathermy of patients.

### **Cardiac Associations with the Schumann Resonance Signal:**

Cherry (2002) shows that the Schumann Resonance (SR) signal is the highly plausible biophysics mechanism, using the melatonin mechanism, for explaining how Solar and Geomagnetic Activity (S/GMA) causes serious human health effects in homeostatic relationship to the Schumann Resonance signal intensity including cancer, cardiac, reproductive and neurological diseases and mortality. The cardiac effects are summarized below.

#### **S-GMA related Cardiac effects:**

A 35-year old cardiologist, with a family history of hypertension and stroke, used an electronic blood pressure monitor to record his blood pressure every 15 minutes for 3 years. This revealed a significant periodicity of 27.7 days in systolic and diastolic blood pressure and heart rate, which was coherent with the GMA Kp-index, Watanabe et al. (1994).

An Italian study of 447 patients with hypertension also found very significant correlations between systolic and diastolic blood pressure and GMA indices over a 5-year period, Ghione et al. (1998). A multiple correlation with potential confounding factors, such as age and date, confirmed the significant correlation with GMA. Stratifying the days into quiet, disturbed and highly disturbed GMA days consistently showed significantly higher values in the highly disturbed days for all blood pressure parameters, except for systolic night-time pressure. The difference between quiet and highly disturbed GMA days was 6 to 8 mm for the 24 hour systolic and diastolic blood pressure. The GMA indices and the blood pressure measurements contain the 27-day period. The authors concluded that these results seem to reflect a real relation between geomagnetic disturbances and blood pressure.

The solar rotation cycle is just below 28 days and it produces the same frequency in the Schumann Resonance signal, Figure 3(a), with sub-harmonic period peaks at, 28, 14, 11, 9, 7 and 3.5 days. The daily admission of patients to the Christchurch, New Zealand hospital for arrhythmic cardiac symptoms has its frequency shown in Figure 3(b) with periods of 28, 14, 9, 7, 5.6, 4.6, 3.5, 2.8 and 1.8 days. This shows a very strong relationship between the Schumann Resonance signal and the loss of synchronization of their heart's rhythm modulated by the solar 27/28 day cycle.

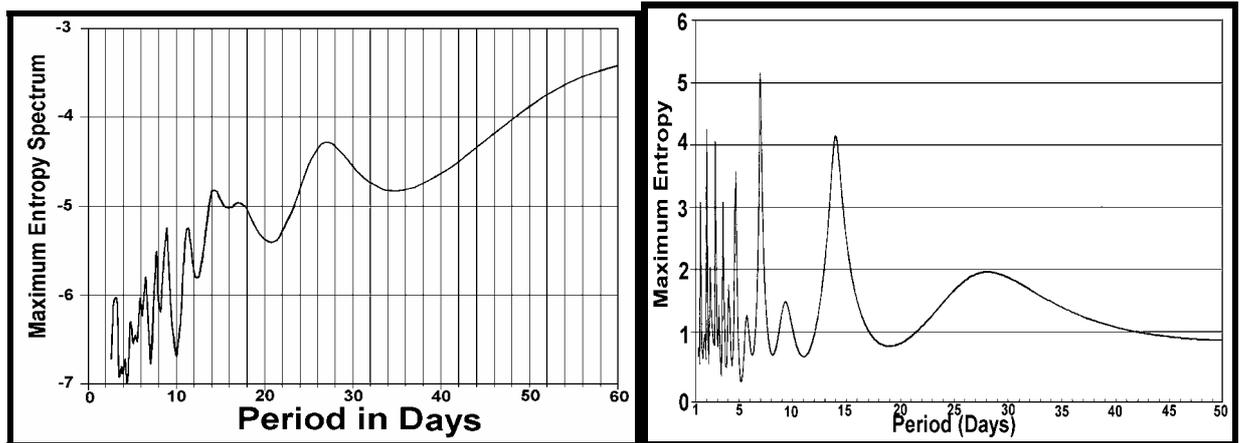


Figure 3: Maximum Entropy Spectrum of (a) The Schumann Resonance Intensity, 1997-99 (left) and (b) for the Cardiac Arrhythmia admissions to Christchurch Hospital, 1997-99 (right).

Because Melatonin is a natural highly potent antioxidant, reduced Melatonin enhances cell death. Geomagnetic activity is associated with reduced Melatonin in more than 6 published studies. Therefore it is plausible that reduced Melatonin, associated with solar and GMA, can be associated with increased rates of heart attacks. Geomagnetic Activity is also correlated with blood pressure changes in at least two independent studies. Hence a correlation with hypertension mortality was investigated and found, Table 1.

**Table 1: Correlation parameters of cardiac mortality in Thailand and Sunspot Number, The gradient is the number of Cases per 100,000 people /100 sunspots, Cherry (2003).**

Disease	Correlation Coefficient	t-value	p-value	Gradient
Hypertension (Male)	0.8497	6.2422	0.000012	0.7438
Hypertension (Female)	0.6653	3.4516	0.00329	0.5718

These correlations with Hypertension show some of the highest t-values and significance, confirming the sensitivity of the heart to altered electrical activity, the Schumann Resonance signal and reduced Melatonin.

Because the Schumann Resonance signal is extremely highly correlated with the sunspot number, Cherry (2002), I have produced graphs of the annual Hypertension mortality in Thailand with the annual sunspot number, Figure 4.

Two independent studies, Watanabe et al. (1994) and Ghione et al. (1998), show that human blood pressure is significantly correlated with GMA and a study shows that arrhythmic heart disease is correlated with acute variations in SR signal and another study produced here for the annual hypertension mortality is highly related to the SR signals and sunspot numbers.

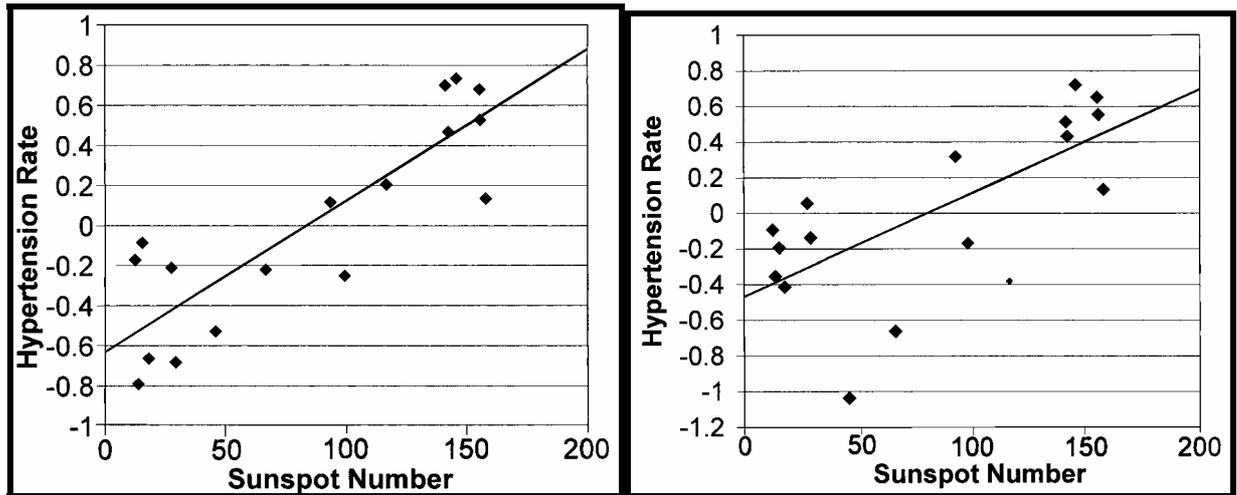


Figure 4: Annual Hypertension Mortality in Thailand related to the sunspot number as an indicator of the annual Schumann Resonance signal strength, Males (left) trend  $p=0.00012$  and Females (right) trend  $p=0.0033$ .

### Schumann Resonance-S/GMA melatonin reduction links:

Melatonin is a diurnal blood pressure regulator. S-GMA, through the Schumann Resonance signal, modulates human melatonin level, therefore these studies confirm that blood pressure change is a melatonin-related biological effect of S-GMA. Hence it is biologically plausible that extreme levels of S-GMA will cause a wide range of cardiac health effects and death.

Burch et al. (1999b) found that the strongest factor reducing melatonin in electrical workers, in addition to their occupational ELF and 3-phase exposures and cell phone usage, was the Geomagnetic Activity, in a dose-response manner, Figure 5. The Schumann Resonance signal, has a mean field strength of  $0.1\text{pW}/\text{cm}^2$  with a mean magnetic field strength about  $1\text{-}3\text{pT}$ .

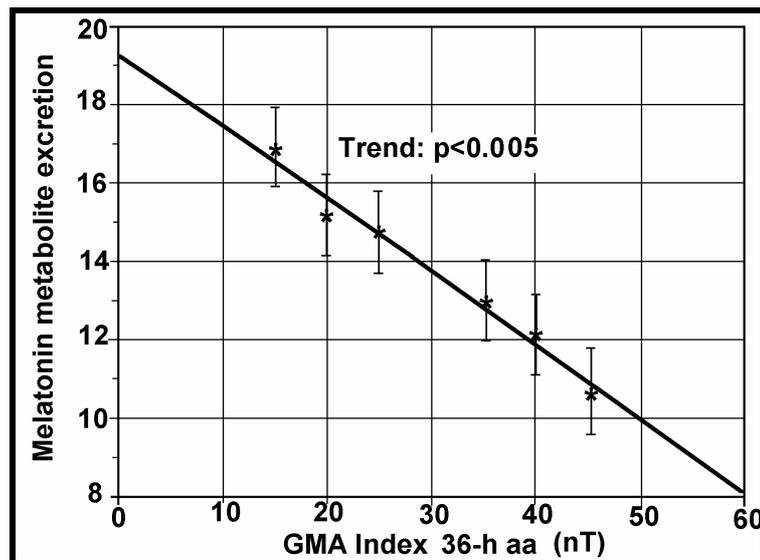


Figure 5: Reduction in the melatonin metabolite 6-OHMS in  $\mu\text{g}$  in urine from U.S. electric utility workers, as a function of the 36 hr global GMA aa-index, Burch et al. (1999).

Burch et al. (1999) showed a probable causal link between the Schumann Resonance signal and reduced melatonin, Cherry (2002). In addition there is Weydahl et al. (2001) and Rapoport et al. (1997, 1998, 2001). Bardasano et al. (1989) observed an extremely significant reduction ( $p < 0.001$ ) in synaptic ribbons of pinealocytes of rats during geomagnetic storms compared with quiet solar days. Thyroxine levels in a single limbic epileptic patient were highly correlated ( $r = 0.66$ ) in a dose-response manner, with daily GMA, O'Connor and Persinger (1996). The strongest association ( $r = 0.76$ ) was found between thyroxine levels and the Kp index during the previous night (2 am to 5 am). These analyses were carried out specifically to test the GMA Melatonin mechanism and they support it.

This is strong enough evidence to conclude that there is a causal link between reduced melatonin in people and animals and Solar/Geomagnetic Activity through the Schumann Resonance mechanism.

Reduced melatonin produces arrhythmic cardiac activity. The cardiac activity of rabbits was monitored during two GMA storms, Chibisov et al. (1995). At the initial and main phase of the storm the normal circadian structure of the cardiovascular parameter was lost. Desynchronization grew during the storm, leading to an abrupt drop of cardiac activity during the main phase of the storm. This was followed by the destruction and degradation of cardiomyocytes. The parameters of cardiac activity became significantly synchronized and the circadian rhythm restored during the storm's recovery period.

Human patients with ischemic heart disease (47-men and 33-women) were monitored for cardiac parameters daily over for 2-3 weeks, Gurfinkel et al. (1995). Changes in their microcirculations were related to GMA and to changes of atmospheric pressure. In the first day of a GMA storm pathological changes of capillary flow were detected in 71.5% of patients with acute myocardial infarction (men: 73.7%, women: 69.2%). They also observed perivascular edema, red blood aggregation, delay and slowing down of capillary flow. Similar changes were detected in 64.8% of patients with angina pectoris, (men: 73.3%, women: 56.3%). The reactions of these patients to GMA disturbances were over 2.5-times higher than the effects of atmospheric pressure changes.

GMA events are significantly correlated with increased blood coagulation and platelet aggregation, Pikin, Gurfinkel and Oraevskii (1998). Blood pressure, capillary flow, blood coagulation and aggregation changes are observed during GMA events, consistent with the effect expected with reduced melatonin in people with heart disease. Therefore, it is reasonably predicted that GMA will be associated with observable changes in cardiac disease and death when large human populations are studied.

Agadzhanian and Makarova (2001) studied changes in a number of respiration and circulation parameters during magnetic storms of varying intensities. The results were analyzed in 126 normal humans belonging to two age groups: 19-21 yr. old young men and women (29 of each) and 51-53 yr. old men ( $n = 36$ ) and women ( $n = 32$ ). Geomagnetic components D, H and Z were used. Systolic pressure, respiration volume, minute respiration volume and peak expiration rate were shown to be the most labile characteristics of the cardio-respiratory system responding by increases on magneto-disturbed days. The parameters under study exhibited sexual and age differences equally on quiescent and magneto-disturbed days. Adaptation to growing tension of the

magnetic field of Earth involves the neuroendocrine system and manifests itself by activation of the sympathetic nervous system entailing relative shifts in the cardio-respiratory parameters under study.

### **GMA Related Human Cardiac Disease and Death:**

Early correlations between S-GMA and heart attacks were assumed by some authors to be spurious, inaccurate and inconsistent, Malin and Srivastava (1979, 1980) and Knox et al. (1979). Results found in India were not confirmed in populations in the U.S. These were seen as inconsistent. The lack of a plausible mechanism also made these results not credible to some researchers. The masking of the natural signals effects by artificial EMR exposures in developed countries is a plausible explanation of the results. In the 1990's many other studies identified relationships that are highly significant and consistent with the original results.

With clinical measurement being able to identify highly significant changes in blood pressure, blood flow, aggregation and coagulation during GMA events, these results are highly plausible. They are mediated by melatonin in the normal diurnal and seasonal cycles. Since melatonin is also significantly correlated with levels of GMA during solar storms this will also have cardiac effects. Reduced melatonin is associated with cardiac arrhythmia and heart rate variability in clinical studies cited above.

De Bruyne et al. (1999) studied older heart patients (>55 years) and compared their heart rate variability (HRV) with their increased risk of mortality from myocardial infarction. They found that both decreased and increased HRV were significant risk factors, with increased HRV being the greater risk factor. This shows a timing related homeostatic relationship and GMA events are related to desynchronization of cardiac rhythms. Measured HRV also demonstrates anomalies in myocardial infarction, sudden death, heart failure, autonomic neuropathy and hypertension, Kerut, McKinnie and Giles (1999).

The EEG pattern, pulse rate, blood pressure and rate of sensomotor reaction were measured in a group of people. The parameters significantly correlated these physiological variables with the Kp-index, Doronin et al. (1998). They noted that the oscillations in the Kp-index had identical periods in the monitored EEG Alpha-Rhythm. This confirms the whole-body changes that occur in conjunction with GMA alteration by changing the brain and heart patterns. This supports the Model that suggests that the brain wave pattern is changed, involving alteration of ELF brain signals, and this is transferred through melatonin receptors and the autonomic nervous system to the cardiovascular system.

### **Cardiac Effects of High GMA:**

During periods of Active Sun and increased GMA the following statistically significant effects have been observed:

- Cardiac Arrhythmia in children, Markarov (1998).

- Novikova and Ryvkin (1977) observed a consistent and significant increase in heart attack incidence and death between active and quiet GMA conditions for 1961-66 at Sverdlovsk, USSR.
- GMA is highly correlated with daily myocardial infarction incidence rates during big GMA storms, Villaresi et. al. (1998).
- GMA activity is also correlated with sudden cardiovascular death, Sitar (1990), and Ischaemic Heart Disease mortality, Otto et al. (1982).
- Monthly solar activity was highly significantly correlated with monthly hospital admissions for cardiovascular disease, Stoupel and Shimshoni (1991). Solar activity is highly correlated with GMA and SR intensity.
- Stoupel et al. (1997) observed that during periods of low solar and geomagnetic activity, solar proton fluxes were correlated with cardiovascular deaths.
- Oraevskii et al. (1998a) found that 75 % of GMA storms caused an increased of the hospitalization of patients with myocardial infarction by 30 to 80%.
- Oraevskii et al. (1998b) report that MIR space orbital station staff experienced a significantly increased heart rate, reduced heart rate variability and decreased respiratory waves, corresponding with a specific adaptation of stress-reaction. At the same time hospital patients with ischemic heart disease had a similar reaction including deterioration of the physiological status, rheologic blood characteristics and heart rate disturbances, associated with GMA disturbances.
- Breus et al. (1998) report disturbance of cardiovascular activity among MIR astronauts during the main phase of solar storms compared to the recovery phase. Similar effects were observed in rabbits.

### **Cardiac Effects of Low GMA;**

Periods of Quiet Sun activity are significantly associated with:

- Stoupel et al. (1990) found a highly significant correlation ( $p=0.01$ ) for higher pregnancy induced hypertension for monthly periods of low GMA.
- Sudden death from cardiac arrhythmia, especially paroxymal atrial fibrillation, and stroke, Stoupel (1993) and Stoupel et al. (1995a). Stoupel, Martfel and Rotenberg (1994). Stoupel, Martfel and Rotenberg conclude that their results are consistent with previous studies showing increased heart electrical instability during periods of lowest geomagnetic activity.
- Ischaemic Heart Disease for ages >70 years. Stoupel et al. (1995b).
- Stoupel et al. (1999) found a very highly significant inverse correlation ( $r= -0.64$ ,  $p=0.0001$ ) for a 72 month period between solar activity and stroke/ischemic heart

disease death. They concluded that monthly ratio of deaths from stroke/ischemic heart disease is related to environmental physical activity.

### **Conclusions about Cardiac relationship to the Schumann Resonance Signal:**

The cardiac studies are consistent with the Schumann Resonance Hypothesis and add considerable weight to the melatonin, homeostatic and arrhythmic factors in the Hypothesis, Cherry (2002). Blood pressure, blood coagulation, heart attack, cardiac arrhythmia and sudden cardiac death are highly correlated with GMA in a homeostatic (U shaped) manner. This data is consistent with the involvement of melatonin. Being directly supported by clinical cardiovascular monitored changes of blood pressure, capillary flow and blood aggregation, multiple studies have very highly significant correlations with solar activity and GMA. This gives robust evidence supporting a causal relationship between GMA and Ischemic and arrhythmic cardiovascular disease, heart attack and death. The highly significant correlation between S-GMA and the SR signal intensity gives robust support for the SR Hypothesis through a Melatonin Mechanism.

Given the causal link to Cardiac Health and Mortality effect to the Schumann Resonance signal with a mean intensity near  $0.1\text{pW/cm}^2$  and magnetic field strength of about 1-3pT, it is extremely plausible that electrical workers chronically exposed to ELF fields about a million times higher (1-3 $\mu\text{T}$ ) electromagnetic fields will experience serious heart disease elevated rates. It is also extremely plausible that people living in vicinity to cell sites and high powered radio and TV towers, airport radars etc, with field strengths typically around 0.1 to 5 $\mu\text{W/cm}^2$ , 1 million to 50 million times higher than the SR signal, will experience significantly elevated cardiac health and mortality rates.

### **ELF Occupational Cardiac Studies:**

Satre, Cook and Graham (1998) observed significantly reduced heart rate variability (HRV) in volunteers sleeping in 60Hz fields. Reduced HRV is known to be an indication of heart disease risk.

This is a powerful set of epidemiological evidence showing that EMR across the spectrum increases the incidence and mortality from arrhythmia related heart disease and from heart attack. For the total cumulative exposure the rate of rise per year for Arrhythmic Heart mortality was  $\text{RR}/\mu\text{T-year} = 1.08$ , 96%CI: 1.03-1.12 and for Acute Myocardial Infarction,  $\text{RR}/\mu\text{T-year} = 1.04$ , 95%CI: 1.03-1.06. The following graph shows the dose-response curve for Acute Myocardial Infarction (Heart Attack) in electric utility workers, Savitz et al. (1999), Figure 6.

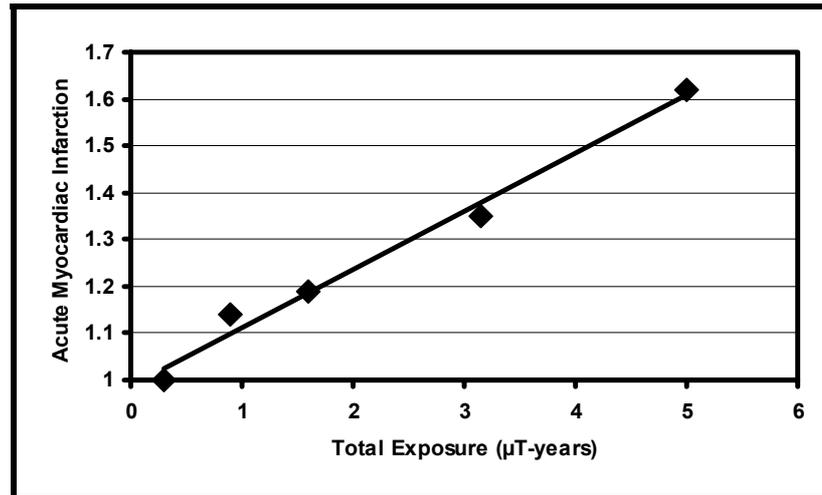


Figure 6: Acute Myocardial Infarction as a function of cumulative exposure to 60 Hz fields in U.S. electricity utility workers, Savitz et al. (1999), trend  $p < 0.001$ .

Savitz et al. (1999) shows crude dose-responses for Cardiac Arrhythmia related heart disease, Figure 7, and a highly significant dose-response for Heart Attack, Figure 6, for exposed electrical occupations and for individual occupations of electrician, lineman and power plant operator.

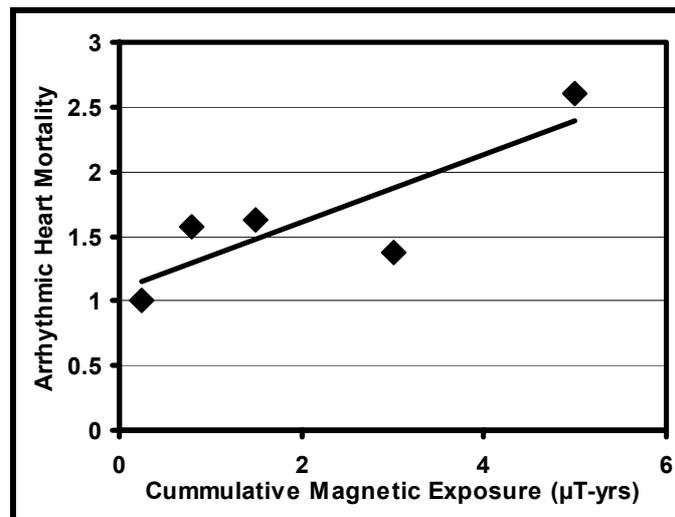


Figure 7: Arrhythmic heart disease mortality as a function of cumulative exposure to 60 Hz fields, with 5-year lag, in U.S. electricity utility workers, Savitz et al. (1999), trend  $p = 0.07$ .

### RF/MW Association with Heart Disease:

Extrinsic EMR signals interfere with hearts and cause heart disease and death. Bortkiewicz et al. (1995, 1996, 1997) and Szmigielski et al. (1998) found that RF exposure altered heart rate variability and blood pressure. Forman et al. (1982) present case studies of microwave exposed personnel with induced hypertension. Braune et al. (1998) showed that cell phone use significantly increased blood pressure.

The United States Embassy in Moscow was chronically exposed for over 10 years to a deliberately directed Soviet radar. The US State Department, after staff expressed concerns, got Professor Abraham Lillian of John Hopkins University to carry out a survey of staff health effects. Two reference groups were used. The general US public and comparison Eastern European Embassy staff and families. With years of tour service a number of illness rates rose significantly. In relation to the heart, the Vascular illness showed the strongest trends, Figure 7. The mean personal exposure was somewhat less than  $0.1\mu\text{W}/\text{cm}^2$ .

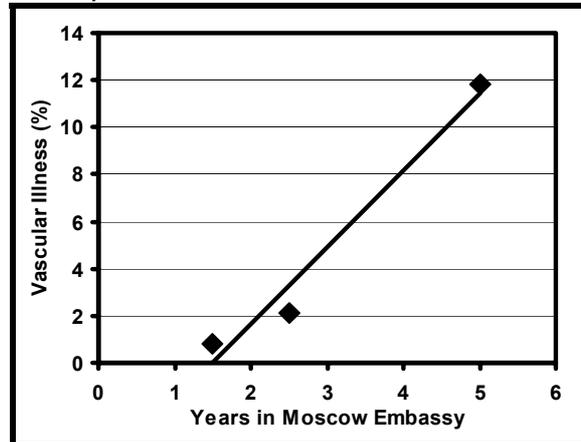


Figure 7: Vascular illness rate (%) in male staff at the United States Embassy in Moscow, for years of service while the Embassy was exposed to a very low intensity of a Soviet radar signal, Table 6.18, Lilienfeld et al. (1968). Trend  $p=0.004$ .

Seven young children of the embassy staff developed blood disorders during the first tour of duty. When compared with other US European Eastern Embassies the rate was over four times higher in the Moscow US Embassy,  $RR = 4.05$ .

The Korean War radar study, Robinette et al. (1980), assessed the relative greater radar pulse microwave exposure of U.S. Navy personnel in occupational groups of repairers versus users of the radar. Two higher exposed groups were AT and FT and a lower exposed group was ET. Comparing the cardiac mortality rate for "Diseases of the Circulatory System" in the FT+AT group compared with the ET group yields,  $RR = 1.27$ , 95%CI: 0.92-1.75,  $n=64$ . For hospital admissions, the diseases of blood forming organs yielded  $RR= 4.33$ , 95%CI: 1.53-12.3,  $p=0.001$ , and for the Circulatory system  $RR = 1.53$ , 95%CI: 1.07-2.18,  $p=0.007$ , and for Cardiovascular disease,  $RR = 2.03$ , 95%CI: 1.34-3.07,  $p<0.001$ .

These military occupational groups exposed to radar have elevated cardiac mortality and highly significantly elevated cardiac disease rates.

Hamburger, Logue and Silverman (1983) observed significant dose-responses for heart disease for male physiotherapists as a function of treatments per month with microwaves,  $OR = 2.51$  (1.09-5.78), Trend  $p<0.05$ ); shortwave,  $OR = 3.40$  (1.56-7.39), trend  $p=0.005$ ; and Combined Microwave and Shortwave,  $OR = 2.88$  (1.21-6.70), trend  $p=0.025$ .

Dose-responses and consistent and significant elevation of disease rates and mortality gives evidence of a causal relationship. Therefore a causal relationship between

radiofrequency and microwaves exposure and cardiac illness in this assessment, is causally related. This is strongly confirmed by the natural electromagnetic radiation, SR signal  $0.1\text{pW}/\text{cm}^2$ , causal link to cardiac illness and death rates. This strongly indicates that cellphone use is likely to be a major risk of Cardiac Disease because of the extremely high levels of microwave exposure from cell phone is produced for the phone users. The Moscow Embassy data also indicates that the passive cellphone exposure is very likely to enhances the risk factors are cardiac illness. This is confirmed by an Austrian study around cell sites presented at the Ischia Congress in October 2001. The study is being carried out by Prof Michael Kundi, of the University of Vienna, and shows a dose-response rate of cardiac diseases from cell site's exposures.

### **Cell Phone Radiation Cardiac Activity:**

Cardiac pacemaker interference:

- Barbaro et al. (1996); showed interference, skipped three beats.
- Hofgartner et al. (1996); significant interference,  $p < 0.05$ ,
- Chen et al. (1996); extremely highly significant interference,  $p = 0.0003$ ,
- Naegeli et al. (1996); extremely highly significant interference,  $p < 0.0001$ ,
- Altamura et al. (1997); reversible interference,
- Schlegal et al. (1998); significantly induced electronic noise,
- Occhetta et al. (1999); various disturbances observed and;
- Trigano et al. (1999) warnings recommended

Blood Pressure increase:

- Braune et al. (1998), Cellphone usage significantly increases blood pressure.

Quite often the cellphone companies fund research to challenge the independent results studies showing adverse effects linked to exposure to cell phone radiation. However, the SR signal, over a billion times weaker than the cell phone signal exposes of the user, show a significant blood pressure alteration in people and causes cardiac disease and death. Therefore it is logical and scientifically reasonable that cell sites exposures and cell phone usage will alter the blood pressure and increase the rate of cardiac diseases and mortality.

### **Conclusions and Recommendations:**

The brain and the heart are very sensitive electromagnetically controlled organs. They work together to maintain a regulated and activity responsive circulation system to provide fluid, energy and oxygen throughout the body. Both of these organs are synchronized by the natural Schumann resonance signal. When solar energy and Geomagnetic Activity alters the Schumann Resonance signal, then neurological and

cardiac functions in human populations are modulated. Because people are sensitive and reactive to this extremely subtle signal, it is not surprising that electrical workers and radar and radio exposed workers have significant and dose-response increases in cardiac disease and death rates. It is therefore strongly scientifically plausible, and confirmed by an Austrian study, that people living in the vicinity of cell sites experienced a dose-response of increase in cardiac illness. This shows that cell phone usage and passive cell phone exposure will not only interfere with electronic cardiac pacemakers but will also interfere with the natural cardiac pacemaker, the human heart. Therefore cellphone usage and the cellphone system is enhancing the cardiac illness and mortality rate in the community.

Santini et al. (2002) show that living in the vicinity of cell site exposure produces elevated neurological effects, many of which are shown in a dose-response manner. Another symptom also shown is a significantly calibrated as cardiovascular problems. A similar study in Austria, carried out by Professor Michael Kundi, found a significant dose- response relationship between cardiac disease and cell site exposure.

This provides strong support and motivation for promoting and using much safer cellular telephone technologies and sighting strategies, and accelerating the move to place radio and TV signals in fiber-optic cables to remove the genotoxic and cardiac damaging radiation and signals from the air in which people are living.

#### References:

- Adey, W.R., 1980: "Frequency and Power windowing in tissue interactions with weak electromagnetic fields". Proc. IEEE, 68:119-125.
- Agadzhanian, N.A. and Makarova, I.I., 2001: "Influence of geomagnetic activity on the cardiorespiratory system in healthy humans". [Article in Russian]. *Aviakosm Ekolog Med* 35(5): 46-49.
- Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D., 1994: "Molecular Biology of the cell". 3rd edition, New York, Garland Publishing, 1994.
- Altamura G, Toscano S, Gentilucci G, Ammirati F, Castro A, Pandozi C, Santini M, 1997: "Influence of digital and analogue cellular telephones on implanted pacemakers". *Eur Heart J* 18(10): 1632-4161.
- Barbaro V, Bartolini P, Donato A, Militello C, 1996: "Electromagnetic interference of analog cellular telephones with pacemakers". *Pacing Clin Electrophysiol* 19(10): 1410-1418.
- Bardasano, J.L., Cos, S. and Picazo, M.L., 1989: "Numerical variation in synaptic ribbons of rat pinealocytes under magnetic storm conditions and on calm days".[In German] *J Hirnforsch* 30(60): 639-643.
- Blackman, C.F., Kinney, L.S., House, D.E., and Joines, W.T., 1989: "Multiple power-density windows and their possible origin". *Bioelectromagnetics*, 10: 115-128.
- Blackman, C.F., 1990: "ELF effects on calcium homeostasis". In "Extremely low frequency electromagnetic fields: The question of cancer", BW Wilson, RG Stevens, LE Anderson Eds, Publ. Battelle Press Columbus: 1990; 187-208.

- Bortkiewicz, A., Zmyslony, M., Palczynski, C., Gadzicka, E. and Szmigielski, S., 1995: "Dysregulation of autonomic control of cardiac function in workers at AM broadcasting stations (0.738-1.503 MHz)". *Electro- and Magnetobiology* 14(3): 177-191.
- Bortkiewicz, A., Gadzicka, E. and Zmyslony, M., 1996: "Heart rate in workers exposed to medium-frequency electromagnetic fields". *J Auto Nerv Sys* 59: 91-97.
- Bortkiewicz, A., Zmyslony, M., Gadzicka, E., Palczynski, C. and Szmigielski, S., 1997: "Ambulatory ECG monitoring in workers exposed to electromagnetic fields". *J Med Eng and Tech* 21(2):41-46.
- Braune, S, Wrocklage, C, Raczek, J, Gailus, T, Lucking, CH, 1998: Resting blood pressure increase during exposure to a radio-frequency electromagnetic field. *Lancet* 351(9119):1857-1858.
- Breus, T.K., Baevskii, R.M., Nikulina, G.A., Chibisov, S.M., Chernikova, A.G., Pukhlianko, M., Oraevskii, V.N., Halberg, F., Cornelissen, G. and Petrov, V.M., 1998: "Effect of geomagnetic activity on the human body in extreme conditions and correlation with data from laboratory observations". *Biofizika* 43(5): 811-818.
- Burch, JB, Reif, JS, Pitrat, CA, Keele, TJ, Yost, MG, 1997: Cellular telephone use and excretion of a urinary melatonin metabolite. Abstract of the Annual Review of Research on Biological Effects of Electric and Magnetic Fields from the Generation, delivery & Use of Electricity, San Diego, CA, 1997, pp.110.
- Burch, J.B., Reif, J.S. and Yost, M.G., 1999b: "Geomagnetic disturbances are associated with reduced nocturnal excretion of melatonin metabolite in humans". *Neurosci Lett* 266(3):209-212.
- Chen WH, Lau CP, Leung SK, Ho DS, Lee IS, 1996: "Interference of cellular phones with implanted permanent pacemakers". *Clin Cardiol* 19(11): 881-886.
- Cherry, N.J., 2000: "Evidence that electromagnetic radiation is genotoxic: the implications for the epidemiology of cancer and cardiac, neurological and reproductive effects". Proceedings of the conference on EMR Health Effects, European Parliament, Brussels. 28<sup>th</sup> June 2000.
- Cherry, N.J., 2002: "Schumann Resonances, a plausible biophysical mechanism for the human health effects of Solar/Geomagnetic Activity". *Natural Hazard* 26: 279-331.
- Chibisov, S.M., Breus, T.K., Levitin, A.E. and Drogova, G.M., 1995: "Biological effects of planetary magnetic storms". [Article in Russian] *Biofizika* 40(5): 959-968.
- Chibisov, S.M., Breus, T.K. and Illarionova, T.S., 2001: "Morphological and functional state of the heart during magnetic storm". *Bull Exp Biol Med* 132(6): 1150-1153.
- De Bruyne, M.C., Kors, J.A., Hoes, A.W., Klootwijk, P., Dekker, J.M., Hofman, A., van Bommel, J.H. and Grobbee, D.E., 1999: "Both decreased and increased heart rate variability on the standard 10-second electrocardiogram predict cardiac mortality in the elderly". *Am. J. Epidemiol.*, 150(12): 1282-1288.
- Doronin, V.N., Parfentev, V.A., Tleulin, S.Zh., Namvar, R.A., Somsikov, V.M., Drobzhev, V.I. and Chemeris, A.V., 1998: "Effect of variations of the geomagnetic field and solar activity on human physiological indicators". *Biofizika* 43(4): 647-653.

- Forman, S.A., Holmes, C.K., McManamon, T.V., and Wedding, W.R., 1982: "Physiological Symptoms and Intermittent Hypertension following acute microwave exposure". *J. of Occup. Med.* 24(11): 932-934.
- Ghione, S., Mezzasalma, L., Del Seppia, C. and Papi, F., 1998: "Do geomagnetic disturbances of solar origin affect arterial blood pressure?". *J. Hum Hypertension*, 12(11): 749-754.
- Gurfinkel' Iul, Liubimov, VV., Oraevskii, V.N., Parfenova, L.M. and Iur'ev, A.S., 1995: "The effect of geomagnetic disturbances in capillary blood flow in ischemic heart disease patients" *Biofizika* 40(4): 793-799.
- Hamburger, S., Logue, J.N., and Sternthal, P.M., 1983: "Occupational exposure to non-ionizing radiation and an association with heart disease: an exploratory study". *J Chronic Diseases*, Vol 36, pp 791-802.
- Hofgartner F, Muller T, Sigel H, 1996: "Could C- and D-network mobile phones endanger patients with pacemakers?". *Dtsch Med Wochenschr* 121(20): 646-652,. [Article in German]
- Kerut, E.K., McKinnie, J.J. and Giles, T.D., 1999: "Modern evaluation of the hypertensive patient: autonomic tone in cardiovascular disease and assessment of heart rate variability". *Blood Press Monit* 4(Suppl 1): S7-S14.
- Knox EG, Armstrong E, Lancashire R, Wall M. and Haynes, R., 1979: "Heart attacks and geomagnetic activity". *Nature* 281(5732): 564-565.
- Lilienfeld, A.M., Tonascia, J., and Tonascia S., Libauer, C.A., and Cauthen, G.M., 1978: "Foreign Service health status study - evaluation of health status of foreign service and other employees from selected eastern European posts". Final Report (Contract number 6025-619073) to the U.S. Dept of State, July 31, 1978.
- Malin, S.R.C. and Srivastava, B.J., 1979: "Correlation between heart attacks and magnetic activity". *Nature* 277 (22 Feb 1979): 646-648.
- Malin, S.R. and Srivastava, B.J., 1980: "Correlation between heart attacks and magnetic activity--a retraction". *Nature* 283(5742): 111.
- Makarov, L.M., 1998: "Role of geomagnetic field in development of biorhythm profile of ventricular arrhythmia onset". *Klin. Med. (Mosk)*, 76(6):31-35.
- Naegeli B, Osswald S, Deola M, Burkart F, 1996: "Intermittent pacemaker dysfunction caused by digital mobile telephones". *J Am Coll Cardiol* 27(6):1471-1477.
- Novikova, K.F. and Ryvkin, B.A., 1977: "Solar activity and cardiovascular diseases". In "Effects of solar Activity on the Earth's Atmosphere and Biosphere". M.N.. Gnevyshev and A.I. Ol' , eds. Pp 184-200, Acad. Sci. USSR, English trans, Israel Prog. Sci. Trans, Jerusalem.
- Occhetta E, Plebani L, Bortnik M, Sacchetti G, Trevi G, 1999: "Implantable cardioverter defibrillators and cellular telephones: is there any interference?". *Pacing Clin Electrophysiol* 22(7): 983-989.

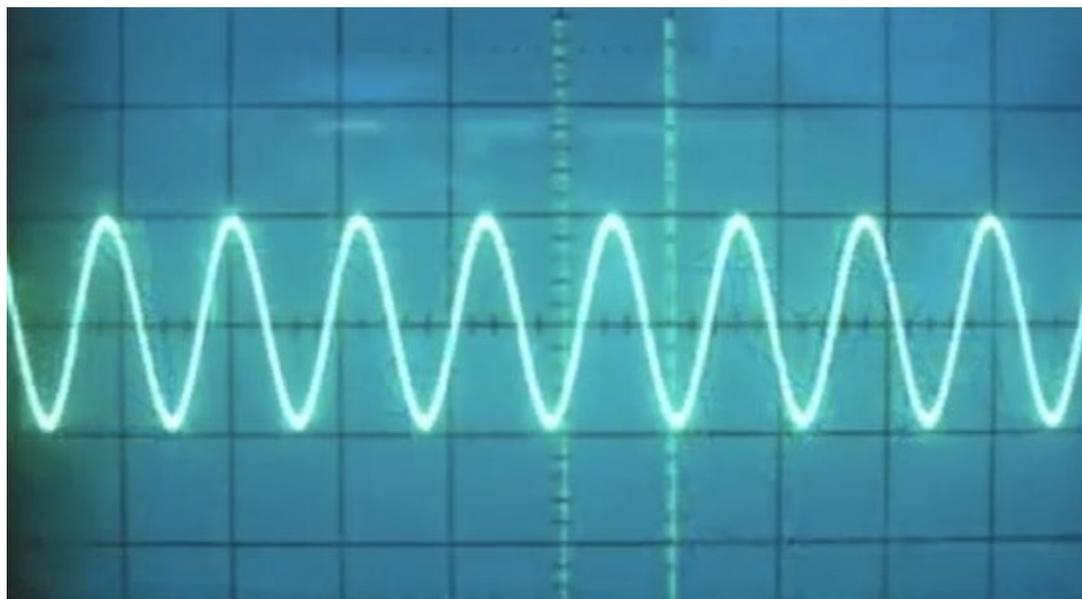
- O'Connor, R.P. and Persinger, M.A., 1996: Increases in geomagnetic activity associated with increases in thyroxine levels in a single patient: implications for melatonin levels". *International Journal of Neuroscience*, 88(3-4): 243-247.
- Oraevskii, V.N., Kuleshova, V.P., Gurfinkel', Iu.F., Guseva, A.V., and Rapoport, S.I., 1998a: "Medico-biological effect of natural electromagnetic variations". *Biofizika*, 43(5): 844-888.
- Oraevskii, V.N., Breus, T.K., Baevskii, R.M., Rapoport, S.I., Petrov, V.M., Barsukova, Zh.V., Gurfinkel' Iul, and Rogoza, A.T., 1998b: "Effect of geomagnetic activity on the functional status of the body". *Biofizika* 43(5): 819-826.
- Otto, W., Hempel, W.E., Wagner, C.U. and Best, A., 1982: "Various periodical and aperiodical variations of heart infarct mortality in the DRG". [In German], *Z Gesamte Inn Med* 37(22): 756-763.
- Pikin, D.A., Gurginkel', Iu.I. and Oraevskii, V.N., 1998: "Effect of geomagnetic disturbances on the blood coagulation system in patients with ischemic heart disease and prospects for correction medication". [In Russian]. *Biofizika*, 43(4): 617-622.
- Rapoport, S.I., Blodypakova, T.D., Malinovskaia, N.K., Oraevskii, V.N., Meshcheriakova, S.A., Breus, T.K. and Sosnovskii, A.M., 1998: "Magnetic storms as a stress factor". *Biofizika* 43(4): 632-639.
- Rapoport, S.I., Blodypakova, T.D., Malinovskaia, N.K., Oraevskii, V.N., Meshcheriakova, S.A., Breus, T.K. and Sosnovskii, A.M., 1998: "Magnetic storms as a stress factor". *Biofizika* 43(4): 632-639.
- Rapoport, S.I., Shalalova, A.M., Oraevskii, V.N., Malinovskaia, N.K., and Vetterberg, L., 2001: "Melatonin production in hypertonic patients during magnetic storms". *Ter Arkh* 73(12): 29-33.
- Robinette, C.D., Silverman, C. and Jablon, S., 1980: "Effects upon health of occupational exposure to microwave radiation (radar)". *American Journal of Epidemiology*, 112(1):39-53, 1980.
- Santini R, Santini P, Danze JM, Le Ruz P and Seigne M., 2002: "Investigation on the health of people living near mobile telephone relay stations: Incidence according to distance and sex". [Article in French] *Pathol Biol (Paris)* 50(6): 369-373.
- Sastre, A., Cook, M.R. and Graham, C., 1998: "Nocturnal exposure to intermittent 60 Hz magnetic fields alters human cardiac rhythm". *Bioelectromagnetics* 19: 98-106.
- Savitz, D.A., Liao, D., Sastre, A., Klecjner, R.C., and Kavet, R., 1999: "Magnetic field exposure and cardiovascular disease mortality among electric utility workers". *Am. J. Epidemiology*, 149(2): 135-142.
- Schlegel RE, Grant FH, Raman S, Reynolds D 1998: "Electromagnetic compatibility study of the in-vitro interaction of wireless phones with cardiac pacemakers". *Biomed Instrum Technol* 32(6): 645-655.
- Schwartz, J.L., House, D.E., and Mealing, A.R., 1990: "Exposure of frog hearts to CW or amplitude modulated VHF fields: selective efflux of calcium ions at 16 Hz." *Bioelectromagnetics*, 11: 349-358.

- Sitar, J., 1990: "The causality of lunar changes on cardiovascular mortality". [In Czech.] *Cas. Lek. Cesk.* 129(45):1425-1430.
- Stoupel, E., Hod, M., Shimshoni, M., Friedman, S., Ovadia, J. and Keith, L., 1990: "Monthly cosmic activity and pregnancy induced hypertension". *Clin Exp Obstet Gynecol* 17(1): 7-12.
- Stoupel, E. and Shimshoni, M., 1991: "Hospital cardiovascular deaths and total distribution of deaths in 180 consecutive months with difference cosmic physical activity: a correlation study (1974-1988)". *Int. J. Biometeorology* 35(1): 6-9.
- Stoupel, E., 1993: "Sudden cardiac deaths and ventricular extrasystoles on days of four levels of geomagnetic activity". *J. Basic Physiol. Pharmacol.*, 4(4): 357-366.
- Stoupel, E., Abramson, E., Sulkes, J., Martfel, J., Stein, N., Handelman, M., Shimshoni, M., Zadka, P. and Gabbay, U., 1995a: "Relationship between suicide and myocardial infarction with regard to changing physical environmental conditions". *Int J Biometeorol* 38(4): 199-203
- Stoupel, E., Petrauskiene, J., Kalediene, R., Domarkiene, S., Abramson, E. and Sulkes, J., 1996: "Distribution of deaths from ischemic heart disease and stroke. Environmental and aging influences in men and women". *J. Basic. Clinical Physiol. Pharmacol.*, 7(4): 303-319.
- Stoupel, E., Abramson, J., Domarkiene, S., Shimshoni, M. and Sulkes, J., 1997: "Space proton flux and the temporal distribution of cardiovascular deaths". *Int J Biometeorol* 40(2): 113-116.
- Stoupel, E., Petrauskiene, J., Abramson, E., Kalediene, R., Israelovich, P. and Sulkes, J., 1999: "Relationship between deaths from stroke and ischemic heart disease: Environmental implications". *J. Basic. Clinical Physiol. Pharmacol.*, 10(2): 135-145.
- Szmigielski, S., Bortkiewicz, A., Gadzicka, E., Zmyslony, M. and Kubacki, R., 1998: "Alteration of diurnal rhythms of blood pressure and heart rate to workers exposed to radiofrequency electromagnetic fields". *Blood Press. Monit*, 3(6): 323-330.
- Trigano AJ, Azoulay A, Rochdi M, Campillo, A., 1999: "Electromagnetic interference of external pacemakers by walkie-talkies and digital cellular phones: experimental study. *Pacing Clin Electrophysiol* 22(4 Pt 1): 588-593.
- Villoresi, G., Ptitsyna, N.G., Tiasto, M.I. and Iucci, N., 1998: "Myocardial infarct and geomagnetic disturbances: analysis of data on morbidity and mortality". [In Russian]. *Biofizika*, 43(4): 623-632.
- Watanabe, Y., Hillman, D.C., Otsuka, K., Bingham, C., Breus, T.K., Cornelissen, G. and Halberg, F., 1994: "Cross-spectral coherence between geomagnetic disturbance and human cardiovascular variables at non-societal frequencies". *Chronobiologia* 21(3-4):265-272.

## Smart Meters: The Winter Solstice Tsunami of 2012

By Patricia Burke

Published: November 24, 2012



During the summer of 2012, I housesat in Medfield, MA, a suburb of Boston. After a short time, I began feeling an in-rush of disruptive energy blanketing the neighborhood, inside the house and out, approximately every other hour, every day and night. I have felt this phenomenon before, on the West coast as well as the East, and because of it I have moved fourteen times in four years, without success.



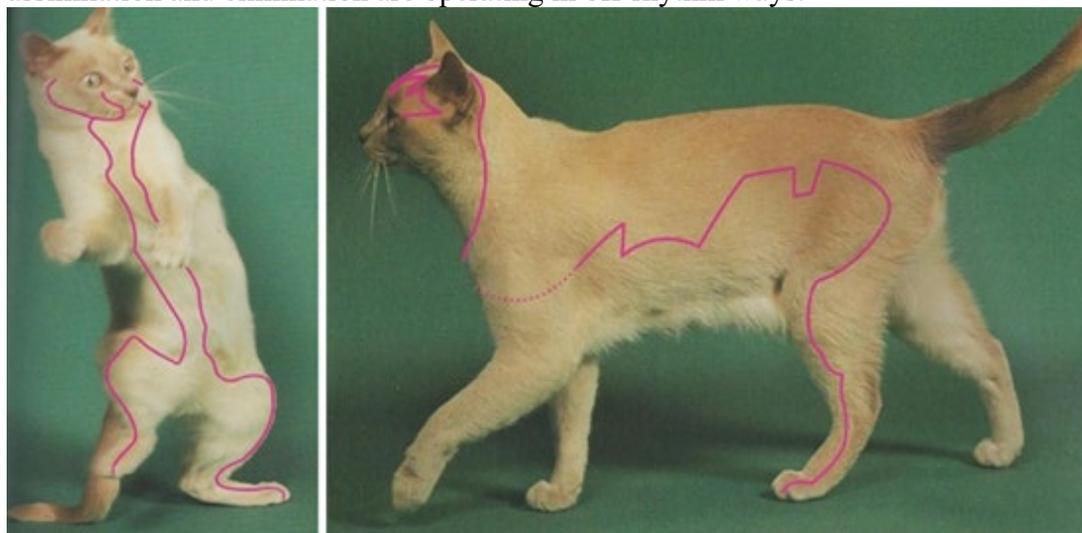
Asia with no hair on ears. (Photo by Janis Luedke)

The young cat I cared for was struggling during the summer. Now Asia is biting herself and tearing at her skin and fur with her teeth, scratching deeply enough to draw blood. She has ripped off most of her whiskers and the

hair on her ears, which are antennas for a cat.

The cat attacks herself along her Stomach and Gall Bladder meridian pathways. These are two of the twelve primary electromagnetic pathways in the human as well as the feline energy field. Because both the gallbladder and the stomach are hollow organs, they can perform bodyguard-like roles by speeding up their function to discharge dangerous energies. I know that the environment is causing my body to react, but the cat only feels the painful burning along her meridian lines, and she is instinctively lashing out at them. Like me, she also experiences urgent thirst whenever the invasive in-rush occurs. This is because our electrical systems are under siege.

Many individuals who experience symptoms attributed to stress or fatigue are using stimulants, sedatives and pain relievers that mask symptoms. Asia and I have reached the point where multiple energy systems are now involved and several organs are in a simultaneous state of overcharge and exhaustion. Our biorhythms are no longer synchronized by the sun because the energies have been diverted to defend our lives, and all aspects of digestion, assimilation and elimination are operating in off-rhythm ways.



(left) Stomach Meridian in Cat (right) Gall Bladder Meridian in Cat. Photos from Four Paws Five Directions, A Guide to Chinese Medicine for Cats and Dogs by Cheryl Schwartz, DVM. Repinted by permission.

We are each in a degenerative tailspin.

The cat lives in a neighborhood surrounded by 8 towers and 85 antennas in a four-mile radius.<sup>1</sup> Inside the home are cordless phones, cell phones and Wi-Fi each emitting different frequencies.<sup>2</sup>

What has most likely driven the cat and increasing numbers of humans to the breaking point is the new juxtaposition of pulsed microwave radiation generated by the deployment of the smart meter grid across the United States. Very few ratepayers are aware of the complexity of this new technology, and the resulting security, safety, and health hazards. Activists in communities worldwide are attempting to raise awareness, because they perceive correctly that humanity is at the eleventh hour.

Each autumn seems to be a vulnerable time for Asia, but this year the magnitude of her suffering raises the question of her quality of life. She has retreated to the downstairs bathroom, sleeping in the sink and eating, drinking and eliminating within two confined rooms at the mid-point of radiation from the antenna-laden water tower up the hill from the house and the pulsing electric meter on the other side.

Although her health was faltering when I saw her in August, by October she bears the same look I saw in college videos of animal experimentation, when electric shocks were administered randomly and the animal had no control over its experience. Bruno Bettelheim and others have written about how this technique broke the spirit of prisoners in Nazi Germany.<sup>3</sup>

Despite her constant licking and meticulous hygiene, she does not smell like a cat, and I do not smell like a human either. Asia now looks a prisoner of war who has been subjected to torture. She gazes out into space, not making eye contact, on alert and overcharge but also hopeless and exhausted.

She is 6 years old. I suspect that she will not be here in February to greet the Chinese New Year celebration of the Year of the Water Snake. She is an empty shell, and, like me, she knows that the tsunami of 2012 has already arrived.

### **Canaries in the Coal Mine, Pets and the Electromagnetic Fields**

American pets may be following the same failed trajectory as the first electrically disabled individuals in Sweden. In 1984, The Swedish Association for the ElectroHyperSensitive (FEB) was founded for individuals afflicted by electromagnetic frequencies. The presenting symptoms at the time were skin rashes and flu-like conditions in computer users. Before “electromagnetic hypersensitivity” was recognized as a disability by the Swedish government, patients were referred to dermatologists, with no recognition of the underlying cause and treated symptomatically. Pets are being heavily medicated at great expense to their owners, often with limited success. They are subjected to extensive allergy testing, antibiotics and steroid regimens.

This is occurring because the cat, rather than the cat's environment, is the focus of inquiry.

The life expectancy of family pets has nearly halved and cancer rates have nearly doubled, according to the educational video Dr. Do More, produced by Dr. Margo Roman of MASH, Main Street Animal Services of Hopkinton, MA.<sup>4</sup> Holistic veterinarians are raising concern about vaccination schedules and the unnatural diet of cheap grain products. But household pets are experiencing the same soup of artificial electromagnetic frequencies as their owners, and stress disorders, fertility issues and glandular problems are skyrocketing.

As Dr. Dietrich Klinghardt states in film footage from the up-coming documentary “[Take Back Your Power](#),” there is one overriding factor that corresponds to rising autism rates, which are doubling every 5 years, and human illnesses in every neurological category, including Parkinson's, MS, ALS, and learning and behavioral difficulties.<sup>5</sup>

Most likely, that factor is also the cause of the cat's decline. The cause is exposure to electromagnetic fields, especially in the high frequency range.

### **EMF Education by Fire**

Like the cat resting her inflamed belly in the coolness of the sink, I moved to California in 2008 in search of safe refuge, in rapidly declining health. Instead of escaping radiation from the church tower near my New England apartment, I ran headlong into the installation of the smart meter grid in northern California.

The smart meter grid is a complex microwave computer-networked electric grid that can remotely track, as well as control, energy consumption. In the United States, bursts of pulsed microwave radiation are being transmitted in the 902-928 MHz range. Wireless gas and water meters are also pulsing data, but in the 450- 470 range using one-way transmitters.

Although smart grids are being implemented worldwide, not all nations are using wireless systems. And each nation has different philosophies for human exposure limits to radiofrequency electromagnetic fields. While more safety-conscious nations have adopted cautionary stances, the United States, Canada, Japan, and parts of western Europe assert that unless tissue is actually heated, there are no biological effects. Over 5,000 research studies, (available on-line at [JustProveIt.net](#)) indicate that biological damage is occurring below the thermal threshold, and that this assumption is wrong.

### Microwave Radiation Limits

Country	Power Density expressed in microwatts/cm <sup>2</sup>
Switzerland	4
China	6
Italy, Russia	10
United States	580

Source: *Living Safely with Electromagnetic Radiation* by Jim Waugh

### **Building Biology, Treating the Whole Patient, and Not Just Chasing Symptoms**

Skilled holistic practitioners on the west coast recognized EHS in 2008, and evaluated the patient's environment as well as the patient. My acupuncturist lent to me his tri-field meter, and his colleague, my chiropractor, came to my house to help assess the EMF burden. A holistic dentist was also part of the collaborative effort because persistent pain in one tooth was one of many symptoms. Although removal of amalgam fillings had improved my health, one remaining metallic post was a working radio antenna.

I met three women whose lives are severely diminished by technology. Norma had a tooth that would not heal, and described the massive nosebleed, head rush and shakes she experienced when her husband installed Wii one Christmas morning. Barb had flown on an airplane with Wi-Fi, deplaned with knee pain, and had an MRI, then a shock to the head while using her phone. She lost her ability to digest and assimilate food, and could only sit in one room in her home. Louise had also undergone recent dental work that left her in ongoing pain. She, too, had experienced a shock to the head while speaking on her phone.

Louise and I both had the characteristic ruddy hue that is mistaken for a healthy tan, but actually indicates that our copper levels are elevated due to the inflammatory response, and our cortisol defenses and blood pressure are skyrocketing. We could no longer use computers, we used speakerphones on corded landlines from the other side of the room, and we had to avoid cellphone towers. EHS diminished every aspect of our lives.

We each had different yang organs overworking to discharge incompatible frequencies in different configurations. Like Asia the cat, we were each already simultaneously overcharged and exhausted according to our inborn constitution, prior to the installation of the new electric grid.

The dominant health care paradigm does not recognize differing organ resiliencies, nor does the dominant health care paradigm recognize EHS, and most western health care offices are among the most inhospitable environments for EHS. The Department of Justice's Americans with Disabilities Act began questioning how EHS sufferers will be accommodated in public buildings in 1999. In "Recognition of the Electromagnetic Sensitivity as a Disability Under the ADA" Dafna Tachover wrote, "For people who are electromagnetically sensitive, the presence of cell phones and towers, portable telephones, computers, fluorescent lighting, unshielded transformers and wiring, battery re-chargers, wireless devices, security and scanning equipment, microwave ovens, electric ranges and numerous other electrical appliances can make a building inaccessible."<sup>6</sup> Common diagnostic techniques such as dental x-rays and MRIs are triggers for EHS individuals.

Many affected patients gravitate to small independent alternative health care modalities with practitioners who are sensitized to their needs. For 2 years, I was spending all of my time and money on healthcare. Through my acupuncturist, I underwent heavy metal detoxification, as do many EHS patients. Extensive allergy testing revealed a clear pattern. I was allergic to whatever I had eaten the day before. My brain, like Asia's, was constantly calling for fuel and rehydration but my digestive tract was working overtime to divert incompatible manmade frequencies, resulting in poor digestion, mal-absorption, and inflammatory response.

Like many individuals in CA who were already in deteriorating health prior to the installation of the new meters, I was turning the power off in the house and sleeping outside in a tent. Then I crashed completely, coinciding with the installation of the new electric meter.

New England Homeowners Are Already Hooked Up To the Grid and Don't Even Know It

Returning to New England in 2010, I rented a home in a coastal community in the off-season, and gradually regained strength, walking along the ocean shore and shunning radiation. However, despite my efforts to avoid all Wi-Fi, cellphone towers, and cellphone users, I did not know that the electric meter on my North Shore rental house, manufactured in 2003, already had a radio transmitter in it. Over the years, homeowners in the northeast perceived that the new meters were being installed so that the meter reader would not need to walk up to the house. Readings could be taken from a truck in the neighborhood. Environmental groups have erroneously embraced the concept of the grid, believing that it is an energy saving technology.

What most people do not realize is that a remote network is already being constructed. As the utilities continue to build out the network of transmitters and receivers, they are able to record minute details concerning energy consumption patterns, which they can sell to third party marketers. New software allows the utilities to recognize when electricity is being used and what appliances are in use. The utilities can also remotely control smart-enabled appliances such as heating and air conditioning systems inside the home. These appliances will communicate in the 2.4 GHz range with the smart meter.

Over the winter of 2011, large white out-of-state engineering trucks blanketed the Cape Ann area, and then two trucks spent the day working on the pole outside my rental home. The next morning, I lost all the ground that I had gained in my 9 month healing incubation. Waking to a burning wave across my body as the network went live, my liver, heart and kidneys went into trauma. I called the mayor's office to protest, and was told that they have no jurisdiction over the utility company. Within 48 hours, I had to move out of the house.

Although the smart meter grid is hailed as the next generation of energy efficiency, it is having a life-altering impact on the health of countless individuals. Industry statistics indicate that only 1 in 10 Americans knows that the grid even exists. Some health officials estimate that 35% of the population is already adversely affected by electromagnetic radiation.



## Smart Meter Grid Deployment Map

In California, the grid came apparent when the new microwave radiation transmitting meters were installed on homes and businesses. Individuals who became ill immediately after the meter was installed recognized a cause and effect relationship. On the east coast, most homeowners have no knowledge of the radio transmitters already installed on their homes, schools, and businesses, now being read remotely, using equipment that may also be creating dirty electricity and unhealthy electromagnetic fields.

### Safety at All Costs?

Americans are in the ironic position of being subjected to unprecedented levels of surveillance in order to defend against terrorism, while the combination of technologies being employed to conduct surveillance is causing

unprecedented danger to life itself.

The smart meter grid, like the cellular phone network, is in part a system of surveillance. Detailed information about privacy concerns is available at [TakeBackYourPower.net](http://TakeBackYourPower.net), in an extensive interview with Glen Chase, Professor of Systems Management specializing in Environmental Economics and Statistics, Faculty Alumni USC, Cal State.

Despite prevailing belief systems of environmentalists, the grid is not a green technology.

### **What Is Green About the Smart Meter Grid is Billions of Dollars Fueling the Next Wave of Economic Growth and Investment Return, Paid for by Ratepayers**

Three state attorney generals have ruled that the smart meter deployment should be halted, citing exorbitant costs to consumers with no proven benefits: Illinois AG Lisa Madigan, Connecticut AG George Jepsen, and Michigan AG Bill Schutte.

Illinois AG Lisa Madigan wrote in June 2012, “The utilities have shown no evidence of billions of dollars in benefits to consumers from these new meters, but they have shown they know how to profit. I think the only real question is: How dumb do they think we are?”

Moratoriums are being called on the grid due to

- Cost billing overcharges and reliability – the expense of the grid, which is anticipated at almost \$200 billion dollars worldwide, must be paid for by the ratepayers.
- Health issues – over 5,000 studies are documenting the health hazards associated with electromagnetic fields.
- Interference with other devices, especially deep brain stimulators for Parkinson's patients and pacemakers.
- Privacy spy meters, electronic privacy information centers – consumption patterns can be sold to interested industries such as appliance manufacturers by the for-profit utilities.
- Security – The smart meter grid being aggressively installed despite the fact that the system is not secure.
- Fire hazards – Reports of smart meter fires and explosions and lack of compatibility with ground fault interrupters.<sup>7</sup>

The strategy of providing economic stimulus funding, bypassing pre-market safety testing, passing legislation that limits liability and enforces consumption, and ignoring subsequent health issues has created windfall profits in certain sectors, but it has not resurrected the economy.

Compact fluorescent bulbs exemplify the added risks of both artificial frequencies and mercury vapors. Will Davis identified the practice of using toxic waste in manufacturing in his book *The War on Bugs*. He explains how industrialists in the last 100 years took toxic waste from coke manufacturing and packaged it as insecticide and fertilizer, avoiding disposal fees and reaping massive profits. Dr. Klinghardt explains the interaction between mercury and frequency-emitting CFLs, as well as health hazards resulting from smart meters and cordless phones, in [TakeBackYourPower](http://TakeBackYourPower) film footage. Legislating the use of CFLs is an example of technology-fueled economics over-running human health concerns, masquerading as a green initiative.

Humanity's Challenge: The Winter Solstice of 2012

The United States allocated \$4.5 billion in funding from the American Recovery and Re-investment Act to the Department of Energy to modernize the electric grid. New electric meters are intended to eventually give customers the ability to lower their electricity usage by responding to financial incentives to shift their energy use to off-peak hours. In New England, peak hours scheduled for a higher price structure are from 7:00 am to 11:00 pm; off-peak hours are 11:00 pm to 7:00 am and weekends and holidays.

Citizens will pay projected investment revenues resulting from the smart grid project to for-profit corporations.

Central Maine Power was awarded \$95,858,307, and the total project value is \$191,716,614.8

Analysts anticipate that U.S. “revenues will grow to \$9.6 billion in 2015 due to metering infrastructure, distribution automation, home area networks, and smart utility enterprise”.<sup>9</sup>

The fundamental flaw of the new smart meter grid is that it directs humanity's relationship with power and energy

away from a skillful partnership with the rhythms of nature, to fluctuating price points set by for-profit utilities. By manipulating pricing based on time of use, consumers are being influenced to run their appliances and charge their electric cars in the middle of the night. By spreading the demand for power to non-prime time, consumers are being told that additional power plants will not need to be constructed. Americans are being unwittingly forced to participate in the rapid build out of a power grid based on faulty values of man-over-nature, man-over-time, and man-over-man beliefs. And, the primary targets of this aggression will be women and children, due to their heightened vulnerability to EMF.

This misguided strategy is the culmination of a core denial of the rhythms of exertion and rest and the intelligent relationship between the radiation of the sun, the magnetism of the moon, and Earth's gravitational field. The recovery of a working relationship with these patterns is the only foundation for a true ecological sustainable life.



We are living the closing chapter in a history of de-evolutionary choices, or we have reached the crucial turning point where the light of dawning consciousness turns humanity back sustains all of the electromagnetic frequencies within the human energy field and all of nature in a rhythmic dance.

As the wheel turns from the Year of the Dragon to the Year of the Snake, unknown to most westerners, the Spleen energy field will move into prominence, followed by the Heart. These organ systems cannot tolerate the assault of artificial EMFs that their yang predecessors have been fighting in the last two years.

When tsunamis are created, initially the sea withdraws, exposing only sand for as far as the eye can see. Then the massive tumultuous wave crashes to shore. History will record the energetic tsunami in 2012 in one of two ways. We will unleash the largest wave of destructive technology ever known to mankind, or we will withdraw our energies from the consumer-driven model fueled in part by lack of recognition of the essence of time. Nelson Mandela wrote, "Sometimes it falls upon a generation to be great." To be alive at the turning point of realignment of human endeavor is an opportunity for individuals everywhere to participate in the emergence of the group soul. The time is now. For this new world we pray.

#### NOTES

1. The website [antennasearch.com](http://antennasearch.com) will provide of detailed map of installations in a 4 mile radius around a home, business, child's school, etc.
2. Although these technologies operate outside the range of human hearing, [www.youtube.com/watch?v=s99i0H-nBw4](http://www.youtube.com/watch?v=s99i0H-nBw4) demonstrates a meter manufactured in Germany that allows humans to hear the frequencies.
3. The Informed Heart by Dr. Bruno Bettelheim
4. <http://mashvet.com/resources/dr-domore-video>
5. [TakeBackYourPower.net](http://TakeBackYourPower.net)

6. [Recognition of the Electromagnetic Sensitivity as a Disability Under the ADA](#)
7. Adapted from EMF Safety Network
8. [http://www.nescoe.com/uploads/Smart\\_Grid\\_Final\\_May\\_2012.pdf](http://www.nescoe.com/uploads/Smart_Grid_Final_May_2012.pdf)
9. <http://www.greentechmedia.com/research/report/us-smart-grid-market-forecast-2010-2015>

#### **Smart Meter Safety Resource Guide**

**Massachusetts:** HaltMAsmartmeters.org; <http://stopsmartmetersmassachusetts.org/>

**Maine:**<http://smartmetersafety.org/>

**New Hampshire:** New Hampshire Coalition Against Smart Meters

**Rhode Island:**<http://www.citizensforsafetechnology.org>

**Vermont:**[EMRPolicy.org](http://EMRPolicy.org)

[WEEP Initiative.org](http://WEEPInitiative.org), the Canadian and international initiative to stop wireless, electric and electromagnetic pollution.

[TakeBackYourPower.net](http://TakeBackYourPower.net) soon to be released documentary film with interview with Dr. Dietrich Klinghardt concerning smart meter health issues.

**EMF Safety Network:**[emfsafetynetwork.org](http://emfsafetynetwork.org)

*Patricia Burke is a meridian yoga teacher, writer, lightning strike survivor, and EHS educator working on Smart Meter Safety issues in Massachusetts and California. She can be reached through her website*

<http://stopsmartmeters.org.uk/www-scribd-comdoc79928679the-who-iarc-listing-of-rfr-as-a-possible-human-carcinogen/>

Email from Dr Robert Baan, the principal author of the 2011 IARC Monograph on the **carcinogenicity of radiofrequency radiation, in which he interprets the 2B classification of RFR as applicable to all form of RFR exposures, including Smart Meters and Wi-Fi:**

*Subject:* **EMF Class 2B Classification**

*Dear Dr Hudson,*

*Thank you for your message, which was forwarded to me, and to which I would like to respond as follows. The IARC Working Group classified “Radiofrequency Electromagnetic Fields” (RF-EMF) as possibly carcinogenic to humans (Group 2B). The information that formed the main basis for this evaluation was found in epidemiological studies on cell-phone use, where a slightly increased risk for glioma (a malignant form of brain cancer) and acoustic neuroma (a non-cancerous type) was reported among heavy users. There were some indications of increased cancer among radar-maintenance workers(occupational exposure), but no reliable data from studies among, e.g., people living close to base-station antennas, radio/TV towers, etc (environmental exposure). Although the key information came from mobile telephone use, the Working Group considered that the three types of exposure entail basically the same type of radiation, and decided to make an overall evaluation on RF-EMF, covering the whole radiofrequency region of the electromagnetic spectrum. In support of this, information from studies with experimental animals showed that effects on cancer incidence and cancer latency were seen with exposures to different frequencies within the RF region. So the classification 2B, possibly carcinogenic, holds for all types of radiation within the radio frequency part of the electromagnetic spectrum, including the radiation emitted by base-station antennas, radio/TV towers, radar, **Wi-Fi, smart meters**, etc. An important point is the radiation level. The exposure from cellular phones (personal exposure) is substantially higher and much more focused (usually on the brain) than exposures from radio/tv towers, antennas, or Wi-Fi. I hope this is useful. Thank you for your interest in our work.*

*Sincerely yours,*

*Robert A Baan PhD The IARC Monographs IARC, Lyon, FRANCE*

# Smart Meter Dangers, Who Knew and Did Not Sound The Alarm?

written by [Nancy Thorner](#) April 20, 2016



## [Nancy Thorner](#)

Nancy Thorner is a musician and patriot who writes regularly for Illinois Review, and occasionally for The Heartland Institute's Freedom Pub blog.



Commonwealth Edison (ComEd) is pushing for the deployment of 4,000,000 smart meters despite the fact that government agencies and the military have known for decades that Radio Frequency/microwaves can cause serious health effects.

[This information is not new](#); it is just being brought to the forefront as a health crisis is emerging in Illinois. ComEd is using the Energy Infrastructure Modernization Act, also known as the “smart grid modernization bill” (written by ComEd lobbyists), and the Illinois Commerce Commission’s interpretation of that bill, as justification for installing millions of wireless smart meters.

The RF/microwave emissions from smart meters are listed by the World Health Organization’s International Agency for Research on Cancer ‘IARC’ as a Class 2B Carcinogen. That makes this the first time in history a known carcinogen has been **mandated** on **ALL** homes, schools, and government buildings.

Barrier Trower, a retired British Secret Service Microwave Weapons specialist, states:

“The paradox is how Radio Frequency/microwave radiation can be used as a weapon to cause impairment, illness and death; and at the same time be used as a communications instrument [such as in smart meters].”

[Trower continues](#), “By 1971 we knew everything that needed to be known.”

“A 1976 document summarizing U.S. Defense Intelligence research **lists all of the health hazards caused by wireless devices and concludes: This should be kept secret to preserve industrial profit.**”

Jerry Flynn, is a retired Canadian Armed Forces captain with specialized training and 22 years of experience in Electronic Warfare and Signals Intelligence. Flynn has worked with U.S. and NATO armies in this specialized capacity. [He writes](#):

“[The U.S. military has known for decades](#) that the RF/microwave frequencies most harmful to man are those within the band 900 MHz to 5 GHz. These frequencies penetrate all organs of the body, thus putting all human organ systems at risk. **Smart meters emit these precise frequencies which, when combined with certain pulsed modulation characteristics and power densities, are most harmful to the brain, central nervous system, immune system, and can cause cancers.** This is precisely why these frequencies are used in Microwave weapons of war.”

ComEd smart meters contain two transmitters emitting high-intensity pulsed signals every few seconds in two frequencies within the “most harmful” range mentioned by Flynn. One frequency is 900 MHz used for the wireless network that relays data from the smart meter on one house to the smart meter on another house and then on to a collector which sends the data to ComEd. The second frequency, 2.45 GHz, is used for appliances inside the house to transmit data to the smart meter.

Although [ComEd claims](#) that data is only transmitted six times a day, what they neglect to mention is that smart meters also [emit high-intensity RF/microwave pulses](#) each time they perform network management functions. According to California court documents, a single smart meter can emit these pulses on average 10,000 to 190,000 a day. [The number of pulses](#) depends on where in the mesh network the smart meter is located and how often it is relaying data from other neighbors’ meters.

It is these around-the-clock, high-intensity pulses within the frequency range “most harmful” to humans that make smart meters so damaging. Consider 4,000,000 ComEd smart meters blanketing Illinois with billions of pulses in these frequencies being emitted every day, forever.

### **Basis for FCC guidelines: Health or Profits?**

The Federal Communication Commission (FCC) knew decades ago, for according to Gittleman, “back in the 1950’s there were growing concerns as to the dangers of these low-level microwaves, so the U.S. military had sought safety limits.”

The [current FCC](#) safety limits are based on thermal exposure alone. The FCC guidelines are ten times more lenient than what the Environmental Protection Agency (EPA) would have permitted to protect the general population from the health hazards of RF/microwave radiation.

In the late 1980’s, the EPA radiation division, staffed with practicing biologists and epidemiologists, decided on a safe limit for human exposure. Before the announcement was made, industry intervened, federal funding for that division of the EPA was cut, and the FCC was given the task of setting the RF/microwave guidelines for the public. The FCC, made up of bureaucrats and engineers, had no experience or training in setting “health related” guidelines. Therefore, from the beginning, FCC guidelines were set at a limit that was too lenient to protect the general population.

### **Government agencies respond to the FCC guidelines**

- **Environmental Protection Agency (EPA), 1990:** [“FCC exposure standards are seriously flawed.”](#) In fact, 40 EPA scientists released a 393-page report titled, “An Evaluation of the Potential Carcinogenicity of Electromagnetic Fields (EMF’s)”, which proposed classifying EMF’s as a “probable” carcinogen and Radio Frequency and microwave radiation as a “possible” carcinogen.
- **Food and Drug Administration (FDA), 1993:** [“FCC rules do not address the issue of long-term chronic exposure](#) to Radio Frequency fields. Data strongly suggests that RF/microwaves can accelerate the development of cancer.”
- **National Institute for Occupational Safety and Health (NIOSH)—a division of the Center for Disease Control (CDC), 1994:** [“FCC’s standard is inadequate](#) because it is only based on adverse health effects caused by body tissue heating (which means thermal).”
- **U.S. Consumer Affairs Commission, 1999:** [“Current thermal guidelines associated with Electromagnetic Radiation \(EMR\) are irrelevant.](#) Cancer and Alzheimer’s are associated with non-thermal EMR effects.”
- **Environmental Protection Agency, 2002:** [“FCC’s current Radio Frequency/microwave exposure guidelines are thermally based,](#) and do not apply to chronic, non-thermal exposure situations.” Norbert Hankin, Director, Radiation Protection Division

### **Medical and legal groups respond to the FCC guidelines**

Today there are more than [900 health and environmentally conscious groups](#) sending comments to the FCC as part of the agency’s reassessment of the guidelines. **The [American Academy of Pediatrics](#)**, with headquarters in Illinois, is one of these concerned medical organizations. **[The Academy of Environmental Medicine](#)**, along with **the [American Academy of Justice](#)** (formerly the Association of Trial Lawyers of America), are two more such groups. All of these organizations are concerned with saving the environment and preserving public health from the government approved harmful levels of microwave radiation.

ComEd touts compliance with FCC standards to assure the public that smart meters are safe. However, FCC exposure guidelines are irrelevant since the limit set is for thermal exposure. ComEd smart meters subject the public to chronic non-thermal exposure.

### **[Which authorities knew](#) or should have known of RF/microwave harm?**

**The U.S. military and intelligence agencies:** As early as the 1950’s, the military and intelligence agencies were aware of the health effects from RF/microwaves. From 1,000 classified studies, it was apparent that even low-level RF/microwaves [could create bio-effects that could be used to disrupt the enemy in covert](#), or battlefield operations. RF/microwaves could be utilized to create confusion, slow reaction time, create nausea, and shock adversaries in the field.

**NASA:** [This space agency has been studying the health effects for years](#) to facilitate protection from electromagnetic radiation for astronauts traveling in space.

**Government Health Departments:** These departments are charged with protecting public health and have a responsibility to keep up on studies. At this time, there are [thousands of peer-reviewed studies showing adverse biological and health effects](#).

**The Department of Energy:** It is the duty of this agency to investigate negative health effects before launching such an expansive national project. No health data was considered before deployment of billions of smart meters in wireless networks.

**The World Health Organization:** In 2011 the International Agency for Research on Cancer ‘IARC’ categorized [Radio Frequency emissions from all wireless devices as a Class 2B Carcinogen](#). ComEd’s wireless smart meters fall into this category. Although the IARC classification has been known for five years, the deployment of 4,000,000 ComEd smart meters is still being mandated.

**The Telecom executives:** Two decades ago Dr. George Carlo, who was in charge of the Wireless Technology Research (WTR) project in 1993 informed the Telecom executives. He reported the results of the research which revealed an [alarming increase in tumors](#) and many other health related problems.

**Lloyd’s of London:** This well-known insurance underwriter now specifically “[excludes liability coverage for claims](#) directly or indirectly resulting from electromagnetic radiation and illnesses caused by continuous, long-term, (non-thermal) radiation exposure.” ComEd’s wireless smart meters will inflict continuous, long-term, (non-thermal) radiation exposure on all life forms.

**Utilities, such as ComEd:** Utilities have been charged with providing safe delivery of electricity. Clearly, there has been no investigation into the safety of incorporating into the electric grid a product utilizing this dangerous technology.

### **What scientists recognize about “the emerging public health crisis”**

The [International EMF Scientist Appeal](#) has been signed by 190 scientists from 39 nations. These scientists have collectively published over 2,000 peer-reviewed papers on the biological or health effects of non-thermal radiation and are calling upon the United Nations, World Health Organization, and UN member states to:

1. Address the emerging public health crisis related to wireless devices, wireless utility meters [smart meters] and wireless infrastructure.
2. Urge that UN Environmental Program initiate an assessment of current exposure standards [in order] to substantially lower human exposures to non-thermal radiation.
3. Take a planetary view of potential for harm that EMF pollution presents to biology—the evolution, health, well-being and very survival of all living organisms worldwide.

### **Illinois politicians and members of the General Assembly: What do they know?**

Members of the General Assembly, who voted to pass the smart grid modernization bill, (after “ComEd’s lobbyists were able to muscle the bill through”, [according to the Illinois Attorney General](#)), and/or voted to [override Governor Quinn’s veto](#), might want to take another look at the health threat being inflicted on ComEd customers. [Why would any political leader knowingly permit their constituents to be forced to live](#) with a meter on their homes that emits a known Class 2B Carcinogen?

**With a mandate in place and no permanent opt-out option available, residents are powerless to protect their families.** In order for justice to prevail, consumer choice has to be restored, and a permanent opt-out option granted to ComEd customers.

### **They knew, they did not tell us, where do we go from here?**

Flynn’s summary on smart meter dangers:

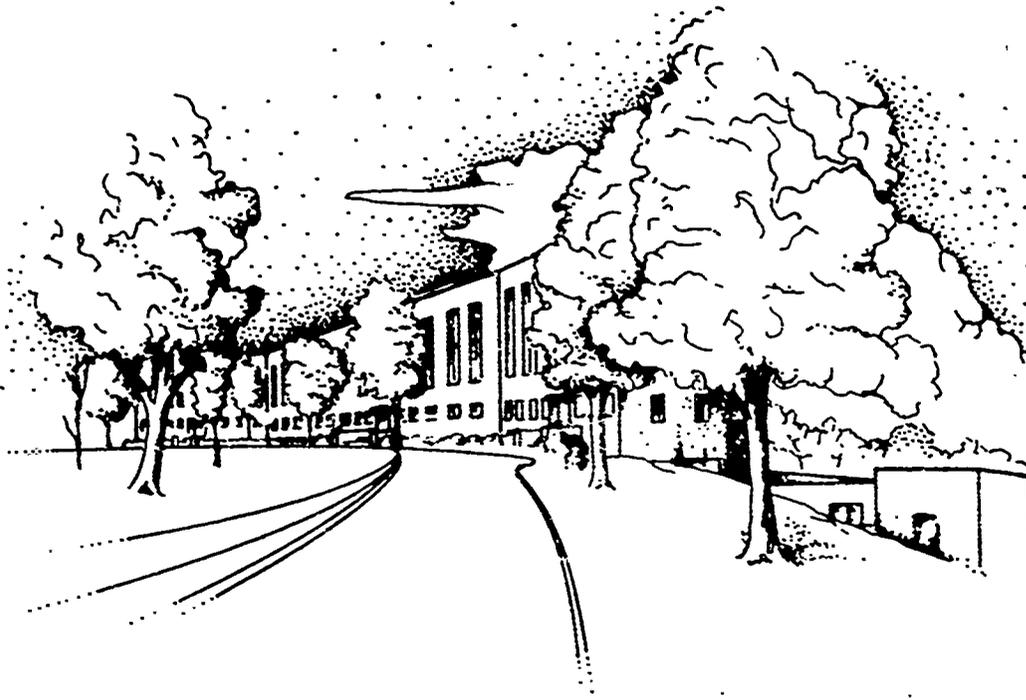
“Pulsed non-thermal radiation, which is emitted by smart meters, is far more damaging at the body’s cellular level to all life forms than any other technology ever devised by man. Militaries of the world have known for more than 50 years that RF/microwaves are the perfect weapon. Today, democratic governments are knowingly and callously authorizing untested (for safety) smart meters to operate (emitting pulsed non-thermal radiation) at the most lethal frequencies known to man.”

**[\[Originally published at Illinois Review\]](#)**

AD 750271

# NMRI

**NAVAL MEDICAL RESEARCH INSTITUTE**



**BIBLIOGRAPHY OF REPORTED BIOLOGICAL PHENOMENA ('EFFECTS') AND CLINICAL  
MANIFESTATIONS ATTRIBUTED TO MICROWAVE AND RADIO-FREQUENCY RADIATION**

**RESEARCH REPORT**

**MF12.524.015-0004B**

**REPORT NO. 2  
REVISED**

Reproduced by  
**NATIONAL TECHNICAL  
INFORMATION SERVICE**  
U.S. Department of Commerce  
Springfield, VA 22151

**BIBLIOGRAPHY OF REPORTED BIOLOGICAL PHENOMENA ('EFFECTS') AND CLINICAL  
MANIFESTATIONS ATTRIBUTED TO MICROWAVE AND RADIO-FREQUENCY RADIATION**

**Zorach R. Glaser, Ph.D.  
LT, MSC, USNR**

**Research Report**

**Project MF12.524.015-0004B, Report No. 2**

**Naval Medical Research Institute  
National Naval Medical Center  
Bethesda, Maryland 20014, U.S.A.**

**4 October 1971**

**Second Printing, with Revisions,  
Corrections, and Additions: 20 April 1972  
(Supersedes AD No. 734391)**

## ABSTRACT

More than 2000 references on the biological responses to radio frequency and microwave radiation, published up to June 1971, are included in the bibliography.\* Particular attention has been paid to the effects on man of non-ionizing radiation at these frequencies. The citations are arranged alphabetically by author, and contain as much information as possible so as to assure effective retrieval of the original documents. An outline of the effects which have been attributed to radio frequency and microwave radiation is also part of the report.

\*Three supplementary listings bring the number of citations to more than 2300.

### Key Words

Biological Effects  
Non-Ionizing Radiation  
Radar Hazards  
Radio Frequency Radiation  
Microwave Radiation  
Health Hazards  
Bibliography  
Electromagnetic Radiation Injury

The comments upon and criticisms of the literature made in this report, and the recommendations and inferences suggested, are those of the author, and do not necessarily reflect the views of the Navy Department or of the Naval Service.

Security Classification

DOCUMENT CONTROL DATA - R & D

Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified.

ORIGINATING ACTIVITY (Corporate author)

NAVAL MEDICAL RESEARCH INSTITUTE  
NATIONAL NAVAL MEDICAL CENTER  
BETHESDA, MARYLAND 20014

2a. REPORT SECURITY CLASSIFICATION

UNCLASSIFIED

2b. GROUP

3. REPORT TITLE

BIBLIOGRAPHY OF REPORTED BIOLOGICAL PHENOMENA ('EFFECTS') AND CLINICAL  
MANIFESTATIONS ATTRIBUTED TO MICROWAVE AND RADIO-FREQUENCY RADIATION

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Medical research interim report, bibliographic (Current to April 1972)

5. AUTHOR(S) (First name, middle initial, last name)

Zorach R. GLASER, Ph.D.  
LT, MSC, USN

6. REPORT DATE

Revised 20 April 1972  
(4 October 1971, Original)

7a. TOTAL NO. OF PAGES

~~103~~ 106

7b. NO. OF REFS

2,311

8a. CONTRACT OR GRANT NO.

b. PROJECT NO

c.

d.

9a. ORIGINATOR'S REPORT NUMBER(S)

MF12.524.015-0004B, Report No. 2, Revised

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned  
this report)

10. DISTRIBUTION STATEMENT

THIS DOCUMENT HAS BEEN APPROVED FOR PUBLIC RELEASE AND SALE; ITS DISTRIBUTION IS  
UNLIMITED.

11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY

BUREAU OF MEDICINE AND SURGERY (NAVY)  
WASHINGTON, D.C. 20390

13. ABSTRACT

More than 2300 references on the biological responses to radio frequency and microwave radiation, published up to April 1972, are included in this bibliography of the world literature. Particular attention has been paid to the effects on man of non-ionizing radiation at these frequencies. The citations are arranged alphabetically by author, and contain as much information as possible so as to assure effective retrieval of the original documents. Soviet and East European literature is included in detail. An outline of the effects which have been attributed to radio frequency and microwave radiation is included as Chapter 1. The revised report (which supersedes DDC report AD#734391) is updated with the inclusion of three supplementary listings, and has incorporated many corrections and additions to the original 2100 citations.

DD FORM 1473  
1 NOV 65

UNCLASSIFIED

Security Classification

UNCLASSIFIED

Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
biological effects Non-ionizing radiation kadar hazards Radio frequency radiation Microwave radiation Health hazards Bibliography Electromagnetic radiation injury radiation adverse effects						

11

## TABLE OF CONTENTS

	<u>PAGE</u>
Abstract	2
Table of Contents	3
Foreword	4
Acknowledgments	5
Chapter 1, Outline of Reported Biological Phenomena ('Effects') and Some Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation	7
Chapter 2, Bibliography, Alphabetical Listing	12
Unsigned Reports and Articles	83
Addenda, Alphabetical by Author	87
Addenda, Unsigned Reports and Articles	89
First Supplementary Listing (5 October 1971)	91
Appendix A, Accession Numbers and Sources	92
Second Supplementary Listing (21 November 1971)	93
Third Supplementary Listing (17 April 1972)	95

## Foreword

It is the hope of the author that this bibliography will provide guidance to the diffuse and conflicting literature on the biological responses to electromagnetic radiation at radio- and microwave-frequencies, with particular reference to the effects of concern to man. Such guidance is needed in the formulation and appraisal of criteria and limits of human exposure to "non-ionizing" radiation, and in the planning and conduct of future research.

The original plans were to categorize and key the literature citations to the "outline of biological and clinical effects" (Chapter 1). This proved to be a much more difficult and time-consuming task than anticipated, and was actually completed only for about 400 papers. Thus, the letter-number combinations given in square brackets for some of the "A" through "C" citations refer to the outline. [NV] indicates the citation was "not verified".

The standard format used throughout the bibliography is: author, (date), journal, volume, (issue): page, "title". The authors are alphabetized, and in chronological order. Multiple authors are also alphabetically ordered according to the second, third, etc., author. Inclusive pagination is given where possible, as is the original language of the citation. Report accession and translation numbers (some of which are cited in Appendix A), and alternate sources are listed when known. The title of books is underlined. When the title of the report was not available (or not given), a short (one line) description of the paper is listed whenever possible. Reports in which the name of the author was not given are listed chronologically using the format, "title", reference, source, (date). In many cases the citation was obtained from secondary (and tertiary) sources. For this reason it was impossible to put every citation into a consistent format.

In a few cases, papers have been cited which were presented at symposia or meetings devoted to the present topic, even when the report title suggests that it does not pertain directly to the topic. This has been done to show the wide range of items considered relevant (at least at the time of the meeting, and by the organizing chairman) in past years. An example is "electroanesthesia".

A few citations of marginal and/or peripheral relationship have also been included so that the reader may judge the applicability to his individual research needs. Examples are reports dealing with the biological effects of static and alternating magnetic fields, experimental techniques using radio frequency and microwave radiation (e.g., electron spin resonance, and nuclear magnetic resonance spectroscopy), and microwave exposure limits, regulations, and standards.

References for a few limited-distribution government reports are available upon request.

The author welcomes information which will correct errors and omissions (both of which no doubt exist). Copies of new papers would be greatly appreciated, and would encourage updating and revising the bibliography periodically.

#### ACKNOWLEDGMENTS

The assistance and support received during the preparation of this bibliography have been considerable, and I am happy to acknowledge my indebtedness and gratitude. Drs. John Keesey and Dennis Heffner, former and present Heads of the Biophysics Division, and Dr. Seymour Friess, Director of the Environmental Biosciences Department of the Naval Medical Research Institute, permitted me the opportunity to work on the bibliography, and offered frequent encouragement.

Acknowledgment is also due to many friends and associates for their helpful suggestions, comments, and loans and/or gifts of reports or other material, which have been invaluable in the course of the work. Mr. Glenn Heimer of the Naval Ship Engineering Center contributed an extensive collection of government reports and documents, many of which had not previously been cited in the open literature.

Special help in tracing and in the acquisition of relevant papers has been received from the librarians and staff members of the NMRI library: Mrs. Thelma Robinson, Mrs. Ernestine Gendleman, Mrs. Eleanor Capps, and Miss Deborah Grove. Their diligence and resourcefulness in tracing and obtaining copies of a large number of papers and reports, often in spite of incomplete and/or inaccurate citations given in other sources, enabled me to include many relevant items in the bibliography.

Mr. Christopher Dodge of the Scientific and Technical Center, Department of the Navy, provided much of the Soviet Bloc literature, linguistic and other technical assistance, and in addition offered valuable comments and encouragement throughout the preparation of this report. Especially noteworthy were the corrections and improvements suggested by Chris following his reading of the entire manuscript.

Helpful also in locating some of the Soviet literature was Mr. E. S. Serebrennikov, of the Science and Technology Division, The Library of Congress.

Credit is due Mrs. Anna Woke (of this Institute) for translating many of the German papers; to Dr. Emilio Weiss, who translated from the Italian, and to Mrs. Edith Pugh who typed many "first drafts"; also to Mrs. Rhoda Glaser for her help in many aspects of the work.

Mrs. Fannie Epstein deserves special mention for her outstanding editorial assistance, and especially for the heroic typing, organization, and checking of the entire report.

The Outline of Reported Biological Phenomena ('Effects') and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation, is patterned after that given by R. Murray, et al., in an article entitled, "How safe are microwaves", which appeared in Non-Ionizing Radiation 1(1):7-8 (1969). Some of the "effects" were listed in the report by S. F. Cleary and W. T. Ham, Jr., entitled, "Considerations in the evaluation of the biological effects on exposure to microwave radiation", (Background document, Part I, 1969, for the Task Force on Research Planning in Environmental Health, Subtask Force on Physical Factors in the Environment). The discussion and suggestions offered by Byron McLees, Edward Finch, Lewis Gershman, and Christopher Dodge relating to the Outline are also gratefully acknowledged.

Preparation of the bibliography was supported by the Bureau of Medicine and Surgery, Department of the Navy, under work unit MF12.524. 015-0094B.

## CHAPTER 1

### Reported Biological Phenomena ("Effects") and Some Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation (See Note)

#### A. Heating of Organs\* (Applications: Diathermy, Electrosurgery, Electrocoagulation, Electrodesiccation, Electrotomy)

1. Whole Body (temperature regulation defects), Hyperpyrexia
  2. Skin
  3. Bone and Bone Marrow
  4. (a) Lens of Eye (cataractous lesions - due to the avascular nature of the lens which prevents adequate heat dissipation.)  
(b) Corneal damage also possible at extremely high frequencies.
  5. Genitalia (tubular degeneration of testicles)
  6. Brain
  7. Sinuses
  8. Metal Implants (burns near hip pins, etc.)
- The effects are generally reversible except for 4a.

#### B. Changes in Physiologic Function

1. Striated Muscle Contraction
2. Alteration of Diameter of Blood Vessels (increased vascular elasticity), Dilation
3. Changes in the Oxidative Processes in Tissues and Organs
4. Liver Enlargement
5. Altered Sensitivity to Drug Stimuli
6. Decreased Spermatogenesis (decreased fertility, to sterility)
7. Altered Sex Ratio of Births (more girls!)
8. Altered Menstrual Activity
9. Altered Fetal Development
10. Decreased Lactation in Nursing Mothers
11. Reduction in Diuresis ( $\text{Ca}^+$  excretion, via urine output)
12. Altered Renal Function (decreased filtration by tubules)
13. Changes in Conditioned Reflexes
14. Decreased Electrical Resistance of Skin
15. Changes in the Structure of Skin Receptors of the (a) Nerve, and (b) Blood-Carrying Systems
16. Altered Blood Flow Rate

---

\* It is also reported that low levels of irradiation produce a cooling effect - "hypercompensation".

Note: These effects are listed without comment or endorsement since the literature abounds with conflicting reports. In some cases the basis for reporting an "effect" was a single or a non-statistical observation which may have been drawn from a poorly conceived (and poorly executed) experiment.

17. Alterations in the Biocurrents (EEG?) of the Cerebral Cortex (in animals)
18. Changes in the Rate of Clearance of Tagged Ions from Tissue
19. Reversible Structural Changes in the Cerebral Cortex and the Diencephalon
20. Electrocardiographic (EKG) Changes
21. Alterations in Sensitivity to Light, Sound, and Olfactory Stimuli
22. Functional (a) and Pathological (b) Changes in the Eyes:  
(a) decrease in size of blind spot, altered color recognition, changes in intraocular pressure, lacrimation, trembling of eyelids; (b) lens opacity and coagulation, altered tissue respiration, and altered reduction-oxidation processes
23. Myocardial Necrosis
24. Hemorrhage in Lungs, Liver, Gut, and Brain
25. Generalized Degeneration of all Body Tissue
26. Loss of Anatomical Parts
27. Death
28. Dehydration
29. Altered Rate of Calcification of Certain Tissue

} At Fatal Levels  
} of Radiation

#### C. Central Nervous System Effects

1. Headaches
2. Insomnia
3. Restlessness (Awake and During Sleep)
4. Electroencephalographic (EEG) Changes
5. Cranial Nerve Disorders
6. Pyramidal Tract Lesions
7. Conditioned Reflex Disorders
8. Vagomimetic Action of the Heart; Sympathomimetic Action
9. Seizures, Convulsions

#### D. Autonomic Nervous System Effects

1. Neuro-vegetative Disorders (e.g., alteration of heart rhythm)
2. Fatigue
3. Structural Alterations in the Synapses of the Vagus Nerve
4. Stimulation of Parasympathetic Nervous System (Bradycardia), and Inhibition of the Sympathetic Nervous System

#### E. Peripheral Nervous System Effects

Effects on Locomotor Nerves

F. Psychological Disorders ("Human Behavioral Studies") - the so-called "Psychophysiologic (and Psychosomatic) Responses"

1. Neurasthenia - (general "bad" feeling)
2. Depression
3. Impotence
4. Anxiety
5. Lack of Concentration
6. Hypochondria
7. Dizziness
8. Hallucinations
9. Sleepiness
10. Insomnia
11. Increased Irritability
12. Decreased Appetite
13. Loss of Memory
14. Scalp Sensations
15. Increased Fatigability
16. Chest Pain
17. Tremor of the Hands

G. Behavioral Changes (Animal Studies)

Reflexive, Operant, Avoidance, and Discrimination Behaviors

ii. Blood Disorders

(V = in vivo)  
(v = in vitro)

Changes in:

1. Blood and Bone Marrow
2. Phagocytic (polymorphs) and Bactericidal functions of blood (v)
3. Hemolysis rate (increase), (a shortened lifespan of cells)
4. Sedimentation rate (increase), (due to changes in serum protein levels or amount of fibrinogen. (?)
5. Number of Erythrocytes (decrease), also number of lymphocytes
6. Blood Glucose Concentration (increase)
7. Blood Histamine Content
8. Cholesterol and Lipids
9. Gamma (also  $\alpha$  and  $\beta$ ) Globulin, and Total Protein Concentration
10. Number of Eosinophils
11. Albumin/Globulin Ratio (decrease)
12. Hemopoiesis (rate of formation of blood corpuscles)
13. Leukopenia (increase in number of white cells), and Leukocytosis
14. Erythrocytosis

I. Vascular Disorders

1. Thrombosis
2. Hypertension

## J. Enzyme and Other Biochemical Changes

### Changes in activity of:

1. Cholinesterase (V,v)
2. Phosphatase (v)
3. Transaminase (v)
4. Amylase (v)
5. Carboxydismutase
  
6. Protein Denaturation
7. Toxin, Fungus, and Virus Inactivation (at high radiation dose levels), Bacteriostatic Effect
8. Tissue Cultures Killed
9. Alteration in Rate of Cell Division
10. Increased Concentration of RNA in Lymphocytes, and Decreased Concentration in Brain, Liver, and Spleen
11. Changes in Pyruvic Acid, Lactic Acid, and Creatinine Excretions
12. Change in Concentration of Glycogen in Liver (Hyperglycemia)
13. Alteration in Concentration of 17- Ketosteroids in Urine

## K. Metabolic Disorders

1. Glycosuria (sugar in urine; related with blood sugar?)
2. Increase in Urinary Phenol (derivatives? DOPA?)
3. Alteration of Rate of Metabolic Enzymatic Processes
4. Altered Carbohydrate Metabolism

## L. Gastro-Intestinal Disorders

1. Anorexia (loss of appetite)
2. Epigastric Pain
3. Constipation
4. Altered Secretion of Stomach "Digestive Juices"

## M. Endocrine Gland Changes

1. Altered Pituitary Function
2. Hyperthyroidism
3. Thyroid Enlargement
4. Increased Uptake of Radioactive Iodine by Thyroid Gland
5. Altered Adrenal Cortex Activity
6. Decreased Corticosteroids in Blood
7. Decreased Glucocorticoidal Activity
8. Hypogonadism (usually decreased testosterone production)

## N. Histological Changes

1. Changes in Tubular Epithelium of Testicles
2. Cross Changes

O. Genetic and Chromosomal Changes

1. Chromosome Aberrations (e.g., linear shortening, pseudochiasm, diploid structures, amitotic division, bridging, "sticky" chromosomes, irregularities in chromosomal envelope)
2. Mutations
3. Mongolism
4. Somatic Alterations (changes in cell not involving nucleus or chromosomes, cellular transformation)
5. Neoplastic Diseases (e.g., tumors)

P. Pearl Chain Effect (Intracellular orientation of subcellular particles, and orientation of cellular and other (non-biologic) particles)

Also, orientation of animals, birds, and fish in electromagnetic fields

Q. Miscellaneous Effects

1. Sparking between dental fillings
2. Peculiar metallic taste in mouth
3. Changes in Optical Activity of Colloidal Solutions
4. Treatment for Syphilis, Poliomyelitis, Skin Diseases
5. Loss of Hair
6. Brittleness of Hair
7. Sensations of Buzzing Vibrations, Pulsations, and Tickling About the Head and Ears
8. Copious Perspiration, Salivation, and Protrusion of Tongue
9. Changes in the Operation of Implanted Cardiac Pacemakers
10. Changes in Circadian Rhythms

# Symptoms after Exposure to Smart Meter Radiation

People from coast to coast in the USA, and from one side of the world to the other, are becoming ill after exposure to the radiofrequency radiation emitted by Wireless Smart Meters. Attached are the results of two surveys of the symptoms being reported.

The first survey comes from the United States and includes 318 adults, from 28 states from California to New York, and addresses wireless utility meters that are principally Wireless Smart Meters. The second survey comes from the other side of the world, Victoria, Australia, and includes 92 adults and children, and addresses Wireless Smart Meters exclusively. Altogether, 410 adults and children are included. Both surveys report new or worsened symptoms after the installation of wireless utility meters in a given individual's environment.

The attached two graphs show the percentage of individuals in each survey who experienced each symptom. The two surveys group the symptoms into somewhat different clusters, but these clusters are similar enough to enable comparison between the surveys. Of the top seven clusters of symptoms in both surveys, six clusters are similar in both description and order of occurrence: (1) sleep disruption; (2) headaches; (3) ringing or buzzing in the ears; (4) fatigue; (5) loss of concentration, memory, and learning ability; and (6) disorientation, dizziness, and loss of balance. Most individuals in the surveys developed multiple symptoms.

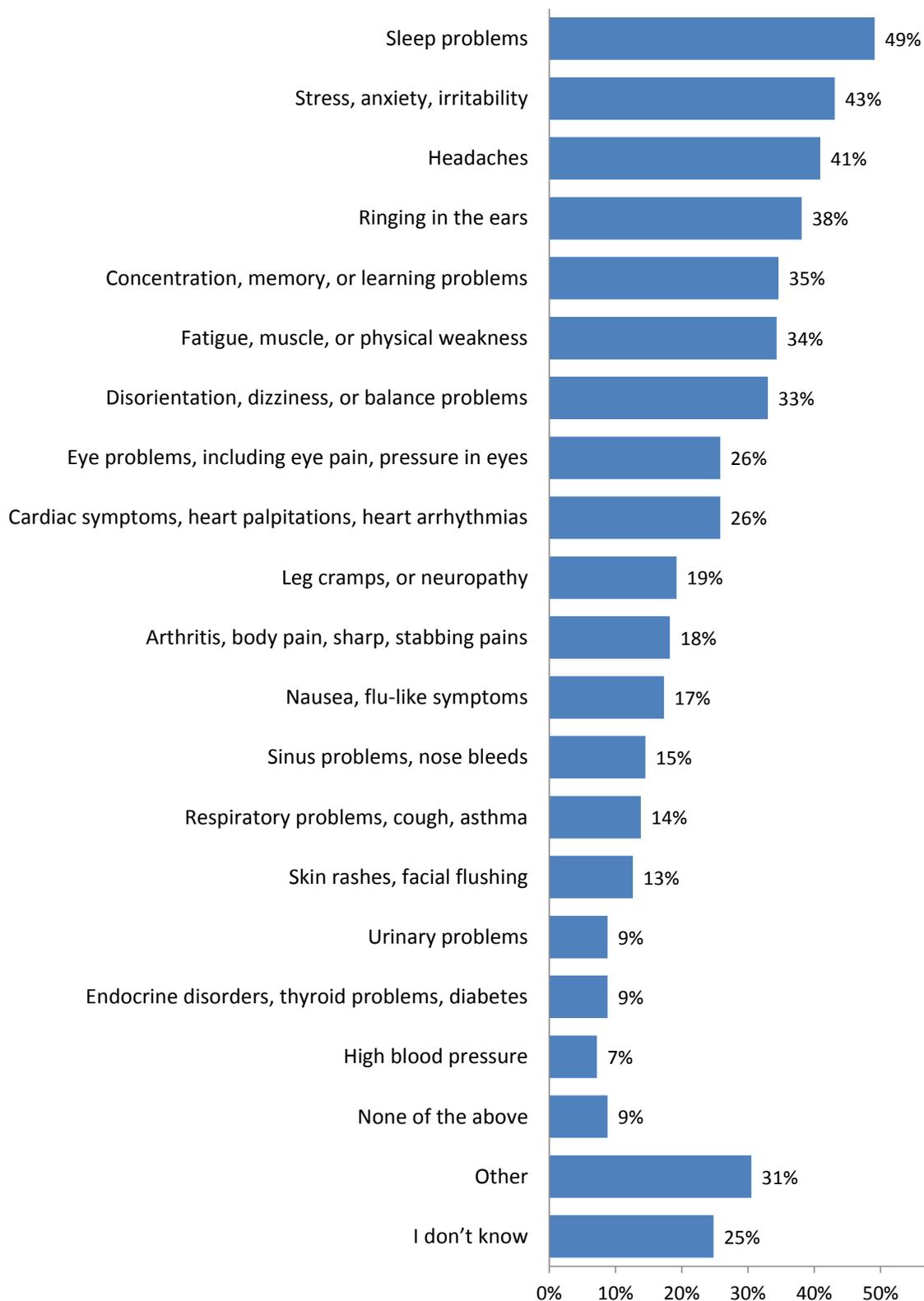
The surveys do not tell us how likely a given individual is to become symptomatic after exposure to the radiation from Wireless Smart Meters. But the surveys do tell us which symptoms a person who does become symptomatic is most likely to experience. The many symptoms found reflect the many body systems that are disrupted by such radiation.

A symptom, of course, is something that can be sensed by an individual, and thus can serve as a warning. Unfortunately, many health effects caused by radiofrequency radiation have no early symptoms and thus give no warning. These health effects become evident only after significant harm has been done. Examples are DNA damage, cancer, and reproduction effects.

---

<sup>1</sup> Ronald M. Powell is a retired career U.S. Government scientist. He holds a Ph.D. in Applied Physics from Harvard University. During his Government career, he worked for the Executive Office of the President, the National Science Foundation, and the National Institute of Standards and Technology.

# New or Worsened Symptoms Reported by 318 Individuals after Exposure to Wireless Utility Meters in the USA<sup>1</sup>



<sup>1</sup> Ed Halteman, Ph.D., statistics, Final Results Summary: Wireless Utility Meter Safety Impacts Survey, September 13, 2011, p. 22 (<http://emfsafetynetwork.org/wp-content/uploads/2011/09/Wireless-Utility-Meter-Safety-Impacts-Survey-Results-Final.pdf>). 97 percent of respondents to full survey were in the USA, from 28 states with most in California (78 percent) and New York (16 percent).

# Executive Summary by Ed Halteman, Ph.D.

## Wireless Utility Meter Safety Impacts

### OBJECTIVES

- To investigate reported public health and safety complaints about wireless utility meters.
- To evaluate the impacts on health and safety due to wireless utility meters.
- To determine whether further study is warranted.

### METHODS

- Survey was designed by the EMF Safety Network (Network).
- The survey was circulated online through various social media outlets including Network's email list, Facebook, and the California EMF Safety Coalition (a discussion group).
- The survey was also posted on Network's website: [www.emfsafetynetwork.org](http://www.emfsafetynetwork.org) where visitors were invited to take the survey.
- 443 responses were received from 7/13/2011 through 9/2/2011. *(318 of the 443 answered the health questions that formed the basis for the bar chart on symptoms. RMPowell)*
- Network commissioned Survey Design and Analysis (SDA) to provide this report of the survey findings.

### RESPONDENT MAKEUP

- 93% are over 40 years old and 43% are over 60 years old.
- 73% are women.
- 78% are from California.
- 68% have Pacific Gas and Electric (PG&E) as their utility provider.
- 49% are EMF Sensitive.
- 41% have had a new wireless meter installed in their home; of these . . .
  - 56% have had it installed for at least six months
  - 89% have electric meters, 53% gas meters and 10% water meters
  - 35% saw an increase in their utility bill
  - 26% have experienced some type of interference
  - 8% experienced burned out appliances or damaged electronics including TV, stereo, computer, refrigerator and other.
- 76% indicated they have wireless utility meters installed in their neighborhood, town or city.
  - 44% near their home
  - 36% in town

### TOP HEALTH ISSUES SINCE NEW METERS INSTALLED

- Sleep problems (mentioned by 49%)
- Stress, anxiety and irritability (43%)
- Headaches (40%) *(Intentionally listed at 41% on symptoms bar graph, rounded up from 40.9%. RMPowell)*
- Ringing in the ears (38%)
- Heart problems (26%)

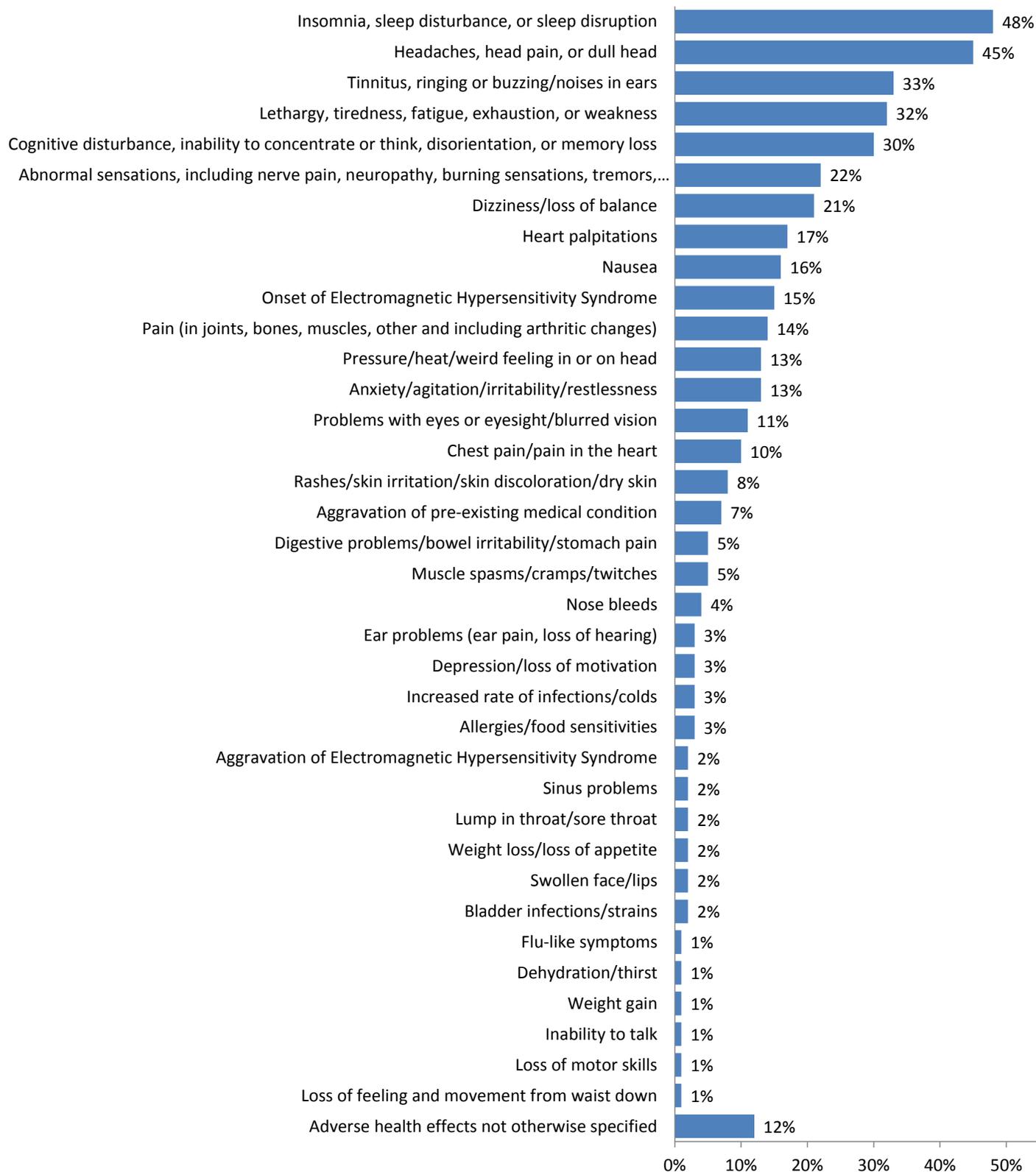
### UTILITY and PUBLIC UTILITY COMMISSION INTERACTIONS *(Title inserted by RMPowell.)*

- 40% (111 people) of those having wireless meters in their homes or community have complained to their utility provider.
  - 96% of these people were either "Unsatisfied" or "Very Unsatisfied" with the handling of their complaint.
- 32% (88 people) complained to the utilities commission.
  - 96% of these people were either "Unsatisfied" or "Very Unsatisfied" with the handling of their complaint
- 94% of respondents want to retain or restore their analog meters and 92% of these respondents do not think they should have to pay any additional money.

### STATISTICAL TESTING SHOWS THE TOP HEALTH SYMPTOMS ARE POSITIVELY ASSOCIATED WITH

- EMF Sensitivity
- Wireless meters installed in the home

# New or Worsened Symptoms Reported by 92 Individuals after Exposure to Wireless Smart Meters in Australia<sup>1</sup>



<sup>1</sup> Federica Lamech, MBBS, Self-Reporting of Symptom Development from Exposure to Radiofrequency Fields of Wireless Smart Meters in Victoria, Australia: A Case Series. *Alternative Therapies*, Nov/Dec 2014, Vol. 20, No. 6, pages 28-38. NIH PMID 25478801 (<http://www.alternative-therapies.com> and <http://www.ncbi.nlm.nih.gov/pubmed/25478801>).

## **Abstract of Dr. Federica Lamech's Article from the National Institutes of Health PubMed Index**

Altern Ther Health Med. 2014 Nov-Dec;20(6):28-39.

### **Self-reporting of symptom development from exposure to radiofrequency fields of wireless smart meters in Victoria, Australia: a case series.**

Lamech F.

Abstract

#### **CONTEXT:**

In 2006, the government in the state of Victoria, Australia, mandated the rollout of smart meters in Victoria, which effectively removed a whole population's ability to avoid exposure to human-made high-frequency nonionizing radiation. This issue appears to constitute an unprecedented public health challenge for Victoria. By August 2013, 142 people had reported adverse health effects from wireless smart meters by submitting information on an Australian public Web site using its health and legal registers.

#### **OBJECTIVE:**

The study evaluated the information in the registers to determine the types of symptoms that Victorian residents were developing from exposure to wireless smart meters.

#### **DESIGN:**

In this case series, the registers' managers eliminated those cases that did not clearly identify the people providing information by name, surname, postal address, and/or e-mail to make sure that they were genuine registrants. Then they obtained consent from participants to have their deidentified data used to compile the data for the case series. The author later removed any individual from outside of Victoria.

#### **PARTICIPANTS:**

The study included 92 residents of Victoria, Australia.

#### **OUTCOME MEASURES:**

The author used her medical experience and judgment to group symptoms into clinically relevant clusters (eg, pain in the head was grouped with headache, tinnitus was grouped with ringing in the ears). The author stayed quite close to the wording used in the original entries. She then calculated total numbers and percentages for each symptom cluster. Percentages were rounded to the nearest whole number.

#### **RESULTS:**

The most frequently reported symptoms from exposure to smart meters were (1) insomnia, (2) headaches, (3) tinnitus, (4) fatigue, (5) cognitive disturbances, (6) dysesthesias (abnormal sensation), and (7) dizziness. The effects of these symptoms on people's lives were significant.

#### **CONCLUSIONS:**

Review of some key studies, both recent and old (1971), reveals that the participants' symptoms were the same as those reported by people exposed to radiofrequency fields emitted by devices other than smart meters. Interestingly, the vast majority of Victorian cases did not state that they had been sufferers of electromagnetic hypersensitivity syndrome (EHS) prior to exposure to the wireless meters, which points to the possibility that smart meters may have unique characteristics that lower people's threshold for symptom development.

PMID: 25478801

**Actual or potential effects of ELF and  
RF/MW radiation on enhancing violence  
and homicide, and accelerating aging of  
human, animal or plant cells.**

**Dr Neil Cherry  
Associate Professor of Environmental Health**

**30<sup>th</sup> August 2002**

**Neil.Cherry@ecan.govt.nz**

**© Dr Neil Cherry 2002-2005**

**Human Sciences Department  
P.O. Box 84  
Lincoln University  
Canterbury, New Zealand**

# **Actual or potential effects of ELF and RF/MW radiation on enhancing violence and homicide, and accelerating aging of human, animal or plant cells.**

Dr Neil Cherry  
Lincoln University  
New Zealand

17/6/98, revised 30/8/02

## **Abstract:**

The brain is a very sensitive Bioelectromagnetic organ and through classical resonance processes can be halted and damage of external electromagnetic fields and radiation. This review will explore the possibility that this could result in violence enhanced rates of homicide. The evidence that electromagnetic fields and radiation electromagnetic are genotoxic means that exposure to any electromagnetic fields and radiation will enhance cell death (Apoptosis). The natural ageing process involves oxygenated free radicals from the breathing process causing enhanced rates DNA damage, cancer and cell death. Exposure to electromagnetic fields and radiation also reduces melatonin which limits a body's ability to scavenge the free radicals and therefore contributes to enhanced Apoptosis and cancer rates. Melatonin is also necessary for a healthy immune system. Reduced melatonin is also associated depression and suicide and therefore is likely to be associated with violence of homicide. Since electromagnetic radiation damages the DNA and reduces melatonin it is scientifically logical that it also enhances many of the natural aging process in people, animals and plants. These conclusions are strongly supported by robust evidence that natural weather related effects are caused by natural electromagnetic fields and radiation with extremely small intensities. Therefore it is logical and proven that humanly generated fields and radiation at intensities from a thousand to many billion times higher, also significantly enhance a wide range of adverse health effects, including cancer, heart disease, sleep disturbance, depression, suicide, anger, rage, violence, homicide, neurological disease and mortality.

## **1. Introduction:**

### **1.1 Brief:**

This report was commissioned by Bruce Ratcliff on behalf of Ratcliff Company Inc. in a letter dated 30 March 1998, with the following brief:

"We would like to know more about any possible relationship between microwave radiation as given off from relay towers and cell phones and premature, rapid ageing of humans, animals and/or plants. Please see page 22 in Firstenberg report on plants.

We recently had three news events which startled the public here in the U.S. They are listed as follows:

1. One where two apparently normal 11 and 13 year old boys shot and killed 4 people and wounded many others apparently with no known cause.

2. A mother in San Francisco smothered and killed her 3 babies. She was on medication which may have been a factor.
3. In another case in San Francisco, a student brought a gun to school and fired off a round.

What is the known and/or classified research relating microwave radiation to irritability, anger and violence?"

### 1.2 Context:

Levels of anger and violence in society are serious causes for concern. Well understood relationships between adult behaviour, parenting approaches, media, and movies and anger and violence, along with stress and frustration which can lead to rage such as road rage, and particularly the roles of alcohol and drugs, are associated with the development of lower self control, and more anger, rage and violence. This makes the social and environmental factors difficult to isolate.

This is not to say that environmental factors such as exposure to toxic substances in the environment should be ignored because of the difficulties involved. Rather, if there is evidence of potential or actual involvement of environmental toxins in enhancing the risk of anger, rage and violence, then it is vital that this be identified and addressed in order to develop strategies to reduce or minimize that particular risk factor. A toxic substance which is ubiquitous throughout a city, state or the whole country, would be of particular concern because of the vast number of people exposed to this enhanced risk.

The subject of this investigation is electromagnetic radiation in the radiofrequency and microwave (RF/MW) part of the electromagnetic radiation (EMR) and the ELF parts of the spectrum. This consideration is extremely important because humanly sourced EMR is ubiquitous and exposure levels are rising exponentially and at a rate which outstrips biological adaptation.

### 1.3 Biological Context:

For too long the RF/MW debate has been dominated by physics and physical concepts and arguments. These have been primarily revolved around exploration of the heating effects of RF/MW and determining "safe" levels of exposure which will avoid dangerous levels of tissue heating.

Many EMR researchers have noted the folly and error of this, e.g. Adey (1981), Frey (1994), and Goldsmith (1994). Human, animal and plant cells are bio-electro-chemical structures which interact in many ways including physically, chemically, biochemically and bioelectrically. Adey (1979) expresses this concern forcibly and scathingly:

**"Faced with the overwhelming complexity of the brain as a tissue and an organ of the mind, physical scientists and medical researchers alike have all too often retreated shamelessly into classicisms and the argots of their respective trades. Too many physicists and engineers cling desperately to thermal models as the alpha and omega of bioeffects from non-ionizing radiofrequency fields, shunning the exquisite beauty of long-range molecular**

interactions and resonant processes in biological macromolecules. In like fashion, medical physiologists, challenged by phenomena I have discussed here, have turned away and fixed their eyes in a glassy stare on the comparative crudity of ionic equilibria as the be-all and end-all of excitatory processes as described in the massive ionic exchanges of Hodgkin-Huxley models.

True science can never be a popularity contest. The time has surely come when we should place these scholasticisms of another age in a proper context, counting ourselves thrice blessed at the prospect that through the use of non-ionizing radiofrequency radiation as a research tool, the intrinsic organization of the brain tissue, the subtleties of neuroendocrine phenomena and the broad sweep of immunological interactions may at least be understood in terms of transductive coupling at the molecular level.”

#### 1.4 Summary of the Resolution from the European Parliament, 1992:

The European Parliament, after a series of hearings on the matter of EMR health effects expressed grave concern (Resolution B3-0280/92):

“Thus in the frequency range 100 kHz to 300 GHz, 50 years ago it was scarcely possible to measure 10 pW/cm<sup>2</sup> on the ground in our countries. Today, depending on the location, values one million to one thousand million times higher are recorded because of the explosion of telecommunications.”

and the following clauses:

- A. having regard to the significant increase, in the environment, of power density of non-ionizing electromagnetic radiation in the various frequency ranges, associated with technological development over the last few decades,
- B. having regard to the precautionary principle included in Article 130r of the Treaty establishing the European Community and the ALARA principle (a-slow-as-reasonably-achievable), according to which it is necessary, in this case to minimize exposure to electromagnetic radiation,
- C. whereas such radiation interacts with matter by non-thermal mechanisms and whereas, as regards radiofrequencies and microwaves, these are therefore added to the purely thermal interaction mechanisms,
- D. whereas, according to an increasing number of epidemiological and experimental studies, even slight exposure to non-ionizing electromagnetic fields increases the risks of cancer, can be accompanied by nervous disorders and disruption of the circadian rhythms and seems capable of affecting developing organisms,
- E. whereas the results of many *in vivo* and *in vitro* studies show increasing clearly the interaction mechanisms underlying such disorders and illnesses, centred mainly in cell membrane, lead to disruption of melatonin secretions, ornithine

**decarboxylase activity and T-lymphocyte efficacy, testifying to the probable role of non-ionizing radiation in promoting cancer,**

**F. whereas synergy phenomena must be expected between non-ionizing radiation and other physical agents, ...**

In clause D the European Parliament (E.P.) agree that electromagnetic fields affect the nervous system by nervous disorders and disrupts the circadian rhythms, such as sleep disruption leading to chronic fatigue syndrome, Altpeter et al. (1995). These also have a relation to behaviour, stress and advanced aging effects.

**1.5 This Report's Approach:**

This review takes a number of innovative approaches that are scientifically sound. The biological processes caused by genotoxic, melatonin reducing, cellular calcium ion altering and gap junction altering substances are described and the evidence that EMF/EMR does all these things is presented. Melatonin related behaviour function, including irritability, anger, rage, violence, homicide and crime are correlated with weather and Solar/Geomagnetic Activity. The biophysical mechanism provides plausible scientific links, the natural environment correlations provide evidence of human reactions and links to extremely weak EMR signals to a wide range of human reactions. Occupational and residential studies are limited in availability and scope but they confirm a reasonable number of the symptoms to support and confirm the soundly based hypothesis which is centered on the extremely bioelectrical sensitivity of the brain, electrical interference of electric functions in the brain, heart and cells by external EMF/EMR signals, with genotoxic, melatonin reduction and calcium ion alteration.

Altered neurological function and behaviour related to the electrobiochemistry of the brain and evidence of changed behaviour. The links to the melatonin effects and the calcium ion mechanisms are through accelerated cell death and cancer in all body organs including the brain, and to the very serious problem of impaired sleep. Impaired sleep has a serious effect on immediate health and well-being, with lethargy, confusion, and chronic fatigue. Chronic sleep impairment, especially with loss of REM sleep efficiency, leads to memory and learning impairment, depression and risk of suicide. Depression is also linked to lung cancer because chronically depressed people are more prone to smoking. Evidence of induced sleep disruption is strongly indicative of a melatonin reduction mechanism in humans. Evidence is strong for EMR and EMF induced melatonin reduction in animals and observational evidence for this in humans is growing.

Some basic principles need to be understood and applied appropriately to study and interpret data in Environmental Health:

1) **The Straw Principle:** There is a classical saying about "The straw that breaks a camel's back". In assessing potentially cumulative environmental factors we need to identify whether a correlation of a symptom with an environmental factor is adding a "straw" or a "log". It is possible sometimes to identify a straw which is closely related to a log because in effect the log is a million straws tied together. On the other hand the straw or twig might be quite different from the log or a bunch of different twigs, and be working in a synergistic way with many different factors.

2) **The Ubiquitous Principle:** Some substances may only be found in special circumstances such as occupational situations. Other substances may expose the whole population in their homes and workplaces and can sometimes even expose them when they are in school, carrying out recreation and holiday travel. An invisible, silent, tasteless, odorless toxic substance that the vast majority of the population are unaware of, can be causing a high proportion of existing health effects.

3) **The Absence of a no-exposed reference group principle:** It is very important when evaluating the effects of a ubiquitous substance that there is no non-exposed reference group. It is necessary for a case-control or cohort epidemiological study to compare the sickness or mortality rate of a non-exposed group with the rates of sickness or mortality in a group specifically exposed to a potential disease agent, not confused by any confounders. Two possible ways of correcting for this factor are a) using a dose response relationship to identify the exposure rate, b) using a historically earlier general population disease rate for a period which is known not to have exposure to the currently studied ubiquitous substance.

In the first case the interpretation of the dose-response gradient must consider the effect of the ubiquitous agent on it because the gradient is dependent on the reference group disease rate. In the second case the careful consideration of any other historical or ubiquitous factors must be considered.

### 1.6 The links between ELF and EMR effects:

Induced electric fields alter the electric field and the charge characteristics at the cell membrane. Biological effects are primarily related to time varying induced fields since our biology has developed in the environment of the earth's static electric and magnetic fields. Induction of electric fields in tissue at the cellular level varies with the intensity and the nature of the environmental field. Typical endogenous EM fields, with ELF modulation, induce fields in the order of  $10^{-1}$  to  $10^{-7}$  V/cm in the pericellular fluid (fluid surrounding the cell). RF/MW fields penetrate the organ or body much more effectively than the ELF fields.

For example, when chick brains were exposed to an applied 56 V/m field ( $832 \mu\text{W}/\text{cm}^2$ ):

- An ELF field 1-32 Hz, induced a tissue gradient of  $10^{-7}$  V/cm.
- An RF field, 147 MHz, ELF modulated, produced a tissue gradient of  $10^{-1}$  V/cm.

Both of these signals significantly changed the calcium ion efflux from the chick brain tissue, Bawin and Adey (1976).

Thus the RF/MW field with a little over a million times higher frequency, produced a cellular tissue gradient 1 million times higher than the ELF field of the same external field strength. This shows the highly penetrative nature of RF/MW fields compared to ELF fields. Since the energy flux relates to the square of the electric field gradient strength, the energy and the electric field gradient imparted to the cell tissue by ELF modulated RF/MW radiation is many orders of magnitude higher than the same external strength of ELF field. This it is highly likely that effects which are found for exposures to ELF fields will be more likely to also be found in association with RF/MW exposure. For example, several studies have found depression and psychovegetative effects when living near high voltage powerlines. The Schwarzenburg Study, Altpeter et al. (1995), Altpeter (1998), found a causal

disturbance to sleep in association with extremely low mean exposures to a short-wave radio transmitter. Chronic sleep disturbance can lead to chronic fatigue and depression. The health study of the staff and families at the U.S. Embassy in Moscow, Lilienfeld (1978), associated depression, irritability, memory loss and difficulty in concentration with extremely low level exposures to a pulsed microwave, radar signal.

### **1.7 Setting the scene by a veteran researcher, Professor W Ross Adey:**

Adey, W.R., 1988a: "The cellular microenvironment and signaling through cell membranes". *Prog. Clin. Biol. Res.*, 257:81-106.

**"The structural and functional aspects of communication between cells have been reviewed, with emphasis on the cell membrane in detection and transductive coupling of oscillating electromagnetic fields in the peri-cellular environment. Imposed fields are powerful and highly specific tools in manipulation of the sequence of events in membrane transductive coupling. They have revealed nonlinear and non-equilibrium aspects of these interactions. In cerebral tissue, extra-cellular fields orders of magnitude weaker than the membrane potential can modulate cell firing patterns, entrain EEG rhythms, alter neurotransmitter release and modulate behavioral states.**

**These sensitivities have also been widely detected in non-neural tissues. It is therefore proposed that an intrinsic communication system between cells based on these weak electromagnetic influences may be a general biological property. A three-step model of transductive coupling is presented. First, a highly cooperative modification of calcium binding occurs in the plane of the membrane surface following a focal event at a receptor site. This "amplifying" stage releases substantially more energy than in the initial events.**

**Cerebral extracellular conductance changes accompanying physiological responses may arise in perineuronal fluid with a substantial macromolecular content and calcium ions may modulate perineuronal conductivity. In the second stage, coupling occurs along transmembrane helical proteins and may be mediated by solitons.**

**The third stage couples transmembrane signals to the cytoskeleton and to intracellular enzyme systems, including membrane-bound adenylate cyclase and the protein kinase system of intracellular messengers. Activation of these intracellular systems is calcium-dependent."**

Adey, W.R., 1988b: "Cell membranes: the electromagnetic environment and cancer promotion". *Neurochem. Res.*, 13(7):671-677.

**"Use of weak electromagnetic fields to study the sequence and energetics of events that couple humoral stimuli from surface receptor sites to the cell interior has identified cell membranes as a primary site of interaction with these low frequency fields. Field modulation of cell surface chemical events indicates a major amplification of initial weak triggers associated with binding of hormones, antibodies and neurotransmitters to their specific binding sites.**

**Calcium ions play a key role in this stimulus amplification, probably through highly cooperative alterations in binding to surface glycoproteins, with spreading waves of altered calcium binding across the membrane surface. Protein particles spanning the cell membrane form pathways for signaling and energy transfer.**

**Fields millions of times weaker than the membrane potential gradient of  $10^5$  V/cm modulate cell responses to surface stimulating molecules. The evidence supports nonlinear, non-equilibrium processes at critical steps in trans-membrane signal coupling. Powerful cancer-promoting phorbol esters act at cell membranes to stimulate ornithine decarboxylase which is essential for cell growth and DNA synthesis. This response is enhanced by weak microwave fields, also acting at cell membranes."**

Dr Adey summarizes the EMR/EMF interactional effects at the cell membrane, demonstrating the great deal of knowledge about this subject which scientific research has already revealed, this includes the cell membrane as the primary interactional site, calcium ions and ODC as key compounds, and very low level effects which are amplified to produce brain function, behavioural and health risk changes.

### **1.8 Outline of This Report:**

This report presents information about the natural weather-related electromagnetic fields and their biological and health effects, how the background artificial EMR/EMF levels have increased, especially over the 20<sup>th</sup> century, and is continuing. It will outline and document the genotoxic and melatonin mechanisms, and the cellular effects of calcium ions. It will give evidence that shows that EMR/EMF can alter these in people and animals, as well as effects in plants in relation to calcium ions and tree ring growth. It will then outline the evidence of effects in the neurological functions of the brain and in behavioural studies of animals. Then the epidemiological evidence of effects in humans will be summarized to lead to the conclusion that there is very strong evidence of serious adverse effects of EMR and EMF on the physical health and emotional and psychological wellbeing of people, as well as deleterious effects on plants and animals.

**An important evidence principle applied here is that a dose-response relationship is indicative of a causal link.**

## **2. The natural and humanly changed EMR/EMF environment:**

Extremely small natural electromagnetic signals are causally associated with plant, animal and human biological and health effects. Therefore Human Biometeorology strongly challenges that basis and appropriateness of human health protection standards for artificial EMF/EMR fields and radiation.

### **2.1 The electromagnetic environment changes with the weather:**

The primary natural electromagnetic signal that has biological links is the Schumann Resonance a signal. This is a global radio signal generated by lightning from tropical thunderstorms and radiating around the world in the resonance cavity between the lowest layer of the ionosphere of the earth. Local weather systems also have associated ELF modulated RF fields. Anticyclones and depression are characterized by very different

natural background of ELF modulated RF fields. Eichmeier and Buger (1969) measured the EMR/EMF characteristics of weather system. They summarize their measurements as:

Cyclone: 10-100 kHz, 30-100 Hz, > 100 mV/m, (RF Exposure ~ 0.0027  $\mu\text{W}/\text{cm}^2$ )

Anticyclone: 10 kHz, 1-3 Hz, < 10 mV/m, (RF Exposure ~ 0.0000027  $\mu\text{W}/\text{cm}^2$ )

They were investigating biological effects found with weather conditions, including altered liver function. Importantly Eichmeier and Buger found that under in controlled laboratory conditions the RF cyclonic-like conditions mouse liver respiration rates were 42 % higher than anticyclonic RF conditions, a highly statistically significant effect ( $p < 0.001$ ). Thus the stronger natural RF field strengths in cyclones is associated with significantly altered liver respiration.

The cyclone is generally much more electrically active because of the convective and thunderstorm activity and precipitation formation. Precipitation formation separates charge, rain and hail becoming negatively charged and cloud droplet positively charged. The positively charged ionosphere creates a static field formed between it and negatively charged earth, called the fair weather field. During rain events, negatively charged rain falling from the cloud to the ground, reduces the vertical gradient of the local electric field. During vigorous thunderstorms the strong negative charge at the base of the cloud induces attraction of positive ions on the surface features, reversing the ground level field.

The ELF modulation of cyclones (depressions) is in the 30-100Hz range, covering the upper frequency range of the daytime EEG rhythms. The anticyclone has modulation in the 1-3Hz range, the nocturnal Delta EEG rhythm. Cyclones are cloudy with less sunshine and higher RF intensities around  $3\text{nW}/\text{cm}^2$ . Both factors are associated with reduced melatonin/serotonin diurnal cycle amplitudes. The local anticyclonic RF field is about  $2.7\text{pW}/\text{cm}^2$ , which is nearly 30 times higher than the global Schumann Resonance signal  $0.1\text{pW}/\text{cm}^2$ .

The effects of the hot dry foehn winds were first identified in Europe. They are associated with depression and suicide in areas near European Alps. In Los Angeles the Santa Ana winds are associated with enhanced homicide, Miller (1968), summarized by Maunder (1970). Miller reports an indicative correlation between the days with Santa Ana winds and homicide in Los Angeles from a 2-year data-set. He observed that in the strongest Santa Ana conditions there was initially a fall in homicide rate (-0.8, -0.7) followed by a rise in homicide rate over 5 days reaching a significant peak on day 2 (+1.0, +3.6, +0.8, +0.2). Weather conditions significantly alter the fair weather fields, Reiter (1992), Figure 1.

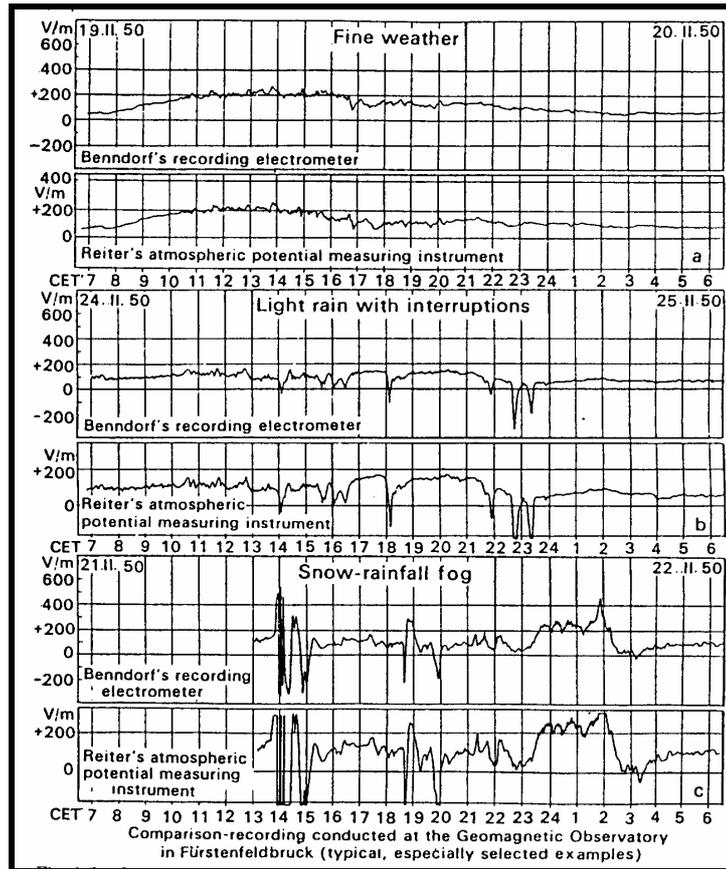


Figure 1: Electric field measurements for a range of weather conditions: (a) Fair weather field, (b), Light Rain with interruptions and (c) Snow/Rainfall and Fog, Reiter (1992).

In Canterbury, New Zealand our own research has shown some similar physical symptoms as those reported in Israel, Europe and America, associated with reduced melatonin. In our survey we found the same symptoms in people living inland and those living along the coast. The challenge was to identify the mechanism of how the people along the coast were affected by the hot dry winds that the people in the Inland were living in and experiencing, but along the coast the hot wind flowed over the sea breeze in the coastal zone and the people were in the cooler, high humidity marine air. It is well established that the hot, dry winds have much higher air ion content, enhancing the strength of the fair weather fields. The hot dry wind is very turbulent producing oscillating ELF electric fields which are associated with reduced melatonin. Therefore both the coastal and the inland living people with in the enhanced ELF electric fields and both experienced the symptoms associated with reduced melatonin.

Solar radiation from the high energy part of the solar spectrum, is absorbed high in the atmosphere, producing ionized atoms and molecules and free electrons. Because free electrons are more easily lost to space, this region, called the Ionosphere, has a net positive charge relative to the earth. This forms a static electric field which varies in strength from day to night, with season and with the presence of thunderstorms. The fair weather field is around 130V/m but can increase to 10kV/m beneath and within thunderstorms.

These ELF and RF signals are superimposed on the time varying static electric field some examples of which are given in Figure 1. The fair weather E field varies quite smoothly from about 20 V/m early in the morning to around 200 V/m during the afternoon. Light rain (b),

shows a nearly constant hourly mean value around 100 V/m, with reductions in E at times of rain, even becoming negative in heavier showers. During heavier precipitation the E-field is much more variable around a mean of about 100 V/m.

## 2.2 Pre-20th Century ambient exposures to ELF-UHF were extremely low:

Naturally occurring static electric and magnetic field strengths must not be confused with the strength of time varying EMR and EMF. Terrestrial biology has evolved in the long standing magnetic field of the earth and the static electric field produced between the ionosphere and the earth. The earth's static magnetic field varies with latitude, Figure 2, and year by year as the field rotates around the poles.

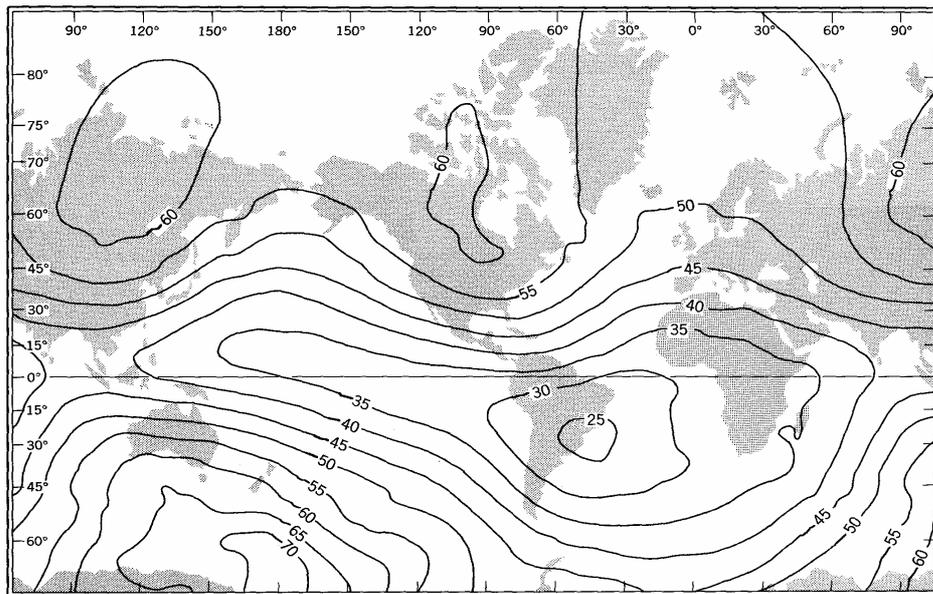


Figure 2: The earth's static magnetic field intensity in microTesla ( $\mu\text{T}$ ) for a given year, 1955.

The terrestrial magnetic field has a diurnal variation because of the distortion produced by the Solar Wind, Figure 3, and the effect of the sun.

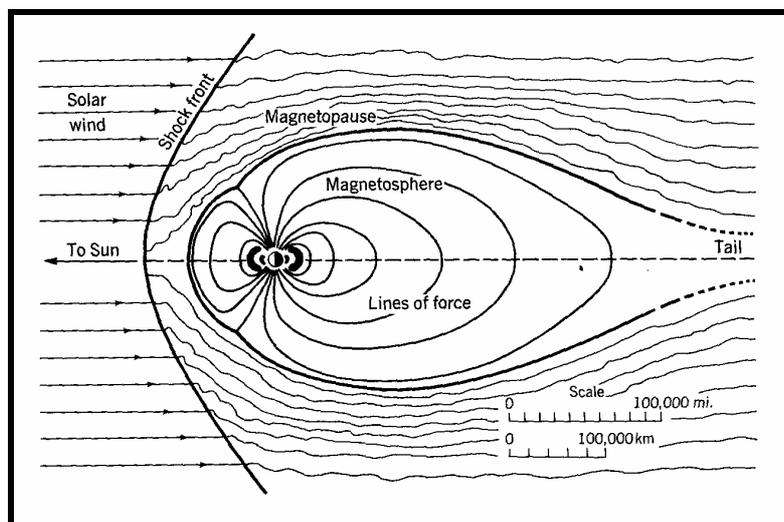


Figure 3: The earth's magnetosphere showing the effect of the solar wind which extends the lee-side magnetic field out into a "tail" region, Strahler (1963).

There are also annual solar and lunar cycles, 11-year sunspot cycles and other periodicities which create periodicities in the earth's magnetic and electric fields. An example of the diurnal magnetic field variation is seen in Figure 4.

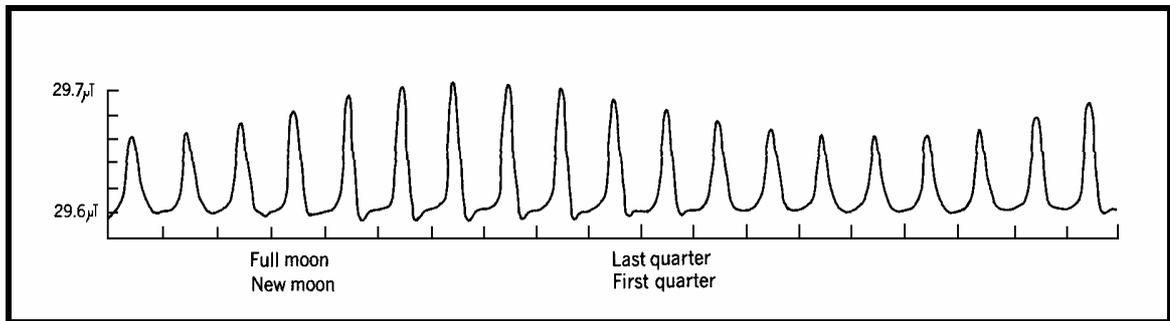


Figure 4: Daily magnetic intensity of the earth's field observed at Huancayo, Peru, throughout part of a month, showing also the moon's effect, Strahler (1963).

The natural sources of the natural radiation are galactic, solar and terrestrial. Detectable components of extraterrestrial sources at radio and microwave frequencies are extremely weak, around  $10^{-20}$  W/m<sup>2</sup>/Hz from a typical radio star. Even the sun cannot be considered a strong source of energy in the non-ionizing spectral region, making ancient ambient levels so low that the possibility of bioeffects is negligible, Adey (1981).

At 10 Hz the components of the solar flux do not exceed 0.001 V/m, with expected tissue gradients of around  $10^{-9}$  V/cm. A 10 Hz signal has a wavelength of 30,000 km making the head an extremely small fraction of the wavelength at EEG frequencies and incapable of significant radiation at these frequencies.

Terrestrial sources, primarily the Schumann Resonance Oscillations, have an amplitude around 0.0002 V/m/Hz. Schumann Resonance Oscillations originate from the radiation from lightning primarily in the tropics, the electric field radiation of which is ducted and resonates in the "electrical cavity" created between the ionosphere and the earth. The fundamental frequency is 7.8 Hz, with harmonics at 14.1, 20.3, 26.4 and 32.5 Hz. Assuming each resonant peak is associated with a 1 Hz bandwidth this results in a 0.001 V/m ELF field strength, or the same order as the solar 10 Hz flux. A combine signal of around 0.002 -0.003 V/m will produce tissue gradients in the order of  $2-3 \times 10^{-9}$  V/cm. The SR signal is in the range 0.1 to 0.25pW/cm<sup>2</sup>.

### **Human Detection of Schumann Resonances for Neurological and Cardiac Synchronization:**

Resonant absorption occurs when there is a frequency match. Figure 5 shows the typical human EEG spectrum and Figure 6 shows the typical daytime Schumann Resonance Spectrum.

Note the strong similarities between the natural E-field ELF variations and the ELF rhythms of the mammalian brain, Figure 7, not just the frequency range but also the diurnal pattern. Below evidence is given that these fields do in fact interact and alter human reaction times for example. Cherry (2002) shows that there is very strong and highly robust evidence that the SR signal is the biophysical mechanism linking Solar/ Geomagnetic Activity to human health effects related to reduced melatonin, including cancer, cardiac, reproductive and neurological health effects and mortality.

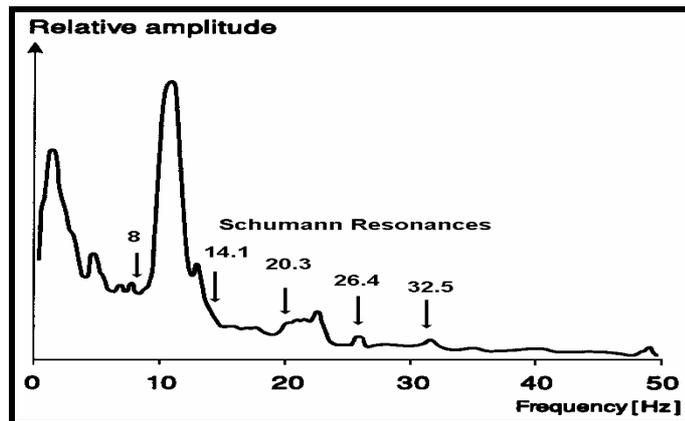


Figure 5: A typical EEG spectrum, with the Schumann Resonance peaks superimposed.

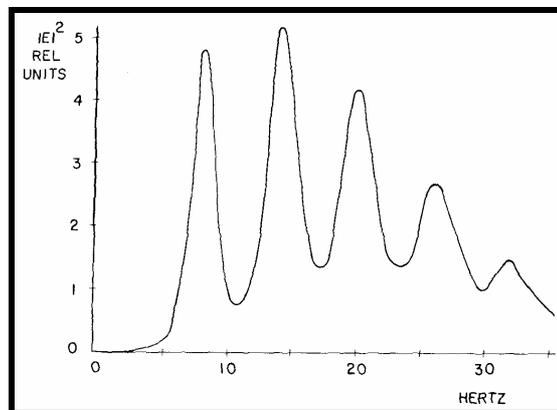


Figure 6: A Daytime Schumann Resonance Spectrum, Polk (1982).

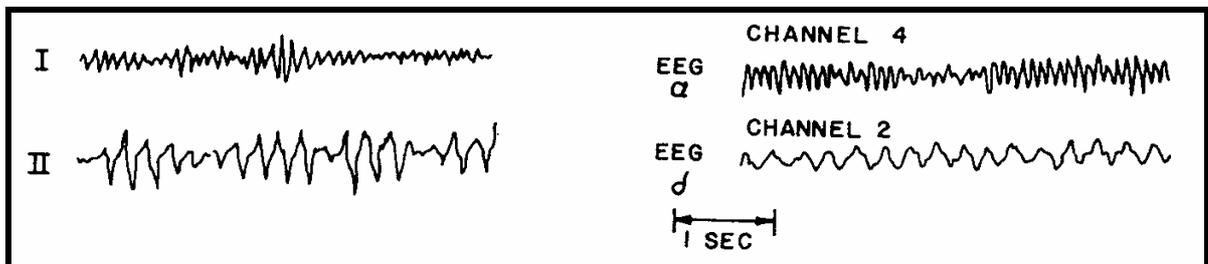


Figure 7: Electric fields from I, the Schumann-Resonance, II, Local fields of about 3 Hz and the  $\alpha$  (10 Hz) and  $\delta$  (3 Hz) human EEG channels, König (1974).

The frequency range of the Schumann Resonances and the human EEG overlap and some peaks coincide, showing the probability of resonant absorption and the likelihood of interaction. Both the high frequency peaks and the diurnal frequency shifts, high during the day and low at night, match between the two spectra. The 3Hz local field signal is very similar to the nocturnal SR signal.

It was proven, but not well known, that human brains detect, use and react to natural low frequency signals, the Schumann Resonances, König (1974). König (1974) reports on the results of an experiment carried out at the Munich Transport Exhibition of 1953, Figure 8. About 49,500 people were recorded in a visual reaction time experiment. Their reaction times were extremely highly correlated with the intensity of the Schumann Resonance signals.

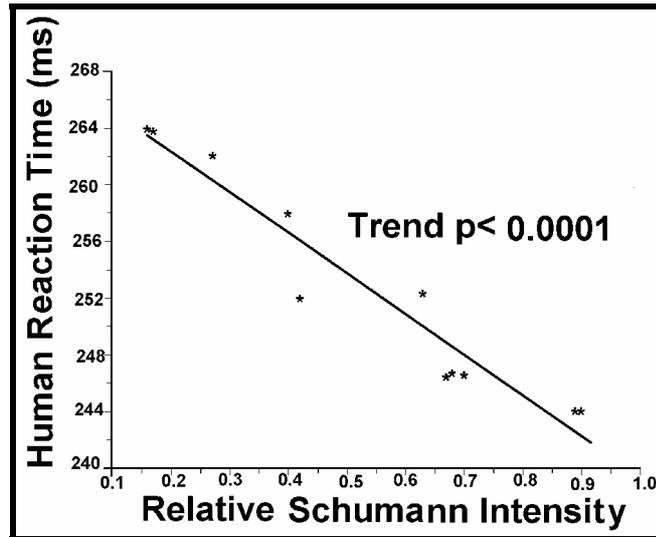


Figure 8: Human reaction times are causally correlated with natural variations in the Schumann Resonance Intensity, Konig (1974). The mean Schumann intensity (Relative Schumann Intensity =0.5) is 0.65mV/m or 0.1pW/cm<sup>2</sup>. The range is 0.2 to 1.2 mV/m (0.01 to 0.4pW/cm<sup>2</sup>).

The Schumann Resonances are global signals that radiate from tropical thunderstorms. They propagate around the world within the cavity created by the earth and the ionosphere. The intensity and spectrum of the Schumann Resonances vary markedly from day to night and with solar activity. At night both the EEG and the Schumann Resonances are dominated by very low frequencies (<5 Hz). With the coincidence of the frequency ranges, some of the high frequency peaks and the diurnal variation of the EEG and Schumann Resonances, it is biologically plausible that there is a resonant interaction between, and EEG reaction to the changing Schumann Resonance signals.

This biological plausibility is significantly strengthened by the observation that mammal brains contain and use phase-locked loop circuitry to detect and react to incoming ELF signals, Ahissar et al. (1997). Hence our brains contain a highly efficient, tuned FM receiver, Motluk (1997).

This result was confirmed by laboratory experiments that showed that 10 Hz signals significantly and consistently increase the reaction speed and 3 Hz signals slowed them down, Konig (1974). These results were independently confirmed by Hamer (1966, 1969). Hamer observed that human reaction times were significantly altered at exposure levels down to 4mV/m, 4.2 pW/cm<sup>2</sup>. This is approaching the level of the Schumann Resonance signal, which averages about 0.08mV/m, 0.1pW/cm<sup>2</sup>.

These experiments give substantial proof that extremely small natural and artificial ELF signals interact significantly with human brains. The signal level of this interaction is 2,000,000,000 times below the ICNIRP ELF guideline. This guideline is based on avoiding acute shocks and not on avoiding proven neurological effects. The maintenance of the standard is obtained by ignoring or rejecting any and all evidence that contradicts it.

Independently Wever (1974), at the Max Planck Institute, showed that by shielding people from the Schumann Resonances the average day length in isolation experiments is significantly longer than simple sunlight isolation, p<0.001. More significantly 30 % of

subjects in the Faraday Cage shielded room desynchronized,  $p < 0.001$ . This was corrected at will by the observers applying a small 10 Hz signal, Figure 9.

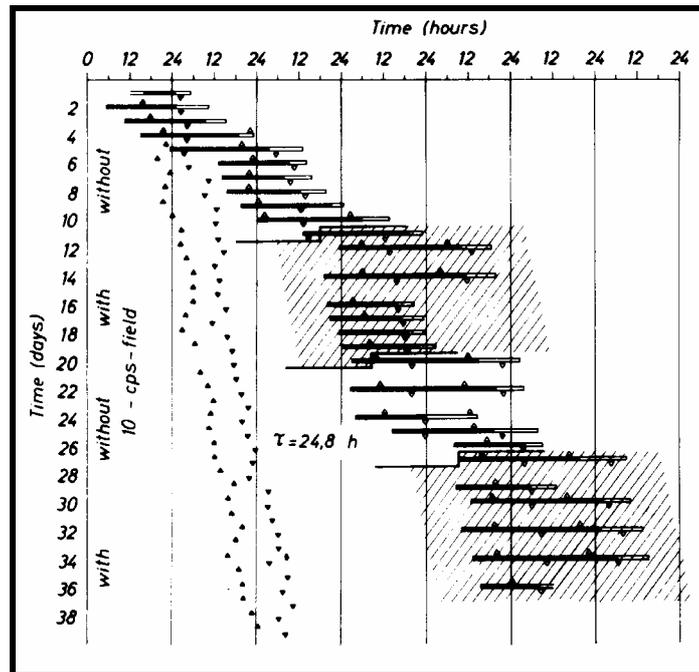


Figure 9: Free running circadian rhythm of a subject living under strict isolation from environmental time cues. The shaded period involve the secret application of 10 Hz pulsed signal with a peak-to-peak voltage of 2.5 V/m, corresponding to an rms voltage of 0.88V/m ( $S = 0.2\mu\text{W}/\text{cm}^2$ ).

**Wever concludes that these experiments “provide strong proof that electromagnetic fields in the ELF range influence human circadian rhythms, and therefore human beings”.**

Together Konig and Wever prove that human brains detect and react to the Schumann Resonance (SR) signal. This signal has a mean field strength of 0.08V/m,  $S = 0.1\text{pW}/\text{cm}^2$ . This is followed up and strongly confirmed by Cherry (2002), which also identified the melatonin mechanism and the human health effects.

This gives a very strong basis for this paradigm shift that recognizes the exquisite sensitivity of the human brain and its regulation and synchronization by these very weak naturally occurring, globally available, ELF signals. The paradigm shift is also based a classical public health approach setting standards based on epidemiology and strong evidence that electromagnetic fields and radiation is a genotoxic carcinogen.

Considering the SR signal, there is independent confirmation. In measuring the melatonin levels in electrical workers in the United States, Dr James Burch and his team at the Colorado State University, Fort Collins, found that ELF fields significantly reduce melatonin, as does cellphone use. Having removed the ELF and cellphone effects there was a residual variation in the data. This was dose-response related to Geomagnetic Activity, Figure 10.

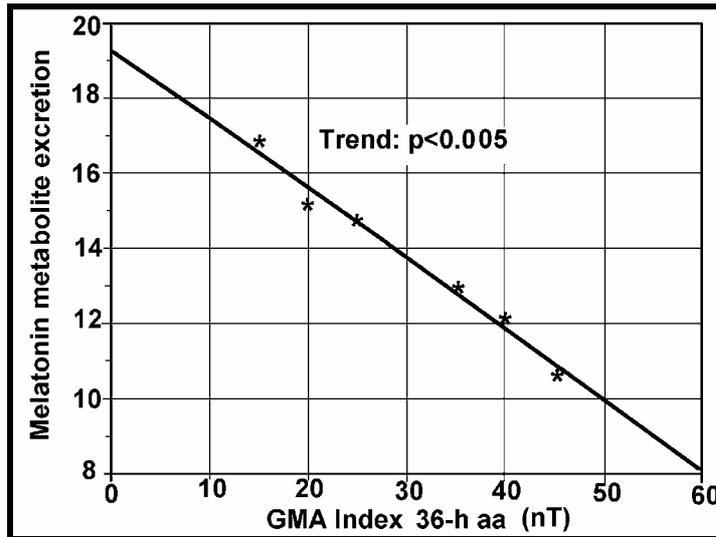


Figure 10: A dose-response reduction in human melatonin associated with increased geomagnetic activity, Burch et al. (1999).

An increase in GMA increases the nocturnal intensity of the Schumann Resonance signal that decreases the melatonin production in a causal manner (highly significant dose-response). Hence our brain's ability to detect and respond to the exquisitely minute signal of the Schumann Resonances results in changes in GMA causing physiological changes in human beings through the reduction in melatonin. A reduction in melatonin is associated with a very wide range of illnesses and diseases, including cancer, neurological, cardiac and reproductive health effects.

Cherry 2002 shows that the Schumann Resonance related health effects, operating through the melatonin mechanism, causes a homeostatic variation of cancer, cardiac, reproductive and neurological health effects in human populations. For example in relation to neurological effects, enhanced SR signal strength from enhanced S/GMA has been strongly correlated with:

Memory and attention deficit, aviation accidents, desynchronisation of the Alpha EEG rhythm, suppression of cortical activity, sensory deprivation (hearing and seeing), aggression, epileptic fits, convulsive seizures, dizziness, mental hospital admissions, suicide, migraine attacks, isolated sleep paralysis and multiple sclerosis incidence.

Lower levels of S/GMA are associated with increased levels of anxiety, vivid dreaming, crime, suicide, sports injuries, fatal work injuries, alcoholism and a psychiatric hospital admission rates.

Since the mechanism which causes these effects is a natural global radio electromagnetic signal with a mean field intensity of  $0.1\text{pW}/\text{cm}^2$  field strength of about  $1\text{pT}$ , it was predicted and confirmed in Cherry (2002) that similar effects would be found from electrical workers. The confirmation was given by multiple occupational epidemiological studies. Not all the identified effects have been found, but this is because not all effects have been investigated. However, the biological plausibility of altered melatonin related effects, produced by residential and occupational exposure to ELF and RF fields are producing all of the identified and many other health and biologically related effects.

### 2.3 The RF levels in U.S. cities in 1980:

The E.P.A. noted the extremely low levels of public RF exposure “50 years ago” was around  $10 \text{ pW/cm}^2$ , from a small number of radio stations. A survey of U.S. cities published in 1980, Tell and Mantiply (1980), found the mean urban public exposure was  $0.005 \text{ } \mu\text{W/cm}^2$ , or  $5 \text{ nW/cm}^2$ , with a median of  $6 \text{ nW/cm}^2$ , 600 times higher than 50 years earlier. At that time 0.59 % of the urban population of the U.S. was exposed to  $1 \text{ } \mu\text{W/cm}^2$  or more. This represents about a million people in 1980 exposed to more than 100,000 times more RF radiation than 50 years earlier. Figure 11 shows the frequency distribution of sampled exposures in U.S. cities in 1980.

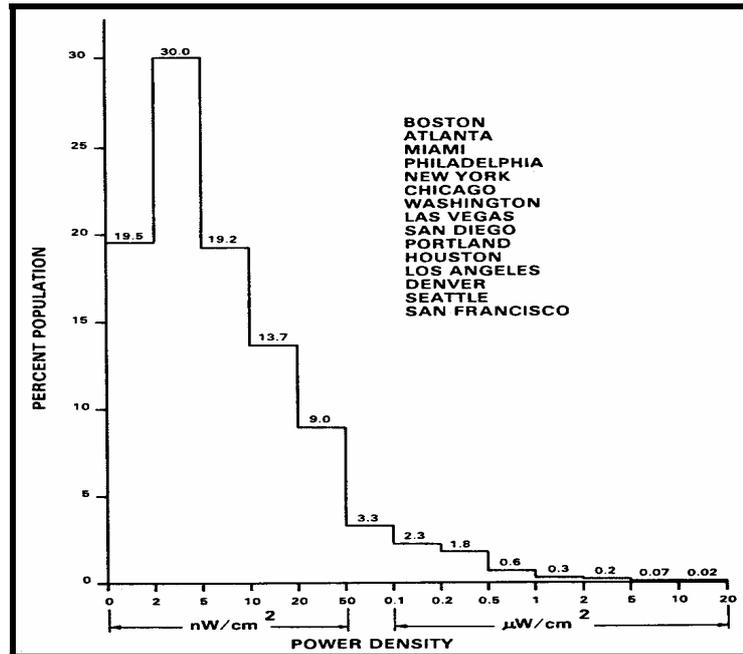


Figure 11: Frequency distribution of population exposures to RF radiation in 15 U.S. cities, Tell and Mantiply (1980).

With the explosion in the number of radio and TV stations, radio telephone networks, cordless phone and cell phones, the mean population exposures in the 21<sup>st</sup> Century will be 10-100 times higher than in 1980. Hence, compared with 50 years ago, the median public exposure levels to RF/MW radiation are generally 6,000 to 60,000 times higher now. For those living near transmission towers or the users of cell phones, the increase of the peak exposure is in the order of 1 million higher. Even the lowest of these, 6,000, is very concerning. If this was a visible or odorous substance, its presence and effects would be very evident and a grave cause for concern. Because RF/MW radiation is odorless, invisible, colorless and tasteless, its presence is virtually ignored and its effects are extremely hard for most people to conceive. Like many invisible toxic chemicals, RF/MW radiation is shown by many independent studies, including at isothermal and very low exposure levels, to be genotoxic. This puts the situation in a very different context if we ask the question,

**“Has a 6,000-fold or more increase in exposure level of people to genotoxic RF/MW had any potential effect or actual on individuals or populations of people ?”**

**Compare this with the public reaction to the question:**

**“Would you be concerned about, and urge the government to deal with your family being exposed to 6,000 times higher dioxin levels than people on Norfolk Island?”**

A genotoxic substance causes cellular DNA damage resulting in enhanced rates of cell death, mutation and cancer. If a substance is genotoxic, it causes cancer, cardiac, reproductive and neurological health effects and mortality. All of these health effects have shown rising rates in developed countries, over the past century, especially since the second World War.

### **3. The Melatonin Biological Mechanism:**

Melatonin reduction has many serious consequences including increased cancer risk for every organ in the body, increased risk of spontaneous miscarriage, impaired immunocompetence, impaired learning, memory, sleep, and enhanced incidence of anger, rage, depression and suicide. Hence when epidemiological studies identify statistically significant associations with any of these symptoms and EMR or EMF, then a melatonin mechanism is a plausible biological mechanism and that study adds to the weight of evidence that EMR and EMF alters melatonin in humans. Direct measurements of human melatonin in situations of EMR/EMF exposure are few in number but some have found reductions.

#### **3.1 The Pineal Gland:**

Melatonin is produced, primarily at night, by the pineal gland. The pineal gland is a cone shaped, pea sized body residing near the centre of the brain, Figure 12.

Light received by our eyes is the primary control source for melatonin. When it is light melatonin production is blocked. At night this blocking effect is removed. Then Tryptophan is converted to serotonin which is then converted to Melatonin at a rate controlled by an enzyme NAT (N-acetyltransferase) which has been activated or limited through protein synthesis from amino acids controlled by cyclic AMP, Figure 12.

Tryptophan, an amino acid from the blood, is converted to the hormone melatonin, which is quickly released into the capillaries of the gland. The enzymes which catalyze the conversion of serotonin to melatonin include N-acetyltransferase (NAT) and hydroxyindole-O-methyltransferase (HIOMT).

The pineal gland produces melatonin at night since the nerve endings which end in the pineal gland release the neurotransmitter norepinephrine (NE) which interacts with the b- and a-adrenergic receptors on the cell membrane; these interactions initiate the processes which control melatonin production. ATP, adenosine triphosphate; PVN paraventricular nuclei; SCN, suprachiasmatic nuclei; SCG, superior cervical ganglia. The melatonin easily passes through the cell wall into the blood stream to be dispersed throughout the body. The pineal gland is located near the centre of the brain. It is an endocrine organ which produces most of the melatonin which is found in the blood, Figure 13.



Because of its action in removing free radicals, melatonin is probably the most efficient natural cell protection and oncostatic agent in our bodies. Every night, our pineal produces large quantities of melatonin which flood almost every cell in our body, cleaning out the free radicals and assisting cell division to take place with undamaged DNA. As we age our nocturnal peak melatonin production falls markedly, making elderly people much more prone to cancer. To test the cancer protecting properties of melatonin, Tan et al. (1993), injected rats with a chemical carcinogen, safrole. Safrole normally damages DNA because it induces the production of large numbers of free radicals. Rats injected with Safrole were found to have extensive DNA damage after 24 h. When melatonin was also injected, the DNA damage was reduced by 99 %. Since damaged DNA can undergo mutation it may result in the growth of a tumour. Thus melatonin is clearly a potent cellular protector against cancer initiation.

### 3.3 Effects of melatonin:

There is evidence of the change of melatonin and serotonin that is linked to depression, anger and rage. As melatonin is a very high free radical scavenger, and free radicals are known to damage DNA. Hence reduced melatonin can lead to cancer or damaged cells which are then programmed to die (apoptosis). Lai and Singh (1997) showed that microwaves increased the single and double-strand DNA breakage in living rats brains. They also showed that the breakage did not occur if either melatonin or a chemical free radicals scavenger (PBN) were infused. They noted that PBN has been shown to protect cells from free radical-induced apoptosis. Hence melatonin has the same oncostatic protection action and reduced melatonin reduces such protection leading to enhanced cancer risk and apoptosis. Lai and Singh (1997) conclude:

**“Since cumulated DNA strand breaks in brain cells can lead to neurodegenerative diseases and cancer and excess free radicals in cells has been suggested to be the cause of human diseases, data in this study could have important implications of the health effects.”**

Free radicals have an important role in aging processes (Reiter (1995)). Aging has been ascribed to accumulated oxidative damage to body tissues, Forster et al. (1996) and Sohal and Weindruch (1996), and involvement of free radicals in neurodegenerative diseases, such as Alzheimer's, Huntington's and Parkinson's, has also been suggested, Borlongan et al. (1996) and Owen et al. (1996). Hence there is evidence that RF/MW can cause serious health problems, such as cancer which can lead to earlier death, and neurodegenerative diseases which are associated with aging.

Once apoptosis begins, cell death occurs within hours through the inter-nucleosomal digestion of the genomic DNA. In most cell systems apoptosis is part of the cell protection system by killing damaged cells so they don't become cancer cells, for example. In brain cells, which have no regeneration, enhanced apoptosis leads to neurodegenerative diseases.

Pineal and serum melatonin concentration drops during the day and rises overnight, Figure 14. This shows the great differences in nocturnal melatonin levels between individuals. Similar variations can be seen for the same people on different nights, reflecting widely differing sleep quality.

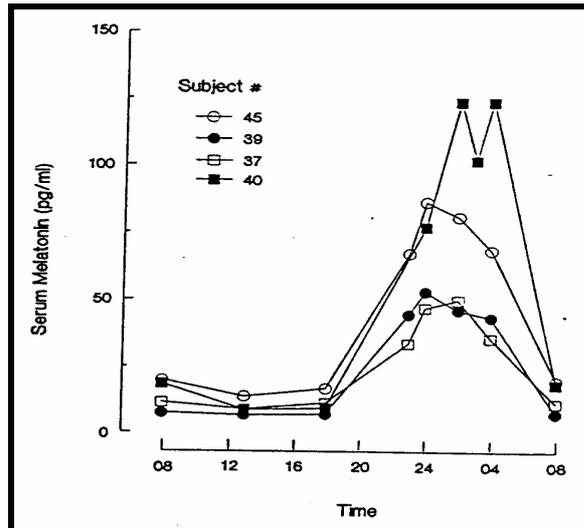


Figure 14: Blood melatonin levels for 4 healthy adult males over a 24 h period, Reiter (1994).

A natural part of aging is the reduced natural levels of melatonin which leads to increasing rates of cell damage, cancer and aging. Melatonin levels peak in childhood around 8 to 10 years and thence declines, Figure 15.

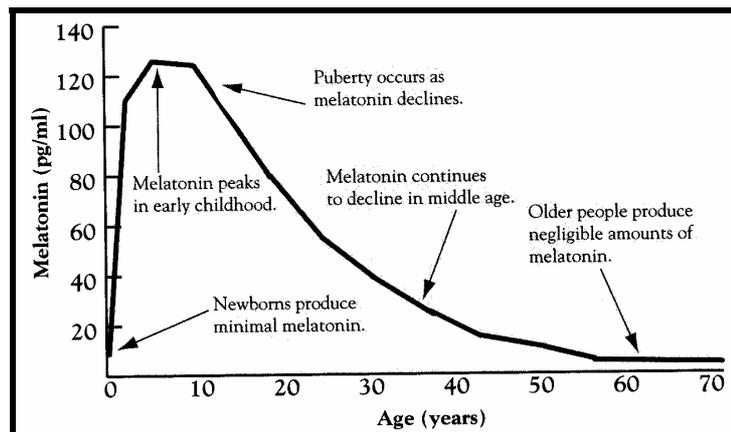


Figure 15: Peak night time melatonin varies throughout life span, Reiter and Robinson (1995).

### 3.4 Melatonin has a role in the immune system:

Melatonin is also linked to the immune system, with enhanced levels of melatonin protects and enhances the immune system. This happens through protecting lymphocytes from chromosome damage, Vijayalaxmi et al. (1995), and stimulating the T-cells, Maestroni et al. (1995), Figure 16.

### 3.5 Melatonin plays many roles:

High night-time melatonin is associated with healthy sleep, memory and learning. Thus the high nocturnal melatonin assists with physical health through good sleep and scavenging free radicals from cells throughout our bodies so that the cells divide and reproduce with healthier, less damaged DNA and chromosomes. Melatonin is critical to our DNA and cell repair systems and the next level of repair and protection system, our immune system.

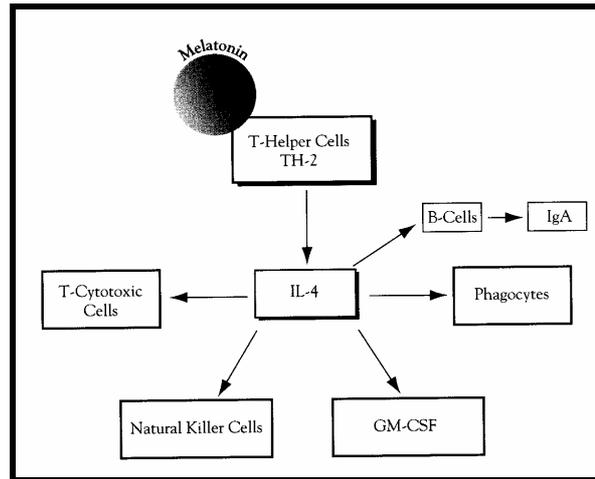


Figure 16: Melatonin stimulates T-helper cells, cited in Reiter and Robinson (1995).

Therefore any evidence that EMR can reduce melatonin, affects our sleep, memory or learning, impair our immune system and enhance apoptosis, has clear links to serious health and advanced aging problems. Reiter and Robinson (1995), identifying the following diseases that are associated with reduced melatonin “Arthritis, diabetes, heart disease, cancer Alzheimer’s Disease and Parkinson’s Disease”. In other sections they identify sleep disturbance that results in chronic fatigue, sudden infant death syndrome (SIDS), manic depression and suicide, Schizophrenia, chronic pain, seasonal affective disorder (SAD), alcoholism, and enhanced ageing. The key roles of melatonin in DNA and chromosome protection through free radical scavenging come together in the uterus where Sandyk (1992) notes that after genetic factors are taken into account, the next most important factors in the risk of spontaneous abortion are melatonin reduction and chromosome aberrations.

### 3.6 Melatonin production is inter-linked to intracellular calcium ions:

Melatonin production is interlinked with intracellular calcium ions through the fundamental role of calcium ions in all human cells, including the cells making up the pineal gland, the pinealocytes. The cyclic AMP and calcium ion dependent signal transduction processes are both involved in the regulation of melatonin production from serotonin within the pineal gland during dark periods, Figure 17.

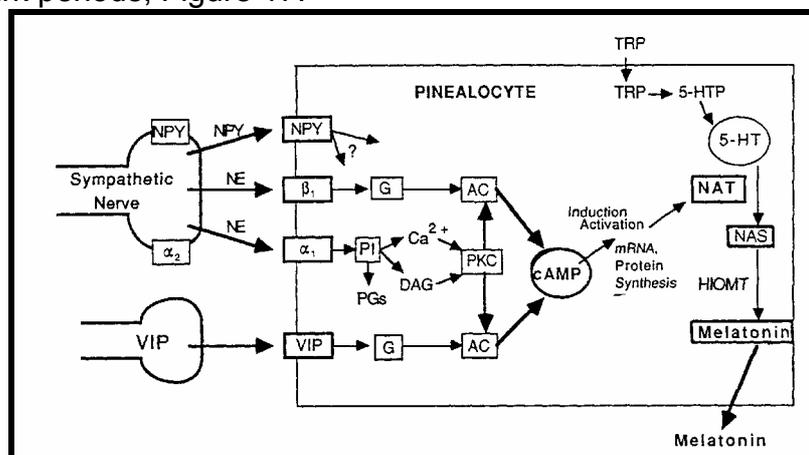


Figure 17: A schematic of the receptors and second messengers underlying the neural control of melatonin production, through which calcium ions mediate the cAMP through the protein kinase C (PKC) and thence the adenylyl cyclase (AC), Krause and Dubocoviich (1990).

### 3.7 EMR and EMF effects on the Melatonin Mechanism:

On the macro-scale, human and animal circadian rhythms are driven by the day/night cycle with a phase-lock synchronization provided by environmental ELF fields ( $E < 0.3 \text{ pW/cm}^2$ ). A fundamental physiological aspect of the circadian rhythm involves the pineal gland and the secretion of a neurohormone called melatonin. Light falling on the eye's retina produces signals which are biochemically amplified around a million times, to stimulate the pineal gland to reduce its melatonin output.

Four independent laboratories, Battelle PNL (Wilson), U.C. Riverside (Luben) and the U.S. EPA (Blackman), Lawrence Livermore Laboratory (Liburdy) have shown that 60 Hz modulated magnetic fields in the 1 to 12 mG range, almost completely negate the oncostatic effect of melatonin in human breast cancer cells, with a dose-response relationship. Wilson et al. (1986) showed significant reductions in pineal melatonin in living rats when they were chronically exposed to 60 Hz modulated electric field at 1.7-1.9 kV/m for 20 h per day, for 30 days, Figure 18.

Welker et al. (1983) studied a range of magnetic field configuration exposures on a group of Sprague-Dawley rats in relation to altered on pineal serotonin-N-acetyltransferase (NAT) activity and melatonin. Experimental inversion of the horizontal component of the natural magnetic field, performed at night-time, led to a significant decrease of both parameters investigated. During day-time, this effect was less conspicuous.

During night-time, inversion of the horizontal component is followed by a reduced pineal secretory activity for about 2 h. After 24 h exposure to the inverted horizontal component, return to the natural condition was followed by a renewed clear depression of pineal NAT activity and melatonin content, indicating that the main stimulus is not the inverted magnetic field itself but rather its change. Changing the inclination of the local magnetic field from 63 degrees to 58 degrees, 68 degrees or 78 degrees, respectively also decreased the secretory activity of the rat pineal gland.

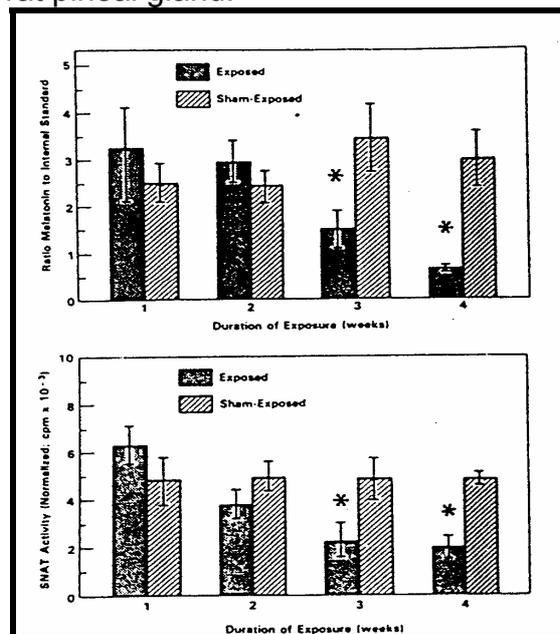


Figure 18: Pineal melatonin (top) and NAT activity (bottom) in groups of rats exposed to a modulated electric field for 1 to 4 weeks. The glands of the animals were collected at night.

In the sham-exposed animals the pineal melatonin and NAT levels were always high. However, after both 3 and 4 weeks of exposure to the electric field, both parameters were depressed ( $p < 0.001$ ).

Hence for rodents, whose cells in many ways behave as human cells, there is direct evidence that chronic electric field exposure over periods of weeks results in reduced pineal melatonin production, Figure 18, and increased serotonin production, Figure 19.

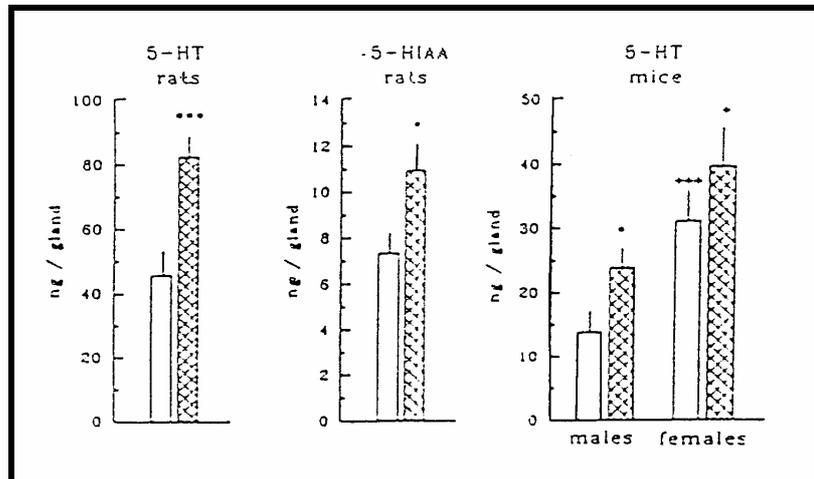


Figure 19: Pineal serotonin (5-HT) and 5-hydroxyindole acetic acid (5-HIAA) levels in rats and mice (cross-hatched bars) with and without (clear bars) exposure to pulsed static MF at night.

A highly statistically significant levels. Lerchl et al. (1988) samples for serotonin and its derivatives by periodically inverting the magnetic field at night.

In Figure 19, both 5-HT and 5-HIAA levels increased as a result of the exposure; these changes are consistent with a reduced melatonin production. \*  $p < 0.05$  and \*\*\*  $p < 0.001$  vs control; +++  $p < 0.05$  control male mice, from Lerchl et al. (1990). Thus it is shown that time varying electric and magnetic fields decrease the melatonin and increase the serotonin and NAT in rodents.

The review paper by Professor Russell Reiter (Reiter (1994)), was prompted by a number of epidemiological studies in which an increased incidence of cancer was reported in individuals living or working in an environment of higher than normal artificial electromagnetic fields. He concludes:

**“Reduction of melatonin at night, by any means, increases cell’s vulnerability to alteration by carcinogenic agents. Thus, if in fact artificial electromagnetic field exposure increases the incidence of cancer in humans, a plausible mechanism could involve a reduction in melatonin which is a consequence of such exposures.”**

He also notes:

**“Epidemiologists should look for other possible changes, including psychological depression, fatigue, sleep inefficiency, chronic feelings of jet lag, endocrine disturbances and other symptoms; all these may result from a chronically low melatonin rhythm.”**

Altpeter et al. (1995) [p 94] noted “a trend suggesting that an increased urine melatonin level is associated with the high probability of sleeping well during the night (OR = 0.903, 95% CI: 0.688; 1.455).”

A recent paper produced for the U.S. RAPID program, Burch et al (1997), reported statistically significant reductions of melatonin in a sample of 142 male electric utility workers. Those who reported occasional to frequent cell phone use had significantly lower melatonin secretion than those reporting no or infrequent cell phone use ( $p = 0.04$ ). After adjusting for age, light exposure and month of participation this association weakened slightly to  $p=0.05$ , whereas those with stable 60 Hz exposure and cell phone use the reduction was significant,  $p=0.03$ . They also concluded that “among cell phone users, there was a progressive decrease of mean 6-OHMS/cr (melatonin metabolite) concentrations in response to temporally stable magnetic field exposures. The results suggest that occupational cellular telephone use may be associated with reduced daytime melatonin production.”

Another study, Sait et al. (1997) concluded that in sensitive individuals there was a highly significant melatonin reduction,  $p= 0.005$ , with an average delay of 55 minutes ( $p<0.001$ ,  $n=11$ ), when exposed to an on/off 50 Hz magnetic field. Their nocturnal peak was reduced by 9 %, but this was not statistically significant. They found that a square wave form was more effective in reducing melatonin than a sinusoidal waveform and they concluded that for an effect to occur the magnetic field exposure had to precede the nocturnal rise in melatonin.

Hence there is direct evidence of melatonin reductions in people exposed to EMF and EMR, but that it varies considerably from person to person, that some people are much more responsive (sensitive) than others and that timing of the exposures is also a factor.

Thus in large exposed populations there are those whose melatonin will be reduced by combinations of EMF and EMR exposure and they are at increased risk of all the above identified health effects. The multiple independent studies showing a causal relationship are summarized below.

### **3.8 EMF/EMR Reduces Melatonin in Animals:**

Light-at-night and electromagnetic radiation, are proven to reduce melatonin and hence pose significant adverse health effects. The evidence for EMR is summarized here. Rosen, Barber and Lyle (1998) state that seven different laboratories have reported suppression of nighttime rise in pineal melatonin production in laboratory animals. They show that a 50  $\mu$ T, 60 Hz field with a 0.06 $\mu$ T DC field, over 10 experiments, averages a 46% reduction in melatonin production from pinealocytes. Yaga et al. (1993) showed that rat pineal response to ELF pulsed magnetic fields varied significantly during the light- dark-cycle. They found that the rate-limiting enzyme in melatonin synthesis, N-acetyltransferase (NAT) activity showed that magnetic field exposure significantly suppressed NAT during the mid- to late dark phase.

Stark et al. (1997) observed a significant increase in salivary melatonin in a group of 5 cows when the short-wave radio transmitter at Schwarzenberg, Switzerland, was turned off for three days, compared to 5 cows that had much lower RF exposure. Hence there are now at

least ten independent observations of melatonin reduction in animals from ELF and RF exposure.

### **3.9 EMF/EMR Reduces Melatonin in People**

Seventeen studies from show that ELF and RF/MW exposure reduces melatonin and enhances serotonin in people. Evidence that EMR reduced melatonin in human beings commenced with Wang (1989) who found that workers who were more highly exposed to RF/MW had a dose-response increase in serotonin, and hence indicates a dose-response reduction in melatonin. Sixteen studies have observed significant EMR associated melatonin reduction in humans. They involve a wide range of exposure situations.

This includes 16.7 Hz fields, Pfluger et al. (1996); 50/60 Hz fields, Wilson et al. (1990), Graham et al. (1994), Wood et al. (1998), Karasek et al. (1998), Burch et al. (1997, 1998, 1999a, 2000), Juutilainen et al. (2000) and Graham et al. (2000); combination of 60 Hz fields and cell phone use, Burch et al. (1997, 1999a); VDTs ELF/RF exposures, Arnetz et al. (1996), and a combination of occupational 60Hz exposure and increased geomagnetic activity around 30nT, Burch et al. (1999b). Two recent studies recorded significant melatonin reduction in women in EMF residential exposure situations, Davis et al. (2002) and Levallois et al. (2002).

### **3.10 Health effect consequences of reduced melatonin:**

Melatonin reduction is a plausible and identified mechanism for epidemiological studies associating depression with living near power lines, Beale et al. (1997) [with a linear dose-response relationship] and Verkasalo et al. (1997) [RR= 4.7, 95% CI: 1.70-13.3, for severe depression in people living within 100 m of high voltage power lines]; for suicide in association with proximity to power lines, and suicide in electrical industries. The staff of the U.S. embassy in Moscow were studied in relation to their being chronically exposed to very low exposure to a radar which was aimed at a part of the embassy. They showed elevated cancer levels, Goldsmith (1995, 1998), and statistically significant elevation in the following symptoms: Depression ( $p=0.004$ ), Irritability ( $p=0.009$ ), Difficulty on Concentrating ( $p=0.001$ ) and memory loss ( $p=0.008$ ) [Table 6.31, Lilienfeld (1978)].

Zyss et al. (1997) noted that “Numerous reports suggest a relationship between the increased incidence of depressive and neurotic symptoms in humans and the exposure to extremely low frequency electromagnetic field (EMF) at the place of residence.” They studied 70 exposed persons (35 male, 35 female) and compared them to a control group of 37. the exposed group were residents of a suburb of Cracow, Poland, living in the vicinity of two 400 V powerlines. The stated: “Our investigation showed the increased psychopathological values in all clinical tests. The difference between the group exposed to EMF and the control population was statistically significant.”

Verkasalo et al. (1997) stated that electromagnetic fields have been suggested to contribute to the risk of depression by causing pineal dysfunction. Some epidemiologic studies have supported this possibility but have generally reported crude methods of exposure assessment and nonsystematic evaluation of depression. Using two available nationwide data sets, the authors identified from the Finnish Twin Cohort Study 12,063 persons who had answered the 21-item Beck Depression Inventory of self-rated depressive symptoms in 1990. The personal 20-year histories of exposure (i.e., distance and calculated annual average magnetic fields) before 1990 to overhead 110- to 400-kv power lines were obtained

from the Finnish Transmission Line Cohort Study. The adjusted mean Beck Depression Inventory scores did not differ by exposure, providing some assurance that proximity to high-voltage transmission lines is not associated with changes within the common range of depressive symptoms. However, the risk of severe depression was increased 4.7-fold (95% CI: 1.70-13.3) among subjects living within 100 m of a high-voltage power line. This finding was based on small numbers. The authors recommend that attempts be made to strive for a better understanding of the exposure characteristics in relation to the onset and course of depression.

Beale et al. (1997) studied 540 adults living near transmission lines completed neuropsychological tests in major domains of memory and attentional functioning, mental health rating scales and other questionnaires. Magnetic field measurements were taken in each room occupied for at least one hour per day to provide an estimate of total-time-integrated exposure. The data were subjected to joint multivariate multiple regression analysis to test for a linear relation between field exposure and dependent variables, while controlling for effects of possible confounders. Performance on most memory and attention measures was unrelated to exposure, but significant linear dose-response relationships were found between exposure and some psychological and mental health variables. In particular, higher time-integrated exposure was associated with poorer coding-test performance and more adverse psychiatric symptomatology. These associations were found to be independent of participants' beliefs about effects of electromagnetic fields.

Bonhomme-Faivre et al. (1998) studied a small group (13) of exposed workers matched to 13 controls and found that those exposed to 50 Hz in the mean range of 0.2  $\mu$ T-6.6  $\mu$ T had “significant increase in degree of certain neurovegetative disorders (i.e., physical fatigue, psychical asthenia, lipothymia, decreased libido, melancholy, depressive tendency, and irritability). In addition, the population experienced a significant fall in total lymphocytes and CD4, CD3, and CD2 lymphocytes, as well as a rise in NK cells. Leukopenia and neutropenia were also observed in two persons chronically exposed to doses of 1.2-6.6 microT. The disorders disappeared when exposure stopped, and they reappeared on re-exposure.”

#### **4. Intracellular Calcium ions:**

As with melatonin, calcium ions are ubiquitous throughout our cells and our bodies. Calcium has been identified as a very important factor of many cellular processes. Morphological changes, cytoskeletal damage, cell death and cytolysis followed the elevation of cytosolic free-calcium levels. Calcium ions are very important for cell homeostasis, in fact, they control many functions of a variety of cellular responses, including secretion, cell proliferation and apoptosis, Mattana et al. (1997).

##### **4.1 Roles of intracellular calcium ions:**

“Even a rather small change in intracellular calcium can exert profound changes in cellular activity. In synaptic terminals of neurons, for example, calcium induces release of neurotransmitter molecules.” Berridge (1985) (p148): Hence any externally induced changes in the concentrations of intracellular calcium ions can have many far reaching consequences for the health and well-being of cells, organs and people.

**Table 1: Calcium ions play many roles in processes within cells, including:**

- As a second messenger in cell regulation signal transduction.
- In a signal transduction process component inter-linked to the cyclic AMP process.
- In the development and activation of the immune system, proliferation of lymphocytes and a variety of other components of immune response.
- In the degranulation and superoxide generation of neutrophils in the immune system.
- In Cell proliferation promotion at key parts of the cell cycle.
- In timing the initiation of DNA synthesis in the cell cycle.
- In Apoptosis (programmed cell death).
- In setting a preference for either apoptosis or proliferation of a damaged cell.
- In Transcription of proto-oncogenes (Genes which produce cancer).
- As a regulator of the opening and closing of the gap junction.

#### 4.2 Calcium ions as cellular messengers:

Calcium ion ( $\text{Ca}^{2+}$ ) functions as a ubiquitous intracellular messenger, Alberts et al. (1994). The first evidence that  $\text{Ca}^{2+}$  functions as an intracellular mediator came from an experiment in 1947, showing that the intracellular injection of a small amount of  $\text{Ca}^{2+}$  causes a skeletal muscle cell to contract. In recent years it has become clear that  $\text{Ca}^{2+}$  also acts as an intracellular messenger in a wide variety of cellular responses, including secretion and cell proliferation. Two pathways of signaling have been well defined, one used mainly by electrically active (excitable) cells and the other by almost all eucaryotic cells.

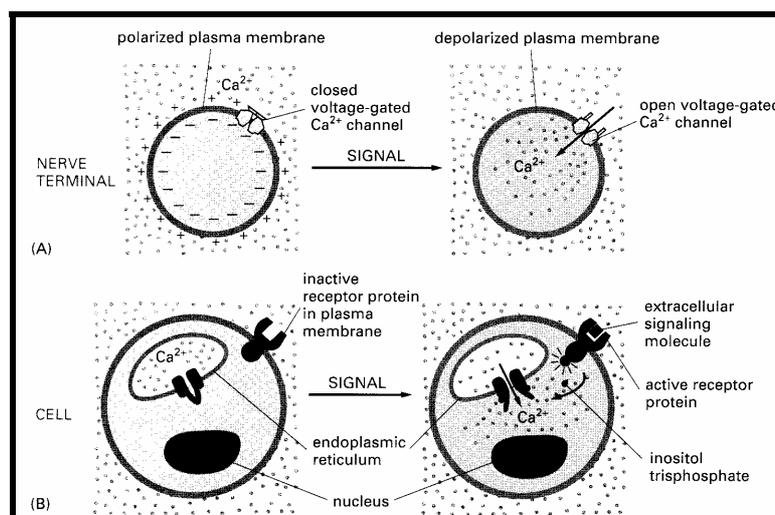


Figure 20: In (A)  $\text{Ca}^{2+}$  enters a nerve terminal from the extracellular fluid through voltage-gated  $\text{Ca}^{2+}$  channels when the nerve terminal is depolarized by an action potential. In (B) the binding of an extracellular signaling molecule to a cell-surface receptor generates inositol trisphosphate, which stimulates the release of calcium from the ER, Alberts et al. (1994).

The first of these pathways has been primarily described in nerve cells, in which depolarization of the plasma membrane causes an influx of  $\text{Ca}^{2+}$  into the nerve terminal, initiating the secretion of neurotransmitter; the  $\text{Ca}^{2+}$  enters through voltage-gated  $\text{Ca}^{2+}$  channels that open when the plasma membrane of the nerve terminal is depolarized by an invading action potential. In the second, ubiquitous pathway the binding of extracellular signaling molecules to the cell-surface receptors causes the release of  $\text{Ca}^{2+}$  from the endoplasmic reticulum (ER), Figure 20.

Calmodulin is a ubiquitous intracellular  $\text{Ca}^{2+}$  receptor. Calmodulin is a  $\text{Ca}^{2+}$  binding protein which is found in all eucaryotic cells that have been examined. A typical cell contains more than  $10^7$  molecules of calmodulin, which constitutes as much as 1 % of the total protein mass of the cell. Calmodulin functions as a multipurpose intracellular  $\text{Ca}^{2+}$  receptor, mediating many  $\text{Ca}^{2+}$  regulated processes. It is a highly conserved, single polypeptide chain of about 150 amino acids, with four high-affinity  $\text{Ca}^{2+}$ -binding sites, and its undergoes a conformational change when it binds to  $\text{Ca}^{2+}$ .

#### 4.3 Calcium ion and cAMP pathways are interlinked:

The cyclic AMP and  $\text{Ca}^{2+}$  intracellular signaling pathways interact at several levels in the hierarchy of cellular control. Firstly, cytosolic  $\text{Ca}^{2+}$  and cyclic AMP levels can influence each other. For example, some forms of enzymes that break down and make cyclic AMP are regulated by  $\text{Ca}^{2+}$ -calmodulin complexes. Also enzymes directly regulated by  $\text{Ca}^{2+}$  and cyclic AMP can influence each other, Alberts et al. (1994). In association with diacylglycerol release, calcium can activate protein Kinase-C dependent signal transduction pathways, thus modifying gene transcription, Clutton (1997). Thus induced alteration of intracellular calcium concentrations, disrupting the homeostasis of the cell, has serious consequences for the health and future development of the cell.

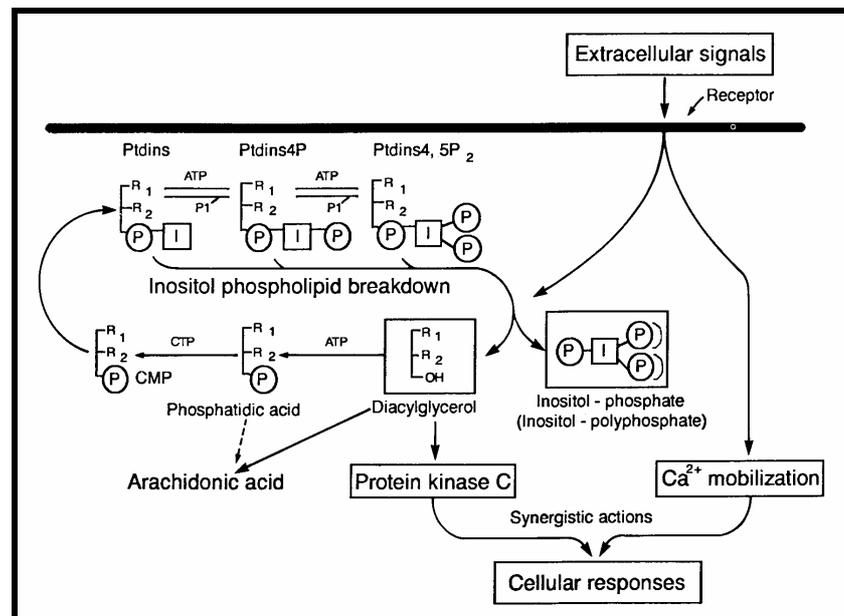


Figure 21: Illustrating the role of protein kinase C and calcium ions in signal transduction and cell responses to tumor promoters, Adey (1990).

Also, calcium ions, in partnership with cyclic AMP, control the proliferation of non-tumorigenic cells in vitro and in vivo. While it does not seem to be involved in the

proliferative activation of cells such as hepatocytes (in vivo) or small lymphocytes (in vitro), it does control two later stages of prereplicative (G1) development. It must be one of the very many regulatory and permissive factors affecting early prereplicative development, because severe calcium deprivation reversibly arrests some types of cell early in the G1 phase of their growth-division cycle in vitro, Whitfield et al. (1979).

However, calcium more specifically and much more often regulates a later (mid or late G1) stage of prereplicative development. Thus, regardless of its severity or the type of cell, calcium deprivation in vitro or in vivo reversibly stops proliferative development at that part of the G1 phase in which the cellular cyclic AMP content transiently rises and the synthesis of the four deoxyribonucleotides begins. The evidence points to calcium and the cyclic AMP surge being co-generators of the signal committing the cell to DNA synthesis.

The evidence is best explained so far by the cyclic AMP surge causing a surge of calcium ions which combine with molecules of the multi-purpose, calcium-dependent, regulator protein calmodulin (CDR) somewhere between the cell surface and the cytosol. The resulting Ca-calmodulin complexes then stimulate many different (and possibly membrane-associated) enzymes such as protein kinases, one of which produces the DNA-synthetic initiator, Whitfield et al. (1979).

#### 4.4 Calcium ions and gap junction communication:

Gap junctions are protein structures which link adjacent cells and provide a channel for the passing of small messenger molecules of 1000 daltons or less. The gap junction can open and close to control the flow. The opening and closing is regulated by the pH and calcium ion concentration. High  $\text{Ca}^{2+}$  shuts the gap junction while low  $\text{Ca}^{2+}$  open the gap junction, p 960 Alberts et al. (1994). Thus calcium ions play another key role in maintaining or interrupting the communication mechanisms for maintaining the health of cells because gap junctions are used to sense differences between cells and to initiate corrections in regulatory behaviour as necessary.

Both cAMP and calcium ions flow through gap junctions. A lowering of the intracellular calcium ion concentration has the effect of closing the gap junction and restricting this regulatory function.

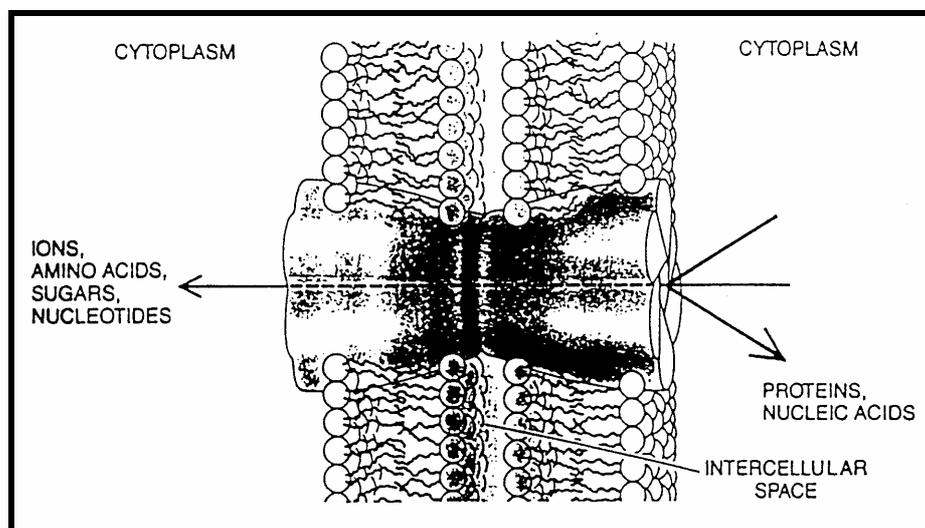


Figure 22: Schematic diagram of a gap junction between two cells.

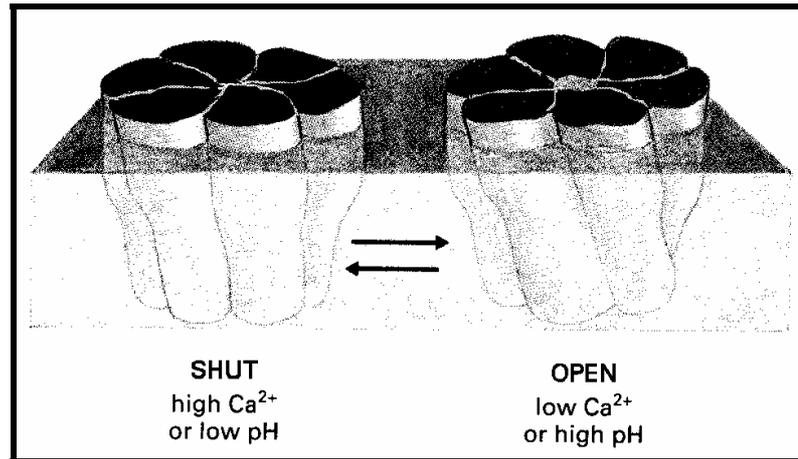


Figure 23: A small rotation triggered by high calcium ions or low pH causes the gap junction to close.

#### 4.5 Calcium ions and the immune system:

Grinstein and Klip (1989) state that:

**“It is now widely accepted that calcium plays a central role in the development of the immune system response. An elevation of  $\text{Ca}^{2+}$  (calcium ions) is a nearly universal feature associated with activation of cells of the immune system. Many responses normally elicited by physiological stimuli can be mimicked by simply elevating  $\text{Ca}^{2+}$  (calcium ions) by means of exogenous ionophores. These latter agents, which selectively increase the permeability of the membrane to divalent cations, such as  $\text{Ca}^{2+}$  (calcium ions), have been reported to induce degranulation and superoxide generation of neutrophils, proliferation of lymphocytes and a variety of other components of immune response.”**

#### 4.6 Calcium ions and cell proliferation:

Calcium ions ( $\text{Ca}^{2+}$ ) have been identified as mediators of proliferative and morphogenetic processes in many eukaryotic cells. Rodriguez-del Valle and Rodriguez-Medina (1993)

Durham and Walton (1982) outline the role of  $\text{Ca}^{2+}$  in cell proliferation.

**“Several lines of evidence suggest that  $\text{Ca}^{2+}$  ions control cell proliferation:  $\text{Ca}^{2+}$  entry into cytoplasm acts as a general mitogen; serum and serum-replacements induce  $\text{Ca}^{2+}$  influx; the  $\text{Ca}^{2+}$  concentrations in growth media required to support the proliferation of normal cells are much higher than those required for cancer cells; serum and growth factors reduce the  $\text{Ca}^{2+}$  requirements of normal cells; tumour promoters alter  $\text{Ca}^{2+}$  fluxes via a mechanism used principally by growth factors. Minor supporting evidence includes the effects of various drugs and viruses, and the behaviour of tumour cell mitochondria and intercellular junctions. It is still not possible to decide exactly where and when inside cells the critical effect of  $\text{Ca}^{2+}$  on proliferation occurs. Carried to its logical conclusion, present evidence suggests that an overridden or bypassed  $\text{Ca}^{2+}$  control process may be the key, common determinant of unrestrained proliferation in cancer cells.”**

Earlier work of Whitfield et al. (1979) revealed that altered intracellular calcium concentrations affected the cell cycle at particular points, producing different effects depending on the stage of the cell cycle.

**“Calcium, in partnership with cyclic AMP, controls the proliferation of non-tumorigenic cells in vitro and in vivo. Calcium must be one of the very many regulatory and permissive factors affecting early prereplicative development, because severe calcium deprivation reversibly arrests some types of cell early in the G1 phase of their growth-division cycle in vitro. However, calcium more specifically and much more often regulates a later (mid or late G1) stage of prereplicative development. Thus, regardless of its severity or the type of cell, calcium deprivation in vitro or in vivo reversibly stops proliferative development at that part of the G1 phase in which the cellular cyclic AMP content transiently rises and the synthesis of the four deoxyribonucleotides begins. The evidence points to calcium and the cyclic AMP surge being co-generators of the signal committing the cell to DNA synthesis.”**

This indicates that induced calcium ion efflux from a cell during the G1 phase of the cell cycle will reversibly stop the proliferation (stop or slow the cell cycle). Thus calcium ion efflux is expected to be associated with a slowing of the cell proliferation rate.  $\text{Ca}^{2+}$  also plays a key role in initiating the DNA synthesis.

#### **4.7 Calcium ions and apoptosis:**

A damaged cell can be programmed to die. This process is called “apoptosis”. Severe cell damage is caused by reactive oxygen species (ROS), which includes hydroxyl radical, hydrogen peroxide, superoxide etc.. After damage, if cellular balance is not restored, a number of pathological processes are elicited. Predominant processes resulting from oxidative stress include oxidative lipid degeneration, the loss of intracellular calcium homeostasis and alteration of metabolic pathways. All of these processes, including altered cellular calcium concentrations, have been recorded as apoptosis models. For example, calcium-dependent endonuclease activation is believed to initiate chromatin fragmentation frequently observed in apoptotic cells, Lemasters et al. (1987) and Orrenius et al. (1989).

#### **4.8 Intracellular calcium concentration alters the damaged cell’s futures:**

Balcer-Kubiczek (1994) links intracellular calcium levels to the future of damaged cells between becoming neoplastic (cancer) or dying by apoptosis. This is demonstrated by the way that the cancer promoter TPA, in low concentrations, “has been shown to switch the effect of calcium elevation from cell death to cell proliferation, probably by the activation of protein kinase C.” and “TPA leads to the maintenance of malignant phenotype by blocking apoptosis, thus allowing potentially transformed cells to survive and to develop transformational damage.”

Cytolysis is the process of dissolution or destruction of cells. Morphological changes, cytoskeletal damage, cell death and cytolysis followed the elevation of cytosolic free-calcium levels. Calcium ions are very important for cell homeostasis, in fact, they control the functions of a variety of cellular responses, including secretion, cell proliferation and apoptosis, Mattana et al. (1997). Hence reductions of intracellular calcium ions has a very important effect. Lower than normal intracellular calcium concentrations fail to activate the

protein kinase C which is necessary for apoptosis to take place. Hence damaged cells survive and proliferate with their transformed genetic damaged or changed material.

## 5. The role of EMR and EMF on Calcium ions:

### 5.1 ELF fields and calcium ion effects in the immune system:

Electromagnetic fields, through their effect on calcium ions, play a vital role in the immune system, Walleczek (1992). Walleczek (1992) quotes research relating to the role of calcium, sodium and potassium ions, including research showing that EMF could alter the activity of the membrane incorporated  $\text{Ca}^{2+}$ -ATPase responsible for pumping  $\text{Ca}^{2+}$  out of the cell (calcium ion efflux).

In addition, data from two laboratories demonstrate that ELF fields alter the activity of another membrane ion pump,  $\text{Na}^+/\text{K}^+$ -ATPase with current densities as low as  $50\mu\text{A}/\text{cm}^2$  and estimated, by the authors, to also have an effect at  $1\mu\text{A}/\text{cm}^2$ . At  $50\mu\text{A}/\text{cm}^2$ ,  $J = 0.5 \text{ A}/\text{m}^2$ ;  $E=2.5 \text{ V}/\text{m}$ , assuming  $\sigma=0.2 \text{ S}/\text{m}$ . Hence  $S= 1.7 \mu\text{W}/\text{cm}^2$  and  $\text{SAR} = 0.00063 \text{ W}/\text{kg}$ . If the extrapolation to  $1\mu\text{A}/\text{cm}^2$  is confirmed then the EMR effects will be occurring at  $1/2500^{\text{th}}$  of the S and SAR levels estimated here.

This demonstrates the extremely low induced currents, SARs and energy densities which are associated with EMR induced changes in ion pumping and calcium, sodium and potassium efflux at the cellular level.

Walleczek and Budinger (1992) report that:

**“To date, at least 10 different laboratories, including our own, have reported ELF magnetic influences on lymphoid cells, and stimulatory as well as inhibitory effects on parameters related to calcium metabolism or RNA- and DNA-synthesis have been observed.”**

They also state that:

**“A plausible magnetic interaction mechanism based on radical pair recombination reactions which are linked to cellular signal transduction and application processes has been proposed (Grundler et al. (1992)). Magnetic field intensities similar to the intensities used in most experiments (e.g. 1-30 mT) are known from magnetochemistry to be able to influence *non-thermally* the kinetics and product yields from radical pair reactions *in vitro*, Steiner et al. (1989). The underlying reaction scheme is well known and is described by the radical pair mechanism.**

**For this mechanism to be applicable to the data reported here, a pathway by which magnetically-sensitive radical-dependent processes could influence mitogen-induced lymphocyte  $\text{Ca}^{2+}$  signaling must be postulated. There is new evidence that such pathways exist.**

**For example, Con A-induced  $\text{Ca}^{2+}$  uptake in rat thymic lymphocytes has been shown to depend on the generation of reactive oxygen radical species. There is also evidence from inhibition studies that cytochrome P-450 activity may be**

involved in  $\text{Ca}^{2+}$  uptake regulation in rat thymic lymphocytes, Alvarez et al. (1992), and it is known that P-450 function proceeds via radical pair recombination steps, Hollenberg (1992). Thus it is plausible to investigate if externally applied magnetic fields may interfere with radical pair reactions and as a consequence, may alter lymphocyte  $\text{Ca}^{2+}$  regulation.”

Calcium ion influx has been shown to play a role in the transcript levels of proto-oncogenes c-myc and c-fos which alters in the presence of electromagnetic fields, Karabakhtsian et al. (1994). (Proto-oncogenes: altered genes which become carcinogenic.) Lin et al. (1994) identified a specific part of the c-myc promoter which is responsive to electric and magnetic fields. Phillips (1993) exposed T-lymphoblastoid cells to 60 Hz magnetic field and found alterations to the transcription of genes encoding for c-fos, c-jun, c-myc and protein Kinase-C.

Modulated electric and magnetic fields alter key genetic characteristics and therefore are mutagenic. This is further confirmed with studies showing EMR/EMF exposure is associated with chromosome aberrations and DNA damage, e.g. Vijayalaxmi et al. (1997) and Lai and Singh (1997). Lindstrom et al. (1995) replicated and extended the research of Walleczek (1992), using the T-cell line (lymphocytes) for human leukaemia cells, and show that oscillating low-level magnetic fields produce the same calcium ion reaction as does an antibody. They show that weak magnetic fields initiate calcium ion oscillations with a threshold flux density of  $40 \mu\text{T}$ , a plateau at  $150 \mu\text{T}$  and a frequency range from 5 to 100 Hz, with a fairly broad peak at 50 Hz. Galvanovskis et al. (1996) report significant 30% reductions in the calcium ion oscillation amplitude in human leukaemia T-cells when exposed to 50 Hz magnetic fields. The key role of modulation frequency in the alteration of calcium ions was recognized early.

## 5.2 Calcium ion efflux and modulation frequency

The very early research on brain cells efflux and influx of calcium ions using external ELF frequency fields in the same range of EEG frequencies was carried out by Dr Ross Adey and his research team, e.g. Figure 24a.

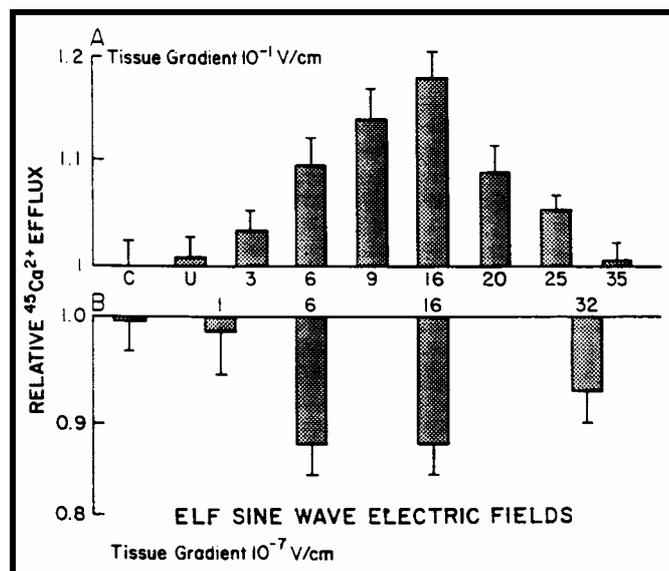


Figure 24a: ELF induced calcium ion efflux in chick brain cells from (A) an ELF modulated 147 MHz signal and (B) an ELF signal, Adey (1988).

Table 2 shows a concentration on using a modulation frequency of 16 Hz which was identified early to be an ELF frequency associated with strong calcium ion efflux compared with frequencies near it. A leading researcher in this area, Dr Carl Blackman of the U.S.E.P.A. has shown that research has identified modulation frequencies which significantly alter calcium ion efflux out to 510 Hz, Figure 24b.

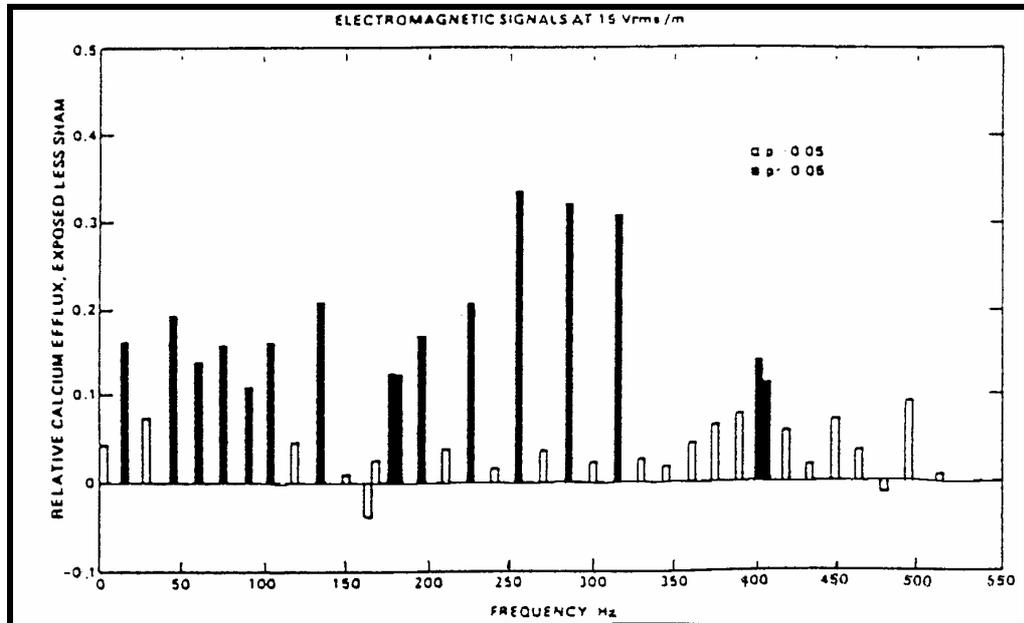


Figure 24b: The effect of 15 V/m electromagnetic fields on the efflux of calcium ions from chicken brain tissue as a function of modulation frequency. The relative efflux is the difference between exposed and unexposed samples. The data from 1 to 120 Hz are taken from Blackman et al. (1985). Blackman et al. (1988).

Their research further shows the involvement of polypeptide molecules, specifically poly-L-lysine, which the authors postulate may explain the intracellular calcium ion EMR effects on cell membrane surfaces, through the polylysine causing strong deformations on the cell surface which could trigger the release of stored calcium cations from intracellular pools, thus starting the oscillations.

Through replicating and extending the experiments of other laboratories, Dr Carl Blackman and his team at the U.S. Environmental Protection Agency have become the world leaders in calcium ion efflux research. That is why he was well qualified to review the research results and conclude, Blackman (1990) that

**"Taken together, the evidence overwhelmingly indicates that electric and magnetic fields can alter normal calcium ion homeostasis and lead to changes in the response of biological systems to their environment".**

There is extremely strong evidence that both ELF and ELF modulated RF/MW radiation causes calcium ion efflux from cells which significantly alters the intracellular calcium concentrations, reducing the efficacy of lymphocytes in the immune system, participating in the alteration of transformation of pineal serotonin to melatonin and altering the damaged cells likelihood of becoming neoplastic or dying by apoptosis.

### 5.3 The melatonin - calcium ion efflux link:

The interdependence of cyclic AMP and calcium ions is outlined in section 3.3 above. The following outlines an hypothesis for modulated RF/MW effects on melatonin.

Since it has been shown:

- That ELF electric fields do reduce melatonin production in living rats brains; Wilson et al. (1986).
- That RF/MW signals produce tissue level electric fields about a million times higher than imposed ELF signals, Adey (1981).
- That RF/MW signals are resonantly absorbed at the cell membrane, Liu and Cleary (1995).
- That altering the electric and thermal fields on the surface of the cell membrane change the binding characteristics of  $H^+$  and  $Ca^{2+}$  ions on the outer surface of the membrane, Adey (1990).
- That modulated RF/MW has been shown to induce significant calcium ion efflux from cells, Table 2 above.
- That it known that the cyclic AMP signal transduction pathway and the Calcium ion signal transduction pathway interact, Alberts et al. (1994).
- That in the pinealocyte cell the cAMP pathway is involved in regulating the transformation of serotonin to melatonin.

The calcium ion mediated responses to neurotransmitters on the membrane of the pineal cells has been discussed by Wilson et al. (1989) in relation to ELF induced melatonin reduction. Thus it is highly probable that pinealocytes exposed to modulated RF/MW will experience an outflow of calcium ions, a reduction of the cAMP signal transduction activity and a reduction in the production of melatonin. This is a highly plausible mechanism to explain why RF/MW can reduce pineal melatonin production with consequent the adverse health effects.

**Table 2: Summary of Studies concerning Calcium ion efflux and ELF Modulation of RF.**

Effects	Species	RF (MHz)	Mod <sup>n</sup> (Hz)	Intensity (mW/cm <sup>2</sup> )	Time (min)	SAR (W/kg)	Reference
<u>Altered calcium-ion efflux in brain tissue in vitro:</u>							
Frequency specificity	Chicken	147	6-20	1-2	20	0.002*	Bawin et al.(1975)
influence of pH and lanthanum	Chicken	450	16	0.75	20	0.0035	Bawin et al.(1978)
frequency and intensity specificity	Chicken	147	16	0.83	20	0.0014	Blackman et al.(1979)
intensity specificity and sample spacing	Chicken	147	9,16	0.083	20	0.0014	Blackman et al.(1980a)
intensity specificity and sample spacing	Chicken	147	16	0.083	20	0.0014	Joines et al (1981)
intensity specificity	Chicken	450	16	0.1-1	20	0.005-0.005	Sheppard et al.(1979)
two intensity ranges	Chicken	50	16	1.5 3.6	20 20	0.0013 0.0035	Blackman et al.(1980b)
theoretical analysis of RF dependence	Chicken	50 147 450	16	-	20	~0.001	Joines and Blackman(1980) Athey (1981); Joines and Blackman (1981).
test of predictions of theoretical analyses	Chicken	147	16	0.37 0.49	20	0.0006 0.0008	Blackman et al.(1981)
no effect for pulse modulation	Rat	1000	16,32	0.5-15	20	0.15-4.35	Shelton and Merritt (1981)
no effect for pulse modulation	Rat	1000 2450	16 8,16,32	1,10 1	20	0.29-2.9 0.3	Merritt et al. (1982)
change in calcium efflux kinetics in synaptosomes	Rat	450	16	0.5	10	-	Lin-Liu and Adey (1982)
frequency and intensity specificity in cultured neuroblastoma cells	Human being	915	16	-	30	0.05	Dutta et al.(1984)
<u>Altered calcium ion efflux in brain tissue in vivo:</u>							
no effect for pulse mod.	Rat	2060	8,16,32	0.5-10	20	0.12-2.4	Merritt et al.(1982)
change in efflux kinetics	Cat	450	16	3	60	0.29	Adey et al.(1982)
Changes found in pancreatic slices	Rat	147	16	2	60-150	<0.075	Albert et al.(1980)
Suppressed T-lymphocyte Changes in Hearts	Mouse Frog	450 240	16-100 0.5,16	1.5	120 30	- 0.00015	Lyle et al.(1983) Schwartz et al (1990)

## 6. Neurological Effects of RF radiation:

### 6.1 introduction to RF and Neurological functions of the brain:

Dr Henry Lai summarizes this research in Lai (1994). His opening statement is:

#### “INTRODUCTION

Many reports in the literature have suggested the effect of exposure to radiofrequency electromagnetic radiation (RFR) (10 kHz-300,000 MHz) on the functions of the nervous system. Such effects are of great concern to researchers in bioelectromagnetics, since the nervous system co-ordinates and controls an organism's responses to the environment through autonomic and voluntary muscular movements and neurohumoral functions. As it was suggested in the early stages of bioelectromagnetics research, behavioral changes could be the most sensitive effects of RFR exposure. At the summary of session B of the proceedings of an international symposium held in Warsaw, Poland, in 1973, it was stated that "The reaction of the central nervous system to microwaves may serve as an early indicator of disturbances in regulatory functions of many systems" [Czerski et al., 1974].

Studies on the effects of RFR on the nervous system involve many aspects: morphology, electrophysiology, neurochemistry, neuropsychopharmacology, and psychology. An obvious effect of RFR on an organism is an increase in temperature in the tissue, which will trigger physiological and behavioral thermal regulatory responses. These responses involve neural activities both in the central and peripheral nervous systems. The effects of RFR on thermoregulation have been extensively studied and reviewed in the literature [Adair, 1983; Stern, 1980]. The topic of thermoregulation will not be reviewed in this chapter. Since this paper deals mainly with the effects of RFR on the central nervous system, the effect on neuroendocrine functions also will not be reviewed here. It is, however, an important area of research since disturbances in neuroendocrine functions are related to stress, alteration of immunological responses and tumor development [Cotman et al. (1987), Dunn (1989), Plotnikoff et al. (1991)]. “

Dr Lai's review reports several thermal effects, e.g. Baranski (1972) reported edema and heat lesions in the brain of guinea pigs exposed to a single 3 h session to 3000 MHz RFR at a power density of 25 mW/cm<sup>2</sup> (SAR 3.75 W/kg). After repeated exposure to a lower level, myelin degeneration and glia cell proliferation were reported for guinea pigs (3.5 mW/cm<sup>2</sup>, SAR 0.53 W/kg) and rabbits (5 mW/cm<sup>2</sup>, SAR 0.75 W/kg). Pulsed RFR produced more pronounced effects than continuous-wave radiation at the same power density. These second set of experiments are athermal and produce an athermal effect.

### 6.2 Blood Brain Barrier:

Frey (1975) reports increases in the permeability of the microwave exposed blood-brain barrier (BBB). For example a 30 minute exposure to 1200 MHz RFR (2.4 mW/cm<sup>2</sup>, SAR 1.0 W/kg) as fluorescent dye was found to have crossed the BBB and was found mainly in the lateral and third ventricles of the brain. Other researchers found BBB changes only with

high exposures, e.g. Merrett et al. (1978). Dr Lai concludes: "It was apparent that in the majority of cases a high intensity RFR is required to alter the permeability of the BBB."

### 6.3 Evoked Potential:

Changes in the Evoked potential have been detected. For example, Taylor and Ashleman (1975) found that when the spinal cord was irradiated with a continuous wave 2450 MHz RFR at an incident power of 7.5 W, decreases in latency and amplitude of the reflex response were observed during exposure (3 min) and responses returned to normal immediately after exposure. They also reported that raising the temperature of the spinal cord produced electrophysiological effects similar to those of RFR.

### 6.4 Calcium ion balance in brain cells:

One of the most repeated effects of ELF modulated RF/MW is the calcium ion efflux from brain cells and muscle cells. Bawin et al. (1976) summarize some of the effects known up to that time. They are:

- Weak extracellular voltage gradients (1-5 mV/mm) have been shown to significantly affect the excitability or firing thresholds of the spinal neurons of cats.
- Nelson (1966) pointed out that the complex structural organization of brain tissues, as seen in the cerebrum, should be highly favorable for multiple electric field interactions, both in the intricate rate of overlapping dendritic trees and between macromolecules on the extracellular space and the glycoproteins of the out cell membrane.
- Weak pulsed electric currents (2-5 mV/mm, 200 pulses/sec) applied across the cat cortex were able to trigger the release of previously bound radioactive calcium ( $^{45}\text{Ca}^{2+}$ ).
- Intracranial injection of  $\text{Ca}^{2+}$  or  $\text{Mg}^{2+}$  in chronically implanted neonatal chicks resulted in an almost immediate synchronization of the hyperstriatal EEG, accompanied by behavioural depression, Bawin et al. (1984). During successive testing days, the animals appeared to recover behaviorally but never showed any sustained EEG arousal. By contrast animals treated with sodium chloride recovered completely within the first hour after injection.

Because of the high sensitivity of the chick forebrain to small perturbations of the extracellular divalent cations, this was chosen for investigating in vitro, possible interactions of weak voltage gradients induced by VHF radiation and ionic movements in cerebral tissue. The experiment showed that weak VHF fields (147 MHz, 1 mW/cm<sup>2</sup>), amplitude modulated at brain wave frequencies (6 Hz and 16 Hz) are able to increase the calcium efflux from the isolated brain of the neonatal chick. This result has been repeated by totally independent laboratories, and extended to a wide range of modulation frequencies up to 510 Hz, Blackman et al. (1988), and down to extremely low exposures. These include 10  $\mu\text{W}/\text{cm}^2$  (SAR=0.0075W/kg), Shandala et al.(1979) and an SAR of 0.00015 W/kg (S = 0.5  $\mu\text{W}/\text{cm}^2$ ), Schwartz et al. (1990).

Hence Calcium ion efflux is shown to alter mammal EEG and behaviour.

## 6.5 EEG alteration by EMR:

Professor Adey, and others, have been able to show that imposed oscillating electromagnetic fields can produce significant and repeatable changes in the behaviour of advanced mammals (cats and monkeys) in the laboratory, Adey et al. (1979). They used 450 MHz microwave signal at  $0.8 \text{ mW/cm}^2$ , modulated at 10 Hz, which produced an EEG level voltage gradient in the cat's brain of  $0.1 \text{ V/cm}$  and no detectable heating.

### 6.5.1 Altered Circadian Rhythm with extremely low exposure to RF and ELF:

Wever (1974) showed changes in human subjects isolated from environmental stimuli including ELF fields, which resulted in altered circadian rhythms which were corrected by applying a 10 Hz,  $2.5 \text{ V/m}$  field, which produces about  $10^{-7} \text{ V/cm}$  in tissue. The experiment was repeated using birds, with similar results, of lengthened circadian rhythms.

**“RF fields that are sinusoidally amplitude modulated at ELF frequencies produce a wide range of biological interactions. Induced electric gradients can be substantially higher than those produced by simple ELF electric fields, and at levels of 10-100 mV/cm, are the same range as intrinsic oscillations generated biologically, such as the electroencephalogram (EEG).”, Adey (1990)**

How does the brain cells sense these EMR fields ? The cell membrane outer surface is charged and the alpha-helix glycoprotein stands outside ends are highly charged. Calcium and hydrogen ions interact with the strands and its receptors, which is the first and most sensitive transductive coupling in brain tissue.

## 6.6 Neurotransmitters are altered by microwaves:

Many studies have shown significant efflux of calcium ions from cells exposed to ELF modulated RF and ELF fields. Since calcium ions ( $\text{Ca}^{2+}$ ) are known to stimulate specific glutamate binding to the synaptic membrane it is of value to determine whether modulated RF/MW alters glutamate binding.

An efflux has been recorded for the amino acid neurotransmitter gamma-aminobutyric acid (GABA), Kolomytkin et al. (1994), in association with microwaves modulated at 16 Hz. This is very significant since GABA and glutamateric synapses make up about 60 % of the CNS and calcium ions appear to hold the key to every aspect of cell-surface transduction, Adey (1979). Kolomytkin et al. (1994) showed that at 915 MHz microwave signal, modulated at 16 Hz, altered the binding of 3H-glutamate and 3H-muscimol in rats brains, at power densities below  $50 \text{ } \mu\text{W/cm}^2$ , which are statistically significantly different from controls to below  $10 \text{ } \mu\text{W/cm}^2$ , Figure 25.

Kolomytkin et al. (1994) link these changes to  $\text{Ca}^{2+}$  ions which have been shown to stimulate specific glutamate binding to synaptic membranes due to the activation of a calcium-dependent protease and resulting proteolysis (splitting into fragments) of cytoskeletal proteins. Since it is shown that modulated microwaves increase the glutamate uptake by synaptomes, Kolomytkin et al. pose the question as to whether microwaves directly affect the synaptosomes or does their sensitivity require some other brain system ? They determined that it was the synaptosomes which were sensitive to the microwaves. They then investigated whether it was a simple heating effect.

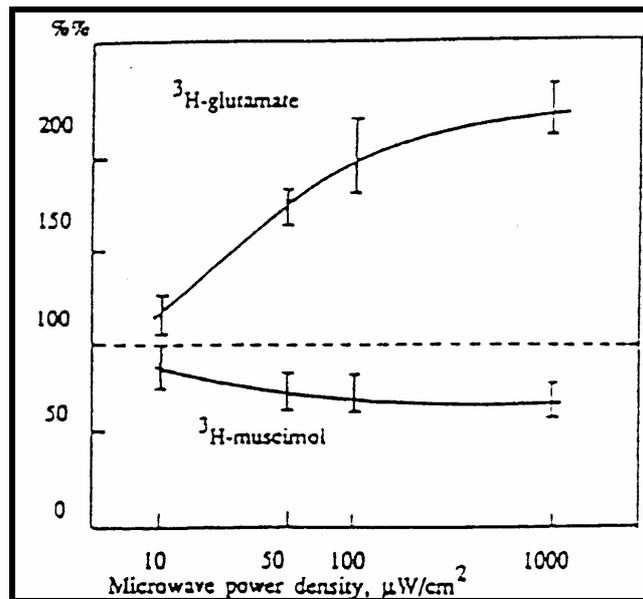


Figure 25: Altered the binding of  $^3\text{H}$ -glutamate and  $^3\text{H}$ -muscimol in rats brains versus microwave power density (915 MHz, modulated at 16 Hz), Kolomytkin et al. (1994).

Heating the samples to produce the same mean SAR did not produce the result. Hence they proposed the mechanism of localized microheating at the cell membrane. This membrane heating in the presence of microwaves has been demonstrated now by Liu and Cleary (1996). However, heating alone at the cell membrane level is unlikely to be the cause of the trends shown in Figure 20 since they follow a systematic change down to below  $10 \mu\text{W}/\text{cm}^2$ .

Kolomytkin et al. (1994) conclude that:

**“Our findings can be directly related to and complement the findings of Frey and Wesler (1990) and Kavakiers and Ossenkopp (1992). Frey found that dopamine and opiate systems of the brain were influenced by exposure to low intensity electromagnetic fields. Kavaliers has shown that electromagnetic fields can influence the functioning of multiple endogenous opoid systems and that the effects depend on the modulation of the field. Considering the great importance of GABA and glutamatergic systems in both normal and pathological brain processes, the finding of low intensity microwaves on these receptor systems is of significance.”**

This conclusion, which shows the findings of three independent studies, conforms to the requests of sceptics to show replication. Replication has been carried out and the effects are confirmed.

## 6.7 The Electroencephalograph (EEG) evidence from animals

The Electroencephalograph (EEG) provides a non-invasive means of monitoring the electrical activity of the brain.

Three studies show arousal in anesthetized rabbits with chronic athermal RFR exposure, Baranski and Edelwejn (1974) ( $7 \text{ mW}/\text{cm}^2$ , 200 h), Goldstein and Sisko (1974) (5 min,

9300 MHz, 0.7-2.8 mW/cm<sup>2</sup> ), and Servante et al. (1975) (rats, 10 days, 3000 MHz, 500-600 pps, 5 mW/cm<sup>2</sup> ).

Dumanskiy and Shandala (1974) and their colleagues reported altered conditioned reflex in rabbits and rats chronically exposed to extremely low levels of VHF and microwave fields. They used either 50 MHz or 2.5 GHz CW fields or 10 GHz 1  $\mu$ s pulses at 1,000 or 20 Hz, with 10-12h daily exposure with 50 MHz and 8 h with microwave fields. They found statistically significant effects with field intensities between 1.9 and 2.0  $\mu$ W/cm<sup>2</sup>.

In each experiment the animals were irradiated for 120 days, with a 60 day follow-up. For the first 10 days the animals were "somewhat excited" and reacted to the onset of exposure. Thereafter responses to conditioned stimuli has a longer latency, with weaker responses to positive stimuli and more numerous missed responses, leading to "pathologic stagnation and inertia".

Shandala et al. (1979) found statistically significant changes in the EEG and brain biochemistry of rats and rabbits exposed to 2.375 GHz microwaves at 10, 50 and 500  $\mu$ W/cm<sup>2</sup>, for 7 hours/day over 30 days. The 10 $\mu$ W/cm<sup>2</sup> and 50 $\mu$ W/cm<sup>2</sup> initially stimulate brain activity, while 500 $\mu$ W/cm<sup>2</sup> causes suppression as seen from the increase in slow, high amplitude  $\Delta$ -waves. After 1 month of exposure to a power density of 10 $\mu$ W/cm<sup>2</sup> (for 7hr/day, i.e. averaging 2.9 $\mu$ W/cm<sup>2</sup>) a reliable ( $p < 0.05$ ) increase was observed in the alpha-rhythm in the sensory-motor and visual cortex due to a suppression of the slow EEG components.

Clifford et al. (1989), in an effort to duplicate research carried out in the Soviet Union. The U.S. group found significantly less Na<sup>+</sup>, K<sup>+</sup> and ATPase activity in microwave exposed animals compared to sham exposed animals. Both groups found incidences of statistically significant effects in the power spectrum analysis of EEG frequency, but not at the same frequency.

These interactions included entrainment of brain EEG rhythms at the same frequencies as the ELF components of the imposed fields, conditioned EEG responses to imposed fields, and modulation of brain and behavioural states, Bawin et al (1973); and in non-nervous tissues, strong effects on cell membrane functions, including modulation of intercellular communication through gap junctions mechanisms, Fletcher et al. (1986), reduction of cell mediated cytolytic immune responses, Lyle et al. (1983), and mediation of intracellular enzymes that are markers of signals arising at cell membranes and couple to the cell interior, Byus et al. (1984, 1988).

Vorobyov et al. (1997) studied short-term alterations of EEG in mice exposed to ELF fields carried on a 945 MHz microwave carrier with exposures in the range 100 to 200  $\mu$ W/cm<sup>2</sup>. They found an induced asymmetry in the EEG on each side of the brain of an ongoing EEG power decrease in the 1.5-3 Hz range in the left hemisphere and a power increase in the 10-14 Hz and 20-30 Hz ranges in the right hemisphere. Significant elevations of EEG asymmetry in the 10-14 Hz range were observed after the first 20 s after five onsets of the microwave field, when averaged spectra were obtained for every 10 s. In their conclusions they comment that :

**"One of the possible key links in this effect can be calcium ion exchange in brain tissue (Adey (1981)). Indeed it was found that the intracellular**

**calmodulin level was changed by modulated microwave fields, Katkov et al. (1992), This change, as is known, can cause the change in receptor sensitivity to mediators, because in neural tissues both the transmitter-receptor mechanism and the second messenger are  $Ca^{2+}$  dependent."**

Many studies show that RF/MW exposure at athermal levels alters the EEG in animals. This is, that brain function relating to thinking and mood, altering the various bands of the EEG spectrum. With so many effects found in the higher mammals, this suggests that human brain activity and function might also be altered by EMR exposure, especially in the microwave range and with the signal contain ELF modulation which might find some way to resonantly interact with the brains EEG signals and alter them.

Lai et al. (1989) studied the acute effect of  $1 \text{ mW/cm}^2$ , SAR= 0.6 W/kg, 2450 MHz radiation exposed rats for 20 to 45 min. in terms of spatial learning and memory function using a radial arm maze. The exposed rats made significantly more errors than sham exposed rats.

Adey (1991) goes a considerable way towards describing the mechanisms which underlie these changes in the brains of higher animals, including people. Dendritic cells in the brain, high levels of entrainment of ELF signals from RF/MW ELF modulated radiation, associated with changes in calcium ion concentrations and altered release and binding of neurohormones and neurotransmitters, such as GABA, serotonin and melatonin, have all been described and linked to EMR exposure.

Adey (1981) states that there is **"unequivocal experimental evidence that fields from ELF to UHF (10 Hz -450 MHz) interact directly with brain tissue"**. Some of the evidence for this is summarised in Table 3.

Table 3: Identified tissue level electric field gradients to which living species are responsive, Adey (1992).

Organism	Function	Tissue Gradient	Imposed Field
Sharks and rays	Navigation and predation	$10^{-8} \text{ V/cm}$	DC to 10 Hz
Birds	Navigation	$10^{-7} \text{ V/cm}$	0.3 G
Birds	Circadian rhythms	$10^{-7} \text{ V/cm}$	10 Hz, 2.5 V/m
Monkeys	Subjective time estimations	$10^{-7} \text{ V/cm}$	7 Hz, 10 V/m
Man	Circadian rhythms	$10^{-7} \text{ V/cm}$	10 Hz, 2.5 V/m
<u>Comparison with Intrinsic Cell and tissue Neurochemical Gradients</u>			
	Membrane Potential	$10^5 \text{ V/cm}$	
	Synaptic Potential	$10^3 \text{ V/cm}$	
	Electroencephalogram	$10^{-1} \text{ V/cm}$	

ELF fields in the order of  $10^{-7} \text{ V/cm}$  are used in orientation, navigation and prey attack in marine vertebrates, in bird navigation and in mammalian biorhythms. Similar ELF fields modify calcium binding in cat and chick cerebral tissue. At higher tissue gradients around

0.1 V/cm induced by RF fields with low-frequency modulation, there are alterations in “spontaneous” ELF fields potentials in EEG wave trains evoked as conditional responses, and in the release of calcium from cerebral tissue.

Dr Adey remarks that **“a striking feature of some of these observed interactions with weak radio-frequency (RF) fields is their relationship to the modulation frequencies in the ELF range and not to the radio carrier frequency.”**

This clearly demonstrates an athermal effect, an effect which is related to the modulation frequency and not to the intensity or frequency of the RF carrier. This data shows that biological systems involving the brain are sensitive to and reactive to induced field tissue gradients at far lower levels than assumed limitations imposed by the Membrane Potential and the Synaptic Potential, and well below field strengths associated with the EEG.

Just because effects are found in animals some claim that it does not necessarily apply to people. Cells and organs of mammals are highly similar to the cells of human beings, who are also mammals. Many toxic substances are tested on animals and the results are applied to people. In the case of EMR the reluctance to apply results shown in animal experiments to people as often related to a strong desire not to agree that there affects from commercially and militarily important technology. When it comes to the question of public health, these sectorial interests should not prevail. However, a strong reason why they should not prevail is also that the effects have also been found in people.

## **7. EMR induced EEG changes in humans:**

Are these effects found in humans? Two papers known to the author show EMR alteration of the human EEG. The first, Von Klitzing (1995) shows dominantly EEG delta to alpha rhythm change when exposed to GSM signal. The second shows sleep and EEG change with GSM phone exposure.

### **7.1 Human EEG delta to alpha when GSM exposed:**

Von Klitzing (1995) shows the same result, alpha enhancement and slow wave suppression in human subjects exposed to a GSM cell-phone like signal with an SAR of 0.001 W/kg ( $S = 0.7\mu\text{W}/\text{cm}^2$ ), (from Eq. 8 using  $\sigma=0.77$  S/m) and a pulse frequency of 217 Hz. The power spectrum of one of the subjects is shown in Figure 26. Von Klitzing’s paper presents an example of the 45 experiments from 17 students tested. Around 70 % of the students showed significant alteration in their EEG at these very low exposure levels.

The human subjects react much more quickly than the rat and rabbit subjects. Not all human being show this sensitivity. The author underwent the exposure and EEG test and showed no significant difference between the exposure and unexposed periods. He therefore joins the 30 % who show no effects.

### **7.2 Cell phone signal alters sleep EEG:**

Healthy people sleeping with a digital GSM cell phone on next to the bed, exposing their heads to about  $50\mu\text{W}/\text{cm}^2$  while their brain EEG was being monitored, Mann and Roschke (1996). This revealed a statistically significant disruption of alpha EEG frequency range and REM sleep. REM sleep decreased from 17.07 % to 13.91 %, which is significant at

$p < 0.05$ . In addition subjects went to sleep faster, a hypnotic effect also reported by Reite et al. (1994) who used a signal of 27.12 MHz modulated at 42.7 Hz.

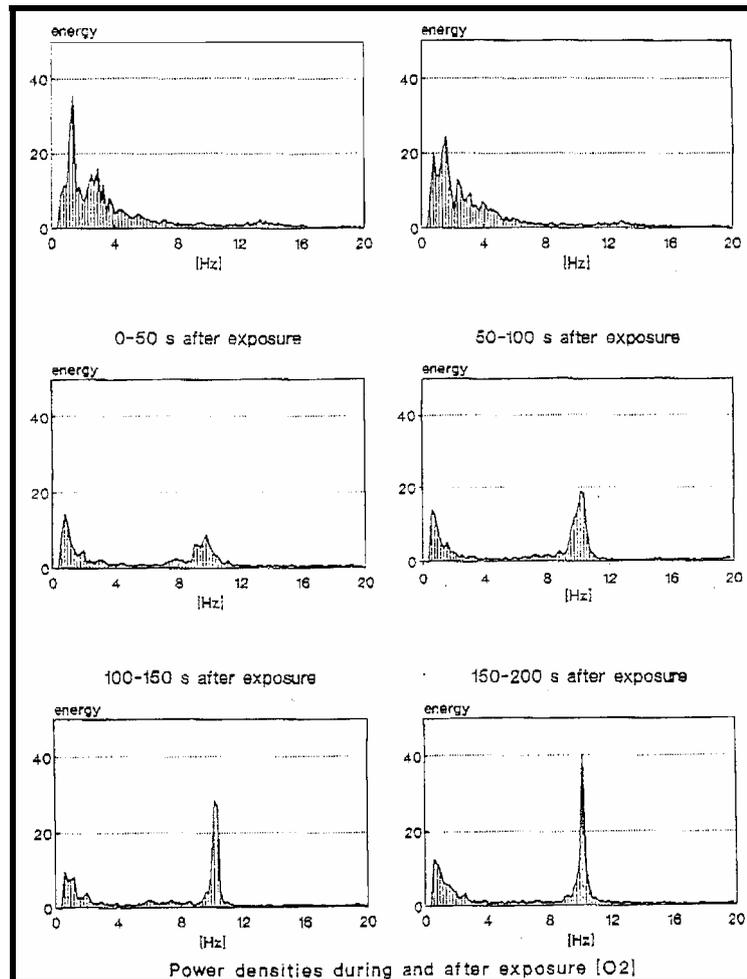


Figure 26: Human Alpha-EEG (O2-position) is altered by pulsed electromagnetic fields following first exposure, Von Klitzing (1995).

Mann and Roschke (1996) exposed 14 healthy, non-smoking, non-drinking, 21-34 year old male volunteers to 900 MHz, pulsed at 217 Hz with a pulse width of 580  $\mu\text{s}$ , digital GSM signal with a resultant average power density at the head of 50  $\mu\text{W}/\text{cm}^2$ . They concluded that:

**“Besides a hypnotic effect with shortening of sleep onset latency, a REM suppressive effect with reduction of duration and percentage of REM sleep was found. Moreover, spectral analysis revealed quantitative alterations of the EEG signal during REM sleep with an increased spectral power density. Knowing the relevance of REM sleep for adequate information processing in the brain, especially concerning the mnemonic functions [Memory functions] and learning processes, the results emphasize the necessity to carry out further investigations on the action of this type of electromagnetic fields and the human organism.”**

The results are summarized in Figure 27.

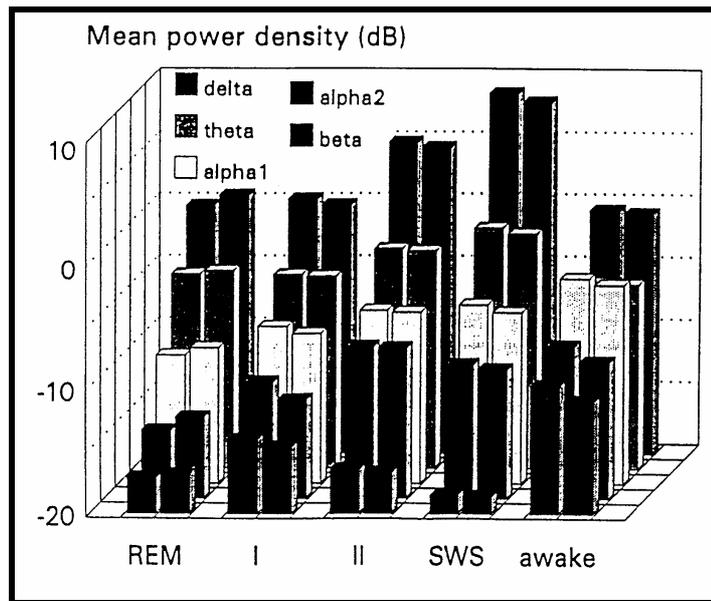


Figure 27: Mean power density (dB) of the averages of different sleep stages in 12 subjects averaged, left columns without field and right columns with GSM digital field of  $50 \mu\text{W}/\text{cm}^2$ .

Reite et al. (1994) also found an hypnotic effect when a 27.12 MHz signal, modulated at 42.7 Hz as applied over a 15 min. period. Exposed subjects reached a deeper state of sleep than sham exposed subjects.

The GSM exposed subjects also reported having fewer “bad dreams”. This is consistent with reduced melatonin. Post sleep subjective surveys found non-significant changes with GSM exposure such as reduced sleep quality, number of wakings. Post waking increased calmness and alertness, along side decreased concentration and increased anxiety. These latter two are frequently associated with increased daytime serotonin. The authors relate REM sleep impairment to memory and learning processes. Recently large numbers of cell phone users have been reporting headache, loss of concentration and memory impairment. This is consistent with these results.

Hence human studies, as with the animal studies above, shows that EMR from pulsed microwaves, including a cell phone signal, induces alterations in the human EEG in awake people, Von Klitzing (1995) and in sleeping people, Mann and Roschke (1996). Earlier German observations found that extremely low levels of EMR altered the reaction times and circadian rhythms of people. This suggests that there could be memory, and learning impairment in humans exposed to low level EMR.

## 8. Studies showing learning difficulties with EMR exposure:

Sound REM sleep is necessary for learning, memory and wellbeing. Any studies associating learning difficulties with EMR exposure would strengthen this association and the evidence of likely melatonin reduction and sleep disruption.

Three published papers or reports identify such effects:

- Chiang et al. (1989) found that visual reaction time, a measure of the function of the visual receptor and the central nervous system, varied with microwave exposure of children up to  $4 \mu\text{W}/\text{cm}^2$ . Children exposed to over  $10 \mu\text{W}/\text{cm}^2$  had lower scores in the

memory function test. They concluded “the data indicate that chronic exposure to EMFs are associated with significant changes in some physiological parameters.”

- Altpeter et al. (1995) showed a statistically significant delay in promotion from primary to secondary school in the more highly exposed school compared to a low exposure school, OR= 0.63, 95% CI: 0.43-0.85,  $p < 0.005$ . This involved short-wave radio exposure. The daily mean exposures in the highly exposed group were in the range 0.031 to  $9.1 \mu\text{W}/\text{cm}^2$ , median  $0.1 \mu\text{W}/\text{cm}^2$  and mean  $0.24 \mu\text{W}/\text{cm}^2$ .
- Kolodynski and Kolodynska (1996) investigated the effects of a RLS radar in Latvia, radiating at 154-162 MHz and pulsed at 24.4 Hz, on the performance of school children living several km in front of the radar compared to children living behind the radar. They concluded that “Motor function, memory and attention significantly differed between exposed and control groups. Children living in front of the RLS had less developed memory and attention, their reaction time was slower and their neuromuscular apparatus endurance was decreased.” Assuming that the closest child lived 2km in front of the radar, the maximum mean measured exposure is in the  $0.16 \mu\text{W}/\text{cm}^2$ .

Hence there is evidence from a wide range of RF/MW frequencies, at public exposure levels of around  $0.1 \mu\text{W}/\text{cm}^2$  and less, of learning, memory, sleep and physical performance of children; sleep disruption, aches, pains and chronic fatigue in adults. All of these symptoms are consistent with the hypothesis that RF/MW reduces nocturnal melatonin with consequent psychological and physical impairment.

## **9. Human Reactions to Atmospheric EMR/EMF changes:**

Thus the German work in the 1960's and 1970's established that naturally occurring EMR and EMF at extremely low levels influenced and altered sleep, circadian rhythm and reaction times. Later German work showed the cell phone and cellphone-like signals alter the human EEG and interfere with REM sleep. Impairment of REM sleep is associated with memory and learning difficulties. The Swiss research (Schwarzenburg Study) found a causal relationship between sleep disturbance and subsequent chronic fatigue, and short-wave radio exposures at extremely low mean levels.

### **9.1 Conclusions - EEG, Learning and EMR:**

These recent studies show unequivocal evidence that low level modulated and pulsed RF/MW signals, including GSM digital signals, alter the human EEG and affect the state of sleep in ways which interfere with information processing and learning. This confirms a neurological basis for the observed impairment of children's learning in Switzerland, Latvia and China.

Hence, far from being isolated examples, as this report brings together multiple studies showing adverse alterations of human EEG, learning, memory, reaction times, sleep efficiency in humans which has also been demonstrated in animals. In rabbits, Dumanskiy and Shandala (1974) and Shandala et al. (1979); and in cats, Bawin et al. (1973). Studies on altered reaction times and circadian rhythms in humans and animals are linked to EEG changes, Adey (1981).

These alterations are consistent with the calcium ion and melatonin effects, both of which also point to increased risks of cancer.

## 10. Cancer results from EMR/EMF

Evidence here shows that RF/MW and ELF are carcinogenic at the cellular level, increase tumours in animals with chronic exposure and increase the incidence of cancer in human populations. Leukaemia and brain tumor are commonly associated with EMR, but cancers of almost all organs have been associated.

### 10.1 The cell membrane is the primary site of many EMR interactions:

Adey (1990) reviewed the evidence for nonlinear cell membrane transductive coupling and concluded:

“We have reviewed event that couple chemical stimuli from the cell surface receptor sites to the interior. Weak imposed electromagnetic fields with low-frequency components (typically in the spectrum below 100 Hz) have proved unique tools in identifying the sequence and energetics in these events. Cell membranes are primary sites of interactions with these fields. recent observations have opened doors to new concepts of communication between cells as they whisper together across barriers of cell membranes. regulation of cell surface chemical events indicates a major amplification of initial weak triggers associated with binding of hormones, antibodies and neurotransmitters to their specific binding sites. Calcium ions play a key role in this stimulus amplification. The evidence supports nonlinear, nonequilibrium processes at critical steps in transmembrane coupling.”

“Communication between cells through gap junctions is also sensitive to low-frequency electromagnetic fields at athermal intensities. We hypothesize that cancer promotion may involve dysfunctions at cell membranes, disrupting inward and outward signal streams.”

“There is evidence that these fields may participate in the promotion phase of carcinogenesis by at least two mechanisms: through effects on immune responses and by direct effects on mechanisms regulating cell growth.”

### 10.2 Cancer and Cell Death are closely linked at the cellular level:

The cellular processes which have the potential to lead to cancer (neoplastic transformation) and to cell death (apoptosis) are very tightly related in terms of the factors which regulate cell growth and development. Apoptosis (programmed cell death) is a pathway of cell death characterized by internucleosomal digestion of the genomic DNA, Balcer-Kubiczek (1994). Neoplastic transformation involves the alteration of the genomic DNA, particularly involving certain genes which appear to suppress programmed cell death; these include the *bcl-2* oncogene, over-expression of *c-myc*, *c-ras*, *c-fos* and *c-jun*, ornithine decarboxylase (ODC) genes or reproduction of the wild-type *p53* tumor suppresser gene. DNA fragmentation can be induced in mammalian cells by a wide variety of stimuli, including cytotoxic, carcinogenic and anticarcinogenic agents. Among other factors, it can be overcome by an elevation of intracellular calcium. It can also be overcome by phorbol esters with tumor-promoting activity, such as TPA (12-O-tetradecanoyl-phorbol-13-acetate).

Low concentrations of TPA have been shown to switch the effect of calcium elevation from cell death to cell proliferation, Kizaki et al. (1989), probably by activation of protein kinase C, McConkey et al. (1988). Hence the calcium ion concentrations inside the cell are a central factor in influencing whether the damaged cell dies by Apoptosis or survives with altered

genetic structure which enhances cell proliferation and hence is neoplastic and potentially tumor forming.

One of the strongest and most repeated effects seen in brains, hearts and muscles of exposure to ELF and RF/MW with ELF modulations, is calcium ion efflux, e.g. Blackman et al. (1981), Adey et al. (1982), and Schwartz et al. (1990). Hence the many experiments which have found statistically significant efflux of calcium ions from cells in EMR exposed organs, which couples with the cellular understanding of the role of calcium in influencing the future of a damaged cell, whether it dies or survives to potentially produce a tumor, provides a clear mechanism for the role of low intensity EMR in promoting cell death and cancer. In most organs the desired outcome is enhancing cell death since damaged cell are removed this way. However, in the brain accelerated cell death is associated with neurodegenerative illnesses and premature senility.

Lai and Singh (1997) found increased DNA damage and enhanced cell death in the brains of living rats exposed to low level pulsed microwaves.

Balcer-Kubiczek (1994) states “In 1985 we published the first evidence of EMF carcinogenesis at the cellular level.”, referring to Balcer-Kubiczek and Harrison (1985). They used the standard cell line C3H/10T1/2 samples exposed to 2.45 GHz microwaves for 24 hours, then treated with 0.1 mg/ml of the cancer promoter TPA. One set of samples had no TPA, the remained had the TPA treatment and a range of microwave exposures for SARs of 0.1, 1.0 and 4.4 W/kg, Figure 28.

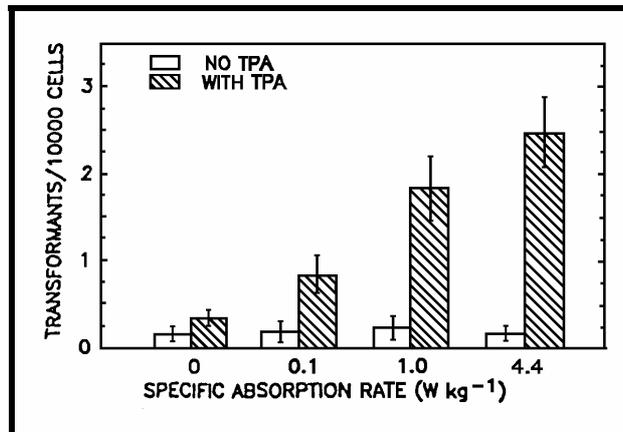


Figure 28: Dose-response relationship for the induction of neoplastic transformation in C3H/10T1/2 cells by a 24 hr exposure to 2.45 GHz microwaves modulated at 120 Hz, with and without post exposure treatment with TPA for 8 weeks, after Balcer-Kubiczek and Harrison (1985).

Balcer-Kubiczek (1994) states that “Our dose response data in terms of SAR for neoplastic effects provides evidence that the effect on tumor induction and development observed in a mouse skin model may operate at the cell level.”

The authors state that these results, and those of Szmigielski et al. (1982), are that **“2.45 GHz microwaves and 60-Hz magnetic fields, seem to act as an initiator or carcinogen, rather than as a promoter of malignant transformation.”**

Since genetic damage can lead to cancer, miscarriage, birth defects and health problem is future generations, evidence of DNA breakage and chromosome aberrations is crucial.

The first identified chromosome aberration study of non-thermal pulsed RF exposure was Heller and Teixeira-Pinto (1959). They concluded that the effects mimicked ionizing radiation and c-mitotic chemicals. More recently it has been shown that extremely significant DNA strand breakage was caused by cell phone radiation exposure to human cells,  $p < 0.0001$ , at a very low SAR level  $0.0024 \text{ W/kg}$ , Phillips et al. (1998). This followed pioneer work on direct DNA strand breakage observations using the Comet Assay by Lai and Singh (1995, 1996, 1997a,b,c).

Sagripani and Swicord (1986) showed that non-thermal levels of microwave exposure can produce single and double-strand DNA breaks in *E. coli* in solution.

Garaj-Vrhovac et al. (1991) showed that cultured V79 Chinese Hamster fibroblast cell exposed to continuous wave (CW) 7.7 GHz microwaves at power density of  $0.5 \text{ mW/cm}^2$  for 15, 30 and 60 min., kept at a constant temperature, produced a significantly high frequency of specific chromosome aberrations such as dicentric and ring chromosomes in irradiated cells. The dose-response relationships were significant at  $p < 0.01$ . They also observed increased cell Apoptosis.

Garaj-Vrhovac et al. (1992) exposed whole human blood samples to the same exposure regime. With the addition of power densities of 10 and  $30 \text{ mW/cm}^2$ . The number of chromosome aberrations increased from 1.5 % in controls to 2.7 to 7.2 % at the rising power densities. There was a statistically significant dose response with  $p < 0.05$  for total aberrations,  $p < 0.001$  for Acentric and  $p < 0.0001$  for micronuclei.

Nordenson et al. (1994) reported that their recent studies have shown a significant increase in the frequency of chromosomal aberrations in human amniotic cells after exposure to a sinusoidal 50 Hz,  $30 \mu\text{T}$  (rms) magnetic field. To evaluate further interactions between chromosomes and electromagnetic fields, they analyzed the effects of intermittent exposure. Amniotic cells were exposed for 72 h to a 50 Hz,  $30 \mu\text{T}$  (rms) magnetic field in a 15 s on and 15 s off fashion.

Eight experiments with cells from different fetuses were performed. The results show a 4% mean frequency of aberrations among exposed cells compared to 2% in sham-exposed cells. The difference is statistically significant, with  $P < 0.05$  both excluding and including gaps. In another series of eight experiments, the cells were exposed in the same way but with the field on for 2 s and off for 20 s. Also in these experiments a similar increase in the frequency of chromosomal aberrations was seen, but only when the analysis included gaps. Continuous exposure for 72 h to  $300 \mu\text{T}$ , 50 Hz, did not increase the frequency of chromosomal aberrations.

By 2002 I have identified over 20 studies showing that ELF exposures are genotoxic and over 50 studies showing that RF/MW are genotoxic, many at low exposure or isothermal levels showing that the mechanism is not thermal nor electric shocks with high induced currents as assumed originally by western scientists.

### **10.3 In vivo animal experiment results:**

Lai and Singh (1997a) used a highly sensitive microgel electrophoresis, COMET assay technique to identify single strand DNA breaks, Figure 27, and double strand DNA breaks,

Figure 28, from 2hr exposure to 0.1 mT and 0.25 mT 60 Hz magnetic fields in living rat brains.

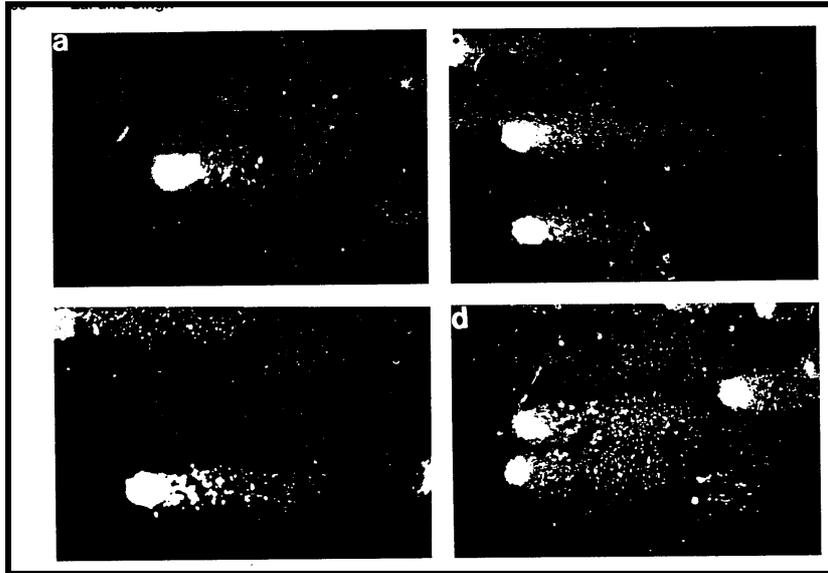


Figure 29: Photographs of single-strand DNA migration pattern of individual brain cells from rats exposed to (a) a bucking condition (0.1mT), magnetic fields of (b) 0.1 mT, (c) a 0.25 mT and (d) 0.5 mT. (x 400).

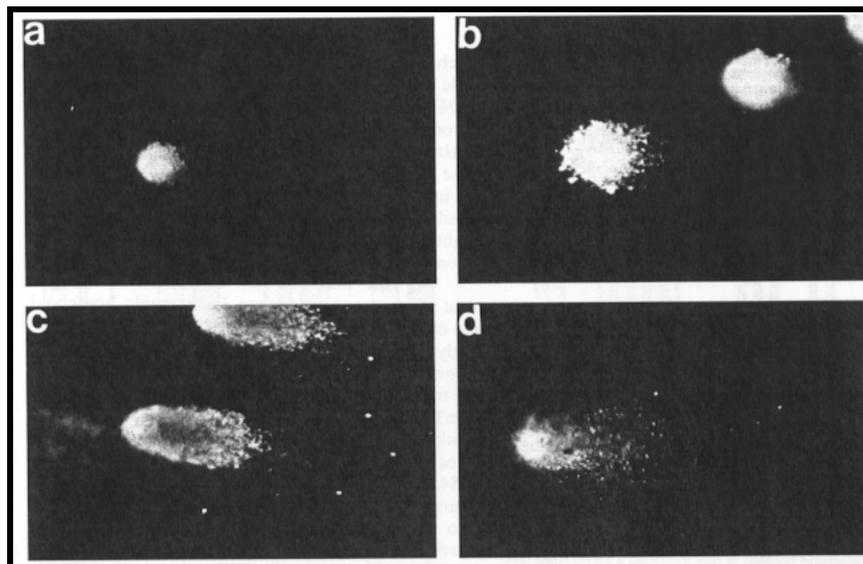


Figure 30: Photographs (expanded x 400) of double-strand DNA migration pattern of individual brain cells from rats exposed to (a) a bucking condition (0.1mT), magnetic fields of (b) 0.1 mT, (c) a 0.25 mT and (d) 0.5 mT.

Lai and Singh (1997a) conclude:

**“Because DNA strand breaks may affect cellular functions, lead to carcinogenicity and cell death, and be related to the onset of degenerative diseases, our data may have important implications for possible health effects of exposure to 60 Hz magnetic fields.”**

Lai and Singh (1997b) investigated the effect of melatonin and a spin trap compound (PBN) both of which scavenge free radicals. They found that rats injected with melatonin or PBN

before ELF field exposure and 2 hours after exposure. Both of these treatments blocked the magnetic field induced DNA single- and double-strand breaks.

Lai and Singh (1997b) conclude:

**“Since melatonin and PBN are efficient free radical scavengers, these data suggest that free radicals may play a role in magnetic field-induced DNA damage.”**

Lai and Singh further state that both melatonin and PBN can have other actions on cells in the brain that can prevent DNA damage therefore further support for their hypothesis can be obtained by studying whether other free radical scavenging compounds also block the effect of magnetic fields.

Timchenko and Ianchevskaia (1995) concluded that an electromagnetic field (EMF) at a frequency of 24 or 14 MHz and intensity of 400 or 200 V/m, increases numbers of hepatocytes from rats with chromosomal aberrations 1.4-1.5-fold.

#### **10.4 Human studies of chromosome aberrations with EMR exposure:**

Ciccone et al. (1993) conducted a case control study of 50 acute myeloid leukemias (AML), 17 chronic myeloid leukemias (CML), 19 myelodysplastic syndromes (MDS), and 246 controls. The chromosome aberrations were recorded according to the International System for Human Cytogenetic Nomenclature. Chromosome aberrations were not associated with chemical exposures (OR = 1.0), but a non-statistically significant excess was noted in association with electromagnetic fields (OR = 2.1).

Valjus et al. (1993) sampled for chromosomal aberrations, sister chromatid exchanges (SCEs), replication indices and micronuclei in peripheral blood lymphocytes among 27 nonsmoking power linesmen with considerable long-term exposure to 50-Hz EM fields, and among 27 nonsmoking telephone linesmen serving as a reference group, pairwise matched with the exposed workers for age and geographical region. Blood samples from the two groups were collected, cultured and analyzed in parallel. No differences between the groups were observed on analysis of SCEs, replication indices or micronuclei. However, the mean rate of lymphocytes with chromatid-type breaks was higher among the power linesmen (0.96% gaps excluded, 1.41% gaps included) than among the reference group (0.44% and 0.70%, respectively). The excess of aberrant cells was concentrated among those power linesmen who had worked earlier in their life. Although the interpretation is somewhat complicated by the confounding effect of previous smoking, these results suggest that exposure to 50-Hz EM fields is associated with a slight increase in chromatid breaks.

Skyberg et al. (1993) studied 13 high-voltage laboratory employees and 20 referents participated in a cross-sectional, matched-pairs study of cytogenetic damage. During cable testing the workers were exposed to static, alternating, or pulsed electric and magnetic fields. The alternating magnetic field levels of 50 Hz were 5-10  $\mu$ T, occasionally much higher. Chromosome aberrations, sister chromatid exchanges, and aneuploidy were studied in peripheral blood lymphocytes. Among seven smoking laboratory employees the mean number of chromosome breaks/200 cells was 2.3, as compared with 0.7 for the job-matched referents. The comparable figures for inhibited cultures were 12.0 versus 6.0. No increase was detected in nonsmokers with either method. The results support, to some

extent, the hypothesis of an increased risk of genotoxic effects among high-voltage laboratory workers, particularly a synergistic effect with smoking.

Garson et al. (1991) studied 38 Australia Telecom radio-linesmen who had been exposed to RF EMR in their work and compared the chromosome damage in lymphocytes compared 38 non-exposed clerical staff. A very detailed assay of chromatid and chromosome gaps and breaks and other aberrations was carried out. Most categories showed a small but statistically insignificant increase in chromosome aberrations, with the sum of aberrations of 2.55% for linemen and 2.18% for controls (RR= 1.17, 95%CI: 0.9-1.6).

For Chromatid Gaps RR=1.2 (0.7-2.1); Chromosome Gaps: RR = 1.5 (0.6-3.5); and Chromosome Breaks (without outlier) 1.4 (0.8-2.3). Adjusting for confounding from recent X-rays and for smoking both produced a small increase in Rate Ratio. The absence of adjusting for coffee drinking is a limitation. Such an adjustment would be likely to favour reduction in the incidence among clerical workers, further increasing the Rate Ratio. The incidence of total chromosome aberrations among the controls does appear rather high.

Is chromosome damage in people evidence of an increased risk of cancer. Hagmar et al. (1994) trichotomize CA into the low (1-33%ile), medium (34-66%ile) and high (67-100%ile). The threshold for low CA is typically 1.0% but in the range 0.5 to 1.5 %, while medium is typically 1.0 to 2.0 %, and high >2 %, but may use a threshold between medium and high of 3 %. They concluded that there was a statistically significant linear trend (P=0.0009) in chromosome aberration strata with regards to subsequent cancer risk.

In addition to Hagmar et al. (1994), other studies finding increased subsequent cancer from earlier measured chromosome aberrations include Nordenson, et al. (1984), Nuzzo and Stefanini (1989), Sorsa et al. (1990), Brogger et al. (1990), Sorsa et al. (1992) and Bonassi et al. (1995).

Taking the typical classification the Australia Telecom study as both exposed and control groups in the high category. If the control group was in the "low" category  $\leq 1\%$ , then the Rate Ratio for the clerical staff would be 2.2 and for the linemen 2.6, both of which are significant ( $p < 0.01$ ) and, according to Hagmar et al. (1994), both have increased cancer risk.

There are multiple studies and hence strong evidence that RF/MW exposure increases chromosome aberrations in humans with a subsequent increase in cancer risk.

Garaj-Vrhovac and Fucic (1993) provide another important aspect to this data. Many factors cause chromosome aberration and repairs are being carried out all the time. The cancer risk occurs because not all chromosomes are repaired and mutated cells persist and tumors grow from them. The pulsed microwave exposure of a group of radar station personnel offered the opportunity to study the recovery rate of chromosome aberrations for 30 days after exposure was ceased. Hence this study gives more evidence that RF breaks chromosomes in humans, and shows the rate of recovery through repair. The most affected person is shown in Figure 31.

The recovery rate is very close to linear and the chromosome damage falls to 10% of the original damage in 28.6 weeks, dropping from 33% to 3.5% after 30 weeks, with a tendency for the repair rate to slow suggesting a more exponential recovery rate. For this person the typical daily recovery rate was 0.14% /day.

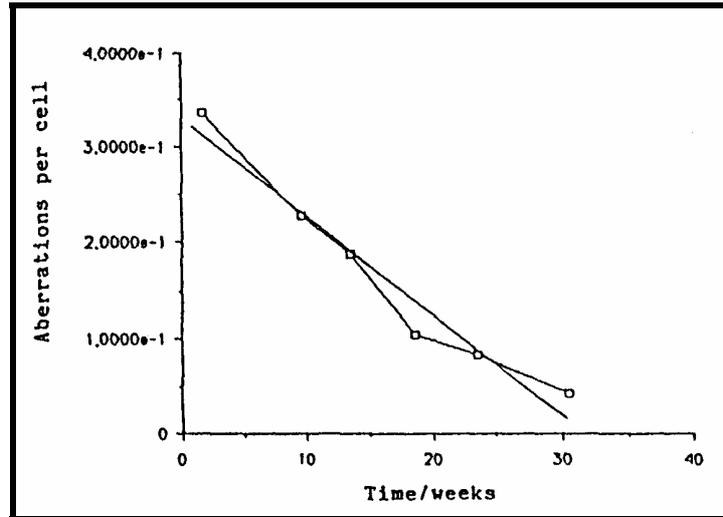


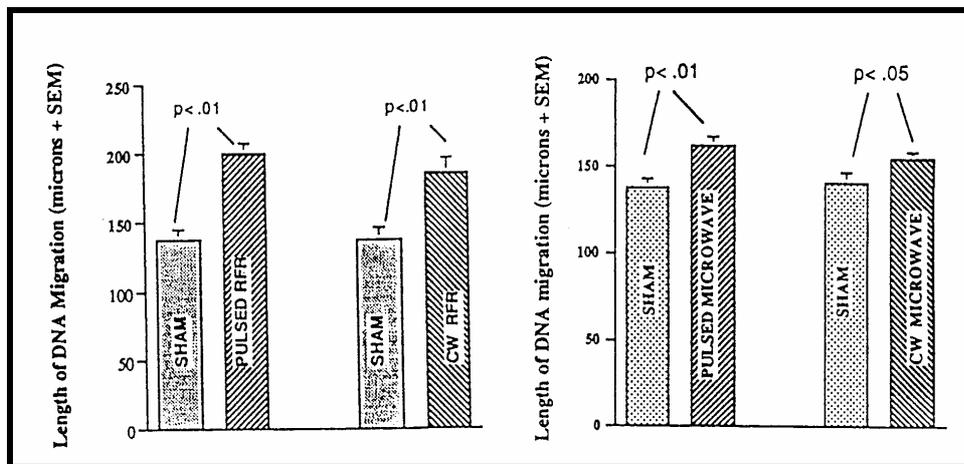
Figure 31: The time-dependent decrease in the number of chromosome aberrations for the subject with extremely high numbers of chromosome impairments,  $y = 0.318 - 0.010x$ ,  $R = 0.98$ .

For two others with lower damaged chromosome rates it was 0.08 and 0.03%/day. Hence daily repair rates are low, suggesting continuing exposure can easily lead to a build up of chromosome damage and an increased risk of cancer.

### 10.5 DNA breakage associated with RF/MW exposure:

Sarkar et al. (1994) found significant modification of the DNA from mouse cells from brain and testes exposed to  $1 \text{ mW/cm}^2$  2.45 GHz microwaves for 2 hr/day for 120, 150 and 200 days.

Lai and Singh (1995) exposed living rats brains to a single 2 h exposure to microwaves at 2.45 GHz, pulsed at 500 pps, at SARs of 0, 0.6 and 1.2 W/kg. They found significant dose-response relationships for single strand DNA breaks in an assay carried out 4 hours after exposure for both the hippocampus and the rest of the brain

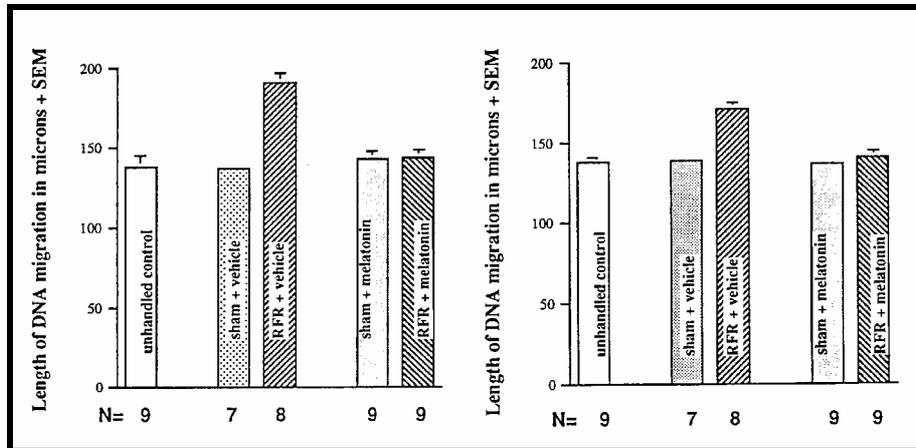


(a) Single strand breaks

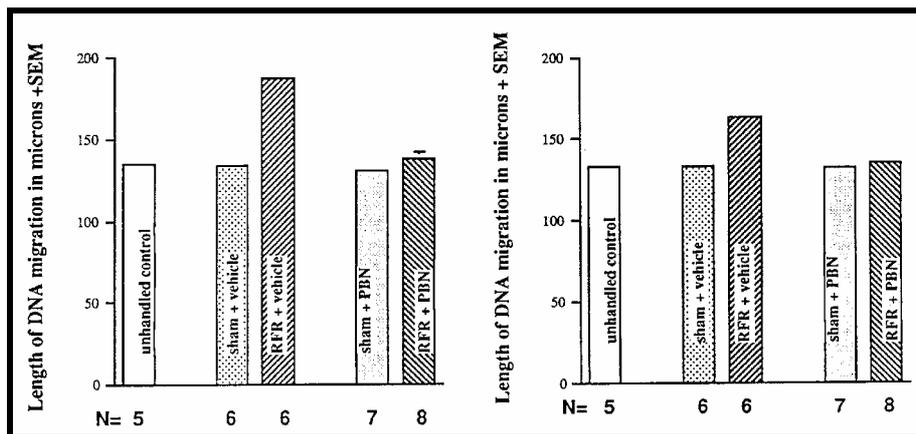
(b) Double strand Breaks

Figure 32: DNA breakage in rat brains (SAR = 1.2 W/kg), Lai and Singh (1996).

A second analysis involved assaying the whole brain and continuous wave microwaves at 2.45 GHz and 1.2 W/kg. This showed a statistically significant increase in single-strand DNA breaks between sham and exposed ( $p < 0.01$ ) but no significant difference between assays at 0 h and 4 h after exposure.



(a) Single strand DNA breakage. (b) Double-strand DNA breakage.  
Figure 33: Effect of melatonin on RF/MW induced DNA breakage, Lai and Singh (1997c).



(a) Single strand DNA breakage. (b) Double-strand DNA breakage.  
Figure 34: Effect of PBN (spin-trap compound) on RF/MW induced DNA breakage, Lai and Singh (1997c).

Lai and Singh (1996) repeated the experiment of Lai and Singh (1995) and extended the analysis to include and assay of double-strand DNA breaks and included both pulsed (500 pps) and continuous microwaves at 2.45 GHz. The exposed condition was  $2\text{mW/cm}^2$  (SAR = 1.2 W/kg). Statistically significant single-strand DNA breaks were found for both the CW and pulsed signals ( $p < 0.01$ ), and for double-strand DNA breaks (pulsed  $p < 0.01$  and CW  $p < 0.05$ ). This data was not available for the MacIntyre Case.

Their most recent work, Lai and Singh (1997c), shows that in the exposed rats brains there is enhancement of free radicals and the acceleration of cell death (apoptosis), which is eliminated by melatonin. It is not yet known whether this is caused by the MW radiation influencing the pineal gland or the retina of the eyes, to reduce melatonin production and hence enhance free radical numbers, or whether the MW radiation produces free radicals locally in the brain.

The implications of this study are very important. The authors, Lai and Singh (1997c),

conclude:

**“Data from the present experiment confirm our previous find in a [Lai and Singh, 1995, 1996] that acute RFR exposure causes an increase in DNA single- and double-strand breaks in brain cells of the rat. In addition, we have found that the effect can be blocked by treating the animals with melatonin or PBN. Since a common property of melatonin and spin-trap compounds is that they are efficient free radical scavengers [Carney and Floyd, 1991; Carney et al., 1991; Floyd, 1991; Lafon-Cazal et al., 1993 a,b; Lai et al., 1986; Oliver et al., 1990; Reiter et al., 1995; Sen et al., 1994; Zhao et al., 1994], these data suggest that free radicals may play a role in the RFR-induced DNA single- and double-strand breaks observed in brain cells of the rat. Consistent with this hypothesis is the fact that free radicals can cause damage to DNA and other macromolecules in cells. Particularly, oxygen free radicals have been shown to cause DNA strand breaks [McCord and Fridovich, 1978]. In addition, a study has implicated free radicals as the cause of some of the biological effects observed after exposure to RFR. Phelan et al. [1992] reported that RFR can interact with melanin containing cells and lead to changes in membrane fluidity consistent with a free radical effect.**

**If free radicals are involved in the RFR-induced DNA strand breaks in brain cells, results from the present study could have an important implication on the health effects of RFR exposure. Involvement of free radicals in human diseases, such as cancer and atherosclerosis, have been suggested. Free radicals also play an important role in aging processes [Reiter, 1995]. Aging has been ascribed to accumulated oxidative damage to body tissues [Forster et al., 1996; Sohal and Weindruch, 1996, and involvement of free radicals in neurodegenerative diseases, such as Alzheimer's, Huntington's, and Parkinson's, has also been suggested [Borlongan et al., 1996; Owen et al., 1996]. Furthermore, the effect of free radicals can depend on the nutritional status of an individual, e.g., availability of dietary antioxidants [Aruoma, 1994], consumption of ethanol [Kurose et al., 1996], and dietary restriction [Wachsman, 1996]. Various life conditions, such as psychological stress [Haque et al., 1994] and strenuous physical exercise [Clarkson, 1995], have been shown to increase oxidative stress and enhance the effect of free radicals in the body. Thus, one can speculate that some individuals may be more susceptible to the effects of RFR exposure.**

**However, it must be pointed out that both melatonin and PBN can have other actions on cells in the brain that can decrease DNA damage. Further support for our hypothesis can be obtained by studying whether other compounds with free radical scavenging properties can similarly block the effect of RFR, and by measurement of other free radical-related cellular effects, such as oxidative molecular damages in lipids, protein, and DNA.”**

This is also relevant to the study carried out by Adey et al. (1996) in which rats exposed to cellphone-like signals had 30 % fewer tumours than controls and the tumours were statistically significantly smaller. These results were reported to the 1996 BEMS conference in Victoria BC. Dr Singh raised the question with Dr Adey, of the possibility of cell death as an explanation for the result. Dr Adey agreed that this was possible, but stated that it

needed to be tested. Garaj-Vrhovac et al. (1991) and Lai and Singh (1997c) have found that result.

It has been shown that a sub-thermal dose of microwaves (0.6 W/kg and 1.2 W/kg) can enhance DNA breakage and accelerate the cell death (apoptosis) in living brains, through the increased production of free radicals. This is associated with a reduction in melatonin. With enhanced rate of cell death tumour cells can die at a faster rate than they grow, producing fewer and smaller tumours.

All of these above experiments were carried out without the use of cancer initiators nor co-carcinogens. They involve the direct application of RF/MW radiation to a sample or an animal and the observation of chromosome breakage, DNA breakage, tumours, free radicals and cell death. Hence they confirm the proposal of Reiter (1994) in section 4.1, that EMR would be both an initiator and promoter of cancer, in his case through melatonin reduction, in this case through direct observation of DNA damage which might involve melatonin reduction since free radicals are observed to be enhanced.

## **10.6 Conclusions on Mutagenic effects of EMR:**

DNA damage is shown by Chromosome Aberrations, Micronuclei Formation, DNA strand breakage, enhanced oncogene activity, neoplastic cell transformation. DNA damage has been found under non-thermal exposure to EMR in many independent studies. ELF and ELF modulated RF have been associated with chromosome aberration and micronuclei formation in cells and in exposed workers. Microwaves have been shown to produce DNA damage in living rats brains. Hence EMR is implicated in increasing cancer rates in exposed populations, Hagmar et al. (1994).

Increased cancer incidence can come about by the direct effect of a DNA damaging carcinogen or by the synergistic effect of co-carcinogens. The co-carcinogenic effect and cancer promotional effect of EMR has been widely suggested and demonstrated through a number of experiments, e.g. Adey (1992b), Byus et al. (1988). Direct effects (in the absence of a cancer initiator) include chromosome aberrations and DNA breakage which is most likely to be the result of the enhanced presence of free radicals in the RF/MW field. The role of melatonin is important here. Direct effects are likely to involve higher mean power densities than co-carcinogenic effects. In Lai and Singh (1995) the inter-animal variability is very small giving a small standard deviation for each exposure group. Even so a linear the dose-response relationship is statistically significant for the "rest of the brain" assayed 4 h after exposure ceased. This suggests that the smallest detectable increase in DNA breakage would be associated, with this small sample size, with an SAR of  $<0.2 \text{ W/kg}$ ,  $\sigma = 1.7$ ,  $S < 62 \mu\text{W/cm}^2$ .

Many early studies showing that microwaves caused chromosome aberrations assumed that the mechanism was the heat effects. We now know from many multiple independent published studies that DNA damage occurs at non-thermal and isothermal exposure levels. The lowest reported DNA damage from cellphone radiation ( $p < 0.0001$ ) was provided by Phillips et al. (1998). Two SAR exposures were in the range  $0.0024 \text{ W/kg}$  to  $0.026 \text{ W/kg}$ . These are equivalent to  $1.2$  to  $13 \mu\text{W/cm}^2$  for microwaves at  $813$  to  $837 \text{ MHz}$  and human brain tissues. This study also showed significant ( $p < 0.0001$ ) DNA repair rates in these human brain cells. We now know that induce DNA repairs is caused by DNA damage and brain cancer cells have very strong repair mechanisms because they cannot be

regenerated and it's a vital organ. The time exposure reaction of brain cells to cellphone radiation caused DNA damage is shown by the data in Figure 2 of Malyapa et al. (1997).

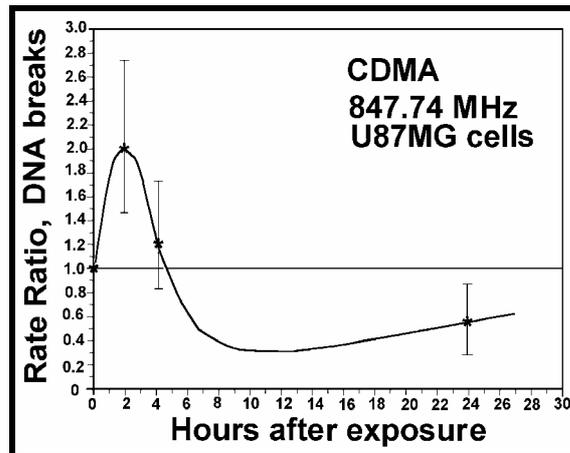


Figure 34a: DNA strand breakage Risk Ratio and 95% CI for the frequency distribution in Figure 2 Normalized Comet Moment of Malyapa et al. (1997).

Figure 34a clarifies the understating of the relationship of microwaves induced DNA damage with DNA repair.

## 11. Long-term Animal Studies:

A small number of long-term animal studies involving RF/MW exposure have been carried out, largely because of their extreme difficulty and very high cost. Balode (1996)

### 11.1 University of California, Berkeley:

Professor Charles Susskind and Dr Susan Prausnitz, Dept of Electrical Engineering, UC Berkeley carried out the first reported long term study for the US Air Force, Prausnitz and Susskind (1962). They exposed male Swiss albino mice to 9.27 GHz microwaves, pulsed with a 2  $\mu$ s pulse at 500 Hz, 4.5 minutes per day, 5 days per week for 59 weeks with an exposure level of 0.10W/cm<sup>2</sup>. This amounts to a mean weekly exposure of 223 $\mu$ W/cm<sup>2</sup>.

Detailed autopsies were carried out on 60 irradiated and 40 control mice who died during the experiment. Two adverse effects were more severe in the exposed compared to the control animals.

- (1) Testicular degeneration (sterility, atrophy with no sperm) occurred in 40 % (23/57) of the exposed animals and 8.1 % (3/37) of the control animals.
- (2) Cancer of the white cells or leukemia was seen in 35 % (21/60) of the exposed animals compared to 10 % (4/40) of the controls. This condition was described as monocytic or lymphatic organ tumours or myeloid leukaemia in the circulating blood.

At the 16-month interim kill, one month after exposure ceased, 30 % (6/20) of the exposed group had leukemia compared to 10 % (1/10) of the controls.

At the final kill at 19-months, 4 months after cessation of exposure testicular atrophy was seen in 21% (14/67) of the exposed group and 5 % (1/19) of the control group, and

testicular weights were lower for the exposed group. At this stage leukosis was the same in both groups at 18 % (12/67) for the exposed group and 21 % (4/19) for the control group.

This gives an overall rate for testicular degeneration of 29.8% (39/124) for the exposed group and 7.1% (4/56) for the control group, giving a Rate Ratio of RR=4.2 . For leukosis the incidence was 26.5 % (39/147) for the exposed mice and 13.0% (9/69) for the control mice, RR = 2.04 .

Cairnie et al. (1980) exposed mice to microwaves at power density of 50 mW/cm<sup>2</sup>. They found that the absorbance in the abdomen area of the liver was 11 times greater than the testes, and while the abdomen temperature was increased the testicular temperature was not. This suggest that the 100mW/cm<sup>2</sup> exposure testicular degeneration could have been the genotoxic effect of microwaves rather than the temperature rise.

Leukosis (the initiation of leukaemia) requires damaged DNA and chromosome aberrations which are transferred from cell to cell through mutation. The same mechanism could cause testicular degeneration. An accumulated cellular level damage mechanism is not necessarily related to the intensity but can relate to total dose in relation to rates of repair. Hence the averaging of weekly exposure is a meaningful adverse effect related level. Actual public exposure levels of 0.2μW/cm<sup>2</sup> and less saw childhood leukaemia incidence and death rate rises at similar exposure levels (2.74 for mortality) in the North Sydney Study.

## 11.2 University of Washington Case Study:

Establishment of a potential adverse human health effect can be obtained from a suitably designed and executed animal experiment. Such an experiment was carried out at the University of Washington by Professor Arthur Guy and his associates, funded by the United State Air Force, Chou et al. (1992).

**Table 4: Crude incidence of neoplastic lesions (Tumours)**

Site/Type	Crude Tumor Incidence			
	Control		Exposed	
Adrenal Cortex	12/85	14.1 %	12/76	15.8 %
Adrenal medulla	1/73	1.4 %	7/67	10.4 %
Thyroid	9/85	10.6 %	12/76	15.8 %
Liver	1/85	1.2 %	3/76	3.9%
Pituitary	21/85	24.7 %	19/75	25.3 %
Testes	0/85	0 %	2/76	2.6 %
Epididymis	0/85	0 %	1/76	1.3 %
Pancreas	2/85	2.4 %	2/76	2.6 %
Urinary bladder	0/85	0 %	2/76	2.6 %
Stomach	4/85	4.7 %	4/76	5.3 %
Duodenum	0/85	0 %	1/76	1.3 %
Lymph node	0/85	0%	1/76	1.3 %
Soft Tissues, Thorax	0/85	0 %	2/76	2.6 %
Mesentery	0/85	0 %	2/76	2.6 %
Lymphosarcoma	3/85	3.5 %	4/76	5.3 %
Total	53/85	62.4 %	63/75	84.0%
	(RR=1.35, 95%CI: 1.11-1.63,p=0.0022)			

The exposed a large group of rats to pulsed radar-like microwaves, 2,450 MHz, pulsed at 800 pps, 10  $\mu$ s pulse, at <0.4 W/kg, the human exposure level allowable under the ANSI standard. These rats were compared to a similar group who were sham exposed. Guy found a total of 18 malignancies in the 100 exposed rats compared to 5 in the 100 sham exposed rats, a ratio of RR=3.6 (1.34-9.70), in particular there were 9 endocrine tumours in the exposed group compared to 2 (ratio RR=4.5 (1.0-20.8)) in the control group. On the other hand, the EPA review team worked with the original University of Washington research team, and undertook further detailed statistical analysis of their results and showed “a statistically significant elevation in the incidence of carcinomas at all sites combined.”

The experiment ran for 25 months with some mice being sacrificed and analyzed at 13 months. Their initial reports concluded no effects except a significant increase in the number of benign adrenal tumours. At 13 months the exposed group had a significantly larger number of B- and T-cells than do controls, but no difference was seen at the end of 25 months. This suggests the immune system was initially disrupted, but over a 2 year period it adapted to the exposure situation. Disturbance of the immune system is also consistent with the developing cancer and tumours growth.

These results were worrying to EPA researchers. Dr Robert McGaughy asked Dr Lawrence Kunz, the pathologist on the University of Washington study, for copies of the survival and histopathologic findings. Dr McGaughy was able to show that three statistical tests showed a statistically significant increase in carcinomas ( $P < 0.05$ ) but no statistically significant increase in sarcomas. These results are listed in Table 13.

The EPA team argue that while most chemical carcinogens affect only one or a few tissues, the distribution of the EM field as a “toxic agent” is more uniform than a “typical” chemical agent, and therefore an “all sites” approach is justified..

McGaughy et al. (1990) point to the more ubiquitous action of melatonin as an example, since,

**“Nocturnal pineal melatonin activity is known to be inhibited by ELF electric fields (Wilson et al 1986) and that the pineal gland function is closely coupled to the function of other glands. Melatonin is known to inhibit tumour growth-enhancing hormones like prolactin and estrogen. The postulate has been made that when the blood melatonin concentration decreases because of the action of EM fields on the pineal gland, a tumour growth inhibitor has been reduce or effectively removed, thereby causing a stimulation of tumour growth.**

**Although only breast and prostate tumours have been discussed in this connection, the same regulation by melatonin might hold for other hormonally-regulated endocrine organs as well.”**

<p><b>The Guy et al. (1985) study, along with other supporting material, led to the recommendation that the US EPA classify RF/MW as a possible human carcinogen (Class C).</b></p>
---

The data presented in this report indicate the progressively strengthening evidence of carcinogenicity and other adverse health effects from chronic non-thermal exposure to RF/MW radiation which raise the evidence to classify RF/MW radiation as a highly probable (Class B1) carcinogen.

Note: All you need in New Zealand Law is evidence of a potential irreversible adverse environmental effect to decline this application and to recommend the identification of a site in a less sensitive receiving environment, or a potential adverse effect to require mitigation or remediation.

### 11.3 Polish Study:

Szmigielski et al. (1982) measured the effects of 2.45 GHz microwave radiation at 5, 10 and/or 15 mW/cm<sup>2</sup>, 2h /day, 6 times/week exposure (average weekly exposure 360, 520 and 1,100 μW/cm<sup>2</sup>), mice able to maintain core temperature under both exposures, specifically investigating lung cancer, breast cancer and skin cancer. Figure 32 shows the result of initiating skin tumours using 3,4 benzo-alpha-pyrene (BP) and assessing the cancer promoting effect of microwaves.

Cancer development started 2 months earlier for the MW exposed mice and reached the 50 % point for the population after 137 days compared to 305 days. Hence MW significantly accelerated the growth and proliferation of skin cancer tumours.

Figure 33 shows the results of planting lung cancer (sarcoma) cells and then exposing the mice to 5 and 15 mW/cm<sup>2</sup> MW radiation. The 5 mW/cm<sup>2</sup> exposure produced an enhancement of lung cancer modules at 2.5 times more than controls after 3 months, but at a similar level to the effect of an over-crowding stress factor. The 15 mW/cm<sup>2</sup> exposure produced about 5.5 times more lung cancer nodules.

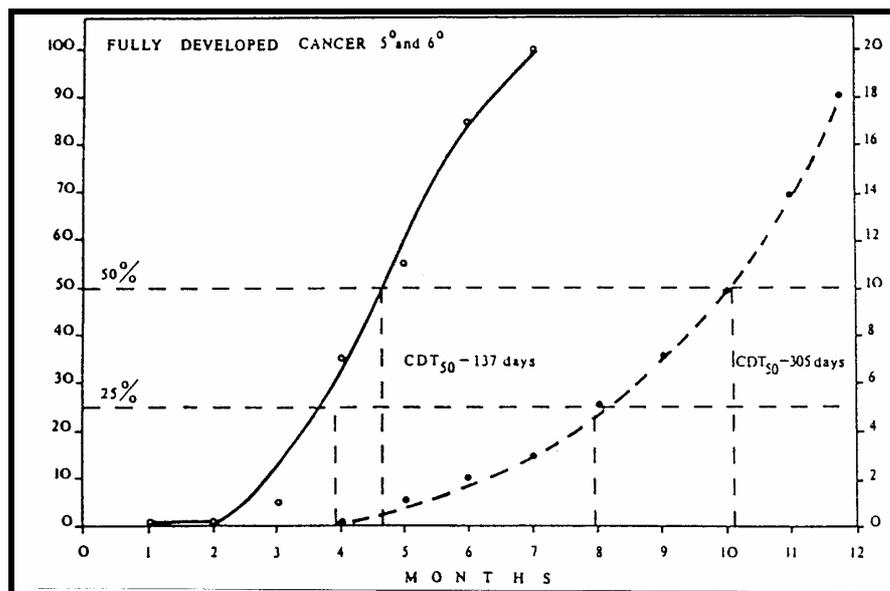


Figure 35: Growth curves of BP-induced skin tumour in mice exposed daily to 10 mW/cm<sup>2</sup> of 2.45 GHz microwave radiation for the whole period of tumour growth. CDT<sub>50</sub> refers to the cancer development time when 50 % of the animals have tumours.

A parallel experiment for breast cancer for control, overcrowding stress, 5 and 15 mW/cm<sup>2</sup> MW exposure, the 50 % development points were 322, 255, 261 and 219 days, respectively. These show a similar relationship to the results in Figure 26 for lung cancer, except that the stress and 5 mW/cm<sup>2</sup> effects are reversed.

These results show statistically significant increases in numbers and rates of development of chemically initiated skin, lung and breast tumours when exposed to low level microwaves, with a significant dose response relationship in each case.

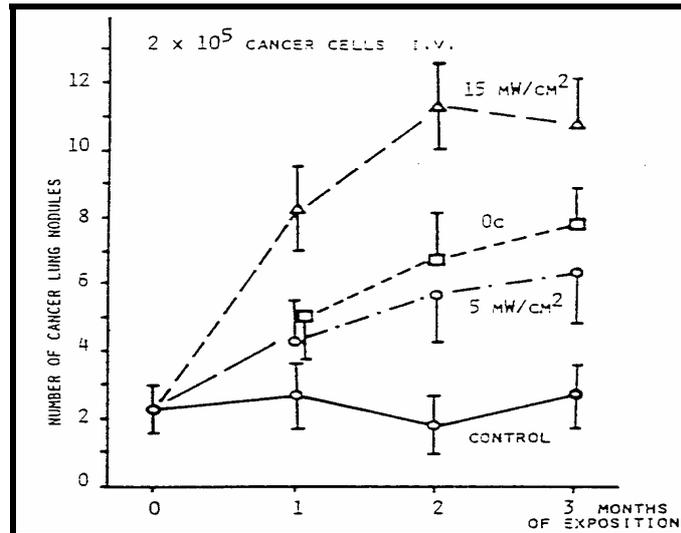


Figure 36: The number of lung tumours (following intravenous injection of  $2 \times 10^5$  viable sarcoma cells) in mice exposed during 1, 2 and 3 months to 2.45 GHz microwaves (2h daily) at 5 or 15 mW/cm<sup>2</sup>. Oc refers to mice treated with nonspecific stress of over crowding.

#### 11.4 Duke University Medical Center:

Eight week old female mice were exposed to 2.45 GHz microwaves at power densities of 5 to 15 mW/cm<sup>2</sup> for 30 min./day over periods between 1 and 17 days, Huang and Mold (1980). Daily mean exposures were about 100 to 300  $\mu$ W/cm<sup>2</sup>, and exposure conditions were essentially isothermal. The results showed, (a) A sustained activation of tissue macrophages resulting in suppression of lymphocyte responsiveness, and (b) a gradual but temporary stimulation directed to the lymphocytes.

Macrophage activation may have caused the early depression of lymphocyte responsiveness. The suppression is later overridden by the cumulative direct stimulation of lymphocytes by microwaves. Prolonged exposures is suggested to eventually result in depressed function in much the same as seen in rheumatoid arthritis which occurs from chronic immune stimulation.

They also conclude that 2.45 GHz microwaves affect the hematopoietic colony-forming abilities through altering the growth of both erythroid and myeloid cells. This is direct evidence of the ability of sub-thermal microwaves to cause chronic immuno-suppression.

### 11.5 Jawaharlal Nehru University Study:

Ray and Behari (1990) exposed young albino rats of both sexes to 7.5 GHz microwaves, pulsed at 1000 kHz and at a power of  $600 \mu\text{W}/\text{cm}^2$ , for 3 hr /day, averaging  $75\mu\text{W}/\text{cm}^2$ .

Microwave exposed rats ate and drank less and thus showed smaller weight gain. Leukocyte count increased by 35 % in the exposed animals along with a 2-fold increase in eosinophils, and Spleen, Kidney, Brain and Ovaries were significantly smaller.

### 11.6 Royal Adelaide Hospital Project:

Repacholi et al. (1997) exposed genetically engineered mice to a cell phone signal for 1 hr/day. This was an Australian industry funded study to allay public fears of cell phone health effects was carried out by a team led by Dr Michael Repacholi at the Royal Adelaide Hospital. In an ABC Four Corners documentary Dr Repacholi describes this study:

**“We tried to get the most sensitive model of mouse that we could find that would get lymphoma and then see if we exposed them to radio frequency field, whether we could promote that cancer above its normal incidence.”**

Mice are often used to test toxins, chemicals and radiation effects because of the strong similarity of their cells to human cells. A search of Medline shows that since 1993 over 21100 cancer studies have used mice and 621 used tumorigenic mice.

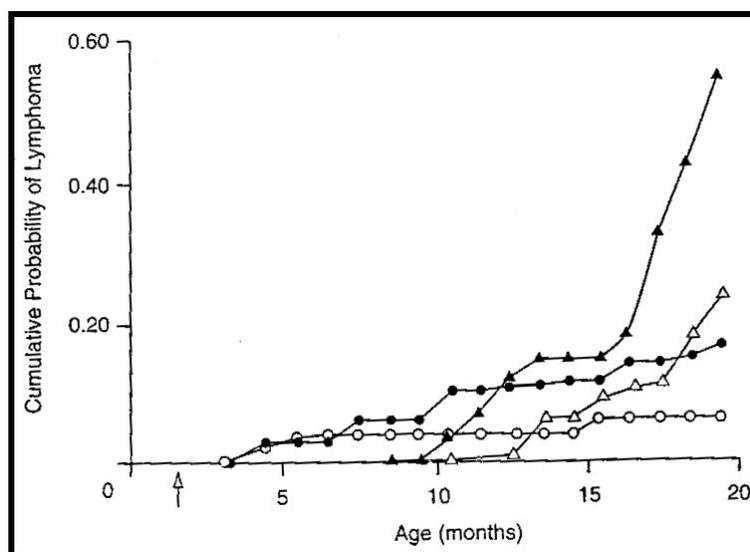


Figure 37: Rate of lymphomas increase in control and exposed groups of mice, Repacholi et al. (1997). The vertical arrow shows when the exposure began.

Their 200 genetically engineered mice normally had 22 % of them to get lymphomas in their immune system, including B-cells. About half of the mice were exposed to a moderate level of cell phone radiation for 1 hour per day for 18 months. The other half were treated the same way but not exposed. At the end of the study 43 % of the exposed mice had lymphomas. The overall Odds ratio was 2.4,  $p=0.006$ , 95% CI=1.3-4.5. This is a highly significant results in which the cell phone radiation more than doubled the cancer rate from a 1 hour per day exposure. Mean exposure range was measured as 0.13 to 1.4 W/kg.

Hence the mean daily exposure was 0.005 to 0.058 W/kg, averaging 0.03 W/kg. This is somewhat below the ICNIRP Guideline of 0.08 W/kg and clearly non-thermal.

### 11.7 Greek Mouse Fertility Study (1997)

Because of health concerns among residents living in the vicinity of an RF transmission tower in Greece, groups of mice were placed at various locations in relation to the tower, Magras and Xenos (1997). The mice fertility over several generations was monitored and related to the RF exposure. Figure 38 shows the fertility rate of the two exposed groups. Where group A the “Low” exposure group ( $0.168 \mu\text{W}/\text{cm}^2$ ) became infertile after 5 generations and B the “High” exposure group  $1.053 \mu\text{W}/\text{cm}^2$ , became infertile after only 3 generations. This is a highly significant result because so few multi-generation studies have been done and the effects of this study occur at extremely low levels and the effect is total infertility.

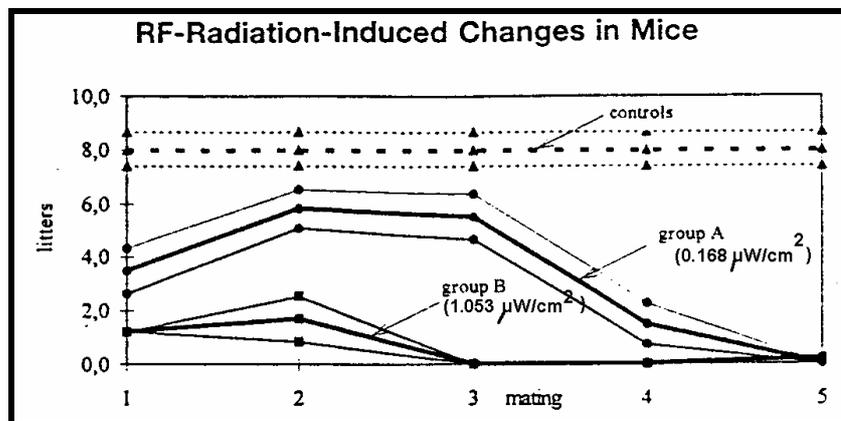


Figure 38: Reproductive rates in two groups of mice exposed to extremely low intensity radio signals, showing a dose response in the time taken to achieve full infertility of 3 matings for  $1.053 \mu\text{W}/\text{cm}^2$  and 5 matings for  $0.168 \mu\text{W}/\text{cm}^2$ .

### 11.8 University of Texas mice study

Vijayalaxmi et al. (1997) was designed to test whether microwaves were genotoxic by assaying the presence of micronuclei in peripheral blood and bone marrow of cancer-prone mice. Their threshold test was if there was a significant increase of micronuclei then microwaves were genotoxic. Their initial results had major errors and when they were corrected they did find significant increases of micronuclei in both blood ( $p < 0.02$ ) and bone marrow ( $p < 0.025$ ). In addition, 12 exposed mice had tumors compared to 8 mice in the control group, OR = 1.5. Therefore their results show that microwaves are genotoxic because they significantly enhance micronuclei formation and increase the tumour rate.

### 11.9 Summary and Conclusions about long-term animal experiments:

Animal experiments confirm that in mice pulsed RF/MW radiation is able to initiate statistically significantly more malignant tumours in many body organs at exposure levels assumed to be non-thermal and safe ( $0.4 \text{ W}/\text{kg}$ ), McGaughy (1990), and in the presence of a chemical cancer initiator to drastically increase the rate of development of lung, breast and skin cancer, Szmigielski et al. (1982), showing the strong co-promotional effects of microwave exposure. Prausnitz and Susskind (1962) found increased in testicular degeneration and increases in leukaemia at Rate Ratios from, chronic exposure to a short daily acute exposure to microwaves. Chou et al. (1992) found that radar microwaves more

than tripled the overall tumour rate in rats. Repacholi et al. (1997) shows that cellphone radiation enhances B-cell tumours in genetically engineered mice. Vijayalaxmi et al. (1997) show a similar result but also found significant increases in micronuclei formation in the microwave exposed mice. These are consistent with the research summarized above on the direct mutagenic effects of RF/MW radiation and the research showing alteration of signal transduction, cell communication which influence the cellular level growth regulation and can lead to cell proliferation and thence to tumour formation and cancer.

Magras and Xenos (1997) showed that mice became totally infertile with exposure to extremely low levels of radiofrequency radiation. This shows the strong value of multi-generational studies which are almost entirely lacking and almost impossible for epidemiology to carry out in relationship to human exposure to RF/MW. Human generations are over 2 decades long and hence a 5 generational study requires over 100 years of known exposure to RF/MW which is impossible at this time because the technology is too new.

With the very close parallel effects of mouse and rat studies and human studies, the results of chronic and multigenerational rodent studies must serve as a direct most probable indicator of effects on people. For example, Vijayalaxmi et al. (1997) show significant increases in chromosome breakage in the blood and bone marrow of cancer-prone mice chronically exposed to 2.45 GHz RF radiation, along with a 50 % increase in mammary tumors in the exposed vs sham exposed mice. Goldsmith (1995) reports enhanced chromosome damage and increased incidence of tumors in the Civil Service population of the U.S. Embassy in Moscow after they had been chronically exposed to a radar signal for varying but very low mean exposures less than  $0.1\mu\text{W}/\text{cm}^2$  (the mean range 1 to  $2.4\mu\text{W}/\text{cm}^2$  as measured on the outside of the walls).

Non-thermal microwaves also caused significant impairment of the immune system functioning. This was recently found in people in association with powerlines (Beale et al (1997)), and recall that powerlines emit RF radiation as well as ELF fields.

#### **11.10 Plant effects:**

The first published chromosome aberration study was for pulsed radiofrequency radiation and showed that in an isothermal situation the genotoxic effect of radiofrequency radiation mimicked ionizing radiation and C-mitotic chemicals. The subject of the exposure was garlic roots. Four of the Latvian studies published in 1996 refer to EMR effects on plants which were exposed to a radar RF pulsed signal. Balodis et al. (1996) measured a significant reduction ( $p < 0.01$ ) in relative additional increment tree ring growth over 20 years of exposure. Figure 35 shows the incremental tree ring growth at 4 km from the radar. Figure 36 shows the measured exposures with distance giving a mean of about 0.1 V/m which corresponds to  $0.003\mu\text{W}/\text{cm}^2$ .

Selga and Selga (1996) found significant cell structure changes in this exposure, including alterations of the Golgi apparatus switched to functions from synthesis of predecessors of cell walls to formation and export of resin predecessors and other cell stressors. These lead to accelerated resin production and promoted senescence of the pine trees.

Magone (1996) studied fast growing plants, *Spirodela polyrhiza* (L.) Schleiden. Generally, the vegetative reproduction rate was accelerated in the first 20 days after the end of exposure. Exposure of plants beginning formation lowered the vegetative growth rate.

Eighty-eight-hour exposure caused the appearance of some abnormal individuals after 30 days of growth. At 55 days growth, various morphological and developmental abnormalities appeared in 6-10 daughter plants from 10 exposed mother plants, compared to 0.1 plants per 10 in the control plants. Plants developed completely to daughter fronds under exposure from the electromagnetic field had a shorter life-span (67 days compared to 87 days in the control) and fewer daughters (8 compared to 10 in the controls).

Schmutz et al. (1996) studies young spruce and beech trees exposed to 2450 MHz for 3.5 years at a range of exposures from  $0.7 \mu\text{W}/\text{cm}^2$  to  $300 \text{ W}/\text{m}^2$ , depending on the location. A negative relationship existed for foliar concentrations of the calcium and sulfur in the beech and the exposure during the first 2 years.

Hence the Skrunda studies on plants show similar effects to those on human beings including stress symptoms, changes in calcium, growth reduction and reproductive changes consistent with chromosome damage. Adverse biological effects are found with exposures down to  $0.003 \mu\text{W}/\text{cm}^2$ .

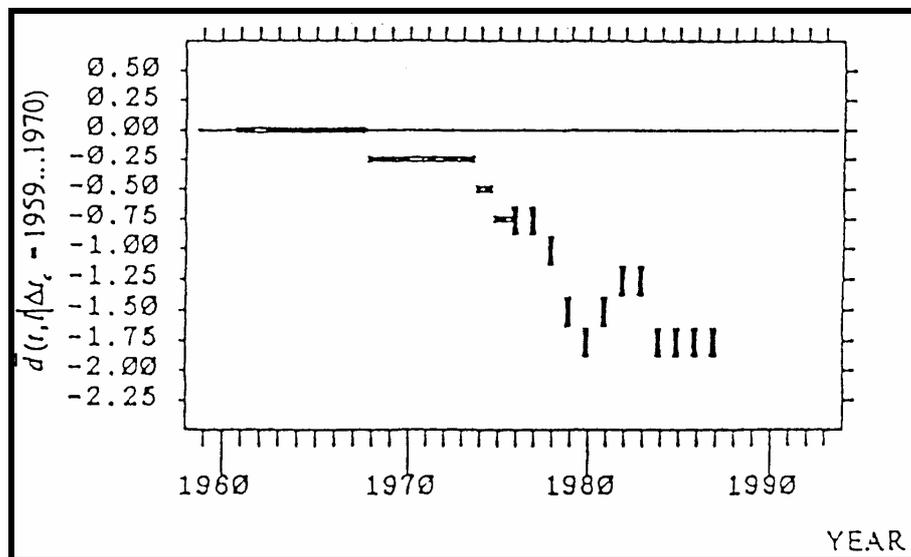


Figure 39: Reductions in annual incremental tree rings growth with  $0.003 \mu\text{W}/\text{cm}^2$  exposure to a pulsed radar signal. Balodis et al. (1996).

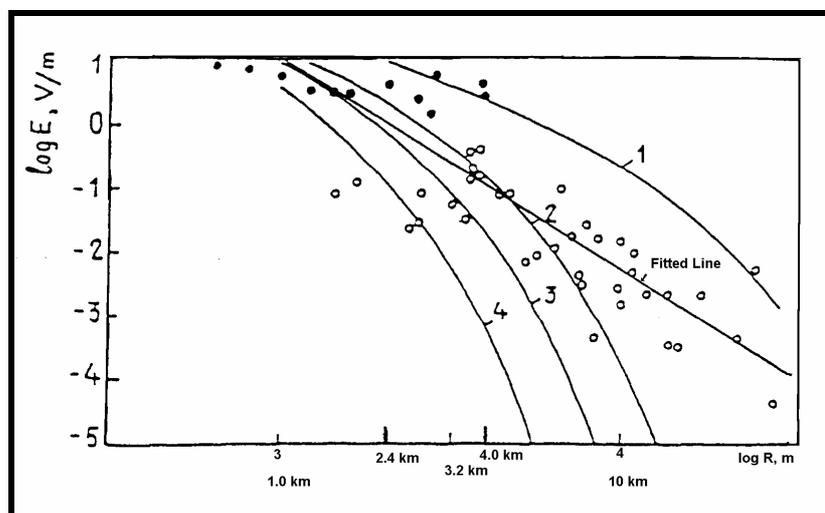


Figure 40: Measured exposure with distance from the Skrunda Radar.

## 12 Human health studies:

### 12.1 Reproductive

#### 12.1.1 Summary of Epidemiological Studies:

During the 1980's and early 90's there were three studies of the reproductive outcomes of physiotherapists (Physical Therapists) who were occupationally exposed to short-wave and infrequently to microwave, radiation during diathermy.

Kallen et al. (1982), in Sweden, used a survey of therapists recalling pregnancy outcomes and work place equipment use during pregnancy, involving 33 cases. None who reported pregnancy outcomes reported exposure to microwaves. They found increased congenital malformations, low birth weight, still birth and death within the first 7 days after birth in association with short-wave diathermy.

Taskinen et al. (1990) in Finland, with 204 cases, found increased spontaneous abortion with short-wave and microwave use (electric therapies  $>5$ /week OR=2.0, CI: 1.0-3.9, n=17 ; shortwaves  $\geq 5$ h/week, OR= 1.6, CI: 0.9-2.7, n= 30; Microwaves, OR= 1.8, CI: 0.8-4.1, n=13), but stronger associations with ultrasound and heavy lifting (Ultrasound  $\geq 20$ /week, OR= 3.4, CI: 1.2-9.0, n=9 . Heavy lifting,  $> 10$  kg or patient transfers  $\geq 50$  times/week, OR=3.5, IC: 1.1-9.0, n=11). Odds ratios increased for pregnancies  $> 10$  weeks: electric therapies OR=2.2, shortwaves 2.5, Microwaves 2.4, ultrasound 3.4 and heavy lifting 6.7 .

They conclude "Physical exertion during early pregnancy seems to be a risk factor for spontaneous abortion. The findings raise suspicion of potential harmful effect of shortwaves and ultrasound on the pregnancy, but no firm conclusion can be drawn on the bases of these results alone." However, this study adds weight when grouped with other studies.

Larsen et al. (1991), studying pregnant physiotherapist's, identified 54 cases and 146 spontaneous abortion cases from Denmark, found a significant increase in malformations, still birth, low birth weight, cot death and prematurely when working with short-wave diathermy.

Taken together, the three Scandinavian studies show adverse changes in pregnancy outcomes associated with short-wave RF, including spontaneous abortion later in the pregnancy, fetal malformations, still birth, low birth weight, cot death and prematurely.

The only study to find effects with microwaves was Taskinen et al. (1990), and then an association with later pregnancy spontaneous abortion.

A further Finnish study on spontaneous abortion in association with the use of VDUs, Lindbohm et al. (1992), found a non-statistically significant elevated risk miscarriage of 10% with all VDU usage, but for those exposed to  $\geq 0.9 \mu\text{T}$ , the odds ratio was 3.4 (95% CI: 1.4-8.6) when compared to rates in workers exposed to  $< 0.4 \mu\text{T}$ . They investigated confounders such as ergonomic factors and mental workload but these change the odds ratio very little. An exposure assessment found a significant dose-response relationship.

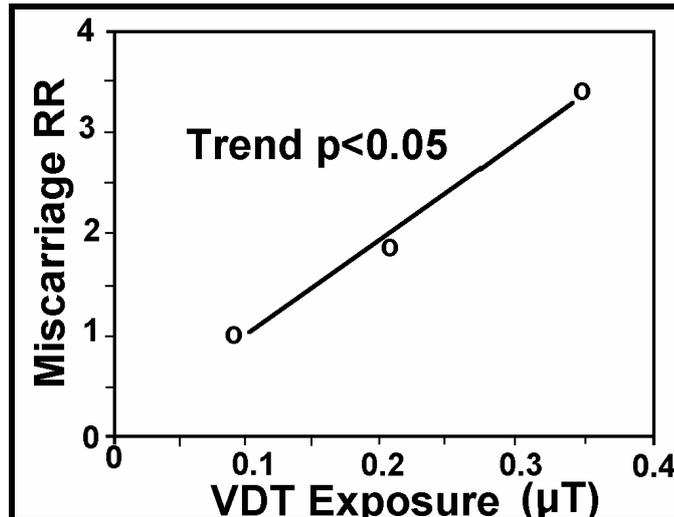


Figure 41: ELF/RF/MW exposure from VDT usage increases miscarriage in a dose-response manner, Lindbohm et al. (1992).

American studies include Vaughan et al. (1984) who found significantly increased risk of fetal death for last pregnancy for therapists, RR=2.0, CI: 1.5-2.5, n=169, and for electronic technicians, RR= 1.5, CI:1.2-2.0, n=202.

The most significant study was carried out by Ouellet-Hellstrom and Stewart (1993) who investigated early spontaneous miscarriage among U.S. Physical Therapists who had used short-wave (27 MHz) or microwave (915 MHz and 2.45 GHz) for diathermy. The sample involved 1753 case pregnancies (miscarriages) and 1753 matched controls. Exposed cases were women who had been exposed to EMR in the 6 months prior to the first trimester or during the first trimester of the pregnancy. They found statistically significantly increased early spontaneous abortions in the first trimester for those using microwave diathermy, OR= 1.28, CI: 1.02-1.59, the odds ratio increasing with exposure (trend  $p < 0.005$ ) giving a statistically significant dose-response relationship, the odds ratio in the highest exposure group being OR= 1.59, CI: 0.99-2.55 .

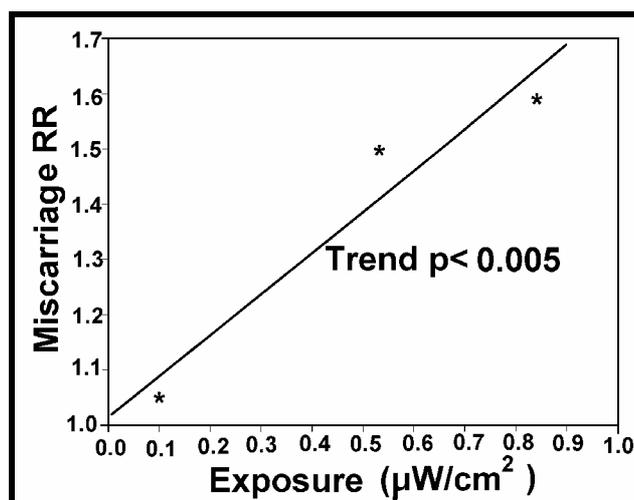


Figure 41a: Microwave exposure associated miscarriage for pregnant physiotherapists, Ouellet-Hellstrom and Stewart (1993).

For those for whom this was the first miscarriage, the association with microwave exposure gave OR= 1.26, CI: 1.00- 1.59, the dose response trend had  $p < 0.01$  and the highest

exposure group had OR= 1.55, CI:0.92-2.61 . Short-wave exposure showed some positive odds ratios but none were statistically significant.

This study shows a very strong relationship between microwave exposure and early miscarriage, with a dose-response relationship, backed by several other studies, and evidence of melatonin reduction and chromosome aberrations, showing a causal relationship between RF/microwave exposures and miscarriage and congenital malformation.

Taken with the Scandinavian studies, the pattern emerges of late pregnancy miscarriage and fetal damage in association with short-wave exposure and early miscarriage in associate with microwave exposure.

A subsequently exchange of correspondence related to this study challenges those who dismiss an athermal mechanism, such as chromosome aberration or melatonin reduction which are known miscarriage risk factors, Sandyk et al. (1992). Hocking and Joyner (1995) show that microwaves produce very small SARs with the uterus, Figure 42.

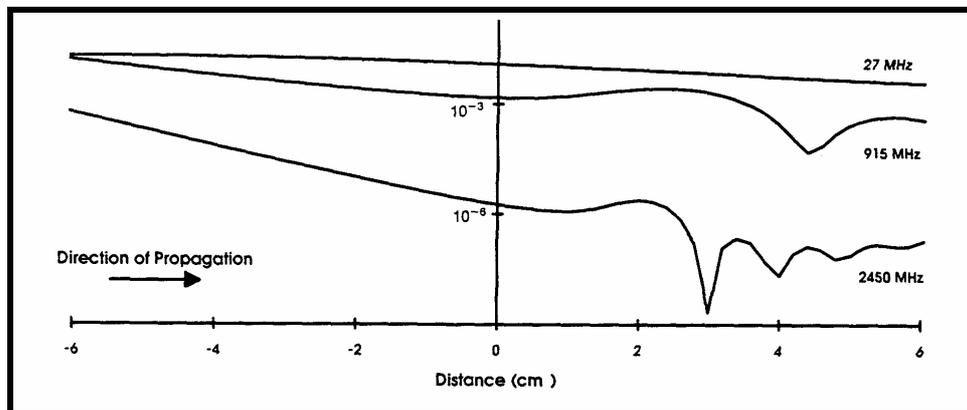


Figure 42: Specific absorption rate (SAR) profile across the uterus for a small woman exposed to  $1 \text{ mW/cm}^2$ , from Hocking and Joyner (1995).

Their table 2 shows maximum SARs in the uterus for the conditions in Figure 38 for short-wave (27.12 MHz) of  $0.209 \text{ W/kg}$ , for microwave (915MHz) of  $0.023 \text{ W/kg}$  and for microwave (2.45GHz) of  $0.000027 \text{ W/kg}$ . With a heating rate of  $0.0045 \times \text{SAR } ^\circ\text{C/min.}$ , Gandhi (1990) and a maximum exposure time per treatment of 5 minutes, the heating of the fetus will be  $0.005$ ,  $0.0005$  and  $0.0000006^\circ\text{C}$ , respectively. Not even the short-wave exposure can produce a detectable heating effect in the uterus environment. The purpose of providing this data was for Hocking and Joyner, employees at that time of Telstra, the Australian telecommunications company, to argue that microwaves cannot be associated with miscarriage because there is no heating. Ouelette-Hellstrom and Stewart correctly reply that the association with microwaves cannot be changed but the explanation (thermal mechanism) can be.

### 12.1.2 Biologically Plausible Mechanism:

Electromagnetically reduced melatonin could be related to spontaneous abortion. According to Sandyk et al. (1992):

**“The causes of spontaneous abortion can be divided into two main categories: those arising from chromosomal anomalies and those arising**

**from abnormalities in the intrauterine environment. In the following communication, we propose that deficient pineal melatonin functions in early pregnancy may be causally related to the development of spontaneous abortions in cases where chromosomal anomalies or structural abnormalities of the uterus have been excluded.”**

Microwaves are shown to be associated with DNA breakage in rats brains, Lai and Singh (1995, 1996) and to cause chromosome aberrations in living humans blood, Garaj-Vrhovac and Fucic (1993), and hence can produce the first cause of spontaneous abortion. Reduced melatonin allows greater concentrations of free radicals to exist. These damage the DNA and chromosomes, leading to a similar mechanism for miscarriage of the deformed fetus.

Therefore, thermal shock and cumulative buildup of thermal lesions is implausible and cumulative cell damage, including melatonin mediated free radical chromosome damage is a highly plausible mechanism.

### **12.1.3 The microwave dose associated with the risk:**

Given the SAR information and the dose-response relationship, it is appropriate to estimate the risk of spontaneous miscarriage in terms of monthly mean exposure.

The quoted mean exposure is 80 - 1200  $\mu\text{W}/\text{cm}^2$ . Assuming a conservatively long estimate of 2 minutes exposure per treatment, 1 treatment per month averages out to the range 0.004 to 0.056  $\mu\text{W}/\text{cm}^2$ , mean 0.03  $\mu\text{W}/\text{cm}^2$ . With 10 treatments per month from 0.04 to 0.56  $\mu\text{W}/\text{cm}^2$ , mean 0.3  $\mu\text{W}/\text{cm}^2$ ; and 20 treatments per month 0.08 to 1.11  $\mu\text{W}/\text{cm}^2$ , mean 0.6  $\mu\text{W}/\text{cm}^2$ . The lowest limit is very difficult to estimate with reliability but the mean level of the middle band is 0.3  $\mu\text{W}/\text{cm}^2$ . This suggests that a 20 to 50% increase in miscarriage occurred with a mean monthly microwave exposure of somewhat less than 0.3  $\mu\text{W}/\text{cm}^2$ . The dose-response relationships in Figures 41 and 41a points to a zero safe level. RF/Microwaves are genotoxic. A genotoxic substance has no safe threshold.

When applying the ubiquitous substance principle and the no non-exposure principle, along with two recently published that is showing that enhanced miscarriage rates are associated with residential power frequency fields, this confirms the conclusions above, Li et al. (2002) and Lee et al. (2002).

### **12.1.4 Relevance to mobile phone base stations:**

The fact that this level of microwave exposure is found near base stations and that there are currently no documented reports of increased incidence of miscarriage occurring near cell sites is not surprising nor a proof that the hypothesis advanced here is wrong. It simply results from the fact that miscarriage is not reported and no statistics are being collected for the general population. Each pregnant woman can only miscarriage once per child, with a several month wait until the next pregnancy. Each spontaneous miscarriage is isolated and does not form a pattern. Many causes are possible. Very few miscarriages are investigated, unless it becomes an issue from a cluster pattern and then a medical or environmental cause is sought. Initially few pregnant women lived near mobile phone base stations. However with the unrestricted sighting policy advocated by the companies and accepted by almost all states and councils, this is changing significantly month by month.

Increased incidence of miscarriage is potentially occurring right now and until it is scientifically assessed, we will not be able to rule out the scientifically indicated probability. The studies presented here give ample grounds for requiring the sighting of cell sites far enough away from residences to avoid an increase in risk of miscarriage.

## **12.2 Cancer**

### **12.2.1 WHO review team's results:**

The World Health Organization (WHO) has reviewed the EMR health research, including studies on cancer published up to about 1992 and published the review report "Environmental Health Criteria 137: Electromagnetic fields (300 Hz to 200 GHz)", Ed. Dr M.H. Repacholi (1993). The team selected 6 cancer related studies, 3 of which the authors conclude no effects, one "radar-exposed populations near air force bases" which has contradictory conclusions and two which do show increases in cancer risk, Figure 39. Given these conclusions on face value their chapter conclusion (8.2.5 in the box) of "no clear evidence of detrimental health effects" appears to be justified. However, two of the four "no effects" studies, Robinette et al. (1980) and Lilienfeld et al.(1978) have been closely studied and followed up by Professor John Goldsmith, Goldsmith (1995, 1998) who concludes that they both show increases in cancer risk. Given this analysis, of the six studies quoted, 5 actually do show increased risks of cancer. Below 24 studies are summarized showing EMR is associated with increased cancer

### **12.2.2 Brief Overview of Epidemiology and RF/MW association with cancer:**

There are many other studies which have found statistically significant increases in adverse health effects, including cancer. It is not that there is no evidence, nor even limited evidence of adverse effects. There is a large body of evidence, only part of which is reviewed here. There are sound scientific reasons for including studies involving ELF high voltage exposures (not reviewed here however), because of the similarity of cellular interactions and because high voltage are a localized source of RF radiation primarily in the 3 to 30 MHz range, which is why you hear a buzz on your car radio as you drive under a powerline.

The following give a brief summary of some of the published studies showing statistically significant increases of cancer from exposure to RF/MW on people.

A major study of radar and radio exposed U.S. Navy personnel, summarized as having no reported effects, includes data which shows statistically significant increases cancer between a group assessed as high exposure compared to a group assessed as low exposure, e.g. All death (RR=1.79 (1.52-2.12)), Accidental Death (RR=2.20 (1.72-2.82)), All Diseases (RR=1.55 (1.19-2.01)), Malignant tumours (RR=1.66 (1.06-2.60)), and Lymphatic and Hematopoietic cancer (RR=2.66 (1.02-4.81)). There was also statistically increased risks of a host of illness including, Musculoskeletal, Organs of Sense, Systematic conditions, Respiratory, Cardiovascular and digestive illness, Skin, Endocrine, Neurological and Mental conditions, Robinette et al. (1980).

<i>EHC 137: Electromagnetic fields</i>			<i>Human responses</i>		
<b>Table 31. Morbidity and mortality studies</b>			<b>Table 31 (continued)</b>		
Exposure conditions	Effect on exposed group	Reference	Exposure conditions	Effect on exposed group	Reference
Radar (pulsed), two groups: (i) <2 (ii) >2 up to 80 W/m <sup>2</sup> , for 1-10 years	No difference in health status between 841 adult males in groups (i) and (ii)	Czerski et al. (1974b); Siekierzynski et al. (1974a,b)	27 MHz shortwave diathermy (questionnaire to 3004 physiotherapists)	Association between heart disease and work with shortwave therapy (number of treatments/week)	Hamburger et al. (1983)
Radar (pulsed), <50 W/m <sup>2</sup> (<0.2 W/kg), for 5-10 years	No effects in clinical evaluations in comparisons between 322 radar workers and 220 non-radar workers; however, more neurasthenic symptoms in exposed group	Djordjevic et al. (1979)	Work at 27 MHz plastic sealers (70% of measurements at the head and hands >300 V/m)	Upper limb paraesthesia and eye irritation noted among 30 exposed workers compared with 11 partially exposed and 22 unexposed workers	Bini et al. (1986)
0.2-5 GHz (pulsed), approx. 10 W/m <sup>2</sup> , 0.05 W/kg (max). Occasional exposure to 1 kW/m <sup>2</sup>	No effect on mortality in male military personnel followed for over 20 years, exposed for 2 years on average (over 40 000 personnel)	Robinette & Silverman (1977); Robinette et al. (1980)	Military personnel exposed to RF/MW fields <2 W/m <sup>2</sup> with daily incidental (minutes) exposures of 2-10 W/m <sup>2</sup> (some times even 100-200 W/m <sup>2</sup> )	Increased risk of cancer morbidity in a retrospective cohort study of military personnel (study group size not given)	Szmigielski et al. (1988)
Males: 2.56-4.1 GHz (CW), 0.05 W/m <sup>2</sup> (max), 0.0002 W/kg (max); Females: 0.8-9.5 GHz (CW), 0.018 W/m <sup>2</sup> (max), 0.0007 W/kg (max), for 0.5-4 years average exposure	No effect on life span or cause of death of 1800 employees and 3000 dependents of US Embassy personnel	Lilienfeld et al. (1978)	51 male/62 female operators of plastic welding machines (27 MHz, 50% of welders exceeded 250 W/m <sup>2</sup> ) 23 female controls (sewing machine operators)	Increase rates of paraesthesia in hands, neurasthenia, and eye complaints; diminished 2-point discrimination ability	Kolmodin-Hedman et al. (1988)
Long-term microwave exposure of military personnel (interviews)	Higher frequency of microwave exposure in 14 polycythaemia cases than in 17 age-matched controls	Friedman (1981)	Amateur radio operators	Deaths from all causes less than expected from national rates; increased risk of leukaemia	Milham (1985)
Radar-exposed populations near air force bases	Increased cancer mortality compared with population-matched controls. No increase in cancer mortality compared with population-matched controls	Lester & Moore (1982); Lester (1985); Polson & Merritt (1985)	1.3-10 GHz, 0.1 to 10- $\mu$ s pulses, RF exposure of radar mechanics often exceeded 10 W/m <sup>2</sup>	No differences in neurological symptoms and findings between 17 exposed and 12 controls; increased protein band in CSF in the exposed group	Nilsson et al. (1989)
Children exposed to various air pollutants and RF	Duration and severity of tonsillitis increased	Shandala & Zvinjatskovsky (1988)			

**8.2.5 Conclusions**

In summary, the epidemiological and comparative clinical studies do not provide clear evidence of detrimental health effects in humans from exposure to RF fields. Some occupational groups, such as exposed physiotherapists and industrial workers, should be studied further. The question of whether RF might act as a carcinogen should be further evaluated in epidemiological studies.

Occupational exposure to RF will be at higher levels than that encountered by the general population, and, thus, there is less likelihood of health effects in the general population as a whole.

Figure 43: Table 31 from WHO (1993) showing the review team's selection of studies on EMR and morbidity and mortality and their summary of the study's conclusions, and, in the box on the bottom right hand side, the review teams conclusions on this set of studies and the reproductive studies.

You will note that the WHO review, WHO (1993) refers to Robinette et al.(1980) as showing no effects. Similarly for Lilienfeld et al. (1978). The data contained in these papers and reports indicate otherwise, Goldsmith (1995, 1997). The following is a summary of the cancer based studies published over the past two decades.

- Cancer incidence in the vicinity of Wichita, Kansas was found to be higher on ridges which were exposed to radar transmissions than those residents who lived in the valleys, Lester and Moore (1982 a). Residents were potentially exposed to two radars, one radar and no radars with relative cancer incidences of 470, 429 and 303 per 100,000 (1.55: 1.42: 1.00), trend  $p=0.03$ . The association persisted through adjustments for age, sex, race and socio-economic factors.

- Lester and Moore (1982b) found significantly higher cancer rates in U.S. counties with Air Force bases compared to those without Air Force bases, which they related to prolonged environmental exposure to RF/MW from radar.
- Polson and Merritt (1985) criticized the analysis of Lester and Moore (1982b), pointing out weaknesses in their use of the data, such as a city could be in a country with no Air Force Base but be closer to a base in another country than a city in that county. Having made corrections for this, Lester and Moore (1985) found strengthened associations between cities and air force bases, with higher incidences of cancer related to radar transmissions.
- Lin et al. (1985) studied 951 cases of brain tumors among white male residents of Maryland during the period 1969-1982. Fifty cases of glioma and astrocytoma were observed among electrical workers exposed to EMR compared to an expected number of 18, i.e. an risk ratio of 2.8. While their exposure was mainly to ELF fields it shows the common link over a wide range of frequencies.
- Increased risk of leukaemia amongst amateur radio operators (Milham, 1985).
- In 1985 an unusual number of children with leukaemia were identified living in the vicinity of broadcasting facilities (OR = 3.4: CI=0.70 -16.41), Maskarinec et al. (1993).
- De Guire et al. (1987) report increased malignant melanoma of the skin in workers in a telecommunication industry, affecting only men, SIR = 2.7 CI : 1.31-5.02).
- Thomas et al. (1987) report a 10-fold increase in astrocytic brain tumor among electronics and repair workers employed for 20 years or more. Some risk was due to solvents, put at a factor of 2, placing RF/MW contribution at a factor of 5.
- Milham (1988) studied 67,829 amateur radio operators in Washington State and California. He concludes "The all-cause standardized mortality ratio (SMR) was 71 but a statistically significant increased mortality was seen for cancers of the other lymphatic tissues (SMR = 162), a rubric which includes multiple myeloma and non-Hodgkin's lymphomas. The all leukemia SMR was slightly but not significantly elevated (SMR = 124). However, mortality due to acute myeloid leukemia was significantly elevated (SMR = 176).
- Szmigielski et al. (1988) studied polish military personnel exposed to microwave radiation and reported that cancer morbidity was three times higher in the exposed group than the control group.
- Electrical workers in Los Angeles County have a 4.3-fold increased risk of certain brain tumors (Preston-Martin et al. 1989).
- An increased incidence of malignant brain tumors has been reported in children of fathers exposed to electromagnetic fields and electronic solvents (Johnson and Spitz, 1989).
- Hayes et al.(1990) report an Odds ratio for all testicular cancer of 3.1 (CI: 1.4-6.9) for a small sample of workers who were occupationally exposed to RF/MW radiation.

- U.S. Navy electrician's mates have an excess risk of leukaemia, RR=2.4 (1.0-5.0), Garland et al. (1990)
- Savitz and Chen (1990) show significant increased risk of childhood cancer (Neuroblastoma (OR=11.8\*), Brain Tumour (OR=2.7\*) and CNS tumors (OR=1.7)) associated with parents who work in electrical and electronic industries.
- Increased risk for all brain tumours (RR=2.9 (1.2-5.9)) and glioblastomas (RR=3.4 (1.1-8.0)) for assemblers, and repairmen in the radio and TV industry, Tornqvist et al. (1991)
- Goldsmith (1995) reports an up-dated analysis of the US embassy in Moscow which does show a significant elevated risk of a wide range of adult cancers, and including childhood leukaemia, after years of microwave irradiation, exposed to average levels of radar produced microwaves of long-term average indoor exposure of 0.2 to 0.5  $\mu\text{W}/\text{cm}^2$ , daily peaks between 5 and 18  $\mu\text{W}/\text{cm}^2$  on the outside walls.
- Increased risk of female breast cancer with exposure to radiofrequency EMF, RR=1.15 (1.1-1.2), Cantor et al. (1995).
- Hocking and Gordon (1996) found a 2.74-fold increase in childhood leukaemia death within 4 km of three TV and FM radio transmission masts in North Sydney between 1972 and 1990. Mean direct exposures were measured in the range 0.1 to 1  $\mu\text{W}/\text{cm}^2$ . Mean personal exposures are in the range 0.002 to 0.02  $\mu\text{W}/\text{cm}^2$ .
- Polish Military personnel (1971-85) exposed to above average radar and radio sourced RF/MW show large increases in leukaemia (Lymphoma: RR=5.8 (2.11-9.74); Chronic lymphocytic: RR=3.7 (1.45-5.18); Acute Lymphoblastic: RR=5.8 (1.22-18.16); Chronic myelocytic: RR=13.9 (6.72-22.12); Acute myeloblastic: RR=8.6 (3.54-13.67) and Total: RR=6.31 (3.12-14.32). Also show statistically significant associations for cancer of the esophagus and stomach, colorectal, skin (including melanomas), CNS and brain. (Szmigielski , 1996)
- U.S. Air Force personnel showed increased incidence of brain tumour with exposure to ELF (RR=1.28 (0.95-1.74)), and RF/MW (RR=1.39 (1.01-1.90)).
- Dolk et al. (1997 a, b) found small but significant increases in adult leukaemia, which decreases with distance from the transmitter, associated with 21 highly powerful Regional FM and TV transmission towers in the United Kingdom. The 20 site study shows adult leukaemia incidence following the typical exposure pattern as it varies with radial distance, i.e. low near the tower, peaking between 1.5 and 3 km and then decreasing with distance. This is a strong dose-response result.

The Sutton Coldfield result, Dolk et al. (1997a), differs from the 20 site result because of five people with leukaemia who live near the tower. These 5 people are a classic cancer cluster. Clustering of cancer has been used as a confounding factor to dismiss the association with a toxin. In this case the cluster is kept in the sample to weaken the result through inconsistency with the 20 site study. If the cluster, which has a highly probable chance of being random, is removed, then the Sutton Coldfield result is fully

consistent with the 20 site result when the exposure and population patterns are appropriately considered, Cherry (2001).

- Szmigielski (1998), a conference paper reported in microwave news, concludes that the data suggests that cancers “develop faster, with a shorter latency period” in servicemen with occupational RF/MW exposures. He also found a dose-response relationship with cancer rate against maximum microwave exposure.

Number of Men	Peak Exposure Range $\mu\text{W}/\text{cm}^2$	Cancer Rate Ratio
1900	100-200	1.69
1320	200-600	1.57
350	600-1000	4.62
280	1000-	4.93

The morbidity rate for hematological and lymphatic cancers was 5.33 times greater than unexposed servicemen, also a highly significant result. (MWN Jan/Feb, 1998 p10)

- Michelozzi, et al (2002) showed that chronic residential RF exposure of people living in the vicinity of the Vatican radio towers, outside Rome, show a significant dose-response increase in adult and childhood leukaemia.

### 12.2.3 Cancer studies conclusion:

A genotoxic substance causes cancer. There is extremely strong evidence that RF/microwave radiation is genotoxic. There is also overwhelming direct evidence that RF/MW radiation is carcinogenic, raising the incidence of cancer in exposed military, occupational and residential populations. Many dose-response relationships, even at residential exposure levels give substantial evidence of a causal link between of cancer and chronic RF/MW exposure. Cancer of many organs is found and is expected since RF/MW exposure is a whole body exposure. Most commonly found cancers are leukaemia and brain tumors.

Evidence that RF/MW causes cancer is also evidence of shortening life and accelerating aging, as cancer is a strong result of aging. In a toxic substances also enhance the apoptosis rate. This is also a basic mechanism for advancing the ageing range.

### 13. Conclusions:

Scientific studies at the cellular level, whole animal level and involving human populations, shows compelling and comprehensive evidence that RF/MW exposure down to very low residential exposure levels, levels which are a minute fraction of present “safety standards”, results in altered brain function, sleep disruption, depression, chronic fatigue, headache, impaired memory and learning, adverse reproductive outcomes including miscarriage, still birth, cot death, prematurely and birth deformities. Many other adverse health effects have been found, predominantly cancer of many organs, especially brain cancer, leukaemia, breast cancer and testicular cancer. Studies have also found that RF/MW exposed parents have more children with CNS cancers and other health defects. These effects are consistent with genetic damage caused by RF/MW. Many scientific studies have found chromosome aberrations and DNA damage with RF/MW exposure, the first being published in 1959. Three primary biological mechanisms are linked to these effects, genotoxicity, altered cellular calcium ions and melatonin reduction. With melatonin reduction there is

usually a rise in serotonin which is associated with awakesness, alertness, anxious, anger, rage and violence depending on the serotonin level, the person and the circumstances. Most of these and many other neurological and health effects are associated with geomagnetic activity, through the Schumann Resonance signal mechanism which alters the human melatonin levels. It strongly supports a causal connection between the extremely low intensity natural electronic signals and the thousands to billions of times higher humanly generated electromagnetic signals, and the listed health effects.

**Hence there is strong evidence that ELF and RF/MW is associated with accelerated aging (enhanced cell death and cancer) and moods, depression, suicide, anger, rage and violence, primarily through genotoxic damage, alteration of cellular calcium ions and the melatonin/serotonin balance.**

#### References:

- Adair, E.R., 1993: "Thermal physiology of radiofrequency radiation (RFR) interactions in animals and humans". pp 245-269, In "Radiofrequency Radiation Standards - Biological effects, Dosimetry, epidemiology and Public Health Policy", Ed Klauenberg, Grandolfo and Erwin, NATO ASI Series A: Life Sciences Vol 274, Plenum Press, New York.
- Adey, W.R., 1979: "Neurophysiologic effects of Radiofrequency and Microwave Radiation". Bull. N.Y. Acad. Med. 55(11): 1079-93.
- Adey, W.R., 1980: "Frequency and Power windowing in tissue interactions with weak electromagnetic fields". Proc. IEEE, 68:119-125.
- Adey, W.R., 1981: "Tissue interactions with non-ionizing electromagnetic fields". Physiological Reviews, 61: 435-514.
- Adey, W.R., Bawin, S.M., and Lawrence, A.F., 1982: "Effects of weak amplitude-modulated microwave fields on calcium efflux from awake cat cerebral cortex". Bioelectromagnetics, 3: 295-307.
- Adey, W.R., 1988a: "The cellular microenvironment and signaling through cell membranes". Prog. Clin. Biol. Res., 257:81-106.
- Adey, W.R., 1988b: "Cell membranes: the electromagnetic environment and cancer promotion". Neurochem. Res., 13(7):671-677.
- Adey, W.R., 1989: "The extracellular space and energetic hierarchies in electrochemical signaling between cells". pp 263-290. In "Charge and Field Effects in Biosystems - 2", eds Allen, M.J., Cleary, S.F. and Hawkrige, E.M., Plenum Press, New York.
- Adey, W.R., 1990: "Electromagnetic fields and the essence of living systems". In "Modern Radio Science", J Bach Anderson Ed., Oxford University Press, 1990, pp 1-37.
- Adey, W.R., 1991: "Signal functions of brain electrical rhythms and their modulation by external electromagnetic fields". pp323-351. In "Induced rhythms of the brain", Eds Basar, e., and Bullock, T.H., Birkhauser, Boston.

- Adey, W.R., 1992a: "Collective properties of cell membranes". pp47-77. In "interaction mechanisms of Low-level electromagnetic fields in living systems", Oxford University Press.
- Adey, W.R., 1992b: "ELF magnetic fields and promotion of cancer: experimental studies". In 'Interaction mechanisms of low-level electromagnetic fields in living systems', Bengt Norden and Claes Ramel (eds), Oxford Univ. Press.
- Adey, W.R., 1992c: "Collective properties of cell membranes". pp47-77 In 'Interaction mechanisms of low-level electromagnetic fields in living systems', Bengt Norden and Claes Ramel (eds), Oxford Univ. Press.
- Adey, W.R., 1993: "Biological Effects of electromagnetic fields". *Journal of Cellular Biochemistry*, 51: 410-416.
- Adey, W.R., Byus, C.V., Cain, C.D., Haggren, W., Higgins, R.J., Jones, R.A., Kean, C.J., Kuster, N., MacMurray, A., Phillips, J.L., Stagg, R.B., and Zimmerman, G., 1996: "Brain tumor incidence in rats chronically exposed to digital telephone fields in an initiation-promotion model". Bioelectromagnetic Society Annual Meeting, June 9-14, 1996, Victoria BC, Canada.
- Albert, E.C., Blackman, C.F., and Slaby, F., 1980: "Calcium dependent secretory protein release and calcium efflux during RF irradiation of rat pancreatic tissue slices". In *Ondes Electromagnetiques et Biologie*, A.J. Berteaud and B. Servantie, eds, Paris, France, pp 325-329.
- Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D., 1994: "Molecular Biology of the cell", 3rd edition, Publ. Garland Publishing, New York.
- Altpeter, E.S., Krebs, Th., Pfluger, D.H., von Kanel, J., Blattmann, R., et al., 1995: "Study of health effects of Shortwave Transmitter Station of Schwarzenburg, Berne, Switzerland". University of Berne, Institute for Social and Preventative Medicine, August 1995.
- Alvarez, J., Montero, M., and Garcia-Sancho, J., 1992; *FASEB J*, 6:786-792.
- Anderson, B.S., and Henderson, A.K., 1986: "Cancer incidence in census tracts with broadcasting towers in Honolulu, Hawaii". Honolulu City Council Report, Contact No. C17015, October 27, 1986.
- Athey, T.W., 1981: "Comparison if RF-induced calcium efflux from chick brain tissue at different frequencies: do scaled power density windows align ?" *Bioelectromagnetics*, 2: 407-409.
- Australian Standard: Radiofrequency radiation, Part 1: Maximum exposure levels - 100 kHz to 300 Ghz, Standards Australia AS 2772.1-1990.
- Barnett, S.B., 1994: "CSIRO report on the status of research on biological effects and safety of electromagnetic radiation: telecommunication frequencies. "Ultrasonics Laboratory, Radiophysics Division, CSIRO, 174 pp, June 1994.
- Balcer-Kubiczek, E.K. and Harrison, G.H., 1985: "Evidence for microwave carcinogenesis". *Carcinogenesis*, 6: 859-864.
- Balcer-Kubiczek, E.K., 1994: "Experimental studies of electromagnetic field induced carcinogenesis in cultured mammalian cells." Chapter 10 in "On the nature of the electromagnetic field interactions with biological systems". Ed. A.H. Frey, Publ. R.G. Landes Co.

- Balodis, V., Brumelis, G., Kalvinskis, K., Nikodemus, O., Tjarve, D., and Znotina, V., 1996: "Does the Skrunda Radio Location Station diminish the radial growth of pine trees?". *The Science of the Total Environment*, Vol 180, pp 57-64.
- Balode, Z., 1996: "Assessment of radio-frequency electromagnetic radiation by the micronucleus test in Bovine peripheral erythrocytes". *The Science of the Total Environment*, 180: 81-86.
- Baranski, S., 1972: "Histological and histochemical effects of microwave irradiation on the central nervous system of rabbits and guinea pigs". *Am. J. Physiol. Med.*, 51: 182-190.
- Baranaski, S., and Edelwejn, Z, 1974: "Pharmacological analysis of microwave effects on the central nervous system in experimental animals". In "Biological effects and health hazards of microwave radiation: Proceedings of an International Symposium". P. Czerski eds, Polish Medical Publishers, Warsaw.
- Bassen, H., Herchenroeder, P., Cheung, A., and Neuder, S., 1977: "Evaluation of an implantable electric field probe within finite simulated tissues". *Radio Science*, 12, Suppl 6: 15-25.
- Bawin, S.M., Gavalas-Medici, R., and Adey, W.R., 1973: "Effects of modulated very high frequency fields on specific brain rhythms in cats." *Brain Research*, 58: 365-384.
- Bawin, S.M., Kaczmarek, L.K., and Adey, W.R., 1975: "Effects of modulated VHF fields on the central nervous system". *Ann. N.Y. Acad. Sci.* 247:74-81.
- Bawin, S.M. and Adey, W.R., 1976: "Sensitivity of calcium binding in cerebral tissue to weak electric fields oscillating at low frequency". *Proc. Natl. Acad. Sci. USA*, 73: 1999-2003.
- Bawin, S.M., Adey, W.R., and Sabbot, I.M., 1978: "Ionic factors in release of  $45\text{Ca}^{2+}$  from chicken cerebral tissue by electromagnetic fields". *Proc. Natl Acad Sci. USA*, 75: 6314-6318.
- Beale, I.L., Pearce, N.E., Conroy, D.M., Henning, M.A. and Murrell, K.A., 1997: "Psychological effects of chronic exposure to 50 Hz magnetic fields in humans living near extra-high-voltage transmission lines." *Bioelectromagnetics*, 18(8):584-594 .
- Berman, E., Carter, H.B., and House D., 1982: "Reduce weight in mice offspring after in utero exposure to 2450 MHz (CW) microwaves". *Bioelectromagnetics*, 3(2): 285-291.
- Berridge, M., J., 1985: "The molecular basis of communication within the cell". *Scientific American*, 253 (4), (Oct) pp 142-152.
- Bini, M.G., Checcucci, A., Ignesti, A., Millanta, L., Olma, R., Rubina, N., and Vanni, R., 1986: "Exposure of workers to intense RF electric fields that leak from plastic sealers". *J. Microwave Power*, Vol 21, pp 33-40.
- Blackman, C.F., Elder J.A., Weil, C.M., Benane S.G., Eichinger, D.C., and House, D.E., 1979: "Induction of calcium-ion efflux from brain tissue by radiofrequency radiation: effects of modulation frequency and field strength". *Radio Science* 14(6S):93-98.
- Blackman, C.F., Benane, S.G., Elder, J.A., House, D.E., Lampe, J.A., and Faulk, J.M., 1980a: "Induction of Calcium-Ion Efflux from Brain Tissue by Radiofrequency Radiation: effect of sample number and modulation frequency on the power-density window". *Bioelectromagnetics*, 1: 35-43.

- Blackman, C.F., Benane, S.G., Joines, W.T., Hollis, M.A. and House, D.E., 1980b: "Calcium-Ion efflux from brain tissue: power density versus internal field-intensity dependencies at 50 MHz RF radiation.", *Bioelectromagnetics*, 1: 277-283.
- Blackman, C.F., Benane, S.G., House, D.E., and Joines, W.T., 1985: "Effects of ELF (1-120 Hz) and modulated (50Hz) RF fields on the efflux of calcium ions of brain tissue, in vitro". *Bioelectromagnetics*, 6:1-11.
- Blackman, C.F., Benane, S.G., Elliott, D.J., and Pollock, M.M., 1988: "Influence of Electromagnetic Fields on the Efflux of Calcium Ions from Brain Tissue in Vitro: A Three-Model Analysis Consistent with the Frequency Response up to 510 Hz". *Bioelectromagnetics*, 9:215-227.
- Blackman, C.F., Kinney, L.S., House, D.E., and Joines, W.T., 1989: "Multiple power-density windows and their possible origin". *Bioelectromagnetics*, 10: 115-128.
- Blackman, C.F., Benane, S.G., and House, D.E., 1991: "The influence of temperature during electric- and magnetic-field induced alteration of calcium-ion release from in vitro brain tissue". *Bioelectromagnetics*, 12: 173-182.
- Bonassi, S., Abbondandolo, A., Camurri, L., Dal Pra, L., De Ferrari, M., Degrassi, F., Forni, A., Lamberti, L., Lando, C., Padovani, P., et al, 1995: "Are chromosome aberrations in circulating lymphocytes predictive of future cancer onset in humans? Preliminary results of an Italian cohort study". *Cancer Genet. Cytogenet.*, 79(2):133-135.
- Bonhomme-Faivre, L., Marion, S., Bezie, Y., Auclair, H., Fredj, G. and Hommeau, C., 1998: "Study of human neurovegetative and hematologic effects of environmental low-frequency (50-Hz) electromagnetic fields produced by transformers." *Arch. Environ. Health*, Mar;53(2):87-92 .
- Borlongan, C.V., Kanning, K., Poulos, S.G., Freeman, T.B., Cahill, D.W., Sanberg, P.R. 1996: "Free radical damage and oxidative stress in Huntington's disease". *J Florida Med. Assoc.*, 83: 335-341.
- Brent, R.L., Beckman, D.A. and Landel, C.P., 1993: "Clinical teratology". *Current Opinion in Pediatrics*, 5(2): 201-211.
- Bretscher, M.S., 1985: "The molecules of the Cell Membrane". *Scientific American*, 253 (4), (Oct) pp 100-108.
- Brogger, A., Hagmar, L., Hansteen, I.L., Heim, S., Hogstedt, B., Knudsen, L., Lambert, B., Linnainmaa, K., Mitelman, F., Nordenson, I., et al, 1990: "An inter-Nordic prospective study on cytogenetic endpoints and cancer risk. Nordic Study Group on the Health Risk of Chromosome Damage". *Cancer Genet. Cytogenet.* 45(1):85-92.
- Brulfert, A., Miller, M.W., Robertson, D., Dooley, D.A., and Economou, P., 1985: "A cytohistological analysis of roots whose growth is affected by a 60 Hz electric field". *Bioelectromagnetics*, 6 (3): 283-291.
- Bullough, J., Rea, M.S., and Stevens, R.G., 1996: "Light and magnetic fields in a neonatal intensive care unit." *Bioelectromagnetics*, 17(5): 396-405.
- Burch, J.B., Reif, J.S., Pitrat, C.A., Keefe, T.J. and Yost, M.G., 1997: "Cellular telephone use and excretion of urinary melatonin metabolite". *Annual review of research in Biological Effects of electric and magnetic fields from generation delivery and use of electricity*, San Diego, CA, Nov 9-13, 1997.

- Burch, J.B., Reif, J.S., Yost, M.G., Keefe, T.J. and Pittrat, C.A., 1998: "Nocturnal excretion of urinary melatonin metabolite among utility workers". *Scand J Work Environ Health* 24(3): 183-189.
- Burch, J.B., Reif, J.S., Yost, M.G., Keefe, T.J. and Pittrat, C.A., 1999a: "Reduced excretion of a melatonin metabolite among workers exposed to 60 Hz magnetic fields" *Am J Epidemiology* 150(1): 27-36.
- Burch, J.B., Reif, J.S. and Yost, M.G., 1999b: "Geomagnetic disturbances are associated with reduced nocturnal excretion of melatonin metabolite in humans". *Neurosci Lett* 266(3):209-212.
- Burch, J.B., Reif, J.S., Noonan, C.W. and Yost, M.G., 2000: "Melatonin metabolite levels in workers exposed to 60-Hz magnetic fields: work in substations and with 3-phase conductors". *J of Occupational and Environmental Medicine*, 42(2): 136-142.
- Byus, C.V., Pieper, S., and Adey, W.R., 1987: "The effects of low-energy 60 Hz environmental electromagnetic fields upon the growth-related enzyme ornithine decarboxylase". *Carcinogenesis*, 8: 1385-
- Byus, C.V., Kartun, K., Pieper, S., and Adey, W.R., 1988: "Increased Ornithine Decarboxylase Activity in Cultured Cells Exposed to Low Energy Modulated Microwave Fields and Phorbol Ester Tumor Promoters", *Cancer Research*, 48, 4222-4226.
- Byus, C.V., 1994: "Alterations in Ornithine Decarboxylase Activity: a cellular response to Low-Energy Electromagnetic Field Exposure". Updated Sept 1994 from Summary and Results of the April 26-27, 1993 Radiofrequency Radiation Conference.
- Cairnie, A.B., Prud'homme-Lalonde, L.F., Harding, R.K., and Zuker, M., 1980: "The measurement of rectal and testes temperature in conscious mice, with observations on the effect of direct heating". *Phys. Med. Bio.*, 25(3): 317-322.
- Campbell, W.H., 1967: "Geomagnetic Pulsations", pp821-909, In "Physics of Geomagnetic Phenomena, Vol II", Matsushita, S. and Campbell W.H., eds, Academic Press.
- Cantor, K.P., Stewart, P.A., Brinton, L.A., and Dosemeci, M., 1995: "Occupational exposures and female breast cancer mortality in the United States". *Journal of Occupational Medicine*, 37(3): 336-348.
- Carney, J.M., and Floyd, R.A., 1991: "Protection against oxidative damage to CNS by ( $\alpha$ -phenyl-tert-butyl)nitron (PBN) and other spin-trapping agents: A novel series of nonlipid free radical scavengers". *J. Mol. Neurosci.*, 4:47-57.
- Carney, J.M., Starke-Reed, P.E., Oliver, C.N., Landum, R.W., Cheng, M.S., Wu, J.F. and Floyd, R.A., 1991: "Reversal of age-related increase in brain protein oxidation, decrease in enzyme activity, and loss in temporal and spatial memory by chronic administration of the spin-trapping compound N-tert-butyl- $\alpha$ -phenylnitron". *Proc. Nat. Acad. Sci. (USA)*, 88:3633-3636.
- Chazan, B., Janiak, M., Szmigielski, S., and Troszynski, M., 1983: "Development of murine embryos and fetuses after irradiation with 2450 MHz microwaves". *Problemy Medycyny Wieku Rozwojowego*, 12:164-173.

- Cherry, N, 2001: Re: "Cancer incidence near radio and television transmitters in Great Britain, II All high power transmitters", Dolk et al. 1997 a,b in *American J. of Epidemiology*, 145(1):1-9 and 10-17. Comment in *American J of Epidemiology* 153(2): 204-205.
- Cherry, N.J., 2002: "Schumann Resonances, a plausible biophysical mechanism for the human health effects of Solar/Geomagnetic Activity". *Natural Hazards* 56: 279-331.
- Chiang, H., Yap. G.D., Fang, Q.S., Wang, K.Q., Lu., D.Z., and Zhou, Y.K., 1989: "Health effects of environmental electromagnetic fields". *Journal of Bioelectricity*, 8:127-131.
- Chou, C-K., Guy, A.W., Kunz, L.L., Johnson, R.B., Crowley, J.J. and Krupp, JH., 1992: "Long-term, low-level microwave irradiation of rats". *Bioelectromagnetics* 13: 469-496.
- Cicchone, G., Mirabelli, D., Levis, A., Gavarotti, P., Rege-Cambrin, G., Davico, L., and Vineis, P., 1993: "Myeloid leukemias and myelodysplastic syndromes: chemical exposure, histologic subtype and cytogenetics in a case-control study". *Cancer Genetics & Cytogenetics* 1993 Jul 15;68(2):135-9.
- Clarkson, P.M., 1995: "Antioxidants and physical performance". *Crit. Rev. Food. Sci. Nutri.*, 35:131-141.
- Cleary, S.F., Liu, L.M., and Merchant, R.E., 1990a: "In vitro lymphocyte proliferation induced by radio-frequency electromagnetic radiation under isothermal conditions". *Bioelectromagnetics*, 11: 47-56.
- Cleary, S.F., Liu, L.M., and Merchant, R.E., 1990b: "Glioma proliferation modulated in vitro by isothermal radio-frequency radiation exposure". *Radiation Research*, 121: 38-45.
- Cleary, S.F., Liu, L.M., and Cao, G., 1992: "Effects of RF power absorption in mammalian cells". *Annals of the N.Y. Acad. Sci.*, 649: 166-175.
- Cleary, S.F., Cao, G., and Liu, L.M., 1996: "Effects of isothermal 2.45 GHz microwave radiation on the mammalian cell cycle: comparison with effects of isothermal 27 MHz radiofrequency radiation exposure". *Bioelectrochemistry and Bioenergetics*, 39: 167-173.
- Clemens, M.R., 1991: "Free radicals in chemical carcinogenesis". *Klinische Wochenschrift* , 69(21-23):1123-34.
- Clutton, S., 1995: "The importance of oxidative stress in apoptosis". *British Medical Bulletin*, 53 (3): 662-668.
- Conti, P., Gigante, G.E., Cifone, M.G., Alesse, E., Ianni, G., Reale, M., and Angeletti, P.U., 1983: "Reduced mitogenic stimulation of human lymphocytes by extremely low frequency electromagnetic fields". *FEBS* 0850, 162 (1): 156-160.
- Davis, S., 1997: "Weak residential Magnetic Fields affect Melatonin in Humans", *Microwave News*, Nov/Dec 1997.
- De Guire, L., Theriault, G., Iturra, H., Provencher, S., Cyr, D., and Case, B.W., 1988: "Increased incidence of malignant melanoma of the skin in workers in a telecommunications industry". *British Journal of Industrial Medicine*, Vol 45, pp 824-828.
- Demers, P.A., Thomas, D.B., Rosenblatt, K.A., Jimenez, L.M., Mc Tiernan, A, Stalsberg, H., Stemhagen, A., Thompson, W.D., McCrea, M.G., Satariano, W., Austin, D.F., Isacson, P., Greenberg, R.S., Key, C., Kolonel, L.N., and West, D.W., 1991: "Occupational exposure

- to electromagnetic fields and breast cancer in men", *Am. J. Epidemiology*, 134 (4): 340-347.
- Demers, P.A., Vaughan, T.L., Checkoway, H., Weiss, N.S., Heyer, N.J., and Rosenstock, L., 1992: Cancer Identification Using a Tumor Registry versus Death Certificates in Occupational Cohort Studies in the United States. *Am. Jour. of Epidem.*;136,10: 1232-1240
- Djordjevic, Z., Kolak, A., Stojkovic, M., Rankovic, N. and Ristic, P., 1979: "A study of the health status of radar workers". *Aviat. space environ. Med.*, Vol 50, pp 396-398.
- Dolk, H., Shaddick, G., Walls, P., Grundy, C., Thakrar, B., Kleinschmidt, I. and Elliott, P., 1997a: "Cancer incidence near radio and television transmitters in Great Britain, I - Sutton-Colfield transmitter". *American J. of Epidemiology*, 145(1):1-9.
- Dolk, H., Elliott, P., Shaddick, G., Walls, P., Grundy, C., and Thakrar, B., 1997b: "Cancer incidence near radio and television transmitters in Great Britain, II All high power transmitters". *American J. of Epidemiology*, 145(1):10-17.
- Dorland 28, 1994: "Dorland's illustrated medical dictionary, edition 28", Publ. W.B. Saunders and Co., Philadelphia, USA.
- Dumansky, J.D., and Shandala M.G., 1974: "The biologic action and hygiene significance of electromagnetic fields of super high and ultrahigh frequencies in densely populated areas". pp289-293, in "Biologic effects and Health Hazards of Microwave Radiation", Ed. P. Czerski, Warsaw Polish Medical Publication.
- Durham, A.C. and Walton, J.M., 1982: "Calcium ions and the control of proliferation in normal and cancer cells." *Biosci. Rep.*, Jan;2(1):15-30 .
- Dutta, S.K., Subramonian, A., Ghosh, B., and Parshad, R., 1984: "Microwave radiation-induced calcium ion efflux from human neuroblastoma cells in culture". *Bioelectromagnetics*, 5: 71-78.
- Enwonwu, C.O., and Meeks, V.I., 1995: "Bionutrition and oral cancer in humans." *Critical Reviews in Oral Biology & Medicine*. 6(1):5-17.
- Feychting, M., and Ahlbom, A., 1993: "Magnetic fields and cancer in children residing near Swedish High-voltage power lines". *Am J. Epidemiology*, 138 (7): 467-481.
- Feychting, M., Schulgen, G., Olsen, J.H., and Ahlbom, A., 1995: "Magnetic fields and childhood cancer- pooled analysis of two Scandinavian studies". *European J. of Cancer*, 31A (12): 2035-2039.
- Fletcher, W.H., Shui, W.W., Haviland, D.A., Ware, C.F., and Adey, W.R., 1986: " A modulated-microwave field and tumor promoters similarly enhance the action of alpha-lymphotoxin (aLT)". *Proce. Bioelectromagnetics Soc.*, 8th Annual Meeting, Madison, Wisconsin, p12, Bioelectromagnetics Society, Frederick, MD.
- Fletcher, W.H., Shiu, W.W., Ishida, T.A., Haviland, D.L., and Ware, C.F., 1987: "Resistance to the cytolytic action of lymphotoxin and tumor necrosis factor coincides with the presence of gap junctions uniting target cells". *J. Immunology*, 139: 956-
- Floyd, R.A., 1991: "Oxidative damage to behavior during aging". *Science*, 254:1597.

- Forster, M.J., Dubey, A., Dawson, K.M., Stutts, W.A., Lai, H., and Sotal, R.S., 1996: "Age-related losses in cognitive function and motor skills in mice are associated with oxidative protein damage in the brain." *Proc. Nat. Acad. Sci. (USA)*, 93: 4765-4769.
- Frey, A.H., 1971: "Biological function as influenced by low power modulated RF energy". *IEEE trans on Microwave Theory and Techniques*, MTT-19:153-164.
- Frey, A.H., Fgeld, S.R. and Frey, B., 1975: "Neural function and behaviour: defining the relationship". *Ann. N.Y. Acad. Sci.*, 247: 433-439.
- Frey, A.H., 1988: "Evolution and results of biological research with low intensity nonionizing radiation". pp 785-837, In "Modern Bioelectricity", Ed A. Marino, Publ. Marcel Dekker Inc, New York.
- Frey, A.H., 1994: "An integration of the data on mechanisms with particular reference to cancer", Chapter 2 in "On the Nature of electromagnetic Field Interactions with Biological Systems", Ed A.H. Frey, Publ. R.G. Landes Co. Medical Intelligence Unit, Austin, Texas.
- Friedman, H.L., 1981: "Are chronic exposure to microwaves and polycythemia associated [letter]". *New England J. Med.*, 304 (6), pp 357-358.
- Galvanovskis, J., Sandblom, J., Bergqvist, B., Galt, S., and Hamnerius, Y., 1996: "The influence of 50-Hz magnetic fields on cytoplasmic Ca<sup>2+</sup> oscillations in human leukemia T-cells". *The Science of the Total Environment*, 180:19-33.
- Gandhi, O.P., 1980: "State of knowledge for electromagnetic absorbed dose in man and animals". *Proc. IEEE*, 68 (1), 24-32.
- Gandhi, O.P., 1990: "ANSI radiofrequency safety guide: Its rationale, some problems and suggested improvements". pp 28-46. In "Biological effects and medical applications of electromagnetic energy", Ed Om.P. Gandhi, Publ. Prentice Hall.
- Garaj-Vrhovac, V., Fucic, A, and Horvat, D., 1990: "Comparison of chromosome aberration and micronucleus induction in human lymphocytes after occupational exposure to vinyl chloride monomer and microwave radiation"., *Periodicum Biologorum*, Vol 92, No.4, pp 411-416.
- Garaj-Vrhovac, V., Fucic, A, and Horvat, D., 1992: The correlation between the frequency of micronuclei and specific aberrations in human lymphocytes exposed to microwave radiation in vitro". *Mutation Research*, 281: 181-186.
- Garaj-Vrhovac, V., and Fucic, A., 1993: "The rate of elimination of chromosomal aberrations after accidental exposure to microwave radiation". *Bioelectrochemistry and Bioenergetics*, 30:319-325.
- Garson, O.M., McRobert, T.L., Campbell, L.J., Hocking, B.A., and Gordon, I., 1991: "A chromosomal study of workers with long-term exposure to radio-frequency radiation". *The Medical Journal of Australia*, 155: 289-292.
- Giuliana, L., Vignati, M., Cifone, M.G., and Alesse, E., 1996: "Similarity of effects induced by ELF, amplitude modulated RF and ELF magnetic fields on PHB in vitro". *Radiation in Work*, Supplement PS 309, p 332.
- Goldhaber, M.K., Polen, M.R., and Hiatt, R.A., 1988: "The risk of miscarriage and birth defects among women who use visual display terminals during pregnancy". *Am. J. Industrial Medicine*, Vol 13, p695.

- Goldsmith, J.R., 1992: "Incorporation of epidemiological findings into radiation protection standards Public". *Health Rev* 1991/92; 19: 19-34.
- Goldsmith, J.R., 1995: "Epidemiological Evidence of Radiofrequency Radiation (Microwave) Effects on Health in Military, Broadcasting, and Occupational Studies". *International Journal of Occupational and Environmental Health*, 1, pp 47-57, 1995.
- Goldsmith, J.R., 1998: "Epidemiologic evidence relevant to radar (microwave) effects". *Environmental Health Perspectives*, 105 (Suppl 6), Dec 1997, pp 1579-1587.
- Goldstein, L. and Sisko, Z., 1974: "A quantitative electro-encephalographic study of the acute effect of X-band microwaves in rabbits". In "Biological effects and health hazards of microwave radiation: Proceedings of an International Symposium". P. Czerski eds, Polish Medical Publishers, Warsaw.
- Graham, C., Cook, M.R., Cohen, H.D. and Gerkovich, M.M., 1994: "A dose response study of human exposure to 60Hz electric and magnetic fields". *Bioelectromagnetics* 15: 447-463.
- Graham, C., Cook, M.R., Sastre, A., Riffle, D.W. and Gerkovich, M.M., 2000: "Multi-night exposure to 60 Hz magnetic fields: effects on melatonin and its enzymatic metabolite". *J Pineal Res* 28(1): 1-8.
- Grayson, J.K., 1996: "Radiation Exposure, Socioeconomic Status, and Brain Tumour Risk in the US Air Force: A nested Case-Control Study". *American J. of Epidemiology*, 143 (5), 480-486.
- Grinstein, S., and Klip, A., 1989: "Calcium homeostasis and the activation of calcium channels in cells of the immune system". *Bulletin of the New York Academy of Medicine*, 65 (1), 69-79.
- Grundler, W., and Keilmann, F., 1978: "nonthermal effects of millimeter microwaves on yeast growth". *Z. Naturforsch*, 33C:15-22.
- Grundler, W., and Kaiser, F., 1992: "Experimental evidence for coherent excitations correlated with cell growth". *Nanobiology* 1: 163-176.
- Grundler, W., Kaiser, F., Keilmann, F., and Walleczek, J., 1992: "Mechanisms of electromagnetic interaction with cellular systems". *Naturwissenschaften*.
- Guy, A.W., Chou, C.K., Kunz, L.L., Crowley, J, and Krupp, J., 1985: "Effects of long-term low-level radiofrequency radiation exposure on rats. Vol 9. Summary. University of Washington, USAFSAM-TR-85-64.
- Hagmar, L., Brogger, A., Hansteen, I.L., et al. (1994): "Cancer risk in humans predicted by increased levels of chromosomal aberrations in lymphocytes: Nordic Study Group on the health risk of chromosome damage". *Cancer Research*, 54: 2919-2922.
- Haider, T., Knasmueller, S., Kundi, M, and Haider, M., 1994: "Clastogenic effects of radiofrequency radiation on chromosomes of *Tradescantia*". *Mutation Research*, 324:65-68.
- Hamburger, S., Logue, J.N., and Sternthal, P.M., 1983: "Occupational exposure to non-ionizing radiation and an association with heart disease: an exploratory study". *J Chronic Diseases*, Vol 36, pp 791-802.

- Haque, M.F., Aghabeighi, B., Wasil, M., Hodges, S. and Harris, M. 1994: "Oxygen free radicals in idiopathic facial pain". *Bangladesh Med. Res. Council Bul.*, 20:104-116.
- Harrison, G.H., McCulloch, D., and Balcer-Kubiczek, E.K., 1985: "Far-field 2.45 GHz irradiation system for cellular monolayers in vitro." *J. Microwave Power*, 20: 145-151.
- Hayes, R.B., Morris Brown, L., Pottern, L.M., Gomez, M., Kardaun, J.W.P.F., Hoover, R.N., O'Connell, K.J., Sutsman, R.E. and Nasser, J., 1990: Occupational and Risk for Testicular Cancer: A Case Control Study. *International Journal of Epidemiology*, 19, No.4, pp 825-831, 1990.
- Heller, J.H., and Teixeira-Pinto, A.A., 1959: "A new physical method of creating chromosome aberrations". *Nature*, Vol 183, No. 4665, March 28, 1959, pp 905-906.
- Hocking, B. and Joyner, K., 1995: "Re: Miscarriages among Female Physical Therapists who report using radio- and microwave- frequency electromagnetic radiation." - A letter to the Editor, *American J. of Epidemiology*, 141 (3): 273-274.
- Hocking, B., Gordon, I.R., Grain, H.L., and Hatfield, G.E., 1996: "Cancer incidence and mortality and proximity to TV towers". *Medical Journal of Australia*, Vol 165, 2/16 December, pp 601-605.
- Hollenberg, P.F., 1992; *FASEB J*, 6:686-694.
- Holly, E.A., Aston, D.A., Ahn, D.K., and Smith A.H., 1995: "Intraocular Melanoma Linked to Occupations and Chemical Exposure". *Epidemiology*, 7(1):55-61.
- Joines, W.T. and Blackman, C.F., 1980: "Power density, field intensity and carrier frequency determinants of RF-energy-induced calcium ion efflux from brain tissue". *Bioelectromagnetics*, 1: 271-275.
- Joines, W.T. and Blackman, C.F., 1981: "Equalizing the electric field intensity within chick brain immersed in buffer solution at different carrier frequencies". *Bioelectromagnetics*, 2: 411-413.
- Joines, W.T., Blackman, C.F., and Hollis, M.A., 1981: "Broadening of the RF power-density window for calcium-ion efflux from brain tissue". *IEEE Trans on Biomedical engineering*, BME-28 (8), pp 568-573.
- Johnson, C.C., and Spitz, C.C., 1989: "Childhood nervous system tumors: an assessment of risk associated with parental operations involving use, repair or manufacture of electrical and electronic equipment". *International J. of Epidemiology*, Vol 18, p 756.
- Juutilainen, J., Stevens, R.G., Anderson, L.E., Hansen, N.H., Kilpelainen, M., Laitinen, J.T., Sobel, E. and Wilson, B.W., 2000: "Nocturnal 6-hydroxymelatonin sulphate excretion in female workers exposed to magnetic fields". *J Pineal Res* 28(2): 97-104.
- Kallen, B., Malmquist, G., and Moritz, U., 1982: "Delivery Outcome among Physio-therapists in Sweden: is Non-ionising Radiation a Fetal Hazard ? *Archives of Environmental Health*, 37(2): 81-84.
- Kalnins, T., Krizbergs, R., and Romancuks, A., 1996: "Measurement of the intensity of electromagnetic radiation from the Skrunda radio location station, Latvia". *The Science of the Total Environment*, Vol 180, pp 51-56.

- Karabakhtsian, R., Broude, N., Shalts, N., Kochlatyi, S., Goodman, R., Henderson, A.S., 1994: "Calcium is necessary in the cell response to EM fields". *FEBS Letters*; 349(1):1-6. JUL 25 1994.
- Karasek, M., Woldanska-Okonska, M., Czernicki, J., Zylinska, K. and Swietoslowski, J., 1998: "Chronic exposure to 2.9 mT, 40 Hz magnetic field reduces melatonin concentrations in humans". *J Pineal Research* 25(4): 240-244.
- Kizaki, H., Tadakuma, T., Odaka, C. et al. (1989): "Activation of a suicide process of thymocytes through DNA fragmentation by calcium ionosphere and phorbol esters." *J. Immunology*, 143: 1790-1799.
- Kolmodin-Hedman, B., Mild, K.H., Jonsson, E., Andersson, M-C., and Eriksson, A., 1988: "Health problems among operators of plastic welding machines and exposure to radiofrequency electromagnetic fields". *Ind. Arch. Occup. Environ. Health*, 60(4): 243-247.
- Kolodynski, A.A. and Kolodynska, V.V., 1996: "Motor and psychological functions of school children living in the area of the Skruna Radio Location Station in Latvia". *The Science of the Total Environment*, Vol 180, pp 87-93.
- Kolomytkin, O., Kuznetsov, V., Yurinska, M, Zharikova, A., and Zharikov, S., 1994: "Response of brain receptor systems to microwave energy exposure". pp 195-206 in "On the nature of electromagnetic field interactions with biological systems", Ed Frey, A.H., Publ. R.G. Landes Co.
- Kondo, T., Arai, M., Kuwabara, G., Yoshii, G., and Kano, E., 1985: "Damage in DNA irradiated with 1.2 MHz ultrasound and its effect on template activity of DNA for RNA synthesis". *Radiation Research*, 104: 284-292.
- König, H.L., 1974: "Behavioural changes in human subjects associated with ELF electric fields". In "ELF and VLF electromagnetic field effects", M.A. Persinger Ed, Publ. Plenum Press, New York.
- Krause, D.N. and Dubocovich, M.L., 1990: "Regulatory sites in the melatonin system of mammals". *TINS*, Vol 13 (11): 464-470.
- Kurose, I., Higuchi, H., Kato, S., Miura, S. and Ishii, H. 1996: "Ethanol-induced oxidative stress in the liver". *Alcohol Clin. Exp. Res.*, 20(1 Suppl): 77A-85A.
- Lafon-Cazal, M., Culcasi, M., Gaven, F., Pietri, S. and Bockaert, J., 1993a: "Nitric oxide, superoxide and peroxynitrite: putative mediators of NMDA-induced cell death in cerebellar granule cells". *Neurophysiol.*, 32:1259-1266.
- Lafon-Cazal, M., Pietri, S., Culcasi, M. and Bockaert, J. 1993b: "NMDA-dependent superoxide production and neurotoxicity". *Nature*, 354:535-537.
- Lai, E.K., Crossley, C., Sridhar, R., Misra, H.P., Janzen, E.G. and McCay, P.B. 1986: "In vivo spin trapping of free radicals generated in brain, spleen, and liver during  $\gamma$ -radiation of mice". *Arch. Biochem. Biophys.*, 244:156-160.
- Lai, H. and Singh, N.P., 1995: "Acute low-intensity microwave exposure increases DNA single-strand breaks in rat brain cells". *Bioelectromagnetics*, Vol 16, pp 207-210, 1995.
- Lai, H. and Singh, N.P., 1996: "Single- and double-strand DNA breaks in rat brain cells after acute exposure to radiofrequency electromagnetic radiation". *Int. J. Radiation Biology*, 69 (4): 513-521.

- Lai, H. and Singh, N.P., 1997a: "Acute exposure increases to a 60 Hz Magnetic Field increases DNA strand breaks in rat brain cells". *Bioelectromagnetics*, Vol 18: 156-165.
- Lai, H., and Singh, N.P., 1997b: "Melatonin and N-tert-butyl-a-phenylnitron Block 60 Hz magnetic field-induced DNA single- and double-strands Breaks in Rat Brain Cells." *Journal of Pineal Research*, 22:152-162.
- Lai, H., and Singh, N.P., 1997c: "Melatonin and Spin-Trap compound Block Radiofrequency Electromagnetic Radiation-induced DNA Strands Breaks in Rat Brain Cells." *Bioelectromagnetics*, 18:446-454.
- Larsen, A.I., Olsen, J., and Svane, O., 1991: "Gender specific reproductive outcome and exposure to high frequency electromagnetic radiation among physiotherapists". *Scand. J. Work Environ. Health*, Vol.17, pp 324-329.
- Lawrence, A.F., and Adey, W.R., 1982: "Nonlinear wave mechanisms in interactions between excitable tissue and electromagnetic fields". *Neurological Research*, 4: 115-153.
- Lednev, V.V. 1995: "Comments on 'Clarification and application of ion parametric resonance model for magnetic field interactions with biological systems', by Blanchard and Blackman. *Bioelectromagnetics*, 16: 268-269.
- Lee GM, Neutra RR, Hristova L, Yost M, and Hiatt RA., 2002: "A nested case-control study of residential and personal magnetic field measures and miscarriages". *Epidemiology* 13(1): 21-31.
- Lemasters, J.L., Di Fuisseppi, J., Nieminen, A.L., Blebbing H.B., 1987: "Free calcium and mitochondrial membrane potential preceding cell death in hepatocytes". *Nature* , 325: 78-81.
- Lerchl, A., Nonaka, K.O., Stokkan, K.A. and Reiter, R.J., 1990: "Marked rapid alterations in nocturnal pineal serotonin metabolism in mice and rats exposed to weak intermittent magnetic fields." *Biochem Biophys Research Communications*, 169: 102-108.
- Lerchl, A., Nonaka, K.O. and Reiter, R.J., 1991: "Pineal gland 'magnetosensitivity' to static magnetic fields is a consequence of induced electric currents (eddy currents)". *J. Pineal Research*, 10: 109-116.
- Lester, J.R., and Moore, D.F., 1982a: "Cancer incidence and electromagnetic radiation". *Journal of Bioelectricity*, 1(1):59-76.
- Lester, J.R., and Moore, D.F., 1982b: "Cancer mortality and air force bases". *Journal of Bioelectricity*, 1(1):77-82.
- Lester, J.R., and Moore, D.F., 1985: "Reply to: Cancer mortality and air force bases, a reevaluation". *Journal of Bioelectricity*, 4(1):129-131.
- Levallois, P., Dumont, M., Touitou, Y., Gingras, S., Masse, B., Gauvin, D., Kroger, E., Bourdages, M. and Douville, P., 2001: "Effects of electric and magnetic fields from high-power lines on female urinary excretion of 6-sulfatoxymelatonin". *Am J Epidemiology* 154(7): 601-609.
- Levin, M. and Ernst, S.G., 1995: "Applied AC and DC magnetic fields cause alterations in mitotic cycle of early sea urchin embryos". *Bioelectromagnetics*, 16 (4): 231-240.

- Li DK, Odouli R, Wi S, Janevic T, Golditch I, Bracken TD, Senior R, Rankin R, and Iriye R., 2002: "A population-based prospective cohort study of personal exposure to magnetic fields during pregnancy and the risk of miscarriage". *Epidemiology* 13(1): 9-20.
- Liburdy, R.P., Sloma, T.R., and Yaswen, P., 1993: "ELF magnetic fields, breast cancer and melatonin: 60 Hz fields block melatonin's oncostatic action on ER+ breast cancer cell proliferation". *Journal of Pineal Research*, 14 (2): 89-97.
- Liboff, A.R., Rozak, R.J., Sherman, M.L., McLeod, B.R., and Smith, S.D., 1987: "Calcium-45 cyclotron resonance in human lymphocytes.", *J. Bioelectromagnetics*, 6: 13-22.
- Lilienfeld, A.M., Tonascia, J., and Tonascia S., Libauer, C.A., and Cauthen, G.M., 1978: "Foreign Service health status study - evaluation of health status of foreign service and other employees from selected eastern European posts". Final Report (Contract number 6025-619073) to the U.S. Dept of State, July 31, 1978.
- Lin, H., Goodman, R., and Shirley-Henderson, A., 1994: "Specific region of the c-myc promoter is responsive to electric and magnetic fields". *J Cell Biochemistry*, Mar; 54(3): 281-288.
- Lin, R.S., Dischinger, P.C., Conde, J., and Farrel, K.P., 1985: "Report on the relationship between the incidence of brain tumors and occupational electromagnetic exposure". *Journal of Occupational Medicine*, 27: 413-419.
- Lin-Liu, S. and Adey, W.R., 1982: "Low frequency amplitude modulated microwave fields change calcium efflux rates from synaptomes". *Bioelectromagnetics*, 3: 309-322.
- Lindstrom, E., Lindstrom, P., Berlund, A., Lundgren, E., and Mild, K.H., 1995: "Intracellular calcium oscillations in a T-cell line after exposure to extremely-low-frequency magnetic fields with variable frequencies and flux densities". *Bioelectromagnetics*, 16: 41-47.
- Liu, L.M., and Cleary S.F., 1995: "Absorbed energy distribution from radiofrequency electromagnetic radiation in a mammalian cell model: effect of membrane-bound water". *Bioelectromagnetics*, 16 : 160-171.
- Lindholm, M.L., Hietanen, M., Kyyronen, P., Sallmen, M., von Nandelstadh, P., Taskinen, H., Pekkarinen, M., Ylikoski, M., and Hemminki, K., 1992: "Magnetic fields of video display terminals and spontaneous abortion". *Am. J. Epidemiology*, 136(9): 1041-1051.
- Lissonin, P., Viviani, S., Bajetta, E., Buzzoni, R., Barreca, A., Mauri, R., Resentini, M., Morabito, F., Esposti, D., Esposti, G., et al., 1986: "A clinical study of the pineal gland activity in oncologic patients." *Cancer*, 57(4): 837-842.
- Lotmar, R., Ranscht-Froemsdorff, W.R. and Weise, H., 1969: "Dampfung der Gewebeatmung (CO<sub>2</sub>) von Mauseleber durch kunstliche impulsstrahlung", *Int. J. Biometeorology*, 13(3&4), 231-238.
- Luben, R., 1995: "Statement of Dr Richard A Luben on the Biology and Biochemistry of EMR, including RF/MW", Planning Tribunal Hearing, Decision A 15/96.
- Lyle, D.B., Schechter, P., Adey, W.R. and Lundak, R./L., 1983: "Suppression of T lymphocyte cytotoxicity following exposure to sinusoidally amplitude-modulated fields". *Bioelectromagnetics*, 4: 281-292.
- Maes, A., Collier, M., Slaets, D., and Verschaeve, L., 1996: "954 MHz Microwaves enhance the mutagenic properties of Mitomycin C". *Environmental and Molecular Mutagenesis*, 28: 26-30.

- Maestroni, G.J., 1995: "T-helper-2 lymphocytes as Peripheral target of melatonin signalling". J. Pineal Research, 18: 84-89.
- Magone, I., 1996: "The effect of electromagnetic radiation from the Skrunđa Radio Location Station on *Spirodela polyrhiza* (L.) Schleiden cultures". The Science of the Total Environment, Vol 180, pp 75-80.
- Mann, K., and Roschke, J., 1995: "Effects of pulsed high-frequency electromagnetic fields on human sleep". Neuropsychobiology, 33: 41-47.
- Mar, P.K., Kumar, A.P., Kang, D.C., Zhao, B., Martinez, L.A., Montgomery, R.L., Anderson, L., and Butler, A.P., 1995: "Characterization of novel phorbol ester- and serum-responsive sequences of the rat ornithine decarboxylase gene promoter." Molecular Carcinogenesis. 14(4):240-50.
- Maskarinec, G., and Cooper, J., 1993: "Investigation of a childhood leukemia cluster near low-frequency radio towers in Hawaii". SER Meeting, Keystone, Colorado, June 16-18, 1993. Am. J. Epidemiology, 138:666, 1993.
- Mattana, A., Bennardini, F., Usai, S., Fiori, P.L., Franconi, F. and Cappuccinelli, P., 1997: "Acanthamoeba castellanii metabolites increase the intracellular calcium level and cause cytotoxicity in wish cells." Microb. Pathog., Aug 23 (2):85-93 .
- McConkey, D.J., Hartzell, P., Duddy, S.K. et al. , 1988: "2,3,7,8-Tetrachlorodibenso-p-dioxin kills immature thymocytes by Ca<sup>2+</sup>-mediated endonuclease activation." Science, 242: 256-257.
- McCord, J.M. and Fridovich, I., 1978: "The biology and pathology of oxygen radicals". Ann. Intern. Med., 89:122-127.
- McGauchy, R., 1990: "Evaluation of the potential carcinogenicity of electromagnetic fields". U.S. E.P.A. external review draft EPA/600/6-90/005B, October 1990.
- McLauchlan, K, 1992: "Are environmental magnetic fields dangerous?" Physics World. pp 41-45.
- McRee, D.I., 1970: "Soviet and Eastern Research on Biological effects of Microwave Radiation"., Proc. of the IEEE, Vol. 68 (1), 84-91.
- Maunder, W.J., 1970: "The value of the weather". Publ. Methuen & Co Ltd, London, 388pp.
- Merrett, J.H., Chamness, A.F. and Allan, S.J., 1978: "Studies on the blood-brain barrier permeability after microwave radiation". Radiation Environmental Biophysics, 15: 367-377.
- Merritt, J.H., Shelton, W.W., and Chamness, A.F., 1982: "Attempt to alter Ca-45<sup>2+</sup> binding to brain tissue with pulse-modulated microwave energy". Bioelectromagnetics, 3: 457-478.
- Michelozzi, P., Capon, A., Kirchmayer, U., Forastiere, F., Biggeri, A., Baraca, A. and Perucci, C.A., 2002: "Adult and childhood Leukaemia near a high-power radio station in Rome, Italy". Am J. Epidemiology 155(12): 1096-1103.
- Milhan, S., 1985: "Silent Keys", Lancet 1, 815, 1985.
- Milham, S., 1988: "Increased mortality in amateur radio operators due to lymphatic and hematopoietic malignancies". Am. J. Epidemiology, Vol 127, No.1, pp 50-54.
- Miller, W.H., 1968: "Santa Ana winds and crime". Prof Geog. 20: 23-27.

- Mitchel, L.M., McRee, D.I., Peterson, N.J., Tilson, H.A., Shandala, M.G., Rudnev, M.I., Varetskii, V.V., and Navakatikyan, M.I., 1989: "Results of a United States and Soviet Union Joint Project on Nervous System Effects of Microwave Radiation." *Environmental Health Perspectives*, 81: 201-209.
- Murphy, J.C., Kaden, D.A., Warren, J., and Sivak, A., 1993: "International Commission for Protection Against Environmental Mutagens and Carcinogens. Power frequency electric and magnetic fields: a review of genetic toxicology". *Mutation Research*, 296(3):221-40.
- Murray, A., and Hunt, T., 1993: "The cell cycle: an introduction". Publ. Oxford University Press, Oxford.
- Mustelin, T., Poso, P., Lapinjoki, S.P., Gynther, J., and Anderssen, L.C., 1987: "Growth signal transduction: rapid activation of covalently bound ornithine decarboxylase during phosphatidylinositol breakdown". *Cell*, 49: 171-176.
- Nelson, P.G., 1966: "Interaction between spinal motoneurons of the cat." *J. Neurophysiology*, 29: 275-287.
- Nilsson, R., Hamnerius, Y., Mild, K.H., Hansson, H-A., Hjelmqvist, E., Olanders, S., and Persson, L.I., 1989: "Microwave effects on the central nervous system - a study of radar mechanics". *Health Physics*, Vol 56 (5), pp 777-779.
- Nordenson, I., Beckman, L., Liden, S. and Stjernberg, N., 1984: "Chromosomal aberrations and cancer risk". *Hum. Hered.*, 34(2):76-81.
- Nordenson, I., Mild, K.H., Andersson, G., and Sandstrom, M., 1994: "Chromosomal aberrations in human amniotic cells after intermittent exposure to 50 Hz magnetic fields". *Bioelectromagnetics* 15(4):293-301.
- Nuzzo, F. and Stefanini, M., 1989: "Monitoring of genetic instability in subjects with increased risk of cancer". *Ann Ist Super Sanita*, 25(1):81-89.
- NZPT, 1996: "New Zealand Planning Tribunal Decision: J.M. McIntyre and others vs BellSouth New Zealand", Decision A 15/96.
- Oliver, C.N., Starke-Reed, P.E., Stadtman, E.R., Liu, G.J., Carney, J.M. and Floyd, R.A., 1990: "Oxidative damage to brain proteins, loss of glutamine synthetase activity, and production of free radicals during ischemia/reperfusion-induced injury to gerbil brain". *Proc. Nat. Acad. Sci. (USA)*, 87:5144-5147.
- Orrenius, S., McCabe, M.J. and Nicotera, P., 1992: "Ca(2+)-dependent mechanisms of cytotoxicity and programmed cell death". *Toxicol. Lett.*, Dec; 64-65.
- Ouellet-Hellstrom, R. and Stewart, W.F., 1993: "Miscarriages among Female Physical Therapists who report using radio- and microwave- frequency electromagnetic radiation." *American J. of Epidemiology*, 138 (10): 775-86.
- Ouellet-Hellstrom, R. and Stewart, W.F., 1995: "Re: Miscarriages among Female Physical Therapists who report using radio- and microwave- frequency electromagnetic radiation." (Reply), *American J. of Epidemiology*, 141(3), p274.
- Owen, A.D., Schapira, A.H., Jenner, P. and Marsden, C.D., 1996: "Oxidative stress and Parkinson's disease". *Ann. NY. Acad. Sci.*, 786:217-223.

- PCFE, 1996: "Public Authority Planning for Cellphone Transmission Facilities", Office of the Parliamentary Commissioner for the Environment, P.O. Box 10-241, Wellington New Zealand, 31 pp.
- Phelan, A.M., Lange, D.G., Kues, H.A, and Luty, G.A., 1992: "Modification of membrane fluidity in Melanin-containing cells by low-level microwave radiation". *Bioelectromagnetics*, 13 : 131-146.
- Phillips, J.L., 1993: "Effects of electromagnetic field exposure on gene transcription". *J Cell Biochemistry*, Apr; 51(4): 381-386.
- Pfluger, D.M. and Minder, C.E., 1996: "Effects of 16.7 Hz magnetic fields on urinary 6-hydroxymelatonin sulfate excretion of Swiss railway workers". *J Pineal Research* 21(2): 91-100.
- Prausnitz, S. and Susskind, C., 1962: "Effects of chronic microwave irradiation on mice". *IRE Trans on Biomed. Elecron.* 9: 104-108.
- Preston-Martin, S., Mack, W., and Henderson, B.E., 1989: "Risk factors for gliomas and meningiomas in males Los Angeles County". *Cancer Research*, Vol 49, p 6137.
- Reite, M., Higgs, L., Lebet, J.P, Barbault, A., Rossel, C., Kuster, N., Dafni, U., Amato, D., and Pasche, B.: "Sleep inducing effect of low energy emission therapy". *Bioelectromagnetics*, 15: 67-75.
- Reiter, R, 1992: "Phenomena in Atmospheric and environmental electricity". *Developments in Atmospheric Science*, 20, Publ Elsevier, Amsterdam.
- Reiter, R.J., 1994: "Melatonin suppression by static and extremely low frequency electromagnetic fields: relationship to the reported increased incidence of cancer". *Reviews on Environmental Health*. 10(3-4):171-86, 1994.
- Reiter, R., 1995: "Oxidative processes and antioxidative defense mechanisms in the aging brain". *FASEB J.*, 9:526-533.
- Reiter, R.J., Melchiorri, D., Sewerynek, E., Poeggeler, B., Barlow-Waiden, L., Chuang, J., Ortiz, G.G. and Acuna-Castroviejo, D., 1995: "A review of the evidence supporting melatonin's role as an antioxidant". *J.Pineal Res.*, 18:1 -11.
- Reiter, R.J., and Robinson, J., 1995: "Melatonin: your body's natural wonder drug". Bantam Books, New York.
- Repacholi, M.H., 1995: "Statement of Dr Michael Repacholi, New Zealand Planning Tribunal Hearing, Decision A 15/96, Christchurch, November 1995.
- Repacholi, M.H., Basten, A., Gebski, V., Noonan, D., Finnie, JH., and Harris, A.W., 1997: "Lymphomas in E $\mu$ -*Pim1* Transgenic Mice Exposed to Pulsed 900 MHz Electromagnetic Fields". *Radiation Research*, 147:631-640.
- Rodriguez-del Valle, N., and Rodriguez-Medina, J.R., 1993: "Calcium stimulates molecular and cellular events during the yeast-to-mycelium transition in *Sporothrix schenckii*". *J. Med. Vet. Mycol*, 31(1): 43-53.
- Rosen, L.A., Barber, I. and Lyle D.B., 1998: "A 0.5 G, 60 HZ magnetic field suppresses melatonin production in pinealocytes". *Bioelectromagnetics* 19: 123-127.

- Roubinette, C.D., and Silverman, C., 1977: "Causes of death following occupational exposure to microwave radiation (radar) 1950-1974." Rockville, U.S. Dept of Health, Education and Welfare, pp 338-344 (US DHEW Publication (FDA) 77-8026).
- Robinette, C.D., Silverman, C. and Jablon, S., 1980: "Effects upon health of occupational exposure to microwave radiation (radar)". American Journal of Epidemiology, 112(1):39-53, 1980.
- Rowley, R., 1990: "Repair of radiation-induced chromatid aberrations: relationship to G2 arrest in CHO cells". International Journal of Radiation Biology, 58(3):489-98.
- Sagripani, J. and Swicord, M.L., 1976: DNA structural changes caused by microwave radiation. Int. J. of Rad. Bio., 1(1), pp 47-50, 1976.
- Sait, M.L., Wood, A.W., Armstrong, S.M., and Martin, M.J., 1997: "Are human plasma melatonin profiles delayed in some individuals in response to 50 Hz magnetic field exposure ?" A-44
- Sandyk, R., Anastasiadis, P.G., Anninos, P.A., and Tsagas, N., 1992: "The pineal gland and spontaneous abortions: implications for therapy with melatonin and magnetic field." International Journal of Neuroscience. 62(3-4):243-50, 1992.
- Sarkar, S., Sher, A., and Behari, J., 1994: "Effect of low power microwave on the mouse genome: A direct DNA analysis". Mutation Research, 320: 141-147.
- Savitz, D.A., and Chen, J., 1990: "Parental occupation and childhood cancer: Review of epidemiological studies". Environmental Health Perspectives", 88: 325-337.
- Schwan, H.P., 1969: "Interaction of microwave and radiofrequency radiation with biological systems". Proc. Symposium on Biological effects and health implications of microwave radiation, Richmond, VA.
- Schwan, H.P. and Foster, K.R., 1980: "RF-field interactions with biological systems: electrical properties and biophysical mechanisms". Proc. of the IEEE, 68(1): 104-113.
- Schwartz, J.L., House, D.E., and Mealing, A.R., 1990: "Exposure of frog hearts to CW or amplitude modulated VHF fields: selective efflux of calcium ions at 16 Hz." Bioelectromagnetics, 11: 349-358.
- Selga, T. and Selga, M., 1996: "Response of *Pinus sylvestris* (L.) needles to electromagnetic fields. Cytological and ultrastructural aspects". The Science of the Total Environment, Vol 180, pp 65-74.
- Sen, S., Goldman, H., Morenhead, M., Murphy, S. and Phillis, I.W., 1994: " $\alpha$ -phenyl-tert-butyl-nitrone inhibits free radical release in brain concussion". Free. Rad. Biol. Med., 16:685-691.
- Servantie, B., Servantie, A.M., and Etienne, J., 1975: "Synchronization of cortical neurons by a pulsed microwave field as evidenced by spectral analysis of electrocorticograms from the white rat". Ann. N.Y. Acad. Sci., 247: 82-86.
- Shandala, M.G., Dumanskii, U.D., Rudnev, M.I., Ershova, L.K., and Los I.P., 1979: "Study of Non-ionising Microwave Radiation Effects on the Central Nervous System and Behavior Reactions". Environmental Health Perspectives, 30:115-121.
- Shandala, M.G., and Zvinyatskonsky, Y.A., 1988: "Environment and health of the population", Kiev, Zdorovja, p150 (in Russian).

- Shelton, W.W., and Merritt, J.H., 1981: "In vitro study of microwave effects on calcium efflux in rat brain tissue". *Bioelectromagnetics*, 2: 161-167.
- Sheppard, A.R., Bawin, S.M., and Adey, W.R., 1979: "Models of long-range order in cerebral macromolecules: effect of sub-ELF and modulated VHF and UHF fields". *Radio Science*, 14 (6S): 141-145.
- Shore, M. (Ed), 1981: "Environmental Health Criteria 16: Radiofrequency and Microwaves", World Health Organization, Geneva, 1981.
- Sibbison, J.B., 1990: "USA: Danger from electromagnetic fields". *The Lancet*, July 14, 1990, p106.
- Silverman, C., 1979: "Epidemiologic approach to the study of microwave effects". *Bull. N.Y. Acad. Med.*, 55(11):1166-1181, December 1979.
- Skyberg, K., Hansteen, I.L., and Vistnes, A.I., 1993: "Chromosome aberrations in lymphocytes of high-voltage laboratory cable splicers exposed to electromagnetic fields". *Scandinavian Journal of Work, Environment & Health*.19(1):29-34.
- Snyder, S.H., 1985: "The molecular basis of communication between cells". *Scientific American*, 253 (4), (Oct) pp 132-144.
- Sohal, R.S. and Weindruch, R., 1996: "Oxidative stress, caloric restriction, and aging" *Science*, 273:59-63.
- Sorsa, M., Ojajarvi, A. and Salomaa, S., 1990: "Cytogenetic surveillance of workers exposed to genotoxic chemicals: preliminary experiences from a prospective cancer study in a cytogenetic cohort". *Teratog. Carcinog. Mutagen*, 10(3):215-221.
- Sorsa, M., Wilbourn, J. and Vainio, H., 1992: "Human cytogenetic damage as a predictor of cancer risk". *I.A.R.C. Sci. Publ.*, 116:543-554 .
- Speers, M.A., Dobbins, J.G., and Miller, V.S., 1988: "Occupational exposures and brain cancer mortality: a preliminary study of East Texas Residents". *American Journal of Industrial Medicine*, 13:629-638.
- Stark, K.D.C., Krebs, T., Altpeter, E., Manz, B., Griol, C. and Abelin, T., 1997: "Absence of chronic effect of exposure to short-wave radio broadcast signal on salivary melatonin concentrations in dairy cattle". *J Pineal Research* 22: 171-176.
- Stein, G.S., and Lian, J.B., 1992: "Regulation of cell cycle and growth control". *Bioelectromagnetics*, Suppl. 1: 247-265.
- Strahler, A.N., 1963: "The Earth Sciences", 2nd Edition, Publ. Harper and Row, New York.
- Stryer, L., 1986: "Cyclic AMP cascade of vision". *Annual review of Neurosciences*, 9: 87-119.
- Stuchly, M.A., and Stuchly, S.S., 1990: "Electrical properties of biological substances", pp75-112, In "Biological effects and medical applications of electromagnetic energy"., Ed. Om P. Gandhi, Prentice Hall, New Jersey.
- Sumiyoshi, H., Baer, A.R., and Wargovich, M.J., 1991: "Heterogeneity of ornithine decarboxylase during mouse colon carcinogenesis and in human colon tumors". *Cancer Research*, 51: 2069-2072.

- Suvorov, N.B., Boitsova, V.V., Medvedeva, M.V., Bogdanov, O.V., and Vasilevskii, N.N., 1994: "The biological action of physical factors in the critical periods of embryogenesis". *Zhurnal Evoliutsionnoi Biokhimii i Fiziologii*, 30(6):762-768.
- Szmigielski, S., Szudzinski, A, Pietraszek, a. et al., 1982: "Accelerated development of spontaneous and benzopyrene induced skin cancer in mice exposed to 2450 MHz microwave radiation." *Bioelectromagnetics*, 3: 179-191.
- Szmigielski, S., Bielec, M., Lipski, S., and Sokolska, G., 1988: "Immunological and cancer-related aspects of exposure to low level microwave and radiofrequency fields". In Marino (Ed), 'Modern Bioelectricity', Marcel Bekker, N.Y., pp 861-925.
- Szmigielski, S., 1996: "Cancer morbidity in subjects occupationally exposed to high frequency (radiofrequency and microwave) electromagnetic radiation". *Science of the Total Environment*, Vol 180, 1996, pp 9-17.
- Taskinen, H., Kyyronen, P., and Hemminki, K., 1990: "Effects of ultrasound, shortwaves and physical exertion on pregnancy outcome in physiotherapists". *J. of Epidemiology and Community Health*, 44:196-210.
- Taylor, E.M., and Ashleman, B.T., 1975: "Some effects of electromagnetic radiation on the brain and spinal cord of cats". *Ann. N.Y. Acad. Sci.*, 247: 65-73.
- Tell, R.A., and Mantiply, E.D., 1980: "Population exposure to VHF and UHF broadcast radiation in the United States". *Proc IEEE*, Vol.68, No.1, January 1980. pp 4-12.
- Thomas, T.L., Stolley, P.D., Stemhagen, A., Fontham, E.T.H., Bleecker, M.L., Stewart, P.A., and Hoover, R.N., 1987: "Brain tumor mortality risk among men with electrical and electronic jobs: A case-control study". *J. Nat. Canc. Inst.*, Vol 79, No.2, pp 233-238., August 1987.
- Timchenko, O.I., and Ianchevskaia, N.V., 1995: "The cytogenetic action of electromagnetic fields in the short-wave range". *Psychopharmacology Series*, Jul-Aug;(7-8):37-9.
- Tornqvist, S., Knave, B., Ahlbom, A., and Persson, T., 1991: "Incidence of leukaemia and brain tumours in some 'electrical occupations'". *British Journal of Industrial Medicine*, 48: 597-603.
- Ullrich, A., Coussens, L., Hayflick, J.S., Dull, T.J., Gray, A., Tam, A.W., Lee, J., Yarden, Y., Whittle, N., Waterfield, M.D. and Seeburg, P.H., 1985: "Human epidermal growth factor receptor cDNA sequence and aberrant expression of the amplified gene in A431 epidermoid carcinoma cells". *Nature*, 309:428-.
- Vagero, D., Ahlbom, a., Olin, R., and Sahlsten, S., 1984: "Cancer morbidity among workers in the telecommunications industry". *British Journal of Industrial Medicine*, Vol 42, pp 191-195.
- Valentino, A.R., 1972: "A small ELF electric field probe". *Proc. IEEE Int. Symp. Electromagnetic Compatibility*, p265.
- Valjus, J., Norppa, H., Jarventaus, H., Sorsa, M., Nykyri, E., Salomaa, S., Jarvinen, P., and Kajander, J., 1993: "Analysis of chromosomal aberrations, sister chromatid exchanges and micronuclei among power linesmen with long-term exposure to 50-Hz electromagnetic fields". *Radiation & Environmental Biophysics*, 32(4):325-36.
- Verkasalo, P.K., Kaprio, J., Varjonen, J., Romanov, K., Heikkila, K and Koskenvuo, M., 1997: "Magnetic fields of transmission lines and depression." *American J.Epidemiology*, Dec 15;146(12):1037-1045.

- Vijayalaxmi, B.Z., Reiter, R.J., Sewerynek, E., Meltz, M.L., and Poeggeler, B., 1995: "Melatonin protects human blood lymphocytes from radiation-induced damage". *Mutation Research*, 346(1): 23-31.
- Vijayalaxmi, B.Z., Frei, M.R., Dusch, S.J., Guel, V., Meltz, M.L., and Jauchem, J.R., 1997: "Frequency of Micronuclei in the peripheral blood and bone marrow of cancer-prone mice chronically exposed to 2450 Mhz radiofrequency radiation". *Radiation Research*, 147: 495-500.
- Von Klitzing, L., 1995: "Low frequency pulsed electromagnetic fields influence EEG of man". *Physica Medica XI* (2) April-June 1995, pp77-80.
- Vorobyov, V.V., Galchenko, A.A., Kukushkin, N.I., and Akoev, I.G., 1997: "Effects of weak microwave fields amplitude modulated at ELF on EEG of symmetric brain areas in rats". *Bioelectromagnetics*, 18:293-298.
- Vorst, A.V. and Duhamel, F., 1996: "1990-1995 Advances in investigating the interaction of microwave fields with the nervous system". *IEEE Trans. on Microwave Theory and Techniques*, 44(10),1898-1909.
- Wachsman, J.T., 1996: "The beneficial effects of dietary restriction: Reduced oxidative damage and enhanced apoptosis". *Mutation Research*, 350:25-34.
- Walleczek, J., 1992: "Electromagnetic field effects on cells of the immune system: the role of calcium signaling". *FASEB J.*, 6: 3176-3185.
- Walleczek, J. and Budinger, T.F., 1992: "Pulsed magnetic field effects on calcium signaling in lymphocytes: dependence on cell status and field intensity". *FEBS* 11896, 314 (3): 351-355.
- Wang, S.G. 1989: "5-HT contents change in peripheral blood of workers exposed to microwave and high frequency radiation". *Chung Hua Yu Fang I Hsueh Tsa Chih* 23(4): 207-210.
- Weinstein, I.B., 1988: "The origins of human cancer: molecular mechanisms of carcinogenesis and their implications for cancer prevention and treatment". *Cancer Research*, 48: 4135-4143.
- Weinstein, I.B., 1991: "Non-mutagenic Mechanisms in Carcinogenesis: Role of Protein Kinase C in Signal transduction and Growth Control"., *Environmental Health Perspectives*, 93: 175-179.
- Weaver, J.C., and Astumian, R.D., 1990: "The response of living cells to very weak electric fields: the thermal noise limit." *Science*, 247 (26 Jan 1990): 459-462.
- Wever, R., 1969: "Untersuchungen zur circadianen Periodik des Menschen mit besonderer Beruchsichtigung des Einflusses schwacher electrischer Wechselfelder". *Bundesminst. f. wiss. Forschg., Forschungsbericht, W 69-21*, 212 pp.
- Wever, R., 1970: "The effects of electric fields on the circadian rhythmicity in men". *Life Sci. Space Res.*, 8: 177-187.
- Wever, R., 1974: "ELF-effects on Human Circadian Rhythms", pp 101-144 in "ELF and VLF Electromagnetic Field Effects", Ed. M.A. Persinger, Publ. Plenum Press, New York.

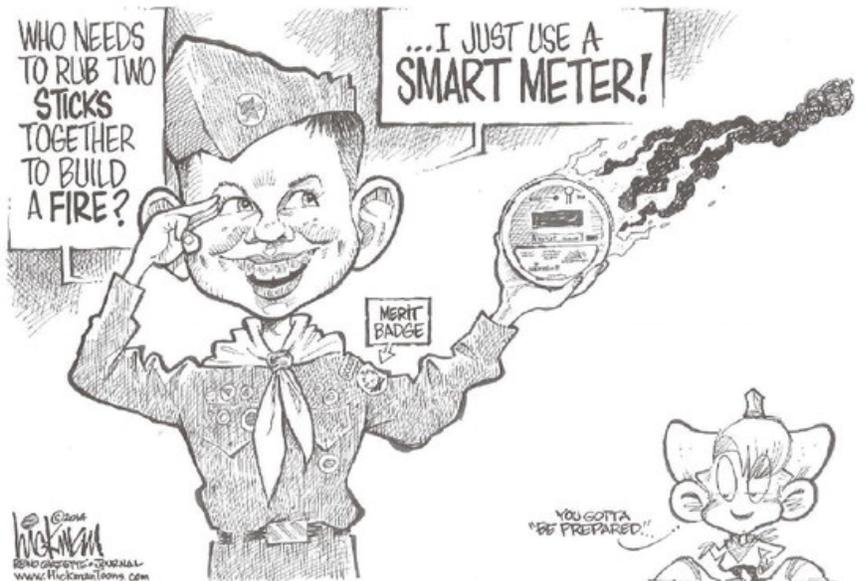
- Welker, H.A., Semm, P., Willig, R.P., Commentz, J.C., Wiltschko, W. and Vollrath, L., 1983: "Effects of an artificial magnetic field on serotonin N-acetyltransferase activity and melatonin content of the rat pineal gland." *Exp. Brain Res.*, 50(2-3):426-432 .
- Whitfield, J.F., Boynton, A.L., MacManus, J.P., Sikorska, M., and Tsang, B.K., 1979: "The regulation of cell proliferation by calcium and cyclic AMP". *Mol. Cell Biochem.*, Nov 1;27(3):155-179 .
- WHO, 1993: "Environmental Health Criteria 137: Electromagnetic fields (300 Hz to 300 GHz)". Ed. M. Repacholi, World Health Organization, Geneva, 1993.
- Wilson, B.W., Chess, E.K., and Anderson, L.E., 1986: "60 Hz electric field effects on pineal melatonin rhythms: time course and onset of recovery". *Bioelectromagnetics*, 7: 239-242.
- Wilson, B.W., Wright, C.W., Morris, J.E., Buschbom, R.L., Brown, D.P., Miller, D.L., Sommers-Flannigan, R. and Anderson, L.E., 1990: "Evidence of an effect of ELF electromagnetic fields on human pineal gland function". *J Pineal Research* 9(4): 259-269.
- Wood, A.W., Armstrong, S.M., Sait, M.L., Devine, L. and Martin, M.J., 1998: "Changes in human plasma melatonin profiles in response to 50 Hz magnetic field exposure". *J Pineal Research* 25(2): 116-127.
- Yoshida, M., Hayashi, H., Taira, M., and Isono, K., 1992: "Elevated expression of the ornithine decarboxylase gene in human esophageal cancer". *Cancer Research*, 52: 6671-6675.
- Zhao, Q., Pahlmark, K., Smith, M-L., and Siesjo, B.K., 1994: "Delayed treatment with the spin-trap  $\alpha$ -phenyl-N-tert-butyl nitron (PBN) reduces infarct size following transient middle cerebral artery occlusion in rats. *Acta. Physiol. Scand.*, 152:349-350.
- Zyss, T., Dobrowolski, J.W. and Krawczyk, K., 1997: "Neurotic disturbances, depression and anxiety disorders in the population living in the vicinity of overhead high-voltage transmission line 400 kV. Epidemiological pilot study". [Article in Polish]. *Med. Pr.*, 48(5):495-505.



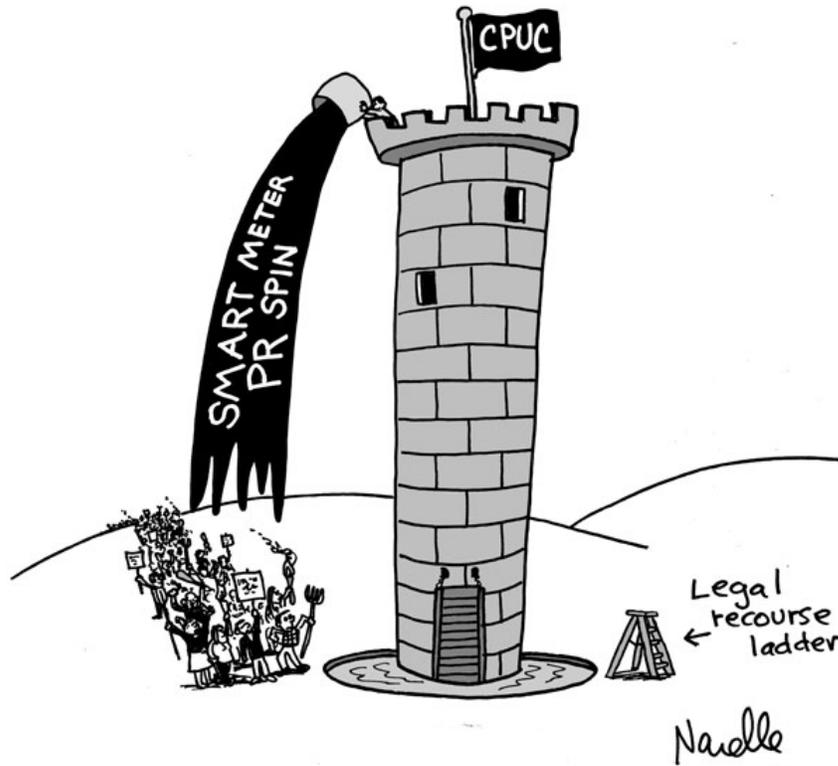
smart meter health complaints

## Smart Meter fires and Explosions

A SLICE OF THE SILVER STATE BY JEFF HICKMAN



## Overview of emails between CPUC and PG&E

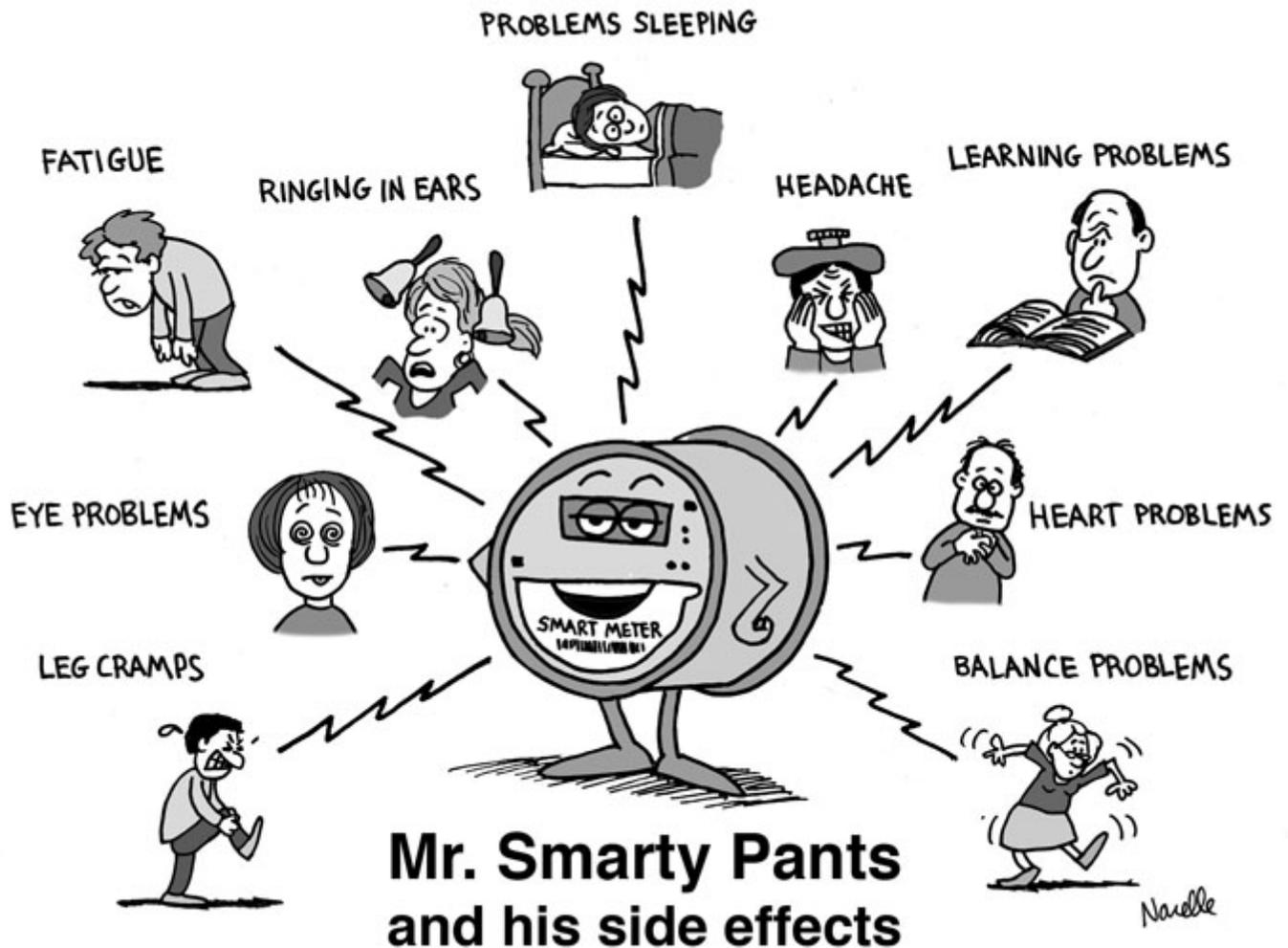


## Protect Nature



Wireless radiation threatens birds, bees, and butterflies

# Smart Meter Health Complaints



All around the world people are reporting wireless radiation is affecting their health. We've collected many smart meter health complaints and posted them here. Utilities claim smart meters are safe, and compare them to cell phones. However cell phones, cell towers, wi-fi and other wireless devices can also affect your health! Reducing your EMF exposure can benefit your overall health and wellness. [Learn more about how to reduce EMF's](#), and sign up for monthly email updates to [stay informed!](#)

**The World Health Organization (WHO) classifies wireless radiation as a 2B carcinogen, based on studies linking cell phone radiation to brain tumors!**

## List of symptoms:

- Sleep problems (insomnia, difficulty falling asleep, night waking, nightmares)
- Stress, agitation, anxiety, irritability
- Headaches, sharp pain or pressure in the head
- Ringing in the ears, ear pain, high pitched ringing
- Concentration, memory or learning problems
- Fatigue, muscle or physical weakness
- Disorientation, dizziness, or balance problems
- Eye problems, including eye pain, pressure in the eyes,
- Cardiac symptoms, heart palpitations, heart arrhythmias, chest pain
- Leg cramps, or neuropathy
- Arthritis, body pain, sharp, stabbing pains
- Nausea, flu-like symptoms
- Sinus problems, nose bleeds
- Respiratory problems, cough, asthma
- Skin rashes, facial flushing
- Urinary problems
- Endocrine disorders, thyroid problems, diabetes
- High blood pressure
- Changes in menstrual cycle
- Hyperactivity or changes in children's behavior
- Seizures
- Recurrence of cancer
- Taken from [EMF Safety Network Survey 2011](#)
- [Symptoms after Exposure to Smart Meter Radiation](#) By Dr. Ron Powell

## Complaints:

---

I have been a cynic towards people who worry about smart meters for a couple years, even was an early adopter nearly 5 years ago. The last year I have been experiencing a chronic sore throat that my doctors can't explain, my kids are developing learning disabilities, among other strange health issues. The more I read, the more I'm concerned about the microwave radiation they give off.

---

---

2/2014 The first ones installed on the side of my apartment building were just steps away from my apartment. I had lived in this apartment for 5 years with no problems. Suddenly I started having terrible problems sleeping. I tried everything I could think of and finally went to my doctor who gave me sleeping

pills. For over a year I needed a pill every night, sometimes a half worked, but only for a few hours and soon I would be using the second half.

On Thursday, 4 days ago, newer and stronger meters we put in to replace the ones installed a little over a year ago. Now I cannot sleep, even with the sleeping pill and I am feeling so fatigued and muddle-brained that I can barely think straight and even have trouble standing up straight. I have literally done nothing since they have been put in and feel achy all over and disoriented, slightly dizzy.

Since I am in a rental, I am going to have to try to move, probably to another state, because I do not feel that California is going to do anything good on this matter to protect my health.

But I want you to know that in my opinion, making all of our technology communicable with wireless technology is going to bite us in the rear **BIG TIME** one day and we will be totally unprepared!

The reason? **THIS IS A TWO WAY COMMUNICATIONS SYSTEM THAT IS OPEN IN THE MOST OPEN WAY POSSIBLE ON OUR PLANET – THROUGH THE AIR!**

I am a systems engineer so I know very well how technology works. I am also an avid science fiction reader and I cannot even count on both hands the number of books I have read with scenarios where Earth is taken over and completely defenseless against invaders because we have WiFi'd **ALL OF OUR EXISTENCE ON EARTH!**

Anybody who knows anything about technology and physics knows this truth. **ANY** electrical signal retriever can catch these wireless messages floating through the air. This **ANYONE** is, say, **ANYONE WITH A CELL PHONE!**

In many of these science fiction stories, those using wireless technologies, (most were begun for **POPULATION SURVEILLANCE!**) were completely defenseless!

Think about it. And while you are at it take a look at the amount of equipment and hardware the US military forces are rushing to implement on every truck, tank, plane, bomb, etc., etc., **EVERYTHING** and **ANYTHING** can be made wirelessly communicate-able. –W.R. CA

---

8/13/2013 Hello, I live in an upstairs apartment, in Turlock, CA. I have been feeling sick since they installed 16 smart meters on a panel 6 feet away from my building. I have developed respiratory problems and insomnia and anxiety and pressure in my head. They have checked me for physical problems and Dr. says there is nothing wrong with me and they keep prescribing me anxiety meds to help me sleep at night that are messing with my heart and my head.

In a desperate attempt to figure out what is wrong with me, I came across a website that revealed a possibility that I may be exposed to the smart meter radiation. My husband has also developed asthma, coughing, bloody nose headaches.

Since then I have left my home and have been getting sicker because I cannot find anyone that believes me. Can you please help me find out how to even test for the exposure in my body?

If I stay away from the meters are my symptoms reversible mainly the insomnia and the anxiety. I have never experienced such a thing before. I am exhausted and I cannot find a doctor to help me. Most doctors are oblivious to what I am suggesting.

---

8/2013 I've been doing my own research for 8 months now, and have definitely concluded that Smart Meters are causing this horrible humming noise in my home. It is ruining my life and is violating my rights as a human being. I noticed it in the rental house I was living in for 7 months. I went to my parent's house to see if I heard it there and sure enough I did. I finally moved to the country in Sonoma County and it's horrible here too. Each place has Smart Meters. It's not like a normal sound from a refrigerator, etc. It's a low frequency humming sound that actually hurts my ears. I can't get to sleep and have had to run a fan or some noise to try to drown it out. But, since it vibrates in my ear, that is hard to do. I've gone online and millions are complaining of this humming noise. This is INSANE! If you do the research, you will find out how harmful these meters are. What are they going to do to our children, who are sleeping in the rooms where they are connected? PGE lied to us, sneaked into our homes to put these in, have not done proper testing, and are causing health problems to millions. Some counties in CA have banned them and I really hope it continues. I will have to ask my landlord if he is willing to opt out, and I will pay whatever to get peace again. This is torture. And yes, there are electrosensitive people out there for the person who said there aren't. Ignorance! Cell phones even hurt my ears. They have even linked heavy cell phone usage to brain tumors. Wake up everyone! It's time to stand up to this bullshit.

---

2013 We had a Smart Meter installed on our home. I got sick and two weeks ago had a mini-stroke. We took the meter off our home after sending Central Hudson (our utility company) several sets of documents – detailing my illness and then my hospitalization – and they did nothing and did not even respond to our requests. After my stroke, we ordered an analog meter online and replaced their radiating meter. We video taped it and sent their meter back to them with a letter, along with all the other correspondence we had sent (return receipt and notarized).

The following Monday the electric company came to our home, with no notice nor explanation, and physically, right in front of me, cut our electric lines with a huge pair of clippers! — New York

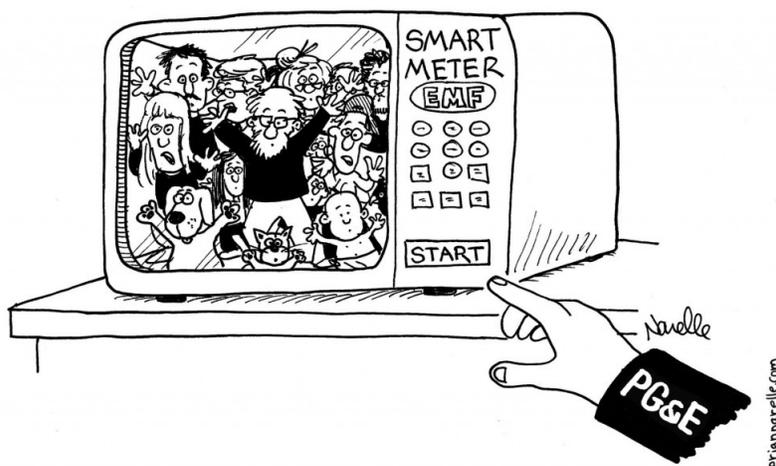
---

5/2013 My family recently moved into a new home which has 4 smart meters, we had wifi also initially. I began feeling ill: symptoms included a sensation of electricity coursing through my body, headaches, my blood pressure soared, the sensation of my brain feeling like it was being squeezed, and a sensation of burning on my skin and eyes. I could not find relief anywhere in my home. The symptoms of my three sons are less than my own and more vague: headache, "feeling sick upon waking", feeling a jolt type feeling sometimes.

I have purchased an RF meter but, even after much reading, still don't understand the subject very well. I do know that my meter indicated that there are strong fields all over my home and very strong pulse points in four corners of my home from the smart meters. There is literally no place in my house that does not show high RF levels. I can't escape from this feeling anywhere in my home and I even experience it where ever wifi is being used and even just near people using cell phones and near cell towers.

The effects that I feel from this exposure take a long to to subside even when I go to my father in laws where the meter shows no high levels of RF. I feel much, much better there but still have burning sensations on a much lower level. I have only been away from my home for about 12 hours now and can feel the symptoms greatly reduced.

I am afraid I am being caused permanent damage and most importantly that my young sons may be receiving damage from this exposure. They are only 7,7 (twins), and 10 years old. I am turning to you all for help because I am certain that I will not receive much help from the authorities. My own family cannot understand what is happening to me and to, I fear, my children. I am not crazy or imagining my symptoms. I hold a MA in Social Work, have a BA in psychology, have been employed in a professional setting for many years prior to the birth of my children. – Anon, Indiana, U.S.



---

4/29/2013 I am a 31 year old Female and I reside in Plantation, FL. I would say I started to notice major health concerns since the FPL Smart meter was put beside our bedroom window and it did me in. It gradually kept giving me headaches. Also, I have permanent retainers from wearing braces, behind my bottom and top teeth. Anytime a wi-fi or cell signal passes me I get a metal taste in my mouth. My Smart Meter peak occurred when I was in a deep sleep around 6:00am and was awoken to massive pressure in my head. It felt like my brain was on fire and it wanted to explode all at the same time. I woke up frantically screaming . I was holding my head and I had my husband scared. I hurried out of the bedroom still holding my head.

We were up all morning trying to figure out what it was. I felt as if my brain had burned. I knew it was from the Smart Meter because I was feeling it a little more each day. I called to have the Smart meter removed. For the rest of the week I felt the left side of my head and face numb. I couldn't speak properly or concentrate. Since then I have not been the same. I have a very difficult time concentrating. The newest thing that is occurring is that I feel my skin burning. I feel the top of my head burning as well.

Since the whole Smart meter incident we have removed our home wi-fi and we put our cell phones on airplane mode. What is killing me though is that our entire community not only has Smart Meters but our association just made a deal with AT&T and every house has U-verse. Each house has a wireless modem which transmits wi-fi and television. Even though we had our wi-fi turned off from the modem we also had the company run all the cable lines through the attic to the rooms for television. Our houses are so close together that our house gets both of our neighbors signals from each side.

---

2013/ I am the proud parent of six, of the six children we have four children who are under the age of six. In July of last year the LADWP placed on our home a RF meter, the RF meter was placed on the back of our home which is directly located about 25 to 30 feet away from the LADWP power pole that is located on our property. In July of last year our children started to exhibit health symptoms and health signs that alarmed myself and my husband. The children began to have fevers out of no where, essentially their bodies were boiling and their fevers would go from 101 to 104 and sometimes to 105. My husband is a Clinical Partner at Cedar Sinai Hospital in the ICU so he is versed in the area of taking care of patients in extreme health decline, but he was not prepared to handle the weekly and monthly bouts that our smaller children began to have. Our children also began to have problems with the inability to control their bodily fluids, our five year old began peeing and pooping herself, our four year began to display the same problems, soon many of the smaller children were all displaying these symptoms and concerns. The children became depressed, and essentially we began to realize that our children were not the children who we cared for prior to the RF meter being placed on our property. We were the only family in our area to have this new meter so we do not have a frame of reference in our community to measure the health side effects against. Please help us, we are good honest people who have suffered for the past few months trying to put the pieces of this puzzle together.

[Admin's note: *The mother wrote that after the Smart Meter was removed in January the children's symptoms "diminished greatly, they no longer get high fevers, or suffer from loss of their bodily function."* Meanwhile LADWP has terminated their power.]

---

[West Kelowna man claims Smart Meters are killing him](#) "...an Okanagan man claims the meters may be interfering with an important medical device – his pacemaker. Jerry Smith, 70, of West Kelowna is partially paralyzed as a result of the 10 strokes he's had since last August...."

---

---

I am an engineer. I have used technology my entire adult life – cell phones, smart phones, wi-fi, laptops, you name it. I really enjoyed all of this and had no issues or fears related to technology.

Then, when a bank of smart meters were put next to our apartment, both my wife and I starting experiencing headaches, insomnia, heart palpitations and tinnitus. Within a couple weeks, I could no longer use a cell phone without the same symptoms. Within a month I could feel the microwave radiation from cell towers. I have had to completely change my life because of this. Jeromy [[Testimony Jeromy submitted to the CPUC](#)]

---

“Is there a list of safe communities with no smart meters? Our whole family is being sickened by the smart meters around us and we need to find a place to live quickly.”

“We are just miserable here. We can’t sleep at night, are dizzy, have headaches, ear pain, and more. We also own our home so it is not easy to just pick up and get away from the smart meters.” CA. 2013

---

---

### **Sick with palpitations, chest pain, insomnia, dizziness...**

I managed to have smart meter installation delayed at my house, but suddenly became sick overnight with palpitations, chest pain, insomnia, dizziness, inability to concentrate and memory loss and fainting spells. AFTER becoming sick I found out that the day I became suddenly sick was the day the smart meter roll-out was completed in my area and the smart meters were remotely turned on from base.

I can no longer drive, I can’t work (I’m a doctor), I have to go and sleep at my mother in law’s place (there are no smart meters there yet).

My life is completely ruined and the energy companies and members of Victorian Parliament completely ignore me. Two doctors have confirmed my disability is entirely due to my sensitivity to smart meters’ radio transmission and I am 100% sure of that as I can always tell accurately if I am in a smart metered area or not.

We are now planning to move to South Australia to survive. What is happening in Victoria is a complete breakdown of democracy and an affront to social justice of enormous proportions and implications.

What if this is happening to an old lady living alone? Where can she go? We are all morally obliged to speak up and do something about it, if not for ourselves, for the vulnerable amongst us that, if affected, could not do anything about it. Posted on [Stop Smart Meters Australia](#)

---

I had no idea that a smart meter would pose a hazard to my health when I agreed to let them install one on my home. Shortly after the smart meter was installed my health took a terrible downturn. I began having heart palpitations, trouble sleeping, unexplained anxiety attacks, dizzy spells, nausea and fatigue. I have been battling anxiety for months and I had no idea why. I've never had these types of symptoms plague me like this before. Then I found out that so many others have had the same reactions to smart meters in their homes and neighborhoods. Smart meters need to be outlawed and all of them must be removed at once. There are enough toxins in our food and the environment without this happening too. I hope I am able to get mine removed, but from what I've read Southern California Edison isn't cooperating. H .M. Orange CA

---

Since the new Smart Meter has been installed my wife has had a ringing in her ears. The only time she has this is in our home. Outside of the house she does not have the problem. J. F. Sacramento CA

---

I was not asked permission to have the Smart Meter installed. In fact, when your representative/installer came to my door informing me he would be installing the meter, I specifically told him that I did not want it installed. He told me that I didn't have a choice in the matter.

I am plagued with various health issues because of the Smart Meters, such as insomnia, constant headaches, blurred vision and ringing in my ears, and other various aches and pains. I understand that others are suffering from various health issues throughout the state and country as well. I do not want this device on my home or in my neighborhood. I want the old analog meter re-installed. I also do not want the new digital meter installed. I specifically want the old analog back which worked just fine. I want this Smart Meter removed now! A.S. Bakersfield CA

---

For the past year, I have been suffering health effects due to the installation of a Smart Meter at my home and the other homes in my neighborhood. I have experienced migraines, disrupted sleep, and electronic sensitivity so that I was unable to use a computer or my cellphone without immediate nausea and headache. I feel constant low-level anxiety when in my house which "magically" goes away every single time we have a power outage. My husband has developed migraines, disrupted sleep, and tinnitus. I am concerned for the long term health consequences on us and on my daughter who is almost 3.

I have called PG&E and they refuse to remove the Smart Meter from my house. Other electricians say that they cannot replace the meter with an analog variety because it would be illegal. This product is making me sick, and even with the money to pay for it, I am not allowed to have it removed.

I would like to see Smart Meters pulled from the market until thorough testing is done and they can be proved safe. It is the responsibility of our government to protect public health from polluting corporations. Charging for the right to "opt-out" is criminal because it subjects the poor to poisonous health effects, and also because people will still receive exposure from their neighbors' properties, especially in urban population-dense environments.

PG&E cannot be relied upon to treat us fairly—my health just does not figure into their bottom line. Sometimes we need people with power to stand up for us.

---

---

I have been suffering since the installation of 3 meters in my complex (of 12 units) and from larger multi-unit complexes on both sides of where I live. This means that the radiation coming off all of these meters encroach on me, even though I have opted out and do not have one...Each day I awake with my head buzzing. I now have fatigue and headaches, nausea unexplained and nosebleeds at the oddest times for no other reason. I have lost so many days of working (I work from home) and now there is no place to go. Our entire county, once a pristine, safe and desirable place to call home is now a sea of massive radiation from the thousands of smart meters now installed.

---

We didn't even know the meter was there when we moved in the house late April, 2011. We'd been feeling strong and well. Suddenly our health started deteriorating rapidly. It was until end of May that I saw the meter and red flags went off. I have been avoiding all types of radiation since the 80's due to poor health...and here it was now permanently attached to my bedroom wall!! We had no place to go. Complaints and pleas to the utility companies were absolutely fruitless. We have removed it ourself.

---

I have been suffering horrible migraine headaches since a SmartMeter was installed on my home in the fall of 2010. The meter was installed without my permission. When the installer arrived unannounced, I happened to be home. I told him I did not want a Smartmeter. He responded by telling me I had no choice and walked right in my gate and installed it.

It took almost a year of 15-18 debilitating migraine level headaches before the cause was discovered. I saw doctors and had blood tests, MRI's CT scans, took migraine medications all with no relief. I kept a headache journal as recommended by headache specialists at UCSF and found no connection to headache development and diet, activity, etc. Looking at every variable possible, it was finally discovered that when I am around Smartmeters, I get headaches. When I am not, I don't get headaches.

I am a high school teacher and was able to go visit my Mom in a neighborhood that has no Smartmeters when school let out in June of 2011. For my 9 day visit with my mother, I had no headaches. When I returned home, the headaches resumed on my first day back. The Smartmeter was then suspected. I shielded the SM with simple aluminum shielding, and the migraine headache significantly reduced to a normal headache. When I remove the shield the intense migraines come back; replace the shield, they go away. The shielding is not 100% blockage. I need this meter completely off my home!!

I cannot walk my dog in my own neighborhood. All the buzz from my neighbors meters make me dizzy and don't help my headaches!! I feel trapped. There aren't many places to escape the horrible effects of

these meters because they are everywhere. I love my job and I love where I live, but I feel I am being forced to leave. I cannot believe this is happening in this country!

The longer I am exposed to this SmartMeter, the more sensitive I am becoming. My doctor says I have developed electrical sensitivity. I am miserable and there are some days I wish someone would just shoot me. These SmartMeters and the technology they use have turned me from a happy and productive member of society, into a desperate and miserable person. Please help!!!!!!!!!!

---

I have been severely harmed by the installation of two smart meters on my family's home where I reside with my elderly parents and nephew.

I was forced to go to the emergency room only three hours after the two meters were installed on our home (one for gas and one for electric) from severe nausea, heart palpitations and a severe headache.

After several days, with the help of several highly trained medical doctors and a PA at my personal doctor's office, I finally found a medication that allowed me to stay home and assisted me in not having to continue to visit hospital services.

However, though the nausea was lessened by the medication they gave me, which by the way is what they give to people who have radiation poisoning, its side effects were too severe (mild to severe constipation and cramping leading to the need for more medical treatments) to continue for more than a few weeks. I was lucky enough to find an Accupuncturist who helped with these symptoms so at least I can now manage my pain.

I also suffered severe headaches (one meter was right outside my room, only two feet from my bed) and I was forced to move from a private room in front of the family house into the back of the house where the pain is much less.

Now I live my life in our family's den, always intruded upon by the need for my parents and other family members who reside here to work in the same area. I have lost all my privacy and I still suffer headaches every day now. I fear my health is also deteriorating as I keep getting colds. I have had one every month since the smart meters were installed. Even in the warm weather. My immune system is being affected negatively.

My only hold on my sanity is my friends and loving mother. Otherwise I would have given up on living months ago. I hold on though I doubt I can withstand a flu or other immune compromised illness. My final act is to stop smart meters here on this planet, if at all feasible.

As I already have fibromyalgia and acid reflux, this is probably the final nail in the coffin for my health. Please stop all smart meter installations and try to get all the ones already installed off people's homes and residences and businesses. I can't hardly go anywhere now without an instant migraine from the fact they are installed everywhere. I hate to think what they are doing to everyone's health in my community. It makes me ill thinking how it is harming our children and elderly right now.

---

A man who identified himself as working for PG&E, came to my door stating that he was here to install a Smart Meter on my home. I said, "No! Please don't do that. I don't want a Smart Meter." I watched him walk out of our gated yard. But he had not left. Moments later, he entered our gated yard again and I heard pounding at the side of my home, where the 4 meters for our townhouse are located. I called out to him, and he came to the front door and told me that he was installing 3 Smart Meters for my neighbors—on MY HOUSE! I said, "No, please don't do that this is my home." He stated that he had his orders and he was installing them. He left a card on my door with a number to call. He did not work for PG&E but a private company—PG&E may have an easement to my property, but his company does not—I believe he was trespassing when I denied access. I begged him to stop—telling him repeatedly that I was not well, and I was not giving my permission for Smart Meters to be installed on my home. He stated, It is my job, & went to the side of my house. I called the number he had given, spoke with a PG&E rep and the connection was lost. I called back and spoke to another rep, who stated that I wasn't on the "list" and that he would place me on it. I explained why I was calling, then he had to speak to his supervisor. He came back and said, "Well I can tell you this, once they are installed, they aren't coming off!" I explained that I could hear the pounding at that moment and that they were in the process of installation and still could be stopped. I was told that nothing could be done.

Since the installation, my heart has been in fibrolation daily & my heart rate & blood pressure are elevated. Our granddaughter's bed in her room is on the same wall as the Smart Meters. She has suddenly developed insomnia & is doing poorly in school. Recently, staying at a hotel she had no trouble sleeping through the nights.

Since installation, our high-speed internet connection has slowed, been interrupted often, dialing out we have static on the phone lines, similar to taking a cordless phone too near a microwave oven in use. Even our Wii reception has been slower & multiple interupts during each episode of Netflix—not interrupted prior, all since the installation.

---

My family has suffered since moving to this house (our old house did not have a smart meter). We have trouble sleeping. Headaches. Our son experiences nosebleeds and attention problems. My Mother feels that her health has declined in many aspects since the installation of her meter (she lives next door). We all have noticed our immune systems are weaker. The biggest complaint is difficulty sleeping.

---

When the SmartMeters were put in my neighborhood, I and others had sleep problems. We did not know that the SMeters were installed on the neighbors' homes as we did not have any SMeters. I have had to sleep in a heavily shielded area to get more than a couple of hours of sleep. I have also had pain in my sinuses and pressure in my face, and increased bleeding episodes.

I do not want an SMeter of any kind. An injury 6 years ago left me hypersensitive to the electromagnetic fields these and other devices emit. I had a lot of pain when appliances with switching power supplies were plugged in (like my computer). A doctor suggested I buy filters for this. That worked.

Please help me and others. I have since looked into the research. This hypersensitivity is caused by over-exposure. Wireless and the high frequencies produced by switching power supplies affects many people. There are 1000's of red flags in the research. Please help stop this criminal use of compulsory technology.

---

Within 5 hours of having a smart meter installed on my apartment building I developed a severe band-like headache. I did not know what a smart meter was when the man with the hard hat knocked on my door to tell me that my power would be turned off for about 10 minutes. I thought nothing of it. The headache persisted through the night and was unresponsive to medication. The next morning I also experienced nausea and began to think that I was coming down with the flu. However, when I left my apartment and went to another city (no meters) my symptoms cleared up. I was perplexed when they returned that evening after I returned home. This pattern continued for the next 3 days: headaches, nausea, some heart palpitations, and feelings of irritability and confusion — all of which resolved when I left Burbank and went into LA City. After 5 days I could no longer tolerate the symptoms and left my home of 23 years, to live out of my car and sleep in the homes of friends and family to avoid the unbearable health issues.

I am disabled and, try as I might, I have been unable to find subsidized housing in an area that is free of meters. I am exhausted and despair at what my future holds. I have told Burbank Water and Power about my problems. A board member told me to move out of Burbank. I contacted the CPUC and was told that they have no jurisdiction over my utility company and was instructed to contact my City Council. I have spoken several times at City Council meetings but the council members are relying on the information provided to them by the CPUC, the California Council of Science and Technology, and Burbank Water and Power. It is the most of vicious of circles. There is no remedy. There is no advocacy.

Several of my neighbors are experiencing similar symptoms, complaining of insomnia, headaches, difficulty concentrating. The mesh network and the meters are a scourge, depriving us of our human rights and our civil rights.

---

I am writing to file a complaint against PG&E and CPUC due to the health hazards of installing a Smart Meter in our home without our consent. When we first discovered its installation in May of 2010, my husband called PG&E with the request to have it removed, and they refused. On July 31, 2010, I went into the living room, about 6 feet from the wall that holds the Smart Meters, and felt a sudden zap of energy that instantly had my chest and throat aching, sending my already delicate health into immune collapse. It took several days before the aching in my chest, and the intense fatigue and brain fog that accompanied it, abated. We hired an electrician to come to our home with his radiofrequency radiation meter, to determine the frequency and strength of the Smart Meter radiation in our home. At the time of his reading on Wednesday, August 4th, the meter was pulsing about 3 times a minute, and inside the house the radiation from the Smart Meter was definitely high in the living room.

This kind of radiation is not good for anyone's health, and as someone with chronic health issues and immune dysfunction, to have a Smart Meter in our home is completely unacceptable. I am writing to

request that the Smart Meters at our home be removed immediately, and that action is taken to remove these meters from our area.

---

We had requested by phone that the smart meter not be installed at our residence. A couple of weeks or so after that, we noticed that our old analog meter was gone and a smart meter had been installed.

---

Within 1 hour of having our smart meter installed my wife started getting heart palpitations, headaches, brain fog and trouble sleeping. I have had brain fog and trouble sleeping. When we leave our home for a day then our systems return back to normal. We went to visit our family away from our home for 2 days to celebrate Thanksgiving and again felt much better. When we returned so did the problems.

We have our own business and have to work out of our home. It seems that America was a country of freedom of choice and not a country where things can be shoved down our throats and when we ask for reasonable changes we are turned down. We should have the choice of what goes on our house that is reasonable and safe to our health.

If you are normal or of normal health than a smart meter may not effect you but to the percentage of people that have medical issues please do not discriminate or destroy their ability to function normally or lose productivity.

---

I find it deeply troubling that the utility did not offer me the option of a new meter. Things like this should ALWAYS be opt-in only. I am also deeply concerned about the health effects of the meters. This should be among the top priorities for our legislators, as exposure to electro magnetic radiation impacts children and the ill the most, but will also make healthy people ill. Meanwhile, doctors are not properly trained to diagnose or treat related illness.

---

Within a month or 2 of installation of my EvilMeter, aka SmartMeter, I noticed for the first time in my life that my heart was skipping beats. It occurred only in the front part of my house. After a few days I remembered the EvilMeter, and checked to see where it was located. It was on the outside of my living room wall, only 1-2 feet from my sofa, where I often used to sit. I tried taking my pulse many places, and my pulse was normal everywhere except in the front part of my house. My irregular heartbeat was worst when near the EvilMeter.

Over the months since then, I have tried to stay out of the front part of my house. But my kitchen, TV, phone and computer are there, so I couldn't completely avoid it. I did spend as much time as I could in my bedroom, e.g., eating most of my meals there, not watching TV, bringing my computer into my bedroom to work on it, etc.

However, a month or two ago I noticed that my skipped heartbeats were getting worse — my heart would only beat 2-3 times, then skip a beat, beat 2-3 times, then skip a beat, etc. That would go on for hours. This was much worse than at first, when it would go back to normal within a short time of going into my bedroom or leaving the house.

So I went to an MD, who diagnosed me with PVC (premature ventricular contraction). It may cause me to have a stroke, a heart attack, or eventually heart failure. I think that is extremely Evil.

Please make PG&E (and other utilities who may be doing the same thing) stop installing EvilMeters, and make them leave the analog meters in place. And please make the utilities replace all installed EvilMeters with analog meters.

---

I am a retired school teacher who has served California well over the years. I am ill from the smart meters (two of them, one gas, one electric) on my property – one at each end of my home. The electric smart meter, the worst of the two, is located on my bedroom wall, right by the headboard of the bed. My head was less than a foot, about 8 inches or less, from the smart meter for six months, as I slept and read in bed, sitting up. I had no idea that the electric meter on my property was causing emissions, including high bursts of radiation, 24/7. I have had my home tested and there is also “dirty electricity” from emissions on the wiring in the bedroom. I developed numerous symptoms, including very shrill (painful) ringing in my ears, severe headaches, skin cancer, dizziness, nausea, sensitivity to rf radiation and more, all following the exposure to the smart meters. Finally my doctor told me about the dangers of smart meters and diagnosed me with radiation illness. I moved out of the bedroom, along with my husband. I now sleep (for the past year) in the living room (very uncomfortably) and he sleeps in another bedroom. The living room is far enough away to lower the headaches, the other bedroom is not. I cannot use 1/3 of my home and property now, due to the smart meters. Getting anywhere near the electric meter, especially, inside or outside, produces extreme illness that lasts for three or four days.

I wrote and called SDG&E and the CPUC many times. Neither one was helpful. They both incorrectly insisted that it was mandatory to have these horrible meters on my property. I wrote and called all elected officials. They have ignored me... This is the worst thing I have ever experienced or seen. America will be destroyed by these multinational companies and the politicians who cater to them, if we don't take action to stop the smart grid.

---

I would like to have the SmartMeter removed from my home immediately. I was not asked permission prior to the SmartMeter device being installed on my home. My family was never consulted about the program, or even notified in advance of installation. I hereby demand that the SmartMeter device be removed from the premises.

Since the installation, I have had headaches, nausea, dizziness, confusion and memory loss. I now understand that there are health concerns related to the wireless network that the SmartMeters use, and I do not want this device on my home or in my neighborhood. My old analog meter worked just fine, and I do not want to risk the health of my family with this SmartMeter.

---

I live in Encinitas and the Smart Meter was installed in my home without even asking or considering the Health issues for myself and those living here. This is so outrageous and plain inconsiderate. I feel very resentful to the SDg&E! I have felt more tiredness, stress and agitation since they were installed and I want them out of my home. Did no one do any research on the effects on Health before considering installing these on our homes. I cannot believe the ignorance of such an act!

---

I have had headaches and progressive MS symptoms since the smart meter was installed. My MS symptoms now have progressed to feelings of numbness in my hands, burning sensations in my left arm, weakness in my left arm and a sense of confusion and memory loss intermittently from week to week. I want these poisonous contraptions OFF my house ASAP!

---

Since about a month after the meter was installed on my home, I began experiencing hives all over my body and near constant ringing in my ears which gets very loud at times. Both symptoms disappeared immediately months later when I was able to leave my home for more than a day. They returned within 24 hours when I returned to my home.

When the installer came to change out my analogue meter which was working perfectly, I followed him out to the side of my house and told him I objected strongly to the meters because of the problems I'd been hearing about inaccurate readings. I had not heard about the health concerns at that point. My objections were ignored so the meter was installed. As stated above, my symptoms began about a month later and have continued non stop since...except when I was able to leave my home for more than 24 hours.

Two and a half years ago, I had major surgery for cancer. It was removed and my follow up treatment worked. I was feeling very well just before the smartmeter was installed. When the hives and ear ringing began, my feelings of well being totally disappeared. My MD is VERY concerned and believes as I do that the Smartmeter is a threat to my health.

---

In the past year, without my consent, a smart meter was installed on my property. Between the time of installation and this writing, I have developed tinnitus—a constant, faint, ringing in my ears that negatively affects my sleep and my overall quality of life. I had no idea why I developed this condition (I have suffered no head injury or severe illness this past year) until I learned today that tinnitus has been associated with the emanations from these smart meters. My wife then attempted to contact PG&E and local electricians regarding the replacement of the smart meter with an analog meter. She was informed by the local electricians that it was illegal for them to remove the smart meter from our property. She was informed by PG&E that they would not remove the smart meter. This situation is intolerable. The idea that a private company is somehow entitled to place a device on my home that is harmful to me and to my family flies in the face of my understanding of property rights in this state and in this country. I would ask

that you give rapid consideration to a method by which homeowners can opt out of having a smart meter. The longer this goes on, the greater the harm that will be suffered by the populace and the greater the damages that will ultimately be recovered against PG&E in the numerous lawsuits that will inevitably result. I own and operate a civil litigation law firm in Los Gatos (Abronson Law Offices). I have previously received inquiries regarding legal action against PG&E. Given my personal experience, I will be taking these more seriously in the future. I and numerous others in my community will also be watching to see how quickly and successfully this issue is addressed in considering how to vote in the next election.

---

I have called to have my smart meter removed 11/30/11 This was installed Jan. 12 2008. Since then I have experienced sleepless nights, anxiety, ringing in the ears and headaches, my children have as well.

When I called to have the smart meter removed I was informed that I will be charged to go back to the analog and will not longer be able to use the Time of Use plan (which I have been a part of before the smart meter...this is a cost saving program as to when the peak and off peak hours are for usage) Their reasoning is that a technician will have to come out monthly to read meter. So I am curious why my NEW monthly tehnician fee who will come out to read my meter will not be able to do the exact same service I had prior to the having the smart meter installed!

---

I have lived in my home in Santa Cruz for over 30 years. This last summer I was away for 5 weeks, when I returned to my home in mid September I began having sleepless nights. I would awake about midnight with my heart racing and be unable to go back to sleep at all. After a week of this I went to visit a friend and slept perfect at her house, that has no smart meter. When I returned the same sleeplessness happened. It finally dawned on me to check the meter which is on the outside wall of my bedroom. The smart meter had been installed against my opt out wishes.

I called PG&E and they have refused to take it off and gave me misinformation on the phone saying that the meter was not even working yet. When I pressed the representative about this, he changed his story. I need this meter off, I am missing work and my health is suffering from lack of sleep.

---

Since the SmartMeters have been installed on the condo building where I live, I started suffering from heart palpitations.

I happens especially during the night awakening me and keeping me awake, without being able to fall asleep again.

I also started suffering from Hypothyroidism, a problem I never had in my life until now (I am 41).

This is an intolerable decay in environmental quality. Since now, I have conducted a very healthy life style, rarely have I got sick form common things such as colds and flu.

How is that eating only organic foods, not smoking, having low stress level got me into an autoimmune disease?

---

Since Smart Meter has been installed, I am suffering from heart palpitations, unusually dry skin, and insomnia for months. My pregnant wife has had chronic headaches for months. I usually keep abreast of health dangers that most people are unaware of, but somehow I missed this one. I was personally violated when my Kafkaesque utilites company, PG&E, came and did this to me without informing me. They come and threaten my health and the health of my family like this. It's an outrage but most folks, as usual, are still asleep to it. I had to spend 200 bucks on EMF shielding fabric for our bedroom, as the accursed "Smart" meter is directly opposite our bed. I've written, I've called, and as I fully expected, PG&E doesn't give a damn about my family.

---

I would like to have my smart meter removed from my home immediately. I never gave my permission to install a smart meter on my home. One day a company representative showed up at my door and said he needed to replace my meter. I did not realize that it was going to be a totally different meter than what I already had. I was not given any information about the smart meter at all. I demand it be removed immediately!

Since the smart meter was installed i have been suffering from debilitating headaches. On some days it is so bad that I cannot function at all. I have also been having severe difficulty with sleeping. After doing research on my on I found out that there are considerable health concerns involved with smart meters. The problems that I have been having are among those health concerns. I demand that my smart meter be removed from my home immediately.

I have called my utility company, Georgia Power, and informed them of these problems and requested by old meter back. I was told that those meter were being phased out and I would not be able to get it back. I was told that I was going to have to deal with the smart meter. They were sorry that I was having problems but there was nothing that could be done. This is not satisfactory! My health and the health of my family are very important. I demand that my smart meter be removed immediately!

---

Since the installation of this new meter, we have both been experiencing ear ringing, headaches, problem sleeping. we would very much like to have our older type meter reinstalled. we don't believe all this to be just a coincidence, because of the timing of it all.

---

Moved into my apartment complex back in November of 2010. The Smart Meter was already installed for our apartment.

Ten out of twenty apartments here have smart meters installed. Our apartment is about 90 ft. away from all of them, yet I still have not had a regular nights sleep since I have moved here. The past year has been pretty painful for me. On average I would normally wake up once through out the entire night. Now its 5-6 times a night if I can even fall asleep!

I don't use wifi unless I have guests over. I keep my cell on speaker away from my head at all times and out of my room at night. obviously I am highly sensitive to electric fields. Not to mention my young indoor cats used to be very active and out in the open of the living room at all times. Here, they hide behind the couch or in the closet as if they are nearly always disturbed=(

The only change in our lives has been the SMART METERS. If all smart meters in my complex are not removed with in the next 3 months, I will have no choice but to move once my lease is up. It will have to be somewhere where they don't allow them. Im sure I will be pushed into backwoods because all of this.

---

Since the installation, I have had bad headaches, and buzzing in my head as well as feeling of my inside is being cooked at night when I try to go to sleep. I have changed my bedroom twice, and now I am sleeping and living in my kitchen where it is the furthest from the SmartMeter. When I go to bed, I turn off the Main Switch to the house over night so that I can sleep. This constant switching on and off the power is making my husband crazy too. He cannot go to sleep until I go to sleep because I need the power off entirely in the house.

I have called my utility company, PG&E, multiple times about getting the SmartMeter removed, and they have told me they will not remove it. They told me there would be an opt out option in the future, but we cannot wait for finalization the opt out program. I do not feel it is fair that I have to suffer when I did not want the SmartMeter on my home in the first place. I am certain that the SmartMeter is causing other health issues for myself and my family because ever since the installation of the SmartMeters, I not only cannot sleep well but my back and leg hurts all the time. I do not want to wait remove this SmartMeter. I would like it removed now!

---

I learned of the dangers of 'Smart' meters shortly after it was installed on my home. Since this time, I have experienced a loud ringing in my ears when I am at home, and my toddler, whose bed is about 15 feet from the 'Smart' meter, has not yet slept a full night in our home since the new meter was installed. He sleeps fine at his grandparents house. He sleeps fine when we are staying elsewhere. He is generally awake and crying every 2-4 hours when we are at home.

Also, the month after my "Smart" meter was installed, my electricity bill almost doubled. This was even after we put our home electronics on a power strip so that we could completely power everything down. We also have gas appliances, so when SCE told me that we were 'probably running our dryer more than usual', they were quite mistaken.

I am also very concerned about fires, as my house was built in 1913 and, while the wiring has been updated since then, there are still some areas of the house that may not have been. After hearing about the

'cause' of fires in some peoples' homes (that their wiring was not up to code), I am concerned that I will also be a victim of this fraud claim.

Had I been informed of the issues surrounding 'smart' meters, I would not have allowed one on my home, near my family.

---

Since moving into this partial basement apartment 2.5 years ago, I noticed an increase in my resistance to environmental sensitivities. I have always lived with cats, and upon moving in here I developed allergy symptoms (sneezing, wheezing and itchy eyes). I also found that whenever I needed to work at my desk, I became extremely lethargic within minutes of sitting down. Soon I discovered information about the negative affects SmartMeters can have on people sensitive to electro-magnetic frequencies. The next time I was doing laundry (which is located in a room directly on the other side of the wall of my living room and desk) I noticed 4 SmartMeters. Four! They are located in a row about 7 – 9 meters away from where I sit at my desk, or couch!

I'd like to mention here that I only found out about the issues surrounding SmartMeters in the last couple of months. Up until now I have spent thousands of dollars in doctors visits, allergy testing and different remedies, diet changes and medication to help get back to health.

So when I saw these SMs ticking away at such a close distance, I went to the internet to figure out a quick-fix barrier to use until I can get these meters switched out to the analogue meters. I discovered that a decent barrier is tin foil and I have since covered the meters with the foil. I noticed an improvement immediately. I have not had allergy symptoms for the past month, and I am able to sustain normal focus while working at my desk. I do not think this is any coincidence.

It is my desire that the KW Hydro company replace these Smart Meters with the analogue meters as soon as possible.

---

This afternoon, my doorbell rang. A very large, intimidating man was standing there, and informed me that he was going to turn my power off for 20 seconds to install a new Smart Meter on my house. I had never heard of a Smart Meter, and told him I didn't want it. He said it was required by the power company. I wanted more time to research it, so I told him to opt us out until I was able to make a more informed decision. He said there was no opt out option and that we had no choice in the matter. He said he would leave a pamphlet on the door and then proceeded to change the box regardless of my objections. I then called the power company and they refused to do anything about it. I am very upset because we were never told about the smart meter, or that there was a delay option. We certainly would have called had we known!

---

Being around Smart Meters gives me nausea, headaches and heart palpitations within minutes. Fortunately my neighborhood has not been completely installed with the meters yet. I no longer can go for walks

around town because I can feel the stabbing of the electrical impulses. Same when driving through neighborhoods where they have been installed. Please stop the madness. I notice DDT and lead are now banned in this country. Since the wireless industry has been totally unregulated so far, it seems that it will just be a matter of time before the health impacts become too great to be ignored any more. I see no reason not to be able to keep the analog meter. PG&E can save money by leaving it there! Meter reading is already included in our rates as is the rollout of the Smart Meters.

---

Since the smart meter was installed on my home I have been plagued by Tinnitus, very loud and consider staying in my home toxic. I also have leg twitching and my whole body convulses like I am shocked. This is torture. I find when I am away from my home the Tinnitus subsides to none at all.

Overall I feel my health is downgrading, also having heart palpitations. I am considering taking this meter off of my home since phone calls to the utility company don't bring them out to replace it with the analog meter. I am also considering a class action suit. This is unconscionable with this device being imposed and infliction of its microwave propagation upon us. My ability to think degraded and I am trying to focus above the noise in my head. My rights to enjoy the quiet peace and privacy of my home has been invaded and violated. I will be contacting attorneys.

The actions of the CPUC, SCE and lack of prompt redress is criminal. None of Californians or Americans should have to withstand this.

---

I would like to have the SmartMeter removed from my home immediately. I was not asked permission prior to the SmartMeter device being installed on my home. I was never consulted about the program. I hereby demand it's removal.

Since the installation, I have had headaches, problems sleeping and humming in my ears. I now understand that there are health concerns related to the wireless network that the SmartMeters use, and I do not want this device on my home or in my neighborhood. My old analog meter worked just fine, and I do not want to risk the health of my family with this SmartMeter.

---

I am requesting the immediate removal of the Smart Meter at my home. I am having severe health issues: headaches, nervousness, inability to sleep, a lowering of my immune system so that I am frequently sick with head colds and cough.

I have called several times and have sent a letter from my Doctor to PG&E with absolutely no response. My telephone conversations were met with no understanding that my request to remove the Smart Meter was valid and important. I was given the PG&E policy line by rote, and my complaint duly set aside.

---

I am writing to request for a zero cost Opt-Out Smart Meter Program. I would like the smart meter to be removed from my home immediately as possible and replaced with an analog meter. All data shows the only benefit for these meters is to PGE. To date PGE is unresponsive as to why my bill is outrageously high when it is only myself and my wife in our home. There is no care, concern or response as to what health effects we might be suffering. To date we are experiencing short term memory issues, sleeplessness issues, headaches.

We did not authorize this meter and were never consulted or given a choice to have it. We are extremely conservative in our power use. I am extremely concerned about the health effects of the smart meter and what they might be doing to us both and our neighbors. It is a travesty that the CPUC could appoint themselves approvers of the PGE smart meter rollout without any actual health, economic studies and actually mandate them without actual legislation homeowner approval. This is a non-legislated private corporate/government deal. I thought that could not happen, but here we are today.

There is actually ZERO PROOF that smart meters are benefiting households or the energy grid regardless of the sales and marketing pitch. There is however considerable research and anecdotal data in the form of studies and many reports demonstrating ill health effects, extreme RF radiation levels and effects, and alleged fraud on the part of PGE – and NO ONE IS BEING HELD TO ACCOUNT! The CPUC is now widely considered a corrupt committee.

Official action is needed now to allow a no cost opt-out program. The meters costs have been illegally passed on to the unwitting consumer with out our consent and PGE consumer billing costs are skyrocketing when the promise was savings! Please hold all accountable for foisting these “smart meters” on the public at our expense without public permission. Restore faith in the rule of law in California. Please act now start with a Zero Cost Opt-Out Program for all Californians.

---

We were never informed a new meter would be installed, we don't even know when it was installed, we just happened to notice it had been changed sometime in the last year. Also in the last year, I have been suffering from debilitating headaches, which have been diagnosed as “Primary Stabbing Headaches” I suffer from these headaches on a daily basis now.

We request that the meter be replaced with the original analog meter.

---

Florida Power and Light notified us by mail in early September 2011 concerning a change in our electrical metering. They stated that they had completed installation an electrical smart meter on our residence.

Since that period of time my family has noticed an abnormal increase in health related issues. These health issues include non-restful sleep periods, fatigue, nausea, headaches, unexplained stomach discomfort, ringing in the ears, etc. Health professionals have been contacted, but no explanation for the abnormal issues have been found.

We have contacted Florida Power and Light to request the removal and replacement of the digital electrical meter, with a conventional analog electrical meter. Up to this point, we have had little response from FPL.

---

My wife has a lifetime history of seizures. She is extremely sensitive to electrical and magnetic fields. Just sitting in front of a computer for too long causes her to have pre-seizure symptoms. For this reason we do not use portable phones and other RF technology. Now PG&E has forced these powerful RF Smart Meters on our neighbors and my wife's seizure symptoms increased almost immediately. So far PG&E has not installed these dangerous devices on our house because we have a locked gate... We are also well aware of the large volume of research that makes it clear exposure to these meters and other RF devices causes cancer. It seems to us that PG&E is determined to kill everyone with these lethal, cancer causing devices.

---

Since a mass "deployment" of Smart Meters in my neighborhood, unbeknownst to my neighbors, our family has suffered health issues. I personally have begun to have ringing in my ears. My daughter has also suffered health issues. I am also concerned because I am aware that this "deployment" was done against the will of my neighbors and without prior notification of the health, invasion of privacy issues.

---

I had my smart meter removed because I was experiencing dizziness, headaches and was unable to sleep and a constant ringing, humming in my ears especially at night. to resolve the problem I had my old analog meter reinstalled. which cost me money plus the opt out fee.... Blackmail... Because I live in a park of about 200 or more homes and because of the high frequency volume, I am still having symptoms to the meters, because most in the park have the smartmeters. I am experiencing headaches on a daily bases and I can not tell you when I've had a good nights sleep. and the constant humming, I am constantly up through out the night... just as if I was plugged in... my health care provider is aware of my conditions and is concerned as well..I was not aware that there were side affects to these meters, but my body is telling me different. when I called and told CMP they minimized it and said it was no different then a cell phone I don't believe it for a moment. I have NEVER had this experience with my cell phone. and I have never had problems with falling to sleep and staying asleep.

---

My complaint is about my neighbor's Smart Meters as well as about the Smart Meter equipment that was installed on the utility poles along the road in my area. My sleep and the general health of my immune system have increasingly deteriorated over the past two years or so since the amount of Smart Meters and Smart Meter equipment has gradually, but steadily, increased in my area. I have spent thousands in medical bills to try and figure out my health problems, but physicians have been unable to find a diagnosis and are left trying to alleviate the symptoms. My doctor agrees that I am adversely affected by radiofrequency, but does not feel qualified to test for this factor.

Communities need to establish safe zones where people can live free from excessive radiofrequency from Smart Meters (and other sources as well). I am forced to try to locate such an area and then move there as the only way to escape the daily assault from PG&E's Smart Meters. Harming citizens in this way is criminal and should be illegal. The fact that the World Health Organization has now classified radiofrequency as a Class 2B Carcinogen clearly illustrates the far-reaching health effects of microwave radiofrequency radiation from Smart Meters. And scientific research has demonstrated that radiofrequency radiation causes many adverse biological effects on the human body long before cancer is induced.

---

I was sitting in my home office when a PG&E employee installed a "SmartMeter" upon my house without knocking on my door first. He did it very quickly and was gone because I went outside when the electricity went out and there was a hugh hammer sound. There I found a notice of what was done.

This is my situation. I moved to the country surrounded by forest several years ago due to extreme sensitivity to electric-magnetic pollution , radiation, and other health issues such as chemical sensitivity. You can imagine how violated I must feel to have this "SmartMeter" installed against my will. The stress of this was tremendous, and as of yet I can not get it removed. I try to just put it out of my mind however, my physical body is experiencing rapid heart beat and head-ache. I realize that Wi-Fi is in the world now but please let my home remain my sanctuary for healing.

I can document my health challenges and their worsening due to the installation of "SmartMeter" on my home.

I will continue to pursue the removal of this health hazard device until it is removed.

---

I live in an apartment building with seven units. When I heard about smart meters I called PG&E and was put on the delayed list. This did not make me very happy because I didn't want one period. Our meters are in a location about 40 feet from my apartment and right next to the building. When I went down recently to look, some of the meters already had smart meters on them. Even though three of us don't, we are still getting the EMF's from the others. I am 74 years old and have lived in this location for more than 20 years. I have been getting headaches lately and I believe it is due to the smart meters. I don't want one and I don't think it's right for us apartment dwellers to be subjected to the smart meters that you installed outside our building next to my meter.

---

Since the smart meter was installed on my home (without choice, just DONE) I have been having ringing in my ears, fatigue and my husband gets severe headaches. The meter is installed outside the wall of the family room where we watch tv and where I'm sitting now at my computer. It's 12 feet away.

I now have called SDGE about getting the SmartMeter removed, and they have told me they will not remove it. One lady told me it was California Law that I have it on my house.

I do not feel it is fair that I am required to wait up to a year to have my SmartMeter removed when I did not want the SmartMeter on my home in the first place. I am also concerned that the SmartMeter may be causing sleep problems and other health issues for myself and my family. I do not want to wait months to remove this SmartMeter. I would like it removed now!

---

Two Smart Meters were installed at our house – gas meter directly behind our kitchen sink – less than 1 foot away, and electric meter – 3 feet from our kitchen/dining room table. I began to develop a host of health problems following this: Intense Tinnitus, trembling, confusion, dizziness and bad abdominal pains, loss of appetite, moodiness and tremendous sleeping problems. I also began to drop things and break out in hives. This has never happen to me before. I am a very healthy, active person. I spent a lot of time in the kitchen cooking, which I love to do – not realizing what was going on. I knew that I felt much better when I left the house, though was still foggy and out of it when I was around the neighborhood. Our house is approx. 18 feet from our neighbors on one side, and 15 feet from the other side. I can feel all these meters. I talked to my Dr. to see what was going on and had bloodwork done. My liver enzymes were elevated – 2x their normal rate – something caused by toxicity. I became scared. When I called PG&E to complain, they spoke to me in a condescending way saying ” Do you own a microwave? It’s no different than a microwave. As long as you are 6ft away from it/them, it’s no problem”. This is a complete lie. They are extremely powerful. We bought a meter and measured it and it goes to extremely high levels of RF in spikes every few seconds, and is transmitting 24 hours a day. I called again and was told there was nothing they could or would do for me. This is when I joined the Stop Smart Meter organization and realized that I was not alone. I have worked in the wireless industry in the past and know that corporateions lie (the manufacturers, the utility, etc. to save money and hide the lack of actual research that has been done. I have seen it firsthand.)

I was getting so sick, we fled to Santa Cruz for a few months – before they were installed there – and I felt fine. All my symptoms went away. PG&E then announced they were going to bulldoze into Santa Cruz county, even though there was a moratorium on the meters until further research was done. What an outrage! We finally left CA and are now living in the midwest where there are no meters. This was extremely upsetting and stressful for both my husband and myself.

---

In mid-October 2011 because of noise from neighbors in the back bedroom, I moved my mattress to the front room of my house. That room is directly over our electric smart meter and our gas smart meter. I couldn’t sleep. Usually I do meditation every night, and sleep easily, but now I cannot do this. I just cannot sleep, night after night. No peace in my heart. I feel my heart jumping for several seconds in a row.

I have no energy. I usually exercise and do stretching. I have exercises I do for my back that I learned from physical therapy, but I cant do them. My ear has noise in it. Its like the noise of my neighbors TV thru the wall, but it is in my ear. I have perfect hearing. Its like a low whishing sound. Since then, I also lost weight for no reason10 pounds. I have nausea and have lost my appetite.

I called the doctor on Oct. 26, and he gave me 100 Lorazepam (2/d) pills and 15 sleeping pills (zolpidem, just before bed).

I took the Lorazepam, everyday but I stopped after a few days. It wasn't helping me to sleep. The sleeping pills did help me to sleep. But I can't take it every night, I am not supposed to according to the information with the pills [effect wears off in 2 wks].

It's about 1 1/2 months now. I am afraid I will have a heart attack or a stroke. I am a sensitive person. I did not know anything about smart meters, I didn't know when they put them in. I called now to find out. PG&E says I am now on a waiting list to have the radio turned off in the smart meter, but they cannot say how long that will be.

---

I have NEVER had headaches in my life but now find myself with one everytime I spend time in the room next to where my smart meter was installed. I want this thing out and my old meter returned.

---

One day I got a notice in the mail that "Smart Meters" were being deployed in my neighborhood in Long Beach whether I liked it or not. I found it interesting that they use a military term to describe this intervention. Since the meter was installed I have had problems with my heart racing for no apparent reason while I am in bed. The meter is on the other side of my bedroom wall. I am in my 60s and everyone I have talked to at Southern California Edison claims the meters are not the problem and no more dangerous than a cell phone. However the phone I can shut off. It has even affected my pets. I have two old dogs and two young cats. Since the meter installation I have noticed that they are panting more and at times seem to have trouble breathing. I do not believe these meters have been studied long enough as to long term effects on humans or animals. I would really like my analog back and have no desire to watch the meter on my computer to see how much energy I'm using. I have no air conditioner; dish washer; clothes washer or dryer. Nor do I have central heating, extra refrigerators or freezers. I use a power strip for my computer and shut it off when not in use. I don't need this big brother utility dictating my energy use. It is an invasion of privacy and it puts meter readers out of work. Higher unemployment rates in this state are NOT needed.

---

I am a health practitioner concerned about the effects of Smart Meters I have seen in my patients. Many previously healthy people are having symptoms dating from the installation of their Smart Meters or shortly thereafter. Some patients already health-compromised, have gotten worse since their Smart Meters were installed. Some are affected more than others. Some have become disabled from their symptoms.

I feel strongly that installation of Smart Meters with their potential health hazards is a violation of the personal rights and freedom of myself and others.

I have refused a Smart Meter and want the right to continue to do so to protect my health.

---

On October 22nd of 2011, my life changed forever. I was sitting writing a letter to my daughter, and I began to get stinging, shooting pains in my jaw and ear area, my sinuses starting filling up and my head felt like it was full of paint. That night I was unable to sleep because of a very alarming case of acute tinnitus, unlike anything I had ever experienced before, and chest pains. The next night I was awakened from a dead sleep at 1:30 in the morning with vacuum-cleaner like tinnitus and an alternating two-tone noise that sounded like notes from an electric keyboard. It was so loud that I opened the window to see if it was coming from outside. I had to put on street clothes and walk away from our apartment in search of relief. A couple of blocks away, the tinnitus diminished greatly. When I came back I had to lie on the couch in the living room and turn on the TV and heater to help mitigate the white noise in my head to try to sleep. Staying asleep was another battle. This nightmare went on for a couple of more nights.

I stayed away from the apartment during the day, and it was patently obvious that the symptoms abated away from the 11 “Smart” meters installed in our building a couple of months prior. As I already had fibromyalgia, missing deep sleep cycles affected my health all day long. My ten year old son and I had to start finding different places to sleep. I soon began to realize that some of the symptoms he had been having disappeared away from the apartment – chest pains so alarming I had to take him to a pediatric cardiologist, “stinging” headaches, and bouts of fatigue.

My son and I have now been homeless since early December, when I was finally able to get us all the way out of our apartment in spite of debilitating symptoms, including head aches, diarrhea, nausea, hand numbness, chest pains, neck pains, and extremely upsetting cognitive impairment. We are having to move into a van and are currently searching for a place to park/live where we can remain relatively healthy – at least functional. I have had to cut down on the hours I can work, and usually have to work under very difficult conditions, in terms of symptoms. There is utterly no mystery here in terms of causation – most symptoms diminish the further away my son and I get from electro-smog sources. After a big exposure, though, it takes some time to recover to the usual level (of discomfort!)

The CPUC has allowed PG&E to ruin my son’s and my health, and that of many, many others, and we have had no recourse but to take the brunt of it with no official help – even doctors at this point are generally ignorant of the EHS phenomenon (in this country). So where’s the accountability? This travesty is indefensible and unconscionable. PG&E needs to stop this madness immediately, and the CPUC needs to make them stop. And we victims of this outrageous breach of public trust need to be compensated.  
Anon, CA.

---

For over a year my parents have been waiting to have their smart meter replaced with an analog meter for health reasons. PGE has been unresponsive and neglected my parents health and their request to have the smart meter removed.

As soon as the smart meter was put onto my sisters home last year, her family began experiencing ringing in their ears, headaches and malfunctioning of electrical devices such as their cell phones, laptop and baby monitor. PGE refused to take off their smart meter. They had to move out of the city because of the health problems they experienced once the smart meter was installed.

During the year that my parents have been living with smart meters their health has deteriorated. In the past year my mother has lost much of her ability to speak clearly and walk without assistance. My father, who was diagnosed with Parkinsons Disease approximately fifteen years ago, yet had improved after a new Deep Brain Stimulation (DBS) procedure in 2009, has also experienced increased problems with balance and speech.

We are concerned that the two smartmeters on their residence are interfering with the functioning of his DBS implant, a pacemaker-like device that sends electric signals into his brain to stimulate dopamine production. The device's use manual warns against exposure to EMF and RF radiation. We called the engineer hotline for the company that manufactures the DBS device, Medtronic, and the staff recommended having the smartmeter removed. We have learned that no studies have been conducted concerning the risk of a smartmeter affecting the health of a person with a DBS. We notified PGE, however they ignored our request to have the smartmeter replaced with an analog meter.

PGE is obligated to comply with the federal Fair Housing Act and the Americans with Disabilities Act, and the California Unruh Civil Rights Act, as well as other state and federal laws, mandating that you make changes to rules, policies, or practices, or services that may be necessary to allow a person with a disability the equal opportunity to use and enjoy a dwelling. Please be advised that my father and mother, are deemed disabled by the Social Security Administration and, therefore, are people with a handicap under the relevant anti-discrimination laws. This letter places you on notice of our need and request for a reasonable accommodation in the form of immediate re-installing analog meters on his dwelling. (Anon Family, Alameda County CA)

---

I am doing all the research I can to fight the Northwestern Energy Co's illegal installation of a smart reader. Since the installation took place in March, 2011, my 14 year old cat has developed a bad eye infection and is now going blind in one eye. Rabbits I recently purchased and put in my barn due to cold weather have given birth to still born or highly deformed litters (the barn is much closer to the smart reader than my house)

One of my goats had twins, one was normal, the other about 1/3 the size of a normal kid and died within 3 days despite being bottle fed (mother rejected her) .

My mother suffers from seizures and immediately started having bad ones after the installation of the smart meter. She is 93 and has recently moved into my house. I am 65 and have had a lot of joint pain since the installation, the ring finger of my left hand started becoming paralyzed during the night in the spring—sometimes it takes several hours in the morning for me to be able to flex my hand and use it properly. Prior to the installation, I had no problems with that hand. Sudden fatigue is becoming a problem as are severe sleep disturbances.

Sincerely, Eunice Farmilant Plains MT

PS. I also wanted to add that my land line causes my dog a lot of distress—even after removing my cordless phone.. As soon as the phone rings and I begin talking, she starts barking and runs to the door to be let out. I experience a high pitch ringing which is intermittent. I did buy a radio frequency meter and

took readings off the digital meter. The exact same signals are given out by my laptop computer while it is on. The signals only stop after the computer is turned off at the surge protector.

I get the same readings from my land line and the television—so it is apparent the frequencies are being carried by both the electrical wiring in the house and the telephone. I have to turn off the television also at the surge controller to stop the frequencies....so now both the computer and television are on for only limited times during the day. I am also going to use a speaker phone so I do not have to hold the receiver near my ear/head.

Part of the problem may be due to the proximity of the meter which sits in front of the electric box in my yard being mounted on the same 6 x 6 post as my telephone connection and my satellite receiver for the television. I wonder if other people have encountered this problem?

The only way I can sleep (nothing is plugged into any electric outlets in the bedroom where I sleep) lately is by taking melatonin.

My bedroom is approximately 40 feet from the digital meter which is free standing. I have procured several microwave ovens and plan to mount the doors from them to both the front and back of the meter as I have read they have an embedded screen which blocks radiation. I am also in the process of buying various forms of screening and grounding devices.

---

I am writing in regards to Smart Meters that I have to deal with on a daily basis. Over the past 6-7 months I have recently developed Tinnitus, Migraines and Blurred sensitive vision. The only change in my life has been the SMART METERS. I have to sit within about a 6-10 ft radius of a smart meter at my work and My neighborhood has been flooded with them. I have called Pg&e but of course they say nothing can be done. At this point I am just looking for help on how to approach this matter. A.M.C Santa Cruz

---

I do not have a SmartMeter on my house and most of my neighbors don't. But as the meters have increased nearby the ringing in our ears is near constant here and sometimes intolerable. Sleeping can be difficult, I have suffered unexplained hair loss, my appetite has gone down and my digestion has suddenly gotten more difficult. Further, I have suddenly become lackluster about things and other health issues have spiked. I feel better now when I am away from home but it is getting increasingly difficult to find places where I can not feel restless or spacey. R.H. Santa Cruz

---

I was switched on to a Smart Meter without my consent. ( a notice was sent out only) Since that time, I've had issues with severe anxiety, depression, sleeplessness, headaches, buzzing and ringing in my ears...I couldn't account as to why I was feeling this way, until I finally read about the smart meters and what they are doing to some of the population....I called my utility co.(salt river project in az.) and asked to speak to a supervisor about this matter. He (Ben Celleck) said that they don't cause these problems and that it's SRP's property and they will deem what they will use. I told him "I'm the customer and I pay SRP for the

service and they should use what I request, not the other way around!”.....I kept insisting to have it changed out and stating it was my right as a customer to have this request..but he keep telling me...”No, they will not change out the meter, but we will come out and check it for any leakage of power.”.....”I said I’m very sensitive with the EMF that it produces and is causing my health problems.” I said. ” I don’t want SRP to just come out and check it, I just want it to be replaced with the analog meter not the smart meter”.....He kept to his same story....”We will not replace with the analog”.....When I got back home (11/2/11) from work, I had received a notice from SRP that they had been out there to inspect my meter and stated they had found nothing wrong with my meter. D.M. Arizona

---

Since the smart meters were installed, I have difficulty breathing, have headaches which I never had, sleep problems, balance problems, physical weakness, nausea, anxiety, depression, and worsening of health conditions. I would like the analog meter back so I can feel normal again. D.D. Santa Cruz

---

I am having serious health issues since the meter was installed. And, not prior. My home has become toxic. I want this meter removed immediately. I can not wait. This is an emergency. Either the utility company comes out immediately and takes it off or I will resort to other measures. This is oppressive tyranny and an assault to my mental and physical well being. M.C. Riverside CA

---

My family and I have been experiencing negative health effects since the smart meter was installed. I have had ringing in my ears and my son has not slept a whole night since the meter was installed. He sleeps fine at his daycare (analog meter) and he sleeps all night at his grandparent’s house (also analog meter).

I would like permission to have my analog meter replaced at no cost to me or my family. L.S. Los Angeles CA

---

Ever since the Smart Meter has been installed in my house I have suffered insomnia, constant headaches and am forced to listen to the sound of electrical humming outside my bedroom. Do not ignore the fact that some people are more sensitive to electricity than others. L.M. Santa Cruz

---

In May of 2010 they installed a RF Smart Meter. Between then and June 2011, I had made four trips to an ER for heart palpitations, tinnitus, extreme fatigue with mental confusion and inability to sleep. On top of being able to accomplish damn little due to the symptoms, the electric bills topped \$200 per month when we didn’t add an appliance or use more of what we had.

In each ambulance ride, the symptoms went away after 30 minutes out of this Smart Meter Neighborhood. Then the symptoms returned within a day.

June 2011, I demanded they remove the smart meter because I was being over-charged. They replaced the RF Smart Meter with a hardwired digital Smart Meter in an attempt to placate me. And I am still being overcharged. The symptoms are a little less severe, but they still exist and are very hard to accommodate in any capacity. Especially the headaches that I've never had until a Smart Meter was installed. John N., New Mexico \_\_\_\_\_

My name is Donald Newsom. I have an account with PG&E in my home. My desk is on the other side of the wall from the smart meter.

I am 42 and in excellent health. However, since this was put on our home without any permission I have had severe headaches and my right eye is twitching now uncontrollably. This doesn't happen when I am away from my home (although now the problems are severe enough they are becoming constant). I believe it's the smart meter. I have phoned them twice to have someone remove it but they will not.

On 10/18/2011 I called PG&E and they transferred me to Angel in Sacramento with the Smart Meter Department. I told Angel that my eye is twitching badly and that my headaches are getting severe. He took my information down and said he'd have someone get in touch with me. I told him I tried this once before, where PG&E said they would have a supervisor call me back, but when they did call 5 days later they hung up immediately after I picked up the receiver – which was 2 rings in. I saw it was PG&E via my caller ID. They did not call back. Thus, Angel told me he would have someone get in touch with me over the next week. I hope so... as I am now demanding this be removed.

I would like to have this smart meter removed. I have 3 adults living here and 4 children all under 13 years of age. PG&E did not allow us to opt out and put the meter on our home while we were away. It seemed to us very sneaky. How can a company put something on my home that may harm me and my children, and then not remove it when I tell them the harm it is now causing? I am hoping someone needs to come out and remove this from our home and put back the old style meter, or turns off the transmitter I am so sensitive to.

My body is now feeling very sick, I have headaches constantly and my eye may need surgery to stop the twitching. Further, we work where we live and home school our kids ... so we are getting much exposure to the RF Transmissions and would like it to stop.

How can we accomplish this?

Donald Newsom, Butte County CA

---

I have very disturbing symptoms after living for a year and a half sandwiched between 30 gas smart meters on one side and 30 electric smart meters on the other side. I also have wi-fi router and wi-fi radio which are probably part of the problem.

I am toasted by inability to sleep more than 4-5 hours and even those hours occur randomly so as to say my sleep patterns schedules are all out of whack. I have intermitant vertigo. I think I am getting cooked by meters in my location because I get unexplainable, VERY uncomfortable sweats that come upon me out of

nowhere feeling like I am being heated up from the inside out, they make me feel very unbalanced and really mad as I usually evacuate my apt and go outside before I take a shower to try to feel good. My facial skin also has dried and aged and wrinkled beyond recognition. Most replies to my inquiries say I must move from this apt a.s.a.p. That is not an easy job.

Where am I going to be safe?

NO wi-fi recommended or maybe wi-fi will invade another neighborhood after I relocate there. Also getting away from the stupid smart meters they are everywhere here now. I know moving off the grid and living with solar power is ideal but that is not likely at this time. I cannot really start living in my car and spend my time at the park or whatever others report such as staying away from their homes as much as possible. MS. Humboldt County

---

Edison installed a new smart meter yesterday. I did not sleep last night. There is something going on in my head and body. I have ringing in my ears at a very high pitch. Like a dog whistle or crystal in some electronic device whistling. It is creating some sort of electric waves from my ear area to my body that is very uncomfortable. It is making me sick. It is like a chill but not quit. I am having a hard time describing it.

I called Edison right away and they tell me there is nothing they can do for me. But they say things like we care and have a nice day while I tell them I am being harmed as we speak. The people at the Edison company are not trained in electromagnetic radiation or electronics and challenge me that I am not having the reaction that I am having. I begged them to remove the meter and it is still whistling away in my head. No concern to Edison that it is killing me. It makes it hard to think. My brain is slowly shutting down.

It is a real wake up call to me since I have worked in the electronic field (Research and development for Hughes aircraft, Semens etc.) I know about EMF and have heard of these things happening but it was always on an intellectual level since I had no personal reaction in the past. At least not like this. Now I know! It is real bad and I am considering getting an ice chest and just turning off the electricity to the house but this produces many other problems I don't know how to get around. I want to change to another electric company but Edison says you can't do that now. What can I do. I can't take this for very long.

Is there a class action suit against the smart meter yet? Allan B., So. CA

---

I have had severe headaches since a Smart Meter was installed on my house. When I leave to visit my Mom in a place where there are no Smart Meters, my headaches subside. As soon as I come home, the headaches return. I have been getting 15 – 18 severe headaches per month for approximately a year now. The days the headache is not severe, it is still present. This is severely affecting the quality of my life and my ability to work. I am barely hanging in there. I don't know how much more I can take.

When the subcontractor working for PG&E came to install the meter, I told him I did not want one. He said I had no choice in the matter and installed the meter anyway.

Despite my health complaints, PG&E will not comply with my request to remove the meter. My request to purchase my own analog meter, have it installed by an electrician, and return their meter to them was also denied.

I cannot believe this is happening in this country!! This is absolutely criminal!!

Lisa Miller, Novato CA

---

This is becoming such a critical issue all over the globe, including my soon-to-be “former home” of 23 years: the city of Burbank, CA. I am being forced to leave the city that I have loved living in, where I have friends and family and community ties. The place that I thought of as a safe and friendly haven.

I began to experience severe health affects within 5 hours of the installation of 4 GE Trilliant smart meters on my small apartment complex on 7/28/2011. Headaches, nausea, insomnia, feelings of agitation and irritability, and difficulty concentrating have made it necessary for me to leave my home. My symptoms resolve within about 30 minutes going to a meterless area. I have been living out of my car since 8/2/2011, stopping in the evenings at the homes of people who are able to let me sleep for the night. My life has been turned upside down. I knew nothing of smart meters until the onset of my symptoms, but I do know for sure that the effects are real. Five out five residents who were polled in my complex (out of 6 total residents who live here full time) have shared that they are having similar physical symptoms. A woman in the building next door has reported that she is unable to sleep in her bedroom. She didn't know she had a bank of 8 meters installed in the basement directly below her bedroom.

I have sought remedy through contacting Burbank Water and Power. Initially I was told it would be too expensive to restore my analog meter by Ron Davis, Chairman of BWP. Another board member suggested I just move out of Burbank. In a bizarre twist, I received a phone call from BWP a month after I spoke about the problem offering me a new refrigerator (free) to replace my “old” refrigerator. This is peculiar, given that my refrigerator is only one year old. I then received another call from BWP suggesting that I might have a problem with a carbon monoxide leak. Given that my carbon monoxide meter reads zero and given that I feel ill in other people's homes in Burbank, I hardly think that this is feasible. BWP employees have suggested that I am reacting to my neighbors' WIFI. While this may be true, I have lived quite comfortably with my neighbors' WIFI until the day the meters were installed. They also suggested that I might be having a problem with the new paint in my apartment (it's a year old) or the new carpet (it's 15 years old). Other helpful suggestions included the idea that something new is in bloom and/or there might be some construction going on around me.

I contacted Judge Yip-Kikugawa, telling her of my plight. I received a terse message back from one of her assistants stating that the CPUC has “zero authority” over BWP and a suggestion that I present my complaints to my City Council. I took the suggestion and tearfully told the Mayor of Burbank and the Council at a meeting in early August. The response was underwhelming, save for that of Dr. David Gordon. After public comments were made, Ron Davis was allowed to take the floor for several minutes, during which he stated that the meters are “safer than safe” and that BWP is working with each concerned citizen to resolve their issues. I do not feel that BWP's effort with me come close to solving my problem. I am losing my home and they are offering me a new refrigerator.

I am desperately saddened by the situation and am seeking a place to go that is not too far distant from my elderly mother and from the community I have lived in all my life...

This must be STOPPED. Civil rights, human rights, and the future of the planet could very well turn on this issue. Dramatic? Yes! True? Absolutely. SG, Burbank CA

---

Since PG&E put in their 'smartmeter' (oxymoron), I wake up with a headache every day and I am always tired no matter how much sleep I get. I have been depressed, lethargic and forgetful. I have so much trouble thinking clearly, it interferes with my daily functioning. I have gone to several doctors about the symptoms, but nothing has helped. I didn't realize how much the meter had been affecting me until I went away for a vacation and all of my 'illnesses' were gone. Now that I am home, all of my "symptoms" are back. On top of everything, SMUD came out to try to install one of the meters, too. I told them I didn't want one. As the men were leaving, I heard one of them say, "She is going to get one anyway." This is absolutely criminal!

Michelle, Sacramento

---

From Dec 2010 to April 2011 four 'smart meters' were installed within 20 feet of our bed. Since that time we've experienced headaches, ringing in the ears, heart palpitations and insomnia, ONLY when we sleep in our bed in this house. We've had SDG&E out on several occasions and have requested to opt-out of the 'smart meters' and return to analog. The SDG&E reps say that there is NO alternative to the 'smart meters'! Also our city block's main grid 'smart meter' is located in front of our home, so short of moving, we don't know what to do! Friends in Northern Calif. tell us that PG&E offers an 'opt out' program for their customers. Plus many cities there have chosen not to have 'smart meters' at all. Why can't SDG&E give us that same option in Southern Calif?

At least with cell phones, microwave ovens and computers, we have the choice to buy them or not, and when to turn them off. What about all the families with small children who live in apartments or condos with hundreds of 'smart meters' in banks of adjoining bedroom walls? We should all have a choice with our metering system, especially since so many are having health issues with the 'smart meters', and the long term effects of microwave exposure are still unknown.

Not long ago we were told that high tension power lines were safe, but over time statistics have shown that the incidence of several types of illnesses, including cancer, is much higher for people living beneath those wires. We can all only hope that you, (our California Public Utilities Commission) will step in and create a state wide free opt-out program soon, or maybe this is something to be put on the ballot and let the residents of California decide for ourselves? Vicki, San Diego

---

Submitted on [2011/09/01 at 9:03 am](#)

I live in Perris CA in an apartment complex that also has swap the old analog meters for smart meters. The meters are directly outside of my bedroom wall. Eversince these smart meters were installed every night while trying to sleep I can hear this buzzing, humming sound that gives me horrible migraine headaches n heart palpitations. I wake up feeling tired, nauseas and not well rested whatsoever due to all the disturbance this smart meter brings upon not only myself but also my little four year old daughter that sleeps with me every night. I know that these smart meters are a big health risk because of all the symptoms my daughter and I have been experiencing since they were installed. I really wish that this issue can be seriously investigated because I know that I'am not the only person experiencing the same issues and our electric company should be held accountable. I hope this matter gets resolved quickly before people become more seriously ill. We need our old analog meters back!!!!

Thanks,  
Julie Reynoso

---

I currently have a 4 bedroom house that I can only use two bedrooms of due to the radiation being emitted from your smart meters. My daughter had the classic symptoms from having slept in the room adjacent to the meter for 9 months before I realized that her problems coincided with the installation of the meters. I have had the radiation levels measured in her room and she was getting dosed with high levels of MW radiation every couple of minutes all night long for nine months. I need my home to be a safe haven, my daughter needs her room back, give me the option to protect my family from microwave radiation. [electrosmog21 on youtube](#). Paul, CA

---

“My health has been effected since my neighborhood had smart meters installed. I have trouble sleeping, often only sleeping a couple of hours each night. I feel this is a giant experiment on the population.”  
Anon.

---

An open letter to SDG&E, Smart Meter Complaint Department

I have made three prior telephone requests advising SDGE of the serious side effects concerning my health since the installation of the smart meter device at my home. Three different individuals came out to my house on three separate occasions, all armed with the same propaganda, the same zero concern for my health or the safety of my home.

I was told, “I don’t know. You are the only one that has complained.” (A false statement.) I was also told, “The smart meter is not causing any problems to your home.” (Another false statement.)

I am a 49-year-old woman and I have never before experienced any of these problems in either this home, or any other home that I have lived in, prior to the smart meter installation.

I came home one day after work, and they had just finished installing my smart meter. I did not think anything of it. I had received a notice a few weeks prior, indicating that a smart meter was going to be installed.

That same evening I awoke between 2:00 and 3:00 in the morning, with ringing in my ears, dizziness, tingling at the upper part of my head that turned into a headache and then nausea. There was also a horrible feeling of uneasiness that I had never experienced before and that prevents me from going back to sleep at night — every night.

One of my dogs awoke at the same time, wandering the hallways whining and crying. This dog refuses to sleep inside at night now, as the pulsed radiation also makes him sick. This dog had slept at the foot of my bed since the day I brought him home until the night the smart meter was installed. I have numerous friends and family who will testify to this, if called to do so.

The same scenario occurs whenever I sleep in my home, a home that I worked six or seven days a week for most of my life to be able to afford, and now you, the utility company, is FORCING PULSED RADIATION where I live and sleep, which if you do your homework and read the numerous articles that have been published by scientists who were not paid off by a utility company, you will see that radiation causes cancer and I will not stand for a cancer causing device to be attached to my home.

I was gone for two weeks on two occasions over the summer, and I sleep fine whenever I am away from my home. I was in Peru for two weeks without these problems and also in Alaska, where I had no trouble sleeping, no trouble concentrating, no dizziness, no ringing in my ears, no tingling at the upper part of my head that turned into headaches.

I also have noticed a strange humming and buzzing in my home around the appliances, coming from the computer, and around all the intercom panels in my home. I've had three people out from SDGE and they all heard the humming and buzzing and told me to turn the intercom down all the way and then I would not hear it.

I asked them, "How do you explain this? This humming and buzzing was not ever here before the smart meter installation? My kitchen appliances never hummed and buzzed before the smart meter installation." I told them, "I don't think my house is safe. This is not normal."

And I just got the blank stare, the "I don't know what to tell you," and the "No, I cannot remove the smart meter." I begged them to return my house and home which I loved back to normal, to please, please remove the smart meter and install the old analog meter that worked just fine and that I never had a problem with. The blank stare and the, "No, I cannot do that," was the only answer I could get out of these people.

I asked one of the gentlemen what his job was at SDGE, as it appeared he had no training as an electrician and was not capable of answering any of my questions. He told me, "Well, my job is to handle questions from people like you." I then replied, "I thought you said I was the only one that complained." Of course, he quickly departed after that. We all know that if he had told me anything different, he would have lost his job.

I want the same remedy that Northern Californians have received. I pay my utility bills just like they do and I want to be treated with the same remedy that [they] received: IMMEDIATE REMOVAL OF MY SMART METER AND REMOVAL OF SMART METERS SURROUNDING MY HOME.

How can the utility commission and the utility companies treat Southern Californians who are being made sick by smart meters any different than customers in Northern California? They cannot. This is a formal request for removal of the smart meter illegally attached to my home and to the homes around me.

Copies of this letter are going out to as many people, organizations, and government agencies as I can send it to, so you can't drop this one in the trash and say you never got my letter.

Sincerely,

Richard and Diane XXXXXXXXXXXXX

---

The following letter was sent to the CPUC judge overseeing the 'Smart' Meter proceeding:

Your Honor,

I am writing from the city of Burbank, in Southern California. On July 28, 2011 Burbank Water and Power, the municipal utility company that "serves" my home city, installed a bank of four GE/Trilliant smart meters on the side of the small fourplex in which I live.

Approximately four hours after the installation was complete I developed a band-like headache that was unresponsive to medication. The next morning I awoke with the headache and slight nausea. I thought I might be coming down with the flu. However, after I was away from my apartment, I noticed that these symptoms resolved — only to return when I was back in my apartment for about 4 hours. This pattern continued for the next three days. I began to have trouble sleeping and difficulty concentrating. I also experienced some transient heart palpitations.

Prior to this I knew nothing about smart meters and had no idea that they could impact human health. I am devastated by these developments.

My current residence has been a haven for me — until the meters went in. In an almost nightmarish scenario the place that I call home is now off-limits for me. This is particularly problematic because I am disabled and rely upon Section 8 rental subsidies in order to survive. I cannot move within my home city because every building is slated to receive the meters by the end of 2011.

I have spent the past 22 days living out of my car, finding shelter at various friends' homes in the evening. The temperatures in Southern California have been in the high 90s and over. I am exhausted, frightened, and do not know where to turn.

I have spoken to the board of BWP at a public meeting. The best they could come up with is the suggestion that I move into another city. This is problematic because the closest city to me is Los Angeles.

To transfer my housing voucher to Los Angeles is a Sisyphean task. The housing authority in Los Angeles (HACLA) is a poorly-run, huge bureaucracy that has been known to cause tenants to lose their housing vouchers through mismanagement. I have called five different telephone numbers to try to get some guidelines about transferring — all to no avail. Meanwhile I struggle to keep my health and my life together. I take anti-seizure medication and my medication schedule has been disrupted by the random and brutal way I am living right now.

This is so very wrong. I have been displaced from my home of 23 years due to the installation of the meters. To be sure, I am currently in the minority of people who are known as electrosensitive but I do not believe that I should not be subjected to the suffering and losses that are my current reality. If I were physically challenged and needed a wheelchair would I be thrown out of my home? I think not — there are laws that protect against this. Why, then, should I be denied the fundamental right of a home — a home that I have been healthy and happy in until the meters were foisted upon me?

Where can I go? My 84-year-old mother lives 10 minutes from me and I believe that it is my duty and right to remain close to her in the event that she needs to call upon me for assistance. As a disabled woman (I've had four brain surgeries), life is difficult enough without being displaced by a technology that I have neither asked for nor consented to. I consider myself to be a resourceful and strong person, but I am feeling overwhelmed by what I am facing: illness and homelessness. I am college-educated and have a middle-class background but even this does not equip me to deal with my current challenges caused directly by the smart meters.

I believe that the utility companies have relied upon poorly-designed studies conducted by organizations (CCST and EPRI) that have ties to the communications industry, the utility companies, and that have financial interests in the smart grid infrastructure. I do not think that a thoroughgoing study into health consequences has been performed by either of these entities. The non-thermal effects of non-ionizing radiation (especially pulsed RF) has NOT been studied by these so-called “impartial” organizations. I think it is an outrageous and tragic turn of events that is affecting me and many other people. I have heard three of my neighbors (young people with no history of electrosensitivity) complain of headaches and insomnia since the meters were installed — and they weren't even aware that they had received them! I am absolutely sure I am not alone in my suffering.

Your Honor, I ask you to take into account my situation when you consider what is being perpetrated upon the citizens of California. This cannot continue. I may be collateral damage — it's too late for me. But, please, think about the population and countless numbers of people who are having their lives upset and threatened by these dangerous devices.

I am not a believer in conspiracy theories, but I do believe what my body is telling me. This is real, this is true, and it should not be allowed to continue.

Thank you for consideration.

Sincerely,

Ms. Shane Gregory, Burbank, CA

---

from: July 26, 2010

Dear Barbara Boxer:

I'm currently living in a corner of my house the size of a single bed surrounded by aluminum foil. This blocks the Wi-Fi from my neighbors' houses and ambient EMF.

The Wi-Fi fields and other EMF make me sick. I've spent the last eight months extremely ill and spend much of my days in state parks where there is no Wi-Fi or electricity. I've had to stop working.

There have been nights at 10:30 pm, when I've been driving around, looking for a place I could sleep with no Wi-Fi, and there was no place to go. If Smart Meters are not stopped, there'll be no place for me to be.

European countries have standards for health for EMF safety. America does not. I may be a canary in a gold mine but I'm an early warning sign for everybody else.

All our bodies are delicate, organic bioelectrical systems and not made to be constantly bathed in the electrical frequencies that Wi-Fi and Smart Meters put out. It's so toxic, and this needs to be addressed so that I can come out from behind the foil screen. There's been no place to turn. Society has had nothing to offer me in terms of help.

This is an urgent and life-threatening issue. Please act on behalf of the well-being of your constituents.

Sincerely, J

One year later, Aug. 19, 2011: Recently I tried to spend the night in a neighborhood that had Smart Meters, in a home that was on the delay list and did not have one. After 8 hours, I was so ill I had to drive out of there at 2:30 in the morning. If I had stayed for another 10 hours, I would have been vomiting and convulsing. An opt-out plan is not a viable solution for health concerns. Smart Meters should not be put in until the health issues are resolved. J

---

### Driven Out by Power Line (PLC) Signals

Jack (not his real name) has been sensitive to wireless transmitters for well over a decade. For that reason he stays away from the cities. He and his girlfriend spend their winters in Arizona, and the summers in eastern Washington State.

In the spring of 2011, they traveled to their rented house in eastern Washington. When he arrived, he could immediately feel something had changed. It was as if a cell tower had been erected nearby, but he could not find one. It was unlikely to be the neighbors, since they lived on a large lot and he could still feel it when he drove some distance away. It seemed to be everywhere. Jack's girlfriend stayed in the house while Jack drove back down to Arizona.

After asking around, they found out that the local utility had swapped out all of the electrical meters over the winter. The new smart meters communicate with the utility's computers by sending signals through the power line back to the substation. This is called power line communication (PLC) and is mostly used in rural areas.

The specific system used is called TWACS. This system works by transmitting pulses 120 times a second. Each pulse contains a brief signal of higher frequencies. Since all meters share a common wire, only one meter in the area can transmit at a time. Each household meter can transmit for only a few minutes each day, or even only once for several days.

The pulses travel for many miles and back feed into all houses on the grid. It makes no difference whether it is the meter on one's own house that transmits, or one on another house. There is a constant stream of pulses on all wires throughout the house. The household wiring, as well as the power lines along the streets, are all turned into unintentional antennas. The signal is not very powerful, but the antennas are huge and everywhere.

Jack came back up to eastern Washington a month later, but he had to camp in the back yard. The pulses bother him even fifty feet (15 meters) from the house, with the power line 150 feet (50 meters) on the other side of the house.

The house is rented. The couple decided not to bother complaining to the landlord and the utility company. Even if they got the old meter back it would not help. There is no way to stop the pulses coming from the outside. Instead, the couple will soon move away to an area without his menace. [Anon.]

---

My name is Diane Nagby and I and my pets are also a victim of the Smart Meter. Dizziness, ringing in my ears, insomnia, nausea, rapid heart beat. I had none of these problems prior to the installation of the Smart Meter. I came home from work and they had just finished installing the Smart Meter. That very night my animals started acting agitated. There is a constant feeling of uneasiness in my household now and at night a loud buzzing/humming noise takes place, which was never present prior to the installation of the Smart Meter. It is just plain old common sense that should tell us any amount of radiation in our household is NOT going to be good for us. A friend of mine that lives in Upland, California experienced a stroke just days after her Smart Meter was installed. How many people have to die, have their homes burned down (because the Smart Meter has been proven to be a fire hazard in some houses), get sick, watch their animals suffer, as I have, before we stand up and say ENOUGH is ENOUGH.

---

Until moving to the current rental I did not have the problems I am getting. I work from home and did not get constant exposure to a Smart Meter, as I did not permit one to be installed on my own property, and then after it was sold I lived in an apartment building that refused the installation of Smart Meters.

Frankly when the electrical shocks in my body began at random I didn't connect the dots to a smart Meter issue. When my vision, recently corrected with a new eye glass prescription began to not focus at random times I didn't connect it to Smart Meters. Even without my glasses at random times I am unable to clear

my vision, as if I just woke from a very deep sleep and am still groggy or am drugged...nope, no drugs either.

The foginess and random electrical shocks go away when I am away from this house. I just learned this morning that there is a 'stupid' meter installed on my bedroom wall. I say stupid because proper studies were not done to assure the safety of the equipment...made where...China! and we know how safety conscious that is.

My body is very sensitive to electrical fields, and I demand that CA which normally is so environmentally conscious, take responsibility for these meters and put a stop to them. Make the electric companies and their investors swallow the cost and not allowed to pass it on to customers. We didn't ask for this fake improvement. Carol Church, Placer County CA

---

On Dec. 31st, 2010, approx. 22 smart meters were installed in our building. They are directly under our apartment. On Jan. 26, 2011, my husband, while sleeping, suffered a tonic clonic seizure. All tests came out ok. But he is now on seizure medication. However, I notice that his hands twitch at night when he is asleep. Then more slowly, I began to feel a buzz in my feet that went up my legs and then twitching developed. Never in my life have I had this sensation. While I am away and at work during the day, it goes away and I don't have these symptoms. Also while in our apartment, especially the bedroom, I get ringing in my ears which I never before have had here. I used to be able to completely relax in my bedroom but now always feel like I'm laying in an electric magnetic field .

I was awakened at 3:30 am this morning because of the tingling in my left foot and leg was so strong also I had a racing heart. This is a feeling of something from the outside coming in. When I get up and walk around a little it seems to be a little better but laying down in the bedroom causes the feeling to return.

Also in the bedroom I experience the brain fog and can hardly complete a sentence. It's a very strange sensation. I have none of this at work — only at home and especially in my bedroom. I know we need to move. M. Dawson, Marin County, CA

---

“This is a health issue,” Pauline HOLETON said. “I’m sensitive to electromagnetic fields. I got a smart meter put on my house in November and got it taken out in January. I told them I would take a chainsaw and rip it off if they didn’t come out and get it. I now have the old analog meter.” [Michigan News story](#)

---

After having a smart meter installed on our home, with out any one ever asking if we wanted one or not, I have terrible headaches every single day. I was never the type who got them. But now it's a constant. And incidentally every time I'm away from my home for a few hours they go away. More importantly my husband has developed a tumor on the side of his head, on his temple. Upon the Dr. ordering the CT scan they also found a cyst in the posterior portion of his brain. I also fear for my toddler because her room is closest to the smart meter. What effects will or does it have on her? This has to stop. Does body

remember the issues with people and PG&E near Bakersfield and Kettleman City? How many people suffered at PG&E's hands. They are not a forthright company! I will do everything I can to get this meter removed from my home. Wish me luck. ~ Placer County, Ca.

---

I am so sick & dying from the smart meters. I was sick before I moved here & became way worse. Several hospital trips and two hospital stays. One in oncology & 1 in trauma dept. I have mercury poisoning from having a lot of silver MERCURY dental fillings (nightmare story) & have had more than my share of radiation for a life time starting 30 years ago when I had Hodgkins disease & then all the years after from EMF exposure. So I could not wait to get out of last building where I fought Sac. city council to stop 6 cell tower panels being put on roof but lost that battle.

I learned there were 8 smart meters on my bedroom wall & 20 across the sidewalk plus right out my door is the spa & pool- we knew why I was throwing up blood, heard surging & ringing noises & literally felt & feel like I am being electrocuted. This is the most horrifying nightmare journey I could ever imagined.

I fight for my life literally everyday. I am on section 8 for the 1st time & only get SSI which is being cut again. I was told from apt. complex & SHRA that I need a doctors note to be able to move & to get out of here but cannot find a doctor who is educated on this & your regular doctors think your crazy. My lease is up & out of retaliation they want me to pay \$150 more to live in this place that is killing me.

I am very sick, sad and very ticked off. If someone can tell me who could write me or give me something saying the PGE meters made me really sick & are killing me ...Where do people go to get diagnosed & I have no car & no where to run or hide but I wish someone was doing my story of my journey for years now but especially now in case I die I wanted people to be educated on what I have had to learn the hard way full circle 1st hand so they do not have to get sick & die & not know the truth of their illnesses & or death and just handed a pill or poison or cut on unnecessarily...I have no EMF protection yet since I am so poor. Belva, Sacramento CA

---

I have recently moved to a place with a smart meter.

Since I have moved I have experienced, headaches, agitation, dizziness, upset, acid reflux, and ringing at certain periods. I am sure it is the smart meter. I am not sleeping well and do not feel refreshed, the headaches are constant when in or near the home, but gone immediately upon my leaving.

I work outside on ranches in rural areas. When I am in these areas I do not experience these side effects. I want this device removed from the side of my home and any within my neighborhood as well. They are not UL approved, they are known to be dangerous and this is illegal and a crime, I will do everything in my power to educate people about this and to stop the installation of these torture devices. D.Holden. CA

---

I suffer from EMF sensitivity and although my husband and I were able to prevent PG&E from installing a smart meter (oxymoron) at our home, we are already feeling the ill effects from our neighbors' "SM" which was installed within 10 feet of our house. My husband and I are both having intermittent heart palpitations and I am suffering from nausea and have intermittent headaches and eye lid spasms that are only on the right side of my head (which happens to be where most of my implanted metal is, including my titanium jaw). I have attached an image to help you understand. I feel so violated, especially when I KNOW they (EMFs) are dangerous. My husband and I have taken every measure we can to at least have a home that we feel can be a sanctuary, and have taken every measure short of installing a faraday cage throughout our house. We have no WIFI in our house, nor do we have cell phones or cordless phones and I have never even owned a microwave oven. We have Stetzer filters on the outlets in every room and we sleep with all electronics unplugged. It is bad enough that I can't go to many public places without physically suffering from unhealthy levels of EMF enhanced by negative ramifications from WIFI. Peer-reviewed science exists warning of the dangers of SMs, yet PG&E continues to sell the story that serves them. Their short-sighted and greedy "fix" to their past blunders will have long term ramifications that will cripple our already suffering medical system. I'm at a loss, perhaps the masses are ingesting so much fluoride from the toxic water Marin Municipal gives us that the world of WALL-E is closer than we think... "say it ain't so..."

Caroline Kim Jonsson, San Anselmo, CA

---

I am EMF sensitive, use to live under cell phone tower, had to run away from it. Now the worse nightmare had come true again, the smart meter just right out side and in our living space, in the front, on the back yard and everywhere around us. Try to escape but don't know where to go, My vertigo is getting worse everyday, not even mention that awful nausea, leg cramp and so on. I work in a commercial kitchen because it is lined with mental walls, I swear to God, every time the radiation come through the wire and lights, it felt like a radiation chamber, we are being slowly cooked, I know people do not want to face it, it is inconvenience truth, but who know among my co-workers many of them whom had prior health concern is now been told need surgery and such, make me wonder how they going to recover from our radiated home, those female co-worker having more emotional break-down and don't know why, can we make a connection here! Or we are going to pay a huge price for it. Robert Bucher, Sonoma

---

The smart meter was installed in my neighborhood about a week ago, after it was installed my dogs started going crazy. I have not had a good night sleep since. I tried to figure out anything that could be causing their change in behavior, but the only thing different was the smart meter. They act just like they do when there is a thunder storm or fireworks going off. They are constantly jumping up and down on me acting very nervous and never lying at rest. They act like they hear something and it is very upsetting to them. Can this be possible? Any other complaints from dog owners? PG&E left a flyer saying it has not been activated as of yet??? Would that make a difference to the high frequency? Any help would be appreciated and I will do all I can to help stop this process. M.R. Sonoma County

PS. I realized that I also had a problem with my garage door opener. I had my garage open on two different occasions...I was very alarmed and upset because my side door is always opened for the dogs. I

heard a loud roar and I couldn't figure out what it was and upon opening the back door, I saw my garage door was up.....lucky my dogs didn't get out.....I didn't even think of the smart meter until now. This happened twice. I had to unplug it. I now believe the coffee pot was crackling from the electric outlet and not on.....I can't be sure of the coffee pot because I can't remember if I saw the green light on or not...but to be awakened in the middle of the night to popping sounds was very unusual.

*ADMIN note: This person's meter was removed the very next day after they called PG&E. This is unusual, the majority of people who have complaints are unable to get them removed.*

---

I have been living with a smart meter for only 3 weeks and have been suffering nausea, anxiety, depression and a low grade head ache. Prior to moving into a smart meter vicinity I had none of these symptoms. Smart meters emit pulsed microwave radiation which has been found by numerous studies to be health damaging. I want my smart meter removed but have been told by P G and E that I have no choice in this. I will continue protesting until my meter is removed and the longer I have to wait the more I will spread the word about P G and Es invasion of my privacy, installation of a health damaging device and refusal to remove it. I.W. Menlo Park CA

---

I cannot explain nor rationalize what I have experienced in the past few months since PG&E installed a smart meter at my residence. Since February 2012 I have had experienced the following: My Labrador Retriever had a case of old dog vestibular "vertigo", both my Schipperkes have been diagnosed with diabetes, one now has Cushing's disease, I myself spent a day in the emergency room with vertigo and almost 3 weeks not being able to work due to the vertigo " I still have symptoms" and now one of my dogs has an unexplained infection? I have been a licensed electrical contractor since 2004 and have been in the trades since 1993, I have never heard of anything like this nor would I believe a silly device on a pole 15' from my home could cause such effects. It's just, could it cause them? I do not see that the device at my home is UL Listed? Has it been tested? I called PG&E and asked to have it removed they said that there would be a fee to remove it and that the power I used from that day on would be charged at the highest rate? How can that be? Why have the PUC if they do not regulate the utility companies? M. F. Sonoma County

---

I have been experiencing ringing in my ears at home for the last 5-6 days. I read an article last night about these smart meters causing tinnitus and I realized the ringing began the same time the meter was installed. I did a test today and while I was gone from my home for a few hours I did not have the ringing, yet after I was home for 1 hour my ears began to ring. How do we protect ourselves from this? No one asked if we wanted it, and If I can no longer deal with this problems where am I supposed to go if they are being erected all over the state of Ca? Maybe one by itself is not a problem, but think of how many neighbors you have all around you. That amount of EMF's have got to become problematic. J.B.

---

I have been trying to figure out why my daughter and I have had such intense headaches and now I know. I want my Smart Meter removed. I am the owner of this home and I should have the right to have or not have a unit that puts out so much radiation. I do not and have not ever had wireless internet or any wireless in my home and yet I have it stuck to my wall without knowing it. I'm very electrically sensitive. Since having it installed I have had very intense headaches that nothing helps as well as heart palpitations.

I called PG&E today to ask that it be removed and they refused. I also filed a complaint with the CPUC today. We'll see what happens. E.B. Stockton CA

---

While my landlord and housemate and I have temporarily succeeded in preventing PG&E from removing our analog electric meter in favor of a wireless smart meter, my next door neighbor's landlord thought it would be a fabulous idea to have one installed. This happened about a year back prior to the massive deployment now underway.

Soon after the install, I began experiencing piercingly loud high-frequency ringing in my ears and noticeable cognitive impairment. I've also become unusually tired whether working at my home office desk, reading, or doing virtually any activity in this house, regardless of having had enough sleep. At first I thought these three symptoms were due to increased doses of Warfarin (generic version of Coumadin), a blood thinner I must take which precisely regulates blood viscosity to support optimum functionality of a mechanical mitral valve embedded in my heart. But, after Judy clued me in on the many dangers of smart meters and told me of the symptoms, I put two and two together and deduced the problems are most likely as a result of the smart meter on my neighbor's home approximately 25-feet from my living quarters. She has also experienced cognitive impairment since she moved in. Unfortunately for her and her five-year-old son, the meter is outside the wall to the living room area. A. P., Los Osos, CA

---

I have been disabled by electrosensitivity for about 5 years, but not to RF, just to ELF (power lines, motors, etc — magnetic fields). But since June of 2010 the area I have been in was thoroughly smart metered, so they have been all around me but not on the house I spend the most time in because we put up No Smart Meter signs. On one side of our house is a parking lot, and on the other was an abandoned house, which is now almost completely remodeled, and this is where the electric smart meter was installed, two weeks ago, just 10 feet away across the driveway, facing our home.

I had some hope that I might be able to "live with" a smart meter — after all, so many people are seemingly unaffected. However, when I went to move the trash bins (which sit about 10 feet from it), the first thing I noticed was a headache and stiff neck, and a building up of an awful feeling that included nausea and dizziness.

As the days went on, I noticed that it was hard to breathe well, like there was a weight on my chest, and tightness in my chest. I also noticed my heartbeat felt different. There was a feeling of panic, wanting to flee but nowhere to go. The nausea/dizzy feeling remained low-level, with some disorientation and balance problems, flu like symptoms. There were pains to the head that came on like strokes of pain from a whip, being laid deep into my brain.

The smart meter seems to be transmitting two different qualities. One is a widespread field that attacks and drains you, and the other is the head pain that comes in sporadic waves and builds up along with a stiff neck and contributes to the draining effect. The pain I believe is from the pulses, which are completely unpredictable and can come several times a minute or there might be 20 minutes with none. The general field has a distinct character of its own, a very NASTY and aggressive character, that creates a sensation so bad that the effect over time is as if there are microscopic teeth constantly gnawing away at you. It is as if, at the most minute level, the cells of your body are being attacked. You become exhausted — you feel like you are under constant siege. The best description I could think of is that when you get away from it and are able to catch your breath and assess how you feel, it is like you have been taking a constant beating at the cellular level. You feel debilitated.

I have a piece of very effective shielding cloth and that is really the only thing that made it possible for me to be in the house at all. I have one square-meter of this, which I folded over into a triangle and wore as a head-wrap. I contemplate getting enough of this shielding fabric to make a burka and/or drape over a small tent for a refuge.

So I wanted to try to describe what it is like, the “smart meter air”: the air is filled with a kind of jangling, a very, very fine but nasty kind of shredding, grinding dissonance.

A.C Alameda County

---

A year ago I developed trigeminal neuralgia along with dizziness and weakness. Now I have peripheral neuropathy which includes burning, tingling and numbness. After reading the article in the LA Times about Smart Meters I called SCE to find out when they installed them here. They said May of 2010, a year ago, which coincides with my neuropathy. There are 8 condo’s utilities up against my bedroom wall. There are 8 more in the building close to my only other outside wall. I live in 500 sq. ft. There is no place to get away from being zapped. Please help. A.F. Orange County

---

About a month after PG&E installed the smartmeters, my husband and I both started getting headaches, some so severe that sometimes I was getting blurred vision. We both had very loud piercing sounds in our ears. Finally my husband said it sounds like a telephone poll or something buzzing outside all night long.

Last Easter, my sister offered to let us stay with her at the Horse Ranch for 2 weeks. First day the headaches went away, and that loud piercing sound in our ears went away overnight. Our sleep went back to normal. The entire time there, we both felt so refreshed from 3 months of agony.

Not less than 2 days after we came back, it all started up again. Now I was nervous and my heart also started racing all of a sudden at times. From what all heard, it almost resembled an anxiety attack! Just that weekend at the PG&E office was people gathered about the smartmeters. I was curious and decided to listen in.

Well, I was shocked! I just remembered that our smartmeters had been in for 4 months, and two of them were outside our bedroom wall. We immediately decided to switch the bedroom with the living room. In fact, sometimes if my husband leaves the bedroom door open, the whole house becomes infected with that piercing hiss and a pain at the back of your head. We looked for another apartment without a smartmeter, and found one in Santa Cruz. Since then, the only small hiss I heard of the marvelous ocean waves instead of that nagging piercing sounds. How on this precious earth can something so monstrous be allowed to continue????? Posted by Ruth on EMF Safety Network

---

I'm already electrically sensitive. I immediately feel very sick when I try to use a cell phone (and have for years). I feel dizzy in a home that has WiFi and also in banks, airports and places with a lot of radiation. Given this, I do not want (and will vehemently fight the installation of) a smartmeter. My 34 yr old daughter became immediately ill right after a smartmeter was installed on the house she was living in. Her symptoms were all the ones I've read about – strange headaches, pain in the ears, dizziness, heart stress and insomnia. She had to move from this house after a few months as she just couldn't sleep! I cannot express strongly enough how criminal it feels to me that the CPUC has mandated 24/7 radiation into my home without my approval and without proper research on long term health effects. Why should I have to prove that EMF is harmful to me? The CPUC should have to prove that it's not harmful. I have never seen such violation of our civil liberties and rights!!!! I demand that I have the right to keep my present analog meter with no additional cost! J. S. Lake County

---

I am going to take on PG&E starting tomorrow for damaging my health due to the installation of 4 smart meters right outside my bedroom window, and since then my health has been continuously deteriorating. I have insomnia, nightmares, headaches like an ice pick is being jammed in my head, fogginess, blurred vision (and getting worse by the week), tinnitus, and heart palpitations, all of which never existed until the installation of the 4 smart meters last Summer, and gradually getting worse. I moved my bedroom into the living room, of which reduced the effects by half, but that's not good enough when something that is killing you is still in your home! All of my symptoms are documented by my physician, but he said they are vague and cannot be evidenced as produced by smartmeters. I was a trained Naturopathic Doctor and absolutely know my own body, and every time I leave the house for extended periods of time, all the symptoms miraculously vanish! It has been a 5 month ordeal calling countless times, PG&E, the Smart Meter reps, both of which tell me there is nothing I can do since they claim they cannot remove the smartmeters... PERIOD! In retaliation, last month I gave them a decision to remove the smart meters in 10 days or I would remove them myself. A man called me from the Smart meter office and said the moment I remove even one of the meters, the police will be called and I will be put to jail. So, the only decision they gave me was to sit at home and die. Seriously... I think I have only a few months to live if they leave these meters outside my bedroom window. I spoke to 2 supervisors from Smart Meter company and both told me there is nothing they can do, and that there was going to be a public hearing about other complaints, but don't know when, said it's going to be a while... and couldn't give me any date as to when I can expect a public hearing on the matter. Both confirmed to me on the phone that there is no reported adverse affects due to the smartmeters, and started trying to convince my body on how safe they are! However, because I know all too well here, one supervisor recommended that if I'm not happy where I live that I should just move out! I can't afford to move out, and why would I want to if I'm very

happy here apart from the damaging health due to the meters. This weekend I have finally had enough! I decided to take PG&E to court in a lawsuit. I am in process of locating the attorney as I write this. I am going tomorrow into the office of PG&E and giving them 10 days to remove the smart meters so it will be recorded on my account since jail or death is my only option at this point! So, my constitutional right to health is being outright violated by ELF Wave poisoning with Big Brother in complete control as someone who is slowly torturing and murdering me! PLEASE HELP, in any way you can, and QUICKLY! Please help do something about this before I am murdered by the PG&E company! I feel like my brain is exploding in my head and it's getting worse by the day!

A.S. Sonoma County

---

I have read in horror the testimonials on this website. My SM was installed at the end of October 2010. Since that time I have developed tinnitus, which is incredibly irritating, bordering on painful. The head of my bed was located on the opposite side of the wall on which the SM is located. I have moved my bed to the other side of the room, but I'm scared to death that it will get worse and that I will experience other symptoms, such as cardiac arrhythmia's, which would be a disaster as there is a history of an inherited disease, Hypertrophhic Cardiomyopathy, in my family and my sister died of Sudden Cardiac Arrest last year, a common cause of death when you have this disease. I called PG&E in panic, but they are all inculcated with the corporate line that there is no research to support the claims of health problems. If this is true, why are so many of the people writing these testimonials talking about developing tinnitus? Where is the point organization that can fight this monster? Margery Entwisle Mill Valley, CA

---

Smart Meters were installed in my neighborhood on April 15, 2011. Since then I have had constant ringing in my ears. Smart Meters violate my constitutional right to be safe and secure in my home, 4th Amendment. Smart Meters violate my privacy and my health. This is a KILLER and you know it. S.B. Orange County CA

---

I've had the Smart Meter installed in my home several years ago. I am now wondering if the Smart Meter was the cause of my sudden onset chronic headaches and dizziness, vertigo, that has left me about 25% functional to this day. G.T. Sacramento

---

I am VERY ill from the Smart Meters! And I am just putting together all the ways this equipment is ruining my health. This needs to stop NOW! W.T. San Mateo County

---

I am (was) a very healthy individual, and have all the past medical information to prove it. In the last year I have been suffering illness that I feel is directly related to the Smart Meter on my home. The

electromagnetic currents are so strong I can feel them and hear them in my home. I now wake with headaches, I have dizzy spells, I'm getting skin rashes and more. I have repeatedly placed complaints with the CPUC and PG&E, to no avail. I have no alternative but to move to a house outside of the PG &E territory. Removing my meter alone won't solve the problem. My house is at the hub, the terminal, for the neighborhood distribution and the adjacent neighbor's meters are on my side of their houses, putting me in direct line of current for three homes. I want these things removed so I can resume my life, which is on hold. C.L. Yolo County

---

As an older adult who has been treated with radiation for lymphoma I am opposed to "smart" meters. I also cannot afford an expensive opt out plan. In fact I believe it is discriminatory to impose such fees on people who have legitimate health concerns. B.R. Marin County

---

Since December I have been experiencing a terrible condition called Tinnitus. I hear sound in my head 24/7 which at times has left me unable to work or sleep and coincides with the installation of new smart meters on my home. Tinnitus is something I would never wish on anyone, it can drive one crazy. It has affected my work and my life. I want my life back. I demand more research done on health impacts of smart meters before installing them on anyone else's home! H.K. Alameda

---

Yes, I got big headaches, depress, and weak every night until early morning on my bed near smart meter. I can't think straight out because of smart meter. I don't feel like to eat because of sick every day. I went to Los Angeles, CA for visiting my sister and feel clear up my mind and restore my health but I have to go back to my home and come back to sick again. Donna Avent, Taft, CA (Kern County)

---

Though I never was electrically sensitive before, an extreme exposure to Electro Magnetic Frequencies (EMFs) from just one of PG&E's digital SmartMeters, (from 10/31/09 to 3/3/10), left me as an electrically sensitive person. Along the way, the experience of dealing with PG&E to take the SmartMeter out was truly creepy. Now, a year after the SmartMeter was removed, 30% of the symptoms still rule my life.

Here is the sequence of events: In early December 2009, I began experiencing nights of fitful sleeplessness. I soon had less and less energy in the day time. I began having localized headaches and worried why I was constantly a bit dizzy. In January the dizziness became worse and I began feeling very oddly 'spaced out'. I began having strange strong cramps in my legs at night that woke me up. My eyes were constantly extremely itchy and incredibly light sensitive, often with strong pains in my right eye. My normal mild tinnitus was far far worse. Also my familiar chest pressure and pains were far more pronounced and far more often. I had no idea these things were related. At first I just felt guilty I had allowed myself to get so out-of-shape that I could not find a solution to the horrible insomnia. By January I had such serious memory problems I often could not remember what I was doing from one minute to the next. I would find myself standing still, staring into space, and vaguely realizing that something must be

wrong with me. By February, when speaking, hard as I tried, I could not remember the most common words, and was spelling words phonetically. Also, the stutter I had as a child began to return.

By the end of February I realized I was becoming more and more dizzy as the days went by. One day I was so dizzy, I literally could not walk and was actually staggering. Also, by then, I frequently saw in the mirror that my face was Bright Bright Red. And since I had no feeling of being hot, I finally knew something was really very wrong and that the cause was not insomnia. But I had absolutely no idea what the cause could be. It is only because of two purely chance incidents that I discovered the cause was just one SmartMeter seven feet below my bed.

In January and again in February a friend using my garage as a theater rehearsal space, twice came upstairs to the apartment to tell me that as a person who rarely got headaches, he could not figure out why lately whenever he was in the garage he would get horrific headaches. But, as it turns out, he had been sitting and standing about ten feet from the SmartMeter.

Through this whole experience, there were two ambulance trips to the emergency room for racing heart. Both times at the onset I was in no stress whatever. When the pills that are supposed to slow the heart rate down did not work, I had no choice but to call an ambulance. Both times, at the hospital, my heart checked out just fine. The first time was before the SmartMeter was taken out. The second ambulance trip to the ER was one morning 6 weeks after the SmartMeter was taken out. I had been sitting for a few hours at my desk 25 feet from a power pole. This was the day I realized that even though the SmartMeter had been taken out, it had left me as an electrically sensitive person and I could no longer use that office or enjoy that roof garden as I had for the past 30 years.

For this whole past year since the SmartMeter was taken out, I have had to completely interrupt my cultural-exchange business and personal life to only focus on finding ways to shield myself from EMFs. Every day is a fight. It is serious stress. I am on constant overwhelm. Lately the symptoms are worse again. The strange leg muscle cramps are waking me up again at night. In this past year I have lost half of my hair. The tinnitus is worse and worse in just the last few weeks. There are fewer and fewer places I can go, out of the house, to avoid EMFs that do not make the Tinnitus worse. I worry a lot about cancer and the health of my neighbor's children. And I know there is no where to escape to. Maya Cain, SF CA

---

I have developed nodules on my thyroid , dizzy spells, difficulty swallowing, and petite seizures, since the smart meters were put in. I have never in my life had anything like this, and I am so upset. I have always been in good health. I am looking for some help, on how to save my life.L. M. Pacifica CA

---

Since the December 4, 2010 installation of PGE Smart Meter in my apartment building, I have been a Smart Meter refugee. December 30th I fled my apartment with severe symptoms and only the clothes on my back to Marin General ER. After 3 months, even though I have been with friends (11 moves), I am now homeless. To date, I have exhausted: the landlord, Legal Aid, Fair Housing, District Attorney, Sacramento, trying to get an atty, Marin Housing Authority, many, many of my doctors, Jared Huffman/Supervisor's office, Health Dept., Environmental Dept., and still cannot get any help. I have

forwarded the recent March CPUC document with “opt-out option” to my landlord, and she still does not think there is a “problem” on the property. Cannot move out b/c of symptoms when on property, cannot pay 3 months rent to transition out, and exhausted and depressed from this battle w/o any disability rights protecting me.

Like many with the symptoms, I am on my last and giving up... exhausted from trying to get help, afraid of my health, depressed, crying all the time, difficult to work, cannot get the proper sleep...I Don't know how much more I can tolerate w/o major support. All I want is my life back. ZEENA QUINN, Marin

---

This past year I have become electro-sensitive due to the many wireless communication bands in the air. I cannot even go into coffee shops anymore without getting ‘burned’, a feeling of intense sunburn. This is one of the many symptoms I now suffer. Recently, my wife has been getting intense headaches for no apparent reason. I myself have recently suffered symptoms of a heart attack. I had to go through extensive testing that hit hard financially. We just discovered that the smart meter had been installed here without our permission, which coincided with our physical problems. We are so upset about this that we are now considering legal options, at the very least to cover the cost of our medical expenses .KB, San Mateo County

---

I woke up this morning to a SMUD employee knocking on my door letting me know they were installing smart meters in the neighborhood he replaced my old meter and went on his way. After he left I noticed my scalp tingling and it just wouldn't stop the unit was place on my wall outside my Kitchen I was sitting in the living room most of the morning. Not only did my scalp tingle but I felt a little dizzy. I left and went on a bike ride and felt fine as soon as I got back I felt dizzy again and my scalp started tingling again. These were both abnormal I never feel dizzy and my scalp rarely tingles. I called SMUD and asked them to take the meter off the guy still has the old equipment and is right down the street I passed by him on my way back from the bike ride through much resistance they agreed to call him and have him put back in the old meter. Within minutes after him leaving with the old meter installed again my head stopped tingling and I no longer felt dizzy. This is proof enough for me there's something wrong with those things. If there is any way I can help in signing some sort of petition or something I will. Please let me know this is a complete home invasion where can you go to relax and feel comfortable if you can't go home to do that. S.L. Sacramento CA

---

About two months ago, after sitting in my living room for several hours, I took my pulse; it was wildly irregular, skipping a beat every 3-7 beats. My pulse had never done that before. I then took my pulse in a number of places inside and away from my house. My living room is basically the only place my pulse skips beats. The irregularities occasionally occurred in a milder form in the dining room, which is at one end of the living room. When my daughter was visiting, we sat in the living room for 20 or 30 minutes, then took our pulses. Both our pulses skipped a beat after 10 to 11 beats. Why was my heart pumping irregularly only in my living room? At some point I remembered that a SmartMeter had been installed a few months earlier on the outside of my living room wall, directly behind my sofa. From what I have

read, an irregular heartbeat can be dangerous. I told PG&E about my experience, but they refused to remove my SmartMeter, so now I don't go in my living room. A.H. Monterey County

---

The following letter is from a prominent doctor in Napa:

"I have a patient who is being injured from the SmartMeter. She has a history of Cardiomyopathy from infection and was doing well until the SmartMeter went in last fall. She is now back in Atrial Fibrillation and needs meds she does not tolerate well. It is all a result of the extra EMF. I will send you copies of articles about how EMF effects patient's heart rate. Is there are special complaint form I could send off to the SmartMeter company that you use? I was going to dictate something for my patient and reference the EMF and heart rate issue".

---

They installed our Smart Meter about 3 months ago and I have been extremely sick from the day it was installed. My husband who never has headaches, now has one 24 hrs. a day. I have been extremely sensitive to RF/EMF since 2005 when a neighbor had 2 Sprint cell towers installed next door and we were forced to sell and move.

We are trying to move now, but you have put Smart Meters on every house that might work for me. How come you don't have a contingency plan for RF sensitive people? You have made my life a living hell and won't even give me an option to have my old meter reinstalled even with a Drs. note saying how sick I am. J.M. Riverside

---

**URGENT!! HEART CONDITION- SMART METERS MUST BE REMOVED IMMEDIATELY!!!** A bank of Smart Meters, that emit radiation 24 hours a day, were installed on the wall of my home, and I have been severely affected with heart palpitations, non-stop ringing in the ears, shortness of breath, insomnia, and sleep interruption, and more. I posted signs not to install smart meters, which is a legal action, but PGE/Wellington Energy illegally trespassed and ignored the signs.

I have a heart condition, and am EMF sensitive, and yet despite many very futile calls to PG &E, they have not removed the meters, nor have they replaced them with the non-wireless analog meters that have worked perfectly for decades. I have been an excellent ratepayer for decades, I am low-income and cannot afford to move. This is unjust discrimination, and gross negligence not to allow an "opt-out" of any kind. And even worse, with PG & E being fully aware that I have a heart condition, they have added more smart meters on the wall of my home, and they are threatening to add double the meters to my home in the next days, or weeks. How can a utility demand that our health, and the health of our families, and pets be exposed to 24 hour radiation, with no ability to say "NO"? Anon, Sonoma

---

For the past few months, I've been having more problems than ever, including difficulty sleeping, fatigue, headaches, and a level of 'brain fog' that I have never experienced previously. I did not correlate this to

SmartMeters, because I had heard that our unincorporated Sleepy Hollow area of Marin was going to be among the last areas to get SmartMeters installed. Recently, I called the PG&E hotline to be placed on their Do Not Install list, which the courteous rep did. I then went outside to look at my meter, which I had NOT done since August. To my shock, a Smartmeter had ALREADY been installed. \*\*\* (No notice was given after the fact, either.)

I called PG&E back, and another rep told me, "It's not hooked up." I called back again, got another rep who told me, "Oh yes it is. It's been hooked up for months!\*\*\*\*I don't know why the other rep said it wasn't." He also told me it 'only transmits in the dead of night for about 40 seconds.' Both reps confirmed that our conversation was being recorded. I would suggest to anyone who calls the PG&E hotline to record the conversation themselves as well. I wish I had!

\*\*\* My health issues correlate directly with the date that the SmartMeter was installed on my property.

I pointed out to him that this contradicted PG&E's rationale for continuous monitoring. Then I hung up. I have since spoken with several neighbors, who also received PG&E's 'notice to install' two weeks ago, yet they, too, discovered that SmartMeters were ALREADY installed on their property. That's either incompetence in coordinating installation scheduling and mailings, or intentional deception. Steven Halpern, Marin County

---

I am extremely sensitive to EMF and RF signals since 2005 when a neighbor had 2 cell towers installed about 400' from our home. We moved from that house and I got better as long as I am not in any contact with any signals. Then we got our SM installed about 9 weeks ago and I have been extremely ill every since. My husband has sent letters to all of SCE management and the CPUC and they all ignored us. He finally got an SCE EMF engineer to reply back and they sent out 2 EMF "specialists" to measure the signals twice, and both times they said our SM meter was OK. My husband has his own meter and showed the specialists that the meter is showing dangerous spiking every 15 seconds. SCE's meter did not show the spikes. My husband got the make and model number of their meters and talked to the company that makes them... apparently the meters they use only average the signals and the 15 second spikes do not show up, so of course they are telling every body that complains they are within the "approved" range. My husband also measured their cell phones and the smart meter signals were about 5 times stronger than their cell phones. We have covered our meter with Heavy duty aluminum foil and a thick metal bucket. We have also lined our garage with it. It does cut our signal a little, but we still have all the other neighbor's signals blasting towards our house. The SM's use a repeater signal that sends the signals from one meter to the next.. they constantly "talk" to each other all day long and send data the same way. It's so bad in our neighborhood that I can't take our dog out for walks anymore. I feel it as soon as I walk out the front door.  
Jana, anon

---

Two weeks ago they installed smart meters on our row of townhouses. A few days later I felt dizzy; this changed to heart beat very strong – occasional racing – and now ringing in ears and pressure in chest as well. Dizziness subsided but have been waking up at 4 am and can't

t get back to sleep. There are also about 20 meters about 75 feet from my house; i look at them in a line of sight.

I seem to have been way more affected when they actually installed them in our block of 7 townhomes even though i am slightly further away from this meter box collection. it's like it comes in through the wires.

Those other ones were installed in Nov. or Oct. and i remember feeling nausea and more migraines from those. A few times a day we get this awful screeching too. I have been in a panic wondering where I can move? if it's gov't mandated then does it matter if we complain?

I also heard that PGandE could have installed all kinds of meters like cabled ones instead.

I never knew anything about smart meters until it happened to me. where can we go to escape, this is so scary. Anon

---

I have six smart meters right outside my bedroom and kitchen since they were put in i have been having headache's ringing in my ears and nausea. i know it's due to the radiation but it's hard to get people to believe me is there any help out there? i would welcome any advice or if anyone is going thru this please contact me. my together we could fight pg&e and have these things removed before they cause permante damage to me & my children or to anyone else.... Daniel G, unknown

---

Smart meters were installed at my house about a year ago and soon after I experienced ringing/buzzing in my ears that keeps me awake at night. I thought my clock radio was on so turned everything off (including computer, vcr...etc) but still heard the noise. Remembered the smart meter install and now see many other people with the same symptoms. More recently my ears have a burning sensation. Is there any way to block the transmission into the house? I feel like the inside of my head is hot. Thank you for the site. How can this experiment be legal? E. C. CA

---

Since I had the SmartMeter placed on my home (master bedroom wall by headboard of my bed) by SDG&E about 3-4 months ago, I have developed increasingly severe reactions to EMF (electromagnetic fields). I have constant ringing in my ears, getting louder and very distracting; headache, sinus pain, feeling of heaviness in chest, disorientation, mental confusion, difficulty concentrating and with calculation and driving, nausea, and very hard to use computer, phones, etc. Can't sleep well, insomnia, though improved with change of bedroom. My doctor wrote a letter demanding under the ADA that SDG&E remove the SmartMeter, the reply was that SM's don't impact health, and that my doctor is wrong that the ADA covers this, and they essentially refuse to remove the SM. Needless to say, I am shocked, horrified, and will take further steps. This is an example of Big Brother in our lives worse than anything I have seen in America in 60 years. They can harm and kill us legally now, in our own country. S.B. San Diego

---

Since the “smart” meter installation I’ve been suffering from headaches, losing sleep, and hearing high pitched ringing from time to time. I’ve already called PG&E to complain and requested they remove the meters...they said someone from their “smart” meter escalation department will be contacting me soon. Would appreciate any suggestions or advice you may have on how to get them off my home. I am very sensitive to RF signals. (Two weeks later...) PG&E is still refusing to remove my “smart” meter even though It makes me ill. I will be forced to sell my home and move if wireless smart aren’t removed from my home and neighborhood. PG&E may have an easement to put a meter on my home...but a meter on my home that shoots RF in to my home and in to me, my partner and my child’s bodies? As a Realtor it seems to me like that should be overstepping the limits of their easement. M.H. Humboldt County CA

---

“One month ago I moved into a house that has a smart meter installed on the same side of the house as my bedroom. I have been having sleep problems including insomnia, nightmares and restless sleep. I am epileptic and sleep deprivation is very dangerous for me. I have also been experiencing unexplained anxiety and irritability. I live in Oakland. I’m also having strange interference on my phone line.”

(Update) ” I have now been living with a smart meter for nearly 4 months. My sleep has deteriorated. I often only get 4-5 hours which is a serious threat to my health as an epileptic. My request to have the meter removed has been denied. I cannot afford to move, and anywhere I move to in this area will likely have the same problems. Past seizures have caused me to suffer brain injuries, and many neurologists believe that seizures cause permanent damage to the brain. PG&E is putting me at risk of major injury and even death, since seizures can be fatal”

.A.L.M. Alameda County CA

---

I am disabled from a spinal injury and neurological damage from a severe case of Encephalitis. I moved into a small apt attached to my Mother’s house three months ago. Both my mother and her husband are also disabled. We all have serious health problems. They were not aware a smart meter was installed a year ago, right behind my bedroom wall. Everyone in the house has been having similar issues since it was installed, exhaustion, stomach issues, ear aches, ringing the ears, dizziness and skin issues. My health issues are complicated already and I cannot move again. I want to know what I can do to get this thing removed. Nobody asked, they just did it. I have signed petitions, I have written letters. What else can I do? My Mom has had 22 surgeries, Cancer, RSD, Interstitial Cystitis and much more. Just the fear that it may be adding to our health problems is unhealthy. She grew up under power poles and has always believed that played a role in her health issues. Although she knows now, I was afraid to even tell her it was there.

I believe we as humans have not had time to adapt to the barge EMF from such devices and we need choices and a voice in the decision processes when it comes to technology such as Smart Meters. There are also privacy and other issues at play here that make me very much against Smart Meters.

T.R. Aptos CA

---

“I have been in the ER overnight three times this week, with unexplained sickness. I have had a CT Scan of the brain, Stress Test, CTA, EKGs, Ultra Sounds, Blood work and still no definite answer. We recently had a Smart Meter installed and these symptoms began about a week after: Extreme Stress, diagnosed TIAs, dizziness, headaches, nausea and fainting. I mentioned this to a doctor and he suggested that the Smart Meters may have something to do with it because the hospital has had quite a rise in illness of this kind reporting to the ER. “J.W. (anon)

---

My family lives very simply, we do not own a tv, do not have a computer in our home or microwave and do not use cell phones at home, we keep them in the car for emergency only. We also watch our energy usage and do not keep appliances plugged in. Within days after our smart meter was installed I experienced a very painful miscarriage. After the miscarriage I started experiencing mysterious pain throughout my body that could not be explained. My two children who are diagnosed autistic regressed in their autism after much work with behavioral therapy and other interventions. I sadly watched my father’s health decline since last fall he became very fatigued and weak and unexpectedly passed away in October 2010 of a heart arrhythmia. I believe the smart meter played a role in his health because he was very healthy until it was installed on their house last fall. T.M. Anon

---

I was unaware that a smart meter has been on our home for over 18 months, until I called to be on the delay list only to be told that I had a smart meter installed in 2009. I never got a knock on the door or a notice of installation, but during that time I had a series of strange health issues including a pressure in my ears for which I went to two doctors, irritability, insomnia, and general nervousness and extreme debilitating fatigue. I am not saying my health was perfect before, but I never had the consistent excitement which I thought was overdose of computer use, even when I used my computer at home for work sometimes 10 hours a day. Now, I hear a buzzing and feel hyper and we have discontinued our use of wireless internet and installed a land phone line so we minimize use of our cell phones as well. We no longer have wireless Internet, but so many of our neighbors do, that we feel like we live in a hyper anxious space. We are moving soon because I survived cancer, I want to stay healthy, and I feel better away from these wireless smart meters and other forms of EMF and RF. We moved to a neighborhood in a forest in West Marin that didn’t have Smart Meters. Less than a week after we closed on our home, the Wellington truck was at the bottom of my driveway, installing smart meters on this rural road in the forest trailhead. We did not get a smart meter because I put us on the delay list for this home, and told the installer not to install. I also had a No Smart Meter Sign. M. G-K Marin County CA

---

” My husband has brain cancer attributed to the radiation from his cell phone. Shortly after installation of the smart meters on our home I was diagnosed with hypothyroidism. I never had the symptoms prior to the installation of the smart meters- fatigue, depression, joint pain, heart racing, and weight gain. I also suffer from atypical trigeminal neuralgia- a very painful nerve disease in the face that causes electrical jolts within my face and head. It worsened with the smart meters.

Denise Alexander of PG&E did have my meters removed when I notified her of my husband's illness. I never mentioned my problems as his alone are reason enough to not be subjected involuntarily to the very thing that is killing him. Shortly after the removal of the meters I received a hand signed letter from Mr. Devereaux that the meters will be going back on. I just received a recorded call from PG&E stated they will be here to put them back on within 30 days. I cannot and will not allow this to happen." E. M. Contra Costa County CA

---

"I purchased a condo in Rocklin CA. I have probably 20 smart meters in the room next to my bedroom (the electrical room wall). My 2 daughters and I all have headaches and there is a buzzing sound. One of my daughters is constantly fatigued. How do I prove that the smart meters are causing these symptoms?" D.O. Rocklin, CA

---

"I have been having headaches, heart palpitations, horrible ringing in my ears, dizziness and some nausea, and a burning of my facial skin for 8 months, since PG&E installed a Smart Meter at my house. These symptoms began gradually in the first weeks after the Smart Meter was installed and have increased in intensity over the months. For the two weeks I was in New Zealand in October, the problems lessened or disappeared completely . Home again and it all started again. I want this Smart Meter taken off of my home. I am sick because of it!!!" L.H. Sonoma County

---

Smart Meter destroying my sleep. Since the Smart Meter was put in my home, I have not had been able to sleep through the night. The Smart meter was installed just a foot from the head of our bed (on the outside of our bedroom wall). Before it was installed, I could easily sleep through the night. Bill Beckham Fresno, CA

---

We recently had our smart meters installed, three of which our on our wall, for the three units on our lot. I have a super healthy routine and was drastically improving my health and wellness. I am Vegan, non smoker, non drinker, I record all of my food intake, exercise avidly and slept regularly from 10 pm until 7am. I began to get unexplainable huge rashes on my face. My doctor freaked out and couldn't believe the photos and ordered labs immediately, he was sure I had Lupus or Rheumaty Arthritis. He sent me to a Rheumatologist ASAP, It then started with the aches and pains, the super dry lips and a loud squealing in my right ear. Even my teeth hurt. Then the buzzing sound intermittently mixes with the high pitch squealing noise in my ear, followed by extreme exhaustion or fatigue in random parts of the day or evening, to where I couldn't even stand. The headaches make me feel like I want to die. I can't sleep until 5 or 6 am and pop back up at 7 am. I am nauseas, and my ear in is extreme pain. I have feelings as if the ground or furniture is moving or being bumped. I get dizzy and have problems orientating myself when I go from standing to sitting or vice versa. My 1200 calorie diet that I record every meal has turned into a 300 calorie diet because I'm too sick to eat. I am having to drink meal replacements because the more I

cook in the kitchen the worse I get. My husband complained of feeling sick, back pain, headaches and an electric-like pulse or shock-like feeling that darts up his body through his brain. When it happens he jumps. It has happened three times now. The downstairs neighbor moved because of her sudden onset of symptoms that began at the same time. Our DVD player now cannot reach a signal on the TV (says no signal) despite the player actually being a part of the TV, all in one piece. My eyes burn and weep full of tears with a mental cloud I can't shake. My stomach turns upside down it feels and I feel a burning sensation on parts of my body. I have missed about 80% of my work schedule and am rapidly deteriorating. I just kept saying, "something is wrong with the air." I didn't know what exactly I meant, it was just a feeling I had. Then someone else said the same thing out of the blue. Then the other evening, I couldn't walk. I was crying profusely from the pain and symptoms. Everyday its worse....I am going to request mine be removed but the neighbors still have them, still posing a threat since they're everywhere around us. ...These meters not only quadrupled our electric bill but also my health that I've worked so hard to achieve came to a complete halt, the same exact day as the meters were installed and everyday since then. ... This isn't fair. I don't want a smart meter. We weren't surveyed or asked. We never got informed until the knock on the door saying "SDGE, were here to install your smart meter." Then we were handed a little piece of paper which didn't disclose much. Now we have a super high electric bill that is way to much for our tiny two bedroom beach apartment and a super ill husband and wife who were otherwise healthy and active until the day of the meter installation. Amy Evans San Diego CA 28 yrs old

---

Last year I lived in Livermore CA. The meters were changed in Livermore last year. It wasn't until I just saw a news story where I have now put 2 and 2 together. Starting in Oct. 09 I have been experiencing terrible ringing in the ears. A hi-pitch hissing/buzzing noise. It's been driving me crazy. I have been to so many doctors since trying to find out what is causing this terrible problem. Doctors cannot find anything wrong. But what I have noticed is this, when I have traveled away from the city to the mountain such as to go camping, the hissing and buzzing go away. But as soon as I get back home the noise starts back up again. NR Tracy CA

---

I live in San Diego in a small apartment building with 3 apartments. SDGE installed 3 Smart Meters on 9/29/10 and I have been sick as a dog ever since, even to the point of missing work. The Meters are located below my apartment, just below my bathroom wall (I am on the second floor). Using my Entech Meter I tested the outlet in my bathroom and the signal was so distorted I could pick up a radio signal! My Gauss Meter also picked up Hot Spots that never existed before.

I suffered from severe joint pains on the day it was installed to the point where I couldn't move my wrist without agonizing pain. I have been in pain ever since and also got a very bad cold. I also developed an odd problem called Phantosmia, in which you can smell something that isn't there (in my case cigarette smoke which I am allergic to). I am EMF sensitive but I have never felt as ill as I do now. I was completely functioning before, whereas after these Meters were installed I just feel awful all the time. S.G. San Diego CA

---

Last week our power company in NE Arizona put a new digital meter on our house. The meter was supposed to remain in a silent mode and not transmit unless someone sent a signal to it from the highway to activate it and get the reading.

Over the next 6 hours I gradually got very sick from the meter. The symptoms were a vise grip headache, nervousness, horrible brain fog (after 3 days I was unable to complete a sentence), total insomnia, stomach rolling and nausea. The meter seemed to run in on the current and I began to have reactions to my electric stove and other electrical appliances that I had not been bothered by before.

After a couple of plea's from my husband, the power company made a decision to return our meter to analog. I had immediate relief in some symptoms, but others took several hours to go away. Due to a weekend and Monday holiday, it took a week to get the meter removed. I was so sick by then I was worried it would leave me highly sensitive to emf's. After 24 hours I seemed to be ok, however. These meters are not safe! Anonymous in Arizona

---

In July 2010, SDG&E installed Smart Meters in my condo complex. I own a townhouse that is situated in clusters: 8 units per cluster. Therefore 16 Smart Meters were installed in the utilites shed outside my kitchen/bedroom walls, ten feet away.

I began having symptoms of head burning and pressure on my chest within a few days. As time progressed the symtoms worsened. I had severe burning in my head and headaches of a new type. I starting having palpitations, arrythmias and flutter. I called SDG& E. Three people including an engineer and the director of the Smart Meter program came to my home, spent an hour talking and photgraphing the meters. They took no measurements of the radiation, though they said they would on the phone. The next day SDG&E informed me that they would not be replacing the meters with the analogue meters. They assured me that they are concerned about people's health.

By six weeks in, my cardiac symptoms were so severe and erratic that I had to move out. I rented an apartment, which turned out to be unsafe as well. The Smart Meters are everywhere. With the intensification of my symptoms, I have become EMF/RF sensitive and now have the above problems around cell towers, Wi-Fi and other sources, accompanied by skin rashes and burning.

I am being evaluated by a cardiologist. I have always had a strong, healthy heart, even told so by doctors. The cardiologist has sent me for an evaluation by a neurologist as well.

Five people have reported symptoms in my home: My father has experienced headaches and visual migraines. My mother reported having pressure on the upper part of her chest and palpitations. One neighbor exposed to these 16 cluster meters is experiencing headaches and chest tightness. Another neighbor has difficulty opening her eyes in the mornings after 8 hours by the meters. Her ophthalmologist could find no explanation. She said she uses her fingers to open her lids. All of the above symptoms have occurred since the smart meter installations. The symptoms are worsening for everyone.

I am running scared living this nightmare. I don't know where to live and fear for my well-being. I already have a prior immune disability and I thought I would be legally protected by the ADA. I don't know

where it is safe for me to live. In addition, the financial impact of this disaster compounds. I pay my monthly mortgage and rented a place, which due to symptoms, I cannot stay in. I am not sure that I can rent or sell my condo in good conscience. I am seeking medical care including treatments not covered by any insurance. My out of pocket costs continue to grow.

R.H., San Diego CA

---

We live in Berkeley and recently had a smart meter installed without our knowledge. Since that time, my husband and I have been having increasingly painful headaches around our ears, along with other symptoms. My father, who has Parkinson's and a Deep Brain Stimulator with two leads, also lives with us. I also have a two year old and a five month old. My two year old is no longer sleeping well and is waking up all night. We strongly feel that the smart meter is unhealthy for our family and want to get it removed. (Anon, Alameda County CA)

---

Since the meters were installed, I am experiencing continuous severe ringing in my ears in my home, which does not happen when I am at work in Marin in an area where the smart meter have not been installed. Family members are also experiencing headaches and one family member, who did not know the smart meters had been installed was working unloading boxes for 1/2 an hour about 5 or 6 feet form the meters. He became very dizzy, had very rapid heart beat and lost consciousness and fell. We are very concerned about the short term and long term effect of the smart meters. We are in the process of trying to move to Fairfax hoping they will be able to keep the smart meters out. As PG&E has refused to move them we were forced into selling our house. This seems extremely unfair. (Anon. SF Bay Area)

---

" I am chemically and electrically sensitive but have gotten much better. I am finding that since they installed our smart meter, I am getting unexplained exzema and rash. I have tried to heal leaky gut and all the things you do to stop it and am still struggling with it. I know that I can't use a cell phone unless it's on speaker phone, and then only a second. I get very ill with continued wi fi exposure. I wanted to ask you if you know how much radiation these smart meters are putting out. I am really pissed about this, I rent and don't own so I feel stuck. " (Anon, Alameda County)

---

After the installation, I started hearing high-pitched frequencies that lasted about 20 seconds...

I called PG&E and told the lady there about hearing high-pitched noises in my house. It's not coming from a specific appliance but rather I'd hear it for 20 seconds or so (kind of like those hearing tests when we were kids) and then it would go away. I heard it in the kitchen, the dining room, and my bedroom. The PG&E rep had never heard of anything like this and forwarded me to the Smartmeter Division. (Anon, Berkeley CA)

This meter was eventually removed.

---

Since the new meter start-up a few weeks ago ... Family members' new or exacerbated symptoms have coincided with the meter start-up. Myself, I hear ... high-pitched buzzing now within our house, absent before. I often go to the clock to check the timing of the microwave hearing, and it most often corresponds exactly to the minutes when our microwave meter picked up the signal, so I have no doubt about the source of this brain penetration. I know of another EHS-er who apparently has a urinary bladder reflex activated by the meters. Note that the frequency range is long known to be among the best for brain penetration. (Anon, Canada)

---

If you are wondering why you have a nagging headache, insomnia, fatigue, etc.—start doing your research on PG&E's Smart Meters... I have a relay Node on the telephone pole in front of my house [installed May 2010] and the 4 people who now live here have the subject symptoms.

---

Gas meter installation was installed in our property on 3/18. The Smart Meter was causing us headaches, achy/watery eyes and loss of sleep; effectively blocking out half of our house. We called PG&E on 3/19 and meter was removed on 3/20. However, because of neighborhood deployment of Smart Meters, we are getting constant light headaches since then, even after the removal of the meters from our property. .. We consider this unnecessary bombardment with radiation an invasion of privacy, disturbance of domestic peace, and potentially a health hazard.

At the initial call on 3/19, PG&E agreed on the removal of the meter, which occurred on 3/20. On 3/27 we received a letter notifying us (again), of a pending Smart Meter install. We called PG&E on the same day, where we were informed that Smart Meter installation is eventually unavoidable per PUC mandate. They also mentioned that research was done and proved that Smart Meter did not cause problems. In our mind, this research should be void and not provide sufficient proof, since we are a living proof that Smart Meter is causing us problems.

I should add that I've been also been sensitive to other devices, such as bluetooth headsets and WiFi. We don't have WiFi at home, and no bluetooth, of course. In the case of WiFi or similar, I consider this as voluntary exposure. In the case of the SmartMeters, it is non-voluntary exposure. Even if I wanted to, I couldn't go outside and turn off the meter. .. Putting corporate greed on top of public health is an outrageous disregard for society. (G.K. Santa Clara County CA)

---

I choose not to have a cell phone, computer, or use other wireless devices in my home. I'm not interested in having "smart" appliances there either. I avoid exposure to cell phone towers and public places that are "hot spots" for wireless use. This is because I experience headaches, a sensation of pressure in my head, increased heart rate, a sensation of dizziness, and other disturbing symptoms when I am around wireless

frequency emissions. Regardless of what others may think, the symptoms are experienced by me, and I DO NOT want to have any wireless devices ON my home, where I cannot get away from them. I have owned this home for 25 years, and plan to stay there. I demand an opt-out option, and refuse to have a Smart Meter on my home.

---

My husband has had an intense electrical/EMF sensitivity for the past 10 years. It has obviously had a great impact on our family. He had to quit his job a few years ago because of the work environment, and as new cell antennas and towers have gone up, we've often worried that we'd have to move. So far, we've managed to be able to stay in the Bay Area where we've lived our entire lives.

Installation of Smart meters began on our block two days ago. We declined, as did many people on our block, but our immediate neighbors both accepted (one of them did so only because he felt it was inevitable even though he was opposed). Since installation, our baby monitor (that we keep in a remote corner of the house) regularly becomes staticy to the point of not functioning, so clearly the microwave radiation is interfering. My husband has developed the same symptoms that he feels when he is near things like cell towers and speed limit monitors (intense pressure in his head and a headache, and agitation), symptoms he feels before he even sees the offending source. And I've been feeling nauseous and agitated with tension in my head, which honestly could very well be from anxiety.

We need to convince PG and E that we can never have a Smart meter installed on our property. And, we NEED to have our neighbors go back to the old kind of meter if we are to be able to stay living here. (Anon, Alameda County CA)

---

..What is happening in America is happening in my state of Queensland.

We had solar panels put onto the roof of our home, and then the power company came along and installed smart metres in our mains power box. There are three mains power boxes, so therefore there are three smart metres transmitting 24/7. My health has deteriorated so much, that I feel that I can't last.

Our state government has just gone ahead and made it mandatory even though the first state to install them, Victoria, is now finding real serious problems.

All I know is that we have 120 units in our complex, which means in a four acre block we have 120 smart metres. I have also found that the radiation from these smart metres are also being piggybacked into our home via the electrical wiring and causing further torment. (Australia)

---

She came home the other day and instantly became very sick: Migraine, heart palpitations, dizziness, depression, nausea, vomiting, intense thirst, parched lips, neuropathy, teeth pressure and buzzing, etc. Her husband had recently done some electric work on the house and went out to check to see if he wired something the wrong way. He came back in and reported that a Smart Meter had been installed by PGE.

She called PGE and reported her symptoms, demanded they remove it, and replace w old meter, which they did. She's feeling better after the removal and replacement of old meter." (Anon, SF CA)

---

"I highly suspect the smart meters as being the cause behind my sudden menstrual irregularity...In early December, a guy knocks on our door saying they're putting a new meter on our home and they're turning off the power – Meanwhile starting in December – I had been having more headaches and difficulty staying on the computer for very long because of them – I thinking to myself, "what is causing this???"

A light bulb goes on finally – I make the connection, it all makes sense now – meters = headaches?

About the time I figure out what is causing the headaches is about the time my period decides to make it's second appearance this month. ...Then I start monitoring my blood pressure for whatever reason, only to find that it has gone up – from usually 125/82 to now reading 148/95" (Anon, Kern County CA)

---

I was just told today by my PG&E reader that there would be a "smart meter" installed on each gas and each electric unit, totaling 14 for my yard! For some reason I was under the impression that there would be one meter for the grouping. That was bad enough but fourteen is absolutely terrifying.

Has there been any comment or discussion on the additional hazards of so many units in one place? My bedroom is about 10 feet from the units. Do I have any recourse at all, that you know of, due to these special circumstances? My next door neighbor, on one side, is already coping with a seizure disorder, I have Lyme disease and there are health issues on the other side of my unit as well. Are there any attorneys around who are taking on this issue? (Anon, Sonoma County CA)

---

I have severe Electrical Hypersensitivity (EHS). I also have severe Multiple Chemical Sensitivities. I have been essentially homeless and searching for housing for 3 years. I was doing ok in my temporary spots in Marin, where Smart Meters had not yet been installed. I had to move to Berkeley, because I could not find another temporary place in Marin, and I've been here for 4 months. My electrosmog sensitivity has gotten worse here, and I was finally clued in to the Smart Meter issue. There are 2 Smart Meters 10 feet from my current bed (for this property) and 1 Smart Meter 30 feet from my bed (for the property next door

I am trying to move out of the East Bay, because the Smart Meters seem to be most fully installed here...

I'm very frightened, for my housing situation, because it was already so difficult to find safe-enough housing, with my chemical and electrical sensitivities, but now the Smart Meters make it feel nearly impossible. I went all the way to Petaluma yesterday, by bus (I don't own a car), and I found a chemically safe-enough rental, but that neighborhood already has Smart Meters installed on every house. The houses are much smaller and closer together, than in Berkeley, so I think the radiation per house is higher there. I was very discouraged to discover this. (S.B., SF bay area CA)

---

A woman, who requested to remain anonymous, called today and let me know she was able to have her Smart Meter removed. She called the PG&E Smart Meter line and told them it was urgent, and insisted they remove it. She also had a prescription letter from her doctor stating that she should not have a smart meter now or in the future. PG&E removed it. (Web Admin)

---

On January 15th PG&E installed the new Smart Meter on our home in Aptos.

I was not home at the time and had no idea it was installed.

I arrived home from a great workout at the gym feeling like the peak of health.

As soon as I got back home I started to feel horrible and had no idea why.

The first thing I noticed was the worst pressure in my head and ears ever.

Then my heart started to beat really fast and then my brain felt wired.

Within 15 minutes I started to get really dizzy, nauseous and weak.

Within 20 minutes my whole body began to ache like nothing I had ever experienced before.

When I got on my computer my whole face and hands started to burn and hurt.

My husband arrived home 30 minutes later and asked how I was and I said the worst ever.

He then said he was going to check the work out the electrician did and saw PG&E installed The new Smart Meters.

I then called PG&E in a panic since i was feeling so awful and filed a complaint and asked them to take it off right away since it was making me so sick.

Santa Cruz is not scheduled until July to get these Meters.

We left and went out of town and I felt better in 30 minutes.

When we arrived home Sunday I felt horrible again and could not sleep that night. I called PG&E first thing Monday morning and pleaded to have it taken off right away since I felt so sick form it all.

Monday night at 8pm a PG&E installer came and took it off and put an old meter back on. Within 15-20 minutes I felt 90% better.

I have been electrical sensitive now for 4 years and these form of radiation was the worst that I ever felt in my life. T.D. Santa Cruz County CA

---

“I have lived in my home in San Leandro since November 2003, and have had two smart meters on my home (1 on gas, 1 on electric meters) since October 2008; and they are throughout my neighborhood since about that same time. I/we are now surrounded by a mesh network of pulsing extremely low emf (ELEMf). In May 2010, I had the signals measured by a local technician who had also checked my home in spring 2008 for possible EMF exposure that I suspected was causing me symptoms of vertigo and anxiety. I can provide a detailed report of his recent measurements showing the pulsing measurements and ranges of EMFs. Contrary to what PG&E has told me that these meters emit below the acceptable tolerable range of exposure, it’s the pulsing ELEMf that can interact with our body’s pulsing ELEMf and interfere with cellular communication. I believe I am having ill affects due to this technology being used, and have been seeking medical attention for symptoms of vertigo, the sound of my blood pulsing through my ears all the time while I’

m at home, hyper-arousal/ADHD leading to inability to focus or relax, interrupted sleep, pressure in my head between my ears, increased headaches; and less frequently, heart-racing anxiety, nausea, and shakes. I take really good care of myself, and do not believe that this noticeable decline in my health is due to me getting older.

I truly feel like I am in a microwave and slowly being cooked. Even my previously healthy houseplants have either died or have big brown spots, like burns. These strange effects have been occurring now for over a year, and it’s finally beginning to make sense.”

A.C. Bay area, CA

---

I personally experienced a smartmeter when PGE installed one on my neighbor’s home 25 ft away on May 7th, 2010. I did not expect to notice anything from one gas meter at that distance. However, I felt increasingly bad as the days wore on, with palpitations, irregular heartbeat, headaches, slight dizziness/weakness, emotional distress, anxiety and inner agitation, especially when on that side of our house. When I would leave to go for a walk out in the country, my headache would go away and I would feel better overall, but symptoms would come back upon return home.

I began to wonder if that one smartmeter could possibly be causing my symptoms, and even asked my neighbor if they had recently purchased any new electronic equipment (I wondered if it might be a DECT phone), but she said no.

Finally, in desperation, on May 22nd, I put a metal wheelbarrow over the meter (I had heard that metal stops much of the radio frequency (RF) radiation). My symptoms began to subside, and I was feeling better on May 23rd and 24th.

On May 24th, I was gone much of the day. Upon return home in the evening, I was feeling fine, and then worked for 2 hours in my office on that side of the house. All of the previously mentioned symptoms reappeared, and I was feeling despondent, even crying, as I went to bed. The next morning I learned that my neighbors had removed the wheelbarrow the day before while I had been gone, because PG&E had finally agreed to come out and deactivate the RF transmitter. That morning, May 25, 2010, a PG&E technician disabled the radio transmitter on the gas meter. I gradually began feeling better since then, although my heartbeat is still quite irregular much of the time. I am no longer getting headaches at home, and do not feel the emotional distress, dizziness or weakness.

I should mention that I am constantly exposed to some level of RF, since I live within 800 or 900 feet of the Sebastopol downtown cell tower, and can pick up 4 or 5 wifi signals in my home. Plus numerous nearby neighbors have "smart"phones or cellphones. We no longer have wireless of any kind in our home (since January 2010). Nor do we have fluorescent light bulbs or a microwave oven. I keep a cellphone in my car, switched OFF, and use it once or twice a month on speaker-phone for extremely brief intervals. I avoid places with lots of cellphones. None of these previous exposures prepared me for the onslaught of the smartmeter operating 24/7 next door, and I was very surprised at it's strength.

For this reason I know that I cannot live in a neighborhood with smartmeters, whether or not they let me "opt out". I am obviously more sensitive to RF radiation than most, but I am sure many others will be similarly affected. And many will have symptoms caused by the meters that they don't understand or correlate to the meters. N.H. Sonoma County

---

In about late September I began to notice I was having some odd symptoms, including the following:

\*Agitation\*Memory loss\*Inability to concentrate\*Nervousness\*Inability to get my work done,\*Interrupted sleep, I felt as if I were becoming unhinged.

During the time between September and earlier this month my husband and son seemed agitated too. My husband's blood pressure rose and he had to begin taking blood pressure medication. He was also experiencing sleep disruptions.

On February 25th and 26th there was a huge snowstorm here. During the storm I spent many hours in my living room, near my fireplace, about five feet away from the electric meter, which is installed outside my living room window. My right ear was facing the meter. My husband was traveling and my son was not at home for the same length of time that I was. The electricity went on and off several times during those two days. At one point I heard a piercing sound along with pressure in my ears. Along with the symptoms I had previously experienced, I began to develop worse symptoms, including the following: \*Heart palpitations,\*A buzzing-pulsing sound, especially in my right ear,\*Agitation,\*Interrupted sleep with nightmares of being attacked,\*Accelerated heartbeat. I was afraid that I would have a heart attack.

The symptoms would lessen when I went outside. It seemed that there was something wrong inside my home, perhaps with the electricity. Through research and talking to electricians, I began to realize that my symptoms might be traceable to something relating to the meters. They were the only recently installed appliances in our home with radio frequencies.

After many desperate phone calls to Con Edison, it removed the digital meters, but only after I presented a note from my doctor, upon which Con Edison insisted. In place of the electric meter Con Edison installed another electric, digital meter that it assured me emitted NO radio frequency...

Con Edison also told me that I would need in the future to provide it with meter readings. Con Edison told me that both my doctor and I would be receiving a follow up communication from its health department, which we never did.

Whether the people at Con Edison lied or did not know what they were talking about is a question that needs to be answered. This meter also had a radio frequency ... I realized this when my symptoms got worse. I was truly afraid that I would have a heart attack. I became terrified in my own home and could not find a comfortable place to sleep, because the buzzing pulsing sound in my ear was so disturbing. Before all of this started I was a healthy 51 year old.

Again, after making many more calls to Con Edison, on March 4 they removed that meter from my house and replaced it with an analog meter (this is the same type of meter Con Edison had initially removed in June 2009).

My immediate responses were so remarkable that I recorded them. \*Tingling in arms,\* Legs felt very heavy, \*The buzzing-pulsing became quieter.\* I felt as if my body was weighted down with exhaustion. Within hours I began feeling better. The loud buzzing-pulsing sound quieted down and my thoughts were less scrambled.

But my difficulties continued. In our home we have lived with wireless appliances, cell phones and fluorescent light bulbs for at least three years, and to my knowledge they have never been a problem for me. Now I cannot be near any of these things because I get a buzzing in my ears and my heart starts to race. The only possible cause for this change is that Con Edison placed meters emitting radio frequencies on and in my home in June.

Since Con Edison removed the digital meters and replaced them with an analog meter I am feeling better, but some of the symptoms have not gone away completely.

When I asked the Con Edison "Meter Relations" department (212-460-4111) if I could see a copy of the test results for human exposure to the frequencies in the meters, I was told that I must obtain a subpoena to acquire that information.

Con Edison also told me that the FCC had approved the meters. When I called the FCC, I was told that it does not address human health issues, but only with regulating frequencies, and the person with whom I was speaking hung up on me....

This could be a very dangerous situation. These meters are being used across New York State and the country. People might become sick from them and not know what is happening to them.

I am requesting that the meter replacement program be stopped immediately and that home owners be given the right to opt-out of receiving these meters if they do not want them, until further testing is done to

learn the effects of the frequencies they emit, especially in combination with other frequencies to which we are already being exposed.

Thank you.

Michele Hertz

New York

---

I am Toril Jelter, a board certified pediatrician specializing in medical and environmental aspects of autism related illness. I have health concerns regarding the unbridled roll out of wireless technologies without adequate health studies before hand. Dear FDA/FCC, I request a moratorium on the Smart Meter roll out ASAP until a proper assessment of health effects has been conducted. Here are a few patient stories for your review: A 2 year old child can't sleep at night. He screams inconsolably for hours. When the mother takes the child away from the SF Bay area to a remote area with poor cell phone reception the child sleeps well every night and naps as a normal 2 year old would during the day. A 40 year old man with MS & EHS (multiple sclerosis and electrohypersensitivity) requests no Smart Meter. His doctor writes a letter to support this request. It is granted BUT only temporarily! His 4 neighbors get a Smart Meter and he develops such severe ringing in the ears (tinnitus) that he is no longer able to sleep indoors. He discovers that the only way he can sleep is to sleep outdoors. (This could be explained by the cumulative effect of EMF in his home + the Smart Meters next door.) A 45 year old woman with MS has been stable for several years. After installment of a Smart Meter she goes down hill rapidly. Depression, flu-like symptoms and severe fatigue. Another woman with MS 50 years old improving. Gets a Smart Meter. Gets worse balance, worsening depression. Falls breaks 2 ribs and punctures a lung. A 10 year old child with high functioning autism gets a Smart Meter. His handwriting deteriorates. He seems more fatigued. He gets flu like symptoms frequently. Looses his appetite. Stops gaining weight. A 65 year old woman gets a Smart Meter, actually 4 at the head of her bed. (condo) She develops severe tinnitus, sleep disturbance, intermittent confusion, memory problems, heart palpitations and diabetes. PLEASE HAVE AT LEAST ONE PERSON READ AND UNDERSTAND

---

For anyone who wishes to fight the installation of a Smart Meter on their home for medical reasons, I would like to share my own successful experience. I live in the San Diego area –most of us in California live very close to our neighbors homes, and unfortunately there is nothing to date we can do to stop installation of their meters. However, nothing in The Telecommunications Act of 1996 prohibits us from complaining about health when installing a Smart Meter on our own homes. A “Smart Meter” is NOT a “wireless facility” [thus exempted from health concerns] and many of us will be/are being harmed by the unwelcome radiation in our homes. Do not let your electric company tell you otherwise. Tell them to very carefully read Section 704 of The Telecommunications Act of 1996 and ask how they would define a Smart Meter as a wireless facility – i.e. are cell phones wireless facilities? Of course not. It defies logic. But be prepared, because that excuse may be attempted by your electric company. SDG&E tried it –unsuccessfully. Bottom Line: You do have a right to complain about health concerns, but be prepared to offer solid proof by way of a physician's documentation.

When I heard SDG&E was going to install Smart Meters in Rancho Santa Fe, CA I did the following to prevent installation of a Smart Meter on my home.:1) I called and followed-up in writing with SDG&E corporate office,informing them that I had a heart condition that could be adversely affected by RF radiation. Anyone who is known to be electro-sensitive should have the same rights as those of us who have heart-related issues.

2) I got a letter from my cardiologist explaining that RF radiation has been known to alter heart rhythms. (But first I had to educate my cardiologist as to what a Smart Meter is and does. I am attaching two documents I took to my cardiologist.)

\* Int Arch Occup Environ Health. 1997 ;70 (1):9-21 9258703

<<http://lib.bioinfo.pl/pmid:9258703>> Exposure to extremely-low-frequency electromagnetic fields and radiofrequency radiation: cardiovascular effects in humans. [My paper] <<http://lib.bioinfo.pl/auth:Jauchem.JR>> J R Jauchem

\* The 2002 letter from Norbert Hankin of the US Environmental Protection Agency to Janet New of (then) The EMR Network [she is now head of the EMR Policy Institute]. [My paper]Norbert Hankin’s revealing letter indicates standards set by the US government in 1996 do not apply to non-thermal effects of RF radiation. In other words, we are not living in a world of protection; the non-thermal effects of RF radiation were not taken into account when the regulations were established. “Safety standards” were never set. “Safety” is a false assumption.

3) I made an appointment to see Gunnar Heuser, MD, PhD., in the Los Angeles area. Dr. Heuser has long specialized in neuro-toxicology and is widely recognized as an one of the top medical experts in this arena. Dr. Heuser can objectively test a patient to document electro-sensitivity, and if they are found to be electro-sensitive, he can write a medial report that can unequivocally state one’ s health may be harmed by exposure to RF

radiation from a Smart Meter. I fell into this electro-sensitive category,  
as have many others. Dr. Heuser is seeing more and more patients adversely  
affected by Smart Meters. He can be reached at: (310) 500-0041. Dr. Heuser's address:  
P. O. Box 2730, Agoura Hills, CA 91376.

4) I then sent letters from my cardiologist and Dr. Heuser to SDG&E's  
corporate office. I told them they could not place a Smart Meter on my home  
due to health concerns. Additionally, I stated I would hold SDG&E legally  
responsible if my health was further impaired by a Smart Meter.

5) The result? SDG&E did not install a Smart Meter on my home.

Susan Foster

Rancho Santa Fe CA

---

January 4, 2010

Ms. Susan Crane

Director, Meter to Bill Process

We Energies

231 W. Michigan Street

Milwaukee, WI 53203

[susan.crane@we-energies.com](mailto:susan.crane@we-energies.com)

Dear Ms. Crane:

My patients, Shivani Arjuna and her husband Dan Small, have asked me to write to you with regard to  
how Shivani is affected by exposure to communication frequencies and "dirty electricity"

frequencies. They are deeply concerned that placement of one of We Energies' new, radio-broadcasting  
meters on their property would be harmful to their health, especially to Shivani's. I share their concern.

People who are aware of experiencing symptoms as soon as they are exposed to radio (RF) and microwave (MW) frequencies are currently termed “electrically hypersensitive,”

or EHS. Shivani is electrically hypersensitive. However, these individuals are by no means the only people actually being affected by such exposure, as ample, rigorous research done over a period of several decades shows chronic exposure causes health damage to people who note no immediate symptoms. Please see, for example, the bibliography of reported biological phenomena associated with radio-frequency and microwave radiation compiled by the US Navy Medical Research Institute in 1971, with over 2,000 references.,

at: [www.dtic.mil/cgibin/GetTRDoc?AD=AD750271&Location=U2&doc=GetTRDoc.pdf](http://www.dtic.mil/cgibin/GetTRDoc?AD=AD750271&Location=U2&doc=GetTRDoc.pdf). Also, please see the summary of EMF effects at: [www.icswebsite.com/emf/emfissues.html](http://www.icswebsite.com/emf/emfissues.html) with 62 more recent references.

The immense proliferation of wireless technologies in the past few years has given rise to health problems that cannot be successfully treated medically, as medicine cannot remove the underlying cause, the exposure to radiation.

Safety regulations of various nations vary widely regarding what level of exposure is supposedly safe. Unfortunately, most countries’ regulations are still based on the old, inaccurate assumption that non-ionizing radiation is not harmful unless it actually heats body tissues. The fact that a given technology adheres to the present standards is meaningless in terms of its actual biological effects. Even an EPA spokesperson has stated that present U.S. standards are not protecting citizens from harmful radiation. Research shows harmful effects at levels far below what is presently allowed.

Years of research also reveal a broad range of symptoms and diseases caused by RF exposure. This is hardly surprising, as the human body functions electrically from the cellular level on. Attached you will find a list of conditions caused by exposure to RF and therefore termed “radio wave sickness.”

There are probably more mechanisms underlying the damage done to health by manmade electromagnetic frequencies than we are presently aware of. (To date, the mechanism by which smoking tobacco causes cancer is unknown.)

However, here is brief information regarding a few known mechanisms:

- o It is established from multiple, independent studies that EMR from ELF to RF/MW reduces melatonin in animals and human beings. Melatonin is not only vital for healthy sleep, it is the most potent, naturally produced antioxidant that helps to protect cells from genetic damage that leads to cancer, neurological, cardiac and reproductive damage, illness and death.

- o Exposure to intensities and field strengths that are extremely low cause a biological effect called calcium ion efflux. Calcium ion alteration of cells by EMR is linked to neurological degeneration, to cancer and many other health effects. The heart is also an electromagnetic organ, with an electric pulse initiating a cascade of calcium ions that cause the cells in the heart to contract and produce a heartbeat. Exogenous electromagnetic signals can interfere with this regular, electrical pulse leading to heart disease and heart attack of the arrhythmic kind.

o Physiological changes that are bedrock indicators of allergic response and inflammatory conditions that are stimulated by EMF exposures include: overreaction of the immune system; morphological alterations of immune cells; profound increases in mast cells in the upper skin layers, increased degranulation of mast cells and larger size of mast cells in EHS individuals; presence of biological markers for inflammation that are sensitive to EMF exposure at non-thermal levels; changes in lymphocyte viability; decreased count of NK cells; decreased count of T-lymphocytes; negative effects on pregnancy (uteroplacental circulatory disturbances and placental dysfunction); suppressed or impaired immune function; and inflammatory responses that can result in cellular, tissue and organ damage if exposure occurs on a continuing basis over time. Mast cells are also found in the brain and heart, and this might account for some of the other symptoms commonly reported: headache, sensitivity to light, arrhythmias and other cardiac symptoms.

o Many studies have shown that RF/MW radiation and ELF fields cause increased DNA strand breakage and chromosome aberrations.

As was concluded by the authors of the Bioinitiative Report ([www.bioinitiative.org](http://www.bioinitiative.org)), it is unwise from a public health perspective to continue “business-as-usual,”

deploying new technologies that increase RF exposures, particularly involuntary exposures.

Any company or industry whose products or operational methodologies cause involuntary exposure to RF radiation would do well to become more informed about these and other effects of such exposure, both to protect the public and to protect themselves from future liability suits.

Though it is no longer possible in today’s world to completely avoid exposure to communications frequencies, EHS individuals such as Shivani, need to live in a personal environment as clear of RF/MW as possible. This is recognized in Sweden, where the government creates safe working and living spaces for such individuals. In the U.S., EHS individuals have to do what they can to create their own safe living spaces. Certainly, these safe havens, on their own property, should not be denied them.

I have been Shivani Arjuna’s physician since 2002 and have noted how her specific symptoms and overall health have corresponded directly to her exposure to RF/MW radiation. Initially, she was experiencing incapacitating and life-threatening symptoms related to such exposure. At present, she is able to remain free of RF/MW exposure-induced symptoms as long as she remains in the safe home space that she and her husband have gone to considerable effort and expense to create. That she remains EHS is clear from how she responds to exposures when not in that safe environment.

It is my opinion that the placement of an RF-broadcasting device connected to the wiring on this property would be extremely detrimental to Shivani’s health and that it must not be allowed.

Such a device connected to their wiring, whether at or away from their house, would cause RF to be broadcast from the wiring throughout their home. I suggest the alternative of asking them to take regular meter readings from their present meter and call or mail these to you, with a We Energies employee checking the meter annually or semi-annually to ensure accuracy.

I look forward to your response and hope you will agree to this solution to ensure that Shivani’s health be respected and protected.

Sincerely,

Roy D. Ozanne, MD, HMD

## 273 thoughts on “Smart Meter Health Complaints”

1. **siouxfan** says:

[November 4, 2010 at 11:49 pm](#)

This is so weird reading these comments. I just moved to Fairfield, CA from Oklahoma and have never heard of this smart meter. Ever since I moved here I noticed weird things happening in my chest. The tightness and palpitations that other people are talking about are exactly what I am experiencing too. It isn't real painful or anything but just worried me since I thought I may be having heart problems...at 25 years old! I've only been here a little over a month and definately noticed something weird way before I even heard about these smart meters or issues anyone was having. Being an electrical engineering major I see what PG&E is saying about it being a very small wattage and how it shouldn't affect anything but something about this new house I moved into is causing something to go on in my body. I Looked outside and I do have a smart meter attached to my house. I'm not really taking sides or anything on this debate of weather it's the smart meter or something else but I do know that there is something weird/different about California that seems to be affecting my health...I just hope it's not something permanent.

2. **SanDiegan** says:

[December 17, 2010 at 6:46 pm](#)

Since I had the SmartMeter placed on my home (master bedroom wall by headboard of my bed) involuntarily by SDG&E about 3-4 months ago, I have developed increasingly severe reactions to EMF (electromagnetic fields). I have constant ringing in my ears, getting louder and very distracting; headache, sinus pain, feeling of heaviness in chest, disorientation, mental confusion, difficulty concentrating and with calculation and driving, nausea, and very hard to use computer, phones, etc. Can't sleep well, insomnia, though improved with change of bedroom. My doctor wrote a letter demanding under the ADA that SDG&E remove the SmartMeter, the reply was that SM's don't impact health, my doctor is wrong that the ADA covers this, and they essentially refuse to remove the SM. Needless to say, I am shocked, horrified, and will take further steps. This is an example of Big Brother in our lives worse than anything I have seen in America in 60 years. They can harm and kill us legally now, in our own country. This is an outrage.

3. **SG** says:

[December 28, 2010 at 9:45 pm](#)

SDGE just replied to my letter to them (Ted Reguly is the head of the Dumb Meter program) and they told me also that it was too bad and ADA does not apply. They said I should write a letter to CPUC if I feel like it. They are sending the same form letter to everyone. I would love to see a class action suit against these creeps.

4. **Sandi** says:

[January 16, 2011 at 10:34 am](#)

Sent from Dr. Tobin Watkinson:

The government FCC PUC WHO etc have allowed technology with lots of money to influence the importance of caution when it comes to the health of those who have to live decisions. People are as different as grains of sand or snow flakes everyone is unique. Our chemistry our audition our speech our electronics. The human body is a series of electrochemical reactions which drive it's function. For anyone to think this organic battery of a body of ours can sit aside a strong (as compared to the body)artificial electrical field without effect or some perception even on a cellular level has a "short"between their ears. Our health and the health of everyone depends on our understanding of these basic physiological principles and progress that is not blinded by profit.

Each and every one of us is at risk and must speak out for our rights to have a voice when inappropriate choices are imposed upon us without our consent.



5. **Sandi** says:

[January 16, 2011 at 10:38 am](#)

Sent from Cynthia Perkins:

Open Letter to Southern California Edison and CPUC

On Thursday, January 6th, I called Southern California Edison to inform you I do not want a Smart Meter installed at my residence.

I am disabled with several health conditions that will be adversely affected by the installation of the Smart Meter.

I have very weak adrenal glands that don't produce enough Cortisol. The combination of EMF/RF in the Smart Meters is known to be very damaging to the adrenal glands. The stress from this type of exposure could push me into Addison's disease and possibly result in death.

I have chronic migraines, which could be magnified with the EMF/FM exposure.

I also have EMF sensitivity. EMF sensitivity is an illness caused by exposure to radiation that is discharged from a variety of sources like cell phones, microwaves, cell phone towers, etc. When I am exposed to certain levels of EMF, I experience migraines, heart palpitations, trembling,

weakness, hot flashes, increased pulse, pain in my gastrointestinal system, dizziness, inability to concentrate, impaired cognitive functioning and hyper-arousal. I do not even own a cell phone, because I'm incapable of using one.

When I called your office, I was met with hostility, confrontation, intimidation and a complete lack of regard for my position. I was told that I had no choice in the matter and if I do not comply my electricity will be shut off.

Therefore, if a Smart Meter is installed at my home, I will hold you, Corix and the CPUC legally responsible for any and all impairments in my health and consider the following possible charges:

#### Assault

I have informed you that installation of a Smart Meter will cause me bodily harm and puts my life at risk. If you install a Smart Meter, I will consider this assault and will file charges accordingly.

#### Manslaughter or Wrongful Death

If I die, then we're talking about manslaughter or wrongful death.

#### Medical Expenses

If you install a Smart Meter, I will hold you legally responsible for all medical expenses incurred by the Smart Meter to my health.

#### Trespassing

If you, Corix or anyone on your behalf comes on my property to install a Smart Meter, I will have you arrested for trespassing.

#### Invasion and Violation of Rights

Last, but not least. This entire procedure is unconstitutional. It is an invasion and violation of my rights. You should not have the right to bathe me with environmental toxins without my permission. You should not have the right to alter my home in any manner without my permission.

I am not willing to play Russian roulette with my life and you should not be permitted to do so either. As someone who lives with five disabling chronic health conditions, there is not room in my life for more suffering that may result from the Smart Meter. You should not have the right to violate and intrude upon what I must do to protect my health.

I should have the right to have electricity service without being forced to put my life and health in danger. I will take any and all measures available to me to be heard on this issue in my community and across the country including the media and the Internet.

For starters, I am using my website which gets more than 70,000 visitors a month, to broadcast all that transpires between me, the CPUC, Corix and Southern California Edison, including your threat to turn off my electricity and your hostile and lackadaisical attitude towards the concerns and rights of the citizens. I will also use Facebook and Twitter. You may want to take a look at the following page on my blog, which I will be updating throughout this process:

<http://www.holistichelp.net/blog/smart-meters-are-hazardous-to-your-health-and-violate-your-rights/>

I am in the process of contacting ABC news, CBS news, NBC news, all the local newspapers, the Internet Radio shows, legislators, City Council, President Obama and anyone else who is willing to listen about your lack of concern for our rights and the threat to turn off my electricity — a woman who is disabled with five chronic health conditions. The lack of electricity would leave me without heat in the middle of winter, not to mention the inability to cook etc.

So, once again, this letter is to inform you that I oppose the installation of a wireless SmartGrid meter at my home. I do not want to be exposed to the wireless radiofrequency/microwave radiation from the meter, the security and hacking risks, the potential fire hazard from the meter, or the electromagnetic interference with electronics and medical devices, the invasion of privacy – nor do I want any more cell antennas in my neighborhood.

I will not opt-in to the Southern California Edison Company program by installing power transmitters inside my home on my home appliances, to report energy usage to SCE. The California Public Utilities Commission should require SCE to conduct additional economic studies that take into account various percentages of people who will NOT join this program. SCE has stated that its current ‘base case’ requires compliance by the public in placing radiofrequency radiation transmitters inside their homes. SCE says the SmartGrid project will cost \$1.6 billion dollars of ratepayer money (for 5 million new wireless meters). This is a waste of ratepayer money if people decline to participate due to health and safety or trespass reasons.

Therefore, I am requesting that you do not shut off my electricity and continue to provide me service with the meter that is currently installed at my residence.

If you do not want to send out a meter reader to read my meter, I will be happy to take a picture of my meter every month and send it to you.

I repeat, I do not consent to the installation of a Smart Meter at the address listed below. Corix, or anyone acting on your behalf does not have my permission to install a Smart Meter at the address listed below.

I would appreciate hearing from you on this matter promptly, as deployment begins on January 18th in my neighborhood.

Sincerely,  
Cynthia Perkins, M.Ed.



6. **Sandi** says:

[April 7, 2011 at 5:16 pm](#)

It's unconscionable that so many stories are coming in and from everywhere and NOTHING is being done. It's like we've been invaded by creatures bent on destroying us. It's worse than any science fiction movie I can conjure. This has to stop. It has to stop now. This is genocide. They're going to reduce the population to a sick, confused mush puddle and then walk them off the cliff.

Howard Glasser Lake County, CA

7. **tharris109** says:

[April 30, 2011 at 8:46 am](#)

moving to CA and concerned about the smart meters. And since I had brain surgery a year ago I get really bad headaches. Worried the EMF's from the Smart meters will cause head aches

8. **Valerie** says:

[May 31, 2011 at 7:23 am](#)

I was wondering does anybody know if these devices have an effect on Patients with pacemakers or even effect the pacemaker itself? I hear that Australia is getting these so called smart meters & my husband has a Gaurdiant pacemaker with 3 leads & already suffers from Tinnitus without a smart meter & I have heart issues as well & our Electrical box is on the outside of our bedroom wall with our bedhead against this wall & cannot be placed any other way in the room due to the design of the room (built in wardrobes & ensuite & large window).

9. **cathryn de gery** says:

[June 2, 2011 at 3:19 am](#)

I live in a 472 sf small studio, there are 7 smart meters outside the wall of my bed. PG&E installed about a year ago, I recently am dying from the terrible headaches, woke up many times at night , with also very loud ring deep in my ear, consistently ring in my ear !!! I want to throw up all the time, very very tired, do not want to do anything, bad memory, I cannot believe I start to feel my heart is beating so heavy painful and just struggled to make it going. I went to see the doctor, I was told to move out of this room far away from smart meter as soon as possible. I contacted with PG&E, they told me that those killer smart meters are not going to be removed no matter what, PG&E is murder !!!! we need to do something about it in Government to get rid off this killer smart meter !!! I do not want smart meter damage my 6 years old child's brain or any part of our body, please stand up to protect our own life !!! I live in los Gatos, Santa Clara , Ca. thank you for reading and need help !!!

10. **A.R.** says:

[June 3, 2011 at 11:33 am](#)

This issue has “Class Action Lawsuit” written all over it. Any activist attorneys out there who would care to take this on? Cell phones and their cancer risks are next...

11. **Mary L.** says:

[June 15, 2011 at 2:17 pm](#)

I have been having increased symptoms over the past few years since a Smart Meter was installed. I did allow it but didn't know then about the health risks, and it's located just outside out bedroom window. I have tinnitus, heart palpitations, many aches and pains that I never had before. I keep going to the doctor's office spending money on trying to feel well, but to no avail. I wish I could find out if we can have it removed.

12. **S. G.** says:

[June 29, 2011 at 2:18 am](#)

Thank you. This has finally answered my questions. A smart meter was placed on our house April 25. I have been having chest pains, joint pains, rashes, horrible piercing headaches, nausea, very heavy menstrual cycles for two months, decreased mental capacity and increased sensitivity to emf's. I have been trying to get Florida Power and Light to help me figure out why I have been having surges on my gauss meter. I feel sorry for all of the Florida residents who are having symptoms and don't know why.

13. **Bill Beckham** says:

[July 2, 2011 at 1:38 am](#)

I live in Fresno, CA and ever since a Smartmeter was installed in our home, I have had trouble sleeping at night. Recently, even my wife has had trouble sleeping. The Smartmeter is installed on the wall outside of our bedroom and moving to a new room is not an option. PG&E says that they will change it back at a large cost and monthly fee.

14. **Robert Leverant** says:

[July 3, 2011 at 5:53 pm](#)

Reading these testimonies, amplify my concerns about smart meter installation on my house, my neighbor's house (which faces my house), and the houses on our street. It is unconscionable that by stealth and power tripping (pun intended) that PG& E can install these toxic devices & get away with mental, physical and emotional abuse of psyche and soma of their customers/citizens in California, U.S.A. I'm glad to see that in some instances, due to the timeliness and cogency of a complaint, that some smart meters were removed and the analogue meters reinstalled. This gives me hope.

15. **Holly Manion** says:

[July 3, 2011 at 6:00 pm](#)

Please, if possible move your bed away from the wall where the smart meters are installed. My friend, John, experienced ringing in his ears when the smart meter was installed on his house. He made a temporary shield for the RF radiation with HEAVY DUTY foil from the supermarket and a grounding wire. He now uses a more permanent solution which reduces the radiation from the smart meter. As a result the ringing in his ears is gone!

You then need to expose one end of the wire about two inches, and tape this to the wall. Here is the IMPORTANT part. The wire needs to be grounded. Run it out the window and attach to a water pipe coming out from the ground, or you will need to get a copper grounding pipe (at Home Depot). Attach the other end of the wire to this copper pipe (that is pounded as far as you can into the ground). This should reduce the majority of the EMF's coming into your home.

16. **John** says:

[July 15, 2011 at 7:29 pm](#)

I have read the symptoms, odd enough it was in 2009 that I have experienced vertigo, and balance problems when the Smart Meter came. With all these 'claims' like what I have, there must be some medical research to back it up as well proof. The EMF meter's on the Ghosthunter's show could detect some form of waves coming from the Meter's. Anythought to this?

17. **JAR** says:

[July 17, 2011 at 10:00 am](#)

It's a shame that reading all these complaints has the effect of summoning up the thought, "These people are nuts." Well, count me in, then.

Central Maine Power did not perform due diligence in alerting people that the meters were to be installed. When installation began in my neighborhood, two weeks ago, exactly two weeks ago, I began experiencing what I can only call a short-circuiting of synapses or something — spasms — which spread across my chest into my arms and legs. Szit szit szit — but intermittently throughout the day and night. These have now largely stopped, but my tinnitus is horrible, and I am not doing anything to exacerbate it.

I don't know whether these effects are due to the Smart Meter installation or not. Perhaps I am having sudden cardiac/neurological problems. But what if my symptoms ARE caused by the emfs? The doctor who I will see in a week, would not cotton, I am certain, to my even posing the question. He will say I am nuts.

I say – in the absence of any scientific evidence for my symptoms, one must consider alternative explanations; in this case – the Smart Meter installations.

Note that I had no idea the Smart Meters were being installed, so, at least, this is not a case of psychosomatic inducement of symptoms. Is there a physicist in the house?

PS The dog has been barking wildly – a completely new behavior for this normally plain ol' dog.



18. **JAR** says:

[July 17, 2011 at 10:03 am](#)

One more thing: my pulse rate, always in the upper range, around 90 bpm, has dropped like a stone. No, as yet known medical explanation for that either. Hate feeling like a nut.

19. **Donna Avent** says:

[July 19, 2011 at 12:26 am](#)

Smart meter make me dizzy and can't think straight. My mind lot of confuse because of radiation by smart meter. I did tell CPUC about restore analog but CPUC did not listen me many times.

20. **Mia Nony** says:

[July 22, 2011 at 11:13 pm](#)

Anyone else here know about Graham Stetzer filters? They are an antidote. They also sell the frequency reading meter which will read your induced electromagnetic levels in the home. The filters are used in the electric outlets in the house to clean up dirty electricity from the smart meter and otherwise. This also means the smart meter stops using your house wiring as a transmission antenna and stops using you as a transmission receiver.

As for physical well being, at least one antidote to ANY radiation exposure and for DNA repair is to take sea vegetables daily.



21. **Mia Nony** says:

[July 23, 2011 at 12:03 am](#)

All of these symptoms are very real. These frequencies slowly cook the human body. Literally. Hence the need to practice self protection daily.

The effect is called the "heat effect". Depolarization of nerve and muscle occur as a result.

In Canada it is illegal to allow any frequency to excite or stimulate body tissues. And yet Health

Canada ignores their own laws. In reality smart meters are illegal.

So is any wireless device or even the wired meters, since those have a special device called a Supply Mode Power Switch or SMPS which – wait for it – protects the meter from 240 high voltage but exposes the human inside the building to radically spiking high voltage in the process, up to 50,000 Giga hertz a spike.

The way I see it? If this is illegal in my country according to Canadian health laws, then if and when this comes to my home I intend to fully and completely wrap the meter in heavy aluminium turkey plates and to hold it in place with duct tape which suppresses the transmission which in turn converts the transmission of the meter from frequency into heat, just like any microwave oven does, and which in turn fries the meter.

I don't know how to use a chainsaw or I would use this but I do very much admire anyone who refuses to accept this illegal surveillance device. I feel exactly this way – or I would maybe use a sledge hammer. Same goes for the smart meter boosters on utility poles in the rural areas as target practice. Call this sedition but who is the illegal one in this picture? The utility corporations, that's who. All of them. All at the same time doing this to all of us all over the globe. Who thought that up? The united Nations, that's who. Fake green microwave pollution. FIGHT BACK!



22. **Mia Nony** says:

[July 23, 2011 at 2:01 am](#)

**TAKING BACK THE POWER FROM THE “POWER” UTILITY:**

We are all essentially junkies, electricity addicts. Think of the power utility as the drug dealer who is counting on us to not ever think of ways to reduce the amount of electricity we have turned on all over the house at any given moment. We seldom think of ways to wean off the use of this electricity nor even think how to pare down what we do use to absolute essentials as needed. Right now every circuit and every wire in the average home is “on”, whether it is needed or not. Every circuit is “live” or “active” for the sake of “convenience”. But at what price? When all circuits are left “live” this turns the whole house into one giant transmission antenna for the smart meter to co-opt. Start to think about how much of this circuitry is truly essential for one's daily use. An electricity free bedroom is a good place to start. Okay here are some ideas friends have shared with me.

1) **LINE THE INTERIOR SURFACE BEHIND THE Smart Meter** ...with a large sheet of anything protective which deflects on one side and is coated on the other interior side so that it does not deflect into the home as well, and choose the shield according to its ability to create back scatter and to reflect radiation, be it specially metal threaded fabric or be it the kind of leaded glass used by x-ray techs or be it a large sheet of lead, or nickel. You can buy and use specially designed carbon paint for the entire interior wall area and even the exterior wall area for at least several yards in all directions behind the meter. Or maybe cover the whole interior area with copper backed wallpaper. Some metals are more effective than others. Aluminium is okay but not as strong at deflection as is copper, for instance. (Although if you were to turn on a cell phone and then wrap it totally in aluminium foil it would eventually turn into heat and fry itself.).

There are also smart meter metal collars and box shields for sale on the net. Truth be told, I am not

sure how much they reduce emissions but I think the idea is to direct the frequency and to narrow its beam.

In any case the general idea is to accomplish the same thing with this purchase of a smart meter shield kit approach or with DIY for this: Wrap a snug metal collar or aluminium wrap around the entire circumference of the smart meter and then box it in on all sides except the face with what ever will deflect or suppress the frequencies, hopefully not toward anyone else's property. This is one approach for those who do not want to be liable for actual damage to the smart meter or who prefer not to wrap it up to suffocate the frequency and shut it down for good.

Whatever you use on the interior wall behind where the meter is installed, do some research on the best materials first.

Make it a VERY LARGE SHEET.

Smart meters have a large field. Visualize them as a giant lightbulb and visualize the field as the light from it.

Better yet also add EMF absorption material on the interior side of the lead or other metal sheet or carbon paint surface which you install on the interior wall shared by the meter. Or you might also try to obtain Carboshield from Germany which actually extinguishes radiation and is used to prevent espionage or hacking. .

Be careful not to operate EMF emission items indoors anywhere at all near the smart meter interior shielding material or that same shield, if it has no absorption layer on it, will tend to also reflect or enhance the emissions from items in your home. Remember all electricity has a field. Same goes for stainless steel appliances which bounce EMFs from other wireless devices in the home.

2) YOUR CIRCUIT BOX IS YOURS. Use this fact to your advantage.

Diagnose every circuit. Then turn off every single circuit that is not absolutely essential to your daily use. Fridge and freezer is all you really need except when cooking and one back up plan is to consider a propane outdoor two burner cookstove and or a BBQ with an oven area, for that. Switch to gas or wood heat where ever possible. Turn your hot water heater on only for a while in advance of when absolutely needed. Turn off all appliances including washer and dryer at the circuit box. Especially turn off any newer appliances which radiate 24/7 and which "talk" to the meter. For bathing try one hour max to heat the hot water tank for a shower, then turn it back off for the rest of the time, by using the HW tank like an on demand heater, and then leave it off at the circuit box the rest of the time. Turn off all bedroom circuits and use only LED battery operated "puck" lights everywhere possible. Filter any and all remaining live circuits with the Graham Stetzer filters to neutralize dirty electricity in any live circuits.

3) Notify the utility that you hereby refuse to allow any surveillance device or wiretapping device to be installed or to remain on your home. It is illegal to monitor your activities. Warn them that you know this.

Go to Youtube and put the name " Jerry Day" or" Smart Meters" into the Youtube search bar. Then listen to what this savvy electronics guy has to say, so straightforward and uplifting and practical advice. Then use the form letter he provides below the video and personalize it, add your account number and address and send it by registered mail with a certified arrangement and a double signature assurance of acceptance, making certain to send it to the head or CEO top management person of the utility company for your area.



23. **Mia Nony** says:

[July 23, 2011 at 2:16 am](#)

Robert Baan a, Yann Grosse a, Béatrice Lauby-Secretan a, Fatiha El Ghissassi a, Véronique Bouvard a, Lamia Benbrahim-Tallaa a, Neela Guha a, Farhad Islami a, Laurent Galichet a, Kurt Straif a, on behalf of the WHO International Agency for Research on Cancer Monograph Working Group

In May, 2011, 30 scientists from 14 countries met at the International Agency for Research on Cancer (IARC) in Lyon, France, to assess the carcinogenicity of radiofrequency electromagnetic fields (RF-EMF). These assessments will be published as Volume 102 of the IARC Monographs.<sup>1</sup>

Human exposures to RF-EMF (frequency range 30 kHz—300 GHz) can occur from use of personal devices (eg, mobile telephones, cordless phones, Bluetooth, and amateur radios), from occupational sources (eg, high-frequency dielectric and induction heaters, and high-powered pulsed radars), and from environmental sources such as mobile-phone base stations, broadcast antennas, and medical applications. For workers, most exposure to RF-EMF comes from near-field sources, whereas the general population receives the highest exposure from transmitters close to the body, such as handheld devices like mobile telephones.

Exposure to high-power sources at work might involve higher cumulative RF energy deposited into the body than exposure to mobile phones, but the local energy deposited in the brain is generally less. Typical exposures to the brain from rooftop or tower-mounted mobile-phone base stations and from TV and radio stations are several orders of magnitude lower than those from global system for mobile communications (GSM) handsets. The average exposure from use of digital enhanced cordless telecommunications (DECT) phones is around five times lower than that measured for GSM phones, and third-generation (3G) phones emit, on average, about 100 times less RF energy than GSM phones, when signals are strong.

Similarly, the average output power of Bluetooth wireless hands-free kits is estimated to be around 100 times lower than that of mobile phones.

EMFs generated by RF sources couple with the body, resulting in induced electric and magnetic fields and associated currents inside tissues. The most important factors that determine the induced fields are the distance of the source from the body and the output power level.

Additionally, the efficiency of coupling and resulting field distribution inside the body strongly depend on the frequency, polarisation, and direction of wave incidence on the body, and anatomical features of the exposed person, including height, body-mass index, posture, and dielectric properties of the tissues.

Induced fields within the body are highly non-uniform, varying over several orders of magnitude, with local hotspots.

Holding a mobile phone to the ear to make a voice call can result in high specific RF energy absorption-rate (SAR) values in the brain, depending on the design and position of the phone and its antenna in relation to the head, how the phone is held, the anatomy of the head, and the quality of the link between the base station and phone.

When used by children, the average RF energy deposition is two times higher in the brain and up to ten times higher in the bone marrow of the skull, compared with mobile phone use by adults.<sup>2</sup> Use of hands-free kits lowers exposure to the brain to below 10% of the exposure from use at the ear, but it might increase exposure to other parts of the body.<sup>3</sup>

Epidemiological evidence for an association between RF-EMF and cancer comes from cohort, case-control, and time-trend studies. The populations in these studies were exposed to RF-EMF in occupational settings, from sources in the general environment, and from use of wireless (mobile and cordless) telephones, which is the most extensively studied exposure source. One cohort study<sup>4</sup> and five case-control studies<sup>5–9</sup> were judged by the Working Group to offer potentially useful information regarding associations between use of wireless phones and glioma.

The cohort study<sup>4</sup> included 257 cases of glioma among 420 095 subscribers to two Danish mobile phone companies between 1982 and 1995. Glioma incidence was near the national average for the subscribers. In this study, reliance on subscription to a mobile phone provider, as a surrogate for mobile phone use, could have resulted in considerable misclassification in exposure assessment.

Three early case-control studies<sup>5–7</sup> encompassed a period when mobile phone use was low, users typically had low cumulative exposures, time since first use of a mobile phone was short, and effect estimates were generally imprecise; the Working Group considered these studies less informative.

Time-trend analyses did not show an increased rate of brain tumours after the increase in mobile phone use. However, these studies have substantial limitations because most of the analyses examined trends until the early 2000s only. Such analyses are uninformative if excess risk only manifests more than a decade after phone use begins, or if phone use only affects a small proportion of cases—eg, the most heavily exposed, or a subset of brain tumours.

The INTERPHONE study,<sup>8</sup> a multicentre case-control study, is the largest investigation so far of mobile phone use and brain tumours, including glioma, acoustic neuroma, and meningioma. The pooled analysis included 2708 glioma cases and 2972 controls (participation rates 64% and 53%, respectively). Comparing those who ever used mobile phones with those who never did yielded an odds ratio (OR) of 0.81 (95% CI 0.70–0.94). In terms of cumulative call time, ORs were uniformly below or close to unity for all deciles of exposure except the highest decile (>1640 h of use), for which the OR for glioma was 1.40 (95% CI 1.03–1.89). There was suggestion of an increased risk for ipsilateral exposure (on the same side of the head as the tumour) and for tumours in the temporal lobe, where RF exposure is highest.

Associations between glioma and cumulative specific energy absorbed at the tumour location were examined in a subset of 553 cases that had estimated RF doses.<sup>10</sup> The OR for glioma increased

with increasing RF dose for exposures 7 years or more before diagnosis, whereas there was no association with estimated dose for exposures less than 7 years before diagnosis.

A Swedish research group did a pooled analysis of two very similar studies of associations between mobile and cordless phone use and glioma, acoustic neuroma, and meningioma.<sup>9</sup>

The analysis included 1148 glioma cases (ascertained 1997—2003) and 2438 controls, obtained through cancer and population registries, respectively. Self-administered mailed questionnaires were followed by telephone interviews to obtain information on the exposures and covariates of interest, including use of mobile and cordless phones (response rates 85% and 84%, respectively). Participants who had used a mobile phone for more than 1 year had an OR for glioma of 1.3 (95% CI 1.1—1.6). The OR increased with increasing time since first use and with total call time, reaching 3.2 (2.0—5.1) for more than 2000 h of use. Ipsilateral use of the mobile phone was associated with higher risk. Similar findings were reported for use of cordless phones.

Although both the INTERPHONE study and the Swedish pooled analysis are susceptible to bias—due to recall error and selection for participation—the Working Group concluded that the findings could not be dismissed as reflecting bias alone, and that a causal interpretation between mobile phone RF-EMF exposure and glioma is possible. A similar conclusion was drawn from these two studies for acoustic neuroma, although the case numbers were substantially smaller than for glioma. Additionally, a study from Japan<sup>11</sup> found some evidence of an increased risk for acoustic neuroma associated with ipsilateral mobile phone use.

For meningioma, parotid-gland tumours, leukaemia, lymphoma, and other tumour types, the Working Group found the available evidence insufficient to reach a conclusion on the potential association with mobile phone use.

Epidemiological studies of individuals with potential occupational exposure to RF-EMF have investigated brain tumours, leukaemia, lymphoma, and other types of malignancy including uveal melanoma, and cancers of the testis, breast, lung, and skin.

The Working Group noted that the studies had methodological limitations and the results were inconsistent. In reviewing studies that addressed the possible association between environmental exposure to RF-EMF and cancer, the Working Group found the available evidence insufficient for any conclusion.

The Working Group concluded that there is “limited evidence in humans” for the carcinogenicity of RF-EMF, based on positive associations between glioma and acoustic neuroma and exposure to RF-EMF from wireless phones.

A few members of the Working Group considered the current evidence in humans “inadequate”. In their opinion there was inconsistency between the two case-control studies and a lack of an exposure-response relationship in the INTERPHONE study results; no increase in rates of glioma or acoustic neuroma was seen in the Danish cohort study,<sup>4</sup> and up to now, reported time trends in incidence rates of glioma have not shown a parallel to temporal trends in mobile phone use.

The Working Group reviewed more than 40 studies that assessed the carcinogenicity of RF-EMF in rodents, including seven 2-year cancer bioassays. Exposures included 2450 MHz RF-EMF and various RF-EMF that simulated emissions from mobile phones. None of the chronic bioassays showed an increased incidence of any tumour type in tissues or organs of animals exposed to RF-EMF for 2 years. An increased total number of malignant tumours was found in RF-EMF-exposed animals in one of the seven chronic bioassays. Increased cancer incidence in exposed animals was noted in two of 12 studies with tumour-prone animals<sup>12, 13</sup> and in one of 18 studies using initiation-promotion protocols.<sup>14</sup> Four of six co-carcinogenesis studies showed increased cancer incidence after exposure to RF-EMF in combination with a known carcinogen; however, the predictive value of this type of study for human cancer is unknown. Overall, the Working Group concluded that there is “limited evidence” in experimental animals for the carcinogenicity of RF-EMF.

The Working Group also reviewed many studies with endpoints relevant to mechanisms of carcinogenesis, including genotoxicity, effects on immune function, gene and protein expression, cell signalling, oxidative stress, and apoptosis. Studies of the possible effects of RF-EMF on the blood-brain barrier and on a variety of effects in the brain were also considered. Although there was evidence of an effect of RF-EMF on some of these endpoints, the Working Group reached the overall conclusion that these results provided only weak mechanistic evidence relevant to RF-EMF-induced cancer in humans.

In view of the limited evidence in humans and in experimental animals, the Working Group classified RF-EMF as “possibly carcinogenic to humans” (Group 2B). This evaluation was supported by a large majority of Working Group members



24. **Mia Nony** says:

[July 24, 2011 at 1:36 pm](#)

Don't wait for local or state laws to protect you Head straight to the top.  
Smart meters are illegal.

Health Canada laws use Safety Code Six – (which, please note, is absolutely no different than the same Code used for all countries including the USA, as these are the international code standards of safety).

International Health Law, as well as the version for Canada in Safety Code Six law, states that any wireless device with incompatible frequencies capable of exciting human tissue and causing the “heat effect” are by ALL Health laws, Canadian ones and those everywhere, “to be avoided” Think about those implications legally!!  
Every single corporation connected with the manufacture and/or the installation of any wireless device is liable under the health laws of every democratic country.  
This means that smart meters are right now ILLEGAL, illegal according to every country's own health safety laws which state the same thing as Canadian law everywhere else.

Testimony has been given to our government by a man named Curtis Bennett to this effect.

I gather that it has been pointed out to the House of Commons in Ottawa, Canada in a Standing Committee that Health Canada has “omitted” by what they are politely calling an “error of omission” This means they have decided to disregard the law, and even since being notified officially Health Canada still has continued to overlook or ignore the link to causation from incompatible frequencies between biological beings and artificially generated EMFs. This is a key legal clause of their own laws and Health Canada has also as good as suspended the procedural use of the “weight of evidence” requirement in the study of incompatibility of frequencies between biological entities and wireless devices.

Note that Health Canada only did so for this sole issue of wireless devices.

This means this must be the same for the USA.

And that means that while everyone is busy trying to demand that local ordinances upheld, the reality is that each local governmental body is answerable to each state and each state may or may not be individually answerable to the Feds. So at the Federal level, at least in Canada, the reality is that smart meters are in total violation of Federal health laws.

Busted?

There is a lawsuit in process in the US based on the same fact, that Health Canada is in violation of its own Federally mandated laws which are no different than those of the USA regarding prohibition of any risk of excitation and stimulation and resulting heat effect on human tissues from frequency conflict between these devices and the human body which has a frequency of about 7 to 7.5 hertz and which has absolutely no EMF shielding. Even a simple coaxial cable has shielding!

We have NONE!

25. **Mike** says:

[July 27, 2011 at 11:23 pm](#)

“My friend, John, experienced ringing in his ears when the smart meter was installed on his house. He made a temporary shield for the RF radiation with HEAVY DUTY foil from the supermarket and a grounding wire. He now uses a more permanent solution which reduces the radiation from the smart meter. As a result the ringing in his ears is gone!”

Does he wear a tinfoil hat too?



26. **Donna Avent** says:

[August 17, 2011 at 9:34 pm](#)

I did FILE A COMPLAINT WITH THE CPUC for two times but same things. CPUC won't listen me. I got two times with same letters CPUC. I have no power against CPUC. I believe CPUC is bed with PG&E. My mind is fog and can't thing straight out and weak because of smart meter. I went to back to Los Angeles, CA and sleep with my sister without smart meter . I feel restore my

health and restore my mind. But I have go back home in near Bakersfield, CA and return my mind fog and weak. I don't think CPUC is willing to ban smart meter. Very hard to remove smart meter.

27. **goliath** says:

[August 27, 2011 at 3:33 am](#)

its obvius and was to a 50 scientist brigade studying these effects and then suppressed by pg/e.....its genocide and nothing less people ,,laugh or deride all you want but this an act of war on the citizens in california...screw pg/e..the needc to schedule a day to remove these g/dam things and throw em out in the street or let this nwo agenda remove you fast as the amount of radiation will cause micro nuclei proliferation and some of you are going to perish soon....i was at an apt with 12 of these damn things and experienced all the same problems so i quit going there to visit ...its pretty scary...

<http://ppjg.wordpress.com/2011/08/15/smart-meters-no-federal-mandate/> ..there is no law stating that we have to allow pg/e to kill us and our pets ...pet seizures are escalating and all the vet says is to further screw up the animal ny giving it barbiturate.....people are all oh this emf stuff this and that blah blah is harmless until they get hit by it ....the govt knows that emf is dangerous as the russians used to bombard the usa embassy there with only .(point) .01 microwatt 24/7 and it caused a shitstorm of cancers in that place...you live in a 65 microwatt environment without the s-meter signals...my dog started to have seizures when someone moved in nextdoor where a wifi had never been and started to leave their wifi on turned up ,,so that with the other wifi complexes in the hood ...anyway it all adds up exponentially...these assholes at pge can threaten all they want but i would and will remove it and whatever else i might have to do and i recommend that people take a proactive stance against these idiots and their hexavalent chrome legacy that they never cleansed up and continue to use ,circa erin brokovitch,,,,where the hell is she now .....

28. **Judd** says:

[August 27, 2011 at 6:27 pm](#)

Reading these comments goes to show what a negligent society we live in. I moved to a small country town after being maimed by a Government run hospital. The house we moved into had a small phone tower about a mile up a hill behind us but that was it. Within a year they built a much larger tower next to the old one and now I get pulsing through my ears while my head is on the pillow at night also ringing and sometimes deafness. This all started when the new tower was built. Then after looking through a spotting scope used for photography I saw in the distance a new phone tower has been built high on top of a hill whose antenna points directly to the one near us. We are right in the middle. This is consistent with all these symptoms happening to both myself and my friend who lives with me. We intend to sell up and move away as soon as possible as these phone towers are making us sick.

29. **[Kheri Hines](#)** says:

[August 31, 2011 at 8:38 am](#)

My name is Kheri Hines and I host internet radio show Center Stage. Friday, Sept 2, 2011 from 8-10pm CST on Center Stage the topic: "Is Oncor's Smart Meters Cheating their Customers," will be discussed. However, we plan to talk about all things SMART METERS. I would love for some of you that have had problems to call in @ (347) 850-8390, we are located on the web @ <http://www.blogtalkradio.com/centerstage>. If you have experienced higher than normal utility bills, health issues, concerned about privacy, or have an issue I did not mention, call in... Send me any data you have on smart meters to [centerstageradio@yahoo.com](mailto:centerstageradio@yahoo.com) if you are not comfortable calling in... Or if you would like to be a part of the panel contact me asap.

30. **Charyl Zehfus** says:

[September 4, 2011 at 2:22 pm](#)

I just wanted to add something for the benefit of people who might read these reports and dismiss them as complaints from the "tin-foil hat" – or nutso – people.

You will find the "tin-foil set" to include people of all ages, from the left, right and middle, from every walk of life – artists, musicians, teachers, administrators, farmers, veterinarians, etc. Traditional medicine is behind the curve on this growing health disaster, and lumps people into other categories, mental and physical. This is just another form of environmental illness, and in time, will be accepted as such. In the meantime, please be kind and respectful of people with the condition. They are isolated enough without being labelled as "tin-foil nuts."

Thanks.

31. **BJ Arvin** says:

[September 23, 2011 at 5:16 pm](#)

Think about it.....is this just part of a huge eugenics operation? They take things we all need, Food (GMOs), Water (fluoride and all kinds of other pollutants), Air (chemtrails) and elec power, then go about their attack. Not to mention vaccines or prescription drugs! Can you imagine what this country will look like after everyone has the meters and all the supporting antennas and relay stations are in place? Talk about Zombie world. The way the people from companies and utilities who are raking in the gov. money for doing this boondoggle are absolutely denying the health effects is CRIMINAL and murderous. THEY don't care! I wonder how many of THEM would sleep in a room that was near a bank of 4-100 meters? Yeah, sure. And I thought I was pushed over the edge with being saturated with aerosol spraying containing God knows what! Time for thousands of us to bring lawsuits (small claims courts) against the people who are responsible for forcing this on us. The makers of the meters, utilities, PUCs, and state or local legislators!!!

32. **Paula Fighting for our lives** says:

[September 28, 2011 at 12:06 pm](#)

Father God Jehovah, as we look at all these terrible health issues here of a smart meter being placed on our homes, we suddenly realize that O God our only hope is You. WE ask in the name

of Jesus that You come to our aid in this matter and straighten all this mess up. Father, we need our monies to live on , not to have to have unnecessary meds and doctor bills to function. Now we choose like the Jews from the holocaust living in Germany. Do we buy meds and go to the doctor or do we loose our place to live. Father, please answer us. Please do something quickly. Our babies are dying , the old are suffering, and the men are not able to work , tired, chronic illness, and anxious. The terrible Emfs are causing all kinds of health problems and bankrupting our country. O God please help us today. Please help us to eliminate this problem and remove this terrible Emf , microwave off of our homes and put people back to work in the name of Jesus. Amen.



33. **Paula Fighting for our lives** says:

[September 28, 2011 at 12:15 pm](#)

I am 50- one small three pound dog died. I have headaches, dizziness, palpitations,scarey heart pains, blood clots, abnormal periods, tingling and itching of the scalp, facial pain, I feel like something is squeezing my entire body in to . It is awful I have fibromyalgia and arthritis before the meter, But now, I have worse, I fight everyday. It is awful. My husband has a hard time at night while asleep, and my grandchildren when in my home have terrible problems, even get wild at times. I do not know what to say or do. I have contacted my local electric company. I ask you to join me in prayer to get something accomplished. And for God to call an advocate to our defense, a strong advocate if they do not listen to us. I pray that it does not take another country taking is over, through the super naturalist of God Jehovah to stop them. They are destroying our temples. God is against this , very much so and as a Christian we all know this to be true. Please pray that America does the right thing, quickly all over the nation. My electric company told me we do not have a smart meter it is hooked through the electrical line that it is not wireless, same difference. Same cause and affect, I assure you. Please pray . I am praying with you.



34. **Paula Fighting for our lives** says:

[September 28, 2011 at 12:17 pm](#)

It is not just CALIFORNIA> I am in TN>>>> WE all need help., thank you that YOU all know we are not nuts. I had an electrician to say this about his wife. That saddens me.

35. **dale sheridan** says:

[October 7, 2011 at 7:38 pm](#)

I was just getting mad at the insane increases to my PGE bill when I started looking at this site. I have been having really weird health problems for about a year now. Dry mouth, buzzing in my head.

I don't think about sex any more and I was beginning to think it was because I'm getting a little old but now I am just about convinced it's the radiation coming from the meter. It is less than 10 feet from my bed. I sleep upstairs and the meter is right below my window.

I need to get away from this thing and determine if these symptoms go away.

This just makes complete sense now. I need to get a meter and start a lawsuit.

36. **Betty Gustafson (Health/Fitness Coach)** says:

[October 11, 2011 at 1:10 pm](#)

Ever since the Smart Meter was installed in my home in California, I have experienced major interruption of my sleep....waking up several times during the night with feelings of agitation and unable to go back to sleep right away – sometimes I lay there for an hour or more – and sometimes I am so restless that I have to just get up!! (even if it's in the middle of the night).

I also, frequently experience tingling sensations in my lower legs through-out the day and night along with pulsating “siren-like” noises in my ears.

I never experienced any of these problems BEFORE the Smart Meter was installed. I always considered myself very fit and healthy, and could always sleep through-out the night!!!

37. **E.B. Myers** says:

[October 14, 2011 at 11:32 am](#)

They installed a smart meter yesterday. The first day they came out we refused it and asked them to leave. Two men returned the next day with the main supervisor. He told me all the info on the internet about smart meters was just lies and hype. I still refused the meter. The super told me I had 10 seconds to decide to have the meter installed or have the power shut off. He told me if I did not give them access to the back yard( where the old meter was located) they would cut power off at the pole and I had about 10 seconds to decide.

Are they (power companies) allowed to use this kind of coercion to achieve their agenda? I still do not want this meter and am fighting to have it removed ASAP.



38. **admin** says:

[October 14, 2011 at 1:36 pm](#)

Which utility company did this? No they are not allowed to use coercion like this. Contact TURN or UCAN if you live in So CA. File a formal complaint with the CPUC.

39. **smartmeter statistic 2011** says:

[October 18, 2011 at 10:40 am](#)

They installed these meters 2 months ago at my house (cincinnati, Ohio) and since then i have felt like i'm always sick. When i visit my parents in the next town i felt fine until last week. They started changing to smartmeters in my parents neighborhood and now i am experiencing the symptoms at their house also. These smartmeters are dangerous.



40. **Aphool Imnaught** says:

[October 21, 2011 at 4:14 pm](#)

RF/microwave radiation mitigation shielding is essential to protect your DNA and to avoid rapid onset of cognitive impairment.

Repair of DNA is also essential. Protect and repair yourselves



41. **Aphool Imnaught** says:

[October 21, 2011 at 4:28 pm](#)

Stop suffering needlessly and take care of the damage to your bodies, and then prevent further damage.

Spirulina & chlorella repair DNA. Hiroshima survivors who took these two items never got cancer. Stick to recommended dose and at first start with less.

Keep proof of all utility bills as paid up.

Carbon sheets can and do absorb and neutralize radiation. Bubble wrap insulation is a product with this stuff between two layers of foil, is easy to staple to an entire wall and deflects radiation. Staple it to the entire interior wall where the meter is located. Then, since there is no anti foil law, wrap the meter itself up totally with the foil insulation, as well.

Then put on the kettle for tea and calmly wait for the utility rep to show up.

They will.

Ignore what they say.

As soon as they leave then rewrap the meter with this special foil. One place to see pictures of the right kind is at [insulation4less.com](http://insulation4less.com)

42. **Kara** says:

[October 24, 2011 at 1:55 pm](#)

PLEASE CALL THE PUBLIC UTILITIES COMMISSION OF CA 1-800-649-7570 AND VOICE YOUR CONCERN. Our smart meter was installed today and I just called Edison to have them remove it. They said they can't do that. Once the new meter is installed they get rid of the old one. Of course that's bs on their part. I called the 3rd party vendor and they said they give the old

meter back to Edison. So what I learned is that we all need to call the Public Utilities Commission of CA and voice your concern. Use your voice. They are going to make a decision soon about what to do for the people who don't want their Smart Meters PLEASE CALL 1-800-649-7570.

43. **Larry Dunmire** says:

[October 29, 2011 at 2:54 pm](#)

The more I read of these MANY comments, the more I have realized that I'm not the only one, such as what the reps at Southern California Edison have attempted to convince me of. I have experienced dry mouth and intense headaches at night, and a racing heart, too. I'm wondering if EMF's also have an effect on the teeth and gums, as I've experienced serious bone-loss and dental problems since the installation of the Smart Meter in August 2010 upon my apartment. Of course, there's the unbearable tinnitus and vertigo upon arising from bed in early a.m. around 3, 4 or 5 a.m. On my leg, I've experienced sores near to where my computer modem rests on the floor.... Come on everyone, let's UNITE and form a group, locate a willing lawyer and class action sue the electrical utility companies ..... what do you say?? I have written the 60 Minutes television show and suggested they do produce an expose on this serious problem!!!! All the best to all of the electrosensitives out there!!!!!! Peace & sleep!!!!!!!

44. **Barbara Pries** says:

[November 3, 2011 at 8:23 am](#)

Before I knew any of this info., a SCE man came around and said that meters were changing and I just said ok for him to install the new one. I have tried to get it taken away and get the old one back, SCE said they couldn't do that. I have called and emailed and have not received a response.



45. **admin** says:

[November 3, 2011 at 9:54 am](#)

<http://emfsafetynetwork.org/?p=6048>

46. **Courtney** says:

[November 4, 2011 at 6:35 pm](#)

I am so relieved to have found this site. Im here in Maine and our community just began installing the new meters. I had symptoms before I realized it was on my home as well as most of you. The symptoms seem to be changing or revolving and include, sleeplessness, anxiety, feeling of being "amped" up through my body, tingling in limbs, dry mouth, feeling sick to my stomach, but never vomitting, heat on my facial skin, twitches, headaches, twinges of pain randomly throughout my body.

I chose not to opt out...we did receive a notice fortunately, but I just couldn't have imagined this NIGHTMARE! It's been almost two weeks and I'm going to call CMP(our company provider) and complain to get my old meter back.

I feel so hopeless, defeated that smart meters will be all around me causing problems. I have increased sensitivity to wireless networks now...and well my job requires me to use a wireless laptop for hours daily...

People who don't know how bad this feels, just don't understand! ...and for those who are involved with the installation, it is all about \$\$\$\$. It always is.

I'm so sorry to those of you whose lives have been turned upside down in this unbelievable nightmare. How can we promote more awareness...? Fight this battle? People who don't feel the effects right now, are still experiencing radiation but...their bodies just aren't in tune with their experiences like ours are. It's a survival mechanism we have...like wildlife have...and there is

nowhere to run



47. **admin** says:

[November 4, 2011 at 6:43 pm](#)

Courtney, there's a great group in Maine working against these meters. Please contact them, you can help each other! Thanks for posting your story- wish you healing. <http://smartmetersafety.com/>

48. **Courtney** says:

[November 5, 2011 at 7:15 am](#)

Thanks Admin! I'm currently staying at my parents (no smart meter yet and they live away from neighbors) this weekend and sadly don't want to go back to the first house and only house I so proudly purchased

It is now my Hell.

49. **Sick of it** says:

[November 5, 2011 at 2:20 pm](#)

I just had my analog meter replaced by PG and E. I went in person to voice my concerns with CPUC. You can read about my story on <http://www.stopsmartmeters.org>  
Good luck be brave and fight back!

50. **honey** says:

[November 11, 2011 at 12:35 am](#)

I have been having serious ringing in my right and stomach issues..also trouble with my skin wrinkling up..as never before..I am sick to my stomach most days..and feel pains in my head and ears..This is a new thing...I can see now that our installation that the electric company forced on us is what is making me sick, my tongue is getting swollen and red bumps on the edges of the back portion, and it is very painful..I am sure now that i think about it that this is the cause.....My family gets anxious, all at the same time..and yes, when i leave this area i start to feel better immediately..I must have them put the old one back..tho i dont think they will..I am a very sensitive person, plastics, smog, and cigarettes make me sick, so do chemicals in my food..I have been ill all the time since they installed the device..Please someone help us....I am going to write to President Obama who is a friend of mine.....wow so good to read this..it lets me know that i am not going deaf as i thought....

51. **Jenny Donegan** says:

[November 11, 2011 at 2:17 pm](#)

I have been diagnose with a thyroid condition that I think is directly related to exposure to smartmeter ionized radiation. Here are the resources I have found informative.

<http://youtu.be/FLeCTaSG2-U>

and this article

[http://www.avaate.org/IMG/pdf/Tiroides\\_Pulse\\_modulated\\_900\\_MHz\\_radiation\\_induce\\_hypothyroidism\\_and\\_apoptosis.pdf](http://www.avaate.org/IMG/pdf/Tiroides_Pulse_modulated_900_MHz_radiation_induce_hypothyroidism_and_apoptosis.pdf)

Not sure what to do, PE&E will not remove the smart meter. My home office is 5 feet from my smart meter and I have been sick for a few months now.

52. **Lody Haroun** says:

[November 15, 2011 at 8:21 pm](#)

I have recently been staying at my brother in laws house for a few days a week. I recently found out that the smart meter was installed without his permission and that the energy company refused to change it back to the analogue meter. This afternoon a 'smart meter visitor' came around to check to see if it 'has an anetenna.. or not' I asked him to explain to me further as to what was going on and he proceeded to tell me that 'he cant tell me untill he finds out if there is an antenna or not'' because he was sent out to a few homes that have had 'missing antenna's or faults' The person refused to answer any further questions... except to justify the meters with the world wide use of mobile phones... which was just ridiculus. I told the gentleman that he needed to research these devices further as he is more exposed to smart meters. The man looked at me as if i was crazy. I can't understand why people cant put two and two together and realise the gov't never spends money for US to save, it only spends money for US to SPEND MORE and for THEIR

SAVINGS – whether they effect the health of the community or not. My brother in law has not been complaining about health effects, however im wondering if this is the case because there was an ‘antenna’ missing, or supposedly missing. I also asked if I was the only person asking him these question and no answer was given. Individuals need to speak up! In parts of Australia you can’t just change over your organisation as some energy providers dont use or accept smart meters and your current provider will refuse to change it back to analogue. The person also said that by Law as of next year every Australian household will have a smart meter... and it will be a choice between smart meter or NO ELECTRICITY. He claimed that the company would shut down electricity if a smart meter was refused. These are scare tactics – I say its killing us softly era – There is NO LONGER A CHOICE ... smart meter or no electricity. Im taking his INFORMATION seriously...

53. **Linda J. Tillotson** says:

[November 16, 2011 at 4:54 am](#)

Since a Smart Meter was installed on our house two years ago the following health issues have transpired. My step father died of lung cancer, my mother has severe headaches, tightness and pain in her chest, my brother in-law has loud ringing in his ears, my sister has insomnia, and I have depression, weakness in hands and arms, constant aching in all my bones along with bouts of insomnia. We want this meter taken off our house and I will do everything possible to make this happen.

54. **nowifimeters** says:

[November 16, 2011 at 10:36 pm](#)

These meters and the LAN antennas they put on our buildings are dangerous. In time we will see. It’s the NWO’s agenda to track and treat us like slaves. We need a triage solution in the meantime, in response to the dangerous wifi meters being put near our homes and work places. I saw recently that tin foil placed over a smart meter lessened the RF.

We need to find a simple and cheap solution to help us survive until we can get away from the meters. Is this to put foil over every meter we see; is it to line our walls that separate us from the meters with some kind of shielding, like foil?

We always laughed at the “tin foil hat” people. But in reality, it may be a short term help. Please lets figure out what we can do to help ourselves in the short term. I recently purchased a meter so I can find out what the exposure is, now that the F\*ing PG&E secretly installed this.



55. **admin** says:

[November 17, 2011 at 8:40 am](#)

I appreciate your suggestion that we need to find a simple and cheap solution to this problem. If you put tin foil on the outside of the meter it will radiate stronger into the home. Shielding is tricky, not simple.

People can change out their own meters for analogs , but this is not cheap. A multi- approach is what we have done and we need to keep raising public awareness.

What do you think of bright colored stickers that say “RF bio- hazard” or something like that and sticking those on every meter you see?

56. **TAH** says:

[November 17, 2011 at 4:42 pm](#)

How can the horrible ill health effects of these “smart” meters be denied??? I suffer from the same exact problems as everyone else has stated here. I didn’t know what was wrong with me either, until I found out about these damn meters!! I am going to sue, sue and sue. I was told told that nothing was being done until some bill or ? gets ruled upon by ?? . What a load of BS! See you clowns in court!

57. **Rob** says:

[November 17, 2011 at 9:26 pm](#)

EMF is everywhere, cell towers, anything electrical battery powered or powered from a utility or a generator has EMF. RF is everywhere, it comes from satellites in space, radio and tv transmissions, once again cell phones, short wave radios, cordless anything, baby monitors.

Every car today produces more EMF than anything you have in your household and just think you are locked in that metal capsule that does not absorb it or allow it to dissipate into the environment. Yes, we don’t always have choices in what companies do to innovate. Though we do have the ability to be educated and change our lifestyles and environments to conform with our beliefs.

58.  **admin** says:

[November 19, 2011 at 1:14 pm](#)

Rob, your point that EMF’s are everywhere is a misconception in that there is more in some areas, less in others. Practicing prudent avoidance means to understand and avoid EMFS and learn how to reduce your exposures wherever possible. To suggest people move to the desserts of South America is derogatory and making fun of people who have become sick, so I removed it from your comment.

59.  [Charyl Zehfus](#) says:

[November 23, 2011 at 10:09 am](#)

Just an idea here about the person who PG&E responded to quickly to remove the smart meter: he or she said it was affecting other appliances, including garage door opener and coffee maker (besides their dogs' new strange behavior). THE LESSON HERE IS BE SURE AND TELL THEM ABOUT INTERFERENCE with THINGS in your home to get a response.

60. **Matt C** says:

[November 30, 2011 at 2:41 am](#)

We DO have a choice nomatter what they say. My choice is soon to junk their stupid "Smart" meters and refuse their service. I am going off grid by makin my own solar panels. It's not that hard. Look at countless YouTube videos for building your own D.I. Y. solar panels. An off grid system you build own and maintain is the only real smart answer to this game of harassment bullying denial ignorance and blame-shifting being played by the big electric utilities. Solar power is DC and DC power is both quieter, and safer for human beings in terms of direct contact and lower EMF and RFI emissions. Directly DC-based motors and appliances also are also generally more efficient because they lose no power like AC appliances do, due to having to invert alternate alternations of voltage (rectify Ac into pulsed DC) and smooth ripple from pulsing rectified peaks to try to achieve a more stable DC-like power supply necessary to operate sensitive electronics etc. Thus I recommend slowly room by room converting your appliances and other machines to accept straight DC input by bypassing their internal AC TO DC circuitry and merely transforming an input voltage to any wanted voltage using a Multi-tap transformer only from your solar DC-power battery storage array. If you aren't technically savy to convert power supplies, new directly DC powered gear can be found ready to order online from a variety of vendors on eBay and from other websites.



61. **admin** says:

[November 30, 2011 at 7:34 am](#)

Matt: you write: "converting your appliances and other machines to accept straight DC input by bypassing their internal AC TO DC circuitry and merely transforming an input voltage to any wanted voltage using a Multi-tap transformer only from your solar DC-power battery storage array. If you aren't technically savy to convert power supplies, new directly DC powered gear can be found ready to order online from a variety of vendors on eBay and from other websites."

Can you provide some links to websites that you found most helpful to understand how to do this?

62. **Linda** says:

[November 30, 2011 at 11:10 am](#)

My electric company hasn't put a smart meter on my house. I think I have one on my gas meter as the meter man does not come into my yard anymore. He just pulls up in his truck and gets the meter reading from there. I called them up and they said it is the same meter, but they just added something to it so they can read it from the street, do you think this is a smart meter?



63. **admin** says:

[November 30, 2011 at 1:07 pm](#)

If they read it from the street it's not like the new smart meters which require no meter readers and constantly transmitting. It may have an RF component, as it is being read from a distance.

64. **Robin Davis** says:

[December 3, 2011 at 5:52 am](#)

I have been reading posts about the smart meter and the affects on others. I too am experiencing ringing in my ears, headaches, fatigue and my husband gets unexplained headaches. The smart meter is mounted on the wall outside our family room and we sit in the room watching tv and me on the internet less than 12 feet from it on a nightly basis.

Tonight (Dec 2) the ringing in my ears got so bad I called SDGE about 6 p.m. and complained. The girls answering the phones sounded like they were reading scripts prepared for these calls. I was hysterical as the ringing increased. Finally through the tears and threatening to take a baseball bat to the meter and taking it off my home, SDGE had a representative call me and they changed out my meter with another newer smart meter. The ringing is still there but it got a bit quieter.

I couldn't sit in my own home without being uncomfortable. While talking to SDGE on the phone I had to flee my own home. I went to my husbands work in tears. The further I got from the house the quieter it got. We went back to the home and a technician met us there to install a new meter.

I want the meter off my home. After reading other posts, I am certain that this is what it is. I can't sit at my computer for extended lengths of time anymore without the ringing.

Does anyone know a law in California that says we have to have them? One of the ladies on the phone (I went through two and had to hang up on one and call back because she was so scripted it was like talking to a machine.) says it was California law that we had to have these smart meters.

I am ready to get a generator and get off the meter. If anyone would like to contact me and compare notes you can email me at rdavis5 at cox dot net and I'll give you my private email and we can exchange information. I am ready to become a local advocate for the removal of these meters.

Robin

p.s. The ringing is there right now but not screaming at me. I am taking Lipo-Flavanoid (just 24

hours now) that my doctor recommended and purchased it at Walmart. It seems to work when I'm not at home but even that doesn't help the ringing when at home.

65. **Kay** says:

[December 8, 2011 at 4:31 pm](#)

Does anyone have suggestions to help us counteract these side effects until the smart meters can be removed? We are experiencing interrupted sleep, headaches, nausea, and fatigue since our smart meter was installed Sept 2011. At night, we take a product called Quietude (from the health food store) to help us sleep; we take two tablets before bed. Also, we wear wristbands called Energy Factor Ionic Lifestyle. We have no affiliation with these companies selling these products, but we wanted to share what we're doing in case it can help others. Our toddler woke up every single night since the installation, so he now wears a wristband too. We have written & spoken out to everyone: Governor Brown, the Mayor & City Council, the homeowner's association, Channel 4 news, the EPA, SCE, the CPUC, and the President. SCE has a delay list now, but it was not enacted until AFTER the installation of our meter, and they will not let us have our analog back and thereby join this delay list. SCE suggested that we move out of our house if we feel unsafe. SCE also came to our townhouse to test the smart meters—we have a bank of ten—and they arrived with a useless MF detector, not an RF detector. Concurrently, we had independent testing done with a friend's RF detector, and the readings were off the charts. We need a class-action lawsuit if there is an attorney out there willing to help...



66. **admin** says:

[December 8, 2011 at 4:36 pm](#)

See this post for more information:<http://emfsafetynetwork.org/?p=6562>



67. **Kay** says:

[December 8, 2011 at 6:13 pm](#)

I wish it were as easy as replacing our single meter (per the link you provided), but unfortunately there is a bank of ten meters on our house. This is why the current opt-out solutions being proposed will not help us—they are geared only towards those with single meters. The opt-out solution needs to accommodate those who have banks of meters on or near their residence.



68. **admin** says:

[December 8, 2011 at 6:26 pm](#)

I will reassert your point in the comment on the opt out. Banks should be removed.

69. **heath hampton** says:

[December 10, 2011 at 11:21 am](#)

i have just encountered and learned about all this, having had a gas smart meter installed two days ago and immediately experiencing ringing in the ears, slight nausea, and discomfort (my head feels weird and hot, with a “buzzing” feeling) – all of these symptoms I recognize as the similar to how I feel if I put a cell phone near my head. (I avoid this by using speakerphone and holding it away from my face.)

My meter is a gas meter with dials, but apparently, according to Entergy La, it transmits once a month. So that sounds like something not too bad. But why the constant symptoms every time I go in my bedroom? (Meter is below and to the right of my second floor bedroom, and faces a metal shed wall.)

I just ordered this, and hope it helps!

<http://www.earthcalm.com/products/scalar-home-protection-system/>

Also, I found this helpful info:

[http://www.eiwellspring.org/smartmeter/Smart\\_Meter\\_overview.htm](http://www.eiwellspring.org/smartmeter/Smart_Meter_overview.htm)

Good luck everyone! HH



70. **Kay** says:

[December 13, 2011 at 4:34 pm](#)

Thank you for the link to the emf gadget that can be used in our homes. Will you update us if it helps you—on any level? Also, thank you for the link to the detailed smart meter info. It was quite helpful.

71. **david** says:

[December 23, 2011 at 1:49 am](#)

hi my names dave i work for a compony that is contracted with DTE ive installed alot of the smart meters and have never felt sick nor have the ppl i work with and the way we install them is we knock on the door and let you know why we are there what we are doing and if you say NO THANKS we say o thank you have a good day now after you turn down the meter the main

company comes out and installs in but once again ive NEVER FELT SICK AROUND SMART METERS I LIVE THEM

72. **Jeremy Hawes** says:

[December 27, 2011 at 6:58 pm](#)

I'm 30 and about 4 -5 days after they installed the smart meter (I rejected twice, but they snuck in my yard and did it anyway) I have increasing ringing in the ears and I am losing sensitivity in my hands and one of the my legs.

No head aches, though higher temperature fluctuations and problems sleeping at times.

Good gosh I hope this ends – I've even looked into other areas to temporarily move, but I'm not sure where doesn't have it.

73. **Monika Krause** says:

[January 2, 2012 at 6:00 pm](#)

I don't have a smart meter yet but will be forced by BC Hydro to get one in February 2012. I am terrified. Two years ago I got wireless internet in my house for the ipods, etc. I just loved all those wireless toys. After about 2 months I started having major health problems. First came the insomnia and I felt my whole body was vibrating in pulses. Then my feet hurt so bad I had trouble walking. The doctor's couldn't see anything wrong on the x-rays, so recommended to fuse the bones in my left foot. Then I got zigzag lightning flashes in my eyes that came every other day. The doctor said they were migraine auras without the headache. I never have had a migraine headache or aura before in my 57 years and no headaches without a cause (like a hangover). The worst was not being able to sleep and being exhausted. One night at 3am I was at my wit's end not having slept in 48 hours. No matter where I tried to sleep, my body felt pulsing vibrations. So I decided to unplug everything in my house. When I unplugged the wireless router the pulsing instantly stopped. This total calm was like a miracle and I found the problem...the wireless radiation. I replaced the wireless router with a regular router and installed shielded cables and plugged everything in. It took 2 months to recuperate and feel better. It's been a year and now I sleep like a log again, I cancelled the foot surgery, and no more migraine auras, none. I'm terrified now to have any wireless in or on my house. I don't want to be that sick ever again. I don't need tests, I know firsthand what made me sick since I was the Guinea pig. I pity the EMF sensitive babies and children in wireless homes. It was difficult for me to figure out what was going on, I thought I was going crazy from lack of sleep. I really didn't want the wireless to be the problem, but it was. Disappointing (I'm a Trekkie), but I want to live and be healthy.

So soon my home will be infiltrated by wireless radiation from smart meters. Then what? Do I wallpaper my home with aluminum foil to reflect the radiation ...to my neighbours? Will EMF sensitivity be defined as a disability as it is in Sweden? Will wireless health damage reduce the number of capable and healthy workers in the western world? Will countries without wireless saturation have healthy populations when the wireless nation's manpower resources are

dwindling?

The future looks interesting, bright for some nations, not so bright for others. Where do we fit in?

74. **Marilynn** says:

[January 3, 2012 at 11:08 pm](#)

I'd like to suggest that everyone posting here give their general location. I am near Willits, Mendocino County, California. The Smart[sic]Meters have been installed in my semi-rural neighborhood, but we don't have one because I posted a very strongly worded warning about violating federal and state trespassing and surveillance laws AND wrapped the analog meter with a bicycle cable and lock. They would have to destroy my property to replace the meter.

I DID NOT put my name on a delay list, because that just gives them permission to install the infernal thing AFTER everybody who is not on the delay list has theirs. I will NEVER consent to a Smart[sic]Meter and furthermore I will NOT pay them a damn cent for the "privilege" of keeping my original, functioning analog meter.

Re: health issues. Obviously there is nothing I can directly attribute to digital wireless meters because the nearest operational meter is some distance from my house. However, I have reason to believe that such a device in close proximity would trigger a reaction in me, as I have had the weird pulsing through my body (described by several people here) at times over the last few years, sometimes to the point of feeling like my head was going to implode. Was I in the path of an EMF transmitter of some kind? I have no way of telling, but since more than 60 of my 67 years was free of such a phenomenon, I can only attribute it to radiation of some sort. (I don't use a cell phone and my internet connection is not wireless.)

I do know people whose entire family started having headaches, insomnia, etc., after a Smart[sic]Meter was installed. Another thing I've noticed is the explosion of shingles (herpes zoster) cases over the last few years. Immuno-deficiency diseases are on the rise as well. Triggered by EMF radiation? Until we know for sure, the only wise course is to shelve these confounded devices until disinterested (read: not-for-profit) third party agencies can certify them as safe for all, especially babies and those in frail health.

75. **Christine** says:

[January 4, 2012 at 8:33 pm](#)

If a homeowner is sensitive to RF waves and has opted out of the smart meter installation, could they file suit against another neighbor for having a smart meter who didn't opt out? I was asked this while handing out fliers about smart meter awareness in Naperville IL.



76. **admin** says:

[January 5, 2012 at 12:10 pm](#)

I know of one case in the US where a neighbor sued a neighbor for Wi-Fi- but I am not sure where the case stands.

77. **esdsix** says:

[January 5, 2012 at 2:29 pm](#)

I think a lawsuit needs to be filed, maybe a class-action. Reason being... There's a smart meter located just below my kitchen window..I had no idea it was there, til recently. But, what I have noticed is anxiety, pain in my neck, and headaches. This usually happens while I'm at home. I just couldn't figure out what it was. I feel this smart meter that's been installed is taking a toll on my health. I am obviously sensitive to these EMF frequencies it emits.. I want it removed, it's not healthy. And it's obvious these power companies are covering it up with excuses. Not only that, considering it's a wireless device, it's a security risk to personal usage information. The data they are collecting is unnecessary and of risk to our health and security. These smart meter devices need to be recalled with no further use against the public. It's way out of hand.

These companies have shown nothing that proves the safety of anything. I've even seen dead bee's near the device, on the ground.

78. **Annie Gibbons** says:

[January 9, 2012 at 11:07 am](#)

I have electromagnetic hypersensitivity, have moved 5 times in three years because of thermal burns to my face and neck because of the proximity of cell mast, and increasing wifi use and ever increasing use of hotter devices polluting the air. Recently I had an upper denture put in because the titanium bridge in my upper pallet was acting like a transmitter making things really worse for me. After this was done I was better, however I have asked the spokespersons for both San Meguiel Power Co. in Montrose Co. Colo. and Holy Cross Electric Co Op. 's spokesperson in Eagle Co. Colo. to realize that smart meters have already been receiving bad reviews from others in the country, and for me these represent an unacceptable threat to my health, and I believe to all of us, especially children and the aged. Both spokespersons were very nice, and said maybe we could have this discussion later. I also sent a letter to the San Meguiel Power Co. board meeting on Dec.14 2011 which carefully explained these very serious concerns. I know that they received this letter. They have an opt out for \$25.00 a month, however if all the other buildings in a neighborhood have them with a router in each block, then the overall electro-smog will be so bad, as to cancel out the one opt out... although at least there is an opt out. Other folks in my area, just don't realize how serious this is. I know because I am suffering with this, and now know all the symptoms, which we are all already suffering with... ie... the five hour energy drink... and sleep meds increase in sales over the past 7 years, which is astronomical! As well as the huge increase in the sales of 24 hr. ant acids for younger and younger people, C-Pac masks for sleep apnea, and a sharp increase in asthma, thyroid problems, , un-diagnosable pain, and stiffness, heart palpitation, and last but not least brain cancers. Our Government has allowed these industries to proliferate and has passed regs. which no one voted on, and mandated these things both to supposedly make

us use energy more efficiently, and then also to line the pockets of those providers who are manipulating the market. It reminds me of how the American Indians were treated... and now it's us. No news channel has reported on this either, since as a people we are in love though advertizing with the notion that all these devices make our lives better, and more powerful. The Green Initiative (?) is at the root of the Smart meter push... the underlying belief is, if the use of electricity is so closely monitored, and controled, it will force people ot make green choices, and spur invention. However the way this is being done, isn't based on free market forces, but on forced control, and manipulation, which already has invited those on the inside to see hugh profits for themselves while absolveing themselves of the health conciquences.... since the rest of us, must be made to stop global warming because it's in all of our best interests, ie, we the people are too dumb to choose otherwise. This is the same sort of rationalization of power that led to the geneocides every where, and in our past too. The belief that green energy must be mandated is the basis of this. Whereas all true green energy initiatives in the past that were truly invented by the people of the United States have been brutally surpressed, because they would have made those corporations in control, loose control of the market, and that was not acceptable since our Government is directed by money, and no longer cares what it does to the people. I realize that all of us who know that electro-smog is reaching the tipping point, must come together in protest, since our singular voices have no value in this system.

79. **Annette Eckert** says:

[January 11, 2012 at 11:48 pm](#)

I have never had migraines until I moved to WI where they just started using smart meters before I moved here. The headaches have become debilitating to the point that I have become bedridden. I feel better when I get away from the constant high-pitched humming. My vision has deteriorated and I have had my Rx changed 8 times in the past year. What were occasionally annoying pains have become nagging frequent chronic pains, probably exacerbated by the poor quality of sleep from the EMFs and constant stress of exposure. I never put 2 & 2 together until recently, although I was aware of the high-pitched noise and the health risks of EMF exposure. This is a situation where we all need to unite and take action. Our future health is at risk, and we're getting sicker every day!

80. **Maria Crioula Preta** says:

[January 12, 2012 at 11:43 pm](#)

I never had a single health issue in my entire life. One day, PG&E cut my electricity for a few hours and when I went outside, the meter was installed. A week after that, I started having constant diarrhea. A week after that the migraine headaches came. I consulted with my doctor and he asked if I had been exposed to radiation! I called PG&E and they said it was not their fault. The somewhat sarcastic ((which I don't appreciate) attendant asked me "Ma'am, we emit less RF than your iPhone". Oh gosh, as if Apple would make a product that hurt me! Of course I have an iPhone, but I don't believe for a second that Apple's RF is harmful like PG&Es RF! Outraging! Months after that, I started vomiting early in the morning and having cravings! I again went to my doctor and he told me I was pregnant! Now, tell me, HOW? I don't have a boyfriend or lover! It

can only be the SmartMeter! This is an outrage! Now I have to support a child as a single moter and PG&E won't even help me!

81. **Bevy Armstrong** says:

[January 16, 2012 at 3:05 pm](#)

i have had my muscles stop working since the installation of the smart meter.i have had 2 surgeries on my right hand, need it on my left hand, the muscles blew in my left knee, i am very sore and tired all the time. my sleep patterns are messed up and i have constant ringing in my ears. my small dog has some of the same symptoms. he is only 2 and has muscle disorder, pain, skin issues, etc. my cats who are siblings suddenly act bizarre and mean. this can't all be coincidental.



82. **Mia Nony** says:

[January 18, 2012 at 12:48 am](#)

All of this suffering has one common denominator, it is a description of all of the symptoms of electrical induction and ammonia poisoning of the brain. SM enabled frequencies allow ammonia and other toxins to cross the blood brain barrier Amalgam teeth fillings make it happen faster. However, it helps to realize that the frequencies enabled by smart meters or SMs can be “foiled” (literally) and blocked. Interior meter wall must be shielded effectively. Many circuits should be shut off at the electrical panel when not in use for all but absolute essentials like a fridge. Surge protectors should also be used for all appliances and shut off whenever not in use. All live wiring inside the walls should have this flexible foil stapled to the walls, so the walls are lined with mylar insulation foil with bubble wrap spacing.

To block frequencies coming through exterior walls and windows they should be screened with aluminium screening.

The radiation itself can be suppressed with carbon paint (expensive) or carbon sheeting (much cheaper).

On the other hand: The fact is that so called “smart” electronics don't just CAUSE interference, they are also vulnerable to interference.

Fight fire with fire.

The goal should be to achieve total suppression of transmission immediately, not just shielding one's walls with aluminium screening from the frequencies from outdoors that take over one's house wiring but putting wire mesh all around the meter and on the interior side of the meter wall.

Next, go to <http://www.freedomtaker.com> and order an analog meter. Instructions for safe replacement come with the kit. So do legal instructions on how to give notice of “just cause” to the utility. Follow the steps for this and hire an electrician after the time line is up.

Essentially you follow the accompanying analog meter kit directions to the letter so that you cannot be held liable for removal of the SM.

You give the utility the correct notice of a deadline for them to remove the meter. When they don't, – and chances are they won't – you are now legally protected by having used due process and in a powerful position to have the SM removed yourself.

Now you return it to the utility, after you replace it with a \$50 analog meter.  
Then you secure the analog meter – lock it up but good. Some people build an entire room around them, come put steel bars in front of them, lots of creative ideas. Go to Google images and put in to the search bar Defend Your Analog Meter for inspiring pictures.  
It really is time to stop suffering needlessly, especially when electronic signals that cause pain and disability can be blocked, suppressed and stopped.  
Remember SM stands for Smart Meter, not SadoMasochism.  
Fight back.

83. **vivian young** says:

[January 21, 2012 at 6:36 pm](#)

I to have been having the same health problems as the people I have been reading about. Every since they installed the smart meter without my permission in September of 2110 I have been sick. I suffer with headaches, insomnia ringing in the ears. what makes in worse for me is that my meter is right behind my head, on the other side of the wall my bed is on. All night I hear this humming and buzzing sound in the wall, with a buzzing in my pillow. I have complain to PG%E over and over and all they say it is nothing they can do about . what really piss me off is the fact that I did not request this health robber, and I was not given the right to opt out. PG%E came to my home while I was at work and put this thing on my house. I call this a violation of my right to choose. I have not felt my self in over a year, not only that beware of the turbines windmills they also cause the same health problem. And they are being put up everywhere, it is called WIND TRUBINE SYNDROME it to makes you sick, I no, I have a smart meter on my house and a wind turbine 1/4 mile from my door with low frequency vibration. Sensitive people do not stand a change in this world full of greedy selfish people, we need to stand together we have a right to life in our home and not be sick.CLASS ACTION LAW SUITE IS IN ORDER.

84. **Dusty Lindsay** says:

[January 22, 2012 at 9:28 pm](#)

We do not have a smart meter yet here in our part of Australia, but they are coming. The only solution to the problem as I see it, is when the smart meters actually cost more to have than the analogue meters. I recon that day will come when some one has come up with a “hacking” system that we all can use that will cause the meters to fail. Is it possible? Well if a teenager can hack into the highest secured computer in the world, then a “smart meter repellent” is merely a brain storm away. So one of you computer geeks go out there and cause havoc to the morons that are causing sooooo much havoc to the unsuspecting electricity using public.

Dusty Lindsay  
Sydney Australia

PS To the concerned, check this link out...

<http://inpursuitofhappiness.wordpress.com/2011/12/30/microwave-mind-control/>

85. **Paul** says:

[January 23, 2012 at 10:22 pm](#)

The smart meter was installed and the symptoms started. After 10 months of headaches, insomnia, high blood sugar levels, tinnitus, memory loss, and feeling tired all the time SRP decided to let me opt out. It's been off for over a month and the symptoms vanished the day they removed it. If you are experiencing these symptoms don't delay getting the smart meter removed. It depletes the natural melatonin levels in your body and attacks your immune system due to not getting good sleep. I have found that since your neighbors have smeters you will get even better sleep if you turn the electricity off to your bedroom. You might want to have your bedroom tested for any other microwave radiation.

86. **Naz Ma** says:

[January 31, 2012 at 11:23 pm](#)

Can some one tell us how to have southern california EDISON remove this device for us?

87. **JAN WALL** says:

[February 7, 2012 at 7:53 am](#)

I have read these posts with HORROR. TO BELVA, CALIFORNIA – YOU POSTED YOU NEED HELP. Please contact a holistic physician and get some substantiation that you must get out of there. I personally am going to see Dr. Gregory Plotnikoff, but he is in Minnesota. You should be able to find one in you area on this website which I will post for you:

<http://www.holisticmedicine.org/>

GOOD luck to all of you. I feel so bad for all of you. I am going to send a letter now to my utility company warning of my sensitivity to EMF and EMR and putting them on notice. It is criminal!  
Jan

88. **Extremely Concerned** says:

[February 7, 2012 at 3:52 pm](#)

My smart meter was installed approximately 2 months ago. Since the installation (by the way I had no idea of the radiation risk when it was installed), I started experiencing headaches and could actually hear the throbbing in my head/ears like a heart beat. I had never experienced it before and had no idea why I was experiencing these symptoms until someone later told me it was probably the smart meter that was installed. Looking back at the time it was installed and when I started experiencing headaches, the connection is undeniable. When I am at work, the headache subsides and I no longer hear the throbbing in my ear. When I go back home it starts all over again! It is a nightmare. I've actually had thoughts of sleeping in my car away from my street. It is unfathomable that the CPUC and the EPA would allow these silent killers to be installed on our homes. Please, for the love of humanity, please remove these meters from our homes!

89. **jarad ries** says:

[February 10, 2012 at 1:57 am](#)

The smart meters have been installed in my side of town since they have I have had headaches everyday my smartmeters is 10 feet from from my head I donunde



90. **jarad ries** says:

[February 10, 2012 at 2:24 am](#)

712000 deathmeters in las vegas thanks nv energy and I'm sure employees. At nv enregy will lose there jobs no need to check. Meters its all radioactive

91. **Mike Filas** says:

[February 18, 2012 at 5:32 pm](#)

First I recommend that everyone purchase a Scalar Home EMF protection system. They are 300 dollars and plug into your outlet to ground you with the Earth. Read the google article "No more privacy smart meters are surveillance devices that" and watch David Icke on youtube "Behind the world events" to learn more what this is about. The smart readers pump your house with radiation and your cfl light bulbs. Your cfl lightbulbs and energy and radiation to your outlets and chipped appliances. "They" have total surveillance in your household and can do things like lower your heat,open your garage door,turn off your refrigerator etc.. "They" can also bombard your electrical brain with subliminal thoughts and do mind control experiments because you are bathed in this frequency grid which uses ELF waves. The same waves the brain works. Crazy place...

92. **[Alice Duncan](#)** says:

[February 19, 2012 at 3:39 pm](#)

I can't believe what I'm reading! I was just saying the other day that my apartment was making me sick! Now I know what it is!! We had our meters switched out a few months ago also! I haven't been able to sleep and my ears are clogged constantly. I am sick and my husband is getting sicker...I thought I was coming down with pnuemonia! I keep looking out my window and opening up my door to find out where that sound is coming from! OMGoodness, it's the meters?! For goodness sake they need to do something about this! Thank you all so much, I thought it was me, but every time I'm away from my apartment I feel better!!!! I didn't have health problems before...OK change them back, I for one, knew the Duncan one's were better...ha ha, little Duncan humor...but this needs to stop! Put us back on the other PG&E!!! Don't you have enough problems with the leaking gas!!! REALLY! Alice Duncan, Citrus Heights

93. **Lessie** says:

[February 22, 2012 at 10:22 am](#)

I have moved 4 times in 1 year, get the same effects from SmartMeters. I thought it was my upstairs neighbor, shocking me. It is terrible, a nightmare. Everyone advised me to call police, but they said they could not do anything, apartment manager think I am crazy. My complaints are same at every apartment, under my pillow, hitting my legs, arms. Those gadgets I ordered to block does not help, waste of money.

94. **Marlene Lundin** says:

[February 26, 2012 at 2:52 pm](#)

I also though I was going crazy. Unable to sleep, headaches.....I was a healthy active senior until the meter was installed. I live with my mother who is 92 and 4 dogs who are resless and also have a hard time sleeping at night. They whine often during the night.....Let's face it Smart meter are making us sick!!!!  
I want my old analog meter back.

95. **Marlene Brandt** says:

[February 26, 2012 at 6:00 pm](#)

I wondered what was going on with my body lately. I have noticed loss of memory, balance problems, feeling nausea every day, fatigue, acid reflex, low grade headache, sleep problems. Now I know. I had a smart meter installed too. I hope I can have it removed. Can't our Congressmen do something about this?

96. **COLORADO** says:

[March 1, 2012 at 11:11 pm](#)

We are looking to create grass root groups across Colorado for Electric Cooperatives and Regular Utility Companies. Please send us an email at [coloradorf@yahoo.com](mailto:coloradorf@yahoo.com) and or join our group.



97. **admin** says:

[March 2, 2012 at 10:04 am](#)

Here's a group started in Colorado: <http://cocitizenonrf.blogspot.com/>

98. **Kassie** says:

[March 4, 2012 at 10:09 am](#)

I live in the San Diego East County area. I came out of my house one day a little over a year ago due to hearing a strange noise and caught the man attaching a smart-meter to my home. I asked him what he was doing and told him to stop it, I told him I did not want a different meter on my house. He was working very quickly and made some comment about how letters had been sent out (I never received one) and that he had to put the meter on and then he drove away. It was very disturbing. I didn't know at that time what a "smart-meter" was or what the health ramifications would end up being.

I do know that since that time I have had unending tinnitus and ringing in my ears, that interrupts my sleep every night. In fact, I also hear it throughout the day when I'm home and before I go to sleep and dread laying down in my bed. I think the only reason I actually nod out for a few hours is from sheer exhaustion. Once I wake up around 3 hours later, I move to the living room, but even that place has become one of unending high-pitched ringing. My ears almost burn from it. In addition, I used to be very focused and energetic, with plans and goals. Now I frequently feel overwhelmed and almost "frozen", having lost the desire to do many of the things I used to greatly enjoy. I couldn't understand what happened to me until recently I started hearing about the smart meters and the EMFs and found this site. I am horrified to see that not only are my symptoms very similar to what others are experiencing, it is nearly impossible to get SDG&E to remove these meters. I'm also afraid because I have had much exposure to radiation starting in my teens due to extensive diagnostic xrays in my youth for scoliosis. Perhaps that is why I am so sensitive to these frequencies now. I also just figured out today that my neighbor's smart meter is 10 feet away from my bedroom wall, which explains why I can't sleep in there and feel so restless all night. It's a toxic zone! I have been feeling like my bedroom in particular has become a menacing environment to me every time I go to lay down, which I couldn't understand why I felt that way, and now today it all makes sense. I pay SDG&E over \$100 a month for their services. Why am I forced to have this equipment that is dangerous, that I don't want, and that can easily be replaced by something less harmful? Do we no longer have any rights at all??? We need to band together and fight for a solution.

99. **Julie Sunflower** says:

[March 4, 2012 at 9:57 pm](#)

I am SICK AND TIRED OF LISTENING to your frequencies of your smart meters that EVERY ONE HATES it is obviously a health issue I can't wait until you go down in many lawsuits over this negligence!

100. **[Deborah Houle](#)** says:

[March 5, 2012 at 1:17 am](#)

I also had the smart meter attached to my home without an "opt out" option that I was aware of. After receiving a horrendous electric bill, we requested a tech to check our meter to see if it was running accurately. The supervisor at the electric company told me we had used a lot of electricity over the weekend. We had family that visited us from out of state. Is this Big Brother??? When the tech arrived at our home to check the meter, he informed us that the electric company employees themselves had opted out of the new meter. Does that tell you something? He said there were

many complaints. Meantime, I've felt faint and jittery and didn't have a clue that my meter may be the culprit. I'm restless when sleeping and have had headaches which have all been recent. This is scandalous. I'm praying for a resolution.

101. **linda sass** says:

[March 5, 2012 at 2:21 pm](#)

I have had headaches and insomnia for the past 4 months I live in an apartment with 29 smartmeters close by.....where else can we complain about smartmeters?????what is a safe distance?????thank you



102. **admin** says:

[March 5, 2012 at 2:49 pm](#)

If you live in CA complain to your utility provider and to the CPUC, Consumers Affairs branch: <https://ia.cpuc.ca.gov/cimsapp/?key=39949189>  
I don't know a safe distance. It's a difficult question to answer.

103. **Conrad H** says:

[March 8, 2012 at 5:34 pm](#)

I have created an interactive complaints map where people can report their issues along with any media they may have and post them geographically. American version is brand new and Canada version is at NoBCsmartmeters.com. Feel free to post your experiences there.

Conrad Hild  
Admin: NoBCsmartmeters.com  
Admin: Smartmetercomplaints.com



104. **Paula Fighting for our lives** says:

[March 10, 2012 at 8:04 pm](#)

I am not certain how much these meters affect us, but I know they are not good for the health at all. I also know that in our town are 180 something cell tower clusters, enabling cell phones to function all over our town. On one side of town the other day, I got sick just driving around them. I have electro sensitivity. I have tried everything on the market, and as of yet, I do not have an answer. I can tell you that I did put pet resonator protectors on the animals, after losing one

animal, and this helped them.

I remain in pain, they were having seizures, all the same kind, one died.

My house is no longer comfortable at all. I so long to have our home back.

I understand your fear, your pain, and I know that you are telling the truth.

People are developing all kinds of diseases and dying, some do not feel the effects and say we are crazy, yet they are being effected as well.

I pray for tis to end and for you and yours to be protected from this evil that surrounds us daily.

105. **Lisa** says:

[March 18, 2012 at 2:09 pm](#)

My neighbors got smart meters installed on Feb 28 or 29th as of March 1st I started getting sick. I started to get diarrhea, sev nausea, heart palitations and chest pains, trouble sleeping, earaches, sev constant migraines, confusion, weakness on left side and a seizer on 3/10/12 my husband could not get a pulse in my neck and called 911.

After the seizer on Sat the side effects from my neighbors smart meters got worse. My husband was calling me every 1/2hr during the day because he was terrified I would have a gm seizer which could kill me if I am alone.

I called multipal times Gov Scott of Florida, Rep Harrell, and have never recieved a call from them. I have other people calling my Rep Harrell daily and they also get no call back. I have called Senator Joe Negron no call back. The PSC is more concerned in protecting FPL then a florida resident it is very obvious specially when you get verbally attacked.

Rep Harrell, Gov Scott, Sen. Joe Negron are more concered covering for FPL (big biz) then protecting their constituents.

I have not had a seizer in 14 years and I was looking to get off my meds, yes 14 years NO zeizer.

FPL did remove the mart meter on one neighbors house as per their request (I spoke to them) I have called FPL many times and told them their damn meter is endangering my life after having a seizer and I was going to SUE them.

Hopefully the other smart meter on my other neighbors house is going to get removed.

106. **RICHARD JACOBS** says:

[March 24, 2012 at 6:48 pm](#)

we have recently moved into a neighborhood in chesapeake virginia (dominion power supplied) with a friend and roommate. right next to our house is a panel with four of these "stupid meters" installed. before moving here me and my wife never had headaches and now constantly do. so does our room mate for the last three months, and has lived here for four years but he did not have headaches till a bit after the meters were installed. i have researched this subject for 3-days straight now on the internet and have found out once again the american political system has sold out the

health of its citizens for corporate profit, california excluded it seems (they are removing them and virginia is buying them). this goes right up to the obama administration who backed this 100%. well i for one have had enough of this “change”. in my opinion change is not good. our health is worth much more than corporate profits. we are going to start a petition to get these “stupid meters” removed.

107. **Jaci in BC** says:

[March 30, 2012 at 11:07 am](#)

I live in an apartment building with the smart meters somewhere in the basement, much farther than 6 feet away from me. However, I have experienced dizziness and disorientation, memory loss, and confusion since they were installed. Other symptoms are present as well, but only when I am in the basement of our building.

108. **John** says:

[April 3, 2012 at 4:28 pm](#)

For everyone suffering from the effects of smart meters, help may be on the way. Recently SC Edison installed a smart meter at my residence, which is also my business location, and in so doing shut the power off without notice and damaged our main computer. After taking SCE to court and having a crooked judge only award me the cost of the damage harddrive, but give us nothing for the labor costs to install the harddrive and reload all the computer software, I am pissed.

Being a defense contractor, we have designed RF shielding for sensitive military equipment, and I am so pissed off at SCE that we are now going to use our engineering talents to design a military grade RF shield to encapsulate smart meters. This will not be a home-brewed design like wrapping aluminum foil around the meter. Our design goal will be to stop 100% of the RF emissions from any smart meter. The “opt-out” programs Edison and the other utility companies are pushing will cost you \$200 – \$300 the first year and \$120 – \$200 every year thereafter. Our plan will be to sell these units at cost with a price goal for the shield to be around 25% of the first year cost and with no future year costs.

Of course these things do not happen overnight, so it will take us a couple of months to get a working design, test it, and figure at the production process. If you don't have to make an immediate decision to pay Edison or your utility company for their “opt-out” program, give us a chance to do this development effort. I, like most of you, am sick and tired of the arrogant attitude from Edison and all these utility companies. I want to make their lives as miserable as they have made ours. I will post again in a couple of weeks and give an update on our progress. Hopefully we will be successful and can put an end to everyone's suffering and Edison's arrogance.

109. **[Miss. J. Webster UK](#)** says:

[April 18, 2012 at 3:55 am](#)

I read with great interest today of your problems with Smart-Meters in the USA. I do not think, so far that we have them in England. However, we are in the middle of the digital changeover for TV's here in England. The reason I am going through relevant sites today, is to find out why since the changeover to HDTV, am I feeling so ill and my sight in particular feeling so bad. With analogue TV I had no such problems. As soon as I look at a digital TV my eyes feel strained and I am most uncomfortable. I have never worn glasses to watch TV but tried to watch for 2 hours the other night, with my driving glasses on. I felt extremely uncomfortable and on removing them and switching off was extremely disorientated and woozy. I felt depressed (never happened before) and not able to focus or concentrate; totally like a zombie. Since then I have not watched TV, only on analogue; no probs with that but the changeover was completed last night, so analogue has been switched off for good now. I do have fibromyalgia badly and a reduced immune system, due to severe allergies some years back, so can relate to so many of your comments on here but am wondering is there is a similar connection with digital TVs and the transmitted waves which are affecting me or if anyone known how I can watch TV again now we are stuck with digital. Some of the things I have read today on various net sites concern me greatly, particularly with relation to HAARP transmitters and HDTVs – see Control by the Sound of Silence and The energy effects of HDTV, which states that the brain cannot translate the signals with Digital waves as it can with Analogue. Or is anyone can direct me to the relevant sites which may answer my questions and my problem. Thank you.

110. **Holly** says:

[April 18, 2012 at 6:15 am](#)

I am having all of the symptoms that are being mentioned here especially insomnia. I am also sleep walking and screaming all through the night. No one is getting any sleep... This is the worst thing that could ever happen to us. Can it not be reversed? I can not get anyone at Georgia Power to switch my meter back to analog. I want my health back!!!!



111. **admin** says:

[April 18, 2012 at 8:58 am](#)

Smart meters will not be mandatory in UK. I do think the switch to digital TV signals was/is a problem, but am unaware of other sites addressing this particlur issue. Maybe another reader can comment?

112. **class action lawsuit** says:

[April 28, 2012 at 4:38 am](#)

Until recently, I lived in a large apartment complex. Shortly after conversion to smart meters I developed really distressing symptoms. I felt dizzy to the point where I couldn't function normally and spent a lot of time lying down. I also developed a high pitched humming/buzzing in my ears that seemed especially loud when I woke up in the morning. I didn't know we had even converted to smart meters since it's an apartment building versus a house and I had never even looked at my meter. Once I developed symptoms I researched online and came up with smart meters being a possible cause – a neighbor showed me a letter from PGE describing the timing of the conversion which was shortly before I developed my symptoms. I guess I missed the letter, not that it would have done me any good to protest. I went to look at my new smart meter after I started developing symptoms and oh my god, it was a huge bank of smartmeters not far from my unit (it's a really big complex). The worst part is I have since moved and my new duplex also has 2 smart meters not to mention the neighbors smart meters. The dizziness seems a bit improved but the humming/buzzing is getting steadily louder. Folks, we have a serious problem. First of all, it should be illegal for any industry to sponsor or quote scientific studies that they themselves have funded (purchased). Scientists are like any other people and just as susceptible to corruption from money as a politician. We have enough independent research that verifies the dangers of the type of radiation put out by smart meter's that PGE should not have been allowed to do this. If there is a class action lawsuit I'm signing up. I have documented the onset of my symptoms for the lawyers when it gets to that. Here's some links for you all including one report produced by a company that shows that radiation from a smart meter can increase to the point of fcc violations – the increase is related to increases of 1000% to 2000% re [http://emfsafetynetwork.org/?page\\_id=2292](http://emfsafetynetwork.org/?page_id=2292)

reflective factors. Here's the link...I hope you all READ IT!!!

[http://sagereports.com/smart-meter-rf/?page\\_id=212](http://sagereports.com/smart-meter-rf/?page_id=212)

Also, consider that the smart meters are on top of the already increased pollution from cell towers, radio towers FM and AM, ham radios, etc. If you want to check out the nearest antenna's and towers to your location use this website:

<http://www.antennasearch.com/default.asp>

Finally, here is a table from this same website that produced the smart meter report showing the serious and severe health consequences that have been shown in scientific studies due to radio frequency radiation.

[http://sagereports.com/smart-meter-rf/?page\\_id=404](http://sagereports.com/smart-meter-rf/?page_id=404)

Finally, don't forget that the smart meters have TWO antenna's, 900 MHz and 2.4 GHz. Do not spend a long time looking closely at your smart meter. It is bad for your eyes – and I mean literally. Seriously, I see PGE's future and in it are a lot of lawyers trying to fight all of us off. My recommendation to all of you is document now – when did your symptoms start appearing? Go to the doctor to get evaluated and have hard documentation. Note if your symptoms improve if you spend time away from the smart meters. Write down all of your symptoms. That way when we haul PGE's aXX to court you'll have a nice neat packet to hand over to the class action lawyers. Good luck until then everyone. I feel for you!!

113. **Phyllis Reed** says:

[April 28, 2012 at 9:24 am](#)

I have always been healthy. I started noticing that I was feeling dizzy, having intense head and body aches, inability to concentrate, and heart palpitations. I did not know how to explain this rapid deterioration in my health. My daughter came to visit and I was discussing this with her and really confused as to why this was happening. She went outside to find that my bed was literally 3 feet from the recently installed SmartMeter. She proceeded to call PG&E to complain about this and they said there was nothing they could do except place our name on a list. I am very disappointed since I was never informed of such a change. Why can they come over and add such a device without our permission? I would like to change back to an analog meter and hope we can do so in the near future.



114. **admin** says:

[April 29, 2012 at 10:31 am](#)

You absolutely can get rid of the smart meter. Call PG&E and tell them to remove it. 866-743-0263

115. **brenda heath** says:

[May 1, 2012 at 6:38 pm](#)

since smart meters i have dizzyness, i feel my balance is off center. and i have noises in my head, like a gun shot going off.

116. **Dave Lynch** says:

[May 3, 2012 at 12:41 am](#)

Opting out of a Smart Meter has now become an extortion racket. Even if you can stand EMF radiation, there is a 4th Amendment Constitutional violation as these meters monitor your daily activity by the hour, without a warrant, and anyone can access your activities with enough computer chops. Your data may also be sold without you knowing about it.

I just received SMUD's \*Opt Out plan:

\* I will be charged a One Time Fee of \$127.00.

\* I will have an additional monthly fee of \$39.40 added to my SMUD Bill.

\* I have 13 days to respond, from today 5-2-12.

They are the only game in town, a monopoly, and I have no alternative. I refuse the meter for it's health issues and violations of privacy I am crushed with cost, Mafia style. Is this just? No, it will happen to you.

When will we all collectively say, enough is enough? Adding insult to injury, our legislators could care less. Personally, I am sick of it. How do we stop this insane criminal behavior?

This is my house, my investment. I have a right to privacy and be able to refuse this EMF device without extortion and I should have the right to be able to buy my utilities at a fair price without these Unconstitutional surveillance devices on my home.



117. **admin** says:

[May 3, 2012 at 7:44 am](#)

Have you seen this? <http://emfsafetynetwork.org/?p=7284>

Have you considered attending a SMUD board meeting and speaking to them?



118. **Mia Nony** says:

[May 14, 2012 at 11:55 pm](#)

THE ANTIDOTE: STRONG LARGE MAGNETS PROPERLY USED WILL  
PHYSIOLOGICALLY REVERSE FREQUENCY INDUCED SYMPTOMS

119. **SMR** says:

[May 16, 2012 at 7:34 pm](#)

Charging a Opt out fee to someone because a smart meter is causing them heath problems because they are RF or electrically sensitive is called "Medical Discrimination" and is against the law. Pay the fee, get the meter out, then sue the power company.



120. **LD** says:

[May 17, 2012 at 7:43 am](#)

The SoCal Edison Smart Meter has invaded my house since Aug. 2010 and turned my littl wooden home into an unbearable electrical or electronic "warzone!!!" The last couple of weeks have been

the worst, and eventhough I call Edison, they say there's "no harm done" from the "Smart" Meters, and I ask the representative how he/she knows, since I'm the one living in this terrible environment and experiencing the terrible effects of the meters !!!!

The Smart Meters upon the wall just outside my bedroom have made this warzone unbearable, and seem to be doing a number of other things to my home, as well, such as for some reason setting off my refrigerator to recycle incessantly and often .

For many nights now, I've been unable to sleep comfortably, or even at all, and I suffer from pitiful and continual heart palpitations at night and the non-stop inability to stop my mind's racing thoughts, and the buzzing and ringing in my ears and head continues continuously until I leave my apartment to "clear my head." Leaving the premises immediately clears my head and the symptoms disappear immediately upon leaving my "electrified" atmosphere !!!!

Other ailments include painful joints in my hands, (rings on fingers increase the pain), my hips and knee, and I feel that the meters affect our body's ability to keep or absorb calcium, with continued tooth/gum problems and difficulties.

I feel that the EMF and EMR's emitted by the Smart Meters and electrical invasion are also responsible for blister-like sores on my shins which appeared soon after the installation of the "Smart" Meters in 2010, and have continued to grow in number and discomfort. For months before I was able to discern that the meter was responsible, I slept quite near to the meters, and my head faced in the direction of the meters, probably five to six feet from the smart meters!!! Not a good idea, at all, i'll tell you. I also feel that the Smart Meter has affected my thyroid gland, as I experienced pains in my lower throat/neck area for months after the meters were installed, and I also lost sufficient amount of weight in that first year (probably as much as 30 pounds, and five inches around my waist!!).

The sleepless nights continue now and as SoCal Edison continues to promise the removal of these terrible, hateful things mounted without our permission upon the outside of our houses !!! These physical issues are just part of the many problems that the so-called "Smart Meters" bring with them into our lives, and there are a number of additional rights issues I've not discussed !!!!

SoCal Edison and the many other utility companies need to waken up to the many REAL harmful physical and mental effects and issues brought upon us by the installation of their "Smart" Meters upon our personal, private property, and again, without our permission or agreement!!!

This torture and torment is terrible, and very REAL, and not imagined. SoCal Edison and the other companies and their employees must be made fully aware of this and not to laugh at, mock, or question our credibility in this regards.

-LD (Newport Beach)

121. **Suzanne** says:

[May 21, 2012 at 10:56 am](#)

I've got an outside wall with five smart meters on it. Inside my house, I've got a large lead crystal bowl and artistic plate against the wall at the approximate place they are on the outside. I'm wondering if copper or aluminum plates would be better at blocking the emanations. The electric company would charge \$15 per month to reinstall the old meters – I'm not paying \$75 per month for other units' meters. I also wonder if the Stetzerizer filters would provide any benefits.

122. **Kerrey Degagne** says:

[May 25, 2012 at 6:17 pm](#)

I am 39 years old and have been plagued by a bunch of health symptoms .Headaches, pain in my chest ,ringing in my ears ,insomnia ,anxiety, joint pain , confusion .I recently went to the emergency for what i though was a heart attack . I am really confused by the lack of support from the government not looking into this situation . How many sick people does it take to remove a smart meter, thousands and they do not care .When the strain on our health care finally busts will the government finally listen . How do i get tested for this and who do i contact for help .I will be contacting my family doctor about this my symptoms have been getting worse over the last 2 seasons since hydro has installed smart meters in my home town.I guess i will write a letter to a member of the government next . Atikokan Ontario

123. **michele maki** says:

[June 2, 2012 at 5:20 pm](#)

Just to piggyback on SOLUTIONS, not to discourage ranting, I have noticed that the “peak” of my head buzz comes just seconds before I hear the choo choo train (that's railroad for anyone under 40 yrs.) sounds its alarm. THIS IS CONSISTENT. In Georgia, the rails are abundant. We live only one-quarter mile from tracks. Anyone with an engineering degree and high mathematical ability should explain to us the probability that the radiation from wires overhead are and IS movement with trains. My guess is it's all connected. We live in a virtual field of buzzing from top to rails. With meters buzzing 24/7 the “pulse” continues. Have you noticed that?

124. **[Todd West](#)** says:

[June 14, 2012 at 5:15 am](#)

I am trying to find a law firm, after over 2 years of being terrorized by infrasonic radio phenomenon and blasted by power surges through my wiring, I narrowed the cause down to Smart Meters. I believe these things are causing an epidemic and MUST be stopped and damages paid to us whom these shoddy/foreign made devices have made sick and disabled. Not to mention many firms and manufacturers have committed outright fraud trying to profit off people's ignorance.

Todd West  
770-769-9126

125. **bernadette johnston** says:

[June 14, 2012 at 5:42 pm](#)

Would the person who commented on Smud's extortion opt out rates please call me. I have a meeting at Congressman Lungren's office and I would like to have some input.

Thanks,  
9168449968 Bernie

126. **Cheryl Yonker** says:

[June 27, 2012 at 5:05 am](#)

Another sleepless night . . .

It's been over a year since Smart Meters were installed here. I'm quite familiar with most all of the symptoms described here – as well as the feeling of desperation. I continue looking for a new home after living in my apartment for 25 years. I think it would be good to establish a website for “Smart Meter Refugees” and people looking for others wanting to build a community without wireless technology.

127. **Bryan** says:

[July 5, 2012 at 11:40 pm](#)

I'm a radio guy, and understand transmitting ok I think. My guess is these meters use a very small antenna, with a lot of wattage, to get the signal to their “base.” All they have to do is use the current from their lines. (Makes sense right!) I mean, if their is no repeaters or anything like that, it would have to mean they use a LOT of wattage then, since their is no other “magical way.” That is what scares me about these. Who knows, they could be using FM radio station strength wattage around your homes, and you could be getting rf causing all of this, on top of the emf. These freak me out. A GMRS radio doing 5 watts can't even go a mile practically. And since you can't see an antenna of any kind, it must be fm, and has an antenna inside of it coiled up. So think of the actual wattage these things could be doing. Just do the math. Man, if they don't have repeaters...heck whatever...GET RID OF THEM. I noticed a “change” too in the environments feel. Something isn't right...it's just like doing a remote at a radio station, and standing next to the vans antenna when transmitting. It's the same feeling!!!

128. **Lady A** says:

[July 9, 2012 at 6:44 pm](#)

Three months after a smart meter was installed on the house where I rent the master suite, I was diagnosed with severe depression and panic attacks. This came out of the blue. When I heard about the meter dangers, I went outside to see where the meter is, and it's ONE FOOT FROM MY HEAD when I'm in bed. There is nowhere to move the bed. When I'm on my cordless phone, it clicks and crackles so loudly I have to leave the room. I have ringing in my ears on and off. I have

lost 40 pounds from all the medications I've been given for the depression and panic attacks. As a 59-year-old woman working part time, I don't have the luxury of moving right now. This sucks.

129. **LC** says:

[July 14, 2012 at 11:56 pm](#)

We moved to Aptos (Calif.) in October of 2011 and are renting a place with three Smart Meters outside the house, near the garage. In April of 2012 I developed severe pain in my neck, hands, wrists, elbows, hips, lower back, and knees. It does not respond to pain medications at all. I was tested for rheumatoid arthritis, Lyme disease, Lupus—all came back negative. I'm a 55-yr-old woman who used to take brisk walks almost daily and now need to go at a much reduced pace over shorter distances with the aid of a walking stick. What is going on?

130. **Lorene** says:

[July 18, 2012 at 3:40 pm](#)

For two years I've had chest pains, heart palpitations, shortness of breath, sleep problems, anxiety, memory problems, have felt exhausted and weak, and I cannot even walk halfway up our stairs without my heart racing and being totally out of breath. I am not overweight. I work out daily. I eat decently. I'm in my early 40's. But my health is like that of an 85 year old smoker! I've been to my family doctor, a pulmonologist, a cardiologist and an allergist and no one could find anything wrong with me. I started having these problems for two years, out of the blue.

I started to research the health effects of RF radiation, and found out that smart meters are huge emitters of this type of radiation. We had two meters installed (against our wishes) two years ago. One is on our gas meter, which is near my office where I work all day and is on the wall of my 6 year old daughter's bedroom. The other meter is on the other side of the house for our electrical.

Basically I have now figured out that my symptoms started soon after the smart meters were installed on our house. My 6 year old daughter has also shown symptoms. She is losing her hair and has frequent nose bleeds, and cannot sleep at night. She also has frequent head aches. I thought that all her symptoms were from her allergies but when she started losing her hair I knew something was up.

Yesterday I put foil on her bedroom wall and floor behind where the meter is, and around the actual meter. Today I woke up for the first time in two years without feeling like absolute crap and my shortness of breath and heart issues are gone. So I think the foil diminished the amount of RF I was taking in each day, all day long. I am having my daughter sleep in another room for the time being, away from that dang thing.

I have asked PG&E to remove our meters and they are doing so. This is due in part to all the backlash they have received from people like those of you who posted to this site, and I'm very grateful for that. Of course they are going to charge us \$ 75 to remove those cancer cannisters. I plan to fight them. I am going to call our local news station to tell them about this and make a huge stink

about this BS. I think PG&E should be paying ME for all the health issues they've caused me and my family and the wasted money I have paid to doctors to figure out what was wrong with me.

131. **Yvonne O'Hare** says:

[July 19, 2012 at 11:16 am](#)

I am woken up nightly by a strong surge and jolt. Then I feel small ripples through my body that start and stop for seconds at a time. This also occurs during the day. My sleep has been disturbed ever since the smart meters were put in. My energy is lower than it used to be and I am very irritable as a result. I can't think as clearly as I used to. But mainly if I am sleep deprived my body doesn't function well.

Not sure what the ultimate toll on body is from the Smart Meters but I am not happy about being used as an experiment.

132. **tim** says:

[July 20, 2012 at 9:55 am](#)

wow this something else. i mean i know all these symptoms can have other related causes but ever since they have installed smart meters in my condo complex a slew of the exact same things have been happening. we live up stairs but the people downstairs closer to the meters fight all the time. her daughter has chronic head aches, the kid is ALWAYS going wild. her mom had a seizure not so long ago. my step father has had random migranes he has been diagnosed with neuropathy and random chest pains. my mother cant get a full night sleep she continuously complains of naseau. i havent been able to get to sleep at a decent time of night to save my life, plus i have been having a hard time using the bathroom and a constant case of dermatitis and psoriasis. im not a stupid person i do know some what about the medical field im a pharmacy technician and i know a bit of what connections could be concerning exposure to EMF meters smart meters ect...

133. **Nancy Garcia** says:

[July 29, 2012 at 12:45 pm](#)

I started feeling dizzy, lost and I did not know why. suddenly something came to my mind of course the digital clock, it has affected my health so bad, but what it really worries me is my child, one morning there was blood on his pillow and I was so scared I started to check him and it was his nose, he did not have the flu nor any other illness.

This is not right, we paid for everything this is a Country of Freedom. We the consumer have the right to choose and this is the time I want the old meter installed back in my house, the digital meter is against our health!!! someone has to do something.

134. **Charley Meckna** says:

[July 30, 2012 at 6:52 pm](#)

Wow!! So many sick ppl my heart goes out to you. My health issues started in 1999 from a cell phone, since then it has gog worst including WIFI routers, smart meters so Yes I to am sick from EMF like smart meters, WIFI, cell phones. All of you also need to remove the WIFI router from the home if you hv them, kthey are Evil for our health. What I hv found out is others including many family, friends and for sure the Government, power & gas companies give a rats ass about us and our health. My own grown childen hv turned against me saying well dad it dont affect us, yea as their father I hope they never do but as a person suffering from what I am, I hope everyone who is a doubter & hater gets it so they hv this same evil feeling of poor health. We did get the gas meter removed & working on the electric. I have found nutrition has healped me, Alive whole food energizer, miracle reds, spirulina, chlorella, saunas & drinking steam distilled water. I hope for a healthy resolve fof us all but am sure we will have to fight. I told the gas & electric co I will destroy their meters if not removed it took 2 days to make it happen. Bug we must be willing to do whatever to save our health after all if is our health we are talking about, the value of our life is all that matters and the issues with these items need to be brought into the light. Be blessed Charley

135. **Tashy41** says:

[July 31, 2012 at 9:41 pm](#)

The best solution I have found to counter the side effects from a smart meter is to take the liver of a toad, bind it tight about my throat and stand naked by the full moon in a barrel of eels' eyes.

Doing this monthly ensures you will be committed indefinitely – thus solving your problems as you will be away from the demonic smart meter.

136. **Stuart** says:

[August 7, 2012 at 6:21 pm](#)

I had a meter installed yesterday. This morning I woke with really bad ringing in my ears. I've NEVER had ringing before. I was wondering if anyone else had experienced any ill effects after the meters were installed, so I checked online today – and found this website. I'm really not happy that we are being forced to have these meters installed. It's bad enough that we get slow cooked by mobile phone and internet signals – now I have a smart meter 1 foot off my bed head.

137. **Carol** says:

[August 8, 2012 at 2:10 pm](#)

Wow! Since our meter was installed I have had headaches and pain in the back of my neck. very tired and I have the hardest time while sitting at my computer which is a large part of my at home business. My computer is directly over the meter! muscle aches and ear aches. So what can we do????



138. **admin** says:

[August 8, 2012 at 3:30 pm](#)

see:[http://emfsafetynetwork.org/?page\\_id=649](http://emfsafetynetwork.org/?page_id=649) for actions you can take

139. **Chuck** says:

[August 17, 2012 at 7:49 am](#)

I am having ringing in my ears, dizzy spells, night sweating, can't sleep at night, cant think, stiff neck, stomached upset and feeling like I am a going to throw up, I want to sleep all day to feel better, bad mood all the time, forgetting things and I thought it was me. this started when they put a earth meter in 1985 on my house and got worse when they installed a smart meter may 12 2010, they refused to remove the earth meter in 1985 and have suffered from then until now and it continues, they finally removed the meter on aug 5 2012 and I felt a little better, but the feelings wont go away, I hear and feel it outside and still in my house, I have seen doctors for the symptoms and they give me drugs which don't help, I am very sensitive to wireless and never had a cell phone or anything wireless at my house, I do not use a microwave oven. I hear and feel it when I enter other places that have wireless, if I leave my house and go to the beach after an hour or so I start to feel better, but when I return to my house I start to feel sick again. I can hear and feel my neighbor's houses also.

They are charging me to remove and a monthly fee on something that is causing health problems, not because I just want it removed for no reason, I feel like this is wrong and don't feel I should pay for extra for this.

140. **Sondra Creed** says:

[August 26, 2012 at 9:32 pm](#)

A man appeared at my door and told me he was going to shut my electricity off for a minute and turn it back on, little did I know he was installing a Smart Meter. I have had major ringing in my ears, stabbing pains on the left side of my head and insomnia. I am ready to crawl out of my skin. I called SCE and was added to teh Opt Out program. I feel we need to start a class action to stop the installation and extortion of funds to keep our health safe from these Smart Meters. I do not feel good nor can I relax at home. I work in a busy Emergency Room and feel it is safer for me to be there than at home now. Our dogs are getting sick since we moved here one has lumps all over his skin the other one in his throat. They were perfectly healthy when we moved in. I feel totally violated with SCE being able to walk onto my property and install a device that has not been researched to benefit their needs and not the needs of the consumers who have to pay for them. Last night I was so frustrated I wrapped heavy duty aluminum foil around my head and slept that way. Today I double wrapped the entire cabinet with foil and covered the meter hoping that will stop the ringing in my ears. I've called and I've written to get this thing removed. We need to start

fighting for our rights and our health. I'm healthy, what right do they have robbing me of my good life??? I want it removed immediately.

141. **bryan nolen** says:

[August 28, 2012 at 3:40 pm](#)

If PGE wants to charge a customer to OP OUT because a serviceman needs to come to your house to read the meter, then they should also DISCOUNT the customer that same amount who is willing to have the meter installed because a serviceman DOES NOT have to come to your house. If PGE claims that these WIRELESS RADIO FREQUENCY METERS are safe to your health, then they should also agree to pay any customer's HEALTH expense and legal fees if they incur a HEALTH problem.



142. **Chuck** says:

[September 6, 2012 at 6:20 am](#)

Well I am feeling a a little better but still hear it and feel it – also strange but my floor is vibrating now also! Its been almost a month with a spinning old meter, after filing a complaint with the PUC, edison Corp called and had a RF Engineer call me ( if you want to call them and get a reading there SCE california number is 800 200 4732 this is a free service they offer all SCE customers – I said I would think about it and havent called yet, ) and they are willing to do a RF EMF Survey on and around my house, my meter is also wrong, I use killawatt meters on everything in my home then add them up and the new meter is almost 100 KWH to much after 30 days, I am filing another complaint with the PUC when I get my bill!  
you must go to the PUC web site and file a complaint with what everyone is saying here and then you will get the ball rolling, DO NOT give up – keep filing complaints untill this is resolved! I will never roll over and kick my feet in the air and play dead!

143. **Keith Gubitz** says:

[September 10, 2012 at 2:42 am](#)

They put the meter in on Wednesday and neither of us have been able to sleep since. This thing is driving us out of our home.

144. **Julie Peterman** says:

[September 16, 2012 at 10:52 pm](#)

I need help please. I live in Ohio and they just installed a smart meter. I told them I didn't want one, but they did it any ways. I am the only person that has one. We in the country and I feel like

they did this on purpose because my old meter was broken, when we moved in this house. How can I get this Smart Meter removed?

145. **George Shaver** says:

[September 22, 2012 at 12:41 pm](#)

I understand from SDG&E, my electric company, that smart meters was installed in my home in April 2011 or about a year and a half ago. I was not notified about the smart meter installation and was not able to avoid it's consequences. I can see now that the 12 smart meters installed on the wall of my bedroom has been the cause of the health disaster that has befallen me. Prior to the SDG&E installation, I was a post polio survivor and I used a cane for improved mobility. Now, a year and a half later, I'm confined to an electric wheelchair that I need 24/7 hours everyday. The only exception is when I am sleeping and when using the toilet. This disaster has befallen me because of the 12 Smart Meters that were installed on the outside wall of my bedroom.

My history of this issue began 6 years ago when I became sick from my cell phone. Because I was able to choose not to use a cell phone, I was able to avoid disasterous health consequences from exposure to RF Radiation. Unfortunately, I was not able to avoid these same microwaves that are radiating from 12 smart meters installed to the back side of the wall in my bedroom.

Can i persuade you to help me with my law suit?

George Shaver  
949-215-2368



146. **admin** says:

[September 22, 2012 at 6:33 pm](#)

George, I have responded to your post in an email. S

147. **Paul** says:

[October 1, 2012 at 3:34 pm](#)

hi my name is Paul. i think i am effected. i am in victoria. please if this the case can someone give the contact details of the doctors that can me as everyone is ignoring.g me. 0433674602.



148. **Paul** says:

[October 1, 2012 at 3:39 pm](#)

adding to my last post. burning skin tinnitus. i can feel my ears vibrating and muscle spasms. I've been trying work out what is wrong with my since October 2011 and then found out my smart went in on the 8th of September 2011 just about to quit my job and lose my family. please help.



149. **admin** says:

[October 1, 2012 at 5:38 pm](#)

Are you in Canada or Australia?

150. **Jacob and Lydia de Raadt** says:

[October 11, 2012 at 10:31 am](#)

We live in a two-level townhouse that we own in Langley BC within a 24 unit complex, and our situation is slightly different. In October 2011, we asked BC Hydro to be exempted from a smartmeter, and the strata council was aware of this. We never received any response from both of them at that time. In January 2012, while boondocking in Arizona, the then strata council president let BC Hydro enter the site and install smartmeters in two locations: thirteen in an electrical room next to our unit, and eleven somewhere else. There are in total 25 meters because one is for the common area streetlighting and the electric gate. But in the middle of these 13 smartmeters they did not touch our analog meter, as a "lone ranger". We returned home at the beginning of March and have been in poor health ever since, with insomnia, muscle pains and heart palpitations , which we never had before, so that we need to avoid our upstairs living room and our downstairs hallway on that side of the townhouse. We cannot really complain to BC Hydro – because they could counter that they allowed us (for now) to keep our analog meter. But we receive all the negative effects from the 13, within 2 metres of our private property! Our family physician just blurted out: "Well, then you have to move!" Where to? We are around 70 years old and have three married children and nine grandchildren close by.

151. **Tammy** says:

[October 21, 2012 at 3:25 pm](#)

I refused to let SCE's contractors come in to install the smart meter, but when I started feeling tired and irritable, and having ringing in my ears a lot more often and my hair started thinning tremendously I wondered why, thinking it must just be hormones. I went outside my house and sure enough, SCE's contractor had broken into my gate and trespassed to install it. I had been feeling this way since about mid August, but didn't notice it was in until a few weeks ago. After reading up on it, I'm thinking that all these recent changes in health has a lot to do with this stupid smart meter HOW do I get rid of the darn thing? I also have 4 kids, I don't want them exposed to the unnecessary transmissions several times a minute. Is there anything I can do?



152. **admin** says:

[October 21, 2012 at 4:21 pm](#)

Call SCE to remove it.

153. **Tim** says:

[November 1, 2012 at 8:41 pm](#)

I travel a lot and have another residence (owned, where we are still fighting not to have smart meters installed). However, at our rented apartment in town (one of 13 in the low rise, older building) my work desk is located within 8 feet of the smart meters for the whole building, which were installed almost right below, earlier this summer. This is a brick building with wood interiors—with little or no insulation between floors and no metal screens, for sure. We were away for most of the summer (including when they were installed) and I was traveling out of town for much of September and part of October. However in the past few weeks I have spent much of my time at my desk and also sleeping within 20 feet of the smart meters. I have a history of good health. Recently, though, I have begun to have unbearable ringing in my ears and am frequently nauseous. I never had problems sleeping before but now wake after just a few hours. Working and concentration have become a real challenge ... I have lost my appetite and now have no interest in cooking, once a passion. We are long time residents of this building, with great neighbours, and have no desire to leave. I am planning to move my work space asap. As I'm travelling again soon it will be interesting to see how much or if the various symptoms subside ... I don't know what action we can take short of moving, although we may start by requesting the landlord to have the room screened in some way, which it is not right now.

154. **Deborah Rackliff** says:

[November 10, 2012 at 9:03 pm](#)

Just realized what's going on and not happy with it at all. I agree we want them off our house and out of our neighborhood. Nov 10 2012

155. **Valerie Fearing** says:

[November 14, 2012 at 11:38 am](#)

I have been severely suffering the same effects as many of you for 10 months.

I do not know how I am going to be able to work.

We did put foil around the meter and on the inside wall the meter is against and it did help quite a bit, but not completely. We also grounded the emissions to the ground after putting up the foil.

Although it is not a solution as removing it is, you all might want to put foil up.



156. **Valerie Fearing** says:

[November 14, 2012 at 11:39 am](#)

I also had to move out of my bedroom and am now sleeping in the living room to be as far away from the smart meter as possible! Terrible just terrible!!!

157. **GaryJohnson4Prez** says:

[November 20, 2012 at 1:05 pm](#)

Thank You CPS Energy for stopping the electrocution ! . Since the REMOVAL of your SMART METER, my family's health immediately improved .Thank you so much, CPS energy, for removing my smart meter within days of making a claim with you. It only took me nine months of complaining of all of my families health problems, to get my smart meter removed. It took for my hospital stay from having a seizure , from your smart meter to GET IT REMOVED!! Finally,no electrifying pulses are running through my vains, and my children can sleep now too.

158. **Bill Nolan** says:

[December 30, 2012 at 8:44 pm](#)

I live in the state of Victoria in Australia. The Victorian State Government has tried to force smart meters into every household BY STEALTH and DECEPTION. I have refused installation and have locked up my meter box. When the installers came and left my place they then went up and down my street and managed to talk their way into installing smart meters in all the other houses including my next door neighbor's house. Two weeks after these installations I started waking up with the presence of a mild headache in my forehead. This was over 4 months ago in August of 2012 and this headache has remained with me ever since. It just doesn't go away. Sometimes it intensifies and becomes debilitating and sometimes it eases but it's presence is always there. I am now very easily irritated by trivial annoyances and tend to react in a hostile fashion. This forceful imposition of smart meters using this dangerous technology is sheer criminality. I previously had no history of head pain whatsoever and now every single time I wake out of sleep the first thing that I am aware of is the presence of pressure and pain in my forehead. Thinking of the problem just in terms of transmission signal strength could be a a deception. I think the problem involves many other factors than just the strength of the wireless communication signal. I think there is something particularly sinister in the physics of the smart meter transmissions, almost like a secret language that has a way of speaking to the brain. It would have to do with transmission fequencies, wave forms, harmonics etc etc and also the pulsing nature of the exposure with smart meters giving off short sharp but frequent bursts of wireless communications. I am not sure where any immediate relief is going to come from. People here are writing to the Victorian State Government expressing that they are having these health problems and pleading that the rollout of smart meters be stopped and the govt is sweeping all these people under the carpet. They just ridiculously hide behind and keep spilling out the same line that "the meters are safe they are within Australian

Standards”. The only thing this means is that if you are exposed to a smart meter for 6 minutes, you won’t be cooked. It’s totally irrelevant and it’s an insult to people’s intelligence. The people of the state of Victoria have been sold down the river by these criminals that happen to run their State Government.



159. **admin** says:

[January 8, 2013 at 2:05 pm](#)

Click on the link to go to the Report: <http://www.bioinitiative.org>

160. **Barbara** says:

[January 25, 2013 at 11:58 am](#)

Shortly after a Smart Meter was installed on our home, my mother and I began having problems. The meter was on mom’s bedroom wall so she started feeling ill right away. For FOUR MONTHS I took her to her doctor AT LEAST every other week. Mom became extremely lethargic. She suffered major muscle pain, dizziness, confusion and headaches. She was rarely able to get out of bed. Her doctor order blood work nearly every time we saw her. She had xrays and a CAT scan done. They could find nothing and insinuated she was ‘just old’. Before the Smart Meter my mother was a vibrant, active, 85 year old woman. I suffered headaches, sleepless ness, irritability and depression. Out of desperation I started searching the internet and thank goodness I found an article about the Smart Meter. Not really knowing if it WAS the meter but at my wits end, I called to have it removed. It took several phone calls, I had to pay \$75 and an additional monthly fee. When I ask about that I was told they must now employ someone to read the meter. OH MY GOSH!! They are going to have to give someone a job!! The man who came to replace it made derogatory remarks to me as well but, as soon as it was gone, mom and I started to feel beter. With in a week or so she was ALMOST her old self. I do believe she suffered permanent damage as she is NOT as vivacious as she was pre Smart Meter. This is WRONG. It is known that these meters cause damage. And to pay EXTRA to protect our health?? What is going on in this world.

161. **Jennifer Turner** says:

[February 5, 2013 at 7:16 pm](#)

For me, I think the “wake up call” has been loosing 2 pets to cancer & having one operated on for cancer in less than a year.

It was approximately 4 years ago when the meters were installed. Since then, there has been an issue with cancer (pets above) & my daughter & I have continued to suffer with numerous health issues.

I had heard that the meters cause problems, but didn't really start thinking about it until I lost my cat 2 weeks ago. It seemed more than odd that I'd have 3 pets with cancer in less than a year.

We have sleeping issues, severe headaches, eye & ear pressure, sinus issues, bloody noses, leg cramps, body aches which include skeletal aches, dizziness/vertigo, concentration issues, chest pains & pressure, etc. It makes me wonder what all my pets must be feeling like.

I want the meters banned & we definately shouldn't have to pay a fee to have an analog meter installed & a monthly fee to have it read. Why should we have to pay a fee to a utility company in order to maintain our health?

162. **steph** says:

[February 14, 2013 at 2:58 pm](#)

I just asked Burbank DWP to remove our smart meter with no reply yet 2/11/13. After numerous trips to the doctor, my daughter has been plagued with daily headaches, her scalp feels like its been burned, chronic fatigue, chronic coughing, metallic taste in her mouth, loss of appetite and weight, muscle cramping, insomnia and over all low immune system. My 27 year old daughter feels like she's dying and all the doctors can say is, "you just need to exercise more" I feel terrible as I didn't want to pay the extortion fees to keep my analog meter. The meter is against her wall where she sleeps. Of course, Water and Power doesn't tell you to use protection against these evil meters. I had no idea what the health risks were until now. We need the meter off A.S.A.P. Help!



163. **admin** says:

[February 15, 2013 at 2:34 pm](#)

Contact Kiku Lani (Co-founder of Burbank Action): [KIwata@emfsafetynetwork.org](mailto:KIwata@emfsafetynetwork.org)

164. **Terry and Rhonda** says:

[March 16, 2013 at 7:21 pm](#)

We own cabins in the Smoky Mountains and notice the difference in our sleep, when we are at our cabin vs. our home. Our home has a s.meter.

165. **JTD** says:

[March 19, 2013 at 9:01 pm](#)

Shortly after our old analog meter was replaced with this "smart" bastard, my mother began acting...erratically. Forgetful, sick, even delusional at times. She was diagnosed shortly thereafter with dementia, possibly Alzheimer's. I've felt light on my feet at times and dizzy. I checked the

house for a defective furnace exhaust, gas leaks, etc. Found nothing. Everything points to this bastard new meter. For what it's worth, our house is 100% Wired as in we use landlines, wired dial-up Internet, no routers, Nothing.

I want this thing removed!

166. **Terry Maness** says:

[March 20, 2013 at 2:07 pm](#)

I have complained for three years about ringing in my ears. I over all had good health. No complaints except the normal colds. Well last year I had an CT, MRI done due to severe head issues "clogged as tho so full it's going to pop". I had fought our electric company over their NOT installing this smart meter, threats of this 75.00 fee and paying 10.00 extra a month for NOT having it. We do NOT have this meter on our property but well well well, our electric bill decided to triple since fighting them and our winning. But not my health. I find that neighbors have it and basically all over they have these things. So what now?????



167. **Terry Maness** says:

[March 20, 2013 at 2:12 pm](#)

Oh and yes the MRI shows I have spots on my brain. Never had any problems what so ever. To this day my ears are heck to live with, the head is constantly full and I am off balance at times. Just pray for help and others like myself.



168. **Mia Nony** says:

[March 31, 2013 at 2:38 pm](#)

Those who forget history are doomed to repeat it.

At least those targeted by the Nazis for understood the policy to get rid of them – The only fatal error was that they thought that the term deportation meant relocation rather than elimination. But people who grew up in North America without overt fascism staring them in the face, without a culling policy openly on the books, without 42,500 death camps located everywhere in Europe, these people have no survival instincts and no ability to wrap their minds around just how far the eugenics gan is prepared to take this.

People who have known freedom assume that its price is NOT eternal vigilance. Few seem to recognize what is unfolding here, even when the jackboot is already at their .doorsteps and in their faces.

And that means that they will be far more successful this time, since your own home is now your own personal "relocation" destination, cheaper by the billions.

169. **Richard Cooper** says:

[April 6, 2013 at 10:03 am](#)

Since the smart meter was installed I have experienced heart palpitations, severe leg pains, headaches, UTI's, irritability and other symptoms associated with the meter. My wife has experienced severe anxiety, irritability, painful leg cramping that lasts for hours. Even my dog is experiencing anxiety and irritability and at certain times the dogs in the neighborhood seem to go collectively insane.

Can anyone tell me if there is a law firm engaged in a group lawsuit regarding these meters? This may be the only way to combat them since we are all aware that the PCU really has no interest in requiring their removal.



170. **Richard Cooper** says:

[April 6, 2013 at 10:20 am](#)

Would anyone whose pets are also having behavioral, loss of hair, strokes or other problems contact me by e-mail and describe what has occurred and the symptoms? Contact me at... [Madoce1@Yahoo.com](mailto:Madoce1@Yahoo.com)

Thank You

171. **Mark Hanson** says:

[April 16, 2013 at 11:18 pm](#)

Since moving into my new home, which has a smart meter, I have developed serious health problems. I built my house and was able to work 14 hours per day, 80 to 90 hours per week, with no problems. After moving in, I began to have serious burning and trembling of my feet and legs. Pain in both arms, numbness in both hands, more headaches and backaches than before, and nose bleeds. They have made my life miserable. I cannot walk any distance or ride a bike any distance without extreme pain, burning and trembling of my limbs.

I have had tests and my neurologist has no answers, and wants to send me to Stanford Medical Center for neuro-muscular tests. I am wondering if anyone has had similar problems, and if they went away when/if their smart meters were removed. PG & E has assured me that they have run numerous tests and found no link to health problems, and no radio waves emitted that are stronger than cell phones or computers.

But then they also said they found no link to cancer and birth defects, and Chromium 6 at Hinkley California either, until it was proven. We know that PG & E lies to the public. So, again, has

anyone found health problems to go away when/if smart meters were removed? If so, please contact me, as my life has become a bit of a living hell. Thanks.



172. **admin** says:

[April 17, 2013 at 10:43 am](#)

Get rid of the smart meters asap and **accept only the true analog**, *not a digital analog meter, not a radio off/out smart meter.*

YES absolutely people have restored their health by reducing their smart meter exposure. You may also have to look for other possible RF exposures in your home and neighborhood and eliminate what you can. Wi-fi routers, cordless DECT phones, use cell phones for emergencies..If there's a cell tower within 1500 feet it could be contributing also, as well as smart grid collectors and repeaters. Usually eliminating what's closest can make a big difference. Keep in touch.

**BTW, PG&E lies!**



173. **Madoce1@Yahoo.com** says:

[April 21, 2013 at 2:01 pm](#)

When a patient has an MRI exam the machine uses RF waves to spin the hydrogen atoms in the human body. These atoms give off a signal which is translated by the computer into an image of that portion of the body. Patients and technologists have reported adverse side effects of MRI systems. Patients have stated that they feel weak and disorientated after the exam. Technologists (including myself) have experienced hair falling out, short-term memory loss, disorientation, weakness and pain in parts of the body. I worked on MRI systems for 3 years and experienced all of the above. On a couple of occasions after finishing for the day and preparing to go home I have had difficulty locating my own car just 50 feet away from the machine. Finally realizing it was my car I got behind the wheel and then paused...trying to remember where it was I wanted to go. I finally switched from MRI back to CT scanning and within a month all symptoms abated and I was back to normal. Radio frequency (RF) waves do have a powerful effect on the body and mind.

After my smart meter was install I once again had similar problems and others as well. Last week I ihad to smart meter removed and an analog meter installed. his week my syptoms are far less sever and I look forward to complete recovery.

174. **Betty Dougia** says:

[May 2, 2013 at 8:07 pm](#)

you are getting sick from the electromagnetic field that the meters, and other devices omit. cops use what is call an electromagnetic impulse gun to do to the human body the same thing the smart meters do. get a gauss meter it will help you find the frequency and protect yourself from it. The American government is testing direct energy weapons on the citizen of this county to see what health effect it causes. google electromagnetic field you will learn a lot. I now have the sickness called environmental hyper sensitivity, caused from living in this field. the cops will target you and use their emp guns on you to make you sick if they do not like you or if you are fighting them in court. THE FCC SAID DO NOT CALL US WE DO NOT CARE IF YOU GET SICK AND DIE.



175. **Betty Dougia** says:

[May 2, 2013 at 8:11 pm](#)

Do not allow any doctor to put your body in a MRI machine, it makes things twice as bad.



176. **Betty Dougia** says:

[May 3, 2013 at 5:39 am](#)

emit\*

177. **Tekola Nisla** says:

[May 6, 2013 at 10:32 am](#)

Wired systems emit RF radiation unless properly shielded against this. Simply living near a power transfer station or wires will expose you to relatively strong EMF field. Also, utility companies transfer data over the power lines, between transfer stations and the regional grid control. This is called PLC or Power Line Communications. This is undoubtedly what PG&E is using to transfer data between utility AND the meters, especially in rural areas.

If any of them are interfering with appliances they are in violation of FCC rules and as such you can have the setup checked, fixed or removed as a communications interference.

As for the mesh-network. It's far more benign than any other digital transfer protocol, it's simple, it transmits in set bursts, just like a cellphone or WiFi but using far less complex modulation. It is called ZigBee, a common automation and hobby protocol found from your fridge to RC toys to domestic automation. Peak signal power is usually around 100mW. It's not intended for long ranges or high power transmissions. The transmitters switch on and off to communicate when to hibernate and save power. While on they transmit "continuously" just like any other radiodevice. Also this text has a fundamental misunderstanding between a pulse, a signal and frequency. The writer seems to confuse signal encoding, which all telecommunication devices do, from your

modem to my 150W radioamateur station, with communication bursts. The transmitter isn't going off for 2 milliseconds, it's just encoding data at that rate, continuously transmitting for however long it needs to communicate with other meters, your fridge, airconditioning, etc. that you might've connected to the smartgrid.

The data is encoded with either binary or quadratic phase shift keying, that is, the signal sine-wave carrier signal transmitting at 900Mhz / 2.4Ghz (the standard uses both) (900 times a second vs. 2400 times a second). With binary phase-shift keying the modulator shifts the phase of the sine-wave by 180 degrees to signify either a 0 or a 1. and QPSK has four phase-shifts 00, 01, 11, 10, having twice the data bandwidth.

All I see is unsubstantiated anecdotal evidence without sources, doctors reports or even an official diagnosis. Talk of PG&E – or it's subcontractors trespassing but nobody sticking to their rights and calling the comps and raising a case and incredible delusional paranoia over wireless systems.

Your paranoia is and unfounded fear mongering has lead to hypochondria and others to develop it as well.

And if you indeed are a verifiable case of RF sensitivity, please post source material. As of now there is no official diagnostic criterion for such a condition in either DSM-IV or ICD-10.



178. **Tekola Nisla** says:

[May 6, 2013 at 10:44 am](#)

“Mia Nony” also writes incorrect claims. A human body emits several different EM Frequencies. One of which is heat, or infrared, also we reflect light which also electromagnetic radiation. And usually we have some radioactivity as a result of natural background radiation in substances consumed and which form us. In addition, Canadians. You live on top of a uranium field. You have Radon hot spots, which are a very real and far more dangerous health risk than radio/microwave radiation which isn't ionizing.

Also, consider this, your brain emits enough EMF that you can actually perform a low-resolution cat-scan simply by attaching an antenna-array over your head and feeding the signal into a computer. That's your brains electrical impulses impinging upon an external sensor array being read using a simple receiver. “Absolutely no EMF”. With out EMF there would be no humans, there's a huge ball of fusion blasting this planet with energy with the whole EMF spectrum and it's the very reason there is any life at all. Man made signals are a camel fart in the desert compared to sun-storms.

179. **Nancy Chevreaux** says:

[May 7, 2013 at 8:37 pm](#)

I noticed a smart meter was installed at my house I own in Oroville, CA. It is strange because I have a locked gate. Someone must have jumped the fence to install this thing. I was not advised in advance or even asked if I agreed to it being installed. These power companies seem to be above the law. I know that if you are a tenant, a landlord must give 24 hours notice to enter your property. I am just confused...and now I am reading about all these side effects from the smart meter. My main concern is the entering of personal property without prior consent and not given a choice to opt out.

Nancy

180. A says:

[May 8, 2013 at 12:56 am](#)

Tekola Nisla, if 100s (most likely 1,000s or more) of people around the world are feeling and have felt (sometimes/often extremely) sick because of wifi smart meters, I think that's a huge problem(!) There should be wifi/wifi-smart-meter-free zones in every country so that people who are sensitive to wifi smart meters and other wifi can have a place to live and exist without wifi of any kind, the way life used to be back in the 20th century/1900s. Smart meter (and wifi) activists like Dafna Tachover, Liz Barris, Dr. Magda Havas, Dr. Barrie Trower, Dr. Henry Lai and numerous other people have said that wifi smart meters and wifi can seriously physically harm people and other organisms. This is real and has been going on for years. Wifi smart meters and wifi are nothing "like the sun" because wifi and wifi smart meters have only been around since the 2000s and 2010s I believe. "Modern," "current" and "trendy" does NOT necessarily mean "good" (and sometimes/often it's not). I pray that wifi/wifi smart meter sufferers are given a place to live without wifi (like there is apparently in Green Bank, West Virginia I've heard).

181. [MLC](#) says:

[May 16, 2013 at 8:18 am](#)

My name is Marguerite LaChance and I would like to tell everyone about the health problems I had after the so-called smart meter was installed on my house.

In May of 2011 the meter was placed on my house without my authorization and with no notice or warning of all the health hazards. Around that same time, I remember that I started feeling tired all the time, getting very dizzy, I started passing out and was having chest pains. I started getting very weak and needed a cane to walk around so I would not fall; but I fell, many times.

My Doctor started treating me for vertigo, with no results.

In March 2012 I passed out again and fell to the ground, because I was so weak and dizzy; the paramedics brought me to the hospital. I was in the ER for a day then transferred to the intensive care for a day, and then I was another day in patient care. They did all kinds of test and blood work but found nothing wrong, except that my heart rate was low; but attributed that to lack of oxygen. So they sent me home with oxygen bottles, which I had to use day and night, but it didn't help.

The chest pains were getting worse, no one knew why. I was in and out of the doctors' office as well as the hospital, having test after test and endless blood work. They could not find anything wrong; at this point the pain was going up to my neck and making my left arm numb.

Then my Dr. did some very intrusive test, and found no answers about what was wrong with me and finally suggested I go to see my cardiologist. They ran more tests and did more blood work but all they could tell me was, my heart did not cause the pain.

I felt like I was dying, but no one had any idea why. I had no life in me, dizzy, headaches, chest pains, weak, couldn't breath, and I needed oxygen all day long. Every living moment of my life was agony, I really though it was over for me, and there was no help.

At this point my son Robert started doing research on the Internet and discovered that other people were having the same health problems. Robert printed many articles for me to read that were written by professionals and Doctors all around the world. These articles are telling people about the problems other people are having from the smart meters.

My son called CMP and asked them to remove the meter and they did so with in two hours, after he told them I had a pacemaker. CMP told us it would cost us \$40 to put back the old meter, even though they took it for free in the first place. They also said, "we would have to pay an extra twelve dollars a month for that." I understand approximately half the state is not on smart meters and they are not paying an extra twelve dollars a month; for the old fashion, safe meters.

I am so very happy to say 3 days after that meter was gone, I stopped having chest pains, and within a week I didn't need the oxygen all the time. My energy started coming back to me and I was walking without the cane. After about a month, I started sleeping nights, no more headaches, no more chest pains, and no more dizziness or passing out falling to the ground. My life is pleasurable again, and I truly enjoy living, Thank the Lord.

I called CMP several times and spoke with at least six different people about all of the issues I experienced. Not one person at CMP seemed to care or even believe me. They are still making me pay extra to live free of the awful effects of their terrible new meter. But I would rather pay them their wrongful fees and live then save twelve dollars a month and die.

182. **Christine Justice** says:

[May 18, 2013 at 6:34 am](#)

I have been sensitive to mobile phones and wifi for a few years and did get a lot of headaches. But only hours after the new smart meters were installed I experienced severe temple pain in my right side and severe ear pain and teeth pain. I have been searching trying to find some kind of protection for me and my children. Does anyone have any suggestions?

183. **Veronica** says:

[May 21, 2013 at 11:35 am](#)

I just wanted to say to all those people who continually state that the smart meters/ARM's don't cause problems, you are lucky if it is not causing problems for you. Not everyone gets cancer, not everyone has heart attacks, not everyone develops kidney disease and not everyone gets electromagnetic sensitivity! Some do, some don't. It would be insane to say, "I didn't have a heart attack from eating poorly, so you couldn't have had a heart attack from eating poorly". There are diseases that affect only a small section of the population—but those people suffer nonetheless. Some in the medical community don't understand the medical problem because it is not taught in school yet. Not having a diagnosis name or the mechanism for the disease does not magically make the constellation of symptoms and the cause vanish. Diseases generally start without a name. There are plenty of Environmental Doctors who are aware of this illness. The people who are suffering from it do not have 3.5 billion dollars at their disposal to show the problem and cause. The industry has unlimited funds to cloud the issue, marginalize the sufferers, and influence legislation. I was told that this was a pilot program in my state of Indiana with opt out options by a representative. However, I have received no other calls or assistance though I have phoned and emailed everyone who is suppose to be representing me. I haven't received any assistance yet from the utilities or the government. Like everyone else, I am shocked by the way this is being handled and shocked by the customers inability to have any say in having a device that is causing so many health concerns and misery. I, myself have spent several thousand dollars on medical tests that simply cannot show that I am affected by the pulse that is emitted every 28-30 seconds from the THREE meters my home . I can only pray to God that we can all join together and hopefully have some leverage against these deadly meters.



184. **Mia Nony** says:

[June 2, 2013 at 12:18 pm](#)

I am at a loss as to why people are not doing something to help themselves. Do they feel they must suffer? ARE they too weak to act to save themselves? Are they not aware that there is only one direction this is going, toward death?

I have a neighbor who did not want a smart meter but who also did not want any conflict with the utility. That neighbour caved in to pressure – and now suffers ALL the classic symptoms of radiation poisoning. Radiation poisoning is not recognized by radiation illiterate doctors. That neighbor's beloved pets are constantly on edge ever since the smart meter was installed, completely altered and anxious.

Instead of prevention or remediation of radiation exposure, that neighbor is only a few months later now scheduled for a craniotomy to relieve skull pressure, blinding headaches, extreme spine pain.

The smart grid is no different than the perfect murder weapon, as no one, doctor or patient, seems able to make the link between radiation 24/7 and the myriad of symptoms of extreme suffering. The exception is those who remove themselves from exposure and notice that the symptoms abate. What I don't understand is this:

In every sense the smart grid is not one bit different than nuclear fall out. The cellular damage is identical, just slower to cause irreversible damage.

If a bomb had gone off, I am beginning to wonder just how many people would shield their homes

and hard shield their home wiring, – even then.

I have nothing but anger for the illegal torture and nothing but empathy for the growing suffering but still ..... unless one is a masochist, would most people, if still able, if doable, not want to STOP it by any means possible?

Unless chlorella and spirulina are taken after cutting out all sugar, as was done after Hiroshima for the survivors, the damage will accelerate.

Unless bentonite clay is taken to bind up the radiation poison in the body, disability will grow.

Unless radiation shielding is put in place until these criminals go to jail for genocide, people will go into sharp decline in ever greater numbers.

Unless people are prepared to use whatever they can afford to use, most importantly house wiring shielding, carbon paint, carbon sheets over meters after utility hours, radiation deflection window screening, double walled foil insulation, metal insect screening correctly applied, etc. (from lessemf.com or somewhere more affordable) .....unless shielding is used to protect oneself from one's own smart radiation emitting device and from the guaranteed irreversible damage caused by it and by all the other meters around one's home, (meaning get neighbors on side and all do shielding, which must be done correctly after ALL wireless is removed from the home), ..... OTHERWISE, this slow motion depopulation will not stop, not until most of the nation is disabled, diseased and dying.



185. **Mia Nony** says:

[June 4, 2013 at 3:59 pm](#)

The following protocol can noticeably ease radiation overload suffering. This is only for the meantime until shielding and removal can occur. However this is not a permanent solution to radiation poisoning, until the source is eliminated.

One of the natural antidotes to electromagnetic poisoning is correctly designed physics aware magnetics, (not the new age pendant type stuff)

These are military grade frequencies and they require a military blocker. Track down an RF choke or electromagnetic filter – the kind they talk about on eiwellspring.com

Depending on the type install the microwave filter or rf choke either at the electrical mast or at the electrical panel. The design must match microwaves to filter out smart frequencies. (poor pity everything biological in nature, with no way to find any shield from this microwave blanket) When researching this, be sure to locate and use military grade filtering.

Dr. Brian Clement, Hippocrates Institute has a protocol for treating EHS.

Incidentally this approach to radiation overload reduction often reverses cancer as well.

– Detox first, using gentle bentonite clay or french green clay.

– Stop intake of ALL sugar and ALL foods which rapidly convert to sugar in the body. Sugar acidifies the body and further predisposes it to microwave induced disease. One tsp of sugar depresses the immune system for 56 hours even without frequencies already doing so.

- Do not take any artificial sweeteners (poisonous) or any sugar substitutes, other than stevia and stevia only in very small amounts
- Eliminate all “white” foods, minimize fried food, shellfish, “hot to the tongue” foods from the diet. This includes dairy. Unsalted butter is fine. Greens are healing. rawfamily.com
- Get rid of excess fat
- Nori type seaweed is anti radiative and is protective of the thyroid
- Remove wheat from the diet due to mould

#### Eat Sea Vegetables

- Spirulina, warning only a minimal amount to begin with, 1/4 tsp. Do not take more than the maximum daily dose of 1 tsp. Only work up to this level slowly as excess will adversely effect bowels.
- OR
- Chlorella – slowly increase up to 30 tabs and then slowly to as high as 120 to 180 tabs in severe cases
- Infrared sauna – 30 to 60 minutes daily – (Sit 4” away from infrared source or radiation)
- Drink PURE water –(not reverse osmosis filtered water as the latter is drained of all essential minerals)  
Drink ½ ounce of clean water per pound of body weight (e.g. 160 pounds = 80 oz equals 10 cups of water per day)
- B vitamins – high quality brands only, such as New Chapter, or Vitamin Code or AOR
- Ionic minerals – Manganese, Magnesium, Phosphorus, Calcium
- Dulse seaweed – buy low salt variety or rinse out the salt
- Take very warm salt baths (use Dead Sea or common salt) for 20 to 30 minutes, best done before bed time. Add ¼ cup of powdered Ginger (least expensive if purchased in Indian markets)

---

Electrosensitivity symptoms can be eliminated in 60% of people and significantly reduced in the rest – Dr Brian Clement

by Andre Fauteux – la Maison Saine –  
March 20, 2012:

– <http://maisonsaine.ca/electrosensitivity-symptoms-can-be-eliminated-in-60-of-people-and-significantly-reduced-in-the-rest-dr-brian-clement/>



186. **A** says:

[June 19, 2013 at 12:29 am](#)

I wonder about how autism (now “1 in 50” children has autism I believe, as of March 2013), cancers (I personally know of several/many people who have died of/had brain cancer, and one person I know died of eye cancer), disabilities and other physical/health problems are connected to wifi and wifi smart meters. I believe they are/can be connected, though most people seem to be “fine” with wifi smart meters/wifi, but at least some people are not. Human (and animal) health is about food, water, environment and genetics. Of course wifi smart meters and wifi aren’t the only things hurting human and animal health. It’s also unhealthy food, water, the environment other than wifi, genetics, etc. It’s so shocking that this is happening and not being stopped thus far. Mia gave some advice to try and help those suffering. That’s good, but ultimately, we need these wifi smart meters, wifi smart appliances and wifi to be outlawed. This is all 21st century stuff, like “Agenda 21” (21st century). Wifi/”wireless” itself has only been around for several years I think(?). I hope we see some national/global action taken against wifi smart meters, wifi smart collector meters, wifi smart appliances and other wifi.

187. [heartbone](#) says:

[June 19, 2013 at 4:12 pm](#)

This attack on the people simply is part of the New World Order depopulation protocol.

- Wi-Fi/cellular telephony/”Smart Meters”
- hidden artificial sugars
- unlabeled GMOs
- water fluoridation
- sterilizing vaccines
- chemtrailing
- prohibition of Cannabis use
- excessive pesticide residues allowed in food
- Codex Alimentarius
- prime-time TV
- Corexit/Synthia mixed into the Gulf of Mexico
- Fukushima releases

@ Mia Nony – June 4, 2013 at 3:59 pm

**I too am an advocate of Bentonite clay for detox.  
However it only works to remove ionizing radiation,  
not the stuff coming from Wi-Fi/cell phones/”Smart Meters”.**

188. **jon** says:

[July 1, 2013 at 10:21 am](#)

there doing this to destroy americans if its your health or your property! cell towers are part of it along with smart meters and chemtrails. any electric field that is generated in your home gives them access to spy on you. if its your vacuum cleaner or cloths dryer any electric motor that is on! sounds crazy right, ya, that's what I thought ! do you hear sounds from your walls, like pinging or the t.v. clicking when it's off, or strange noises ,I believe that's echo microwave radar working! I know all the symptom's ,the pain, fog, no energy etc! when your ears are ringing their power is on . I have to say this, it seems not many people are working but I see utility trucks digging up grass belts everywhere and installing fiber optic cable and cameras . new generators and high power transformers being installed in neighborhoods that have been around for 20-30 years why? this is war for the souls of men!

189. **Cathleen Bowen** says:

[July 5, 2013 at 4:42 am](#)

Hi,

I stumbled across these complaints whilst looking for something else. I have suffered many of these symptoms for several years. But the worst thing is that my mum who lives next door had tinnitus, pressure on her head, dizziness and heart palpitations. She passed away 3 months ago. The night she took ill she complained of her usual head pressure and of being more dizzy than usual. Because her doctor had assured us that nothing was wrong I gave her some paracetamol and put her to bed. She then started to scream – o my head it feels like its going to burst.

We called an ambulance – by the time she got to hospital she was in a coma – she had suffered a massive cerebral bleed. She died a week later niver having recovered.

The Electricity metre in her house was changed a few years ago and the house next door was renovated around the same time – probably around the time she first complained of her tinnitus and pressure.

I'd really like to know if this affected mum's health but here in Ireland you get laughed at for putting forward any of these theories.

We cant all be wrong though so keep up the good work.



190. **admin** says:

[July 5, 2013 at 2:21 pm](#)

Hi Cathleen,

I am going to send you an email privately. If you don't receive it please email me. Found this flyer on smart meters from Ireland, so there's resistance starting there.

<http://www.mast-victims.org/showasset.php?id=1773>

Sandi

191. **Mary** says:

[July 8, 2013 at 3:54 pm](#)

we had the smart meter installed for 1 year, since then I have been experiencing headaches sharp pain in my head, dizziness, fatigue, loss of balance, heart palpitations I know this is from the smart meter, it is right outside my kitchen window and every time I go in my kitchen I get all the sensations, especially the dizziness and light headedness, I been feeling really sick since this has been installed. I also have trouble sleeping, and I get nausea a lot, I want this meter off my house please get a bill together so people like me can opt out of this without paying and outrageous amount



192. **A** says:

[July 26, 2013 at 7:46 pm](#)

I am so annoyed that this issue doesn't receive coverage by the "mainstream media" every single week (heck, every single day) – There are literally 100s or 1,000s (most likely many more) of people suffering from wifi smart meters in the U.S. and all around the world (and many/some have been for years), and the national media in the U.S. doesn't cover it? They've been talking about "the royal baby" and Anthony Weiner's, well, you know (Huma (his wife), you could do so much better – You deserve a husband that doesn't cheat on you ("sexting" or otherwise), just like Hilary Clinton did/does), but do they talk about the wifi smart meter health controversy as a (weekly) "top story" on national news in the U.S. and world? Not that I've seen(!) – Fibromyalgia seems fairly common these days, with body muscle pain and weakness/fatigue/hard to physically get out of bed often being main/possible symptoms, headaches, seizures (Lil Wayne, Rick Ross and Kelly Osbourne to name 3 famous examples in the past year or 2), brain bleeding/strokes (in the past year, Bruno Mars' mom died of it, Cathleen's mom (above, on Smart Meter Health complaints) died of it, a member of the band Mumford and Sons had surgery for it, country singer Randy Travis had surgery for it, etc.), autism affecting "1 in 50" children as of March 2013, cancers (including brain, eye, breast, etc.) apparently increasing, etc. – It feels like we are living in the twilight zone in many ways in late July 2013, like this is the new "normal" – Wifi smart meters (and other wifi) can, and have, physically injured and/or disabled (or worse) many people around this world – This is not OK and can no longer be ignored(!)



193. **admin** says:

[July 26, 2013 at 9:21 pm](#)

Here's some recent smart meter health impacts coverage from Oklahoma!  
<http://kfor.com/2013/07/23/customers-says-oge-smart-meters-making-them-sick/>

194. **Tom** says:

[August 7, 2013 at 4:17 am](#)

I cannot believe how they are forcing these things onto our homes when they have never been proven to be safe! I live in Chicago & ComEd is stating we will NOT have a choice and they are going to be installing these “smart meters” on all homes in our area in 2015. They say the radiation is nothing compared to a cell phone or microwave. We told them we don’t use cell phones & have never owned a microwave specifically because of the radiation. They don’t care. They are putting them on and I am terrified for my family’s health!

195. [monica hershaft](#) says:

[August 9, 2013 at 10:45 am](#)

I had one installed in February. They said it’s not a smart meter but an RF meter (radio frequency) and my life has been hell ever since. It’s been increasingly affecting my sleep and the insomnia has been getting worse and worse over time to the point where maybe I get 3 hours now. I also have been getting headaches increasing in severity and frequency. Now my period has stopped coming and I’ve been irritable, edgy, and spinny. I wake up feeling hungover and sick. The DWP says they won’t remove it and is charging me \$30 to have someone come investigate. I was not warned about anything and also was told to get this meter because I had received a \$900 bill (I live alone) for the reason that they couldn’t get to my meter to read it and that’s why I needed a digital meter so my bills would be more accurate. My bills have gone up by over \$100 since they installed it. I used to live in a bigger house and had a much smaller bill prior to this. Something needs to be done!

196. **Earthlinghere** says:

[August 12, 2013 at 3:50 pm](#)

We live a pretty enviromentally aware, progressive city. We eat organic food, and have flouride free water. And I forsee the next step of this progressiveness will l be decrease use of cell phones, cell phone towers, wi-fi and absolute elmination of smart meters. We have digital meters to check frequency pulsations in our home and in cars etc... while driving in a new digital car while talking on your cell phone is not safe. According to our field meter the waves register so high that the measurement is off the charts. I wonder if this is why it seem like every other person has cancer? Anyhow, PGE told us they will happily remove the meters for \$ 250.00 and the cost every month for a human being to come to our home to read the meter is I believe 52.00 .

San Fransisco basically has a choice if you want smart meters or the old meters The price remains the same. In Hawaii there are no cell phone zones on certain parts of the island to protect children from dangers of EMF waves, so awareness is increasing . See the way things are going anymore we would love to run off into the “Lost Horizon” and get lost in the countryside there .



197. **admin** says:

[August 13, 2013 at 6:11 am](#)

Did PG&E tell you the cost to opt out was \$250 and \$52 a month? If so, this is not true. It's 75 and 10 a month and less for low income. AND we are opposing these fees in a legal proceeding at the CPUC. Sandi



198. **A** says:

[September 3, 2013 at 11:47 pm](#)

it's september 3, 2013, and has anything changed in regards to the wifi smart meters around the u.s. and world? not that I can see – I still see several of them around my neighborhood and place of work every single day – you really would think that enough people have (loudly) complained (nationally and globally) about these things to get them outlawed, but no, not yet – all we can do is hope that there will be a great “sea change” in the near future and that people will really begin to realize and finally accept that wifi smart meters (and all other wifi) are (very). bad. for. human(and animal). health! this is not “rocket science” (far from it), and a “tipping point” appears to be coming in the near future, with all this wifi radiation pretty much everywhere every single day

199. **Jash P.Thiessen** says:

[September 15, 2013 at 4:34 am](#)

Just Never Ends The Scenario of must be wired up to the nearest Satellite Tower....We have so many of them now there several now in our Neighborhood in a 1 Mile Radius...our City of Quesnel,British Columbia ,Canada also has one of the Highest Rates of Cancers in Canada according to Health Canada and the Canadian Cancer Society.....tomorrow we are all dragging ourselves through Yet another Terry Fox Marathon Walk or Run..Do not forget Steven Fonyo who felt inspired to finish the Journey and Live still.....Where are all those Carconegics coming from?..It is a well researched Fact ...The Foods we eat is laced with Pesticides and other cancer causing Chemicals which both the F.D.A. and allows in small Minute Portions...Now our Air is also allowed to be laced with small amounts of Pollutants known to cause Cancers such as Vehicle Emissions.PaperPulpmill Emissions which are monitored for Emissions considered acceptable....In our Day and Age the Authority of the Air rules the Airwaves and quietly puts out Radiation .....The Scientific Facts are there and the Whole World of Governments are on the Same Ship The Titanic.....A Sinking Ship of Major Proportions unless the Whole Ship is Turned away from that Iceberg of Technological Disaster.....Safer Technology.....Greener Technology....

200. **Ian** says:

[September 20, 2013 at 5:04 pm](#)

I live in NZ in Auckland (boarding) with a friend who is an electrician. Some months ago they installed a new meter which no longer requires them to come into the house to check the reading. Old meter is still on the board.

Siunce then I notced sometimes at night I copuld hear this humming but no one else could, they thought I was making it up.

Lately I been getting headaches at night and for a long while now I do not sleep very well at all. Also I have noted my eyes have detorated really quickly where it is getting to the ppoint I have to waer them all the time. Before it was for reading only.

This is an old house so the meter board is in the hallway and seeing they no longer come into the house I am guessing what they installed is a smart meter. The board is also right outside my bedroom..

The brand on this meter is Elster Metrix and has a digital readout. Is someone able to confirm that this is a smart meter for me please.

The main tenant is not open to listening even though he is an electrician about these sorts of things as he is in this mode where the world powers would not do these things and he thinks I am a conspiracy theorist..Basical thinks I am making things up.

Is there anything I can do to protect myself while living here ?

Any assistance appreciated.



201. **admin** says:

[September 21, 2013 at 9:03 am](#)

You can call the utility to ask if the meter is emitting RF, either wireless or what the industry calls unintentional radiation. You can try reducing other wireless devices already in the home to see if reducing your overall exposure helps. Be sure to complain to the utility, and whomever oversees utility safety. Shielding meters is tricky, and if the RF is in the wiring then the meter should be removed. Know you are not alone.

202. **Timm Slybo** says:

[September 29, 2013 at 1:23 am](#)

If its on your own property, You should make a “faraday cage” cover for the smart meter so that it is completely insulated and the RF signal cannot escape. Its not hard to do.!

203. **HAHA** says:

[October 2, 2013 at 8:21 am](#)

Hi!! I am a kooky guy! THE SMART METERS TALK TO ME! THEY TELL ME THEY ARE POISONOUS! THE GOVMT HAS INSTALLED A CAMERA ON THEM TO SPY ON ME! HOW DARE THE ELECTRIC COMPANIES TRY AND UPDATE A TECHNOLOGY THAT IS MORE THAN 60 YRS OLD!! AND ALSO MY BABY MONITOR, CELL PHONE, RADIO, MICROWAVE AND OH YEAH... THE CONSTANT RADIATION THAT BOMBARDS MY BODY FROM THE SUN IS EFFECTING MY HEALTH... CAN WE OPT OUT OF THE SON??? morons



204. **A** says:

[October 2, 2013 at 10:28 pm](#)

“HAHA”, I hope neither you nor any of your friends or family members get sick/have gotten sick from wifi radiation, including wifi radiation from wifi smart meters – the fewer people suffering in the world, the better – but believe you me, 100s/1,000s or more people all around the u.s. and world are currently, and have been, physically suffering from wifi smart meters and other wifi radiation for years now

205. **GP** says:

[October 3, 2013 at 5:22 pm](#)

Smart Meters are ruining my life. I have now been exposed to smart meters in both Indiana and Illinois and have become significantly ill during direct exposure. Having now had more prolonged exposure it takes more time to recover. When exposed, I am disoriented, dizzy, nausea, have significant brain fog and moodiness. I also have major headaches, tinnitus and am unable to sleep for more than 3-4 hours. I have recently discovered with prolonged exposure I have started to have significant chest pain and had to go to the ER to make sure I was having any cardiac event. I have incurred significant financial burden as I cannot live in my own home in Central IL and have been sleeping in my car or a hotel. I also have had to work partially in Northern Indiana but quickly discovered I could not live there due to the meter radiation. My \$500 rent per month in Valparaiso has not turned into a \$1500 rent in Chicago with a daily 3 hour commute and added \$200 train ticket. I still have major issues as my job in Valparaiso still exposes me to these meters during the day and I have had to adjust the amount and pattern of work that I do each day. But I may not be able to control my work load soon and don't know what I am going to do. My symptoms always start upon exposure and always decrease and eventually disappear when I remove myself from them. It is a very clear and definitive precipitant and it is degrading and dismissive when the electric companies tell me that there are no problems from them. Thus far I have been met with resistance and no opt out options.

206. **D Hall** says:

[October 7, 2013 at 1:43 pm](#)

HAHA says, "CAN WE OPT OUT OF THE SON???" I don't know but if you do have kids maybe your son would like to opt out of living with you because you sir, are an ignorant moron.

207. **J** says:

[October 7, 2013 at 4:13 pm](#)

It's spelled "Sun"- you obviously are not very bright..No pun intended!



208. **J** says:

[October 7, 2013 at 4:18 pm](#)

"Ha Ha" obviously has no health problems and doesn't have a compromised immune system!



209. **A** says:

[October 10, 2013 at 9:01 pm](#)

everyone gets health problem(s), sooner or later – not only is there wifi radiation from wifi smart meters, wifi, cell towers, etc., but I have also heard that the fukushima nuclear disaster from march 2011 could still be affecting the world with nuclear radiation more than 2 years later – I don't mean to be a "negative nelly", but if we can't control some things, we should at least try to control the things that we can actually control, like, oh I don't know, getting rid of wifi smart meters all over the u.s. and world and going back to non-wifi analog meters? who knows what the future will bring (it doesn't look too good now), but hopefully things will get better

210. **Selisha** says:

[October 20, 2013 at 10:02 pm](#)

Hi, my name is Selisha. (My mother suffers from EHS & has been homeless due to smart meters now for nearly 5 months.)

We wanted to ask if you could please add your voice & encourage others to add their voices to a potentially precedent-setting case developing against smart meters, starting here in San Diego with plans to spread out. An attorney is seriously interested in taking the EHS case on to stop all this ridiculous violation of EHS—an ADA-recognized disability. This attorney to my knowledge has never lost a trial & has a strong disgust for injustice, so if he takes the case, this is a good chance with far-reaching implications. He's a personal injury trial attorney who is very happy that EHS is accepted as an illness by the ADA, & he wants to help ordinary people harmed by others carelessness or intentional wrongdoing.

But the office needs as much information as possible (and they are happily delving into it all), particularly from experts, in their own words.

To go forward with a proceeding, Jayme (the daughter of the attorney, who is evaluating all the EHS evidence before it goes before her father) needs 3 things:

1. She needs to speak to EHS sufferers, & particularly hear about how smart meters have driven you or someone you know from a home or in some other way impeded the right to socialize or be at home. (Public settings included as well—stores, offices, transit—however smart meters & wireless has held you or someone you know captive.)
2. At least 1 medical expert in the who can unequivocally testify that smart meters themselves are dangerous and causing the damage claimed. (to corroborate EHS victims' claims) This is important to stem the almost certain tide of power company denial!
3. And another expert who can verify fair damage amounts (settlement amounts, etc).

The attorneys are trying to do this right, and the more people they have to help with these 3 things, the better & the quicker the process.

Please call her (the attorney's daughter)  
Her name is Jayme (619) 236-9696 Her Father's name is Sean Simpson

(Let her know Selisha told you about them)  
<http://www.simpson-moore.com/seansimpson>

Thanks, potentially this can help get a survey together & help more than just one state, but set precedents to stop this ridiculous violation of a valid ADA-recognized disability.

Thanks, please let me know you received this, & please send to ANYONE else who could be of help  
Selisha (858) 571-7181

211. **Neil Mc George** says:

[October 22, 2013 at 10:39 am](#)

Which handheld meter do you recommend for testing for cancer causing RF?



212. **admin** says:

[October 22, 2013 at 10:53 am](#)

<http://www.radmeters.com/Cornet-ED78S.html> for home use



213. [Selisha](#) says:

[November 5, 2013 at 9:52 pm](#)

Hi, this is Selisha. (Mom has EHS & has been homeless for 5 months due to smart meters forcibly installed on our apartment complex.) I'm writing to ask if you know where the newer findings are saying that cellphones & wifi are conclusively carcinogenic? I know before that WHO has said possibly they are carcinogenic, but I keep hearing & I remember coming across new findings saying conclusively & definitively that they are carcinogenic, not just "possibly" or "potentially." I need them for an upcoming submission but just couldn't locate them.

Please let me know or if you know someone who might be able to direct me to these papers...

Thanks so much, Selisha (858) 571-7181



214. **admin** says:

[November 7, 2013 at 2:35 pm](#)

The WHO classification is a 2B possible carcinogen- they have not changed that.

215. **Richard** says:

[November 7, 2013 at 9:56 pm](#)

Selisha (and admin) – Actually, the WHO classified RF radiation as a Class 2B Agent, which they define as possibly carcinogenic to humans... "This category is used for agents for which there is limited evidence of carcinogenicity in humans..."

>> That is what has not changed.

Anyone interested (Selisha?) in the WHO's work and conclusions should first familiarize themselves with the definitions laid out in their Preamble to all that RF work. REF: <http://monographs.iarc.fr/ENG/Preamble/CurrentPreamble.pdf>

I am unaware of any more recent studies or analysis of previous work that even comes close to "new findings saying conclusively & definitively that they are carcinogenic". If any such work exists, then PLEASE let us know.

216. **Paul H** says:

[November 10, 2013 at 8:28 am](#)

Richard is unaware of the mechanism involved with the slow destruction of mankind due to microwave (300MHz-300GHz) frequency radiation. It seems impossible for some to put pieces of a puzzle together. They are only capable of looking at the finished product.

For a quick video go here

<http://www.youtube.com/watch?v=EnUK3Z3Lyfo>

How could the smart meters' 900 MHz frequency be effecting my head?

[http://www.avaate.org/IMG/pdf/resonancia\\_craneo\\_Israel.pdf](http://www.avaate.org/IMG/pdf/resonancia_craneo_Israel.pdf)

Are stress responses to geomagnetic storms mediated by the cryptochrome compass system?

<http://rspb.royalsocietypublishing.org/content/early/2012/03/12/rspb.2012.0324.full>

Cryptochrome and magnetic sensing. (smart meter emissions are pulsed magnetic waves capable of disturbing the cryptochrome)

<http://www.pnas.org/content/early/2012/03/08/1118959109.full.pdf>

<http://www.ks.uiuc.edu/Research/cryptochrome/>

Why are cryptochrome so important for sleep?

<http://www.nature.com/ncomms/journal/v4/n4/full/ncomms2670.html>

What is the pineal gland?

[http://en.wikipedia.org/wiki/Pineal\\_gland](http://en.wikipedia.org/wiki/Pineal_gland)

What is melatonin and why is it so important?

<http://www.ncbi.nlm.nih.gov/pubmed/15589268>

Why the FCC doesn't protect against biological effects.

[http://www.hese-project.org/de/emf/WissenschaftForschung/Ho\\_Dr.\\_Mae-Wan/showDoc.php?lang=de&header=Dr.%20Ho&file=Non-Thermalbiological%20Effects.html&back=../showAuthor.php?target=Ho\\_Dr.\\_Mae-Wan](http://www.hese-project.org/de/emf/WissenschaftForschung/Ho_Dr._Mae-Wan/showDoc.php?lang=de&header=Dr.%20Ho&file=Non-Thermalbiological%20Effects.html&back=../showAuthor.php?target=Ho_Dr._Mae-Wan)

Is the power company lying to you?

<https://maisonsaine.ca/sante-et-securite/electrosmog/smart-meters-correcting-gross-misinformation.html>

Do the cell phone companies know they are producing a harmful product?

T-Mobile's ECOLOG study

<http://www.wifiinschools.com/uploads/3/0/4/2/3042232/ecolog20001.pdf>

iPhone users can read their disclaimer on their phones. Instructions below.

Go to SETTINGS  
next; ABOUT  
then; LEGAL  
finally; RF EXPOSURE

Notice the word BODY and not HEAD. Yet it has a touch screen.

I understand that some may not be able to understand the above mentioned since it wasn't dictated in a university type atmosphere.



217. **A** says:

[November 11, 2013 at 6:55 pm](#)

Yeah, Paul, some/a lot of people think that universities/colleges/grad. schools/professionals/the mainstream media, etc. have some of the “smartest” people in the U.S. and world working for them – And this is true in some ways, but not in other ways – Wifi industries make billions of dollars every year selling billions of humans wifi products yearly – These multi-billion-dollar industries pay “professionals” in universities, grad. schools, mainstream media, etc. millions of dollars to claim that wifi “cannot hurt people and/or animals” in their “scientific” “studies”, when it is very obvious that many humans (and other animals/organisms) have been physically injured (or worse) by wifi products for several+ years now (including wifi cell towers) – Wifi smart meters are some of the most dangerous wifi products still being forced on millions of people worldwide – I don't know when or if there will be an anti-wifi-smart-meter U.S. and global “sea change” that could possibly outlaw those evil little blinking, pulsing buggers (along with other wifi products), but only time will tell

218. **Renoaku** says:

[November 12, 2013 at 2:19 am](#)

I don't remember exactly when the Smart-Meter was installed into our home over a year ago, However since the installation of the “Smart Meter” My Family Members, and I have experienced Multiple Health Problems, and can only think that it is related to the Smart Meter.

Within a Couple of months after the Smart Meter was installed I started Experience Anxiety/Panic Disorder, I went to see Multiple Doctors and was diagnosed with Panic Disorder. I also Experience other symptoms on the list like Body pain, but the worst symptom I have had was Anxiety. Oh and I forgot Sleep Problems too.

My Mother which is a Diabetic is also now experience Respiratory Problems, Multiple Urinary Infections, Arthritis Pains, Trouble Breathing, Anxiety, Sleep Disorder.

We both have also had the ringing in the ear thing for me it is very rare but sometimes.

Over the Last 2 months though I have not had as much problems with Anxiety not sure why I was put on Medication but Didn't take it because of the side effects on the meds itself, although the only thing I can think of when this all started is the "Smart Meter" which was installed in my house, I have no problem with Smart Meters, myself, but seeing all the complaints, and no scientific to prove these can't effect our health is the problem, I would rather pay an additional \$5 a month for someone to come out and read my old meter than to remotely monitor a meter with an automated API and risk health problems, or other concerns.

The Panic Disorder was so bad at one time that it could have been life threatening to myself, and others because of this.

I believe that we should have the right to Go back to the Old Analog Meters without any problem to determine if this is the actual cause, I have grown up around Computers myself for over 10 year's exposure to Radiation from Multiple PC monitors, Microwaves, Wireless WI-FI from my modem never had any problem but the Smart Meter maybe causing us health problems and we would like a way to rule this out.

Not sure how to go about asking to go back to a Analog Meter though as I am in Texas, and I read the AEP Site they say we have to be connected to the Smart Meters.

Now I am no expert but I do believe the Smart Meter could very well cause health problems, perhaps it has many factors on a persons Life, and how they live, and proper research should have been done before making the meter have to be installed in everyone's House. I understand the Need for Digital Meters because this is the Digital Age, however I feel there are more safe ways to read a meter like through the Power Line itself rather than having every home broadcast Wide WI-FI signals out of the persons property that could cause health problems, or constantly broadcasting information over wide distances.

I would very much like the ability to OPT-Out and Determine if this is the cause to our family's Health Problems.

219. **Laura** says:

[November 14, 2013 at 9:49 pm](#)

All of us have been having too many headaches since the new meter was put in. Our daughter sleeps with the meter on the other side of her head. She wakes up with headaches and nausea. At first I thought it was my imagination. But last year she attended the school year out of our home. At one point I asked her when was the last time she had a headache, and she could not remember. This year she has returned and her headaches are back and getting worse. We are getting a analog meter put back on the house. I have a dull headache most of the time with sharp pains in my head. I hope the absence of the meter corrects the problem with all of us.

220. **shauna** says:

[December 14, 2013 at 10:47 pm](#)

I have had similar problems on and off for about a year. My head gets really tight and foggy and sometimes the pressure in my head gets so bad I feel like my head is going to explode. It gets really scary when this happens and wonder if I should go to the hospital, especially when it wont go away. I know this is due to my sinus's swelling. It also effects my eyes and vision when this happens. Along with these symptoms I get a really nervous and shaky feeling for some reason and get a drunk feeling in my head. I also get red rashes and burns on my face, disorientation, memory loss, and confusion. I did some research about these symptoms and have come to the conclusion that it could be electromagnetic sensitivity or electromagnetic poisoning. Just recently my fingers on my right hand started twitching and when I go someplace else it all starts to clear up after a few days.

This depresses me because I just got my Bachelors degree in graphic design and just started a career in this field and I cant seem to be on a computer for more then 10 minutes without my eyes and face burning and my head feeling like its going to pop. I have been given freelance assignments and job offers, but I don't think I'll be able to do it..... So I guess my career is down the drain.

This all started when I moved into my apartment a year and a half ago, I never had problems like this before. I could use a computer as much as I wanted and now suddenly I am so sick and foggy headed all the time. I have heard about living near cell phone towers and having smart meters can make you sick. I found out that there is a cell phone tower a couple a blocks away from me and I am suspicious that my apartment complex is using smart meters. I am moving in a couple of weeks and hopefully I will start feeling better after I do.

So about a week ago I ordered an EMF shielding tent to sleep in and it has been helping a lot but I do have to spend a considerable amount of time in it. If I spend too much time in my apartment without being in the tent I start getting really sick again. The tent makes me feel a lot better and I can sleep really good and it makes the symptoms go away, even the twitching in my fingers.

221.



**admin** says:

[December 15, 2013 at 10:50 am](#)

Once you move- hopefully a good distance (at least 1/2 mile or more) away from cell towers and hopefully away from smart meters, consider reducing your overall electrical exposure. Most helpful is turning off the electricity at the breaker box- but every home/situation is different. Also I have found using a MAC notebook on battery, on a grounding pad, with an extended keyboard and wired mouse really helps ALOT. More ideas here: <http://emfsafetynetwork.org/safety-precautions/>  
Thanks for sharing your experience with a faraday tent. Sandi

222.

**James Ginn** says:

[December 25, 2013 at 10:43 am](#)

This is absolutely amazing. I just happened to catch Joyce Riley's show on the radio this morning and they were talking about smart meters. And then it dawned on me. I have been having trouble sleeping for several weeks with an interrupted sleep which is totally foreign to me as I usually sleep like a log. Also I have noticed that I get these little pangs of nausea every so often that last but a few seconds and appear randomly throughout the day. I have been unable to account for such symptoms as I have never experienced anything like this before and have always been very healthy and fit.

And yes it now makes sense since these symptoms have been going on only for a few weeks and that is about how long the new smart meter from Hydro Quebec has been installed.

When doing a web search I came across this site and I thank you for all the info. Its good to see someone is on the case.

223. **Joel** says:

[December 26, 2013 at 1:13 am](#)

You people are a bunch of woowoo wingnuts.  
Probably don't vaccinate your kids either.

224. **Abdullah** says:

[January 2, 2014 at 5:11 pm](#)

I've been having problems for a long time, lots of health issues, finally noticed the source of the problems was the smart meters, cordless phone docking stations, wifi, cellphone towers, etc.

It's getting ridiculous, and then there are denizens of hell like Joel here to try and promote the sickness and discourage the sanity. Wish I could install all the smart meters in the world on his face, he can have all the vaccines too.



225. **L** says:

[January 2, 2014 at 9:00 pm](#)

"Joel," it seems that dozens/100s of people from around the U.S. and world have complained about wifi smart meters on this website alone – You're accusing a lot(!) of people (globally) of being "woowoo wingnuts," which is pretty rude, not to mention scientists like Dr. Magda Havas, an associate professor at Trent University in Ontario, Canada, and Barrie Trower, an English physicist who was a microwave weapons expert and who worked for the Royal Navy and the British Secret Service (according to the youtube video: "Wifi, Microwaves and the Consequences to Our Health – Barrie Trower") – Too many people (globally) have physically suffered (and worse) from wifi radiation from wifi smart meters (and other wifi, possibly along with other cause(s)) for too many years now

226.       Xy says:

[January 5, 2014 at 3:50 am](#)

I'm a born again bi-directional transmitter,  
Covertly sensitive & weak.  
No matter how much damage I cause  
I inherit the earth, not the meek.

It's never ever my own fault  
No matter what I do.  
I'm uninsurable, nosy, risky, greedy,  
Yet they're all easy to subdue.

I'm illegal – I arc & corrode wires.  
I'm feared ...yet they imbue  
Me with powers far beyond what  
Any digital device can do.

When I sneak on to home wiring  
Homeowners just cry & shriek.  
They seem helpless and act hopeless.  
A laughing stock for any geek.

I can set home wires on fire  
Faster than one can strike a match.  
I operate remotely,  
Using stealth to data snatch  
And latch on to every move they make,  
For privacy to dispatch.

Luckily they don't catch on  
I possess a unique streak.  
I tend to succumb instantly to  
Certain magnetic techniques.  
A few rotations around my sides  
Make my mother board just freak.

My much touted "power"  
Is actually just a sham.  
Most worry about stopping me,  
And fear my tamper tell all cam.  
They really just do not get  
How vulnerable I am.

The flighty think I'm almighty  
They're just so dead easy to scam.  
Good thing they've never figured out  
How simple I am to jamb.

227. [Guy mckinney](#) says:

[January 8, 2014 at 2:06 pm](#)

I had been given a notice in mail a couple months ago that a service tech was to come out and put in a smart meter ! I immediately called them to let them know I wanted to opt out. I told them I didn't want one installed die to my rights to say no ! I started also having insonomia bleeding of nose. Headache etc I received my bill today looked at it and it was almost twice as high as last December and I didn't even put up Christmas lites this year due to the closeness of the holidays. So wow I called nevada energy and asked them why is my bill so high. They said well it was about the same last year I said no its almost twice as much I live alone and she said well after we installed the smart meter the energy has been about the same !!! I asked what you put in a smart meter you jumped my gate ? You entered my property without my permission broke my gate to enter ? Ill file a trespassing charge now because that is called breaking and entering she told me they have to have access to their equipment !!! They never had the right to enter more did they have to because they could just look over fence to get meter readings. So if I'm out of line someone please call me. 775-843-7685



228. **admin** says:

[January 8, 2014 at 3:19 pm](#)

Outrageous. contact this NV group: <http://www.trueemfsolutions.com/contact/>  
I doubt you can get them on a trespassing charge. However document your experience by making a declaration.  
You should be able to call the utility and opt out. Or tell them you never consented to having a transmitter on your home and tell them to restore the analog meter at no additional charge. Good luck.

229. **Polly** says:

[January 13, 2014 at 3:55 pm](#)

Shortly after my SM was installed I started having severe itching in my ears. It feels like bugs crawling inside. I never had headaches until the meter was installed. This has been going on for almost 2 years now. In the past 3 months I had 2 double ear infections. I never go to the Dr., but had to go to Urgent Care for the infections. I told the Dr. it felt like bugs crawling inside my ear and he couldn't explain what was going on. He asked me what a Smart Meter is??? My electric Co. won't change the meter and if they did, I am afraid my neighbors meters would affect me as

well. I am miserable. My son is also suffering from the RF. His ears are bleeding and he has pains shooting thru his head. This is so cruel. What are we suppose to do. Pack up and leave our home and live in the woods. That's what I am about to do. We are being tortured.

230. [Robert](#) says:

[January 20, 2014 at 9:56 pm](#)

I am wondering if people with mercury amalgam fillings are more sensitive to smart meters, in general. If you have mercury amalgams, you could join the frequent-dose-chelation group in Yahoo, and post your story. <http://health.groups.yahoo.com/group/frequent-dose-chelation/> If you can not get away from a smart meter, try shielding, especially your sleeping area. You can buy cheap aluminum mylar "emergency" blankets to provide some shielding. Website <http://www.createhealthyhomes.com> has useful information.

231. [how to get rid of tinnitus](#) says:

[January 21, 2014 at 7:17 pm](#)

As opposed to adults, the elderly are much more vulnerable when it comes to developing tinnitus symptoms. Apart from their age, the body systems of the elderly (primarily their senses) are already vulnerable to degenerating.

Chances are they already have an altered smell and taste, probably have hearing difficulties, or probably have vision problems.

232. [Paul Vonharnish](#) says:

[February 1, 2014 at 8:27 am](#)

To all those complaining here, and the other 5 billion who are being intentionally snuffed by electromagnetic radiation devices: Get a weapon. Learn how to use it. When they come onto your PRIVATE property to install their death machines, open fire. If you think governments will ever protect you from these thugs and their snuff machines, you are brain dead already. Smart meters and smart devices in general, have only one purpose, which is to kill off the "worthless eaters". Fight back with every weapon you can lay your hands on.

233. [charlie](#) says:

[February 6, 2014 at 9:45 pm](#)

Yes, radio waves do effect amalgams. In WW2 the radar personell had to replace theirs every couple of months. mercury is also loosened when you visit the MRI.

I am trying to think of possible solutions to this radiowave problem, i sympathise with all of you (i too am severely sensitive to a specific type of radio wave that i dont often come accross... mobile

phones do not effect me much and i dont have smart meters in my area). Im not a professional with radiowaves but have a little electronics experience.

We know that microwaves heat water. Therefore water absorbs microwaves. Install few fish tanks into the room you cannot use. (No fish please). Build a strong wooden structure to hold them (see next about risks of metal bolts). Although i feel it may not work that well. Adding salt should cause the wave to conduct through (bad).

Next is antannas. There is an invention called “chaff”, this confuses radar when the bits of foil are dropped from a plane, because the foil is cut to a specific length (half the wavelength travelling at the speed of light) to retransmit the signal. You will find something similar encased in a plastic lump sticker on shop items, when they pass through the sensors, the red lights turn on and the alarm sounds. We are told the meter signals are 2.45Ghz and 900Mhz. therefore the chaff for 2.45G is 5.9014cm (2.323 inch) long and 900Mhz is 16.65cm (6.557 inch) long. If you have any metal object in your house that are these lengths or a multiple thereof, you should trim so they do not become emitters. I first heard of chaff when someone said you can use it as a passive WiFi extender. In the video about the YAGI antanna, bars of about this length are added to focus the RF energy.

<http://www.youtube.com/watch?v=lsIHtCUSfN4> (about the YAGI antanna and the dipole antanna), the video is slightly broken.

In order to absorb some of this energy, one of the simplest things you can build is a dipole antanna, which is not unlike the chaff.

diple antannas consist of two wires end to end, between them is the load. The load can be a small torch light bulb (if you want to see it, and want to replace the bulb when it wears out). You can buy little blinky things for your mobile too, but these dont absorb much energy. The total length of the two wires are the same figures mentioned earlier. you can zig-zag the wires if you need to fit it into a confined space like your meter box (not sure about coiling, like onto a pen shell, maybe). the 900Mhz is seemingly on the 2G mobile phone band, and 2.450Ghz is about halfway between WiFi channels 6 and 11 (You can tell me if your meter is transmitting on both frequencies by installing both sizes). I dont think you should copy the YAGI antanna, having the elements which are designed to focus what comes from the transmitter. simply make a bunch with bulbs on each one.

My questions:

\*I dont know what sort of load is best, if you make it a short circuit, you will only get a reflector, in fact you can find a radio receiver by the little bit of signal it does reflect. More than likely this has something to do with the laws of thermodynamics.

\*And i dont know if you can deviate from the design slightly: should you have a number of half lengths in parallel with a singular load?

\*should you install multiple units oriented in each axis, X,Y,Z?

\*should you vary the lengths a bit? perhaps +/- 1%

Finally, let me tell of something i did when i was younger on the school bus, which should help everyone:

I brought a little radio with me on the bus and sat near the bus driver. I found that if i tuned my

radio near the station of the bus's radio, the bus's radio would fade. From memory, it was slightly off frequency, rather than right on the station, which i thought was odd.

Summary:

Use the dipole antenna in the meter box. you can probably use a resistor (an electronic component) to replace the bulb, but check with a second unit with a bulb that the resistor is not adding to the length (it shouldn't), and should respond the same when brought together as if you had a bulb on it (two bulbs needed for the experiment). Conduct the experiment at night if the bulbs do not light. A camera without an IR filter can see heat before you can and also make sure that the bulb was not destroyed. It may best to have something near your body also, since we know that it can drain all the radio waves in a small vicinity around it. If you hear noises, instead of the dipole antenna, try the chaff, it may actually mute any hum completely. One person here wrote the noise they hear is associated with the trains, so it's seemingly an instantaneous measurement of the electromagnetic noise you are in (and you should be able to detect if it is better or worse). Why the chaff? The thinking is the laws of thermodynamics, for every action there is an equal and opposite reaction. Because i had my radio near the bus, it was sending out a signal to cancel the waves being received by the bus. Even in the video link, the reflecting element of the YAGI mutes the signal. The chaff, being a short circuit, completely mutes anything nearby because of its ability to retransmit the signal.

Well i hope this helps someone, even for the development for proper shields... enjoy... and if you are in a building with heaps of meters enjoy your personal sun bath! (although there may be negative ramifications for "sabotage").

Other melatonin research trails involve blue light before bed (look that one up).



234. [charlie](#) says:

[February 7, 2014 at 3:25 am](#)

Following on from the previous message.

If you intend to use LEDs instead of a lamp, ensure that you use two in parallel and facing opposite directions, because a single LED has a finite reverse voltage, two LEDs clamp the voltage low. Even with this precaution, they can be cooked much easier from too much power. I suggest greater wattage heatsinked ones but still no guarantees.

an alternate link to the previous video shows the making of the lamp antenna:

<http://makezine.com/2010/02/03/seeing-radio-waves-with-a-light-bul/>

here is a link about another handmade dipole antenna including the simple formula:

<http://antirez.com/news/46>

The WIFI function of the meter is likely to control in-house things (for example Google's 'smart thermostat'), therefore both transponders would be active. And perhaps is the motivation for charging people 9% more for their power for keeping their old meter.

Some recent computer processors (yes, CPUs) come with a 3G transponder for security (anti-theft) and possible remote activated system updates (since Jan 2011, although not all of them, and I'm still not sure if you can trust the CPUs that are "fine"). The public is only aware of Intel products, AMD is not known. I am not sure when it gets used.

Finally, about fires: For all we know, these house burnings are deliberate – that is, remote controlled. If you had a firecracker attached to your house, what would you do to protect your investment if it were to ignite? But when I read about these, there isn't any information about the current going through them at the time. If excessive and prolonged then sure it might burn (it may even be the fault of the installer), if all you have is a fridge running then it could be more sinister, because these things are supposed to be rated for high current (the conductors are supposed to be large), and with a singular bad connection, the large conductors should heatsink the heat.

You can tell a very bad connection by doing this. Measure the AC voltage using an RMS meter designed for mains AC (cheap meters have a warning to not use on mains and are not RMS), then have your wife cook. Measure the voltage again and that would be your voltage drop. If your cooktop has 600W elements that would be  $600W/110VRMS=5.45A$ . You see a 16VRMS drop then 87W is being lost somewhere (and assuming power factor = 1). If you are in a rural area far from anyone, by yourself on your own power pole transformer then this will not work as well unless you have a number of other loads occurring in the building. Better is access to the Grid side (because the transformer windings have a finite resistance). If it burns after your test (which found perhaps only a 5W loss) then it may not be good news for anyone.

If it uses a solid state relay for disconnecting you then that's an additional problem, the voltage will drop from being turned "on" will consume 1-2% of the energy intended for the load (SSRs have a 1.1-1.6V drop, in addition to a resistance that increases with heat, in other words, the possibility of thermal runaway). Some sources recommend "semiconductor" fuses to protect SSRs in the event of a load short circuit. If you have the normal filament type of fuse (rather than circuit breakers) used with older meters, then it's of little surprise the meter burned out instead of the fuse. Therefore a possible reason for the fires is previously the fuses only get warm. Upgrade to circuit breakers. If the conductors were poorly connected to the SSR then there is an increased possibility of a fire. I don't think a bad power factor would contribute to a fire (provided there is not much other load) but may (likely) contribute to your bill (not sure if it would be called your "peak power consumption").

"SCR-output devices can be expected to fail short at high temperature, while MOSFET-output devices can be expected to fail open." Here, "short" means the load remains powered. The latter can fail part conducting (can heat further).

SSRs are said to produce EMI but I assume this only occurs when switching, because I can't find anything.



235. **J** says:

[February 26, 2014 at 8:53 pm](#)

I was looking at a 2013 book by David Icke, 61, “The Perception Deception”, and he talks about wifi smart meters (and C.F.L. lightbulbs, etc.) in his book and how negatively they affect (at least some) people’s health globally – There are many people in the world, including scientists, who think that wifi smart meters are (very) harmful to (at least some) humans – You would think that would be enough to ban wifi smart meters globally, but only time will tell

236. **John** says:

[March 12, 2014 at 3:35 pm](#)

In Florida FPL is threatening me with a letter saying i will have to pay \$250+ a year extra if i keep my Analog meter and don’t exchange for Smartmeter! -( by March 30,2014) It’s getting crazy! Fascist Dictatorship – Comply or PAY!

237. **Mark** says:

[March 23, 2014 at 8:04 am](#)

Moved to South Carolina from the UK in late 2011 and rented an apartment in a nice complex. I do not know if smart meters are installed but I suspect they may be. Moreover, every apartment, and there are about 300 of varying sizes, have wireless internet access. There’s a cell tower that I can see from my living room window. The local airport is about 3-4 miles distant but the aircraft noise isn’t that bad.

I considered myself to be a pretty healthy person. I watch what I eat and drink and all that good stuff. I’m able to work from home a few days a week but I’ve been avoiding that. I started to develop problems with my concentration and became easily fatigued. My sleep is frequently disturbed and I’m getting vague aches and pains all over my body. I have started to feel quite lethargic and have lost interest in things that I formerly found pleasurable. It is quite categorically not depression for when I leave the building for any length of time, the symptoms markedly recede and I feel much better.

I’m moving away next month to a more rural environment which I hope will be beneficial but the only thing that I attribute my symptoms to is exposure to massive doses of EMF.



238. **admin** says:

[March 23, 2014 at 1:31 pm](#)

Some buildings are “sick” with EMF’s from bad wiring. It may be electrical fields, and magnetic fields in addition to wireless. You might consider getting a Trifield meter and a cornet RF meter and measure any new possible place, before you move.

239. **Debbie** says:

[April 8, 2014 at 8:49 pm](#)

Do you want to defeat the smart meter without vandalizing the box ! It will drive the utility company nuts. As they will not be able to read the box anymore. Not will you get hit with pulsed radiation....Wrap it in foil. Yes ordinary kitchen foil. You are effectively building a faraday cage which shall block all electric magnetic radiation emission.

Another solution is a metal trash can. But everyone has foil, it is cheap and does not damage the meter.

I would not recommend this for electrical boxes unless you are very careful. But gas, it works perfectly.

If they will not remove it, wrap it up... Goodbye problem. From your local computer engineer...

See:

<http://www.thesurvivalistblog.net/build-your-own-faraday-cage-heres-how/>

240. **Linda** says:

[April 22, 2014 at 9:30 pm](#)

Smart meters, two of them, were recently installed on the rear of my daughter’s home in Michigan. My grandson started having grand mal seizures, we believe as a result. He had been living at another location with no problems but as soon as he moved in to where he is now, he started having grand mal seizures. My daughter, his mother, is having daily debilitating headaches, as well. She is paying to have to pay to have the smart meters replaced with analog. Another problem is, the next door neighbor’s smart meter is facing my daughter’s home right where my grandson’s bedroom is, maybe twenty feet away if not closer!! He was getting pulsed with three meters, simultaneously, one for gas the other for electric!! I’m sure the whole neighborhood is alive pulsating with these waves. He will have to move. His life is in danger from having the grand mal seizures. He stopped breathing with one of them and unresponsive another recent time, each time going to the ER and even staying in the hospital for a couple of days. The medication destroys the liver. This is a horrible situation!!

241. **Heather** says:

[April 23, 2014 at 3:21 pm](#)

Thank God I finally figured this out.

For the last 2 years I have been trying to figure out what's wrong with me. I was living in Los Angeles and Ojai. In LA, I felt fine. When in Ojai, I woke up all night, headaches, brain explosions in my sleep, (very scary and had never knew those existed) balance problems, facial flushing, depression, confusion, hard time finding words when talking, etc. After 8 doctors, MRI's, blood tests, getting tokd I could have cancer, etc., my neighbor helped me figure it all out. Reading these posts confirms it. It was this horrible Smart Meter.

The Smart Meter was removed 4 days ago. Already feeling better. Not back to normal yet but headaches went away right away, facial redness all better right away, eye sight no longer blurry, no numb hands when waking up. No pain in elbows. Sleeping well again.

There's is something that needs to be done about these Smart Meters. Most people have no clue how bad they are for us. I'm thankful for all of these posts. I hope something will be done for those people in states that won't take out these meters.

242. **Lynelle** says:

[April 25, 2014 at 1:03 am](#)

I have a solution!!!! (read on...)

I was relieved to see I am not the only one with these strange symptoms. I can't believe how many posts are on here. It's phenomenal!

I just happened to see a post about Smart Meters on Facebook last week (Apr 13, 2014)—a youtube video called “\* DANGER\* Smart meters being installed by global utilities....UN Agenda 21 \* DANGER\*” and another called “The Dark Side of Smart Meters.” VERY enlightening! I went down stairs from my 2nd story home office, and checked the meter on our house to see if it was one of these Smart Meters. It's located just under my home-office desk outside the garage wall. It was. Didn't think anything more about it.

I had talked to a M.D. at urgent care a few weeks earlier because of frequent and recurrent arrhythmia, palpitations and chest pains. I didn't connect the extreme DIZZINESS, balance problems, malaise, trouble forming words, fatigue, pain behind my eyes, irritability, endocrine problems, learning problems, and head pain to the heart problems, however. It was a week after viewing the videos, that I sat down at my computer and within 10 minutes began getting that dizzy feeling again...and exhaustion. I had woken up that morning feeling energetic and motivated—ready to tackle the office and the world! But that all got flushed when I sat at my desk to begin work—and felt awful in short order. It was then I had a lightbulb moment.

I searched for that youtube video and after re-viewing the video, called the electrical co and learned they would change it out for a mere \$10, but then would also FINE ME \$5/mo for not having it. What?!? So I wrote letters and also called the California Public Utilities Commission and was directed to a Smart Meter Hotline...where all I could do was leave a message. My complaint was that I was NOT going to pay a FINE for NOT having something I never gave

permission to install anyway! It's been on my home since Dec 5, 2011.

I talked it over with a couple friends. One found a DIY solution on youtube. <http://youtu.be/CwzeMOH-Jl4> “DIY Smart Meter Shield: light-duty, temporary, portable” I told my husband about it, and we decided to try it. The ready made covers are \$100-200, and besides, I wanted something RIGHT AWAY! So we went to Lowe’s that night, got the materials covered the wall behind the meter inside the garage and I crafted a cover for it and slipped it on before bed. In the morning, I felt so much better! And I felt great all day for the first time in years. My husband said, “I like this new woman I’m married to!” Why? Because I am now witty, bubbly, energetic, productive, even tempered and rested.

We also ordered a tri-meter to test the change in output. I plan to go to all the neighbors and alert them to this hazard. I will MAKE the little covers for them and offer them at a reasonable cost, just to reduce the EMF’s surrounding me from these hazardous little radiation producing body-roasters.



243. **admin** says:

[April 25, 2014 at 9:30 am](#)

Excellent. Please do contact the CPUC to complain <https://appsssl.cpuc.ca.gov/cpucapplication/> because there are millions of these all over CA- and beyond and people don’t know they are a hazard. Thanks for posting your experience and sharing the video, Sandi

244. **Nina** says:

[April 25, 2014 at 9:48 pm](#)

Lynelle –

Though shields will reduce exposure, they won’t eliminate it. People have had symptoms return over time. Your symptoms are very serious, and symptoms tend to increase with increased exposure. For instance, if you have wireless internet in the house or use cell phones, you are increasing your exposure, and may notice symptoms you didn’t have before when using them. This is in addition to the continued Smart Meter radiation.

Take Back Your Power <http://www.takebackyourpower.net> is a great movie with information on the many problems with Smart Meters, including electrical fire danger, surveillance aspects, and the risks of hacking. Inviting your neighbors for a movie night, many may decide to give the utility company an ultimatum to remove the Smart Meters or you will replace them yourselves.

Jerry Day has these videos, one talks about removing and replacing Smart Meters and he has forms to send to the utility company.

<http://emfsafetynetwork.org/?p=6562>

[http://www.youtube.com/watch?feature=player\\_embedded&v=8JNFr\\_j6kdI](http://www.youtube.com/watch?feature=player_embedded&v=8JNFr_j6kdI)

245. **Ray Marks** says:

[May 6, 2014 at 10:17 pm](#)

What I would do is hire one or two companies to come out and read the radiation levels in several different areas of your home. If you want to start cheap, I found this...

<http://www.lessemf.com/rf.html> But what you have to remember is that the goal here is to bring the utility company into litigation, and once you have proof from a company that knows how to measure radiation, any lawyer should take your case pro-bono, after all your under attack. You will have to find out exactly what time your meters upload data cause what I'm reading is they only do it for 90 seconds between 3-4 am in the morning. For such a short time of radiation, it would have to be a whopper to be affecting people the way that I'm reading on here. It's to my understanding these meters only upload data once a day.

The only thing I have ever suffered from was cell radiation back about 2000. It was my first cell phone and I started to have problems with my eyes twitching. I lived in a rural area which means my cell would be automatically switched to max output to hold contact with the tower. The eye problem persisted and eventually got worse, and I went to an eye doctor and they told me they would give me a steroid shot in the eye, and I said screw that. Soon I developed heart attack symptoms, I would double over, hard to breath, and rush to the window trying to get fresh air. I thought it was carbon monoxide and bought testers that proved me wrong. In a weird stroke of luck I had stopped using the phone for two weeks, and soon realized that all the symptoms went away. Weeks later my wife needed a cell so we could move to Spokane and look for property, and I warned her what it did to me. She hooked it up, and used it for a few days and her eyes started to twitch like mine had.

Keep in mind that cell output is suppose to be the same as those wireless meters, the problem with a cell is your holding it right up to your head. Depending on how far away you are from a meter, the power would drop exponentially.

Call the utility company and ask them what time yours uploads data. Get a professional to verify what parts of your home is getting hit the hardest and how hard. Do some research to try to compare the results to say a CAT scan, or an MRI, or an X-ray. If you can establish it's severe enough in comparison, you probably have a case. I don't think the judge would like to hear that your being exposed to the equivellant of an X-RAY every day. And if he tries to down play it, ask him if he would volunteer to having an X-RAY every day for the total amount of time you have been exposed.

246.



**admin** says:

[May 7, 2014 at 8:19 am](#)

Most smart meters are transmitting at least a couple times a minute, and even can transmit 2-3 X a second.(and more as the appliances join in)

247.

**Snowy** says:

[May 24, 2014 at 5:48 pm](#)

I know a couple who feel that they literally saved their own lives, attest that they reclaimed the full use of their minds because of the installation of a very high quality industry grade whole house suppressor. They had it installed either between the meter and the service panel or right in the service panel, not sure which, but it was one with emf filters built in too, and LED lights to let them know about any power surges, its status, etc

Apparently these suppressors get rid of not only electrical transients from incorrect wiring but wireless induced total harmonic distortions and noise which is making so many so ill. I know they had to ascertain that the one they had installed was well grounded.

Has anyone else out there had success with use of any industry grade, emf filter enabled, whole house suppressor? I don't mean the regular hardware store variety which apparently can give a false sense of assurance since you are usually unaware when or if they fail.

I refer to the really top end skookum kind which industry uses to prevent damage to electronics, one that saves LED displays, wiring, and inflated bills, installed to save a ton of money. Anyone?

I mean the kind which smooths out the artificial "smart" sine wave and eliminates those wretched transients emitted by every aspect of every node in the entire wireless grid and especially the harmonics and transients emitted by the smart "meter"'s SMPS?

Worth researching, wouldn't it be? If the claims from industry are what they seem to be claiming, world wide, then if I understand this, the good suppressors are designed to filter everything from lightning to the smallest frequencies.

I know they are not cheap.

Also this type of suppressor has full replacement warranty and is said to protect against frequency graphing and activity data analysis and capture (privacy)- as well as frequency interference with bioelectrical human and animal systems (health)- as well as to save money (over billing, gouging)

248. **Michael Elliott** says:

[May 31, 2014 at 7:21 pm](#)

The smart meter is a nightmare! my bill is terribly and I have many many health problems that I've never had in my life! I want it removed, it is killing me and my pet! OG&E has not replied.... I believe my bill is triple what it should be

249. **[Darragh McCurragh](#)** says:

[July 8, 2014 at 11:01 am](#)

What is difficult to understand is why these "smart" meters need to give off any undue radiation (except the 50 or 60 Hertz "buzz" that comes with the electricity as such). The "smart" is not about sending WiFi or microwave signals to "outer space" continuously. Even if a smart meter were to be read from outside the building to save time and be independent of people being at home when they are read (although they should transmit this information through other channels anyhow), then they need not radiate continuously but only once a meter reader approaches the building and sends an activation signal, after which it would send out a data packet and switch its sender off again.

250. **george anderson** says:

[July 8, 2014 at 10:18 pm](#)

I tried to delay this for as long as I could. The meter went in today and I am in fear for my life. I am already feeling the symptoms that so many of you describe. We all need to flood the lines and call your congressman and bitch like hell every day.

251. **Hans** says:

[August 6, 2014 at 3:09 am](#)

Easy way to TEST if you're susceptible to all this WiFi stuff:

– VACATION on an UNINHABITED island, a large forrest or somewhere high-up in the mountains. (As long as there's nothing there).

Vacationing in true nature for a few weeks will let you easily find out if you got sick/have symotoms from the 'WiFi BEFORE' and 'AFTER'.

You'll be sure to notice a clear difference.

Pluck the day,  
Hans

252. **Randy** says:

[August 28, 2014 at 3:31 pm](#)

I am electrically sensitive and have been very concerned about smart meters as well. I found out this week though that my symptoms are not from my smart meter but from the COLLECTOR routers around my city. They are mounted on utility poles every mile or so. When I drive by or am exposed to the radiation from these COLLECTOR devices I get immediate symptoms which last for hours. I was then paranoid my smart meter was making me feel sick. I wanted people to know that the smart meter is just part of the whole system your electrical utility is using and there are other parts which are probably worse than the smart meter itself. So find out where the collectors are located and do your best to avoid them.

253. **Joyce Dent** says:

[September 13, 2014 at 7:07 am](#)

Been sick for over a month now not sure if they are smart meters, but can not sleep in bedroom...my head thumps everynight, have fast pulse day and night...so tired , can get no sleep..sore throat also once a year..doc can't figure this all out, but I think I have...How do you

know it s a smart meter??? There are at least 24 meters on my bedroom wall in this complex..I am sick... and the big thing with high volage is outside my bedroom window also Joyce

254. **kris sherman** says:

[November 1, 2014 at 10:10 am](#)

I got a golf ball size tumor on my leg right where it sits next to my computer tower. I also found out that the 8 SMART METERS on the other side of my wall ARE WIRED right under my desk creating another big surge of EMF. Double whammy for me. i had it cut off 2 weeks ago and it was malignant Melanoma. I got a EMF detector and got very HIGH in the danger zone, readings where the meters are wired. I have a friend who cant walk anymore so I went to see whats up and when i knocked on her door there was 9 SMART meters on the wall next to the door. just inside where she sits all day, very high readings and she puts her feet on the floor where its wired. She is in BAD shape

What you cant see CAN definitely HARM you

255. **TeeShark** says:

[November 12, 2014 at 2:26 pm](#)

Man you guys are a few sandwiches short of a picnic! I hate the utility companies and will usually back any fight against the thieves but I cannot get behind this hair brain idea. How many of the people claiming health problems are just looking for a lawsuit so they can sit on their fat @ss? How many of you own more then 2 cats (in general... Multi cat owners tend areto be eccentric or in lala land. If these meters suddenly started causing you problems then why did your problems not start when wifi and cell phones became common place. Walk/Ride down the road with a smart phone and see how many wifi networks you walk/ridr through. Besides you can beech all you want... The utility companies employ the best of the best lawyers just to deal with you nuts on a regular basis.

256. **Margaretha Tierney** says:

[November 23, 2014 at 4:21 am](#)

I had a smart meter installed under protest on my bedroom wall. Two weeks later I felt terrible, my head felt so strange. I had to go overseas and the feeling left me. On my return, the second night in that room and the awful head feeling came back. I changed bedrooms and it was gone. Then went overseas for three months, no problems. On return slept in that room and second night strange sick feeling back. Slept in another room. Went overseas and on my first night at a motel this awful strange feeling came back with waves going through me. It lasted while away and continued on my return for months. Some said I had parasites, but no evidence of them. Every six weeks, the feeling would be back for two weeks and then go again. Felt good for a few months. Two weeks ago it was back with a vengeance, waves through my body at night, palpitations and my right leg would not walk properly. The doctor was concerned about a stroke. Since then have felt terrible for two weeks, but last week good again. Interesting that every Monday I am terrible for exercise class, but

right all week. What happens Sunday night that is different? Am told every tenth house has a 'mother meter' that acts on behalf of the other nine houses. Don't know what it does differently. Until I can get total protection of all radiation in my house, I believe the symptoms will continue and perhaps get worse. Looking into the best and cheapest protection at present.



257. **admin** says:

[November 23, 2014 at 9:56 am](#)

Find support via an Australia stop smart meters group <http://stopsmartmeters.com.au/actions-you-can-take/support-groups/>

258. **Suzanne** says:

[December 9, 2014 at 6:34 pm](#)

We had a meter installed (against our wishes) about 6-8 weeks ago. We have been experiencing sleepless nights, severe muscle calf cramps during the night, tin flavored saliva, joint pains, ringing in the ears, blurred vision on occasion, dizziness, joint pains, continual nausea, headaches. Even our 4 cats have been behaving "differently." Did not want this NOR did we approval of the installation!! Visit the doctor and the answer is medications....NO, we have been healthy and take good care of ourselves!! It is BS!!

259. **Frank** says:

[December 17, 2014 at 6:25 am](#)

Sleeplessness, tingling and head feels like a balloon and other strange sensations. Thought is was my job and so quit, losing out on the year end bonuses of few thousand dollars and took a job at half the pay which barely gets me by. Symptoms continued and came across this site and realized the sleepless nights and funny pressure in the head began a week or so after the smart meters had been installed last month. Ridiculous and treasonous.

260. **Kathleen** says:

[December 21, 2014 at 6:52 pm](#)

My Tinnitus is driving me crazy! Ever since the new electric digital meter was installed outside the bedroom window where just below that window lies my head every night, I've had this problem. Also have weird headaches, sleeplessness, irritability, memory problems. I'm not alone, my husband has most of the same problems, except for the headaches and Tinnitus. We had no choice but made to install it. If we didn't want it the electric co. would charge us a fee and our bill would increase monthly. I'm so sick of it! I am going to do research to find out what I can do to maybe block the signals from coming into our house!

261. [theevolutionofosiris](#) says:

[December 25, 2014 at 11:57 am](#)

was driving through millburn new jersey residential area in september 2013 and I felt my head pounding to the point I thought i was going to die. I also saw white PSE&G trucks around and think they were putting in smart gas meters around there. The emf rf shielded coat I wore next time and the headband did not work to stop the effects the next time I went so now I go another route when traveling through milburn the shopping center area does not have these meters installed, yet. Hope they won't put them there. see stop smartmeters new jersey blog <http://theevolutionofosiris.wordpress.com/2013/03/11/stop-smart-meters-in-new-jersey/> for more. smart meters are so much more dangerous than cell phones and cannot be shielded because it's a web and it all communicates with your appliances which will all eventually be smart, and every smart meter communicates with each other, so it's like there is no escape from this earthly hell.



262. [theevolutionofosiris](#) says:

[December 25, 2014 at 12:13 pm](#)

People talk about how they did not give the electrical company permission to install them. I think these people are all acting like children. The moment you signed up for electricity, you gave them permission to do whatever they wanted, and you don't have permission to touch their property, that's why they sometimes bring police to help them install the meters and prevent you from interfering. If you want to have electricity without smart meters, find another utility, form your own utility, or turn off power in your home and use solar panels. Stop trying to write your utility and convince them not to do it. They are taking orders from higher ups the powers that be, and they are not going to listen to your demands. What you need is not a grassroots organization that tries to lobby congress but one that takes matters into its own hands and forms its own community supported power. This is all part of Agenda 21 and it is world wide so wake up people wake up. Ted Gunderson was talking about it in the 1990s.



263. [theevolutionofosiris](#) says:

[December 25, 2014 at 1:38 pm](#)

People do not realize that everything is controlled and leading to world government, so they cant contact their congressmen and expect it to do anything. Unless they are already good friends with someone on the inside who can help, then there is no reason to do that. What they need to do is realize that Take Back Your Power is controlled opposition. They give you great information, but a horrible solution that wont work. Such as trying to legally fight utilities, unless your judge is a patriot, it wont happen, many judges are bought off for agenda21 and even the fair ones will rule that the smart meter is the property of the electric utility company and home owners who entered

into contract with them do not have the right to mess with them. So I saw people protecting their homes inside them with emf shielding, if that works, good for them, eventually appliances that do not emit emf will be phased out and companies will only be making ones that do, and then in order to get safe appliances, we would need inventors who know what they are doing to compete with the evil appliance companies. I know I had an energy star freezer and it emit very high emf that bothered me and I was sitting 8 feet away, but an old Westinghouse refrigerator does not bother me, not even if I put my head up against it. So again to reiterate, there are three solutions, not proposed by the movie which is controlled opp, always looking to protesting your government to fix your problem when thhe government is in bed with them too. You need to form your own government on your block, start there, and get families together to say no. One family in a sea of families who don't care wont work. It was their evil idea to creat the nuclear family competition, families are strong if they work together, but separate, they are weak. Form your own electric utility, install solar panels on your block, put your minds together to find some other way to get power. As an entire block, get the next block, get the whole town to march to city hall and demand change, remove the people there from power if they refuse. This must be done locally. A few angry parents at a town council meeting will get ignored. Again you cannot stop them from installing it by putting a note or lock on their property. If you cant do any of this, move to a town that is not moving forward with agenda21 and bide your time.

264. **Christine** says:

[January 9, 2015 at 9:51 pm](#)

Live in an art deco apartment block of 8 where we had a switchboard upgrade mid 2014. Now, in October and then January blood tests have detected raised lymphocyte and B cell levels. The haematologist says I have a 1-2% chance of developing leukaemia. I know leukaemia is connected with radiation and so i started to look around my home. Nine smart metres are in a galvanised iron box 2.6 metres from my bedroom window. Inside a brick wall, there are switchboards for four of the units – all busily emitting radiation and even closer than the smart metres. Of course, I have all the usual things in my bedroom to add to my toxic exposure – mobile phone, wireless VOIP phone that runs on a modem, a laptop, two lights, a fan and a fan heater. I'm moving into the back bedroom away from the smart metres and keeping laptop, mobile etc in the lounge room. So scary. Technology is developing so rapidly, it's mathematically impossible to mitigate the new hazards that change brings.

265. **William Johnson** says:

[October 31, 2015 at 8:54 am](#)

I'm currently experiencing the ringing ears. I live in SOUTHERN, CALIFORNIA. I HOPE THEY CAN DO SOMETHING ABOUT THIS MENACE SOON!!!!

266.  **Snowy** says:

[March 28, 2016 at 2:50 pm](#)

Wireless Wake-Up Call

<http://tedxberkeley.org>

I have to say this: I would like to but so far I just do not understand any kind of first response to the smart meter when it takes the form of passive masochism as a reaction to a threat of this size, rather than, for instance, being someone motivated to locate inner resolve and access the determination to solve this problem – now. Smart meters are not an insurmountable threat. They are just plastic computers with no ground wires and no suppressors. They turn YOU into the ground, you and all your loved ones and appliances. NO ground wire is how the smart grid makes money. And sickens you slowly while it potentially kills you.

Is this unconscionable?

Of course.

Is there any point to being indignant but not doing anything to solve this home invasion?

Of course not.

Anyone who is a parent is duty bound to not let their own children suffer.

Any pet lover should be motivated not to let this continue.

I especially do not understand what seems like almost an epidemic of passivity. Way too many humans are acting like pushovers, seemed overwhelmed by this assault on our bodies, our private properties, our minds, our lives and our private homes.

Aren't you angry enough to get even?

FIGHT BACK.

It is all perfectly legal.

Take back your lives.

How?

Use what is available, what has already been used by industry for decades, what is used by anyone electrically and electronically cognizant, a perfectly legal way to sabotage the node of the smart grid on the side of your home and which can be used to regain peace, quiet, sleep, health.

Nearly everyone has a home computer, right?

Are its wireless features shut off, blue tooth, off, airplane mode on?

Nearly everyone has wifi, right? Is it a hard wired modem?

I can only hope that those affected by smart meters already have all the other forms of domestic wireless shut off? And hopefully do not use cell phones or worse still, portable home phones?

Are those who are angry about smart meters part of the problem or part of the solution?

Are they at very least already hard wired in their homes?

Are they already practicing safe tech in their lives, cars, anywhere possible?

Have they got an Electromog monitor to use to monitor sources of rf and radar and microwave harm inside the home or to show others at the office?

Do those who have demonized the smart meter as if it is all powerful happen to recall that any computer is extremely vulnerable to interference, to failures, to glitches, as well as unable to overcome total suppression of its wireless features?

Well, all a smart meter is is a computer.

And a very vulnerable, cheap one, at that.

It is SO dead easy to stop these frequencies.

Unless you think for some reason that you deserve to suffer?

Get active, make friends with your neighbour. He and./or she will listen to how to do this, too, once you tell him or her that this will drop the cost of his and/or her utility bills.

Just appeal to self interest, it works every time.

Imagine if a whole neighbourhood- and then the next one, and the next one, spread the word around that there is a solution to smart meter invasion.

Imagine the impact exponentially, if area after area were to all decide to stop suffering, and get even by suppressing the frequencies in the privacy of their own homes.

What if the entire area all ordered, bought and had installed in their circuit box (sharing two 15 amp circuits is fine, these things do not carry any juice), the right kind of purposefully designed smart meter suppressor, which already exists and is perfectly legal to own and use.

Then the Wide Area Network single harmonic distortion that is damaging everyone would cease inside the home.

The smart meter over billing would cease, because the pulses and surges would cease inside each home.

The privacy would return because the frequency graphing would be inaccessible, because the fire starting, privacy robbing, health damaging, hackable pulses and surges would cease inside your home.

Instead, for some reason, while complaints have increased exponentially, the smart meter has become mythologized into being impossible to overcome, as if it were a giant invader, a monster, which simply is not true. It is a cheap device, easily neutralized, legally.

I am trying to appeal here to any residual sense of initiative of the majority to counter this system, to undermine, legally sabotage and otherwise practice self defence against this radar system.

I want to locate the the “don’t get mad, just get even” response one would expect when everyone has been invaded to this degree, in every possible way.

For some reason, faced with an invasion every bit as real as any other, it seems as if far too many people are using learned helplessness to “comply”, to “submit” , to allow themselves to be harmed, damaged, robbed, invaded, homes burned down, and each one is getting picked off, one at a time.

Why continue with endless appeals to “higher authorities” to “do something about this”?

Authorities? Almost all of them are the same authorities who initiated the global smart grid in the first place, it is a top down initiative, and your life and privacy and safety do not matter.

But? Surely these things do matter to you, right?

Well then stop the smart meter and smart grid frequencies from at least entering your home.

And shut off the power to all bedrooms.

Do you really want to be divided and ruled?

Why? Particularly when it is so easy to undermine a smart meter?

Just get a specialized device, a sine wave tracking frequency attenuator (no not an ordinary household lightning suppressor), a sine tamer.

Get an industrial grade sine wave tamer that is also a suppressor used by industry everywhere to save a ton of money on wireless induced premature failure or burn out, etc.

A sine tamer (sine wave tamer) is what will address this smart meter invasion and is even able to neutralize wireless frequencies piggy backing onto your household wiring system (unless you live right beside a cell tower, maybe not then).

Anyway, that is what will make a major difference to the quality of your lives and recover your health so that you can make level headed decision to walk away from a system that is so corrupt it has in place plans to hack you into the dark and cold, on purpose, for a very very long time, possibly years.

No we don't sell them. We just have one, and sleep and live well, in our hard wired home. We bought and had installed a sine tamer, because we were and are single minded about overcoming this issue and we were determined not to become irreversibly chronically disabled with EHS.

Health is wealth.

Protect it or lose it.

We had an electrician take about 15 minutes to install that sine tamer which has a 25 year warranty.

And that, as they say, was the end of that problem in our home.

We even had our house given a base line reading beforehand, read by a bau biologist, both before and then again after.

Sine wave tracking frequency attenuators are out there, not hard to find one designed to stop a smart meter from the harm and hazard it was intended to cause.

You just need the ones designed for weak emfs with variable clamping, and electronic detection of the slightest pulse or surge.

Best part is the keep you safe if and when you go off grid, which should be your very next stop since this grid is not going to remain reliable or affordable or insurable.

Stop suffering, please?

TAKE BACK YOUR POWER, as Josh Del Sol entitled his smart meter movie.

Get a Sine Tamer or equivalent.

Surely this will be the best investment you will ever make for getting back your home and protecting your loved ones, your private property, your own inviolate sanctuary.

Just do it, it is soooooo worth it.

267. **kate** says:

[June 4, 2016 at 3:55 pm](#)

I moved into a home with 3 smart meters installed just a few meters away from where i was sleeping. i know how dangerous they are, so it was a priority to get them removed. i didn't realise how quickly they would make me sick! in the room i felt really hot, irritable & wld forget what i was doing. i wld start to get a migraine & tinnitus. within a couple of weeks i was so ill i cldnt get out of bed. i literally never get sick, i am super healthy. i have put radiation protection fabric over them until i can get them removed. i still have tinnitus remaining.

268. **Don** says:

[June 6, 2016 at 12:35 pm](#)

Question (thought!)of the day on this one!

The smart meters are inter-grading signals with Nano medical implants and brain tooth /gum cell phone communication implants and this is what is attacking people and we are being mind hacked or electrical harassment targeting and possibly system attacked from hackers around the world!

The electrical grid is all screwed up and is crossing electrical signals( Not intentionally!) into internal body implants and we a feeling the ground electric the same way cows do from electrical runoff!

269. **Anonymous** says:

[August 17, 2016 at 5:43 pm](#)

We are in North Kingstown, Rhode Island, USA. We also hear high pitch noise for the past many years. We complained to many authorities about it and there were no help or not even a response from them. What is this all about? From our analysis, it may very well be coming from low orbiting weather satellites as the noise becomes more prevalent whenever there is an impending storm or inclement weather. Even otherwise, we hear this high pitch noise at a low tonal strength or volume, especially, at night causing sleep deprivation. We were able to record this noise using a software and it is not something we hear out of nothing or inside the ear. Some class mates of our daughter who live in this town mentioned to her that they also hear high pitch noise. In essence, the entire community may be helpless in resolving the high pitch noise. What is more irritable about this noise nuisance is that it causes sleep deprivation.

Is there any federal agency we could contact to complain about this noise disturbance as this is a nuisance not only to us but also the people living in the community.

If we can't anticipate help from federal agencies to stop this nuisance, how do we stop it with some method? We used tin foil in our bedroom and it stopped for some time but it became ineffective after sometime. We then used tin foil and Mylar type insulators and it stopped for some time. It is not effective any longer. This is why I searched Google to find some help to stop this high pitch noise nuisance from now on and came across this site. We may say that our privacy is also compromised by these abusers of the satellite mounted sonar radars. This must STOP.



270. **admin** says:

[August 17, 2016 at 5:55 pm](#)

Complain to whatever agency you can- they pass on the responsibility- FDA is likely, but FCC also. Try any and all.

271. **Jon** says:

[August 25, 2016 at 1:27 am](#)

I assume these complaints are about American smart meters?



272. **admin** says:

[August 25, 2016 at 6:56 am](#)

Most are, but complaints have come from Aus, Canada, UK also.

273. [holiam inderin](#) says:

[September 8, 2016 at 2:55 am](#)

waw, Live in an art deco apartment block of 8 where we had a switchboard upgrade mid 2014. Now, in October and then January blood tests have detected raised lymphocyte and B cell levels. The haematologist says I have a 1-2% chance of developing leukaemia. I know leukaemia is connected with radiation and so i started to look around my home. Nine smart metres are in a galvanised iron box 2.6 metres from my bedroom window. Inside a brick wall, there are switchboards for four of the units – all busily emitting radiation and even closer than the smart metres. Of course, I have all the usual things in my bedroom to add to my toxic exposure – mobile phone, wireless VOIP phone that runs on a modem, a laptop, two lights, a fan and a fan heater. I'm moving into the back bedroom away from the smart metres and keeping laptop, mobile etc in the lounge room. So scary.

Technology is developing so rapidly, it's mathematically impossible to mitigate the new hazards that change brings.

# Many Are Claiming Health Problems Caused by Smart Meters

October 12, 2011

A broad consortium of government agencies, environmental groups, and utilities and their industry organizations is touting the benefits of a "smart grid." Generally, this is conceived as an extensive revamp of the electrical system to make it more efficient and reliable, less polluting, and less expensive. Proponents of the smart grid envision it as having many benefits to both electric utilities and their customers — and see its costs largely as the dollar costs of building infrastructure.

- [US Dept. of Energy, Smart Grid](#); [Henry Kenchington](#), Deputy Assistant Secretary, Research and Development, Office of Electricity Delivery and Energy Reliability, 202-586-1878.

One component of the smart grid is smart meters, which operate as part of electric, gas, or water systems, and transmit meter readings to the utility many times a day, often via radio waves but sometimes via hard-wiring. This allows utilities to save money since meter readers are no longer needed. It also gives utilities frequent input on how much demand there is on their system at any one time, allowing them to fine tune their operations, use various tools (such as demand-based pricing) to equalize demand throughout the day and reduce peak loads, and plan for future supply needs.

The concepts sound good to many people, but serious flaws are becoming apparent as utilities rapidly install smart meters across the country, according to a rising chorus of critics. They are concerned about privacy (since they say utilities can interpolate many behavioral aspects of building occupants via the detailed reporting of utility use), security (since any utility's system could be hacked), and accuracy (with reports of very inaccurate readings from a small percentage of meters). Each of these issues warrants investigation and coverage.

Another major issue is possible human health impacts from smart meters. That is the focus of the remainder of this Tip.

## SMART METER HEALTH IMPACTS?

The health impacts of smart meters is a difficult topic, due in large part to the scarcity of pertinent science. As a result, some of your coverage will need to focus on the unknowns, rather than the knowns.

But the numerous allegations of health damage from people in the US and around the globe, the common threads in the descriptions of health damage (often appearing to involve the neurological, immune, and/or endocrine systems), and the evidence from thousands of published studies that address a wide range of electrical, magnetic field, and radio-frequency impacts, suggest this could be a major public health issue that warrants coverage.

The main questions are: with no smart meter-specific evidence of safety regarding a wide range of possible health impacts, should utilities be allowed to force smart meters on people? Should the meters be proven safe before they are installed — or should the "precautionary principle" be reversed, as it often is with US law regarding chemical pollution? In other words, is it acceptable to allow utilities to install these meters, then require people to prove they are being harmed? And in this case, with many government agencies and major environmental groups supporting smart meters, who will be the watchdogs?

Regarding the science, there appears to be virtually none specifically addressing smart meters, based on a search of [PubMed](#) using the term "smart meter." PubMed is the repository for the vast majority of the world's health-related research in the past half-century or so.

Looking beyond smart meter-specific research, there have been many studies of the electromagnetic spectrum involving cell phones and other electrical devices. You can find these on PubMed using search terms such as "radiowave," "cell phone," or "electromagnetic field." You may want to narrow your search to radiowave frequencies of 902-928 MHz, the band in which smart meters tend to operate, just above that of cell phones. Or you can scan more than 5,000 studies inventoried by an advocacy group:

- [Prove-It Initiative, Studies.](#)

However, the great majority of this research has focused only on thermal effects and cancer. Thermal effects (think of cooking meat in a microwave oven) are the health endpoint addressed by current FCC guidelines for wireless emissions. There has been relatively little research on health concerns such as damage to the immune, neurological, endocrine, cardiovascular, pulmonary, and other physiological or biological systems.

Another key issue is that the vast majority of the research has been conducted either in vitro, on animals, or on healthy humans. There has been almost no research on people with underlying health disorders, even though it's widely accepted that the body's defense systems in such people tend to be impaired. With about half the US population suffering from one or more chronic disorders, that's a large pool of people who could plausibly be more vulnerable to forces such as wireless emissions.

- CDC, ["Chronic Diseases and Health Promotion."](#)

One ongoing study that is attempting to investigate effects beyond thermal and cancer endpoints, at least for cell phones, is being led by Michael Wyde, a toxicologist with the National Institute of Environmental Health Sciences. His study is scheduled to be completed in 2014.

- [Michael Wyde](#), 919-316-4640.

## **CLAIMS AND COUNTERCLAIMS**

Given the existing evidence, the Council of Europe (an advisory body to the European Parliament that has been tasked with promoting democracy and protecting human rights and the rule of law) issued a resolution in May 2011 expressing numerous concerns about possible harm from various electromagnetic emissions, and generally recommending a cautious approach, saying "there could be extremely high health and economic costs if early warnings are neglected," similar to what happened with asbestos, leaded gasoline, and tobacco. The Council also said current international standards "have serious limitations."

- Council of Europe, [Resolution 1815, "The Potential Dangers of Electromagnetic Fields and Their Effect on the Environment."](#)

The EPA agreed in 2002 with the Council's caveat about existing standards, saying frequently-made claims that the FCC guidelines provide protection against a wide range of possible health effects from wireless emissions are unjustified.

- EPA, [July 16, 2002, letter from Norbert Hankin](#) (no longer listed with the agency), Center for Science and Risk Assessment, Radiation Protection Division, to Janet Newton, the EMR Network.

Nonetheless, many utility officials and others addressing this issue today are making just those kinds of claims, and saying smart meters pose no risk.

- ["Radio-Frequency Exposure Levels from Smart Meters: A Case Study of One Model,"](#) February 2011, by the Electric Power Research Institute.
- ["An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter,"](#) December 2010, by the Electric Power Research Institute.
- ["No Health Threat from Smart Meters,"](#) 2010 (fourth quarter), by the Utilities Telecom Council.
- ["Health Impacts of Radio Frequency Exposure from Smart Meters,"](#) California Council on Science and Technology, April 2011.
- ["A Discussion of Smart Meters and RF Exposure Issues,"](#) Edison Electric Institute, Association of Electric Illuminating Companies, and Utilities Telecom Council, March 2011.

In addition to the dearth of research on nonthermal or noncancer effects, there is little or no research addressing the fact that smart meters are connected to a building's electrical system, and could interact with it in a variety of ways. That condition makes existing research on cell phones inapplicable, since cell phones have no such connection. In addition, smart meter critics say some manufacturers acknowledge their smart meter emits almost constantly for function, security, and operational reasons; this is in contrast to the claim by many utilities that the meters operate for only a very brief time, such as a fraction of a second once each hour, when transmitting a reading to the utility. Long-term, 24/7 emissions seldom, if ever, are studied in wireless emission research.

## **METER INDUSTRY**

A few of the many meter manufacturers you might consider contacting to check on this angle are listed below, along with their newly-formed national organization. Or ask the utilities you are covering which manufacturer(s) they are using or considering.

- [Landis+Gyr](#) (acquired in May 2011 by Toshiba).
- [Tantulus.](#)
- Silver Spring: [Realizing the Promise of Advanced Metering](#) and [Whitepapers.](#)
- [Smart Meter Manufacturers Association of America.](#)

## **HYPERSENSITIVITY IN SOME?**

Another issue that distinguishes smart meters from cell phones, wireless computers, microwave ovens, and similar devices is that users of the latter typically have a choice whether to use them; with

many utilities forcing customers to have a smart meter installed, no one served by that utility has a choice.

The number of people who are vulnerable to emissions from smart meters and other electrical devices — who are typically described as having electrical hypersensitivity — likely is small. A limited number of studies suggest the numbers may be 1.5-5% of the general population.

- Wikipedia: [Electromagnetic Hypersensitivity, Prevalence.](#)

Based on decades of anecdotal accounts, health problems can show up within seconds of exposure in some people, or in months in others. With the longer time frames, most people, and their doctors, will have a very difficult time making the connection between their health problems and a wireless device. That difficulty is illustrated in the following media article, and in some of the accounts inventoried at the second URL below:

- ["Study Lends Some Credence to Wifi Claims,"](#) SantaCruz.com, Jul 13, 2011, by Alastair Bland.
- EMF Safety Network, [Smart Meter Health Complaints.](#)

One prominent person who has discussed her pronounced, rapid-onset electrical hypersensitivity, long before the advent of smart meters, is Gro Harlem Brundtland, former prime minister of Norway and director-general of the World Health Organization.

- [Interview with Gro Harlem Brundtland,](#) translation of cover story in Norwegian newspaper *Dagbladet*, by Aud Dalsegg, March 9, 2002.

In many cases, people with known or suspected electrical hypersensitivities are knowledgeable and proactive enough to ask their utility to allow them to opt out of having a smart meter. For people who are unknowingly electrically hypersensitive, and in whom symptoms may not show up for months, they likely won't know enough to ask to opt out, and may suffer severe consequences. Until much more science is available — pinning down the specific electrical forces that may be doing the damage, the types of damage that are possible, and the traits of people who are vulnerable — current efforts to mitigate problems will be based on guesses.

## **UTILITIES FACE QUESTIONS**

As utilities increasingly are being forced to respond to customer concerns about smart meters, they have numerous issues they may be considering:

Given there is no mandate from the federal government requiring utilities to install smart meters, do utilities want to go this route?

If they do, should they conduct more research, in order to protect their customers, and themselves from future lawsuits?

There are many smart meter manufacturers. Are any of their systems safer than others? Can they prove it?

Even though there is little research on the potential health effects of hard-wired smart meters, and there are some indications this option may also be harmful to people with electrical hypersensitivity,

should utilities consider this option instead of wireless smart meters (which appear to be the dominant system being selected by utilities)?

Should utilities allow any customers to opt out? If not, are they willing to accept legal liability for any short- or long-term health problems that may occur? If they do allow opt outs, under what circumstances (for instance, do they need proof of health vulnerability, or is concern about possible health effects sufficient grounds)? Are utilities justified in charging such customers extra, or is this an anticipated expense that should be shared by all customers? Is there a way to minimize any additional expenses, such as allowing customers to self-report their monthly readings (with random checks by the utility), or charging a customer a flat monthly amount, based on historical usage, and reading the meter once a year and adjusting the final bill each year accordingly? What percentage of people can utilities allow to opt out, and still have a functional, more-efficient system?

Should utilities comply with the Institute of Medicine's report released June 21, 2011, recommending that all levels of federal government consider the health impacts of their actions — even when those actions don't seem to have a direct health component — since utilities are playing a quasi-governmental role and making decisions that affect a significant number of people?

- "For the Public's Health: Revitalizing Law and Policy to Meet New Challenges," Institute of Medicine, June 2011. [Release](#) (with link to the report).

The US Dept. of Health and Human Services has kept a very low profile regarding the health concerns being raised by critics of smart meters. It may be worthwhile to ask DHHS officials what efforts they may be making, in light of the IOM recommendations. A possible starting point is:

- [Howard Koh](#), Assistant Secretary for Health, 202-690-7694.

## STATES AND MUNICIPALITIES

As noted above, there is no federal mandate to install smart meters. After reviewing currently available information, PNM, a major New Mexico utility, says it won't be installing smart meters for at least 5 years, saying they aren't cost-effective.

Other utilities are allowing, or have been forced to allow, customers to opt out, under certain circumstances, and with varying cost structures. Examples include:

- Central Maine Power: [MPUC Decides Smart Meter Investigation](#), May 17, 2011, and [Skelton, Taintor & Abbott Wins Landmark Smart Meter Case](#), May 25, 2011.
- In Colorado, Xcel Energy, Black Hills Energy, and Poudre Valley REA have allowed opt outs on a case-by-case basis.
- For Xcel's experimental program in Boulder, the Colorado Public Utilities Commission is recommending a voluntary opt-in program, which is just the opposite of a mandatory participation program that allows no opt out.
- Arizona Public Service is discussing whether and how to allow opt outs.

Some states are taking an active role. In California, the state is requiring Pacific Gas & Electric to revisit its proposed opt out policy, after vehement reaction against the initial proposal.

- California Public Utilities Commission, ["PG&E Smart Meter Opt-Out Proposal"](#); Sept. 14, 2011, ["Workshop on Smart Meter Opt-Out Options."](#)

- In Arizona, the [Arizona Corporation Commission](#) (whose duties include oversight over public utilities) held a workshop Sept. 8, 2011, and is considering how to proceed. Arizona Corporation Commission.
- In Illinois, governor Pat Quinn vetoed in September 2011 legislation that would have authorized a smart grid. Instead, he favors other ways of modernizing the state's grid. His veto might be overridden by the state legislature later this year. ["Illinois Governor Vetoes Smart Grid Legislation,"](#) EnergyBoom, Sept. 13, 2011, by Joseph Baker.

Cities and counties also are responding to the concerns of their constituents, even though they may have no legal authority to force a utility to comply, since that power often is vested in a state utility agency. For instance, in California, 36 cities, 10 counties, and one tribal jurisdiction that are home to nearly 2.7 million people have expressed some level of opposition to installation of smart meters.

- Stop Smart Meters, ["CA Local Governments on Board."](#)

When you're exploring the politics of who has the authority to make decisions on this issue, a few points to keep in mind are:

- Utilities generally have a monopoly in any given location, and customers usually don't have any other provider to choose from.
- There usually is some type of state utility commission that has legal oversight over a utility. However, in some states, such as Colorado, the utility commission has no power over utilities such as member-owned cooperatives. One of the reasons state legislators exempted member-owned cooperatives from oversight was because they assumed members could have any problems addressed through the directors, who are elected. But there have been a number of cases where directors were unresponsive or didn't provide independent oversight. The net result may be an unregulated monopoly.

## ADVOCACY GROUPS

There are many advocacy groups, with various levels of sophistication and representing a wide range of geographic areas. In addition to ones referred to above, others you might consider as sources include:

- [Arizonans for Safer Utility Infrastructure.](#)
- [The Utility Reform Network.](#)
- [Electromagnetic Health.](#)
- [Smart Meter Dangers](#), a project of [Center for Electrosmog Prevention.](#)

Dozens of advocacy groups met Oct. 5-6, 2011, in Washington, D.C. The speakers and sponsors of this conference are possible sources for your coverage.

- [Wireless Safety Summit.](#)

## IN THE NEWS

One example of media coverage of the smart grid issue that provides an overview of many political, economic, historical, health, and technological aspects is:

- ["The Problems with Smart Grids,"](#) originally in CounterPunch, March 18, 2011, by B. Blake Levitt and Chellis Glendinning.

For many other examples of media coverage of the smart grid and smart meters, search:

- [Environmental Health News.](#)

As indicated by the discussion above about Gro Harlem Brundtland, smart meters are just one of the latest electrical devices of concern to people with electrical hypersensitivity. Though these concerns have been expressed for decades, there is little data documenting whether the number of people being affected may be increasing with the rapid expansion in the number of wireless devices and the geographic areas affected. This and many other aspects of electrical hypersensitivity are fodder for additional media coverage, and some of the sources noted above may be helpful.

One related angle is that the U.S. Supreme Court has been pondering whether to hear a class action case (technically known as multidistrict litigation) involving cell phones. The case involves a suit against 19 defendants, primarily cell phone manufacturers and telecommunications companies. The suit is being led by the Public Citizen Litigation Group's Allison Zieve.

- ["Cellphone Study Raises Profile on Safety Lawsuits,"](#) Reuters, June 1, 2011, by Dan Levine.

Any Supreme Court decision might influence the FCC, which has considered whether to eliminate the current telephone landline system and have everyone use wireless or wired broadband. If that strategy is adopted, and wireless is the dominant system, that could seriously impair the ability of people with electrical hypersensitivity to communicate.

- [Proposed rules, Feb. 9, 2011.](#)

[People & Population](#), [Health](#), [Energy & Fuel](#), [TipSheet](#)

-

## ORIGINAL CONTRIBUTIONS

# Leukemia, Brain Tumors, and Exposure to Extremely Low Frequency Electromagnetic Fields in Swiss Railway Employees

C. E. Minder and D. H. Pfluger

Railway engineers provide excellent opportunities for studying the relation between exposure to extremely low frequency magnetic fields and leukemia or brain tumors. In a cohort study of Swiss railway personnel with  $2.7 \times 10^5$  person-years of follow-up (1972–1993), the authors compared occupations with high average exposures (line engineers: 25.9  $\mu\text{T}$ ) to those with medium and low exposures (station masters: 1  $\mu\text{T}$ ). The mortality rate ratio for leukemia was 2.4 (95% confidence interval (CI): 1.0, 6.1) among line engineers (reference category: station masters). The mortality rate ratio for brain tumors was 1.0 (95% CI: 0.2, 4.6) among line engineers and 5.1 (95% CI: 1.2, 21.2) among shunting yard engineers (compared with station masters). Two exposure characteristics were evaluated: cumulative exposure in  $\mu\text{T}$ -years and years spent under exposure to magnetic fields of  $\geq 10$   $\mu\text{T}$ . There was a significant increase in leukemia mortality of 0.9% (95% CI: 0.2, 1.7) per  $\mu\text{T}$ -year of cumulative exposure to extremely low frequency magnetic fields. The increase by years spent under exposure of  $\geq 10$   $\mu\text{T}$  was even stronger: 62% per year (95% CI: 15, 129). Brain cancer risk did not show a dose-response relation. This study contributes to the evidence for a link between heavy exposure to extremely low frequency magnetic fields and leukemia. Its strengths include reliable measurements and reliable historical reconstruction of exposures. *Am J Epidemiol* 2001;153:825–35.

brain neoplasms; electromagnetic fields; environmental monitoring; leukemia; occupational exposure

**Editor's note:** An invited commentary on this article appears on page 836, and the authors' response appears on page 839.

Several papers (1–3) reviewing residential and occupational epidemiologic studies of cancer risks and exposure to extremely low frequency (ELF) magnetic fields have concluded that there is a weak association between exposure to electromagnetic fields and leukemia and brain tumors. Several occupational epidemiologic studies have explored the relation between ELF magnetic field exposure and leukemia or brain tumors (4–10), with contradictory findings. Kheifets et al. (2) have investigated the causes of discrepancies in studies of brain cancer and have suggested many possible reasons for these discrepancies. However, it is evident that one of the principal challenges of studies of the health effects of ELF magnetic fields is exposure assessment, since historical measurements are usually lacking (11,

12). High-quality work in this area has been conducted by Feychting and Ahlbom (13) for residential exposure and by Savitz and Loomis (8) for occupational exposures.

In Switzerland, the study of railway workers offers an excellent possibility for investigating the health effects of ELF magnetic fields. Exposures of railway engineers can be measured and extrapolated accurately, since the position of a train's driver is fixed and electromagnetic characteristics stay the same over the lifetime of an engine, thus permitting reliable extrapolation. In addition, the Swiss railways have extensive, mostly electronic records on their employees, which allows cohort studies. An earlier study showed excess mortality from malignancies of the hematopoietic and lymphatic systems for engineers as compared with workers in metal construction and engineering and technical personnel (14). Subsequently, measurements of ELF magnetic fields in Swiss railway engines were made, showing magnetic field strengths in the 3–6,000  $\mu\text{T}$  range at the workplaces of railway engineers (15).

The purpose of the present study was to use better methodology to reassess whether, for Swiss railway engineers, exposure to electromagnetic fields is associated with an increased risk for leukemia or brain tumors. In particular, we wanted to investigate the following two hypotheses (adapted from the original project funding proposal from 1991, with slightly changed wording):

1. *Occupational hypothesis.* Among four groups of railway employees—line engineers, shunting yard engi-

Received for publication March 15, 2000, and accepted for publication August 10, 2000.

Abbreviations: CI, confidence interval; ELF, extremely low frequency; ICD-8, *International Classification of Diseases*, Eighth Revision.

From the Institute for Social and Preventive Medicine, University of Berne, Berne, Switzerland.

Reprint requests to Dr. C. E. Minder, Institute for Social and Preventive Medicine, University of Berne, Finkenhubelweg 11, CH-3012 Berne, Switzerland (e-mail: minder@ispm.unibe.ch).

neers, train attendants, and station masters (defined more precisely below)—the groups with higher exposures to ELF magnetic fields experience higher mortality from leukemia and brain tumors than those with lower exposures.

2. *Dose-response hypothesis.* Independent of job description, there is a dose-response relation between leukemia and brain cancer mortality and cumulative exposure to ELF magnetic fields and time spent exposed to ELF magnetic fields of  $\geq 10 \mu\text{T}$ .

## MATERIALS AND METHODS

### Cohort

The cohort was established using Swiss Federal Railways personnel and pension records. The cohort comprised all male persons recorded as actively employed or retired and alive in the microfiche copies of personnel or pension records from 1972, 1974, and 1978 or in the computer tapes of the Federal Railways Personnel and Pension Department between 1980 and 1993. Only members of four job categories—line engineer, shunting yard engineer, train attendant, and station master—were considered.

### Vital status and cause of death

Mortality follow-up covered the period between January 1, 1972, and December 31, 1993. Probabilistic record linkage (16, 17) was used to determine the vital status and mortality endpoints of cohort members by linking personnel or pension records to (anonymous) death certificates. Linkage variables used were date of birth, date of death, place of residence, occupation, marital status, and duration of marriage if married. Prior to linking, knowledge of the vital status of cohort members was completed by searching union journals and noting all deaths in the four study job categories. The computerized records of death certificates were then matched by name and date of birth to personnel or pension records. Only deaths with complete agreement regarding dates of birth and death on the personnel or pension record and the death certificate and with an odds ratio for correct linkage (vs. linkage due to random agreement) exceeding 1,024 were accepted. Finally, the vital status of all 123 linked cases with a cause of death of leukemia, other hematopoietic or lymphatic neoplasm, or brain tumor were manually verified against archived pension records. The data sources (personnel records, pension records, and death certificates) and linkage variables used did not differ between occupations.

### Outcomes

The main mortality outcomes were leukemia (*International Classification of Diseases*, Eighth Revision (ICD-8), codes 204–207; 37 cases) and brain tumors (ICD-8 code 191; 23 cases) (18). In addition, we analyzed deaths from any cause, all cancer deaths, and lung cancer deaths (ICD-8 code 162) for validation purposes. Table 1 gives the

numbers of deaths in each category, including leukemia subtypes.

### Work situation

Swiss railway employees work 8-hour days, 5 days per week. Line engineers and train attendants are on rotating shift work, beginning with the late shift at 4:00 p.m. and moving forward 1 hour each day until they are on the early shift, beginning around 4:00 a.m. After each cycle of shift work, they are off work for 3–4 days. Line engineers are the drivers of all scheduled trains. Mostly, they drive large and powerful engines. Each line engineer drives several different engines daily, with a changing composition of engines over time. Shunting yard engineers drive smaller engines around the shunting yards, setting up train compositions. They also switch between engines. Train attendants accompany passenger trains, checking tickets and assisting travelers. Station masters are responsible for train traffic within a station perimeter. They work partly in an office and partly on the station platforms.

Employment data with beginning and ending dates, duration, and job category were available for all cohort members. We assigned each person to the job category last mentioned. With few exceptions, this corresponded to the job held the longest, since there was limited switching between job categories. However, younger line engineers often worked in shunting yards (M. Gerber, Motive Power Construction Division, personal communication, 2001).

### Assessment of magnetic field exposure

Swiss trains run on 16 $\frac{2}{3}$ -Hz alternating current. For our measurements, we used a device developed by Bramur, Inc. (Lee, Massachusetts). Tests conducted at the technical laboratory of Swisscom (Berne, Switzerland) confirmed that it was reliable for recording magnetic flux density in the frequency range between 0 Hz and 100 Hz. Measurements of root mean square field strength were taken at 10-second intervals and stored in a battery-powered computer. Figure 1 shows the readings from one driving cycle. The raw readings were processed to extract mean exposure, as well as the time fraction with field strength at or above 10  $\mu\text{T}$ . This fraction is a simple measure of exposure dynamics.

*Exposure assessment for line and shunting yard engineers.* For measurements of exposure in the driver's seat of the engine, three measuring heads were mounted on a wooden stand just behind the driver at the level of his head, thorax, and feet without the use of metal parts. For each major type of engine that had been used in Switzerland since 1905, measurement series covering complete driving cycles (starting, acceleration phase, driving phase, braking, and stopping) lasting from 20 minutes to 4 hours were taken. For the most numerous engines, the impact of the kind of train (freight train, normal train, or fast train) and the particular route taken on the magnitude of the magnetic fields was examined. The variability within a specific type of engine was found to be moderate (coefficients of variation of mean exposure per time unit calculated from one driving cycle did not exceed 26 percent).

**TABLE 1. Numbers of workers exposed to extremely low frequency electromagnetic fields and numbers of deaths, by cause and occupation, Swiss railway cohort, 1972–1993**

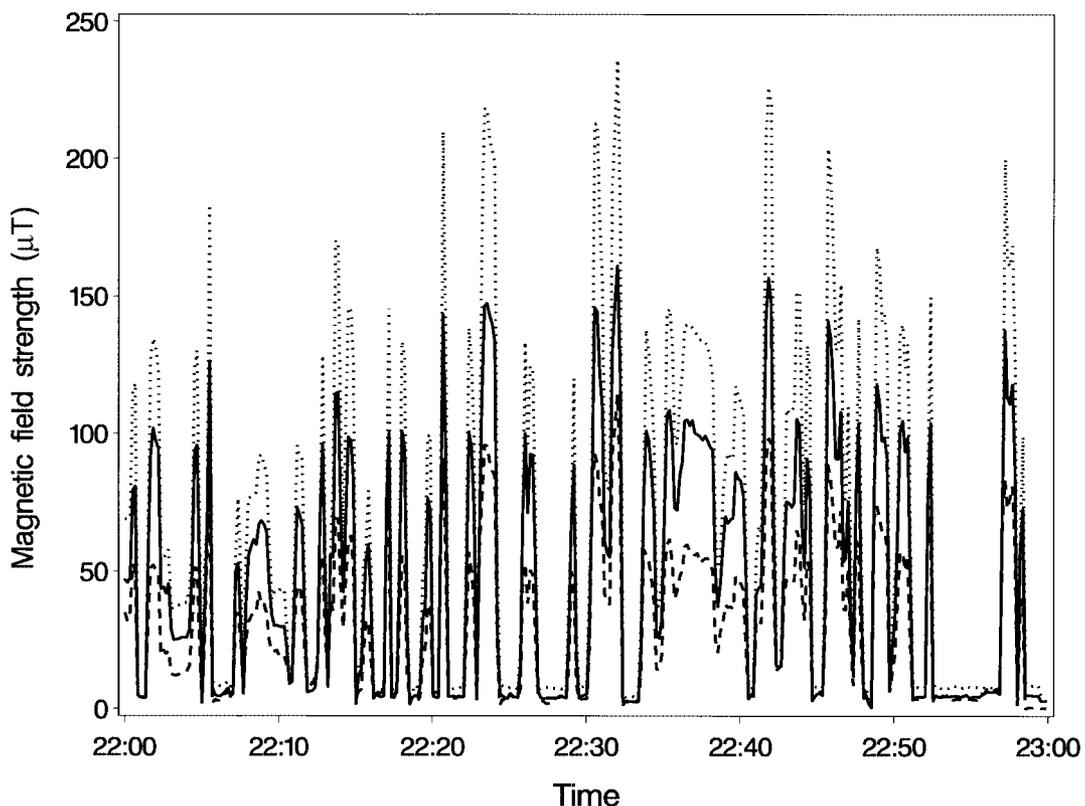
	Occupation				
	Line engineer	Shunting yard engineer	Train attendant	Station master	Total cohort
No. exposed	6,879	1,314	5,720	4,157	18,070
No. of deaths, by cause					
All causes (000–999)*	1,152	244	1,315	868	3,579
All cancers (140–209 and 225)	388	88	391	256	1,123
Lung cancer (162)	77	20	88	58	243
Malignancies of the hematopoietic and lymphatic systems (200–209)	40	11	26	21	98
Leukemias (204–207)	19	3	9	6	37
Chronic lymphatic leukemia (204.1)	7	1	2	6	16
Chronic myeloid leukemia (205.1)	6	0	2	0	8
Acute lymphatic leukemia (204.0)	0	0	1	0	1
Acute myeloid leukemia (205.0)	3	2	3	0	8
Other (204.9, 205.9, 206, and 207)†	3	0	1	0	4
Brain tumors (191)	4	5	11	3	23

\* Numbers in parentheses, *International Classification of Diseases*, Eighth Revision (18), code(s).

† Monocytic leukemia and further nonspecifically coded diagnoses in the death registry.

For modified engines in which exposure was not measured, the measurements of the corresponding main type of engine were used.

*Calculation of historical exposure.* Swiss line engineers switch engines several times daily, and over time they drive a changing mix of engines. We obtained the numbers of engines



**FIGURE 1.** Graphic representation of exposure levels measured at 10-second intervals during one driving cycle in a line engine, Swiss railway cohort, 1972–1993. Solid line: head; dotted line: thorax; dashed line: feet.

in service every 5 years from 1905 to 1995 and estimated the ELF magnetic field load for each 5-year calendar period by calculating weighted averages of engine-specific exposures. A similar approach was used to estimate the historical exposure of shunting yard engineers, including an average of 36 percent steam-powered engines (1905–1965) and later diesel-electric engines (1954–1995). We assumed that steam-powered and diesel-electric engines gave zero exposures (diesel-electric engines being direct-current engines).

For independent validation of the historical exposure reconstruction, we assembled the engine sequences of the daily service tours of 52 line and 14 shunting yard engineers for several weeks in 1993 (19).

**Exposure assessment for train attendants and station masters.** Train attendants and station masters do not work at the same location for extended periods of time. Therefore, spot measurements lasting for 2–30 minutes were taken at their most frequent places of work (train attendants: various positions within the coaches; station masters: platform and office). Exposure was then estimated as a time-weighted average of location-specific field strengths. The weights were estimated in close collaboration with railway authorities, taking into account the fractions of air-conditioned and electrically powered coaches.

**Calculation of historical exposure.** For train attendants and station masters, only recent measurements were available. Historical exposures were linearly interpolated between 0  $\mu\text{T}$  for 1900 and the exposure level of 1993.

### Data analysis

Data were analyzed using SAS (20) and Stata (21). Record linkage was carried out using probabilistic linkage with the LinkPro subroutine package (17). For cohort analysis, we used Clayton's algorithm as described by Breslow and Day (22), with 5-year age groups/5-year periods/exposure categories as units of analysis. The cumulative exposures were classified into three categories: 0–4.99  $\mu\text{T}$ -years, 5.00–74.99  $\mu\text{T}$ -years, and  $\geq 75$   $\mu\text{T}$ -years. We determined these cutoffs from the empirical frequency distribution of cumulative exposure to obtain an approximately equal distribution of person-years across the exposure categories. Similarly, the time fractions of each year spent under ELF magnetic field exposures of  $\geq 10$   $\mu\text{T}$  were cumulated over life. These were

aggregated into the following groups:  $\leq 0.099$  years, 0.100–0.499 years, and  $\geq 0.50$  years (feet:  $\leq 0.199$  years, 0.2–0.499 years, and  $\geq 0.5$  years).

To estimate mortality rate ratios and their 95 percent confidence intervals, we carried out Poisson regressions using number of deaths from leukemia or brain cancer per unit of analysis (see above) as the dependent variable and 5-year age group, 10-year calendar period, and job or exposure category as the independent variables. For estimation of the dose-response curves, we classified exposures into five classes by subdividing the lowest class and the middle class. The number of person-years at risk was included as an offset in the models. We carried out trend analyses using weighted regression with mortality rate ratios as dependent variables and job-related exposures as independent variables.

## RESULTS

Basic information on the cohort is presented in tables 1 and 2. There were 18,070 cohort members and 270,155 person-years of mortality follow-up.

### Information on linkage

Manual mortality follow-up in union periodicals yielded 1,729 records—8.2 percent of all engineers and 10.7 percent of all train attendants and station masters. Restricting linkage to those links in which dates of birth and death agreed resulted in the loss of 147 (4.1 percent) potentially linkable deaths. Manual checking of 121 linked cancer deaths resulted in our finding one person who was still alive; i.e., one incorrect link was discovered.

Each cohort member was assigned the job he held when he left the cohort. Job changes were not frequent. Fifteen percent of shunting yard engineers were promoted to the position of line engineer. Fewer than 2 percent of line engineers changed to shunting yard engineer, and none became train attendants or station masters. Fewer than 2 percent of station masters and train attendants changed their job category.

### Accuracy of exposure information

Treating the engine mix driven by each line engineer as a random sample of all engines available at the time, the coef-

**TABLE 2. Demographic and employment information for workers exposed to extremely low frequency electromagnetic fields, by occupation, Swiss railway cohort, 1972–1993**

Occupation	Person-years of observation (1972–1993)	Median duration of employment (years)	Median year of starting work	% actively employed on January 1, 1972*	Median age (years) on January 1, 1972*
Line engineer	94,168	24.6	1968	90.1	47
Shunting yard engineer	22,116	32.4	1958	94.5	43
Train attendant	88,986	34.0	1956	86.6	48
Station master	64,886	39.5	1952	87.9	41
Total	270,155 †	33.0	1958	88.8	46

\* Excludes those who entered the cohort after January 1, 1972.

† Differs from sum because of rounding imprecision.

ficient of variation of the cumulative occupational exposure reconstruction was estimated at 18 percent for the head, 25 percent for the thorax, and 40 percent for the feet. For shunting yard engineers, the coefficient of variation of the reconstructed estimate of cumulative exposure was estimated to be 26 percent regardless of body location. Estimates of cumulative exposure obtained by reconstructing average exposure using the daily work plans of 52 line engineers and 14 shunting yard engineers over a 2-week period were within 10 percent of the historical reconstruction estimates described above. For station masters, the coefficient of variation of the reconstruction was approximately 40 percent. For train attendants, the coefficient varied from 25 percent at the head and thorax levels to 60 percent at the feet.

Table 3 shows the exposure characteristics of the four occupations for the years 1930, 1960, and 1990. There was a fairly steady increase in the estimated exposure levels.

To assess the quality of endpoints, we checked mortality outcomes against cancer registry data. Not all of Switzerland is covered by cancer registries. For deceased cohort members with a diagnosis of malignancy on their death certificates who had lived in an area covered by a cancer registry, we verified the diagnosis against the corresponding cancer registry entry. This applied to 11 out of 37 cases of leukemia and 12 out of 23 cases of brain tumor. For two of 12 brain tumors on death certificates, the three-digit ICD-8 diagnosis was misspecified. Of the 11 leukemias on death certificates, all were classified as leukemias in the cancer registry files.

### Study hypotheses

To assess the occupational hypothesis (see Introduction), we calculated mortality rate ratios for five causes of death and three job categories—line engineers, shunting yard engineers, and train attendants—each compared with station masters (table 4). No differences between occupations were apparent for all-cause mortality or lung cancer mortality. However, there appeared to be differences in leukemia mortality between engineers on the one hand and train attendants and station masters on the other, although statistical significance was not attained. Risk of brain tumor mortality appeared to be elevated for shunting yard engineers and train attendants, but only the shunting yard engineers' risk relative to that of station masters was significant.

The association between occupational leukemia mortality rate ratios from table 4 and mean exposures from table 3 for these occupations in 1930 proved to be significant ( $p$  for trend = 0.04), as did the associations for the years 1960 ( $p$  = 0.03) and 1990 ( $p$  = 0.03). The associations between occupational leukemia risks and the fractions of time members of these occupations spent under magnetic fields  $\geq 10$   $\mu$ T in strength were also significant ( $p$ 's for trend < 0.05 for 1930, 1960, and 1990). None of the analogous associations of exposure and brain tumor mortality risk were significant. Thus, the occupational hypothesis was confirmed for leukemia and refuted for brain tumors.

To assess the dose-response hypothesis (see Introduction), we estimated a dose-response curve by including all occupations together in a Poisson regression with number of

**TABLE 3. Characteristics of low frequency electromagnetic fields, Swiss railway cohort, 1972–1993**

Occupation and year of exposure	Mean exposure ( $\mu$ T-years)	% of time exposed to fields $\geq 10$ $\mu$ T*
Line engineer		
1930	9.3	9.9
1960	17.9	29.5
1990	25.9	47.5
Shunting yard engineer		
1930	2.6	1.4
1960	13.4	9.7
1990	13.4	9.7
Train attendant		
1930	0.4	0.4
1960	1.9	2.2
1990	3.3	3.6
Station master (reference group)		
1930	0.1	0.0
1960	0.6	0.0
1990	1.0	0.0

\* Percentage of working time spent under exposures of  $\geq 10$   $\mu$ T.

leukemia (or brain tumor) deaths as the dependent variable, offset person-years at risk (22, p. 137), and the independent variables age group, calendar period, and exposure category. The results are shown in table 5 for various measures of exposure. For leukemia, there was an excess risk in the highest exposure category regardless of the way exposure was assessed. This excess attained significance for time spent under ELF magnetic fields  $\geq 10$   $\mu$ T at the thorax level; it did not reach significance at the other body sites or for mean exposure. For brain tumors, no consistent increase in risk with dose was visible, regardless of the measure used. However, the lowest category seemed to have a lower risk—significantly so for time spent under ELF magnetic fields  $\geq 10$   $\mu$ T at the level of the feet.

On the basis of the fairly steady increase in leukemia mortality risk by exposure seen in table 5, we carried out Poisson regression analyses using exposure as a continuous linear covariable, thus obtaining a more powerful analysis. These results are presented in table 6. With every measure of exposure, a significant increase in the mortality rate ratio with exposure was obtained; the largest and most significant effect estimates were for years under ELF magnetic fields  $\geq 10$   $\mu$ T at the head and thorax levels. The analyses of table 6 confirm the dose-response hypothesis for leukemia. We conducted a sensitivity analysis incorporating both job classification and exposure for the leukemia deaths. While both the effects of job classification and the effect of exposure became insignificant, the estimate of percentage increase in leukemia mortality per  $\mu$ T-year of cumulative thorax exposure increased from 0.94 percent to 1.46 percent (95 percent CI: -1.15, 4.1).

**TABLE 4. Risk ratios (adjusted for age and calendar period) for various causes of death among workers exposed to extremely low frequency electromagnetic fields, by occupation, Swiss railway cohort, 1972–1993**

Cause of death	Occupation (reference group: station masters)					
	Line engineer		Shunting yard engineer		Train attendant	
	RR*	95% CI*	RR	95% CI	RR	95% CI
All causes	1.01	0.93, 1.11	1.08	0.94, 1.25	1.07	0.98, 1.17
All neoplasms (140–209 and 225)†	1.14	0.97, 1.34	1.21	0.95, 1.54	1.07	0.91, 1.25
Leukemias (204–207)	2.44	0.97, 6.11	2.00	0.50, 8.07	1.09	0.39, 3.05
Brain tumors (191)	1.02	0.23, 4.55	5.06	1.21, 21.2	2.67	0.75, 9.62
Lung cancer (162)	0.98	0.70, 1.38	1.12	0.67, 1.86	1.04	0.75, 1.45

\* RR, risk ratio; CI, confidence interval.

† Numbers in parentheses, *International Classification of Diseases*, Eighth Revision (18), code(s).**Confounder assessment**

Engineers were not involved in the cleaning and maintenance of railway engines. Cleaners in use during the study period were phosphatic and sulfuric acids and, later, formic acid. Benzene was never used as a cleaning fluid (P. Lauber, Cleaning Services, personal communication, 2001). Polychlorinated biphenyls were never used in Swiss Railways transformers (M. Gerber, Motive Power Construction Division, personal communication, 2001). Line

and shunting yard engineers receive periodic medical check-ups, including chest radiographs. These could lead to, at most, 0.3 cases of leukemia over the whole lifetime of our cohort (estimate of the Swiss Workers' Accident Insurance Fund, December 13, 1989). In an unpublished survey of 378 railway employees carried out in 1994, we found that station masters and line engineers had the smallest fractions of smokers (8 percent and 12 percent, respectively), while shunting yard engineers and train attendants smoked more frequently (38 percent and 29 percent, respectively).

**TABLE 5. Risk ratios (adjusted for age and calendar period) for leukemia and brain cancer mortality among workers exposed to extremely low frequency electromagnetic fields, by location and measure of exposure, Swiss railway cohort, 1972–1993**

Measure of exposure and site of measurement	Person-years of follow-up*	Leukemia (ICD-8† codes 204–207)				Brain tumors (ICD-8 code 191)			
		No. of deaths	Crude RR†	Adjusted RR	95% CI†	No. of deaths	Crude RR	Adjusted RR	95% CI
Cumulative exposure ( $\mu$ T-years)									
Thorax									
0–4.9‡	32,753	6	1.00	1.00		1	1.00	1.00	
5–74.9	108,500	9	0.45	0.78	0.27, 2.24	11	3.32	2.84	0.35, 22.9
$\geq 75$	128,902	22	0.93	1.64	0.64, 4.19	11	2.80	2.36	0.29, 19.3
Years spent under extremely low frequency electromagnetic fields of $\geq 10 \mu$ T									
Head									
0.0–0.099‡	32,777	6	1.00	1.00		1	1.00	1.00	
0.1–0.49	107,811	9	0.46	0.78	0.27, 2.24	11	3.24	2.83	0.35, 22.8
$\geq 0.5$	129,568	22	0.93	1.65	0.65, 4.20	11	2.78	2.38	0.29, 19.4
Thorax									
0.0–0.099‡	88,427	9	1.00	1.00		4	1.00	1.00	
0.1–0.49	86,265	6	0.68	0.97	0.33, 2.81	12	3.08	2.55	0.80, 8.14
$\geq 0.5$	95,463	22	2.27	2.43	1.10, 5.36	7	1.62	1.27	0.37, 4.42
Feet									
0.0–0.199‡	75,856	6	1.00	1.00		3	1.00	1.00	
0.2–0.49	99,774	12	1.52	1.54	0.57, 4.12	11	2.79	3.89	1.06, 14.2
$\geq 0.5$	94,525	19	2.54	2.08	0.82, 5.29	9	2.41	1.45	0.39, 5.40

\* Differences in totals are due to rounding imprecision.

† ICD-8, *International Classification of Diseases*, Eighth Revision (18); RR, risk ratio; CI, confidence interval.

‡ Reference group.

**TABLE 6. Estimated increase in leukemia mortality due to exposure to extremely low frequency electromagnetic fields, based on different measures of exposure, Swiss railway cohort, 1972–1993**

Exposure measure	% increase per year of exposure*	95% confidence interval
Cumulative exposure at thorax ( $\mu\text{T}\cdot\text{years}$ )	0.94	0.225, 1.65
Years spent under extremely low frequency electromagnetic fields of $\geq 10 \mu\text{T}$		
Head	62	15, 129
Thorax	78	22, 161
Feet	53	7, 118

\* This quantity corresponds to  $100 \times (\text{mortality rate ratio} - 1)$ , with the mortality rate ratio corrected for age (linear and quadratic), period, and exposure.

## DISCUSSION

### Findings

The results of the present study demonstrated a dose-response relation between leukemia mortality and occupational exposure to 16-Hz magnetic fields. The picture of this excess mortality was consistent: It occurred in the highly exposed occupational groups, as well as in persons with high exposures. Even within each occupation, more highly exposed persons were at higher risk, although this relation was no longer significant. A dose-response relation was observable using different measures of exposure: cumulative exposure at the thorax level as well as cumulative time spent under exposures  $\geq 10 \mu\text{T}$  at the head, thorax, and feet. There was a statistically stronger and more significant association of leukemia risk with length of exposure to ELF magnetic fields at levels of  $\geq 10 \mu\text{T}$  than with cumulative exposure at the thorax level. This could indicate that the dynamics of the exposure process play a more important role than has been suspected so far. An important health effect of exposure dynamics would provide an explanation for the inconsistent results found in occupational and residential studies of the health effects of ELF magnetic fields.

Brain tumors seemed to aggregate in the occupations of shunting yard engineer and train attendant. These two occupational groups may have a common exposure that causes brain tumors. However, it is unlikely that electromagnetic fields are solely responsible for this finding. We did not find a dose-response relation between exposure to ELF magnetic fields and risk of brain tumor mortality. Speculatively, the results shown in table 5 could be interpreted to mean that risk of brain tumor mortality exhibits a threshold with respect to ELF magnetic field exposure. We found elevated brain tumor rates for occupations that in other studies had been found to entail exposure to the highest electric fields: shunting yard engineers and train attendants. Hence, our results fit in with Guénel et al.'s (23) conclusion that brain

cancer risk relates more to electric field exposure than to magnetic field exposure. However, Guénel et al.'s findings were not confirmed by Miller et al. (24).

### Limitations

In this study, there was potential for exposure bias from several sources. Measurements were done in different ways for the four occupational groups. The effect of this was probably minor, since the largest potential for bias was with the occupations of generally low exposure: These were measured least precisely. Historical extrapolation could be based on erroneous judgment about past exposures, either over- or underestimating exposures. It is hard to assess the possible effect of this, except that the relative order of occupations with respect to exposure would probably be preserved. In view of the above discussion, the nonassessment of electric field exposure must be considered a weakness.

### Ascertainment of death

Probabilistic record linkage poses the problem of false positives (false links) and false negatives (missed links). With the restrictive strategy we used, the numbers of deaths and causes linked to the wrong person were certainly small. From the manual verification of cancer deaths, in which we found one person still alive among 122 deaths checked, we estimate it to have been less than 1 percent. On the other hand, we probably missed some deaths, which reduced the power of our study as well as the size of the estimated effects of ELF magnetic fields. The number of deaths missed was probably less than 4 percent, since most of these deaths would have been found among the 147 additional deaths linked when less restrictive linkage rules were applied. We can discern no reason why these losses should have differed according to occupation. Ascertainment of causes of death such as leukemia and (especially) brain cancer may be subject to errors. A validation study showed that the quality of cause-of-death data was good for leukemia and fairly good for brain tumors (see Materials and Methods section).

### Exposure assessment

We had employment data, including duration and type of activity, for all members of our cohort. All of the major engines that had ever been in use were measured repeatedly so that exposure could be assessed precisely, and extrapolation was fairly straightforward. Taken together, this means that in the present study, accurate exposure assessment was possible for the highly exposed group. For the less exposed groups of station masters and train attendants, the relative accuracy is lower. Because newer electric and electronic equipment, most notably air conditioning in coaches (since 1964) and computers in station offices (since 1985), was introduced rather recently, the linear historical interpolation used probably led to an overestimate of the historical expo-

sure of these groups, decreasing any estimate of the effects of ELF magnetic fields. However, for these occupations as well, the absolute level of exposure was determined fairly accurately ( $\pm 1 \mu\text{T}\cdot\text{years}$ ).

The data logging at 10-second intervals permitted us to quantify and investigate the health effects of length of time spent under magnetic fields of  $\geq 10 \mu\text{T}$ , in addition to the more customary cumulative exposure. In a crude way, this measure describes the dynamics of the exposure process. We neglected leisure time and home exposures, because we judged them to be negligible in comparison with occupational exposures.

### Confounder assessment

From the information obtained about the substances used for cleaning and maintenance, there seems to be no reason to suspect any confounding effect. A substudy showed that line engineers smoked less than either shunting yard engineers or train attendants. Line engineers, working mostly alone in their driver's stands, tend to have fewer contacts with other people than workers in the other occupations investigated. Both of these characteristics reduce the exposure of line engineers to two suspected (but not well established) causes of leukemia.

### Comparison with literature

Comparison of our study with other occupational or residential studies in the literature is complicated somewhat by the fact that most other studies were concerned with the effects of 50- or 60-Hz alternating current on health, while in our study, 16 $\frac{2}{3}$  Hz was the frequency assessed. It is instructive to compare our study with three other studies (7, 25, 26) of railway personnel exposed to 16 $\frac{2}{3}$ -Hz ELF magnetic fields. Table 7 provides a comparison with these studies.

The similarities between these studies with respect to both the occupational risk profiles for leukemia and brain tumors and the exposure situation are remarkable. Swiss and Swedish railway engineers show substantially elevated risks of leukemia, which is also observed among Norwegian tram drivers. This supports the notion of the importance of dynamic exposure aspects. Swiss shunting yard engineers and train attendants, Swedish conductors, and Norwegian track walkers have elevated brain tumor risks, which suggests a risk of continuous long term exposure to electric and magnetic fields. However, several major distinctions should be borne in mind: first, the lower exposures of Swedish railway employees compared with Swiss (there were no exposures given for the Norwegian railway workers) and, second, differences in reference groups. Both factors could be expected to lead to a reduction in risk among the Swedish workers relative to the Swiss workers. Third, there are differences in study sizes, as well as in distribution of diagnoses: The Swiss study had more power to detect effects on leukemia in engineers, while the Swedish one had more power for brain tumors. Fourth, the ratio of the number of cases of leukemia to the number of cases of brain tumors ranged from nearly 5 in Swiss line engineers to 0.4 in Swedish conductors.

We are aware of two occupational studies besides this one that permit the estimation of a dose-response relation (4, 10). Table 8 summarizes the findings of these studies. There is no statistical disagreement between the findings of the present study and those of Floderus et al. (4), but there is statistical disagreement with the findings of Tynes et al. (10). However, the latter study reported results on exposure that are difficult to reconcile with each other: A yearly average exposure of 20  $\mu\text{T}$  (10, p. 647) would necessitate 95 years of exposure for accumulation of 1,900  $\mu\text{T}\cdot\text{years}$ , which is the border between the highest and second highest exposure categories in Tynes et al.'s table 3 (10, p. 650).

Several factors lead us to believe that the accuracy of our assessment of line and shunting yard engineers' exposure in the present study was quite good. First, line and shunting yard engineers spend a large fraction of their working time in the same, fixed location, which permits accurate assessment of exposure. Thus, daily workplace exposures could be measured exactly as they had occurred over the past 50 years, using the same engines and measuring at the driver's position. Second, reconstruction of group exposures relied on these measurements and on historical records of numbers of engines in use. We know of no other study in which similar features could be exploited to obtain accurate exposure assessment. Assessment of train attendants' and station masters' exposure was less accurate, since only recent exposure situations could be measured for these occupations.

The findings of the present study do not result from data-dredging, because we evaluated two hypotheses formulated a priori (see Introduction).

The frequency of 16 $\frac{2}{3}$  Hz has some special interest in view of findings on a frequency-dependent calcium efflux from cells at the frequency of 15 Hz and multiples thereof (27). Another mechanism of cancer promotion being discussed is based on melatonin, since melatonin appears to be involved in modulation of the immune system (28) and has oncostatic properties (29). In a related study, the melatonin metabolism of locomotive engineers was investigated (19). This study showed a suppression effect after onset of exposure which could not be explained by the shift work. Comparable findings were reported by Burch et al. (30). Thus, a possible pathway of leukemia causation is a disturbance of melatonin metabolism.

### Conclusions

This study contributes to the evidence that exposure to ELF magnetic fields in high dosages over prolonged time promotes or generates leukemia. The best estimate of the dose-mortality relation is an increase of approximately 1 percent per  $\mu\text{T}\cdot\text{year}$  of cumulative thorax exposure. On a methodological level, this study reinforces the impression that accurate assessment of electromagnetic field exposure through historical reconstruction is crucial. With the moderate size of the risks involved and the rarity of leukemia and brain tumors, even moderate exposure misclassification will invariably lead to insignificant results.

What are the consequences of this study and similar studies with respect to prevention? We believe that moni-

**TABLE 7. Results of four studies on leukemia, brain tumors, and exposure to 16%-Hz electromagnetic fields**

Swiss railway cohort, 1972–1993 (current study)				Floderus et al., 1994 (7)				Tynes et al., 1992 (25)			Alfredsson et al., 1996 (26)			
Occupation	Exposure†	No.	RR‡	Occupation	Exposure§	No.	RR¶	Occupation#	No.	SIR‡,**	Occupation	Exposure††	No.	RR¶¶
<i>Leukemias (ICD-8* codes 204–207)</i>														
Line engineer	17.9	19	2.4	Railway engine driver	4.0	6	1.6	Railway engine driver	4	1.0	Railway engine driver	15	15	1.2
Shunting yard engineer	13.4	3	2.0	Conductor	0.6	7	1.1	Tram driver	4	1.4	Conductor	7	5	1.6
Train attendant	1.9	9	1.1	Railway worker	0.3	17	1.2	Railway track walker	13	0.9				
Station master‡‡	0.6	6	1.0											
<i>Brain tumors (ICD-8 code 191)</i>														
Line engineer	17.9	4	1.02	Railway engine driver	4.0	8	1.1	Railway engine driver	5	0.44	Railway engine driver	15	10	1.0
Shunting yard engineer	13.4	5	5.06	Conductor	0.6	16	1.3	Tram driver	6	2.04	Conductor	7	2	0.8
Train attendant	1.9	11	2.67	Railway worker	0.3	31	1.2	Railway track walker	12	2.20				
Station master‡‡	0.6	3	1.00											

\* ICD-8, *International Classification of Diseases*, Eighth Revision (18).

† Mean exposure ( $\mu$ T) in 1960 (table 3).

‡ RR, risk ratio; SIR, standardized incidence ratio.

§ Daily mean exposure ( $\mu$ T).

¶ Risk ratio relative to all males aged 20–64 years and working in 1960.

# From group II (i.e., long term exposure).

\*\* Standardized for age.

†† Mean exposure ( $\mu$ T).

‡‡ Reference category.

**TABLE 8. Results of three studies showing a dose-response relation between exposure to extremely low frequency electromagnetic fields and leukemia risk**

Study	% increase in risk per $\mu\text{T}\cdot\text{year}$	95% confidence interval	Comments
Swiss railway cohort, 1972–1993 (current study)—table 6	0.94	0.23, 1.65	Based on thorax exposure. Typical exposure, 15 $\mu\text{T}$ .
Floderus et al., 1993 (4)—table 3*	6.2†	–13.1, 30.0	Twenty years' exposure assumed. Typical exposure, 0.2 $\mu\text{T}$ .
Tynes et al., 1994 (10)—table 3	–0.02†	–0.13, 0.08	Based on midpoints of exposure categories. Typical exposure, 20 $\mu\text{T}$ .

\* Primarily 50-Hz exposures.

† Computed using weighted regression.

toring of electromagnetic field exposure is indicated for railway personnel, both to maintain their health and to prevent an accentuation of risk through further increases in exposure.

## ACKNOWLEDGMENTS

This study was supported by a grant (32-32459.91) from the Swiss National Science Foundation.

The authors thank N. Antille, M. Bräuchi, G. Burkard, T. Furrer, M. Gerber, Dr. R. Gränicher, P. Kurth, E. Mathez, D. Reichen, D. Schneider, and J. P. Terrapon of the Swiss Federal Railways for their help with data access and data acquisition. They acknowledge the various Swiss tumor registries and hospital pathology centers for verifying the diagnoses. The authors also thank Drs. T. Abelin, M. Egger, R. Gugelmann, G. Schüler, and A. Stuck for their many valuable comments and suggestions.

## REFERENCES

- Thériault G. Electromagnetic fields and cancer risks. *Rev Epidém Santé Publ* 1992;40:55–62.
- Kheifets LI, Afifi AA, Buffler PA, et al. Occupational electric and magnetic field exposure and brain cancer: a meta-analysis. *J Occup Environ Med* 1995;37:1327–41.
- National Institute of Environmental Health Sciences. NIEHS report on health effects from exposure to power line frequency electric and magnetic fields. (NIH publication no. 99-4493).

- Research Triangle Park, NC: National Institute of Environmental Health Sciences, 1999. (<http://www.niehs.nih.gov/emfrapid/home.htm>).
- Floderus B, Persson T, Stenlund C, et al. Occupational exposure to electromagnetic fields in relation to leukemia and brain tumors: a case-control study in Sweden. *Cancer Causes Control* 1993;4:465–76.
- Sahl JD, Kelsh MA, Greenland S. Cohort and nested case-control studies of hematopoietic cancers and brain cancer among electric utility workers. *Epidemiology* 1993;4:104–14.
- Thériault G, Goldberg M, Miller AB, et al. Cancer risks associated with occupational exposure to magnetic fields among electric utility workers in Ontario and Quebec, Canada, and France: 1970–1989. *Am J Epidemiol* 1994;139:550–72.
- Floderus B, Törnqvist S, Stenlund C. Incidence of selected cancers in Swedish railway workers, 1961–79. *Cancer Causes Control* 1994;5:189–94.
- Savitz DA, Loomis DP. Magnetic field exposure in relation to leukemia and brain cancer mortality among electric utility workers. *Am J Epidemiol* 1993;141:123–34.
- Harrington JM, McBride DI, Sorahan T, et al. Occupational exposure to magnetic fields in relation to mortality from brain cancer among electricity generation and transmission workers. *Occup Environ Med* 1997;54:7–13.
- Tynes T, Jynge H, Vistnes AI. Leukemia and brain tumors in Norwegian railway workers, a nested case-control study. *Am J Epidemiol* 1994;139:645–53.
- Savitz DA, Pearce N, Poole C. Update on methodological issues in the epidemiology of electromagnetic fields and cancer. *Epidemiol Rev* 1993;15:558–66.
- Sahl JD, Kelsh MA, Smith RW, et al. Exposure to 60 Hz magnetic fields in the electrical utility work environment. *Bioelectromagnetics* 1994;15:21–32.
- Feychting M, Ahlbom A. Magnetic fields and cancer in children residing near Swedish high voltage power lines. *Am J Epidemiol* 1993;137:467–81.
- Balli-Antunes M, Pfluger DH, Minder CE. The mortality from malignancies of haematopoietic and lymphatic systems (MHLS) among railway engine drivers. *Environmetrics* 1990;1:121–30.
- Minder CE, Pfluger DH. Extremely low frequency electromagnetic field measurements (ELF-EMF) in Swiss railway engines. *Radiat Prot Dosimetry* 1993;48:351–4.
- Newcombe HB. Handbook of record linkage. New York, NY: Oxford University Press, 1988.
- InfoSoft, Inc. LinkPro 1.2. Winnipeg, Manitoba, Canada: InfoSoft, Inc, 1991.
- Eidgenössisches Statistisches Amt. Internationale Klassifikation der Krankheiten und Todesursachen, Ergänzt für den schweizerischen Gebrauch ab 1969. Eighth Revision. Berne, Switzerland: World Health Organization, 1970.
- Pfluger DH, Minder CE. Effects of exposure to 16.7 Hz magnetic fields on urinary 6-hydroxymelatonin sulfate excretion of Swiss railway workers. *J Pineal Res* 1996;21:91–100.
- SAS Institute, Inc. SAS, version 6. Cary, NC: SAS Institute, Inc, 1989.
- Stata Corporation. Stata statistical software: release 5.0. College Station, TX: Stata Corporation, 1997.
- Breslow NE, Day NE. Statistical methods in cancer research. Vol 2. The design and analysis of cohort studies. (IARC scientific publication no. 82). Lyon, France: International Agency for Research on Cancer, 1987.
- Guénel P, Raskmark P, Andersen JB, et al. Incidence of cancer in persons with occupational exposure to electromagnetic fields in Denmark. *Br J Ind Med* 1993;50:758–64.
- Miller AB, To T, Agnew DA, et al. Leukemia following occupational exposure to 60-Hz electric and magnetic fields among Ontario electric utility workers. *Am J Epidemiol* 1996;144:150–60.
- Tynes T, Andersen A, Langmark F. Incidence of cancer in Norwegian workers potentially exposed to electromagnetic fields. *Am J Epidemiol* 1992;135:81–8.

26. Alfredsson L, Hammar N, Karlehagen S. Cancer incidence among male railway engine-drivers and conductors in Sweden, 1976–90. *Cancer Causes Control* 1996;7:377–81.
27. Wilson BW, Stevens RG, Anderson LE, eds. Extremely low frequency electromagnetic fields: the question of cancer. Columbus, OH: Batelle Press, 1990.
28. Maestroni JM. The immunoneuroendocrine role of melatonin. *J Pineal Res* 1993;14:1–10.
29. Blask DE. The pineal: an oncostatic gland? In: Reiter RJ, ed. *The pineal gland*. New York, NY: Raven Press, 1984: 253–84.
30. Burch JB, Reif JS, Yost MG, et al. Nocturnal excretion of a urinary melatonin metabolite among electric utility workers. *Scand J Work Environ Health* 1998;24:183–9.

## LETTER TO THE EDITOR

**Extremely low frequency (ELF) electromagnetic fields and leukaemia in children**

Sir – In your issue of November 1989, which contained our article on low frequency electromagnetic fields and leukaemia (Coleman *et al.*, 1989), your Guest Editorial by Dr R.A. Cartwright addressed the same topic. While welcoming the importance you attach to this research, we were surprised at Dr Cartwright's suggestion that current evidence points to a risk of leukaemia from ELF fields that is 'minute [and] verging on the point of non-existence'. While this may be a reasonable view of the evidence in adults, the evidence about leukaemia in children gives some cause for concern.

The results of all the epidemiological studies on ELF fields in the home and leukaemia risk in children are summarised in Table I, which gives the relative risk estimates (RR) for high field homes compared to low field homes. The definition of high and low magnetic field varied between studies. Four of the six studies show an increased risk, although the risks are small, the highest being the two-fold risk found in the original study by Wertheimer and Leeper (1979). A crude pooling of the studies subsequent to the first is consistent with Dr Cartwright's interpretation that there is little evidence of any risk. However, the methodology of the early studies was strongly criticised (Coleman & Beral, 1988), and two recent studies of leukaemia (Savitz *et al.*, 1988; Coleman *et al.*, 1989), both carefully designed to avoid bias, gave closely similar results in children, both of which approached formal statistical significance. Crudely pooling the results of these two studies gives a risk estimate (RR) of 1.5 (95% CI 0.9–2.3).

As discussed in our paper, the true magnitude of any risk is likely to have been underestimated in epidemiological studies performed to date, because of the inherent difficulties in assessing the intensity of ELF fields in the home over the period relevant to leukaemogenesis (Savitz *et al.*, 1989). The uncertainties in the exposure estimates will tend to dilute the estimated risk considerably.

The statistical power of studies is limited by the relative rarity of high-field homes. The range of magnetic fields in homes is wide (Kaune *et al.*, 1987; Maddock, 1987), but most homes fall at the low end of the range, in the region of 100nT (1 mG), with relatively few above 200–300nT, as shown by the small numbers in the 'High Field' category in Table I. This is particularly true in the UK where electricity distribution is predominantly in underground cables.

Further epidemiological studies are required in order to establish whether such low intensity, low-frequency fields are associated with leukaemia. The epidemiological evidence needs to be particularly strong as there is no clear biological evidence of a mechanism. ELF fields undoubtedly affect biological systems (Byus *et al.*, 1987; Ahlbom *et al.*, 1987) but have not been shown to produce mutagenesis or chromosomal damage. Future work needs to focus on highly exposed groups: there are at least 12,000 houses in the UK close to high-tension powerlines; the young residents of these and adjacent homes might provide a suitable population for study in the UK. Such a study is in progress in the Nordic countries (A. Ahlbom, personal communication). Further, four new independent studies are under way or about to begin: one international, and one each in Canada, USA, and Sweden. These large, well-designed studies should provide an improved estimate of the size of any risk.

Yours etc.,

J. Bell  
London School of Hygiene  
and Tropical Medicine, UK.  
M.P. Coleman  
International Agency for  
Research on Cancer, France.

**Table I** Childhood leukaemia and ELF fields: summary of results from all published studies

Reference	Place of study		'High field' homes	'Low field' homes	RR	Definition of 'high field' homes
Wertheimer and Leeper (1979)	USA	cases	52	84	2.28	HCC <sup>a</sup>
		controls	29	107		
Fulton <i>et al.</i> (1980)	USA	cases	48	150	0.97	Top quartile of observed range > 3mG (300nT)
		controls	56	169		
Tomenius (1986)	Sweden	cases	4	239	0.34	
		controls	10	202		
Myers <i>et al.</i> (1985)	UK <sup>b</sup>	cases	9	169	1.30	< 50m from powerline
		controls	11	269		
Savitz <i>et al.</i> (1988)	USA	cases	27	70	1.54	HCC <sup>a</sup>
		controls	52	207		
Coleman <i>et al.</i> (1989)	UK	cases	14	70	1.5	< 50m from trans-former substation
		controls	15	126		

<sup>a</sup>HCC high current configuration; these homes include those with major substations within 150m, high tensions wires within 40m, thin three-phase primary wires within 20m, or first-span secondary wires within 15m of the home. <sup>b</sup>The results of this study were preliminary, and included both leukaemia and lymphoma.

## References

- AHLBOM, A., ALBERT, A.E., FRASER-SMITH, A.C. & 6 others (1987). Biological Effects of Power Line Fields. New York State Power Lines Project, Scientific Advisory Panel Final Report.
- BYUS, C.V., PIEPER, S.E. & ADEY, W.R. (1987). The effects of low energy 60Hz environmental electromagnetic fields upon the growth-related enzyme ornithine decarboxylase. *Carcinogenesis*, **8**, 1385.
- COLEMAN, M.P. & BERAL, V. (1988). A review of epidemiological studies of the health effects of living near or working with electricity generation and transmission equipment. *Int. J. Epidemiol.*, **17**, 1.
- COLEMAN, M.P., BELL, C.M.J., TAYLOR, H.L. & PRIMIC-ZAKELJ, M. (1989). Leukaemia and residence near electricity transmission equipment: a case-control study. *Br. J. Cancer*, **60**, 793.
- FULTON, J.P., COBB, S., PREBLE, L. *et al.* (1980). Electrical wiring configurations and childhood leukaemia in Rhode Island. *Am. J. Epidemiol.*, **111**, 292.
- KAUNE, W.T., STEVENS, R.G., CALLAGHAN, N.J., SEVERSON, R.K. & THOMAS, D.B. (1987). Residential magnetic and electric fields. *Bioelectromagnetics*, **8**, 315.
- MADDOCK, B.J. (1987). Public exposure to power-frequency fields. CIGRE Study Committee 36, Montreal, 8-9 June 1987.
- MYERS, A., CARTWRIGHT, R.A., BONNELL, J.A. & CARTWRIGHT, S.C. (1985). Overhead power lines and childhood cancer. *IEE Conference Publ.*, **257**, 118.
- SAVITZ, D.A., WATCHEL, H., BARNES, F.A. *et al.* (1988). Case-control study of childhood cancer and exposure to 60Hz magnetic fields. *Am. J. Epidemiol.*, **128**, 10.
- SAVITZ, D.A., PEARCE, N.E. & POOLE, C.E. (1989). Methodological issues in the epidemiology of electromagnetic fields and cancer. *Epidemiol. Rev.*, **11**, 59.
- TOMENIUS, L. (1986). 50Hz electromagnetic environment and the incidence of childhood tumours in Stockholm county. *Bioelectromagnetics*, **7**, 191.
- WERTHEIMER, N. & LEEPER, E. (1979). Electrical wiring configurations and childhood cancer. *Am. J. Epidemiol.*, **109**, 273.



## **SECTION 24**

---

# **Key Scientific Evidence and Public Health Policy Recommendations**

**David O. Carpenter, MD**  
**Director, Institute for Health and the Environment**  
**University at Albany, East Campus**  
**Rensselaer, New York**

**Cindy Sage, MA**  
**Sage Associates**  
**Santa Barbara, California**

Prepared for the BioInitiative Working Group  
July 2007

## **Table of Contents**

### **I. Key Scientific Evidence**

**A. Weight of Evidence Assessment and Criteria for Causality**

**B. Summary of Evidence**

### **II. Fallacies and Answers in the Debate over EMF Evidence**

**A. Only a small number of children are affected.**

**B. There is insufficient evidence that adult diseases are secondary to EMF exposure.**

**C. The risk is low**

**D. There is no animal evidence**

**E. We do not know a mechanism**

**F. Vested Interests: How They Shape the Public Health Debate**

### **III. EMF Exposure and Prudent Public Health Planning**

### **IV. Recommended Actions**

### **V. Conclusions**

### **VI. References**

## I. KEY SCIENTIFIC EVIDENCE

Exposure to electromagnetic fields (EMF) has been linked to a variety of adverse health outcomes. The health endpoints that have been reported to be associated with ELF and/or RF include childhood leukemia, adult brain tumors, childhood brain tumors, genotoxic effects (DNA damage and micronucleation), neurological effects and neurodegenerative disease, immune system dysregulation, allergic and inflammatory responses, breast cancer in men and women, miscarriage and some cardiovascular effects.

Effects are not specifically segregated for ELF or RF, since many overlapping exposures occur in daily life; and because this is an artificial division based on frequencies as defined in physics that has little bearing on the biological effects. Both ELF and RF, for example have been shown to cause cells to generate stress proteins, a universal sign of distress in plant, animal and human cells.

The number of people exposed to elevated levels of EMF has been estimated in various studies, and there is general agreement among them. In the United States, few people have chronic or prolonged exposures over 4 mG (0.4  $\mu$ T) (Kheifets et al, 2005b). Section 20 has information on average residential and occupational ELF levels. The highest exposure category in most all studies is  $\geq 4$  mG ( $\geq 0.4$   $\mu$ T). Many people have daily exposures to ELF in various ways, some of them up to several hundred milligauss for short periods of time, but relatively few people with the exception of some occupational workers habitually experience ELF exposures greater than 1-2 mG (0.2 – 0.3  $\mu$ T - App. 20-A).

The exposure of children to EMF has not been studied extensively; in fact, the FCC standards for exposure to radiofrequency radiation are based on the height, weight and stature of a 6-foot tall man, not scaled to children or adults of smaller stature. They do not take into account the unique susceptibility of growing children to exposures (SCENIHR, 2007; Jarosinska and Gee, 2007), nor are there studies of particular relevance to children.

Differences in exposure patterns between infants, children and adults; 2) special susceptibilities of infants and children to the effects of EMF; and 3) interactions between chemical contaminants

and EMF are lacking; as are studies on chronic exposure for both children and adults. There is reason to believe that children may be more susceptible to the effects of EMF exposure since they are growing, their rate of cellular activity and division is more rapid, and they may be more at risk for DNA damage and subsequent cancers. Growth and development of the central nervous system is still occurring well into the teenage years so that neurological changes may be of great importance to normal development, cognition, learning, and behavior. Prenatal exposure to EMF have been identified as possible risk factor for childhood leukemia. Children are largely unable to remove themselves from exposures to harmful substances in their environments. Their exposure is involuntary.

Like second-hand smoke, EMF is a complex mixture, where different frequencies, intensities, durations of exposure(s), modulation, waveform and other factors is known to produce variable effects. Many years of scientific study has produced substantial evidence that EMF may be considered to be both carcinogenic and neurotoxic. The weight of evidence is discussed in this report, including epidemiological evidence and studies on laboratory animals.

Relative risk estimates associated with some of these endpoints are small and the disease is fairly rare (for childhood leukemia, for example), For other diseases, the risk estimates are small but the diseases are common and EMF exposures at levels associated with increased risks are widespread and chronic so the overall public health impacts may be very large.

## **A. Weight of Evidence Assessment and Criteria for Causality**

A weight-of-evidence approach has been used to describe the body of evidence between health endpoints and exposure to electromagnetic fields (ELF and RF).

The number and quality of epidemiological studies, as well as other sources of data on biological plausibility are considered in making scientific and public health policy judgments. Methodological issues that were considered in the review of the epidemiological literature include 1) quality of exposure assessment. 2) sample size of the study, which detects the power to detect an effect, 3) extent to which the analysis or design takes into account potential

confounders or other risk factors, 4) selection bias, 5) the potential for bias in determining exposure. Assessment of the epidemiological literature is consistent with guidelines from Hill (1971), Rothman and Greenland (1998) and the Surgeon General's Reports on Smoking (US DHHS, 2004), and California Air Resources Board (2005). Factors that were considered in reaching conclusions about the weight of evidence overall included strength of the association, consistency of association, temporality, biological plausibility, dose-response and issues with non-linear dose-response, specificity and experimental evidence.

There is a relatively large amount of human epidemiological information with real world exposures, including data from occupational studies. There is less animal data in most cases, except for the genotoxicity studies. Human epidemiological evidence has been given the greatest weight in making judgments about weight-of-evidence, where the results across high quality studies give relatively consistent positive results. Meta-analyses of childhood leukemia, adult leukemia, adult brain tumors, childhood brain tumors, male and female breast cancer and Alzheimer's disease were relied upon in assessing the overall strength of epidemiological study results. Sections 5 – 15 provide analysis of the relevant scientific studies that are key evidence in making public health policy recommendations with respect to exposure to electromagnetic fields (both ELF and RF).

## **B. Summary of Evidence**

### **1. Childhood Leukemia**

Several meta-analyses have been conducted to assess risks of childhood leukemia from exposure to ELF. The results of these studies that combine or pool results of many individual studies (including studies that report both effects and no effects) consistently report increased risks.

#### **Meta-Analysis: Studies of Childhood Leukemia and EMF**

Greenland et al., (2000) reported a significantly elevated risk of 1.68 [95% CI 1.23-2.31] based on pooled results from 12 studies using a time-weighted average of exposure greater than 3 mG (0.3  $\mu$ T). This is a 68% increased risk of childhood leukemia.

Ahlbom et al., (2000) reported a doubling of risk based on a meta-analysis of nine (9) studies. The results reported an elevated risk of 2.0 [95% CI 1.27-3.13] for EMF exposures equal to or greater than 4 mG (0.4  $\mu$ T) as compared to less than 1 mG (0.1  $\mu$ T)

### **Other Relevant Evidence**

In 2002, the International Agency for Cancer Research (IARC) designated EMF as a “possible human carcinogen” or Group 2B Carcinogen based on consistent epidemiological evidence. The exposure levels at which increased risks of childhood leukemia are reported in individual studies range from above 1.4 mG or 0.14  $\mu$ T (Green et al., 1999) for younger children to age six (6) to 4 mG (0.4  $\mu$ T). Many individual studies with cutpoints of 2 mG or 3 mG (0.2-0.3  $\mu$ T) report increased risks. Plausible biological mechanisms exist that may reasonably account for a causal relationship between EMF exposure and childhood leukemia.

### **Recurrence of Childhood Leukemia and Poorer Survival Rates with Continued EMF Exposure**

Foliart reported more than a four-fold (450% increased risk) of adverse outcome (poorer survival rate) for children with acute lymphoblastic leukemia (ALL) who were recovering in EMF environments of 3 mG (0.3  $\mu$ T) and above (OR 4.5, CI 1.5-13.8). Svendsen reported a poorer survival rate of children with acute lymphoblastic leukemia (ALL) in children exposed to 2 mG (0.2  $\mu$ T) and above. These children were three times more likely (300% increased risk) to die than children recovering in fields of less than 1 mG (OR 3.0, CI 0.9-8). Children recovering in EMF environments between 1- 2 mG (0.1-0.2  $\mu$ T) also had poorer survival rates, where the increased risk was 280% (OR 2.8, CI 1.2-6.2).

### **Higher Lifetime Cancer Risks with Childhood EMF Exposure**

Lowenthal (2007) reported that children raised for the first five years in home environments exposed to EMF within 300 meters of a high voltage power line have a five-fold (a 500 percent increased risk) of developing some kinds of cancers sometime in later life. For children from newborn to 15 years of age; it is a three-fold risk of developing cancer later in life (Lowenthal et al., 2007). There is suggestive evidence for a link between adult leukemia and EMF exposure.

### **Attributable Risk**

Wartenberg estimates that 8% to 11% of childhood leukemia cases may be related to ELF exposure. This translates into an additional 175 to 240 cases of childhood leukemia based on 2200 US cases per year. The worldwide total of annual childhood leukemias is estimated to be 49,000, giving an estimate of nearly 4000 to 5400 cases per year. Other researchers have estimated higher numbers that could reach to 80% of all cases (Milham, 2001).

## 2. Childhood Brain Tumors

### Childhood Brain Tumors

There is suggestive evidence that other childhood cancers may be related to EMF exposure. The meta-analysis by Wartenberg et al., (1998) reported increased risks for childhood brain tumors. Risks are quite similar whether based on calculated EMF fields (OR = 1.4, 95% CI = 0.8 – 2.3] or based on measured EMF fields (OR = 1.4, 95% CI = 0.8 – 2.4).

## 3. Adult Brain Tumors

### Brain Tumors in Electrical Workers and in Electrical Occupations (Meta-analysis)

A significant excess risk for adult brain tumors in electrical workers and those adults with occupational EMF exposure was reported (Kheifets et al., 1995). This is about the same size risk for lung cancer and second hand smoke (US DHHS, 2006). A total of 29 studies with populations from 12 countries were included in this meta-analysis. The relative risk was reported as 1.16 (CI = 1.08 – 1.24) or a 16% increased risk for all brain tumors. For gliomas, the risk estimate was reported to be 1.39 (1.07 – 1.82) or a 39% increased risk for those in electrical occupations. A second meta-analysis published by Kheifets et al., ((2001) added results of 9 new studies published after 1995. It reported a new pooled estimate (OR = 1.16, 1.08 – 1.01) that showed little change in the risk estimate overall from 1995.

## 4. Brain Tumors and Acoustic Neuromas in Cell Phone and Cordless Phone Users (Meta-Analysis)

### Glioma and Acoustic Neuroma

Hardell et al., (2007) reported in a meta-analysis statistically significant increased risk for glioma with exposure of 10 years or greater in persons using cell phones. Risks were estimated to be 1.2 (0.8 – 1.9) for all use; but when ipsilateral use was assessed (mainly on same side of head) it increased the risk of glioma to 2.0 (1.2 – 3.4) for 10 years and greater use.

For acoustic neuromas, Hardell et al., (2007) reported the increased risk with 10 years or more of exposure to a cell phone at 1.3 (0.6 – 2.8) but this risk increased to 2.4 (1.1 – 5.3) with ipsilateral use (mainly on the same side of the head). There is a consistent pattern of increased risk for brain tumors (glioma) and acoustic neuromas at 10 years and greater exposure to cell phones.

The meta-analysis by Lakhola et al., (2006) reported that brain tumor risk was 1.3 (0.99 – 1.9) for ipsilateral use of a cell phone, but no data was given for exposures at 10 years or greater (all exposures were of shorter duration).

The meta-analysis by Kan et al., (2007) reported “no overall risk” but found elevated risk of brain tumors (RR = 1.25, CI 1.01 – 1.54)  $\geq$  10 years, reinforcing the findings of other pooled

estimates of risk. No estimates of increased risk with ipsilateral use were provided, which would have likely increased reported risks.

## 5. Neurodegenerative Diseases

### Alzheimer's Disease and ALS

Evidence for a relationship between exposure and the neurodegenerative diseases, Alzheimer's and amyotrophic lateral sclerosis (ALS), is strong and relatively consistent. While not every publication shows a statistically significant relationship between exposure and disease, ORs of 2.3 (95% CI = 1.0-5.1 in Qio et al., 2004), of 2.3 (95% CI = 1.6-3.3 in Feychting et al., 2003) and of 4.0 (95% CI = 1.4-11.7 in Hakansson et al., 2003) for Alzheimer's Disease.

Hakansson et al., report more than a doubling of risk for ALS 2.2 (95% CI = 1.0-4.7).

Savitz et al., (1998) reports more than a tripling of risk for ALS (3.1, CI = 1.0 – 9.8).

## 6. Breast Cancer (Men and Women)

A meta-analysis by Erren (2001) on EMF and breast cancer reported pooled relative risks based on studies of both men and women. A total of 38 publications were reviewed; there were 23 studies on men; 25 studies on women; and 10 studies on both men and women. The pooled relative risk for women exposed to EMF was 1.12 (CI 1.09 – 1.15) or a 12% increased risk, Erren observed that variations between the contributing results are not easily attributable to chance ( $P = 0.0365$ ). For men and breast cancer, he reported a fairly homogeneous increased risk (a pooled relative risk of 1.37 [CI 1.11 – 1.71]).

This analysis is well conducted. The results were stratified according to measured or assumed intensity of exposure to EMF; and the estimate of risk for the most heavily exposed group was extracted. Independent estimates of RRs were grouped according to gender, type of study (case-control and cohort), country where the study was conducted and method used to assess exposure. Pooled estimates of RRs and their 95% confidence intervals (CI) referring to various combinations of these factors were calculated according to appropriate statistical methods (Greenland, 1987). Misclassification possibilities were thoroughly assessed, and whether the results were sole endpoints or there were multiple endpoints in each study did not affect the RRs.

Erren qualifies his findings by discussing that latencies for cancers can be 20 to 30 years, Further, he notes that studies of total EMF exposures from both home, travel and workplace are rarely available, and these EMF sources are ubiquitous. Both could result in underestimation of risks. Another way in which risks might be masked is by variations in age of study participants. Forssen and colleagues (2000) reported no increased RRs for breast cancer in women of all ages

when they combined residential and occupational EMF exposures (RR = 0.9, CI 0.3 – 2.7). However, when risks for the women younger than 50 years of age were separated out and calculated, the RR increased to 7.3 (CI 0.7 – 78.3) although with wide confidence intervals based on only four cases. Erren notes

*“When possibly relevant exposures to EMF in the whole environment are assessed only partially, errors in the categorization of exposure status are likely to occur. If such misclassification is random and thus similar in subgroups being compared (nondifferential), then the error will tend to introduce bias towards the null. Substantial random misclassification of exposures would then tend to generate spurious reports of ‘little or no effect’. Note for example that estimates of smoking-associated lung cancer risks in the early 1950’s could have been seriously distorted if exposure assessment had not considered smoking either at work or at home.”*

*“Collectively, the data are consistent with the idea that exposures to EMF, as defined, are associated with some increase in breast cancer risks, albeit the excess risk is small.”* Erren (2001)

## **7. Combined Effects of Toxic Agents and ELF**

### **ELF and Toxic Chemical Exposures**

There is also the issue of what weight to give the evidence for synergistic effects of toxic chemical exposure and EMF exposure. Juuilainen et al., (2006) reported that the combined effects of toxic agents and ELF magnetic fields together enhances damage as compared to the toxic exposure alone. In a meta-analysis of 65 studies; overall results showed 91% of the *in vivo* studies and 68% of the *in vitro* studies had worse outcomes (were positive for changes indicating synergistic damage) with ELF exposure in combination with toxic agents. The percentage of the 65 studies with positive effects was highest when the EMF exposure preceded the other exposure. The radical pair mechanism (oxidative damage due to free radicals) is cited as a good candidate to explain these results. Reconsideration of exposure limits for ELF is warranted based on this evidence.

## **II. FALLACIES AND ANSWERS IN THE DEBATE OVER EMF EVIDENCE**

There are several arguments (false, in our view) that have been presented by those who minimize the strength of the relationship between exposure to both 50-60Hz ELF and RF EMFs. These are as follows:

**A. “Only a small number of children are affected.”**

This argument is not correct because we do not know precisely how many children are affected. In 1988 Carpenter and Ahlbom attempted to answer this question based on the results of the New York State Powerlines Project and the results of the study of Savitz et al. (1988), and concluded that if the magnetic fields homes in the US were similar to those in Denver, Colorado fully 10 to 15% of US childhood leukemia (about 1,000 cases) could be associated with residential magnetic field exposure. They then concluded that exposure to magnetic fields from non-residential sources (particularly appliances) must be at least equal in magnitude, and that if so these two sources of exposure would account for 20-35% of childhood leukemia.

There have been several meta-analyses of the childhood leukemia data (Wartenberg, 1998; Greenland et al., 2000; Ahlbom et al., 2000). All have concluded that there is a significant association between residential exposure to magnetic fields and elevated risk of leukemia in children. Greenland et al. (2000) performed a meta-analysis of 15 studies of magnetic field or wire code investigations of childhood leukemia, and calculated the attributable fraction of cases of childhood leukemia from residential magnetic field exposure in the US was 3%. Ahlbom et al. (2000) conducted a different meta-analysis that concluded there was a significant 2-fold elevation of risk at exposure levels of 4 mG (0.4  $\mu$ T) or greater. Kheifets et al. (2006) attempted to calculate the attributable fraction of worldwide childhood leukemia due to EMFs, based on the meta-analyses of Ahlbom et al. (2000) and Greenland et al., (2000). They concluded that the attributable fraction of leukemia was between <1% to 4%. The recent WHO Environmental Health Criteria ELF Monograph #238 (2007) states “(A)ssuming that the association is causal, the number of cases of childhood leukaemia worldwide that might be attributable to exposure can be estimated to range from 100 to 2,400 cases per year. However this represents 0.2 to 4.9% of the total annual incidence of leukaemia cases, estimated to be 49,000 worldwide in 2000. Thus, in a global context, the impact on public health, if any, would be limited and uncertain.”

These reports are important, in that they show consistency in there being a clearly elevated risk of leukemia in children with EMF exposure from power line fields in homes. These meta-analyses lead to the conclusion, reflected in the WHO report, that there is an association between childhood cancer and exposure to elevated magnetic fields in homes. We strongly disagree, however, with the overall conclusion that these calculations indicate that the fraction of childhood leukemia attributable to EMFs is so small as to not have serious public health implications.

There are several reasons why the WHO ELF Environmental Health Criteria Monograph conclusion is not justified. These studies all considered either only measured magnetic fields in homes or wire codes from power lines, ignoring exposure from appliances, wireless devices and all exposures outside of the home. Thus these metrics do not come close to accounting for any individual’s cumulative exposure to EMFs. If residential magnetic fields cause cancer, then those from other sources will add to the risk. The failure to measure total EMF exposure would tend to obscure the relationship and lead to

gross underestimation of the true relationship between exposure and disease. While the evidence for a relationship between exposure and childhood leukemia may be considered to be definitive at exposure levels of 3 or 4 mG (0.3 or 0.4  $\mu$ T) or higher; there is evidence from some (but not all) of the other studies for an elevated risk at levels not greater than 2 mG (0.2  $\mu$ T) (Savitz et al., 1988; Green, 1999). There is absolutely no evidence that exposures at lower levels are “safe”, since persons with these exposures are usually the “control” group. Therefore this WHO statement fails to acknowledge the true magnitude of the problem, even when considering only childhood leukemia. The global attributable risk of childhood leukemia as a result of exposure to EMFs must be significantly greater than that calculated from consideration of only residential 50/60 Hz magnetic fields in studies where there is no unexposed control.

As detailed in other chapters in this report (Chapter 10), there is some evidence for a relationship between EMF exposure and brain cancers in children. We have almost no understanding of the mechanisms behind the development of brain cancers, and any cancer in a child is a tragedy. While evidence for a relationship between EMF exposure and childhood brain cancer is not as strong as for leukemia, it is of concern and deserves more study. Of even greater concern, given the clear evidence for elevated risk of childhood leukemia upon exposure to 50/60 Hz EMFs, is the relative lack of a comparable body of information on the effects of radiofrequency EMFs on the health of children. A recent study of South Korean children (1,928 with leukemia, 956 with brain cancer and 3,082 controls) living near to AM radio transmitters reports an OR of 2.15 (95% CI = 1.19-2.11) for risk of leukemia in children living within 2 km of the nearest AM transmitter as compared to those living more than 20 km from it (Ha et al., 2007). No relation was found for brain cancer. This study is consistent with the hypothesis that radiofrequency EMFs have similar effects to 50/60 Hz EMFs, but more study is needed. Since radiofrequency EMFs have higher energy than do power line frequencies, one might expect that they would be even more likely to cause disease. The enormous and very recent increase in use of cell phones by children is particularly worrisome. However there is little information at present on the long-term consequences of cell phone use, especially by children.

## **B. “There is insufficient evidence that adult diseases are secondary to EMF exposure.”**

It is correct that the level of evidence definitively proving an association between exposure to EMFs and various adult diseases is less strong than the relationship with childhood leukemia. However there are multiple studies which show statistically significant relationships between occupational exposure and leukemia in adults (see Chapter 11), in spite of major limitations in the exposure assessment. A very recent study by Lowenthal et al. (2007) investigated leukemia in adults in relation to residence near to high-voltage power lines. While they found elevated risk in all adults living near to the high voltage power lines, they found an OR of 3.23 (95% CI = 1.26-8.29) for individuals who spent the first 15 years of life within 300 m of the power line. This study provides support for two important conclusions: adult leukemia is also associated with

EMF exposure, and exposure during childhood increases risk of adult disease. Thus protecting children from exposure should be a priority.

The evidence for a relationship between exposure and breast cancer is relatively strong in men (Erren, 2001), and some (by no means all) studies show female breast cancer also to be elevated with increased exposure (see Chapter 12). Brain tumors and acoustic neuromas are more common in exposed persons (see Chapter 10). There is less published evidence on other cancers, but Charles et al. (2003) report that workers in the highest 10% category for EMF exposure were twice as likely to die of prostate cancer as those exposed at lower levels (OR 2.02, 95% CI = 1.34-3.04). Villeneuve et al. (2000) report statistically significant elevations of non-Hodgkin's lymphoma in electric utility workers in relation to EMF exposure, while Tynes et al. (2003) report elevated rates of malignant melanoma in persons living near to high voltage power lines. While these observations need replication, they suggest a relationship between exposure and cancer in adults beyond leukemia.

Evidence for a relationship between exposure and the neurodegenerative diseases, Alzheimer's and amyotrophic lateral sclerosis (ALS), is strong and relatively consistent (see Chapter 12). While not every publication shows a statistically significant relationship between exposure and disease, ORs of 2.3 (95% CI = 1.0-5.1 in Qio et al., 2004), of 2.3 (95% CI = 1.6-3.3 in Feychting et al., 2003) and of 4.0 (95% CI = 1.4-11.7 in Hakansson et al., 2003) for Alzheimer's Disease, and of 3.1 (95% CI = 1.0-9.8 in Savitz et al., 1998) and 2.2 (95% CI = 1.0-4.7 in Hakansson et al., 2003) for ALS cannot be simply ignored.

In total the scientific evidence for adult disease associated with EMF exposure, given all of the difficulties in exposure assessment, is sufficiently strong that preventive steps are appropriate, even if not all reports have shown exactly the same positive relationship. While there are many possible sources of false positive results in epidemiological studies, there are even more possible reasons for false negative results, depending on sample size, exposure assessment and a variety of other confounders. It is inappropriate to discount the positive studies just because not every investigation shows a positive result. While further research is needed, with better exposure assessment and control of confounders; the evidence for a relationship between EMF exposure and adult cancers and neurodegenerative diseases is sufficiently strong at present to merit preventive actions to reduce EMF exposure.

### **C. "The risk is low."**

This argument is incorrect because at present it is not possible to determine the magnitude of the risk. Clearly as far as EMFs are concerned there is no unexposed population. Therefore one can only compare groups with different levels of exposure. We can perhaps say with confidence that the elevated risk of leukemia from residential exposure of children to magnetic fields is "low" (meaning ORs in the range of 2-4), but this does not consider the child's exposure to appliances, exposure in automobiles and at

daycare or school, exposures in playgrounds and at all of the other places that a child spends time. Even if the risk to one individual is low, the societal impact when everyone is exposed may be very significant.

In addition the exposure assessment is grossly inadequate, even in the best of studies. Most reports deal only with either characterization of the fields within residences or with job titles in occupational settings. Some studies attempt to quantitate other sources of exposure, such as frequency of cell phone usage or use of other appliances, but these studies almost always do not consider residential exposure from power lines. In no investigation has it been possible to follow the exposures of a large number of people over a number of years with accurate monitoring of total exposure to EMFs. This would of course be almost impossible to do for the very good reason that as a person moves through his or her environment the exposures vary from place to place and from moment to moment. However to truly and objectively determine the risk of exposure to EMFs it is essential to consider residential, occupational (or school) and recreational exposures to the full range of the electromagnetic spectrum, including appliances and wireless devices. This has not been accomplished in any study, and without such information it is not possible to determine the overall magnitude of the risk. It is possible, indeed likely, that upon consideration of both childhood and adult diseases that the risk is not low.

#### **D. “There is no animal evidence”.**

It is correct that there is no adequate animal model system that reproducibly demonstrates the development of cancer in response to exposure to EMFs at the various frequencies of concern. McCann et al. (1997) reviewed the animal studies, and while they found most to be negative there were several that showed suggestive positive results. They also clearly identified issues that need to be improved in further animal carcinogenesis investigations. However Kheifets et al. (2005a) in a policy review noted that “even consistent negative toxicological data cannot completely overcome consistent epidemiological studies. First, a good animal model for childhood leukemia has been lacking. Second, particularly for ELF, the complex exposures that humans encounter on a daily basis and a lack of understanding of the biologically relevant exposure calls into question the relevance of exposures applied in toxicology. Another limitation of toxicologic studies is that animals cannot be exposed to fields that are orders of magnitude more powerful than those encountered by humans, decreasing their power to detect small risks.” Further, they conclude that “(A)lthough the body of evidence is always considered as a whole, based on the weight of evidence approach and incorporating different lines of scientific enquiry, epidemiologic evidence, as most relevant, is given the greatest weight.”

One positive animal study is that by Rapacholi et al. (1997), who demonstrated that lymphoma-prone transgenic mice developed significantly more lymphoma after exposure to 900 MHz fields (lymphoma being the animal equivalent of human leukemia) than did unexposed animals. More striking is the report from Denver, Colorado using the wire-code characterization originally developed by Wertheimer and Leeper (1979) showing

that pet dogs living in homes characterized as having high or very high wire codes, as compared to those with low or very low wire codes or buried power lines, showed a OR of 1.8 (95% CI = 0.9-3.4) for development of lymphoma after adjustment for potential confounders, whereas dogs that lived in homes with very high wire codes had an OR of 6.8 (95% CI = 1.6-28.5) (Reif et al., 1995). This study is impressive because the exposure of the dogs reflects the environment in which exposure has been associated with elevated risk of human cancer in two independent investigations (Wertheimer and Leeper, 1979; Savitz et al., 1988).

It is curious that in many legal situations the courts are reluctant to accept only evidence that substance X causes cancer in animals without corresponding evidence in humans. In the case of EMFs we have strong evidence that EMFs cause cancer in human, but much less evidence from animal models. The US Supreme Court, in the case of *Daubert vs. Merrell Dow Pharmaceuticals*, effectively ruled that animal studies were not relevant to human health, and that the only admissible evidence must be from human epidemiological studies! While this is certainly not a justifiable conclusion, the situation with regards to EMF health effects is that we have strong evidence for human cancer from epidemiological studies, but do not have good evidence for cancer in experimental animals. But it is humans that we should be concerned about, not the laboratory rats.

#### **E. “We do not know a mechanism.”**

We do not know the mechanism of cancer in general, although we know a lot about cancer. It came as a major surprise to most scientists when Lichtenstein et al., (2000) reported that genetic factors play a minor role in causing most types of cancer, since it was commonly assumed that genetics was the major cause. However Lichtenstein et al. concluded from their study of identical twins that environmental factors were the initiating event in the great majority of cancers. This does not, of course, mean that genetic susceptibility to environmental contaminants is unimportant, but only that genetic factors alone do not result in cancer. We know mechanisms of action for some carcinogenic substances, but for most cancers we know neither the environmental trigger nor the mechanism of action. So there is no reason to negate the evidence that EMFs cause cancer just because we do not know a single mechanism to explain it's mode of action.

We do not know the mechanism or cause for development of Alzheimer's Disease or ALS. We do know that both are more common in individuals in certain occupations, and that exposure to certain metals appears to be associated with increased risk (Kamel et al., 2002; Shcherbatykh and Carpenter, 2007). In the case of Alzheimer's Disease there are abnormalities of amyloid  $\beta$  and tau protein (Goedert and Spillantini, 2006), but very limited understanding of why or how they form. Neither the association with metals nor the presence of abnormal proteins constitutes a mechanism for cause of disease. So rather than discounting the relationship between EMF exposure and neurodegenerative diseases we should be using this information as a tool to better understand the etiology of these diseases.

There is clear evidence from animal and cell culture studies that ELF and RFR have biological effects. Furthermore, these effects occur at intensities commonly experienced by humans. We know a number of ways in which EMFs alter cell physiology and function, as detailed in various chapters in this report. EMFs affect gene transcription (Chapter 5 and 6), cause the synthesis of stress proteins (Chapter 7) and cause breakage of DNA, probably through generation of reactive oxygen species (Chapter 6 and 9 - Lai and Singh, 2004). Any one of these actions might be responsible for the carcinogenic and neurodegenerative actions of EMFs. However, as with many environmental agents, it would be a mistake to assume that there is only one target or mechanism of action. It is unlikely, for example, that the effects on the nervous system and behavior are secondary to exactly the same cellular targets and actions that lead to cancer. It is likely that there are multiple mechanisms of action leading to disease. But the lack of complete understanding of basic mechanisms does not alter the importance of the relationships.

## **F. Vested Interests: How They Shape the Public Health Debate**

There is no question but that global implementation of the safety standards proposed in this report has the potential to not only be very expensive but also could be disruptive of life and economy as we know it if implemented abruptly and without careful planning. Action must be a balance of risk to cost to benefit. However, “deny and deploy” strategies by industry should not be rewarded in future risk assessment calculations. For example, if significant economic investments in the roll-out of risky technologies persist beyond the time that there is reasonable suspicion of risk available to all who look, then such costs should not be borne by ratepayers (in the case of new powerlines) or by compensating industry for bad corporate choices. Such investments in the deployment of new sources of exposure for ELF and RF should not count toward the balance sheet when regulatory agencies perform risk assessments. Mistakes may be made, but industry should make mid-course corrections to inform and protect the public, rather than deny effects pending “proof”. Whether the costs of remedial action are worth the societal benefits is a formula that should reward precautionary behavior. Prudent corporate policies should be expected to address and avoid future risks and liabilities. Otherwise, there is no market incentive to produce safe (and safer) products.

The deployment of new technologies is running ahead of any reasonable estimation of possible health impacts and estimates of probabilities, let alone a solid assessment of risk. However what has been missing with regard to EMF has been an acknowledgement of the risk that is demonstrated by the scientific studies. As discussed in earlier sections, in this case there is clear evidence of risk, although the magnitude of the risk is uncertain, and the magnitude of doing nothing on the health effects cost to society is similarly uncertain. This situation is very similar to our history of dealing with the hazards of smoking decades ago, where the power of the industry to influence governments and even conflicts of interest within the public health community delayed action for more than a generation, with consequent loss of life and enormous extra health care costs to society.

Just because a problem is difficult to solve is not a reason to deny that a problem exists. In fact solutions to difficult issues usually can't be expected until the issues are known and creative thinking is brought to bear to find a solution.

The most contentious issue regarding public and occupational exposures to ELF and RF involves the resolute adherence to existing ICNIRP and IEEE standards by many countries, in the face of growing scientific evidence of health risks at far lower levels. Furthermore there is widespread belief that governments are ignoring this evidence. There are two obvious factors that work against governments taking action to set exposure guidelines based on current scientific evidence of risk. These are: 1) contemporary societies are very dependent upon electricity usage and RF communications, and anything that restricts current and future usage potentially has serious economic consequences and 2) the electric power and communications industries have enormous political clout and even provide support for a significant fraction of what research is done on EMF. This results in legislation that protects the status quo and scientific publications whose conclusions are not always based on only the observations of the research. It hinders wise public health policy actions and implementation of prevention strategies because of the huge financial investments already made in these technologies.

In 1989, in an editorial for Science Magazine, Philip H. Abelson called for more research into low-frequency electromagnetic fields. At that time, he confirmed that a US Office of Technology Assessment (OTA) study had determined that “*(o)verall, the evidence is too weak to allow firm conclusions either way*” but a policy of prudent avoidance strategy was suggested, Abelson defined this as “*to systematically look for strategies which can keep people out of 60 Hz fields*”. Both policy actions were developed in the midst of scientific uncertainty, but rising concern for possible health impacts to the public. At that time, with high level of unknowns, the appropriate level of policy action was prudent avoidance or precautionary action. Nearly two decades later, the level of action warranted is higher – based on many new scientific publications confirming risks may exist – and justifying prevention or preventative action.

### III. EMF EXPOSURE AND PRUDENT PUBLIC HEALTH PLANNING

- *The scientific evidence is sufficient to warrant regulatory action for ELF; and it is substantial enough to warrant preventative actions for RF.*
- *The standard of evidence for judging the emerging scientific evidence necessary to take action should be proportionate to the impacts on health and well-being*
- *The exposures are widespread.*
- *Widely accepted standards for judging the science are used in this assessment.*

Public exposure to electromagnetic radiation (power-line frequencies, radiofrequency and microwave) is growing exponentially worldwide. There is a rapid increase in electrification in developing countries, even in rural areas. Most members of society now have and use cordless phones, cellular phones, and pagers. In addition, most populations are also exposed to antennas in communities designed to transmit wireless RF signals. Some developing countries have even given up running land lines because of expense and the easy access to cell phones. Long-term and cumulative exposure to such massively increased RF has no precedent in human history. Furthermore, the most pronounced change is for children, who now routinely spend hours each day on the cell phone. Everyone is exposed to a greater or lesser extent. No one can avoid exposure, since even if they live on a mountain-top without electricity there will likely be exposure to communication-frequency RF exposure. Vulnerable populations (pregnant women, very young children, elderly persons, the poor) are exposed to the same degree as the general population. Therefore it is imperative to consider ways in which to evaluate risk and reduce exposure. Good public health policy requires preventative action proportionate to the potential risk of harm and the public health consequence of taking no action.

## IV. RECOMMENDED ACTIONS

### A. Defining new exposure standards for ELF

This chapter concludes that new ELF limits are warranted based on a public health analysis of the overall existing scientific evidence. The public health view is that new ELF limits are needed now. They should reflect environmental levels of ELF that have been demonstrated to increase risk for childhood leukemia, and possibly other cancers and neurological diseases. ELF limits should be set below those exposure levels that have been linked in childhood leukemia studies to increased risk of disease, plus an additional safety factor. It is no longer acceptable to build new power lines and electrical facilities that place people in ELF environments that have been determined to be risky. These levels are in the 2 to 4 milligauss\* (mG) range (0.2 – 0.4  $\mu$ T), not in the 10s of mG or 100s of mG. The existing ICNIRP limit is 1000 mG (100  $\mu$ T) and 904 mG (90.4  $\mu$ T) in the US for ELF is outdated and based on faulty assumptions. These limits are can no longer be said to be protective of public health and they should be replaced. A safety buffer or safety factor should also be applied to a new, biologically-based ELF limit, and the conventional approach is to add a safety factor lower than the risk level.

While new ELF limits are being developed and implemented, a reasonable approach would be a 1 mG (0.1  $\mu$ T) planning limit for habitable space adjacent to all new or upgraded power lines and a 2 mG (0.2  $\mu$ T) limit for all other new construction. It is also recommended for that a 1 mG (0.1  $\mu$ T) limit be established for existing habitable space for children and/or women who are pregnant (because of the possible link between childhood leukemia and *in utero* exposure to ELF). This recommendation is based on the assumption that a higher burden of protection is required for children who cannot protect themselves, and who are at risk for childhood leukemia at rates that are traditionally high enough to trigger regulatory action. This situation in particular warrants extending the 1 mG (0.1  $\mu$ T) limit to existing occupied space. "Establish" in this case probably means formal public advisories from relevant health agencies. While it is not realistic to reconstruct all existing electrical distribution systems, in the short term; steps to reduce exposure from these existing systems need to be initiated, especially in places where children spend time, and should be encouraged. These limits should reflect the exposures that are commonly associated with increased risk of child hood leukemia (in the 2 to 5 mG (0.2 to 0.5  $\mu$ T) range for all children, and over 1.4 mG (0.14  $\mu$ T) for children age 6 and younger). Nearly all of the occupational studies for adult cancers and neurological diseases report their highest exposure category is

4 mG (0.4  $\mu$ T) and above, so that new ELF limits should target the exposure ranges of interest, and not necessarily higher ranges.

Avoiding chronic ELF exposure in schools, homes and the workplace above levels associated with increased risk of disease will also avoid most of the possible bioactive parameters of ELF discussed in the relevant literature.

It is not prudent public health policy to wait any longer to adopt new public safety limits for ELF. These limits should reflect the exposures that are commonly associated with increased risk of childhood leukemia (in the 2 to 5 mG (0.2-0.5  $\mu$ T) range for all children, and over 1.4 mG (0.14  $\mu$ T) for children age 6 and younger). Avoiding chronic ELF exposure in schools, homes and the workplace above levels associated with increased risk of disease will also avoid most of the possible bioactive parameters of ELF discussed in the relevant literature.

## **B. Defining preventative actions for reduction in RF exposures**

Given the scientific evidence at hand, the rapid deployment of new wireless technologies that chronically expose people to pulsed RF at levels reported to cause bioeffects, which in turn, could reasonably be presumed to lead to serious health impacts, is a public health concern. A public health action level that implements preventative action now is warranted, based on the collective evidence. There is suggestive to strongly suggestive evidence that RF exposures may cause changes in cell membrane function, cell communication, metabolism, activation of proto-oncogenes and can trigger the production of stress proteins at exposure levels below current regulatory limits. Resulting effects can include DNA breaks and chromosome aberrations, cell death including death of brain neurons, increased free radical production, activation of the endogenous opioid system, cell stress and premature aging, changes in brain function including memory loss, retarded learning, performance impairment in children, headaches and fatigue, sleep disorders, neurodegenerative conditions, reduction in melatonin secretion and cancers (Chapters 5, 6, 7, 8, 9, 10, and 12).

As early as 2000, some experts in bioelectromagnetics promoted a  $0.1 \mu\text{W}/\text{cm}^2$  limit (which is 0.614 Volts per meter) for ambient outdoor exposure to pulsed RF, so generally in cities, the public would have adequate protection against involuntary exposure to pulsed radiofrequency (e.g., from cell towers, and other wireless technologies). The Salzburg Resolution of 2000 set a target of  $0.1 \mu\text{W}/\text{cm}^2$  (or 0.614 V/m) for public exposure to pulsed radiofrequency. Since then, there are many credible anecdotal reports of unwellness and illness in the vicinity of wireless transmitters (wireless voice and data communication antennas) at lower levels. Effects include sleep disruption, impairment of memory and concentration, fatigue, headache, skin disorders, visual symptoms (floaters), nausea, loss of appetite, tinnitus, and cardiac problems (racing heartbeat). There are some credible articles from researchers reporting that cell tower -level RF exposures (estimated to be between  $0.01$  and  $0.5 \mu\text{W}/\text{cm}^2$ ) produce ill-effects in populations living up to several hundred meters from wireless antenna sites,

This information now argues for thresholds or guidelines that are substantially below current FCC and ICNIPR standards for whole body exposure. Uncertainty about how low such standards might have to go to be prudent from a public health standpoint should not prevent reasonable efforts to respond to the information at hand. No lower limit for bioeffects and adverse health effects from RF has been established, so the possible health risks of wireless WLAN and WI-FI systems, for example, will require further research and no assertion of safety at any level of wireless exposure (chronic exposure) can be made at this time. The lower limit for reported human health effects has dropped 100-fold below the safety standard (for mobile phones and PDAs); 1000- to 10,000-fold for other wireless (cell towers at distance; WI-FI and WLAN devices). The entire basis for safety standards is called into question, and it is not unreasonable to question the safety of RF at any level.

A cautionary target level for pulsed RF exposures for ambient wireless that could be applied to RF sources from cell tower antennas, WI-FI, WI-MAX and other similar sources is proposed. The recommended cautionary target level is  $0.1 \mu\text{W}/\text{cm}^2$ \*\* (or 0.614 Volts per meter or V/m)\*\* for pulsed RF where these exposures affect the general public; this advisory is proportionate to the evidence and in accord with prudent public health policy. A precautionary limit of  $0.1 \mu\text{W}/\text{cm}^2$  should be adopted for outdoor, cumulative RF exposure. This reflects the current RF science and prudent public health response that would reasonably be set for pulsed RF (ambient) exposures where

people live, work and go to school. This level of RF is experienced as whole-body exposure, and can be a chronic exposure where there is wireless coverage present for voice and data transmission for cell phones, pagers and PDAs and other sources of radiofrequency radiation. An outdoor precautionary limit of 0.1  $\mu\text{W}/\text{cm}^2$  would mean an even lower exposure level inside buildings, perhaps as low as 0.01  $\mu\text{W}/\text{cm}^2$ . Some studies and many anecdotal reports on ill health have been reported at lower levels than this; however, for the present time, it could prevent some of the most disproportionate burdens placed on the public nearest to such installations. Although this RF target level does not preclude further rollout of WI-FI technologies, we also recommend that wired alternatives to WI-FI be implemented, particularly in schools and libraries so that children are not subjected to elevated RF levels until more is understood about possible health impacts. This recommendation should be seen as an interim precautionary limit that is intended to guide preventative actions; and more conservative limits may be needed in the future.

Broadcast facilities that chronically expose nearby residents to elevated RF levels from AM, FM and television antenna transmission are also of public health concern given the potential for very high RF exposures near these facilities (antenna farms). RF levels can be in the 10s to several 100's of  $\mu\text{W}/\text{cm}^2$  in residential areas within half a mile of some broadcast sites (for example, Lookout Mountain, Colorado and Awbrey Butte, Bend, Oregon). Like wireless communication facilities, RF emissions from broadcast facilities that are located in, or expose residential populations and schools to elevated levels of RF will very likely need to be re-evaluated for safety.

For emissions from wireless devices (cell phones, personal digital assistant or PDA devices, etc) there is enough evidence for increased risk of brain tumors and acoustic neuromas now to warrant intervention with respect to their use. Redesign of cell phones and PDAs could prevent direct head and eye exposure, for example, by designing new units so that they work only with a wired headset or on speakerphone mode.

These effects can reasonably be presumed to result in adverse health effects and disease with chronic and uncontrolled exposures, and children may be particularly vulnerable. The young are also largely unable to remove themselves from such environments. Second-hand radiation, like second-hand smoke is an issue of public health concern based on the evidence at hand.

## V. CONCLUSIONS

- We cannot afford “business as usual” any longer. It is time that planning for new power lines and for new homes, schools and other habitable spaces around them is done with routine provision for low-ELF environments . The business-as-usual deployment of new wireless technologies is likely to be risky and harder to change if society does not make some educated decisions about limits soon. Research must continue to define what levels of RF related to new wireless technologies are acceptable; but more research should not prevent or delay substantive changes today that might save money, lives and societal disruption tomorrow.
- New regulatory limits for ELF based on biologically relevant levels of ELF are warranted. ELF limits should be set below those exposure levels that have been linked in childhood leukemia studies to increased risk of disease, plus an additional safety factor. It is no longer acceptable to build new power lines and electrical facilities that place people in ELF environments that have been determined to be risky (at levels generally at 2 mG (0.2  $\mu$ T) and above).
- While new ELF limits are being developed and implemented, a reasonable approach would be a 1 mG (0.1  $\mu$ T) planning limit for habitable space adjacent to all new or upgraded power lines and a 2 mG (0.2  $\mu$ T) limit for all other new construction, It is also recommended for that a 1 mG (0.1  $\mu$ T) limit be established for existing habitable space for children and/or women who are pregnant . This recommendation is based on the assumption that a higher burden of protection is required for children who cannot protect themselves, and who are at risk for childhood leukemia at rates that are traditionally high enough to trigger regulatory action. This situation in particular warrants extending the 1 mG (0.1  $\mu$ T) limit to existing occupied space. "Establish" in this case probably means formal public advisories from relevant health agencies.
- While it is not realistic to reconstruct all existing electrical distributions systems, in the short term; steps to reduce exposure from these existing systems need to be initiated, especially in places where children spend time, and should be encouraged.

- A precautionary limit of 0.1 ( $\mu\text{W}/\text{cm}^2$  (which is also 0.614 Volts per meter) should be adopted for outdoor, cumulative RF exposure. This reflects the current RF science and prudent public health response that would reasonably be set for pulsed RF (ambient) exposures where people live, work and go to school. This level of RF is experienced as whole-body exposure, and can be a chronic exposure where there is wireless coverage present for voice and data transmission for cell phones, pagers and PDAs and other sources of radiofrequency radiation. Some studies and many anecdotal reports on ill health have been reported at lower levels than this; however, for the present time, it could prevent some of the most disproportionate burdens placed on the public nearest to such installations. Although this RF target level does not preclude further rollout of WI-FI technologies, we also recommend that wired alternatives to WI-FI be implemented, particularly in schools and libraries so that children are not subjected to elevated RF levels until more is understood about possible health impacts. This recommendation should be seen as an interim precautionary limit that is intended to guide preventative actions; and more conservative limits may be needed in the future.

## VI. References

- Abelson, PH. 1989. Effects of electric and magnetic fields. *Science* 245: 241.
- Ahlbom A Day N Feychting M Roman E Skinner J Docterty J Linet M McBride M Michaelis J Olsen JH Tynes T and Verkasalo PK 2000. A pooled analysis of magnetic fields and childhood leukaemia. *Br J Cancer* 83: 692-698.
- California Air Resources Board 2005. Appendix III, Part B-Health Effects. Proposed identification of environmental tobacco smoke as a toxic air contaminant.
- Carpenter DO and Ahlbom A 1988. Power lines and cancer: Public health and policy implications. *Forum Appl Res Pub Policy*, Winter, 96-101.
- Charles LE Loomis D Shy CM Newman B Millikan R Nylander-French LA Couper D 2003. Electromagnetic fields, polychlorinated biphenyls and prostate cancer mortality in electric utility workers. *Am J Epidemiol* 157: 683-691.
- Erren TC 2001. A meta-analysis of epidemiologic studies of electric and magnetic fields and breast cancer in women and men. *Bioelectromagnetics Supplement* 5: S105-S119.
- Feychting M, Jonsson F, Pedersen NL and Ahlbom A 2003. Occupational magnetic field exposure and neurodegenerative disease. *Epidemiology* 14: 413-419.
- Foliart DE Pollock BH Mezei G Iriye R Silva JM Epi KL Kheifets L Lind MP Kavet R 2006. Magnetic field exposure and long-term survival among children with leukemia. *British Journal of Cancer* 94 161-164.
- Goedert M and Spillantini MG 2006. A century of Alzheimer's Disease. *Science* 314: 777-784.
- Green L 1999. Childhood leukemia and EMF. *Cancer Causes Control* 10: 233-243.
- Greenland S 1987. Quantitative methods in the review of epidemiological literature. *Epidemiologic Reviews* 9:1-30.
- Greenland S Sheppard AR Kaune WT Poole C, Kelsh MA and the Childhood leukemia-EMF study group 2000. A pooled analysis of magnetic fields, wire codes, and childhood leukemia. *Epidemiology* 11: 624-634.
- Ha M Im H Le M Kim HJ Kim BC Gimm YM and Pack JK 2007. Radio-frequency radiation exposure from AM radio transmitters and childhood leukemia and brain cancer. *Am J Epidemiol* 166: 270-279.
- Hakansson N, Gustavsson P, Johansen C and Floderus B 2003. Neurodegenerative diseases in welders and other workers exposed to high levels of magnetic fields. *Epidemiology* 14: 420-426.
- Hardell L Carlberg M Söderqvist F Hansson Mild K Morgan 2007. Long-term use of cellular phones and brain tumours: increased risk associated with use for  $\geq 10$  years. *Occup Environ Med*; doi:10.1136/oem.2006.029751.

Hill, AB. 1971. Principles of Medical Statistics Chapter XXIV. Statistical Evidence and Inference, Oxford University Press, Oxford University, Oxford, UK, p. 309-323.

IARC (International Agency for Research on Cancer) 2002. Monographs on the evaluation of carcinogenic risks to humans: Volume 80. Non-ionizing radiation, Part 1: Static and extremely low frequency (ELF) electric and magnetic fields. Lyon, France: IARC Press.

Jarosinska D Gee D. 2007. Children's environmental health and the precautionary principle. *Int J Hyg. Environ Health*. doi:10.1016/j.ijheh.2007.07.017.

Juutilanen J Kumlin T Naarala J. 2006 Do extremely low frequency magnetic fields enhance the effects of environmental carcinogens? A meta-analysis of experimental studies. *Ing J Radiat Biol* 82: 1-12.

Kamel F Umbach DM Munsat TL Shefner JM Hu H Sandler DP 2002. Lead exposure and amyotrophic lateral sclerosis. *Epidemiology* 13: 311-319.

Kan P Simonsen SE Lyon JL Kestle JRW 2007. Cellular phone use and brain tumor: a meta-analysis. *J. Neurooncol* DOI 10.1007/s11060-007-9432-1.

Kheifets Afifi AA Buffler PA Zhang ZW 1995. Occupational electric and magnetic field exposure and brain cancer: a meta-analysis. *JOEM* 37:12. 1327-1341.

Kheifets L 2001. Electric and magnetic field exposure and brain cancer: a review. *Bioelectromagnetics Supplement* 5:S120-S131,

Kheifets L Shimkhada R 2005a. Childhood Leukemia and EMF: Review of the Epidemiologic Evidence. *Bioelectromagnetics Supplement* 7: S51-S59.

Kheifets L Sahl JD Shimkhada R Repacholi MH 2005b. Developing policy in the face of scientific uncertainty: Interpreting 0.3 or 0.4  $\mu$ T cutpoints from EMF epidemiology studies. *J Risk Anal* 25: 927-935.

Kheifets Afifi AA and Shimkhada R 2006. Public health impact of extremely low-frequency electromagnetic fields. *Environ Health Perspect* 114: 1532-1537.

Lai H and Singh NP 2004. Magnetic-field-induced DNA strand breaks in brain cells of the rat. *Environ Health Perspect* 112: 687-694.

Lahkola A Tokola K, Auvinen A 2006. Meta-analysis of mobile phone use and intracranial tumors. *Scand J Work Environ Health* 32(3):171-177.

Land Salzburg - Landessanitätsdirektion – Umweltmedizin - Federal State of Salzburg - Public Health Department - Environmental Health Unit, International Conference on Cell Tower Siting, Salzburg Resolution, Salzburg, Austria, June 2000.

Lichtenstein P Holm NV Verkasalo PK Iliadou A Kaprio J Koskenvuo M Pukkala E Skytthe A and Hemminki K 2000. Environmental and heritable factors in the causation of cancer: Analyses of cohorts of twins from Sweden, Denmark and Finland. *N Engl J Med* 343: 78-85.

Lowenthal RM Tuck DM and Bray IC 2007. Residential exposure to electric power transmission lines and risk of lymphoproliferative and myeloproliferative disorders: a case-control study. *Int Med J* doi:10.1111/j.1445-5994.2007.01389.x

McCann J Kavet R and Rafferty CN 1999. Testing electromagnetic fields for potential carcinogenic activity: A critical review of animal models. *Environ Health Perspect* 105 (Suppl 1): 81-103.

Milham S Ossiander EM 2001. Historical evidence that residential electrification caused the emergence of the childhood leukemia peak. *Medical Hypoth* 56: 290-29

Qio C Fratiglioni , Karp A Winblad B Bellander T 2004. Occupational exposure to electromagnetic fields and risk of Alzheimer's Disease. *Epidemiology* 15: 687-694.

Reif JS Lower KS Oglivie GK 1995. Residential exposure to magnetic fields and risk of canine lymphoma. *Am J Epidemiol* 141: 352-359.

Repacholi MH, Basten A, Gebiski V, Noonan D, Finnie J and Harris AW (1997) Lymphomas in Eμ-Pim1 transgenic mice exposed to pulsed 900 MHz electromagnetic fields. *Rad Res* 147: 631-640.

Rothman KJ Greenland S. 1998. *Modern Epidemiology*, 2<sup>nd</sup> ed. Philadelphia: Lippincott-Raven.

Savitz DA Checkoway H Loomis DP 1998. Magnetic field exposure and neurodegenerative disease mortality among electric utility workers. *Epidemiology* 9: 398-404.

Savitz DA Wachtel H Barnes FA 1988. Case-control study of childhood cancer and exposure to 60-Hz magnetic fields. *Am J Epidemiol* 128: 21-38.

European Commission, Health and Consumer Protection, 2007. Scientific Committee on SCENIHR Report on Emerging and Newly Identified Health Risks – Possible Effects of Electromagnetic Fields (EMF) on Human Health.

Shcherbatykh I Carpenter DO 2007. The role of metals in the etiology of Alzheimer's Disease. *J Alzheimer's Dis* 11: 191-205.

Svendsen AL Weihkopf T Kaatsch P Schuz J 2007. Exposure to magnetic fields and survival after diagnosis of childhood leukemia: a German cohort study. *Cancer Epidemiol Biomarkers Prev* 16(6) 1167-1171.

Tynes T Klaeboe L Haldorsen T 2003. Residential and occupational exposure to 50 Hz magnetic fields and malignant melanoma: a population based study. *Occup Environ Med* 60: 343-347.

US Department of Health and Human Services (US DHHS, 2004). The health consequences of smoking: cancer. A report of the Surgeon General. US DHHS Public Health Service, Office on Smoking and Health, U Government Printing Office, Washington DC, 17-24.

US Department of Health and Human Services (US DHHS) 2006. The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General <http://www.surgeongeneral.gov/library/secondhandsmoke>

Villeneuve PJ Agnew DA Miller AB Corey PN 2000. Non-Hodgkin's lymphoma among electric utility workers in Ontario: the evaluation of alternate indices of exposure to 60 Hz electric and magnetic fields. *Occup Environ Med* 57: 249-257.

Wartenberg D 1998. Residential magnetic fields and childhood leukemia: A meta-analysis. *Am J Public Health* 88: 1787-1794.

Wertheimer N Leeper E 1979. Electrical wiring configurations and childhood cancer. *Am J. Epidemiol* 109: 273-284.

WHO - World Health Organization 2007. Extremely low frequency fields. *Environmental Health Criteria*, Vol. 238. Geneva, World Health Organization.

<http://www.thesleuthjournal.com/media-blackout-smart-meter-dangers/>

## Media Blackout On Smart Meter Dangers

January 29, 2014 | By Professor James Tracy | [General Health](#), [Mainstream Media](#),

Major power utilities continue to deploy “smart” electrical meters on businesses and private residences throughout the United States and Canada. Yet those in North America and elsewhere remain in the dark on the negative health effects of such devices that systematically blast their homes with radio-frequency (RF) radiation on a minute-by-minute, round-the-clock basis.

In 2009 the Obama administration partnered with utilities by allocating \$3.4 billion in federal stimulus funds toward building a nationwide “smart grid,” where smart meters figure centrally.[1] The project is part of President Obama’s “Climate Action Plan” that under United Nations auspices seeks to reduce US carbon emissions 20% by the year 2020.[2]

There is more than ample research available that has associated negative health effects of RF radiation emitted by smart meters [3] for regulatory authorities to place restrictions on power utilities and compel them to abide by the precautionary principle. Such restrictions would require power providers to refrain from wide scale installation of smart meters until a sufficient body of scientific research demonstrating the safety of such devices has been produced and rigorously evaluated.

Yet in the US and elsewhere the imperative of having a “smart grid,” the prospect of a carbon trading scheme, lax (and in at least some cases corrupt) state and federal regulatory bodies, and the sheer power of the utilities combine to jeopardize the long term health of the entire population.

In a purportedly democratic society news outlets play a decisive role in such an impending health crisis. By failing to report on the dubious health research of smart meters and the fact that the public is being involuntarily subjected to such technology, news media are a key factor in the citizenry’s continued ignorance and inaction.

In May 2011 the World Health Organization’s International Agency for Research on Cancer categorized “radiofrequency electromagnetic fields as possibly carcinogenic to humans based on an increased risk for glioma, a malignant type of brain cancer, associated with wireless cellphone use.”[4] Despite this warning from a well-recognized source, the utilities stubbornly insist that all residences must be equipped with a smart meter issuing dangerous electropollution.

The Environmental Protection Agency (EPA) ceased studying the health effects of radiofrequency radiation when the Senate Appropriations Committee cut the department’s funding and forbade it from further research into the area.[5] Thereafter RF limits were codified as mere “guidelines” based on the EPA’s tentative findings and are presently overseen by the Federal Communications Commission (FCC).

These weakly enforced standards are predicated on the alleged “thermal effect” of RF to which the FCC subscribes. In other words, if the energy emitted from a wireless antenna or device is not powerful enough to heat the skin or flesh then no danger is posed to human health.[6]

To this day power utilities cling to this severely outmoded and unscientific standard when confronted with the formidable body of research linking RF to cancer, destruction of DNA, and other negative health effects. News media seldom question the FCC policy when it is cited by utilities and regulators alike to underline the supposed overall safety of smart meters.[7]

An electronic LexisNexis search of newspaper articles referencing “smart meters” appearing between May 31, 2011, the date WHO classified RF a Class 2B carcinogen, and June 19, 2014, yields close to 839 pieces published in English language papers. Yet for the same time span only one tenth of the sample (82 articles)

mentions “smart meters” and “carcinogen” or “carcinogenic” in the same report. Of these, 65 of the articles appeared in Canadian, and to a much lesser degree Australian or UK papers. Note that each sample includes guest editorials and letters to the editor penned by concerned citizens.

Using parameters from the date May 31, 2011, the date WHO declared RF a Class 2B carcinogen, to January 19, 2014, of 93 newspaper articles referencing “smart meter” and “World Health Organization,” 76 were published in Canadian, and to a much lesser degree UK, Australian, Malaysian or New Zealand outlets. As the above suggests, the extremely limited awareness especially in the US of the potential health consequences of exposure to the continual RF emitted by smart meters is primarily because the issue is being blacked out in the press. When such dangers are reported, they are tempered by the refrain of the FCC’s “thermal effect” policy, which in light of the abundant countervailing research amounts to disinformation. In December 2013 I contacted the reporter at the local metro-daily *Palm Beach Post* covering the state power utility, Florida Power and Light, and its smart meter policy to remind her of the bevy of public health and medical research documenting the likely consequences of sustained RF exposure. I also directed her to the WHO statement classifying RF as potentially carcinogenic.

To the *Post*’s credit a subsequent story highlighting Florida Power and Light’s “opt out” policy referenced the WHO statement. Yet the piece appeared deep in the business section of the paper, and the WHO warning was accompanied by the Florida Public Service Commission’s familiar rejoinder.

In 2011 the World Health Organization’s International Agency for Research on Cancer classified radio frequency electromagnetic fields such as those emitted by cellular phones, microwaves and smart meters as possibly carcinogenic to humans.

The PSC has said its authority does not extend to health issues related to meters. Smart meters are certified for compliance with radio frequency emission standards by the Federal Communications Commission, and the FCC has deemed that meters in compliance with the standards do not have adverse health impacts.[8]

While one or more hidden agendas likely exist to keep the public unaware of the health dangers associated with RF and smart meters (again, think carbon trading, in addition to the social control possibilities via energy rationing and surveillance soon to be realized through the “smart grid,”) a more immediate cause for such censorship is simply profit and continued media monopoly control of public opinion and discourse.

The telecommunications industry whose services are largely predicated on RF has recently exhibited the largest growth in advertising outlays, which are surely recognized in bottom line terms by the news and media industries.[9] With potential continued revenue growth on this scale, raising questions and relaying information that can safeguard public health and allow citizens to ask intelligent questions concerning the health of themselves and their loved ones simply constitutes poor business practice.

#### Notes

[1] [“President Obama Announces \\$3.4 Billion Investment to Spur Transition to Smart Energy Grid,”](#) The White House, October 27, 2009.

[2] Ed King, [“Obama Promises to Cut Carbon Pollution in Climate Action Plan,”](#) Responding to Climate Change, June 26, 2013.

[3] See, for example, the American Association of Environmental Medicine EMF-RF Reference List ([PDF](#)) and AAEM’s April 12, 2012 Press Advisory ([PDF](#)).

[4] World Health Organization International Agency for Research on Cancer, [“IARC Classifies Radiofrequency Electromagnetic Fields as Possibly Carcinogenic,”](#) May 31, 2011.

[5] Susan Luzzaro, [“Field of Cell Phone Tower Beams,”](#) *San Diego Reader*, May 18, 2011,

[6] FCC Office of Engineering and Technology, <http://www.fcc.gov/oet/rfsafety>. See also James F. Tracy [“Wireless Technology and the Accelerated Toxicification of America,”](#) [memoryholeblog.com](http://memoryholeblog.com), July 7, 2012.

[7] When this author obtained documents through a public records request from the Florida Public Service

Commission on Florida Power and Light's smart meter campaign—a very simple and routine endeavor for any journalist—it was evident that no human health impact studies on statewide smart meter deployment were ever considered. The PSC merely accepted FPL's rationale and related public relations literature.

[8] Susan Salisbury, "[Media Opt-Out Fee to Be Considered, PSC Staff Proposes Enrollment, Monthly Cost for Device For Device Foes,](#)" *Palm Beach Post*, January 3, 2014, B4.

[9] "[Ad Spend By Sector: Consumer Goods and Telecom Take the Cake in 2012,](#)" *Nielsen.com*, April 25, 2013.

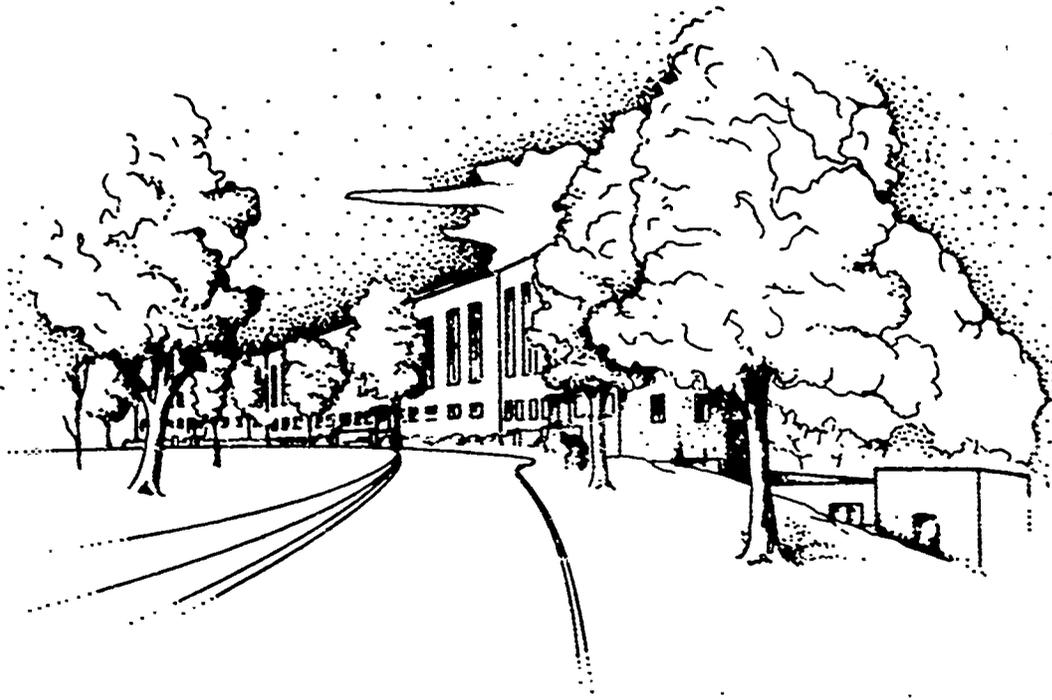
---

**Professor James F. Tracy** is an Associate Professor of Media Studies at Florida Atlantic University. James Tracy's work on media history, politics and culture has appeared in a wide variety of academic journals, edited volumes, and alternative news and opinion outlets. James is editor of *Union for Democratic Communication's Journal Democratic Communiqué* and a contributor to Project Censored's forthcoming publication *Censored 2013: The Top Censored Stories and Media Analysis of 2011-2012*. Additional writings and information are accessible at [memoryholeblog.com](http://memoryholeblog.com).

AD 750271

# NMRI

**NAVAL MEDICAL RESEARCH INSTITUTE**



**BIBLIOGRAPHY OF REPORTED BIOLOGICAL PHENOMENA ('EFFECTS') AND CLINICAL  
MANIFESTATIONS ATTRIBUTED TO MICROWAVE AND RADIO-FREQUENCY RADIATION**

**RESEARCH REPORT**

**MF12.524.015-0004B**

**REPORT NO. 2  
REVISED**

Reproduced by  
**NATIONAL TECHNICAL  
INFORMATION SERVICE**  
U.S. Department of Commerce  
Springfield, VA 22151

**BIBLIOGRAPHY OF REPORTED BIOLOGICAL PHENOMENA ('EFFECTS') AND CLINICAL  
MANIFESTATIONS ATTRIBUTED TO MICROWAVE AND RADIO-FREQUENCY RADIATION**

**Zorach R. Glaser, Ph.D.  
LT, MSC, USNR**

**Research Report**

**Project MF12.524.015-0004B, Report No. 2**

**Naval Medical Research Institute  
National Naval Medical Center  
Bethesda, Maryland 20014, U.S.A.**

**4 October 1971**

**Second Printing, with Revisions,  
Corrections, and Additions: 20 April 1972  
(Supersedes AD No. 734391)**

## ABSTRACT

More than 2000 references on the biological responses to radio frequency and microwave radiation, published up to June 1971, are included in the bibliography.\* Particular attention has been paid to the effects on man of non-ionizing radiation at these frequencies. The citations are arranged alphabetically by author, and contain as much information as possible so as to assure effective retrieval of the original documents. An outline of the effects which have been attributed to radio frequency and microwave radiation is also part of the report.

\*Three supplementary listings bring the number of citations to more than 2300.

### Key Words

Biological Effects  
Non-Ionizing Radiation  
Radar Hazards  
Radio Frequency Radiation  
Microwave Radiation  
Health Hazards  
Bibliography  
Electromagnetic Radiation Injury

The comments upon and criticisms of the literature made in this report, and the recommendations and inferences suggested, are those of the author, and do not necessarily reflect the views of the Navy Department or of the Naval Service.

Security Classification

DOCUMENT CONTROL DATA - R & D

Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified.

ORIGINATING ACTIVITY (Corporate author)

NAVAL MEDICAL RESEARCH INSTITUTE  
NATIONAL NAVAL MEDICAL CENTER  
BETHESDA, MARYLAND 20014

2a. REPORT SECURITY CLASSIFICATION

UNCLASSIFIED

2b. GROUP

3. REPORT TITLE

BIBLIOGRAPHY OF REPORTED BIOLOGICAL PHENOMENA ('EFFECTS') AND CLINICAL  
MANIFESTATIONS ATTRIBUTED TO MICROWAVE AND RADIO-FREQUENCY RADIATION

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Medical research interim report, bibliographic (Current to April 1972)

5. AUTHOR(S) (First name, middle initial, last name)

Zorach R. GLASER, Ph.D.  
LT, MSC, USN

6. REPORT DATE

Revised 20 April 1972  
(4 October 1971, Original)

7a. TOTAL NO. OF PAGES

~~103~~ 106

7b. NO. OF REFS

2,311

8a. CONTRACT OR GRANT NO.

b. PROJECT NO

c.

d.

9a. ORIGINATOR'S REPORT NUMBER(S)

MF12.524.015-0004B, Report No. 2, Revised

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned  
this report)

10. DISTRIBUTION STATEMENT

THIS DOCUMENT HAS BEEN APPROVED FOR PUBLIC RELEASE AND SALE; ITS DISTRIBUTION IS  
UNLIMITED.

11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY

BUREAU OF MEDICINE AND SURGERY (NAVY)  
WASHINGTON, D.C. 20390

13. ABSTRACT

More than 2300 references on the biological responses to radio frequency and microwave radiation, published up to April 1972, are included in this bibliography of the world literature. Particular attention has been paid to the effects on man of non-ionizing radiation at these frequencies. The citations are arranged alphabetically by author, and contain as much information as possible so as to assure effective retrieval of the original documents. Soviet and East European literature is included in detail. An outline of the effects which have been attributed to radio frequency and microwave radiation is included as Chapter 1. The revised report (which supersedes DDC report AD#734391) is updated with the inclusion of three supplementary listings, and has incorporated many corrections and additions to the original 2100 citations.

DD FORM 1473  
1 NOV 65

UNCLASSIFIED

Security Classification

UNCLASSIFIED

Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
biological effects Non-ionizing radiation kadar hazards Radio frequency radiation Microwave radiation Health hazards Bibliography Electromagnetic radiation injury radiation adverse effects						

11

## TABLE OF CONTENTS

	<u>PAGE</u>
Abstract	2
Table of Contents	3
Foreword	4
Acknowledgments	5
Chapter 1, Outline of Reported Biological Phenomena ('Effects') and Some Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation	7
Chapter 2, Bibliography, Alphabetical Listing	12
Unsigned Reports and Articles	83
Addenda, Alphabetical by Author	87
Addenda, Unsigned Reports and Articles	89
First Supplementary Listing (5 October 1971)	91
Appendix A, Accession Numbers and Sources	92
Second Supplementary Listing (21 November 1971)	93
Third Supplementary Listing (17 April 1972)	95

## Foreword

It is the hope of the author that this bibliography will provide guidance to the diffuse and conflicting literature on the biological responses to electromagnetic radiation at radio- and microwave-frequencies, with particular reference to the effects of concern to man. Such guidance is needed in the formulation and appraisal of criteria and limits of human exposure to "non-ionizing" radiation, and in the planning and conduct of future research.

The original plans were to categorize and key the literature citations to the "outline of biological and clinical effects" (Chapter 1). This proved to be a much more difficult and time-consuming task than anticipated, and was actually completed only for about 400 papers. Thus, the letter-number combinations given in square brackets for some of the "A" through "C" citations refer to the outline. [NV] indicates the citation was "not verified".

The standard format used throughout the bibliography is: author, (date), journal, volume, (issue): page, "title". The authors are alphabetized, and in chronological order. Multiple authors are also alphabetically ordered according to the second, third, etc., author. Inclusive pagination is given where possible, as is the original language of the citation. Report accession and translation numbers (some of which are cited in Appendix A), and alternate sources are listed when known. The title of books is underlined. When the title of the report was not available (or not given), a short (one line) description of the paper is listed whenever possible. Reports in which the name of the author was not given are listed chronologically using the format, "title", reference, source, (date). In many cases the citation was obtained from secondary (and tertiary) sources. For this reason it was impossible to put every citation into a consistent format.

In a few cases, papers have been cited which were presented at symposia or meetings devoted to the present topic, even when the report title suggests that it does not pertain directly to the topic. This has been done to show the wide range of items considered relevant (at least at the time of the meeting, and by the organizing chairman) in past years. An example is "electroanesthesia".

A few citations of marginal and/or peripheral relationship have also been included so that the reader may judge the applicability to his individual research needs. Examples are reports dealing with the biological effects of static and alternating magnetic fields, experimental techniques using radio frequency and microwave radiation (e.g., electron spin resonance, and nuclear magnetic resonance spectroscopy), and microwave exposure limits, regulations, and standards.

References for a few limited-distribution government reports are available upon request.

The author welcomes information which will correct errors and omissions (both of which no doubt exist). Copies of new papers would be greatly appreciated, and would encourage updating and revising the bibliography periodically.

#### ACKNOWLEDGMENTS

The assistance and support received during the preparation of this bibliography have been considerable, and I am happy to acknowledge my indebtedness and gratitude. Drs. John Keesey and Dennis Heffner, former and present Heads of the Biophysics Division, and Dr. Seymour Friess, Director of the Environmental Biosciences Department of the Naval Medical Research Institute, permitted me the opportunity to work on the bibliography, and offered frequent encouragement.

Acknowledgment is also due to many friends and associates for their helpful suggestions, comments, and loans and/or gifts of reports or other material, which have been invaluable in the course of the work. Mr. Glenn Heimer of the Naval Ship Engineering Center contributed an extensive collection of government reports and documents, many of which had not previously been cited in the open literature.

Special help in tracing and in the acquisition of relevant papers has been received from the librarians and staff members of the NMRI library: Mrs. Thelma Robinson, Mrs. Ernestine Gendleman, Mrs. Eleanor Capps, and Miss Deborah Grove. Their diligence and resourcefulness in tracing and obtaining copies of a large number of papers and reports, often in spite of incomplete and/or inaccurate citations given in other sources, enabled me to include many relevant items in the bibliography.

Mr. Christopher Dodge of the Scientific and Technical Center, Department of the Navy, provided much of the Soviet Bloc literature, linguistic and other technical assistance, and in addition offered valuable comments and encouragement throughout the preparation of this report. Especially noteworthy were the corrections and improvements suggested by Chris following his reading of the entire manuscript.

Helpful also in locating some of the Soviet literature was Mr. E. S. Serebrennikov, of the Science and Technology Division, The Library of Congress.

Credit is due Mrs. Anna Woke (of this Institute) for translating many of the German papers; to Dr. Emilio Weiss, who translated from the Italian, and to Mrs. Edith Pugh who typed many "first drafts"; also to Mrs. Rhoda Glaser for her help in many aspects of the work.

Mrs. Fannie Epstein deserves special mention for her outstanding editorial assistance, and especially for the heroic typing, organization, and checking of the entire report.

The Outline of Reported Biological Phenomena ('Effects') and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation, is patterned after that given by R. Murray, et al., in an article entitled, "How safe are microwaves", which appeared in Non-Ionizing Radiation 1(1):7-8 (1969). Some of the "effects" were listed in the report by S. F. Cleary and W. T. Ham, Jr., entitled, "Considerations in the evaluation of the biological effects on exposure to microwave radiation", (Background document, Part I, 1969, for the Task Force on Research Planning in Environmental Health, Subtask Force on Physical Factors in the Environment). The discussion and suggestions offered by Byron McLees, Edward Finch, Lewis Gershman, and Christopher Dodge relating to the Outline are also gratefully acknowledged.

Preparation of the bibliography was supported by the Bureau of Medicine and Surgery, Department of the Navy, under work unit MF12.524. 015-0094B.

## CHAPTER 1

### Reported Biological Phenomena ("Effects") and Some Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation (See Note)

#### A. Heating of Organs\* (Applications: Diathermy, Electrosurgery, Electro- coagulation, Electrodesiccation, Electrotomy)

1. Whole Body (temperature regulation defects), Hyperpyrexia
  2. Skin
  3. Bone and Bone Marrow
  4. (a) Lens of Eye (cataractous lesions - due to the avascular nature of the lens which prevents adequate heat dissipation.)  
(b) Corneal damage also possible at extremely high frequencies.
  5. Genitalia (tubular degeneration of testicles)
  6. Brain
  7. Sinuses
  8. Metal Implants (burns near hip pins, etc.)
- The effects are generally reversible except for 4a.

#### B. Changes in Physiologic Function

1. Striated Muscle Contraction
2. Alteration of Diameter of Blood Vessels (increased vascular elasticity), Dilation
3. Changes in the Oxidative Processes in Tissues and Organs
4. Liver Enlargement
5. Altered Sensitivity to Drug Stimuli
6. Decreased Spermatogenesis (decreased fertility, to sterility)
7. Altered Sex Ratio of Births (more girls!)
8. Altered Menstrual Activity
9. Altered Fetal Development
10. Decreased Lactation in Nursing Mothers
11. Reduction in Diuresis ( $\text{Ca}^+$  excretion, via urine output)
12. Altered Renal Function (decreased filtration by tubules)
13. Changes in Conditioned Reflexes
14. Decreased Electrical Resistance of Skin
15. Changes in the Structure of Skin Receptors of the (a) Nerve, and (b) Blood-Carrying Systems
16. Altered Blood Flow Rate

---

\* It is also reported that low levels of irradiation produce a cooling effect - "hypercompensation".

Note: These effects are listed without comment or endorsement since the literature abounds with conflicting reports. In some cases the basis for reporting an "effect" was a single or a non-statistical observation which may have been drawn from a poorly conceived (and poorly executed) experiment.

17. Alterations in the Biocurrents (EEG?) of the Cerebral Cortex (in animals)
18. Changes in the Rate of Clearance of Tagged Ions from Tissue
19. Reversible Structural Changes in the Cerebral Cortex and the Diencephalon
20. Electrocardiographic (EKG) Changes
21. Alterations in Sensitivity to Light, Sound, and Olfactory Stimuli
22. Functional (a) and Pathological (b) Changes in the Eyes:  
(a) decrease in size of blind spot, altered color recognition, changes in intraocular pressure, lacrimation, trembling of eyelids; (b) lens opacity and coagulation, altered tissue respiration, and altered reduction-oxidation processes
23. Myocardial Necrosis
24. Hemorrhage in Lungs, Liver, Gut, and Brain
25. Generalized Degeneration of all Body Tissue
26. Loss of Anatomical Parts
27. Death
28. Dehydration
29. Altered Rate of Calcification of Certain Tissue

} At Fatal Levels  
of Radiation

#### C. Central Nervous System Effects

1. Headaches
2. Insomnia
3. Restlessness (Awake and During Sleep)
4. Electroencephalographic (EEG) Changes
5. Cranial Nerve Disorders
6. Pyramidal Tract Lesions
7. Conditioned Reflex Disorders
8. Vagomimetic Action of the Heart; Sympathomimetic Action
9. Seizures, Convulsions

#### D. Autonomic Nervous System Effects

1. Neuro-vegetative Disorders (e.g., alteration of heart rhythm)
2. Fatigue
3. Structural Alterations in the Synapses of the Vagus Nerve
4. Stimulation of Parasympathetic Nervous System (Bradycardia), and Inhibition of the Sympathetic Nervous System

#### E. Peripheral Nervous System Effects

Effects on Locomotor Nerves

F. Psychological Disorders ("Human Behavioral Studies") - the so-called "Psychophysiologic (and Psychosomatic) Responses"

1. Neurasthenia - (general "bad" feeling)
2. Depression
3. Impotence
4. Anxiety
5. Lack of Concentration
6. Hypochondria
7. Dizziness
8. Hallucinations
9. Sleepiness
10. Insomnia
11. Increased Irritability
12. Decreased Appetite
13. Loss of Memory
14. Scalp Sensations
15. Increased Fatigability
16. Chest Pain
17. Tremor of the Hands

G. Behavioral Changes (Animal Studies)

Reflexive, Operant, Avoidance, and Discrimination Behaviors

ii. Blood Disorders

(V = in vivo)  
(v = in vitro)

Changes in:

1. Blood and Bone Marrow
2. Phagocytic (polymorphs) and Bactericidal functions of blood (v)
3. Hemolysis rate (increase), (a shortened lifespan of cells)
4. Sedimentation rate (increase), (due to changes in serum protein levels or amount of fibrinogen. (?)
5. Number of Erythrocytes (decrease), also number of lymphocytes
6. Blood Glucose Concentration (increase)
7. Blood Histamine Content
8. Cholesterol and Lipids
9. Gamma (also  $\alpha$  and  $\beta$ ) Globulin, and Total Protein Concentration
10. Number of Eosinophils
11. Albumin/Globulin Ratio (decrease)
12. Hemopoiesis (rate of formation of blood corpuscles)
13. Leukopenia (increase in number of white cells), and Leukocytosis
14. Erythrocytosis

I. Vascular Disorders

1. Thrombosis
2. Hypertension

## J. Enzyme and Other Biochemical Changes

### Changes in activity of:

1. Cholinesterase (V,v)
2. Phosphatase (v)
3. Transaminase (v)
4. Amylase (v)
5. Carboxydismutase
  
6. Protein Denaturation
7. Toxin, Fungus, and Virus Inactivation (at high radiation dose levels), Bacteriostatic Effect
8. Tissue Cultures Killed
9. Alteration in Rate of Cell Division
10. Increased Concentration of RNA in Lymphocytes, and Decreased Concentration in Brain, Liver, and Spleen
11. Changes in Pyruvic Acid, Lactic Acid, and Creatinine Excretions
12. Change in Concentration of Glycogen in Liver (Hyperglycemia)
13. Alteration in Concentration of 17- Ketosteroids in Urine

## K. Metabolic Disorders

1. Glycosuria (sugar in urine; related with blood sugar?)
2. Increase in Urinary Phenol (derivatives? DOPA?)
3. Alteration of Rate of Metabolic Enzymatic Processes
4. Altered Carbohydrate Metabolism

## L. Gastro-Intestinal Disorders

1. Anorexia (loss of appetite)
2. Epigastric Pain
3. Constipation
4. Altered Secretion of Stomach "Digestive Juices"

## M. Endocrine Gland Changes

1. Altered Pituitary Function
2. Hyperthyroidism
3. Thyroid Enlargement
4. Increased Uptake of Radioactive Iodine by Thyroid Gland
5. Altered Adrenal Cortex Activity
6. Decreased Corticosteroids in Blood
7. Decreased Glucocorticoidal Activity
8. Hypogonadism (usually decreased testosterone production)

## N. Histological Changes

1. Changes in Tubular Epithelium of Testicles
2. Cross Changes

O. Genetic and Chromosomal Changes

1. Chromosome Aberrations (e.g., linear shortening, pseudochiasm, diploid structures, amitotic division, bridging, "sticky" chromosomes, irregularities in chromosomal envelope)
2. Mutations
3. Mongolism
4. Somatic Alterations (changes in cell not involving nucleus or chromosomes, cellular transformation)
5. Neoplastic Diseases (e.g., tumors)

P. Pearl Chain Effect (Intracellular orientation of subcellular particles, and orientation of cellular and other (non-biologic) particles)

Also, orientation of animals, birds, and fish in electromagnetic fields

Q. Miscellaneous Effects

1. Sparking between dental fillings
2. Peculiar metallic taste in mouth
3. Changes in Optical Activity of Colloidal Solutions
4. Treatment for Syphilis, Poliomyelitis, Skin Diseases
5. Loss of Hair
6. Brittleness of Hair
7. Sensations of Buzzing Vibrations, Pulsations, and Tickling About the Head and Ears
8. Copious Perspiration, Salivation, and Protrusion of Tongue
9. Changes in the Operation of Implanted Cardiac Pacemakers
10. Changes in Circadian Rhythms



---

—

---



---

---

---

---

—

---

---



---







ñ







# County of Santa Cruz

## COUNTY ADMINISTRATIVE OFFICE

701 OCEAN STREET, SUITE 520, SANTA CRUZ, CA 95060-4073

(831) 454-2100 FAX: (831) 454-3420 TDD: (831) 454-2123

SUSAN MAURIELLO, J.D., COUNTY ADMINISTRATIVE OFFICER

January 18, 2012

AGENDA: January 24, 2012

Board of Supervisors  
County of Santa Cruz  
701 Ocean Street  
Santa Cruz, California 95060

### SmartMeter Moratorium

Dear Members of the Board:

On December 13, 2011, your Board directed this office to return today with a report on issues associated with the current SmartMeter moratorium ordinance, and information on the possible extension of the moratorium for an additional year. Your Board also directed the Public Health Officer to return with an analysis of the research on the health effects of SmartMeters, and directed County Counsel to return with a report regarding the legality of a public utility refusing service to customers who are willing to pay for service and are willing to have an analog meter.

As your Board is aware, the California Public Utility Commission is considering PG&E's application for modification to PG&E's SmartMeter proposal to include an option for residential customers who do not wish to have a wireless SmartMeter. The item was scheduled on the January 12, 2012 agenda, but the commission anticipates that a vote on the proposal will not happen prior to February 1, 2012.

### Moratorium Ordinance

Your Board has heard significant amounts of testimony regarding SmartMeters and concerns about their possible impact on health, questions about their accuracy, their inability to recover real-time data, privacy concerns, and the lack of safety standards for chronic long-term exposure to electromagnetic frequency radiation. In addition, PG&E has not presented studies to support their primary justification that the SmartMeter program will encourage customers to more effectively manage their utilization of electricity.

Given the broad concern about SmartMeter technology and your Board's desire to go on record, this office and County Counsel believe that notwithstanding the enforcement challenges, that it is in the best interest of public health, safety, and welfare for your Board to adopt the attached ordinance (Attachment A) implementing a temporary moratorium on the installation of SmartMeters in or on any home, apartment, condominium or business within the unincorporated area of the County. The purpose of the moratorium is to allow additional time to educate the CPUC about these concerns and allow time for adequate study of the impacts resulting from the SmartMeter technology.

PG&E, asserting that local governments do not have jurisdiction on the installation of the meters, has ignored the previous Santa Cruz County ordinance as well as similar ordinances adopted in other jurisdictions. PG&E believes that only the California Public Utilities Commission (CPUC) has the authority to stop installation of the meters. Elected representatives, including the Board of Supervisors of Marin County, have acknowledged the limits of their ordinances to actually stop the installation of the meters. However, jurisdictions have adopted their ordinances with statements that such ordinances play an important role by informing the CPUC of significant community concerns.

#### Health Officer Report

The Public Health Officer's report is provided as Attachment B. The report discusses the health risks associated with SmartMeters, the scientific reports and actions the public might take to mitigate potential harm.

#### PG&E Shutoff Update

At the December 13, 2011, meeting, your Board questioned the PG&E representative about the utility company's decision to shut off power to the homes of residents who removed their SmartMeters. Subsequent to that meeting, PG&E restored power to those residences with the intent of charging them based on past electrical bills.

#### Petition

At your January 10, 2012 meeting, your Board was presented with a petition to the California Public Utilities Commission regarding PG&E SmartMeter Opt-out Application, (Petition A.11-03-014). The petition provides the opportunity for local elected officials to urge the Commission to continue Petition A.11-03-014 for further public hearings. The petition is provided as Attachment C. It is recommended that your Board direct the Chair to sign the petition on behalf of the Board and submit it to the PUC.

#### IT IS THEREFORE RECOMMENDED THAT YOUR BOARD:

- (1) Direct the Chair to send a letter to the PUC calling for independent testing and monitoring of SmartMeters in place to determine duty cycles and frequency, especially in the following circumstances
  - Where both gas and electric meters are located closely together
  - Where there is a bank of SmartMeters such as on a multi-family residential building or apartment building
  - Where there is a collector meter on a home that serves the home, plus as many as 5000 other residential units in the area
  - Where a SmartMeter on a home acts as a relay for other local neighborhood meters

- (2) Direct the Chair to send a letter to the PUC and PG&E allowing any Santa Cruz County resident to request removal of a previously installed SmartMeter and the replacement with an analog meter
- (3) Accept and file the report from the Public Health Officer
- (4) Direct the Chair to sign the petition to the California Public Utilities Commission on behalf of the Board urging the Commission to delay consideration of a preliminary decision on PG&E's SmartMeter application until further public hearing and input are completed, and
- (5) Adopt the attached ordinance imposing a temporary moratorium on the installation of SmartMeters within the unincorporated area of Santa Cruz County and direct the Clerk of the Board to place the ordinance on the February 7, 2012 agenda for final consideration.

Very truly yours,



SUSAN A. MAURIELLO  
County Administrative Officer  
Attachments:

- A. Proposed Ordinance
- B. Report from Public Health Officer
- C. Petition to CPUC

cc: PG&E  
California Public Utilities Commission

## ORDINANCE NO. \_\_\_\_\_

**AN UNCODIFIED ORDINANCE OF THE COUNTY OF SANTA CRUZ  
IMPOSING A TEMPORARY MORATORIUM ON THE INSTALLATION  
OF SMARTMETERS AND RELATED EQUIPMENT IN, ALONG,  
ACROSS, UPON, UNDER AND OVER THE PUBLIC STREETS AND  
OTHER PLACES WITHIN THE UNINCORPORATED AREA OF SANTA  
CRUZ COUNTY**

The Board of Supervisors of the County of Santa Cruz find as follows:

**WHEREAS**, the County of Santa Cruz (the “County”), through its police powers granted by Article XI of the California Constitution, retains broad discretion to legislate for public purposes and for the general welfare, including but not limited to matters of public health, safety and consumer protection; and

**WHEREAS**, the County of Santa Cruz has a franchise agreement with PG&E that has been in effect since 1955; and

**WHEREAS**, in addition, the County retains authority under Article XII, Section 8 of the Constitution to grant franchises for public utilities, and pursuant to California Public Utilities Code section 6203, “may in such a franchise impose such other and additional terms and conditions..., whether governmental or contractual in character, as in the judgment of the legislative body are to the public interest;” and

**WHEREAS**, Public Utilities Code section 2902 reserves the County’s right to supervise and regulate public utilities in matters affecting the health, convenience and safety of the general public, “such as the use and repair of public streets by any public utility, the location of the poles, wires, mains, or conduits of any public utility, on, under, or above any public streets, and the speed of common carriers operating within the limits of the municipal corporation;” and

**WHEREAS**, Pacific Gas & Electric Company (“PG&E”) is now installing SmartMeters in Central and Northern California and is installing these meters within the County of Santa Cruz; and

**WHEREAS**, concerns about the impact and accuracy of SmartMeters have been raised nationwide, leading the Maryland Public Service Commission to deny permission on June 21, 2010 for the deployment of SmartMeters in that state. The State of Hawaii Public Utility Commission also recently declined to adopt a smart grid system in that state. The CPUC currently has pending before it a petition from the City and County of San Francisco, and other municipalities, seeking to delay

the implementation of SmartMeters until the questions about their accuracy can be evaluated; and

**WHEREAS**, major problems and deficiencies with SmartMeters in California have been brought to the attention of the Board of Supervisors of the County of Santa Cruz, including PG&E's confirmation that SmartMeters have provided incorrect readings costing ratepayers untold thousands of dollars in overcharges and PG&E's records outlined "risks" and "issues" including an ongoing inability to recover real-time data because of faulty hardware originating with PG&E vendors; and

**WHEREAS**, the ebb and flow of gas and electricity into homes discloses detailed information about private details of daily life. Energy usage data, measured moment by moment, allows the reconstruction of a household's activities: when people wake up, when they come home, when they go on vacation, and even when they take a hot bath. SmartMeters represent a new form of technology that relays detailed hitherto confidential information reflecting the times and amounts of the use of electrical power without adequately protecting that data from being accessed by unauthorized persons or entities and as such pose an unreasonable intrusion of utility customers' privacy rights and security interests. Indeed, the fact that the CPUC has not established safeguards for privacy in its regulatory approvals may violate the principles set forth by the U.S. Supreme Court in *Kyllo v. United States* (2001), 533 U.S. 27; and

**WHEREAS**, significant health questions have been raised concerning the increased electromagnetic frequency radiation (EMF) emitted by the wireless technology in SmartMeters, which will be in every house, apartment and business, thereby adding additional human-made EMF to our environment around the clock to the already existing EMF from utility poles, individual meters and telephone poles; and

**WHEREAS**, FCC safety standards do not exist for chronic long-term exposure to EMF or from multiple sources, and reported adverse health effects from electromagnetic pollution include sleep disorders, irritability, short term memory loss, headaches, anxiety, nausea, DNA breaks, abnormal cell growth, cancer, premature aging, etc. Because of untested technology, international scientists, environmental agencies, advocacy groups and doctors are calling for the use of caution in wireless technologies; and

**WHEREAS**, the primary justification given for the SmartMeters program is the assertion that it will encourage customers to move some of their electricity usage from daytime to evening hours; however, PG&E has conducted no actual pilot projects to determine whether this assumption is in fact correct. Non-transmitting time-of-day meters are already available for customers who desire

them, and enhanced customer education is a viable non-technological alternative to encourage electricity use time shifting. Further, some engineers and energy conservation experts believe that the SmartMeters program--in totality--could well actually increase total electricity consumption and therefore the carbon footprint; and

**WHEREAS**, this Board of Supervisors sent a letter to the CPUC on September 15, 2010 expressing concern about reports that SmartMeter technology was interfering with the proper functioning of common household devices and requesting a response from the CPUC; and

**WHEREAS**, there has been no response by the CPUC to the letter sent by the Board of Supervisors; and

**WHEREAS**, because the potential risks to the health, safety and welfare of County residents are so great, the Board of Supervisors wishes to adopt a moratorium on the installation of SmartMeters and related equipment within the unincorporated area of the County of Santa Cruz. The moratorium period will allow the Council on Science and Technology and legislative process referenced above to be completed and for additional information to be collected and analyzed regarding potential problems with SmartMeters; and

**WHEREAS**, there is a current and immediate threat to public health, safety and welfare because, without this urgency ordinance, SmartMeters or supporting equipment will be installed or constructed or modified in the County without PG&E's complying with the CPUC process for consultation with the local jurisdiction, the County's Code requirements, and subjecting residents of Santa Cruz County to the privacy, security, health, accuracy and consumer fraud risks of the unproven SmartMeter technology; and

**WHEREAS**, the Board of Supervisors hereby finds that it can be seen with certainty that there is no possibility that the adoption and implementation of this Ordinance may have a significant effect on the environment. This Ordinance does not authorize construction or installation of any facilities and, in fact, imposes greater restrictions on such construction and installation in order to protect the public health, safety and general welfare. This Ordinance is therefore exempt from the environmental review requirements of the California Environmental Quality Act (CEQA) pursuant to Section 15061(b)(3) of Title 14 of the California Code of Regulations; and

**WHEREAS**, there is no feasible alternative to satisfactorily study the potential impact identified above as well or better with a less burdensome or restrictive effect than the adoption of this interim urgency moratorium ordinance; and

**WHEREAS**, based on the foregoing it is in the best interest of public health, safety and welfare to allow adequate study of the impacts resulting from the SmartMeter technology; therefore it is appropriate to adopt a temporary moratorium that would remain in effect from the date of its adoption until December 31, 2012, unless your Board acts to repeal it prior to that date.

**NOW, THEREFORE BE IT ORDAINED** by the Board of Supervisors of the County of Santa Cruz as follows:

### **SECTION I**

Moratorium. From and after the effective date of this Ordinance, no SmartMeter may be installed in or on any home, apartment, condominium or business of any type within the unincorporated area of the County of Santa Cruz, and no equipment related to SmartMeters may be installed in, on, under, or above any public street or public right of way within the unincorporated area of the County of Santa Cruz.

### **SECTION II**

Violations of the Moratorium may be charged as infractions or misdemeanors as set forth in Chapter 1.12 of the Santa Cruz County Code. In addition, violations may be deemed public nuisances, with enforcement by injunction or any other remedy authorized by law.

### **SECTION III**

This Board of Supervisors finds and determines that: (a) there is a current and immediate threat to the public peace, health, or safety; (b) the moratorium must be imposed in order to protect and preserve the public interest, health, safety, comfort and convenience and to preserve the public welfare; and (c) it is necessary to preserve the public health and safety of all residents or landowners adjacent to such uses as are affected by this interim ordinance as well as to protect all of the citizens of Santa Cruz County by preserving and improving the aesthetic and economic conditions of the County.

### **SECTION IV**

If any provision of this interim ordinance is held to be unconstitutional, it is the intent of the Board of Supervisors that such portions of such ordinance are severable from the remainder and the remainder is given full force and effect.

**SECTION V**

This interim ordinance is not subject to the California Environmental Quality Act (CEQA) pursuant to Section 15060(c) (2) – the activity will not result in a direct or reasonably foreseeable indirect physical change in the environment and Section 15060(c) (3) – the activity is not a project as defined in Section 15378 of the CEQA Guidelines, because it has no potential for resulting in physical change to the environment, directly or indirectly.

**SECTION VI**

This ordinance shall take effect on the 31<sup>st</sup> day after the date of final passage.

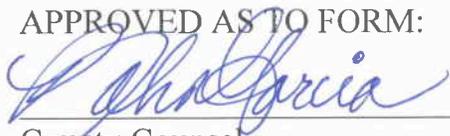
PASSED AND ADOPTED THIS \_\_\_\_\_ day of \_\_\_\_\_, 2012, by the Board of Supervisors of the County of Santa Cruz by the following vote:

- AYES: SUPERVISORS
- NOES: SUPERVISORS
- ABSENT: SUPERVISORS
- ABSTAIN: SUPERVISORS

\_\_\_\_\_  
Chairperson of the Board of Supervisors

Attest: \_\_\_\_\_  
Clerk of the Board

APPROVED AS TO FORM:

  
\_\_\_\_\_  
County Counsel



# County of Santa Cruz 0257

## HEALTH SERVICES AGENCY

POST OFFICE BOX 962, 1060 EMELINE AVE., SANTA CRUZ, CA 95061-0962  
 TELEPHONE: (831) 454-4114 FAX: (831) 454-5049 TDD: (831) 454-4123

**Poki Stewart Namkung, M.D., M.P.H.**  
**Health Officer**  
**Public Health Division**

### Memorandum

Date: January 13, 2012  
 To: Santa Cruz County Board of Supervisors  
 From: Poki Stewart Namkung, M.D., M.P.H. *PON*  
 Health Officer  
 Subject: Health Risks Associated With SmartMeters

### Overview

On December 13, 2011, Santa Cruz County Board of Supervisors directed the Public Health Officer to return on January 24, 2012, with an analysis of the research on the health effects of SmartMeters.

### **Background**

In order to analyze the potential health risks associated with SmartMeters, the following questions should be asked:

- 1) What is the SmartMeter system and what is the potential radiation exposure from the system?
- 2) What scientific evidence exists about the potential health risks associated with SmartMeters?
- 3) Are there actions that the public might take to mitigate any potential harm from SmartMeters?

SmartMeters are a new type of electrical meter that will measure consumer energy usage and send the information back to the utility by a wireless signal in the form of pulsed frequencies within the 800 MHz to 2400MHz range, contained in the microwave portion of the electromagnetic spectrum. SmartMeters are considered part of 'smart grid' technology that includes: a) a mesh network or series of pole-mounted wireless antennas at the neighborhood level to collect and transmit wireless information from all SmartMeters in that area back to the utility; b) collector meters, which are a special type of SmartMeter that collects the radiofrequency or microwave radiation signals from many surrounding

buildings (500-5000 homes or buildings) and sends the information back to the utility; and c) proposed for the future, a power transmitter to measure the energy use of individual appliances (e.g. washing machines, clothes dryers, dishwasher, etc) and send information via wireless radio frequency signal back to the SmartMeter. The primary rationale for SmartMeters and grid networks is to more accurately monitor and direct energy usage.

The public health issue of concern in regard to SmartMeters is the involuntary exposure of individuals and households to electromagnetic field (EMF) radiation. EMFs are everywhere, coming from both natural and man-made sources. The three broad classes of EMF are:

- extremely low frequency, ELF (from the sun or powerlines)
- radio frequency, RF (from communication devices, wireless devices, and SmartMeters)
- extremely high frequency, known as ionizing radiation (x-rays and gamma rays)

Much of this exposure is beyond our control and is a matter of personal choice; however, public exposure to RF fields is growing exponentially due to the proliferation of cell phones, and wireless fidelity (Wi-Fi) technology. To understand the relationship between EMF from SmartMeters and other sources, it is helpful to view the electromagnetic spectrum:

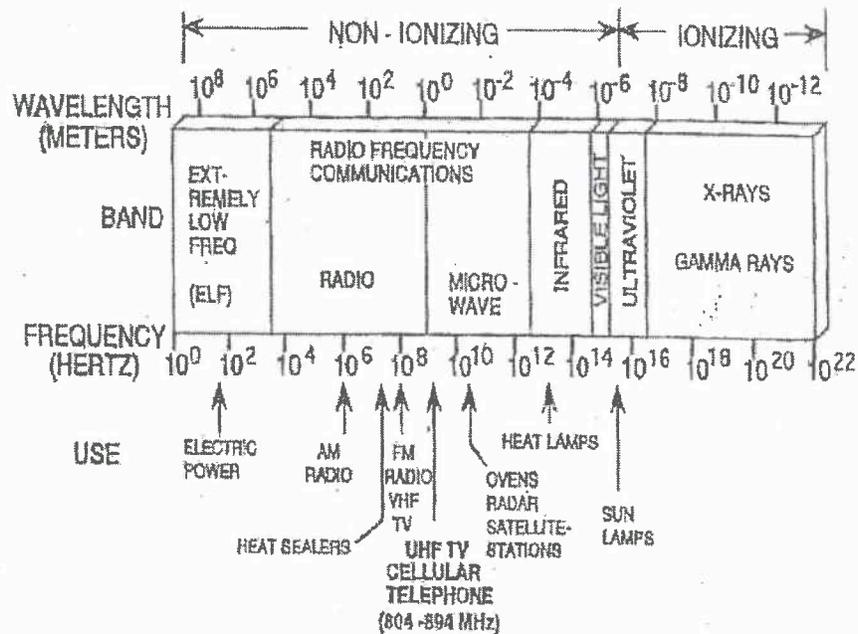


Fig. 1: The electromagnetic spectrum, showing the relations between ELF and RF fields, wavelength and frequency, and the ionizing and non-ionizing portions of the spectrum.

The Federal Communications Commission (FCC) has adopted limits for Maximum Permissible Exposure (MPE) that are based on exposure guidelines published by the National Council on Radiation Protection and Measurements (NCRP). The limits vary with

the frequency of the electromagnetic radiation and are expressed in units of microwatts per centimeter squared. A SmartMeter contains two antennas whose combined time-averaged public safety limit of exposure is  $655\mu\text{W}/\text{cm}^2$  (Sage, 2011). According to the California Council on Science and Technology (CCST) Report (2011), within distances of three to ten feet, SmartMeters would not exceed this limit. However, CCST did not account for the frequency of transmissions, reflection factors, banks of SmartMeters firing simultaneously, and distances closer than three feet. There are numerous situations in which the distance between the SmartMeters and humans is less than three feet on an ongoing basis, e.g. a SmartMeter mounted on the external wall to a bedroom with the bed placed adjacent to that mounting next to the internal wall. That distance is estimated to be one foot. The CCST Report also states that SmartMeters will generally transmit data once every four hours, and once the grid is fully functional, may transmit "more frequently." It has been aptly demonstrated by computer modeling and real measurement of existing meters that SmartMeters emit frequencies almost continuously, day and night, seven days a week. Furthermore, it is not possible to program them to not operate at 100% of a duty cycle (continuously) and therefore it should not be possible to state that SmartMeters do not exceed the time-averaged exposure limit. Additionally, exposure is additive and consumers may have already increased their exposures to radiofrequency radiation in the home through the voluntary use of wireless devices such as cell and cordless phones, personal digital assistants (PDAs), routers for internet access, home security systems, wireless baby surveillance (baby monitors) and other emerging devices. It would be impossible to know how close a consumer might be to their limit, making safety a uncertainty with the installation of a mandatory SmartMeter.

This report will focus on the documented health risks of EMF in general, the relevance of that data to SmartMeters exposure, the established guidelines for RF safety to the public at large, and then provide recommendations to ameliorate the risk to the public's health.

### **Evidence-based Health Risks of EMFs**

There is no scientific literature on the health risks of SmartMeters in particular as they are a new technology. However, there is a large body of research on the health risks of EMFs. Much of the data is concentrated on cell phone usage and as SmartMeters occupy the same energy spectrum as cell phones and depending on conditions, can exceed the whole body radiation exposure of cell phones (see Attachment B1, Figure 4). In terms of health risks, the causal factor under study is RF radiation whether it be from cell phones, Wi-Fi routers, cordless phones, or SmartMeters. Therefore all available, peer-reviewed, scientific research data can be extrapolated to apply to SmartMeters, taking into consideration the magnitude and the intensity of the exposure.

Since the mid-1990's the use of cellular and wireless devices has increased exponentially exposing the public to massively increased levels of RF. There is however, debate regarding the health risks posed to the public given these increased levels of radiation. It must be noted that there is little basic science funding for this type of research and it is largely funded by industry. An intriguing divide, noted by Genuis, 2011 is that most

research carried out by independent non-government or non-industry affiliated researchers suggests potentially serious effects from many non-ionizing radiation exposures; most research carried out by independent non-government or non-industry affiliated researchers suggests potentially serious effects from many non-ionizing radiation exposures research funded by industry and some governments seems to cast doubt on the potential for harm. Elements of the controversy stem from inability to replicate findings consistently in laboratory animal studies. However, analysis of many of the conflicting studies is not valid as the methodology used is not comparable. Despite this controversy, evidence is accumulating on the results of exposure to RF at non-thermal levels including increased permeability of the blood-brain barrier in the head (Eberhardt, 2008), harmful effects on sperm, double strand breaks in DNA which could lead to cancer genesis (Phillips, 2011), stress gene activation indicating an exposure to a toxin (Blank, 2011), and alterations in brain glucose metabolism (Volkow, 2011).

In terms of meta-analyzed epidemiological studies, all case-control epidemiological studies covering >10 years of cell phone use have reported an increased risk of brain tumors from the use of mobile phones (Hallberg, 2011). Other studies have pointed to an increasing risk of acoustic neuroma, salivary gland tumors, and eye cancer after several years of cell phone use and the tumors occur predominantly on the same side of the head as the phone is used. The analysis of brain cancer statistics since the mid 20<sup>th</sup> century in several countries reveals that brain tumor formation has a long latency time, an average of over 30 years to develop from initial damage.(Hallberg, 2011). Therefore using studies such as the Interphone Study which looked at shorter latency periods for the development of specific brain cancers will result in inconclusive data.

Another potential health risk related to EMF exposure, whose legitimacy as a phenomenon remains contentious, is electromagnetic hypersensitivity (EHS). In the 1950's, various centers in Eastern Europe began to describe and treat thousands of workers, generally employed in jobs involving microwave transmission. The afflicted individuals often presented with symptoms such as headaches, weakness, sleep disturbance, emotional instability, dizziness, memory impairment, fatigue, and heart palpitations. Clinical research to verify the physiological nature of this condition did not begin in earnest until the 1990's and found that the EMF involved was usually within the non-ionizing range of the electromagnetic spectrum. In the early 2000's, estimates of the occurrence of EHS began to swell with studies estimating the prevalence of this condition to be about 1.5% of the population of Sweden (Hilleert et al., 2002), 3.2% in California (Levallios et al., 2002), and 8% in Germany (infas Institut für angewandte Sozialwissenschaft GmbH, 2003).

In 2004, WHO declared EHS "a phenomenon where individuals experience adverse health effect while using or being in the vicinity of devices emanating electric, magnetic, or electromagnetic fields (EMFs)...Whatever its cause, EHS is a real and sometimes debilitating problem for the affected persons (Mild et al., 2004)."

Currently, research has demonstrated objective evidence to support the EHS diagnosis, defining pathophysiological mechanisms including immune dysregulation in vitro, with

increased production of selected cytokines and disruption and dysregulation of catecholamine physiology (Genuis, 2011).

Until recently, the diagnosis of EHS has not received much support from the medical community due to lack of objective evidence. In an effort to determine the legitimacy of EHS as a neurological disorder, however, a collection of scientists and physicians recently conducted a double-blinded research study that concluded that "EMF hypersensitivity can occur as a bona fide environmentally-inducible neurological syndrome (McCarty et al., 2011).

### **Safety Guidelines**

The guidelines currently used by the FCC were adopted in 1996, are thermally based, and are believed to protect against injury that may be caused by acute exposures that result in tissue heating or electric shock. FCC guidelines have a much lower certainty of safety than standards. Meeting the current FCC guidelines only assures that one should not have heat damage from SmartMeter exposure. It says nothing about safety from the risk of many chronic diseases that the public is most concerned about such as cancer, miscarriage, birth defects, semen quality, autoimmune diseases, etc. Therefore, when it comes to nonthermal effects of RF, FCC guidelines are irrelevant and cannot be used for any claims of SmartMeter safety unless heat damage is involved (Li, 2011).

There are no current, relevant public safety standards for pulsed RF involving chronic exposure of the public, nor of sensitive populations, nor of people with metal and medical implants that can be affected both by localized heating and by electromagnetic interference (EMI) for medical wireless implanted devices. Many other countries (9) have significantly lower RF/MW exposure standards ranging from 0.001 to 50  $\mu\text{W}/\text{cm}^2$  as compared with the US guideline of 200-1000  $\mu\text{W}/\text{cm}^2$ . Note that these recommended levels are considerably lower than the approximately 600  $\mu\text{W}/\text{cm}^2$ . (time-averaged) allowed for the RFR from SmartMeters operating in the low 900 MHz band mandated by the FCC based on only thermal consideration.

In summary, there is no scientific data to determine if there is a safe RF exposure level regarding its non-thermal effects. The question for governmental agencies is that given the uncertainty of safety, the evidence of existing and potential harm, should we err on the side of safety and take the precautionary avoidance measures? The two unique features of SmartMeter exposure are: 1) universal exposure thus far because of mandatory installation ensuring that virtually every household is exposed; 2) involuntary exposure whether one has a SmartMeter on their home or not due to the already ubiquitous saturation of installation in Santa Cruz County. Governmental agencies for protecting public health and safety should be much more vigilant towards involuntary environmental exposures because governmental agencies are the only defense against such involuntary exposure. Examples of actions that the public might take to limit exposure to electromagnetic radiation can be found in Attachment B2.

**References:**

- Balmori, A. "Electromagnetic Pollution from Phone Masts. Effects of Wildlife." Pathophysiology (2009).
- Blackman, C. "Cell Phone Radiation: Evidence from ELF and RF studies supporting more inclusive risk identification assessment,." Pathophysiology (2009): doi: 10.1016.
- . "Cell Phone Radiation: Evidence from ELF and RF Studies Supporting More Inclusive Risk Identification Assessment." Pathophysiology (2009).
- Blank, M, Goodman R. "Electromagnetic field stress living cells." Pathophysiology (2009): doi: 10.1016.
- Blank, M. "Prefice." Pathophysiology (2009): doi10.1016.
- Carpenter, D. and Sage, C. "BioInitiave Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields." (2007).
- Carpenter, David O. "Electromagnetic Fields and Cancer: The Cost of Doing Nothing." (2009).
- Carpenter, David O. " Report on the CCST document "Health Impacts of Radiofrequency from Smart Meters"." (n.d.).
- Carpenter, David O. Sage Cindy. "Setting Prudent Public Health Policy for Electromagnetic Field Exposures." Reviews on Environmental Health (2008): Vol. 23 No.2 .
- Consultants, Sage Associates - Environmental. "Assesments of Radiofrequency Microwave Radiation Emmissions from SmartMeters." (2011).
- Davanipour, E. Sobel. "Long Term Exposure to magnetic fields and the risks of Alzheimer's disease and breast cancer." Pathophysiology (2009): doi: 10.1016.
- De-Kun Li, MD PhD MPH. "Repsonse to CCST." Written Testimony (2009).
- Genuis SJ, Lipp CT. "Electromagnetic Sensitivity: Fact or Fiction?" Sci total Environ (2011): doi: 10.1016.
- Goldworthy, Andrew. "The Biological Effect of Weak Electronmagnetic Fields." (2007).
- Hallberg O, and Morgan J. "The Potential Impact of Mobile Phone Use on trends in Brain and CNS Tumors." Neuro and Neurophysiology (2011).
- Hallberg, O et. al.,. "Apparent decreases in Swedish Public Health indicators after 1997-Are they due to improved diagnostic or environmental factors?" Pathophysiology (2009): doi: 10.1016.
- Hankin, Norbert EPA. "Response to Janet Newton EMR Network re: Radiofrequency Guidelines." (2002).
- Hardell, L. et al.,. "Epidemiological evedence for an association between use of wireless phones and tumor diseases." Pathophysiology (2009): doi: 10.1016.
- Hillert, L et al.,. "Prevalence of self-reported hypersensitivity to electric or magnetic fields in a population-based questionnaire survey." Scab J Work Environ Health 28 (2002): 33-41.

- Hirsch, Daniel. "Comments on the Draft Report by the Council on Science and Technology "Health Impacts of Radio frequency from Smart Meters"." (2011).
- Hondou, Tsuyoshi. "Passive exposure to Mobile Phones: Enhancement of Intensity by Reflection." (2006).
- Huttunen, P. et al.,. "FM-radio and TV tower signals can cause spontaneous hand movements near moving RF reflector." Pathophysiology (2009): doi: 10.1016.
- Infas. "Study on concern and anxiety of the general public with respect to the possible risks due to high frequency electromagnetic fields used." (2004).
- Johannsson, Ollie Professor Dept of Neuroscience, Karolinska Institute Stockholm, Sweden. "Commentary." (2011).
- Khurana, Vini G. et al.,. "Cell phones and brain tumors: A review including the long-term epidemiologic data." Science Direct, Surgical Direct, Surgical Neurology (2009).
- Kreutzer, Rick CDPH. "Technical Commentary on CCST Report: Health Impact on Radio Frequencies from SmartMeters." (2011).
- Kundi, M., Hutter MP. "Mobile Phone base stations-Effects on wellbeing and health." Pathophysiology (2009): doi:10.1016.
- Lai, Henry Dept. of Bioengineering Univ. Of Washington. "Biological Effects of Radiofrequency Radion." (2002).
- Levallois, P and et al. "Study of self-reported hypersensitivity to electromagnetic fields in California." Environ Health Perspect (2002): 110 (Suppl 4); 619-23.
- Levis, Angelo G. et al. "Mobile phones and head tumors. The discrepancies in cause-effect relationships in the epidemiological studies-how do they arise?" Environmental Health (2011).
- Lotz, W. Gregory. "Letter to Richard Tell in support of RF exposure guidelines." (n.d.): 1999.
- Maret, Dr. Karl. "Commentary on the CCST report " Health Impacts of Radio Frequency from Smart Meters"." (2011).
- Mauer, Sandy EMF Network. "PG&E SmartMeters violate FCC RF Exposure Compliance Rates." (2010).
- McCarty, DE et al.,. "Electromagnetic hypersensitivity: Evidence for a novel neurological syndrome." Int. J Neurosci (2011).
- Mekaya, MA et al., Dept of Biophysics University Anakara, Turkey. "Pulse modulated 900 Mhz radiation induces hypothyroidism and apoptosis in thyroid cells: a light, electron microscopy and immunohistochemical study." (2010).
- Mild, Kjell Hansson and Emilie van Dventer Paolo Ravazzani editors Mike Repacholi. "Electromagnetic Hypersensitivity - Proceedings International Workshop of EMF Hypersensitivity Prague, Czech Republic ." (2004).
- Neutra, Dr. Raymond Richard. "Commentary." (2011).
- Organization, World Health. "IARC Classifies radiofrequency electromagnetic fields as possible carcinogenic to humans." (2011).

Organization, World Health. "Electromagnetic fields and public health: Base stations and wireless technologies." Fact Sheet 304 Accessed on January 31, 2011 (2006):

<http://www.who.int/mediacentre/factsheets/fs304/enIndex/Html>.

— . "Electromagnetic fields and public health: Electromagnetic hypersensitivity." Fact Sheet No. 296 (2011):

<http://who.who.int/mediacentre/factsheets/fs296/index.html>.

— . "Interphone study reports on mobile phone use and brain cancer." (2010).

Peevey, Michael. "Ruling and Scoping Memo to PUC: Opt out program and its cost." (2011).

Phillips J.L. et al. "Electromagnetic fields and DNA damage." Pathophysiology (2009): doi: 10.1016.

Pourlis, A.F. " Reproductive and developmental effects of EMF in vertebrate models." Pathophysiology (2009): doi: 10.1016.

Sage, C and Carpenter D. O. "Public health implications of wireless technologies." Pathophysiology (2011): 16: 233-246.

Schüz, Joachim et., al. "Cellular Phones and the Risks of Glioma and Meningioma." American Journal of Epidemiology (2006): doi: 10.1093 .

Supervisors, Santa Cruz county Board of. "Temporary Moratorium on the Installation of SmartMeters." (2011).

Techology, California Council on Science and. "Health Impact of Radio Frequency Exposure from Smart Meters." (2011).

Tell, richard. "Summary Discussion of RF Fields and the PG&E SmartMeter System (2005 report and 2008 report)." (2009).

Volkow, N. D et al.,. "Effects of cell phone radiofrequency signal exposure on brain glucose metabolism." JAMA (2011): 305:808-13.

Yakemenko, I et al.,. "Long Term Exposure to Microwaves Provokes Cancer Growth: Evidences from Radar and Mobile Communications systems." Experiental Oncology (2011).

Figure 4 from Hirsch; 2011

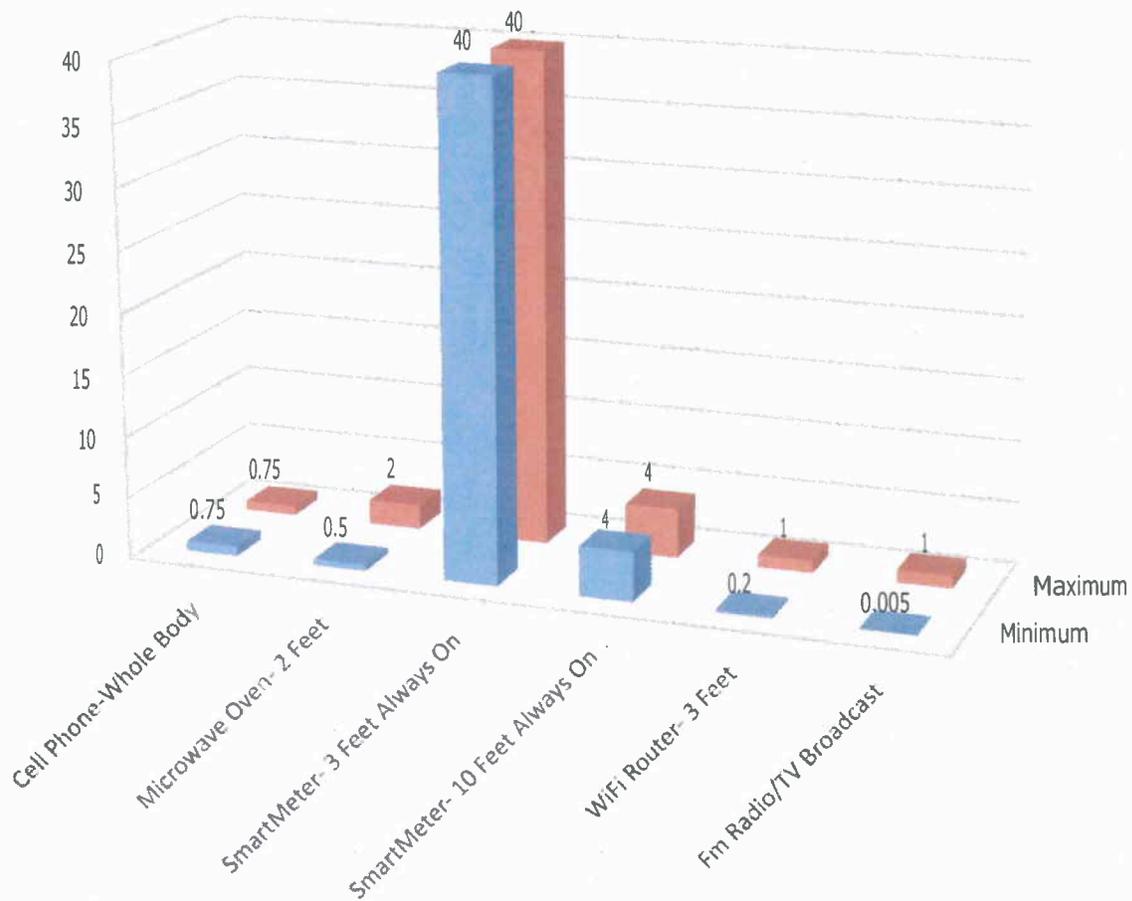


Figure 4. Comparison of Radio-Frequency Levels to the Whole Body from Various Sources in  $\mu$ W/cm<sup>2</sup> over time [corrected for assumed duty cycle and whole body exposure extrapolated from EPRI/CCST SmartMeter estimated levels at 3 feet].

Examples of strategies to reduce electromagnetic radiation.

(Genuis SJ, 2011)

Sources of adverse EMR	Considerations to reduce EMR exposure
Cell phones and cordless phones	<ul style="list-style-type: none"> <li>• Minimize use of cell and cordless phones and use speaker phones when possible</li> <li>• Leave cell or cordless phone away from the body rather than in pocket or attached at the hip.</li> </ul>
Wireless internet	<ul style="list-style-type: none"> <li>• Use wired internet</li> <li>• Turn off the internet router when not in use (e.g. night-time)</li> <li>• Use power line network kits to achieve internet access by using existing wiring and avoiding wireless emissions.</li> </ul>
Computers releasing high EMR	<ul style="list-style-type: none"> <li>• Limit the amount of time spent working on a computer</li> <li>• Avoid setting a laptop computer on the lap</li> <li>• Increase the distance from the transformer.</li> <li>• Stay a reasonable distance away from the computer</li> </ul>
Handheld electronics (electric toothbrush, hair dryer, Smart phone, electronic tablets, etc.)	<ul style="list-style-type: none"> <li>• Limit the use of electronics and/or revert to using power-free devices</li> <li>• Turn devices off before going to sleep</li> <li>• Minimize electronics in bedrooms</li> </ul>
Fluorescent lights	<ul style="list-style-type: none"> <li>• Consider using alternate lighting such as incandescent (Uncertainty exists about the safety of LED lights)</li> <li>• Rely on natural sunlight for reading</li> </ul>
Household power	<ul style="list-style-type: none"> <li>• Measure levels of EMR and modify exposures as possible</li> <li>• Avoid sleeping near sites of elevated EMR</li> <li>• Filters can be used to mitigate dirty power</li> </ul>
High voltage power lines substations, transmission towers, and emitters (cell phone tower, radar, etc.)	<ul style="list-style-type: none"> <li>• Consider relocating to an area not in close proximity to high voltage power lines</li> <li>• Maintain considerable distance from emitters</li> <li>• Consider forms of shielding (shielding paints; grounded metal sheets)</li> </ul>
Utility neutral-to-ground bonded to water pipes	<ul style="list-style-type: none"> <li>• Increase size of neutral-wire to substation and install dielectric coupling in water pipe.</li> </ul>

Petition to the California Public Utilities Commission Re: PG&E SmartMeter Opt-out Application, A.11-03-014

We the undersigned elected officials urge the Commission to delay consideration of President Peevey's preliminary decision until further public hearing and input are completed. The decision, which calls for charging fees to customers who elect to opt out of the SmartMeter program, conflicts with local planning authority, does not protect the health or safety of all residents and imposes a prejudicial financial burden on ratepayers who chose to opt out of the program. We therefore urge the Commission to continue consideration of this matter until further public hearings are completed to ensure the due process rights of all stakeholders.

The order does not provide an empirical basis for the amount of the fees to be charged to opt out customers nor does it consider the net financial impact of PG&E's latest proposal to permit customer retention of analogue meters. Hence the order effectively eliminates a full and fair hearing process for these contested issues of fact to be considered and resolved.

Historically, telecommunications carriers throughout this state have complied with local planning codes which provide notice to residents as to the construction of transmission facilities. Pacific Gas and Electric Company ignored such codes in the deployment of the Smart Meter telecommunications network. Currently many of our jurisdictions have passed ordinances which impose a moratorium on wireless SmartMeters and have petitioned to opt out on a jurisdictional basis. The current order is silent on these issues and effectively discards them without consideration.

The decision also ignores the longstanding controversy and concern about the health impacts associated with electro-magnetic fields. A 1998 California Department of Health Services study commissioned by the California Public Utility Commission itself found that 3.2% of Californians reported hypersensitivity to electro-magnetic fields. A May 2011 study released by the World Health Organization/International Agency for Research on Cancer reclassified RF radiation of the type emitted by wireless equipment throughout the Smart Meter system as "possibly carcinogenic" to humans. President Peevey's order effectively imposes a different rate on many utility customers who need to avoid exposure in violation of California Public Utilities Code section 453(b) which states in pertinent part that "No public utility shall prejudice, disadvantage, or require different rates or deposit amounts from a person because of ancestry, medical condition, marital status or change in marital status, occupation..."

President Peevey's decision does not address these concerns nor does it the financial viability of wired equipment alternatives. In so doing, it eliminates a much anticipated public hearing process.

For all of the foregoing reasons, we respectfully urge the Commission to continue Petition A.11-03-014 matter for further hearings.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Jurisdiction

**From:** Mark Stone [BDS050@co.santa-cruz.ca.us]  
**Sent:** Monday, January 09, 2012 1:30 PM  
**To:** Maureen McCarty  
**Subject:** FW: smart meter opt-out letter and moratorium on smart meters

-----  
**From:** theodora kerry[SMTTP:THEKERRY@COMCAST.NET]  
**Sent:** Monday, January 09, 2012 1:30:14 PM  
**To:** Mark Stone  
**Subject:** re: smart meter opt-out letter and moratorium on smart meters  
**Auto forwarded by a Rule**

This letter is directed to the whole Board of Supervisors, and, as such, should be included in the public record.

Dear Chairperson Stone,

Having attended the board meeting on Dec. 13, and witnessed the Board's active interrogation of the P.G.&E. rep's woeful defense of her employer's shutting off of electricity to customers who dared to protect their health and that of their children by removing their smart meters, I'm very disappointed to read the agenda for tomorrow's meeting only to find that the expected follow-through re: smart meters was no where to be found. While you did approve a letter to the CPUC expressing your opposition to opt-out charges, many of us need you to go further and protect our right to analog meters, as many health problems have been linked to smart meters that have their wireless component turned off. Despite PG&E's crying "public safety concerns", the analog meters have proven to be safe for decades, unlike the recently installed smart meters which have already been linked to health problems, fires, and overcharging. Unfortunately, the CPUC is supposed to decide this issue as early as Jan.12, leaving you no time to write a stronger letter to the CPUC given that the issue is not on the agenda. While I applaud the strong stance you took with the PG&E's rep at the last meeting, that in itself does little to protect us, your constituents. Even the smart meter moratorium as been little more than window dressing as the Sheriff continues to use his power to protect PG&E contractors, instead of the local citizenry. I reiterate my call for you, the Board of Supervisors, to use your power of the purse strings to make it clear to the Sheriff that he is expected to support the moratorium/citizens, not the profiteering corporations.

Regardless of what you eventually decide, you, like the rest of us, are equally at the mercy of these meters. What you allow to be done unto us by PG&E is also being done unto you.

Theodora Kerry  
Santa Cruz, CA 95060

<http://www.theoaklandpress.com/health/20141012/oakland-residents-hope-to-get-issues-with-smart-meters-heard-at-state-level>

## Oakland residents hope to get issues with smart meters heard at state level



Carole Garcia, 58, with the smart meters that sit outside her Rochester Hills home. Garcia says the meters are causing her health problems she never had before moving in.

Tuesday, October 7, 2014. Tim Thompson-The Oakland Press

By [John Turk](#), The Oakland Press

Posted: 10/12/14, 8:30 AM EDT|Updated: on 10/13/2014

### FYI

DTE has installed more than 1.1 million of the new meters in southeast Michigan, and has a goal of 2.6 million by 2015. For more about smart meters, visit [dteenergy.com](http://dteenergy.com).

Carole Garcia keeps all her bloody tissues in a gallon Ziplock bag she's saved.

The Rochester Hills resident wants evidence, she said, because it's her smart utility meter causing her nose to bleed every day. She wants her old analog meter back, but can't get it due to a policy she says doesn't give her an option.

"I've done everything I could possibly do to get these things removed ... and I have three doctors that have written letters saying the smart meters on my home should be taken off," said Garcia, 58, a laid off auto worker.

"The people should have a voice, and I don't feel like I'm being heard."

Garcia said she's reached out to numerous legislators who haven't gotten back in touch. But she — along with over 100 people across Michigan — could have her story heard at the state level if Rep. Tom McMillin has anything to say about it. He's pushing for those who don't want smart meters installed on their homes to put their testimony on record before the end of the year.

[Smart meters, or advanced meters](#), use radio frequency networks similar to those in cell phones or microwaves to record the amount of electricity used in a home or business.

[Groups against the meters have mounted an opposition to the devices over the past four years nationwide, but major utilities such as DTE Energy contend they are safe](#), and have published studies saying so.

Garcia and nine others went to Lansing in mid-September to get their stories heard. They met with State Rep. Aric Nesbitt, R-District 66, the chairman of the House Energy and Technology Committee, to inquire about a hearing on the smart meter issue. Nesbitt has not responded to the group yet, and was not immediately available for comment

on the meeting.

Garcia, who moved to Rochester Hills from Sterling Heights in 2012, said she started getting symptoms within the first six months of moving in, and began to visit doctors because she didn't know why.

"I have two smart meters outside my bedroom wall. I would wake up with severe headaches, very nauseated and dizzy, with a bloody nose. I found I had fatigue, chest palpitations, blurred vision in my left eye and also noticed both my shoulders started to hurt when I woke up," said Garcia, 58. "I'm tossing and turning at night."

[Romeo-based doctor and preventive medicine specialist James Ziobron](#) wrote on Garcia's behalf that since her exposure to smart meters, she developed an entirely new set of symptoms she hadn't experienced before her move. "I feel that her recent problems are all due to the smart meter ... (and) in any event, Carole should have her smart meters removed as soon as possible," Ziobron wrote.

DTE Energy's Joseph McCormick, the utility's manager of the smart metering program, did not return calls for comment. However, spokesman Alejandro Bodipo-Memba said DTE is confident that its AMI, or Advanced Metering Infrastructure, meters are safe.

"There are a number of studies that show that," said Memba. "Customers who choose to opt out are required to pay a \$67.20 initial one-time fee to install a non transmitting advanced meter and \$9.80 a month for a manual meter reading and related services."

One of those studies — published in [2011 by the Edison Electrical Institute and others — can found on DTE's website](#). It states that radio frequency exposure for a person standing three and 10 feet from a continuously operating smart meter would result in 125 and 1,250 times less exposure than a person talking on a cell phone.

Scott Simons, another DTE spokesman, added: "Advanced meters typically broadcast signals for less than two minutes in any 24-hour period. Even baby monitors have more RF exposure than advanced meters."

Simons cited another study from the American Cancer Society that stated there was no clear evidence that radio frequency waves cause adverse health effects.

#### **No choice?**

A main concern for Garcia and others, however, is that DTE's opt-out policy doesn't allow them to fully opt out of having an advanced meter at their homes. DTE confirms that a customer who chooses to opt out would have the radio frequency shut off on their smart meters, but would still have the device connected to their home.

Simons said the reason the advanced meters would stay on a home is that analog meters are "obsolete and we're not making them anymore. Meters have progressed in the last 100 years, and we're taking advantage of the technology so our customers can benefit from it."

Former residential builder Dominic Cusumano, 60, and his wife, Lillian — who were sued in 2012 by DTE for \$25,000 and a felony charge for replacing a smart meter on their home with an analog meter — said the [policy, which the Michigan Public Safety Commission ruled last year was allowed](#), is being contested in appeals courts because it doesn't give homeowners the choice to replace smart meters with analog meters.

Cusumano, who owns homes in Addison Township and St. Clair Shores, said his family replaced their smart meter in Addison because his wife was falling ill, and the smart meter was causing it.

Oakland Circuit Judge Shalina Kumar has since placed the Cusumanos' case on hold — and they're keeping their analog meter for now — pending as many as six Michigan Court of Appeals cases dealing with the opt-out policy. If any of those cases come back favorably, noted Cusumano, his case has a chance of going to trial in circuit court, and he thinks he could win. He also said that opposition to smart meters is growing.

#### **More against smart meters**

There are about 150 people throughout Michigan who Cusumano keeps in contact with, and networks of thousands "from Maine to California" who share with others across the country their issues with the device, he said.

Cusumano, Garcia and others say that stateside, Rochester Hills Rep. Tom McMillin — [who introduced a bill last year that would address DTE's opt-out policy and the health, safety and privacy issues claimed by many about the smart meter](#) — has been a champion for their cause.

Since the bill was introduced, McMillin has pushed for hearings for Garcia, Cusumano and others to get their issues

on the record in the Energy and Technology Committee — and if not there, in the House Oversight Committee, which he chairs.

McMillin also wrote letters to DTE's McCormick, saying many complaints have come from constituents who said DTE Energy threatened to turn off their power due to their objection of the installation of a smart meter in their home. He asked McCormick how many customers have had their power turned off, whether DTE planned on shutting off power to elderly residents — “potentially putting their lives in danger due to their non-compliance” — and whether McCormick believed DTE's response to the objections could create physical confrontations.

McCormick wrote back on April 2 that the “recent correspondence (McMillin) referenced was sent in response to a very small number of customers who have replaced DTE equipment with unauthorized, non-DTE meters.

“Customers who resort to this type of action have placed themselves and others, including DTE employees ... at risk of being seriously or fatally injured.”

DTE's Simons said that so far, out of two million meters installed by DTE, there have been 3,200 requests to opt out. He added that DTE takes every case on an individual basis, “but the meters are owned, operated and maintained by us. To take our meter and replace it with something else is against the law.”

McMillin said while he doesn't know what health concerns smart meters pose, he thinks people should at least be given a choice to keep their analog meters.

“We have to figure this stuff out now. I feel the frustration of these citizens and feel like they should be able to get their concerns dealt with on the record.”

## Testimony of Rebecca M. in the

### DTE Advanced (Smart) Meter Opt-Out Case, U-17053

*What follows are the relevant portions of the testimony Rebecca M. offered in the DTE opt-out case, U-17053. The judge refused to allow any of this health testimony, stating that it was impermissible because the only thing to be decided at the hearing was whether DTE's proposed radio-off smart meter opt-out fulfilled cost-of-service principles. An appeal has been filed an appeal with the Michigan Court of Appeals.*

#### DIRECT TESTIMONY OF REBECCA M.

**Q. What are your qualifications to testify?**

A. I take my electric service from Detroit Edison. My health has been extremely affected by the smart meter that was first on my home and the nontransmitting Itron digital meter that is now on my home.

**Q. How long have you lived at your current residence?**

A. 25 years.

**Q. Are you retired?**

A. I am a retired.

**Q. Before a smart meter was installed on your home, did you have problems with wireless technology?**

A. No. Prior to the installation of my smart meter, I did not have any problems with wireless technology. I did not experience symptoms when using a cell phone; I did not experience symptoms when I used wireless internet or when I entered a facility that offered wireless internet; and I did not experience symptoms from the wireless technology that was already in my home, which, at the time of the smart meter installation, included a wireless water meter, and a cordless phone.

**Q. Prior to the installation of a smart meter on your home, were you affected by other electrical devices?**

A. No, not that I was aware of.

**Q. When was a smart meter installed on your home?**

A. A wireless smart meter was installed on my home on the morning of Saturday, March 10, 2012, while I was not home.

**Q. Did you know the meter was going to be installed?**

A. Yes. A few weeks before the installation, I had received a notice from DTE that a new, upgraded, wireless meter would be installed on my home. When I got the notice, I called DTE indicating

that I would rather not have the wireless meter. I was told that I had no choice. Although I would have preferred not to get it, I was not anticipating a problem with it either. It was a "preference" not to have it, as opposed to an aversion.

**Q. You say you preferred not to get one, then tell us why you didn't want it.**

A. As I said, it was just a preference. When I got my first cell phone, I read the manual, and it indicated that, for safety reasons, I should hold the cell phone about an inch from my head when using it. I believed the manufacturer's warnings which indicated there may be risks involved with this technology. I have used, and still use, lots of wireless devices. It's not that I worry about their effects and avoid them; it is more that I weigh the benefits, and I purchase the ones which I see as highly beneficial, I choose not to use the ones that are not. The meter did not fall into the "highly beneficial" category. I am concerned about the environment and I am already conscientious regarding my energy usage at home. I keep my thermostat lower and wear warm clothing in the winter, I turn down my heat at night and when I am gone, I don't often use air conditioning during the summer, I have replaced older appliances for newer, more efficient ones, My TV is very small and I rarely watch it, I turn off the lights I don't need. In weighing the proposed benefits a smart meter, it didn't seem like something I needed. However, when I called DTE, I was told I didn't have a choice. I didn't get upset or argue. I just accepted it. Had I had any idea what an impact it would have on my life, though, I would have protested immediately

**Q. What happened when you returned home after the meter had been installed?**

A. I returned home a little after 1 p.m.. There was a note on my door indicating the new meter had been installed. I didn't think much about it. Shortly after arriving at home, I went into my kitchen to prepare lunch. There are no words that can adequately describe what happened next. Here's my best effort:

As I stood at my kitchen sink (a stainless steel sink, opposite my refrigerator), I felt a very uncomfortable vibration, like a low-level electric current, going through my body; there was a buzzing sound in my head; and I experienced a jittery feeling in my body.

When I stepped away from the sink, the feeling lessened considerably, but was still noticeable, especially whenever I was in close proximity to the back wall of my home.

My first thought was, "That must be the new meter. This will take some getting used to." At that point, I wasn't upset and I didn't panic. I honestly thought that my body would just need some time to adjust to it, and then everything would be okay.

Later, a friend who is a physics professor explained that my extreme reaction may have been because radio waves were bouncing off the metal surfaces of the sink and/or the refrigerator. I don't know what caused it; I just know it was weird and extremely uncomfortable.

**Q. So you weren't worried about the new meter?**

A. No. not yet. I wasn't worried prior to the installation, and when I first had the reaction, I just thought it was something my body would adjust to. Looking back, of course, I think, "How could I have been so stupid? Why didn't I leave my house immediately?" At the time, though, as strong as my initial reaction was, it didn't occur to me that exposure to a meter could cause problems, or have prolonged consequences. I assumed I'd get used to it and the weird feeling and buzzing in my head would go away. It was seeing my blood pressure suddenly shoot up, that suggested to me that the meter was causing more than a "weird feeling." That's what triggered my concern.

**Q. Had you heard of smart meters prior to having one installed on your home?**

A. Yes and no. I was not aware of any controversy. I had seen an article that said energy companies were installing new meters; that in some locations, people were being forced to accept the meters whether they wanted them or not; and that it wasn't right. I tend to be more accepting of things, and because I considered the views of this person to be a little extreme, I hadn't taken the article seriously. I hadn't given it much thought, that is, until my personal experience with smart meters.

**Q. What happened next, the day the meter was installed?**

A. As the day progressed, I developed a dull headache and I had a hard time focusing and concentrating. I also became hoarse. At first, I didn't make a connection between these symptoms and the meter. I did later, though, when these symptoms persisted, and when they developed at home, but went away after being away from home for awhile.

That first day, in addition to the headache and lack of focus, by early evening, my blood pressure had gone up significantly. High blood pressure had not been an issue for me. I had had a blood pressure monitor, and for several years I had checked it occasionally. There had never been cause for concern.

**Q. Why had you made the decision several years ago to check your blood pressure from time to time?**

A. I care about my health. Checking it occasionally was a precautionary measure.

**Q. Why are you so sure that the smart meter influenced your blood pressure readings?**

A. Quite by coincidence, I had taken lots of readings right before smart meter installation. I do Bikram Yoga almost every day. It is a 90 minute, rigorous series of 26 postures, that is done in a room that is 105 degrees. It is a good workout. A fellow classmate had mentioned health benefits she attributed to her yoga practice, lower blood pressure being one of them. As I said, I didn't have blood pressure issues, but I wondered what effect, if any, my yoga practice had on mine. I decided to do an experiment: My plan was to take my blood pressure three times a day: before class, after class, and a reading later in the day. It was because of this experiment that I noticed the immediate spike in my blood pressure.

**Q. What were your blood pressure readings prior to the smart meter installation?**

A. Exhibit A is my record of blood pressure readings from March 1 through March 12. Prior to March 10 (installation day), the range in readings was 108/61 to 133/75. The average reading was 119/64.

**Q: What were your readings the day of the installation?**

A. Before yoga, my blood pressure was 118/72. After yoga, it was 125/72. By 5:00 p.m. it was 150/90. Later, it was 157/86. I remember that right before going to bed that night it was 165/90, but I did not record that reading.

It was the rise in my blood pressure that triggered my concern. It made me aware that my body was being affected on more levels than I had realized. and that the weird feeling I was experiencing was not something to take lightly

**Q. What did you do then?**

A. That night, rather than sleep in my own bed, I slept in the upstairs bedroom furthest away from my smart meter. The next day, Sunday, March 11, I called a friend and I arranged to stay at her house. I slept at her house from Sunday until I left for a three-week trip to Brazil on March 18.

**Q. The second night, you slept at a friend's house. Did you notice a difference when you slept at your friend's house?**

A. I didn't experience the buzzing sound in my head at her house, and the next morning my blood pressure was down again. I slept better than I had at my own house, and I didn't wake up with a headache. The weird, jittery feeling I had when at home lessened, but was still noticeable.

**Q. Did you return to your home?**

A. Yes. I could not totally avoid being in my own home that week because, in addition to packing for my trip, I had many things I had to take care of before leaving. However, I stayed away from home as much as I could.

**Q. What happened when you were in your own home that week?**

The weird, jittery feeling and difficulty focusing persisted; I had headaches. Also, my eyes hurt, I became hoarse, and I developed a dry cough. For the first time in my life, I started on blood pressure medicine.

**Q. Did you call DTE?**

A. Yes. Monday, March 12, the first business day after my meter was installed, I called DTE from home. I was told there was no way to opt out of a smart meter. I explained that the meter was making me sick and that I couldn't stay in my house. I said I wanted to be transferred to someone who could help me. The person I talked to said she could not transfer me to a supervisor, but that she would arrange for someone to call me back. I indicated again that it was very uncomfortable for me to be in

my house, but that I would wait there for the call. I said it was an emergency, and that I needed to talk to someone as soon as possible. No one called back. I called again that day or the next, and got no response.

How were you feeling inside your home waiting for the call? The jittery feeling, the difficulty concentrating, and the buzzing in my head were worse. I was also upset that I was getting such a run-around from DTE. I knew I was leaving the country in a few days. I had hoped that I'd be able to come back to a home with a normal, comfortable environment.

**Q. Did DTE get back to you?**

A. Not right away. When I had not heard back by Wednesday, March 14, two days after being told someone would call me back, I sent an email to DTE via their online complaint site.

I was eventually told I was being referred to Elaine Curtis. I talked to Elaine on Friday, March 16.

**Q. What did she tell you?**

She said DTE would remove my meter if I could provide a letter from my doctor indicating my smart meter was making me ill.

**Q. Had you seen a doctor?**

A. Yes. I had seen my doctor earlier in the week, on Wednesday, March 14. At that time, of course, I had not yet talked with Elaine Curtis, so I did not know I would need a letter. Since it was Friday by the time I learned about the need for a doctor's letter; and I was scheduled to leave for Brazil early on Sunday, I was unable to talk to her before I left. I called her office on Friday afternoon, and when I didn't reach her, I left a message.

I had contacted my doctor immediately; I had been concerned about all of my symptoms, but especially the high blood pressure readings. I wanted to get in to see someone before leaving on my trip. My appointment was on Wednesday, March 14. Following the appointment, I started taking a beta blocker. She said it should lower my blood pressure without making it go too low when I was away from smart meters. She was right, it did. It also helped relieve the persistent jittery feeling I was having. I continued to sleep at my friend's and spend as little time at home as I could.

**Q. You were gone for three weeks. How did you feel in Brazil?**

A. I was fine in Brazil. I felt great and I slept very well. The headaches, the buzzing in my head, and the weird jittery feeling all went away and did not come back until I returned home.

**Q. Did your doctor write the letter?**

A. Yes. In spite of the fact that communicating from Brazil proved to be a challenge because phone lines and access to email were not always available or consistently working, my doctor did send the letter to DTE. Six days prior to my returning home, I received an email from Elaine Curtis indicating

that she had received the letter from my doctor, and that the meter would be removed. Dr. Kyle Morgan faxed her letter directly to DTE; DTE has the letter. I do not have a copy.

**Q. Did DTE follow your doctor's instructions?**

Not exactly. In addition to indicating the meter was making me ill, Dr. Morgan had specified an analog meter. DTE replaced my smart meter with a different digital meter, not an analog meter.

Elaine Curtis said that DTE no longer had a distributor for analog meters. From Brazil, I sent an email to DTE via the DTE complaint link.

The many typographical errors exist because, after losing power in the middle of writing my letter several times (and therefore, losing what I had written), I finally sent this one, errors and all.

DTE ignored both my request for an analog meter and my doctor's letter specifying the need for an analog meter. If DTE had wanted to install an analog meter, it would have been very easy to do so. Hundreds, even thousands of used analog meters, in good working condition, were available.

**Q. Was the smart meter removed?**

A. Yes, but it took awhile. Since I had received the email from Elaine Curtis on April 4th indicating that my meter would be replaced, and since I wasn't coming home until April 10th, I had hoped that my smart meter would be gone when I got home. As soon as I arrived home, I walked to the back of my house and checked. It hadn't been changed. I went back to stay at my friend's house, and I called Elaine Curtis immediately. I don't remember if I actually talked to her that day, or if I left a message and she called me back. When we talked, she thought that my smart meter had already been removed. She said she would check into it and get back to me. She did. When she called me back, she assured me it would be removed within a few days. It was. I don't remember what day it actually came off.

**Q. Why did you request an analog meter?**

A. I had not had any problems with the old analog meters; and, although I didn't understand the concept, I had heard the term "dirty electricity" associated with digital technology. At that point, I wanted my old, familiar, healthful home back.

**Q. Did replacing the smart meter with a digital meter solve the health problems caused by the smart meter?**

A. No. Although there was an improvement, the new digital meter did not solve the problem. My symptoms were not as severe as they had been with the smart meter, but the weird jittery feeling, the headaches, the buzzing sound in my head, the cough, memory problems, and the difficulty focusing—all came back, just to a lesser degree.

**Q. What did you do?**

A. I contacted Elaine Curtis again. She said she didn't think the new meter could cause problems, but that she would look into it. When she got back to me, she said that the new digital could not be the problem because it did not send a signal.

In the meantime, I had talked to my friend who teaches physics. She said that because radio frequencies travel long distances, my current problems might be caused by the RF from my neighbors' meters. She recommended putting up heavy duty tinfoil, shiny side toward the meters, where I suspected the RF might be entering my home. The tin foil would help shield my home, since radio waves are reflected by metal and shiny surfaces. She also explained that there are materials which diffuse radio frequencies.

Someone else said that the problem could be that the new digital meter was dumping dirty electricity into my home, and that could be causing the problem.

**Q. What did you do then?**

A. I did what I could to solve the problem:

My first intervention was to line my garage and cover an outside wall with heavy duty tin foil to shield my house from my neighbor's smart meter that was closest to my house, and where I felt it the most. That helped....a little. The buzzing in my head was definitely still there, but not quite as intense. The other symptoms remained.

Next, I lined the inside wall with tin foil that shares the wall with my meter, On top of that, I put 3 layers of absorbing material. After this intervention (and every other intervention), I waited awhile to see what, if any, effect it had on how I felt or on my symptoms.

**Q. Did it help?**

A. Yes. Although better, it was still difficult to be in my home.

Now that I was spending more time at home, other symptoms surfaced. I wasn't sleeping through the night: I'd wake up after three, four or five hours and not be able to go back to sleep. I'd feel tense, jittery. I became hoarse, and I developed a cough. After being home for about three weeks, I began to notice breathing problems: I would get out of breath just by going upstairs, and I had difficulty breathing in my Bikram Yoga Class when doing postures that I had done with ease prior to the smart meter installations. Also because of my yoga practice, I noticed a slight weakness on my left side, that had not been there earlier. I was not able to do some of the strength building postures I had done earlier.

The buzzing sound in my head would seem louder late at night and early in the morning, and I would always wake up with a headache and a buzzing sound in my head.

**Q. Have the interventions you've done helped?**

A. There is no question that each intervention has helped. The problem is that my home has never gone back to being what it was before: I still can't tolerate being in my home for more than a week or two without experiencing very worrisome symptoms. At this point, I still have concerns regarding smart meter effects on my blood pressure; and I have even bigger concerns about my breathing and my lungs. If I am home for more than a week, I get out of breath when I go up stairs, or when it is humid outside, and in I am no longer able to do some of the Bikram Yoga breathing exercises and postures that I formerly did with ease. So far, all of these symptoms improve or go away entirely when I leave my home for an extended period of time. I can't keep searching for people and places to visit, and as more smart meters are installed, there will be fewer places I can go for relief.

**Q. What else have you done to your home?**

A. Since my first attempt at using tin foil as a shield had helped . . . a little. . . I put up more. I put tin foil on some inside walls. I also put tin foil in my bathroom, and on the back wall of the bedroom that shares a wall with the meter.

I ordered material which is designed to absorb radio frequencies from [lessemf.com/](http://lessemf.com/). I put three layers of that material over the tin foil lining the back wall of the bedroom closest to my digital meter. I also lined one of the walls in my bedroom with this material.

The RF absorbing material is black; not exactly my color I'd choose for my bedrooms.

Because I was still experiencing symptoms, a few months ago I ordered a Graham - Stetzer meter and filters. I had read that the EMF levels can be measured and reduced by adding the filters. Again, I did notice a difference with the filters in place, but not enough of a difference to keep me symptom free.

Last month, I covered the back wall of my home with tin foil. It looks awful, but it made a difference. Again, it helped, but it has not totally taken care of the problem. With each intervention, I have felt a little calmer and the symptoms seem a little less intense, but none of the interventions has totally solved my problems. As I mentioned, I am especially concerned about the breathing difficulties I experience after being in my home for awhile. My blood pressure remains a concern as well, although I have been getting normal readings without medication since my last intervention of putting tin foil on the entire back side of my home.

I tried to spend as much time out of my home as possible. I left whenever I could. I went on trips for one to three weeks. Some were planned; others were trips I took just to get away from my house. Some symptoms, such as coughing, would go away as soon as I left my home. Others would go away after being out of my home for a period of time. The amount of time required for it to go away, depended on the symptom.

**Q. How long can you stay in your house before noticing symptoms?**

A. The length of time before I experience symptoms depends on the symptom: If I return home after being away for a week, I feel jittery and get a buzzing sound in my head immediately upon entering my home. Within a few hours of being home, my eyes may hurt and become dry, and I will become hoarse and develop a cough. Things like breathing problems and weakness on my left side surface after being home for a week or more.

**Q. How are things now?**

A. I'm still spending as much time as possible away from home. From March 10, 2012, when smart meters were installed in my neighborhood, to the present, the longest stretch of time I will have been at home at one time is 30 days. Usually I am home only a few weeks before leaving again. When I leave, I try to be away for one to three weeks.

So far, when I have spent time away from my home, my symptoms have all lessened or completely gone away. When I return, they return.

Although being in my home is more tolerable than it was, even with all that I had done, my health while in my home is still not back to what it had been prior to the smart meter installations

**Q. Did these interventions help? Is the digital meter no longer a problem?**

A. The interventions have helped, but all the problems remain. Whenever I return home, I immediately experience a buzzing sound in my head, I become hoarse, and I get a dry cough. My reactions are systemic: If I am at home for an extended period of time (a few weeks), additional symptoms surface:

- weakness on my left side,
  - joint pain,
  - chest pain,
  - difficulty focusing,
  - hot flashes,
  - breathing problems,
  - shortness of breath,
  - skin things (a rash above my right eye; rough hardened skin on my knuckles)
- my eyes hurt and become dry,  
all my teeth on my upper left jaw ache.

**Q. Did you make any more attempts at mitigation?**

A. I had not shielded the back of my house, both because I didn't think I could get tinfoil to stay up, and because I knew it would look terrible. Finally, though, in October, out of desperation to make

my home more livable, I lined the entire back of my house with tinfoil. It looks awful. Again, it has not totally taken care of the problem and it is only a temporary measure, but it helped. I still haven't spent more than a few weeks in my home since this latest addition of tinfoil, but so far my sleep is more normal, the jittery feeling is not as intense, I don't feel as spacey. I am still getting hoarse, but less often, and my eyes hurt less. The weird, unsettled sensation in my body and the uncomfortable buzzing sound in my head persist.

With each intervention I have seen an improvement in my symptoms, but my house is in no way back to what it was before smart meters were installed in my neighborhood or the digital meter was installed on my home.. In addition, the tinfoil, besides being ugly, is a temporary solution that won't hold up over time.

**Q. How do you know that it is the digital meter that is causing these health effects?**

Although I know it seems unbelievable that a meter could trigger all these health effects, the meter was the only thing that has changed in my home environment. Furthermore, at least so far, all these problems go away when I leave my home: some go away immediately upon leaving; others go away in time. The symptoms return when I return.

**Q. So when you go to someone else's house that has a smart meter, do you have problems?**

A. Yes, to varying degrees. I always experience the buzzing sound and a jittery feeling. I may or may not experience other symptoms.

**Q. When you go into public buildings that have smart meters, do you have problems?**

A. Fortunately, most of the places I frequent do not have smart meters yet, so I can't answer this adequately. However, the spiritual center I attend has a smart meter and it is very uncomfortable to go there, so I have not been going.

**Q. Have you been in any home besides your own that has a digital meter?**

A. Yes. I have a friend who lives on Lake Tahoe. She remodeled her home several years ago, and has a digital meter. It is not a smart meter. I really don't know if it is the same as my meter. Her home is very deep, and the meter is way at the back. I couldn't sleep when I stayed in a back bedroom. I was able to sleep when I slept on her sofa, in the front of the house. The weather was great when I was there, and we spent most of our time outside hiking or by the water. I didn't have as much trouble there as I do at my own home. Her meter is older; I don't know if it is like mine.

**Q. In your experience, will the nontransmitting digital meter (the kind now on your home and the kind DTE is proposing as the alternative to the smart meter) solve the health problems you experience with smart meters?**

A. No.

**Are the nontransmitting digital meters an acceptable alternative to the smart meter?**

A. No

**Q. Please list all the health effects you experience from smart and nontransmitting digital meters, whether on your own home or elsewhere.**

- buzzing in my head
- Elevated blood pressure
- Muscle weakness, especially on my left side
- headaches
- cramps in legs and feet, extremely cold feet
- eyes hurt, blurry vision
- breathing problems, shortness of breath
- joint pain, arthritis like symptoms
- chest pain
- concentration and memory problems
- All of my teeth on one side aching

**Q. How do you know that it was the smart meter that first caused these health effects and not something else?**

A. The symptoms surface when I spend time at home. They go away when I leave. They surface when I am home again. I don't know if the symptoms are caused by my digital meter or my neighbors' smart meters, but the installation of smart meters in my neighborhood is the only thing that has changed in my environment.

**Q. Please list all the health effects you currently experience from the digital meter on your home.**

A. Without the remediation or if I am around other people's smart meters, I sometimes experience all of them, especially buzzing in my head.

With the mitigation, I still experience buzzing in my ears and a I am not as calm, I'm more agitated. To date, I haven't stayed at home long enough to know if the other symptoms will surface again.

**Q. Please list all the health effects you in the past experienced from the digital meter on your home but do not currently experience.**

A. Since putting tin foil on the back of my home, my blood pressure has been normal without medication as long as I avoid smart meters.

**Q. Has anything else changed that would account for the subsiding of these effects?**

A. No

**Q. Did you experience any of the health problems you have enumerated prior to the installation of smart meters?**

A. In 2007 I became ill after being exposed to a very toxic paint. The symptoms I did not experience were the buzzing in my head and the elevated blood pressure. I did experience the other symptoms. I recovered from that injury, and, until the smart meter was installed, I had not had experienced any of these symptoms since my recovery in 2008.

**Q. Did you have health problems prior to the installation of smart meters? If so, what were they and when did they begin?**

A. Prior to the installation of my smart meter, I was healthy, I exercised regularly, I ate a good diet, and I was on no medication..

**Q. Did you do anything else to deal with this problem?**

A. Like I said, I put up shielding materials and I started spending as much time as possible away from home. I took several trips. Although some had been planned, I have taken others for the sole purpose of getting away from my house. From March 10, 2012, when my smart meter was installed, to present, the longest stretch of time I will have been home at one stretch is 30 days. When I have spent time away from home, I have generally left for one to three weeks at a time. Each time I left, my symptoms went away within a day or two of being out of my house. I am still spending as much time away from my house as possible.

At this point, I have spent about \$2000 in materials and devices to tolerate living in my home, and I still have only a temporary fix that doesn't completely solve the problem. And, DTE is proposing additional charges to opt out.

DTE could probably use my home as an example of a smart meter success story: Their records should show that my energy usage has gone down since smart meters were installed in my neighborhood. It's a good example of how misleading it can be to just look at one source of data. My "real" energy usage is up—considerably. I consumed a lot more energy when you consider:

- transportation to doctors,
- products purchased to remediate my home
- medications I will need that I would otherwise not have needed
- driving and flying to destinations in order to stay away from home
- utilities consumed at visiting destinations

These are not just monetary expenses for me. They involve energy expenditures that far outweigh any energy savings DTE might claim.

My home no longer feels like "home." The number of places I can go and remain symptom-free is dwindling as Ann Arbor, the rest of Michigan, and the rest of the country is being installed. I would sell my house and move, but, at this point, I don't know where I could go.

**Q. Please list all of the health problems you currently experience from the digital meter on your home?**

A. Since my last mitigation, my most common symptoms are buzzing in my head, jitteriness, and breathing problems. The breathing problems are the ones that concern me the most.

**Q. Do you experience problems when you enter homes or other buildings with smart meters?**

Yes. I can tell immediately if there is a smart meter.

**A. Have the health effects you experience as a result of smart meters affected your ability to interact socially with others? If the answer is yes, describe how.**

A. Yes, of course. I am avoiding going places that have smart meters. It limits where I can go and who I spend time with.

**Q. Have the health effects you experience as a result of smart meters affected your ability to access public services, such as the public library, government offices? If the answer is yes, describe how.**

A. Not yet.

**Q. Have the health effects you experience as a result of smart meters affected your ability to access religious or spiritual services? If the answer is yes, describe how.**

A. I am involved with a meditation group. I have not been attending programs because I experience symptoms if I am in the building for an extended period of time.

**Q. Have the health effects you experience as a result of smart meters affected your ability to freely access health services? If the answer is yes, describe how.**

A. Not yet.

**Q. Have the health effects you experience as a result of smart meters affected your ability to perform one or more major life activities not already mentioned? If the answer is yes, describe what activities and how the effects have affected your performance of these activities.**

A. So far I have been lucky. Most of the places I frequent do not have smart meters yet. I am not looking forward to the day when smart meters are everywhere. It will be a nightmare for me.

**Q. What do you feel is a reasonable accommodation to allow you to perform major activities of daily living?**

A. A free opt out for everyone.

An analog meter option.

The Establishment of Smart Meter Free Zones and/or Facilities

The removal of smart meters everywhere.

From: [www.smartmetereducationnetwork.com](http://www.smartmetereducationnetwork.com)

# Symptoms after Exposure to Smart Meter Radiation

People from coast to coast in the USA, and from one side of the world to the other, are becoming ill after exposure to the radiofrequency radiation emitted by Wireless Smart Meters. Attached are the results of two surveys of the symptoms being reported.

The first survey comes from the United States and includes 318 adults, from 28 states from California to New York, and addresses wireless utility meters that are principally Wireless Smart Meters. The second survey comes from the other side of the world, Victoria, Australia, and includes 92 adults and children, and addresses Wireless Smart Meters exclusively. Altogether, 410 adults and children are included. Both surveys report new or worsened symptoms after the installation of wireless utility meters in a given individual's environment.

The attached two graphs show the percentage of individuals in each survey who experienced each symptom. The two surveys group the symptoms into somewhat different clusters, but these clusters are similar enough to enable comparison between the surveys. Of the top seven clusters of symptoms in both surveys, six clusters are similar in both description and order of occurrence: (1) sleep disruption; (2) headaches; (3) ringing or buzzing in the ears; (4) fatigue; (5) loss of concentration, memory, and learning ability; and (6) disorientation, dizziness, and loss of balance. Most individuals in the surveys developed multiple symptoms.

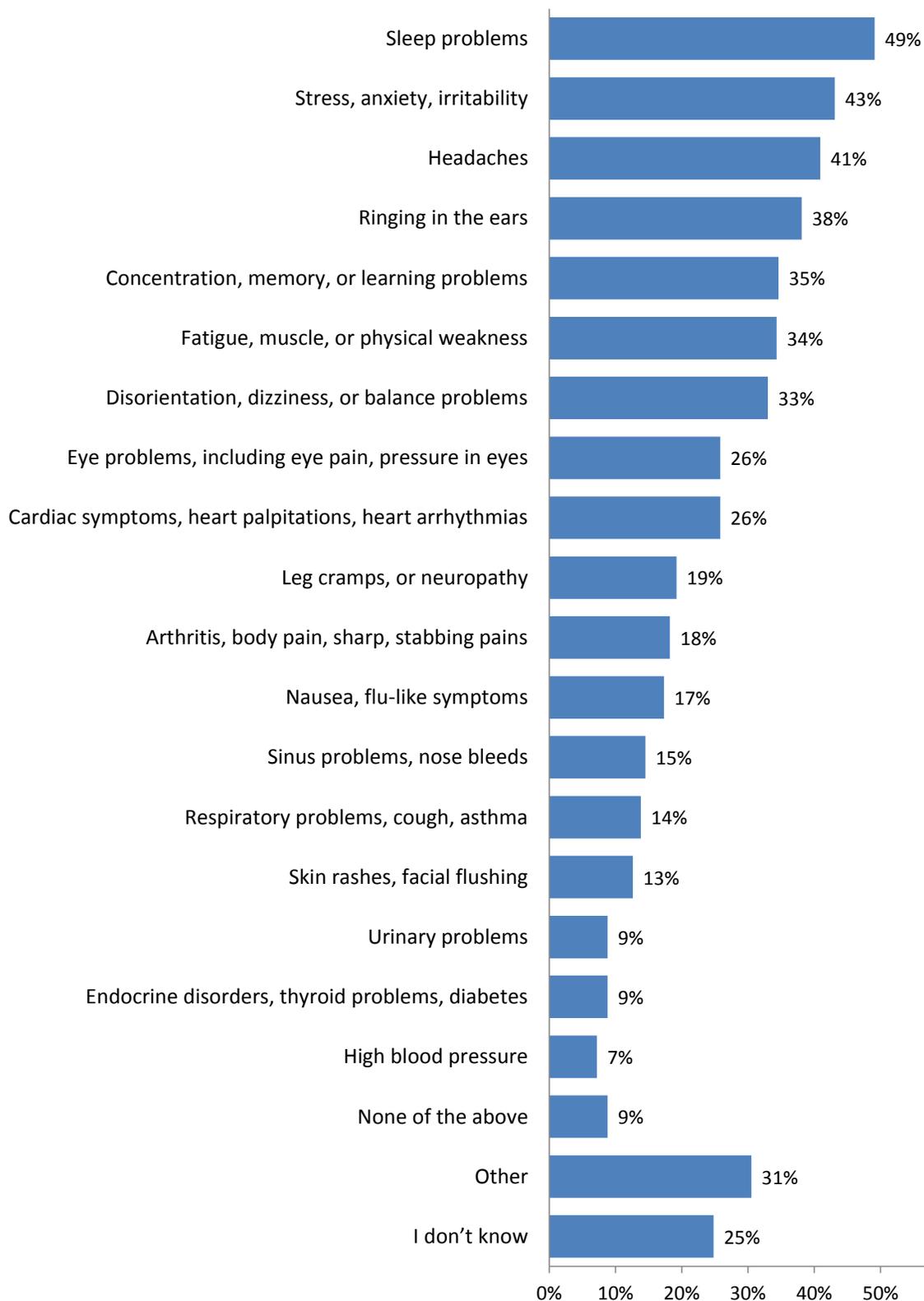
The surveys do not tell us how likely a given individual is to become symptomatic after exposure to the radiation from Wireless Smart Meters. But the surveys do tell us which symptoms a person who does become symptomatic is most likely to experience. The many symptoms found reflect the many body systems that are disrupted by such radiation.

A symptom, of course, is something that can be sensed by an individual, and thus can serve as a warning. Unfortunately, many health effects caused by radiofrequency radiation have no early symptoms and thus give no warning. These health effects become evident only after significant harm has been done. Examples are DNA damage, cancer, and reproduction effects.

---

<sup>1</sup> Ronald M. Powell is a retired career U.S. Government scientist. He holds a Ph.D. in Applied Physics from Harvard University. During his Government career, he worked for the Executive Office of the President, the National Science Foundation, and the National Institute of Standards and Technology.

# New or Worsened Symptoms Reported by 318 Individuals after Exposure to Wireless Utility Meters in the USA<sup>1</sup>



<sup>1</sup> Ed Halteman, Ph.D., statistics, Final Results Summary: Wireless Utility Meter Safety Impacts Survey, September 13, 2011, p. 22 (<http://emfsafetynetwork.org/wp-content/uploads/2011/09/Wireless-Utility-Meter-Safety-Impacts-Survey-Results-Final.pdf>). 97 percent of respondents to full survey were in the USA, from 28 states with most in California (78 percent) and New York (16 percent).

# Executive Summary by Ed Halteman, Ph.D.

## Wireless Utility Meter Safety Impacts

### OBJECTIVES

- To investigate reported public health and safety complaints about wireless utility meters.
- To evaluate the impacts on health and safety due to wireless utility meters.
- To determine whether further study is warranted.

### METHODS

- Survey was designed by the EMF Safety Network (Network).
- The survey was circulated online through various social media outlets including Network's email list, Facebook, and the California EMF Safety Coalition (a discussion group).
- The survey was also posted on Network's website: [www.emfsafetynetwork.org](http://www.emfsafetynetwork.org) where visitors were invited to take the survey.
- 443 responses were received from 7/13/2011 through 9/2/2011. *(318 of the 443 answered the health questions that formed the basis for the bar chart on symptoms. RMPowell)*
- Network commissioned Survey Design and Analysis (SDA) to provide this report of the survey findings.

### RESPONDENT MAKEUP

- 93% are over 40 years old and 43% are over 60 years old.
- 73% are women.
- 78% are from California.
- 68% have Pacific Gas and Electric (PG&E) as their utility provider.
- 49% are EMF Sensitive.
- 41% have had a new wireless meter installed in their home; of these . . .
  - 56% have had it installed for at least six months
  - 89% have electric meters, 53% gas meters and 10% water meters
  - 35% saw an increase in their utility bill
  - 26% have experienced some type of interference
  - 8% experienced burned out appliances or damaged electronics including TV, stereo, computer, refrigerator and other.
- 76% indicated they have wireless utility meters installed in their neighborhood, town or city.
  - 44% near their home
  - 36% in town

### TOP HEALTH ISSUES SINCE NEW METERS INSTALLED

- Sleep problems (mentioned by 49%)
- Stress, anxiety and irritability (43%)
- Headaches (40%) *(Intentionally listed at 41% on symptoms bar graph, rounded up from 40.9%. RMPowell)*
- Ringing in the ears (38%)
- Heart problems (26%)

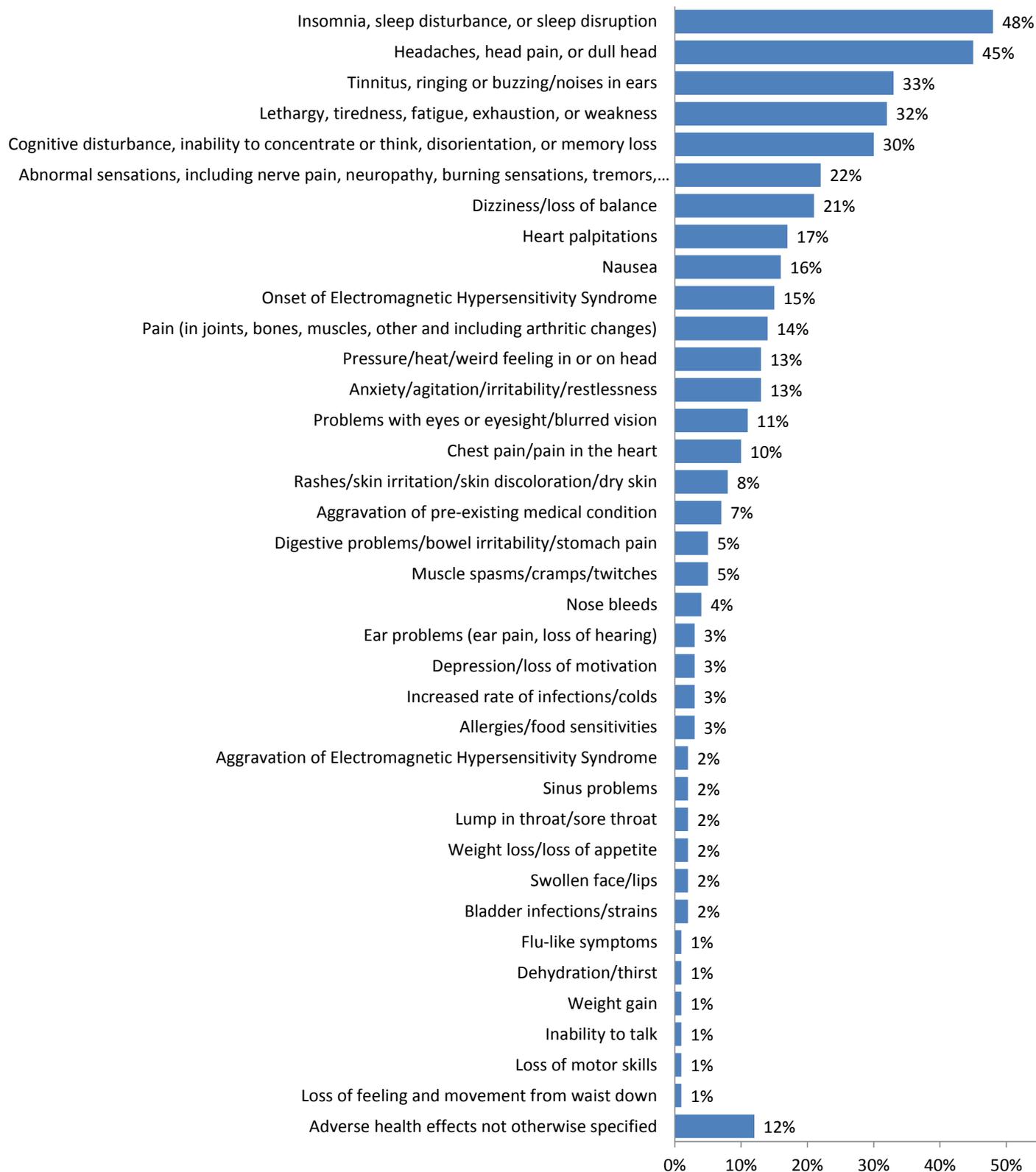
### UTILITY and PUBLIC UTILITY COMMISSION INTERACTIONS *(Title inserted by RMPowell.)*

- 40% (111 people) of those having wireless meters in their homes or community have complained to their utility provider.
  - 96% of these people were either "Unsatisfied" or "Very Unsatisfied" with the handling of their complaint.
- 32% (88 people) complained to the utilities commission.
  - 96% of these people were either "Unsatisfied" or "Very Unsatisfied" with the handling of their complaint
- 94% of respondents want to retain or restore their analog meters and 92% of these respondents do not think they should have to pay any additional money.

### STATISTICAL TESTING SHOWS THE TOP HEALTH SYMPTOMS ARE POSITIVELY ASSOCIATED WITH

- EMF Sensitivity
- Wireless meters installed in the home

# New or Worsened Symptoms Reported by 92 Individuals after Exposure to Wireless Smart Meters in Australia<sup>1</sup>



<sup>1</sup> Federica Lamech, MBBS, Self-Reporting of Symptom Development from Exposure to Radiofrequency Fields of Wireless Smart Meters in Victoria, Australia: A Case Series. *Alternative Therapies*, Nov/Dec 2014, Vol. 20, No. 6, pages 28-38. NIH PMID 25478801 (<http://www.alternative-therapies.com> and <http://www.ncbi.nlm.nih.gov/pubmed/25478801>).

## **Abstract of Dr. Federica Lamech's Article from the National Institutes of Health PubMed Index**

Altern Ther Health Med. 2014 Nov-Dec;20(6):28-39.

### **Self-reporting of symptom development from exposure to radiofrequency fields of wireless smart meters in Victoria, Australia: a case series.**

Lamech F.

Abstract

#### **CONTEXT:**

In 2006, the government in the state of Victoria, Australia, mandated the rollout of smart meters in Victoria, which effectively removed a whole population's ability to avoid exposure to human-made high-frequency nonionizing radiation. This issue appears to constitute an unprecedented public health challenge for Victoria. By August 2013, 142 people had reported adverse health effects from wireless smart meters by submitting information on an Australian public Web site using its health and legal registers.

#### **OBJECTIVE:**

The study evaluated the information in the registers to determine the types of symptoms that Victorian residents were developing from exposure to wireless smart meters.

#### **DESIGN:**

In this case series, the registers' managers eliminated those cases that did not clearly identify the people providing information by name, surname, postal address, and/or e-mail to make sure that they were genuine registrants. Then they obtained consent from participants to have their deidentified data used to compile the data for the case series. The author later removed any individual from outside of Victoria.

#### **PARTICIPANTS:**

The study included 92 residents of Victoria, Australia.

#### **OUTCOME MEASURES:**

The author used her medical experience and judgment to group symptoms into clinically relevant clusters (eg, pain in the head was grouped with headache, tinnitus was grouped with ringing in the ears). The author stayed quite close to the wording used in the original entries. She then calculated total numbers and percentages for each symptom cluster. Percentages were rounded to the nearest whole number.

#### **RESULTS:**

The most frequently reported symptoms from exposure to smart meters were (1) insomnia, (2) headaches, (3) tinnitus, (4) fatigue, (5) cognitive disturbances, (6) dysesthesias (abnormal sensation), and (7) dizziness. The effects of these symptoms on people's lives were significant.

#### **CONCLUSIONS:**

Review of some key studies, both recent and old (1971), reveals that the participants' symptoms were the same as those reported by people exposed to radiofrequency fields emitted by devices other than smart meters. Interestingly, the vast majority of Victorian cases did not state that they had been sufferers of electromagnetic hypersensitivity syndrome (EHS) prior to exposure to the wireless meters, which points to the possibility that smart meters may have unique characteristics that lower people's threshold for symptom development.

PMID: 25478801

**Shawn E. Abrell**, WSB No. 41054, *Pro Hac Vice*  
4614 SW Kelly Avenue, Suite 200, Portland, Oregon 97219  
Tel.: 503.224.3018 Fax: 503.222.0693  
E-Mail: shawn.e.abrell@gmail.com  
*Lead Counsel for Plaintiffs*

**Tyl W. Bakker**, OSB No. 90200  
621 SW Alder, Suite 621, Portland, Oregon 97205  
Tel.: 503.244.4157; Fax: 503.220.1913  
E-Mail: tylbakker@gmail.com  
*Local Counsel for Plaintiffs*

**United States District Court**

**District of Oregon**

**Portland Division**

**AHM**, by and through  
her Guardian *ad litem* and father,  
David Mark Morrison, and  
**David Mark Morrison**, individually,

Plaintiffs,

v.

**Portland Public Schools**,

Defendant.

Civil Action No. 3:11-cv-00739-MO

**Second Amended Declaration  
of Curtis Bennett**

I, Curtis Bennett, under penalty of perjury pursuant to 28 U.S.C. § 1746, hereby make the following declaration in support of a preliminary and permanent injunction enjoining Portland Public Schools' use of WI-FI:

1. I am the world's foremost authority on applying infrared technologies at molecular levels. I am committed to contributing to the overall improvement of the Earth's ecosphere by extending mankind's vision beyond the visible.

2. I am a Canadian Interprovincial Journeyman Electrician (Red Seal) with a theoretical and practical background in electromagnetic field designing. My education included extensive mathematical theory substantiated in a practical, laboratory environment. Ultimately, I earned Canadian provincial and national credentials.

3. I earned a construction engineering technologist (building construction and design) Diploma from the Northern Alberta Institute of Technology. This education consisted of every aspect of construction, from contracts to completion.

4. I completed an education in engineering, magnetic fields, heat transfer, and electron flow specifically to compliment my extensive background with a technology that allows us to see temperature beyond our visible spectrum.

5. I have consulted with defense agencies, oil, gas, lumber, mine, and manufacturing industries, hydrologists, fire departments, medicine, energy, governments, municipalities, and insurers.

6. As a first response consultant, I consulted the Defense Minister for the Canadian Military (Canada's Chief in Command) on the vulnerability of Canadian (and other countries') ports after 9/11.

7. I have extensively studied theory on magnetic and electromagnetic fields, including radiofrequency fields, for many years. It is how we produce electricity.

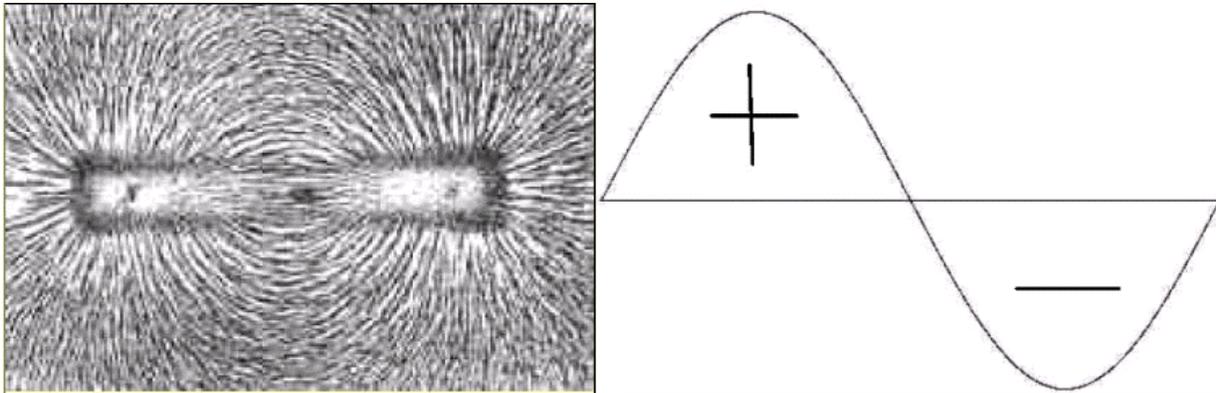
8. I have presented to Canada's Standing Committee on Health specific to 'An Examination of the Potential Health Impacts of Radiofrequency Electromagnetic Radiation.' <http://www.magdahavas.com/wordpress/wp-content/uploads/2010/04/HESA-Report-final.pdf>. Prior to presenting to the committee, I informed Health Canada of the error in safety code as our jurisdictional authority regarding the dangers of radio frequency interaction with humans. I reported

that safety standards and Canada's Safety Code 6 (Canada's requirements for the use of radiation emitting devices) contained errors or omissions substantiating harm is being done. Specifically, in September, 2010, I discovered an error in Health Canada's Safety Code 6, which I reported to Health Canada and followed-up in October as expert witness for Canadian Parliament's Standing Committee. The error is that Safety Code 6 failed to consider that any given person is an intricate unprotected electrical unit with its own frequencies and voltages. Safety Code 6 treats humans as a piece of tissue or furniture and negates to mention human frequencies or electrical sensitivity. Safety standards negating the electrical conflicts made the process miss causation or the mechanism scientifically linking harm with electromagnetic frequencies (EMFs). Thus, the failure to include people has resulted in no consideration for the frequency conflicts between radiofrequency radiation and humans. The only reason I picked up on the missing electrical aspects of humans is because of the rollover of our work into medical education. As electrical professionals we don't deal with human electrical properties, we aren't allowed to use them for conductors.

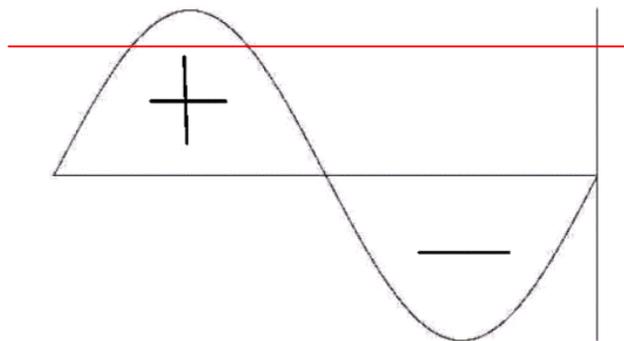
9. Academia of the world is literally blind to temperature, and after decades of advanced research as an infrared consultant (all applications), I now lecture for education credits needed for medical licensing(see CurtisBennett credentials). I have presented in the United States & Canada to Medical Doctors and health professionals regarding the dangers of radio frequency interaction with humans(see cell phone radiation images from 2002). By employing infrared at the molecular level, we are able to see things such as breast cancer, below surface groundwater (nature's hidden treasure) [www.thermoguy.com/groundwater.html](http://www.thermoguy.com/groundwater.html) , and forest fires through blinding smoke <http://www.thermoguy.com/blog/index.php?itemid=39> . Another application is showing how solar electromagnetic fields are causing buildings to 'burn,' or generate extreme heat, which they are not designed <http://youtu.be/dKGHKtkqeMc> . It is a program where concepts of cellular energy and the function of the human body are integrated with the growing focus on the dangers of radiofrequency radiation, including WI-FI, and cellular technology.

My participation in the medical program includes magnetism, electromagnetic frequencies, and the mechanism as to how they are dangerous <http://youtu.be/jcBDxpSWA4k>. Additionally, I lecture regarding buildings and their toxins, groundwater, forest fires and their toxicity, medical imaging including before and after images of physiology changes with treatment. My presentation of environmental pollution is of electromagnetic fields versus magnetic fields. In the application of schools and electromagnetic fields, what I teach and offer as testimony herein, includes the following:

a. The following show a magnetic field versus an electromagnetic field:



The picture top left is a magnetic field of a bar magnet. The top right diagram is an electromagnetic field, represented by a frequency. Unlike the electromagnetic field, the magnetic field doesn't have a frequency and would measure as a straight line (red) which is demonstrated below:



b. To create electricity you need a **magnetic field, a conductor, and motion.**

We create electricity by moving a conductor through a magnetic field or by moving the magnetic field around the conductor. When it comes to children in a WI-FI environment, the WI-FI router is providing the magnetic field while also moving the field (at 2.4 or 5 GHz),

children are the conductors. The admitted power density in the classrooms is effectively putting the unprotected children as well as the teachers inside the circuit.

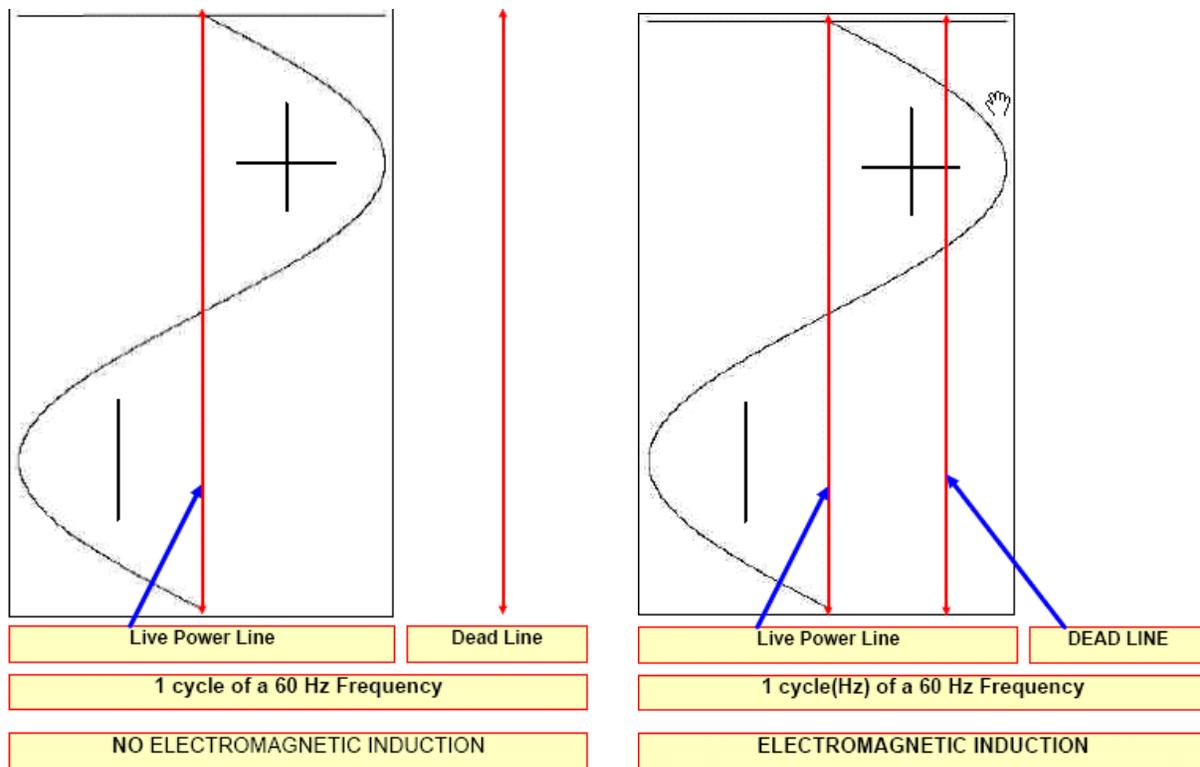
c. As conductors within the electromagnetic fields, children, teachers, and staff are very precise, as well as intricate, electrical beings functioning healthily at approximately 7.8 Hz and 25 to 100 Mv.

d. WI-FI is installed to communicate with the wireless devices called computers. The other wireless devices in the room, called children, do not function at wireless frequencies. Human cells operate at low voltage, their own frequencies, and to impose a very fast foreign frequency at GHz speeds on the human electrical system causes serious electrical problems.

e. At a molecular level, these fast radiofrequency waves are going through humans causing atoms and molecules to change direction or polarize at twice the frequency. Other results are *electrical induction of and* eddy currents within human biological systems. We know with absolute certainty that induction must be happening because SAR values themselves are the Specific Absorption Rate, which is caused by induction. The resultant heat can be caused by electromagnetic induction as (i) heat is a byproduct of creating currents in the body, (ii) the body polarizing at twice the frequency produces heat (microwave effect), or (iii) heat<sup>1</sup> could result from electrical failure from mixing frequencies. The diagrams below evidence electrical induction (the 'Dead Line' represents a conductor/child):

---

<sup>1</sup> Safety standards admit heat is generating, which is why a power load (volts times amps) (specific absorption rate) was assigned to tissue of 1,000 microwatts/cm<sup>2</sup> of localized heat. What causes the heat is electromagnetic induction. The error or mechanism missing in safety standards is they negated to consider all the frequencies or electromagnetic fields, such as humans.



f. Electromagnetic induction on a bare conductor (a child) running at its own frequency brings on a host of electrical problems for the unprotected child including nerve and muscle depolarization (stimulation), in addition to heat. Canada’s Safety Code 6, which is based on similar international standards as used in the United States, provides that the unintentional excitation of tissue is to be **avoided** as is **heat effect** because studies show it can lead to nerve and muscle depolarization.<sup>2</sup> Depolarization is part of the natural process but should not be initiated because of electromagnetic induction (electromagnetic triggers like opening a car door from inside.

<sup>2</sup> ‘For frequencies from 3 to 100 kHz, *the predominant health effect to be avoided is the unintentional stimulation of excitable tissues*, since the threshold for electrostimulation in this frequency range will typically be lower [less radiation or slower frequencies] than that for the onset of thermal effects. *Experimental studies have demonstrated that exogenous electric and magnetic field exposures can induce in situ electric fields and currents within biological tissue that can lead to nerve and muscle depolarization \* \* \**. Limits for maximum external electric and magnetic field strengths have been established in Safety Code 6 to avoid *in situ* electric field strengths greater than that of the minimum excitation threshold for excitable tissues.’ (Italics added) Health Canada, Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz Safety Code 6 (2009), [http://www.rfsafetysolutions.com/PDF%20Files/Health%20Canada%20Safety%20Code%206%20Standard\\_2009.pdf](http://www.rfsafetysolutions.com/PDF%20Files/Health%20Canada%20Safety%20Code%206%20Standard_2009.pdf).

the building). By way of example, recent work by Zhou *et al.*, suggests intermediate frequency fields allow large segments of the DNA molecule, but not its entire length, to become polarized. This polarization causes charge to pile up at bends or clumps, which then attract one another, causing the DNA polymer to collapse. Zhou *et al.*, *Collapse of DNA in ac Electric Fields*, Phys Rev Lett 106, 248103 (June 16, 2011), quoted from *The DNA also collapses* <http://physics.aps.org/synopsis-for/10.1103/PhysRevLett.106.248103>. On June 22, 2011, this phenomenon was discussed by the The Lancet, summarizing the latest International Agency for Research on Cancer's reclassification of radiofrequency electromagnetic frequencies as a 'possibly carcinogenic to humans' (Group 2B): (with the reported mechanism linking the frequencies to adverse health effects, if Health Canada had shared the mechanism, the W.H.O. would have reclassified the frequencies as a Group 1 as causing cancer).

*EMFs generated by RF sources couple with the body, resulting in induced electric and magnetic fields and associated currents inside tissues.* The most important factors that determine the induced fields are the distance of the source from the body and the output power level. Additionally, the efficiency of coupling and resulting field distribution inside the body strongly depend on the frequency, polarisation, and direction of wave incidence on the body, and anatomical features of the exposed person, including height, body-mass index, posture, and dielectric properties of the tissues. Induced fields within the body are highly non-uniform, varying over several orders of magnitude, with local hotspots. See, [http://www.natap.org/2011/newsUpdates/062311\\_01.htm](http://www.natap.org/2011/newsUpdates/062311_01.htm). (there is no acceptable induction allowed)

g. A 2009 study found an underestimation of exposure to children in the 1,900 MHz (220 percent) and 835 MHz (144 percent) frequencies, and which will be true for 2.45 GHz and 5 GHz frequencies as well:

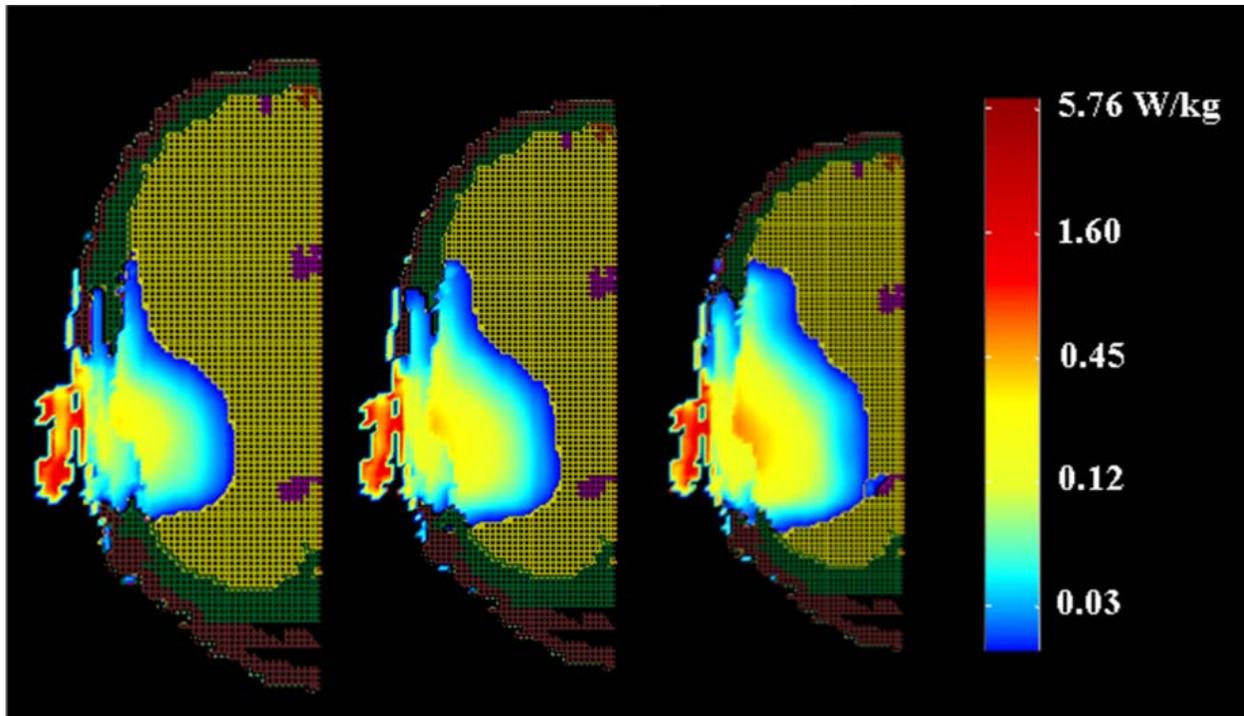
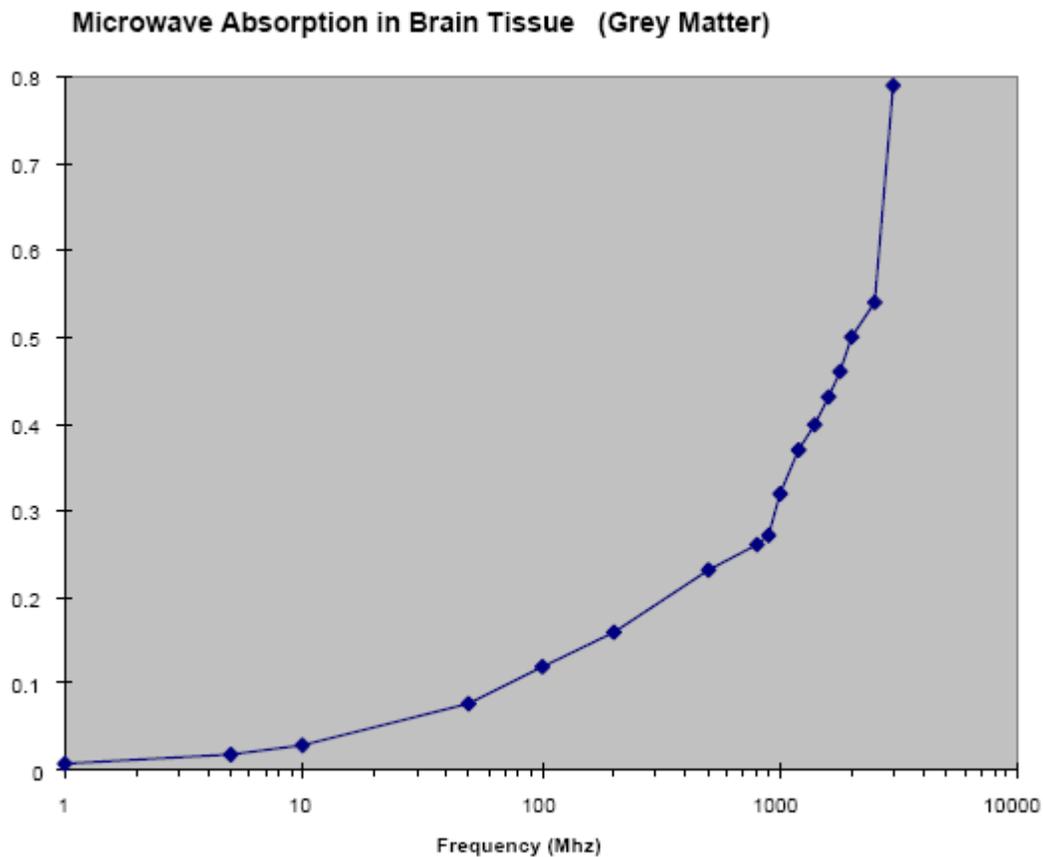


Figure 2. SAR distribution at 1900 MHz: (a) 11.1% larger, (b) average, and (c) smaller, Gandhi & Kang, *Phys. Med. Biol.*, 47, 1501-18, 2002.

The underestimation of exposure was due to the thinner pinna and the skull for the smaller models which results in closer placement of the mobile telephones to the brain of children. This is Because of the larger height, the adult head is generally in the weaker magnetic field region resulting in lower induced current densities for the brain for adults. The heads of children, on the other hand, are in the stronger magnetic field regions resulting in higher induced currents for the brain as compared to adults. Underestimation of EMF/NIR Exposure for Children for Mobile Telephones and for Electronic Article Surveillance(EAS) Systems. Om P. Gandhi, [www.icems.eu/docs/brazil/Gandhi\\_09.ppt](http://www.icems.eu/docs/brazil/Gandhi_09.ppt). Present frequency exposure is based on 6 minute exposure for adult males.

h. The graph below, from physicist William Curry PhD,'s presentation Wireless LANs in the Schoolroom, shows how absorption in brain tissue (grey matter) increases exponentially toward the ultra-high frequency (UHF) area of the microwave oven and WiFi. (I have included a link to a declassified military document where they refer to microwave hearing? Popping noises they found were associated with the thermal elasticity of the brain)  
[http://www.thermoguy.com/pdfs/Bioeffects\\_of\\_Selected\\_Non-Lethal\\_Weapons.pdf](http://www.thermoguy.com/pdfs/Bioeffects_of_Selected_Non-Lethal_Weapons.pdf)



Curry, Wireless LAN's in the school room, <http://www.stayonthetruth.com/wireless-lans-in-the-school-room---bill-p-curry.php>

i. The graph above, from physicist William Curry PhD,'s presentation Wireless LANs in the Schoolroom, shows how absorption in brain tissue (grey matter) increases exponentially toward the ultra-high frequency (UHF) area of the microwave oven and WI-FI.

j. In the case of the Portland Schools, the additional, unused but still deployed carrier frequency of 5 Hz would likely increase absorption in other, smaller organs, such as the thyroid.

k. The graph also illustrates the problem with the drive of the wireless industry toward ever-higher frequencies within the cm microwave band. While nearly all the lower frequency bands have already been allocated by the FCC for specific types of radio transmissions, and transmission of ever more information content on any given channel requires greater bandwidth, each new deployment undermines further the integrity of the population's health. Engineers who design these systems have no training that would qualify them to consider the effects on biologic systems, which is why public health scientists need to be called in to policymaking prior to contracting and deployment, not after the fact.

l. I also wish to speak about the direct effects of RF/MW radiation upon the human organism are not the only known effects. According to Howard Bassen, PhD of the Food and Drug Administration (FDA), there are 'increased reports that medical devices, such as pacemakers, apnea monitors, electrically powered wheelchairs, etc., have failed to operate correctly because of interference from various emitters of radiofrequency energy \* \* \* Reasons for this problem are twofold: 1) increasing numbers of electronically controlled medical devices with inadequate electronic protection against RFI, and 2) a significant increase in the number of RF sources in the environment.' <http://ewh.ieee.org/soc/embs/comar/interfer.htm>. This is another strong reason why WI-FI should not be introduced into the school environment. Central Maine Power is installing smart meters and admit the frequencies are interfering with electrical devices inside buildings. In recent public forums, I have been asked specifically about pacemakers and health monitoring equipment in extended care facilities with disabled patients. The frequencies will affect health and possibly interfere with health monitoring equipment which administers medications plus much more. <http://www.dslreports.com/shownews/Power-Utility->

m. Dr. Bassen also acknowledges the scale of this problem: ‘Hundreds of incidents of RFI induced medical device failure have been reported, studied, and summarized \* \* \* The consequences have ranged from inconvenience to serious injuries and death. However, many more incidents may occur that are not reported because most users of medical devices are unaware that RF fields are present when problems are recognized and because of the intermittent nature of the failures that could cause them to be unobserved.’ *Id.*

n. This problem is not new, but long-established, and interference can occur even from very distance infrastructure, and at exceedingly low radiation levels. As Dr. Bassen states: ‘In the mid-1980s, \* \* \* FDA had become aware that approximately 60 infants died in the United States while being monitored for breathing cessation by one model of apnea monitor. Subsequent tests have shown that this particular monitor is extremely susceptible to low level RF fields, including those from *mobile communication base stations several hundred meters away and FM radio broadcast stations more than one kilometer away.* [Emphasis added.] Other apnea monitors have been shown to be similarly susceptible to malfunction...Cellular phones have also been shown to cause unintended firings of implantable cardiac defibrillators. Governments and taxpayers are funding health costs, wireless technologies are contradicting those objectives. Sudden Infant Death Syndrome rates in British Columbia, Canada are up 30 percent over 2010. The B.C. Coroner's Office under the Solicitor General of BC is investigating. In our inquiry as to electromagnetic triggers from wireless technologies contributing to vulnerable babies stopping breathing, we are asked to submit electrical information to the Coroner's Office on the EMFs as well as the medical education program lecturing the dangers of Wi-Fi in medical education. I have provided additional information to the Coroner's Office on the BC Smart Meter program bringing emfs to people's homes.

o. Dr. Bassen also acknowledges FDA's awareness that pulse-modulated wave, such as wifi deploys, exacerbates interference: 'Modulation also affects the degree of interference for a given set of exposure conditions; amplitude modulation (including pulsed RF) is usually the most significant for RFI. *Id.*

p. We see biological effects in water lines conditioned with a weak electrical signal. Goldsworthy A (1999), Whitney H, Morris E, Biological Effects of Physically Conditioned Water (available upon request), Biology Department, Imperial College of Science Technology and Medicine, London, Wat. Res. Vol. 33, No. 7, pp. 1618-1626, 1999. It shows that ordinary town water supplies, when treated with pulsed radio frequencies (as used to remove lime scale from plumbing) becomes biologically active in yeast, probably by removing calcium from cell membranes. The results were broadly similar to those of direct exposure to electromagnetic fields and is what prompted Dr. Goldsworthy to conclude that calcium removal from cell membranes was a likely mechanism for the observed biological effects on animals. The chilling possibility to emerge from this was that the biological effects of electromagnetic fields could be transmitted in the bloodstream (like the water) and exposure in any part of the body could have an effect all over the body, not just the parts that are directly exposed; nowhere is safe.

10. I have personal knowledge of Portland Public Schools WI-FI installation, which operates at carrier signals of 2.45 and 5 GHz or 2.45 and 5 billion Hz (cycles per second). Conflicting electromagnetic frequencies (electromagnetic compatibility) between WI-FI and children (approximately 7.8 Hz & 25 to 100 mV) are producing severe electrical problems that would cause function failure in similarly tuned electro-mechanical devices in use for commercial industry or homes, computers. See for example, *Effects of 6-10 Hz ELF on Brain Waves*, Article by David S. Walonick, originally printed in *Borderlands* (Vol. XLVI, Nos. 3&4, May – August 1990), <http://journal.borderlands.com/1999/effects-of-6-10-hz-elf-on-brain-waves/>. This study found evidence that ELF magnetic waves can affect brain waves. The

specific ELF frequencies in studying were 6-10 Hertz, the same as those produced by the human brain in the theta and alpha states. It further stated that, generally, specific brain wave frequency ranges can be associated with mood or thought patterns. Frequencies below 8 Hertz are considered theta waves. While these seem to be some of the least understood frequencies, they also seem to be associated with creative, insightful thought. Alpha frequencies are from 8 to 12 Hertz and are commonly associated with relaxed, meditative states. Most people are in an alpha state during the short time immediately before they fall asleep. Alpha waves are strongest during that twilight state when we're half asleep and half awake. Beta frequencies (above 12 Hertz) coincide with our most 'awake' analytical thinking. *Id.*

11. Based upon a review of the Mount Tabor Middle School WI-FI Floor Plan (Complaint, Ex. A), a given child is subject to signals from multiple WI-FI transmitters and numerous laptops. Each child has different DNA, hydration, toxicity, nutrition, lifestyle, etc.; with the point being every one of them is a different electrical device in the WI-FI application. WI-FI is interacting with each child differently and as it goes through walls, it is going through the children, as well as teachers and staff.

12. RF/MW radiation will interact differently with all material depending on that material's emissivity. Emissivity is a material's ability to absorb or emit wavelengths of radiation. The more absorbent the material, the higher the emissivity. Reflective materials will reflect the EMF radiation and it may hit absorbent material with the reflected angle. The children, and other absorbent material will be interacting with the frequencies. The radiation ultimately is absorbed by children's body tissue, which is one of several substances that rather ideally, meaning maximally, absorbs such radiation. The only upside is that the absorbent materials including the children will heat the classrooms by some tiny increment. But this will not save Portland Public Schools on energy costs; since the WI-FI system itself requires and wastes enormous amounts of energy, as do all wireless infrastructures.

13. The digital wireless signals used in WI-FI are pulsed, ultra high (2.45 GHz) and super high (5 GHz) frequency signals, emitted in bursts, at regular intervals, in very rapid succession. Imposed on these pulsed ultra and super high frequency microwaves are extremely low frequency modulations of the RF carrier waves. Carrier waves transport data and are also referred to as Information Carrying Radio Waves. This man-made and very complex RF/MW electromagnetic radiation product cannot be compared to the naturally occurring and biologically compatible radiation of our environment, where electromagnetic frequencies are now billions of times higher than levels from which all life evolved. See, Adamantia Fragopoulou, Yuri Grigoriev, Olle Johansson, Lukas H Margaritis, Lloyd Morgan, Elihu Richter and Cindy Sage. Scientific Panel on Electromagnetic Field Health Risks: Consensus Points, Recommendations, and Rationales. REVIEWS ON ENVIRONMENTAL HEALTH VOLUME 25, No. 4, 2010. see <http://www.iemfa.org/index.php/all>.

14. WI-FI is not even installed for the superficial cost convenience because a safe operational cabled system is already installed into, upon information and belief, each room. Even if the additional initial installation costs of setting up additional wireless routers/switches in each room may at first appear more 'cost effective,' this does not take into account their long-term, overall costs. Moreover, it would have saved money to keep the system that's already in place, and not to override it with a redundant and energy-wasteful one - or two in this instance, since they have 5 GHz deployment that is not even being used, too! Also, the staff and equipment required to manage wireless capacity and to monitor usage, puts the overall costs much higher. So-called 'smart' wireless devices associated with wireless networks can cause unexpected congestion, adding to the costs. Additionally, wired computer stations deliver data faster, safer, and more sustainably, while providing real economy and advancing technology in education. Educational technology advancements are important and can be achieved safer and faster, and without taking from children their privacy rights, as WI-FI does by way of its cyber-insecurity. Wiring is the only option, and represents real, sustainable economic growth.

15. Within the relevant scientific community it is generally accepted many bioeffects and adverse health effects occur as a result of low-level RF/MW radiation exposure, with unrealized domino-effect costs of many kinds, some of which all people will suffer, sooner or later. Specialists also consider the secondary effects to human society of losses of wildlife, essential insects, plants and other environmental damages from ubiquitous and unnatural PM RF/MW radiation.

16. In my opinion as a professional with Canadian national and pro AHM, other students, and school staff and faculty adverse health effects and should be discontinued immediately as this as a national and global emergency.

Dated this 19<sup>th</sup> day of December, 2011.

*/s/ Curtis Bennett*

---

CURTIS BENNETT

**Shawn E. Abrell**, WSB No. 41054, *Pro Hac Vice*  
4614 SW Kelly Avenue, Suite 200, Portland, Oregon 97239  
Tel.: 503.224.3018; Fax: 503.222.0693  
E-Mail: shawn.e.abrell@gmail.com  
*Lead Counsel for Plaintiffs*

**Tyl W. Bakker**, OSB No. 90200  
621 SW Alder, Suite 621, Portland, Oregon 97205  
Tel.: 503.244.4157; Fax: 503.220.1913  
E-Mail: tylbakker@gmail.com  
*Local Counsel for Plaintiffs*

**United States District Court**

**District of Oregon**

**Portland Division**

**AHM**, by and through  
her Guardian *ad litem* and father,  
David Mark Morrison, and  
**David Mark Morrison**, individually,

v.

**Portland Public Schools,**

Defendant.

Civil Action No. 3:11-cv-00739-MO

**Declaration of  
Dr. Magda Havas, B.Sc., Ph.D.**

I, Dr. Magda Havas, B.Sc., Ph.D., under penalty of perjury pursuant to 28 U.S.C. § 1746, hereby make the following declaration in support of an injunction enjoining Portland Public Schools' use of WI-FI:

1. I am a scientist researching the adverse health outcomes of electromagnetic radiation exposure, including from sources such as WI-FI networks and cell towers. Ironically, Portland Public Schools has decided against lucrative cell tower contracts based on health, yet uses inside schools WI-FI networks and laptops that can emit higher levels of electromagnetic radiation at user distances than do cell towers outside schools.

2. My Curriculum Vitae may be found below.

### **Guidelines**

3. The Federal Communication Commission (FCC) and the school WI-FI provider infer, respectively by their guidelines and assertions of product testing, that school WI-FI deployment is not harmful, provided that exposures to radio frequency (RF) radiation from the WI-FI remain below FCC guidelines. This is false.

4. FCC guidelines were established in 1991 by the ASTM-IEEE Committee chaired by microwave oven co-developer John Osepchuk, who is now retired from Raytheon. These guidelines apply only to an average exposure measured for a maximum of 30-minutes, and neither assure or infer safety for greater than 30-minute exposure durations. FCC guidelines apply only to 'thermal' exposure levels, and do not protect or claim to protect against biologic effects at subthermal or microthermal exposure levels.

5. The specific carrier frequency deployed by the Portland Public Schools for WI-FI is the same as that used by the microwave oven: 2.45 GHz. This frequency, which has a wavelength of approximately 12.24 cm or 4.8 inches, not only maximizes absorption-per-exposure in living tissues approximating dimensions of the human head and brain, but also has a specific harmonic resonance with the water molecule, for the intended purpose of agitating at the molecular level. Water molecule agitation occurs in all biological tissues that contain water exposed to 2.45 GHz, including to those exposed to WI-FI radiation, not only to those placed in

an oven and exposed to the higher exposure levels an oven produces.

6. Duration is a very potent contributing factor toward adverse health effects. Chronic exposure, a maximum (24/7) or near-maximum duration of constancy over hours per day, will increase adverse effects.

7. FCC guidelines are not safety standards, but rather mere guidelines. I am informed that FCC has neither authority over nor expertise in health matters.

8. There is a voluminous and ever growing number of primary, peer-reviewed scientific publications relevant to school WI-FI deployment, publications which conclude adverse health and biological effects below 'short-term, thermal-based' guidelines (see [www.bioinitiative.org](http://www.bioinitiative.org)). These studies are consistent in demonstrating harmful outcomes. A large and growing number of scientific, public health and medical organizations, and individuals therefrom, have publicly pronounced the need for stricter policy, including even to ban certain hazardous activities that deploy pulse-modulated microwave radiation. For these reasons it is unthinkable to introduce WI-FI microwave radiation into a school environment where young children and school employees must spend hours each day.

9. Public exposure standards and guidelines for microwave (MW) radiation, which radiation WI-FI deploys, differ by five orders of magnitude (10,000 times) around the world. The strictest standards are in Salzburg, Austria, and Liechtenstein, where the public exposure limit is  $0.1 \mu\text{W}/\text{cm}^2$  (microwatt per square centimeter). See short video (<http://videos.next-up.org/SfTv/Liechtenstein/AdoptsTheStandardOf06VmBioInitiative/09112008.html>). In Switzerland the limit is  $1.0 \mu\text{W}/\text{cm}^2$ . However, in both Canada and the United States the guideline, not even a 'standard' or 'limit,' for WI-FI frequencies is  $1,000 \mu\text{W}/\text{cm}^2$ ! FCC guidelines allow considerable radiation at the more hazardous microwave frequencies.

**Guidelines for various countries**

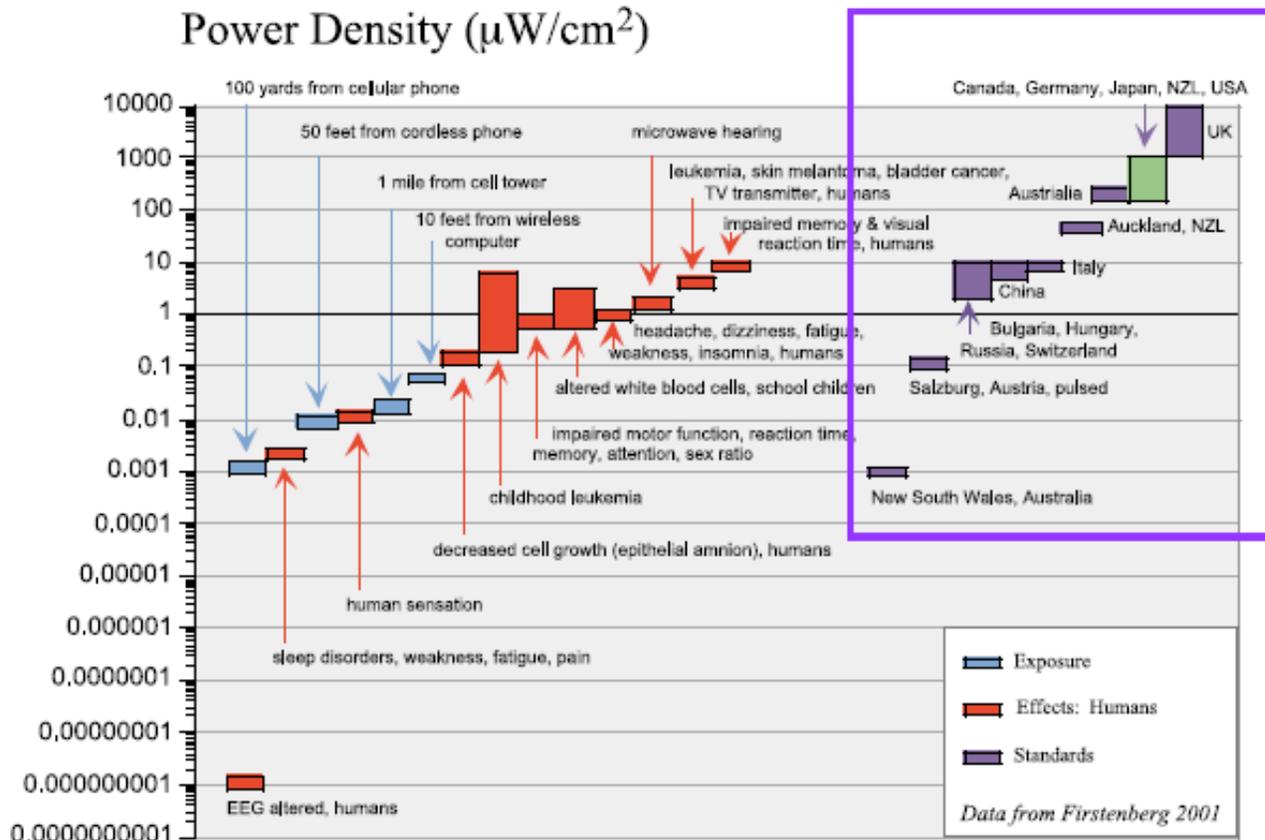


Figure 1. Guidelines, exposures and effects of radio frequency radiation at various power densities. Data from Firstenberg, A 2001 Radio Wave Packet, Cellular Phone Taskforce.

10. The Public Health Department Salzburg recommends for **all kindergartens and schools** in the region of Salzburg not to use WI-FI or DECT cordless phones, based on health grounds.

11. The FCC guideline is similar to the International Commission on Non-ionizing Radiation Protection (INCIRP) guideline, which is based on 30-minute exposure of public and 6-minute exposure of those occupationally exposed. Both are purported to protect against **heat occurrence in a 6-foot, 200-pound adult male**. The guideline for RF radiation is frequency-specific and ranges from 200 to 1,000  $\mu\text{W}/\text{cm}^2$  for the frequencies 0.3 MHz to 100 GHz, with the higher exposure ( $1000 \mu\text{W}/\text{cm}^2$ ) for frequencies between 1.5 and 100 GHz

(i.e. WI-FI range). The latter includes Portland school WI-FI frequencies. This guideline is based on the false assumptions that below these frequency-specific power densities there exists no heating of human tissues; and that if RF (including MW) radiation does not heat tissue, there is no harm.

12. Established adverse biological outcomes of RF and MW radiation exposure (power density) levels below the FCC guidelines include, without limitation, the increased permeability of the blood brain barrier, nerve damage, alterations in calcium efflux kinetics, increased DNA breakage, induced stress proteins, decreased immune-protection markers, and—at the whole-body level—cognitive and sleep impairments, headaches, dizziness, weakness, tinnitus, cardiac irregularities, hormonal and reproductive aberrations, skin dermatitis, reproductive problems, cancer and more.

13. According to Norbert Hankin, Chief EMF Scientist, US Environmental Protection Agency:

The U.S. Federal Communications Commission, (FCC's) exposure guidelines are considered protective of effects arising from a thermal mechanism but not from all possible mechanisms. Therefore, the generalization by many that the guidelines protect human beings from harm by any or all mechanisms is not justified. <http://www.protectschool.org/epa%20letter.pdf>.

14. ANSI/IEEE and ICNIRP may infer RF/MW radiation exposure can be 'safe' in the context of an exposure level too weak to produce a rise in body temperature, i.e., too weak to produce a 'thermal' effect, which is defined as 'Biological effects that result from heating of tissue by RF/MW energy.' See, *Questions and Answers about Biological Effects and Potential Hazards of Radiofrequency Electromagnet Fields*, FCC OET Bulletin 56, 4<sup>th</sup> Ed (1999) [http://transition.fcc.gov/Bureaus/Engineering\\_Technology/Documents/bulletins/oet56/oet56e4.pdf](http://transition.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet56/oet56e4.pdf). The claim is misleading and false. First, all RF/MW radiation deposits heat, and there is always at least microthermal temperature increase in exposed persons. Further, it is untrue that exposure levels less than 1,000  $\mu\text{W}/\text{cm}^2$  for radiation between 1.5 and 100 GHz cannot produce a thermal

increase; since body tissues vary in their water content, producing internal hot spots, and since wavelength also significantly influences absorption.

15. Moreover, there is no question that non-thermal or microthermal adverse biologic events do occur. These adverse outcomes of RF (including MW) exposure may be amplified per other contributing factors including duration of exposure, frequency/wavelength, complexity of the radiation microenvironment, and the recipient's vulnerability and susceptibility.

### **Guidelines Extrapolated**

16. As stated above, the current FCC guideline is based on flawed assumptions concerning a heating effect mechanism, set at 6 minutes for those occupationally exposed and 30 minutes for public exposure. A guideline based on a 30-minute (or 6-minute) exposure does not apply in the case of exposure likely to be 24/7 for decades. However, were this guideline extrapolated for long-term exposure, the exposure limit would decrease, approaching and exceeding guidelines and standards established by other countries (Table 1):

Table 1. FCC Guideline for public exposure to radio frequency radiation extrapolated for longer exposure and compared to Russia and Salzburg.

<b>Exposure Time</b>	<b>Time (hr)</b>	<b>Guideline (microW/cm<sup>2</sup>)</b>	<b>Comments</b>
30 minutes	0.5	<b>1000</b>	FCC Guideline, public exposure
60 minutes [casual computer use]	1	<b>500</b> =1000/2	extrapolation of FCC guideline for 1 hour exposure daily
daily computer use [6 hrs/day]	6	<b>83</b> =500/6	extrapolated FCC <i>daily</i> exposure limit
weekly computer use [6 hr/day x 5 d /wk]	30	<b>16.7</b> =500/30	extrapolated FCC <i>weekly</i> exposure limit
		<b>10</b>	<b>Russian Guideline</b>
monthly computer use [as above for 4 weeks]	120	<b>4.17</b> =500/120	extrapolated FCC <i>monthly</i> exposure limit
annual computer use [as above for 40 weeks]	1200	<b>0.42</b> =500/1200	extrapolated FCC <i>annual</i> exposure limit
		<b>0.1</b>	<b>Salzburg Guideline outdoor environments</b>
10-year computer use [as above for 10 years]	12,000	<b>0.04</b>	extrapolated FCC <i>10-year</i> exposure limit
		<b>0.01</b>	<b>Salzburg Guideline indoor environments</b>

17. For better protection of young, healthy *adults* who use a wireless computer daily for one year, their exposure should not exceed **0.42**  $\mu\text{W}/\text{cm}^2$  (a value similar to Salzburg). In fact, in 1999, the European Parliament had proposed a limit of **0.3**  $\mu\text{W}/\text{cm}^2$  for all of Europe. For better protection over **13 years'** wireless computer use, young, healthy adults' exposure should not exceed **0.03**  $\mu\text{W}/\text{cm}^2$ . (Thirteen years is the number of years that students in the public schools, K-12, will have to be exposed to WI-FI, if it is not banned.) These extrapolated exposure limits do not take into account other exposures from RF/MW sources such as infrastructural antennas, cell and cordless phones, Wii, 'smart' boards, smart meters and grids, microwave ovens, and the many other manmade, environmental exposures. Nor do they protect vulnerable persons, for whom one would have to extrapolate further, making WI-FI unfeasible.

18. FCC will tell you their guideline is not intended for long-term extrapolation in this manner. However, since FCC, EPA and FDA all lack a long-term guideline and have no Standard whatsoever; and given that the extrapolated values fit the scientific data for long-term health effects, the potential exposure limits of 0.42  $\mu\text{W}/\text{cm}^2$ , 0.03  $\mu\text{W}/\text{cm}^2$  and less for vulnerable persons respectively recommended above can help Portland officials to determine more appropriate exposure limits for schools until realistic guidelines and standards are established at the federal level for non-thermal or microthermal effects, for chronic and long-term durations of exposure, and for vulnerable subgroups and specific occupational and environmental conditions. Until such time as real standards exist, no further wireless systems or infrastructures should be imposed upon society for involuntary exposure.

19. Firstenberg (Firstenberg, A, 2001, Radio Wave Packet, President, Cellular Phone Taskforce, [http://www.goodhealthinfo.net/radiation/radio\\_wave\\_packet.pdf](http://www.goodhealthinfo.net/radiation/radio_wave_packet.pdf).) also compiled a list of studies (many more recent studies exist) showing adverse biological outcomes at RF/MW radiation exposure levels below FCC guidelines (Table 2):

Power Density ( $\mu\text{W}/\text{cm}^2$ )	Reported Biological Effects	References
0.000000000001	Altered genetic structure in E. Coli	Belyaev 1996
0.0000000001	Threshold of human sensitivity	Kositsky 2001
0.000000001	Altered EEG in human subjects	Bise 1978
0.0000000027	Growth stimulation in <i>Vicia fabus</i>	Brauer 1950
0.00000001	Effects on immune system in mice	Bundyuk 1994
0.00000002	Stimulation of ovulation in chickens	Kondra 1970
0.000005	Effect on cell growth in yeast	Grundler 1992
<b>0.00001</b>	<b>1/100 million<sup>th</sup> of FCC guidelines</b>	
0.00001	Conditioned "avoidance" reflex in rats	Kositsky 2001
0.000027	Premature aging of pine needles	Selga 1996
0.002	Sleep disorders, abnormal blood pressure, nervousness, weakness, fatigue, limb pain, joint pain, digestive problems, fewer schoolchildren promoted	Altpeter 1995, 1997
0.0027	Growth inhibition in <i>Vicia fabus</i>	Brauer 1950
0.0027 to 0.065	Smaller tree growth rings	Balodis 1996
<b>0.01</b>	<b>1/1000<sup>th</sup> of FCC guidelines</b>	
0.01	Human sensation	Kolbun 1987
0.06	Altered EEG, disturbed carbohydrate metabolism, enlarged adrenals, altered adrenal hormone levels, structural changes in liver, spleen, testes, and brain—in white rats and rabbits	Dumanskij 1974
0.06	Slowing of the heart, change in EEG in rabbits	Serkyuk, Reported in McRee 1980
0.1	Increase in melatonin in cows	Stark 1997
0.1 to 1.8	Decreased life span, impaired reproduction, structural and developmental abnormalities in duckweed plants	Magone 1996
0.13	Decreased cell growth (human epithelial amnion cells)	Kwee 1997
0.168	Irreversible sterility in mice	Magras 1997
0.2 to 8.0	Childhood leukemia near transmitters	Hocking 1996
0.3	Impaired motor function, reaction time, memory and attention of schoolchildren, and altered sex ratio of children (fewer boys)	Kolodynski 1996
0.6	Change in calcium ion efflux from brain tissue	Dutta 1986
0.6	Cardiac arrhythmias and sometimes cardiac arrest (frogs)	Frey 1968
4	Altered white blood cell activity in schoolchildren	Chiang 1989
1	Headache, dizziness, irritability, fatigue, weakness, insomnia, chest pain, difficulty breathing, indigestion (humans—occupational exposure)	Simonenko 1998
1	Stimulation of white cells in guinea pigs	Shandala 1978
<b>1</b>	<b>Within 16 feet (5 meters) of a Wi-Fi node in San Francisco</b>	<b>Maifeld 2007</b>
2	"Microwave hearing"—clicking, buzzing, chirping, hissing, or high-pitched tones	Frey 1963, 1969, 1971, 1973, 1988, Justeson 1979, Olsen 1980, Wieske 1963, Lin 1978
2.5	Breakdown of blood-brain barrier (used a digital cellular phone to provide the radiation)	Salford 1997
5	Leukemia, skin melanoma and bladder cancer near TV and FM transmitter	Dolk 1997
5	Biochemical and histological changes in liver, heart, kidney, and brain tissue	Belokrinitskiy 1982
<b>10</b>	<b>1% of FCC guideline</b>	
10	Damaged mitochondria, nucleus of cells in hippocampus of brain	Belokrinitskiy 1982a
10	Impaired memory and visual reaction time in people living near transmitters	Chiang 1989
10	Decreased size of litter, increased number of stillborns in mice	Il'Chevich (reported in McRee 1980)
10	Redistribution of metals in the lungs, brain, heart, liver, kidney, muscles, spleen, bones, skin, blood	Shutenko 1981
<b>1000</b>	<b>FCC Guideline, 6-minute occupational exposure and 30 minute public exposure based on heating</b>	

Table 2. Reported biological effects associated with radio frequency radiation. Data from Firstenberg. Shaded sections were not part of the original report.

20. Assuming, arguendo, that guidelines were protective of children, since the measurement of Portland Public School's laptops revealed in excess of **2.0  $\mu\text{W}/\text{cm}^2$** , a child could only be exposed for **41.7 hours**, or less than **42 school days** [=500/2.0/6 hours] according to Table 1. Similarly, the school's WI-FI routers measured as high as **1.65  $\mu\text{W}/\text{cm}^2$** , allowing for exposure of **50.5 school days** before exceeding guidelines [=500/1.65/6 hours]. However, there is no safe amount of radiation for children. Many peer-reviewed studies conclude harm at levels and durations below these levels, and to humans less vulnerable than schoolchildren, and under less coercive circumstances than school WI-FI. Per the many variables contributing to biologic effects, as stated earlier, there is no safe amount of radiation for children. The late physics Professor Neil Cherry PhD of Lincoln University, New Zealand, stated it best:

Electromagnetic fields and radiation damage DNA and enhance cell death rates and therefore they are a Ubiquitous Universal Genotoxic Carcinogen that enhances the rates of Cancer, Cardiac, Reproductive and Neurological disease and mortality in human populations. ***Therefore there is no safe threshold level. The only safe exposure level is zero, a position confirmed by dose-response trends in epidemiological studies.*** <http://www.neilcherry.com/>.

21. The Environmental Protection Agency has recommended that electromagnetic radiation (which includes WI-FI radiation) be classified as a 'probably human carcinogen.' United States Environmental Protection Agency, Evaluation of the Potential Carcinogenicity of Electromagnetic Fields, External Review Draft, No. EPA1600/6-901005B, October 1990. The following is a statement from Norbert Hankin PhD, EPA Environmental Scientist, December 19, 2000:

This \* \* \* should not be overlooked \* \* \* the potential for an impact by wireless communications technology on a child's educational process, i.e., by possibly affecting learning ability. [It] stems from recent studies involving short-term exposures that demonstrated subtle effects on brain functions, produced by low-intensity, pulse-modulated radiofrequency radiation \* \* \* [E]ven a slight degree of impairment of learning ability over years of exposure \* \* \* may negatively affect the quality of life that could be achieved by these individuals when adults.

22. If WI-FI is not turned off in the Portland schools children will be exposed over a thirteen-year period to 15,600 hours of so-called 'low-level' microwave radiation. The term 'low-level' is not accurate since the radiation received from WI-FI is billions to trillions of times higher than natural background levels at the same frequencies. Even the industry-funded INTERPHONE study showed that exposure of *adults* to cell phone radiation, for more than 1,640 hours over a ten-year period (which is 30 min per day of intermittent exposure for cell phone use v. 6 hours per day of constant exposure in a school with WI-FI) resulted in a 40 to 80 percent increased risk of brain tumors [<http://www.ncbi.nlm.nih.gov/pubmed/17636416>]. Cell phone MW radiation is very similar in frequency and nature to WI-FI MW radiation, though by frequency and duration not quite as harmful as that of WI-FI. Any effects that occur to adults are more likely to occur, and to occur more severely, in children from WI-FI. A constant, chronic exposure, such as WI-FI deploys, is likely to be more damaging than the intermittent duration of cell phone usage.

### **Studies**

23. Through my studies, I have personally seen and/or become aware of thousands of military (and therefore previously classified) documents as well as hundreds of Eastern European and Russian studies showing adverse health outcomes of radio frequency and microwave exposure. The results from these early studies are confirmed by more recent studies. Some of the studies that I may offer as evidence include the following. They are classified according to effects: neurological/sleep/learning/behavior/electrohypersensitivity; stress/hormones/blood-brain-barrier/immune system/enzymes; cardiac; reproduction; cancer/DNA damage/anti-oxidants/death and are ordered according to whether they are human studies; animal (*in vivo*) studies; or *in vitro* studies. Within each category the studies are in alphabetic order according to author. Attached as Addendum 'A,' are some of the studies on which I have based my

conclusions and opinions.

### **Electro-hyper-sensitivity**

24. A condition identified by Russian researchers many decades ago, Microwave Sickness, is generally referred to in the West as Electro-Hyper-Sensitivity (EHS). These names are sometimes used loosely as a catch-all for a variety of adverse health outcomes of RF/MW radiation, other than cancer and genotoxicity. But they should not be confused. In EHS, either a single, acute or a long-term, low-level exposure to electromagnetism, including RF/MW radiation, induces limbic sensitization, producing abnormal brainwave spikes, such that successive exposures amplify the person's responses to electromagnetism over time. By this mechanism, a person has difficulty functioning in a society with inescapable RF/MW radiation (and ELF or extremely low frequency fields). Again, this is to be distinguished from other temporary effects of RF/MW radiation in non-sensitized persons, and by way of other mechanisms. After EHS has been induced, symptoms are retriggered by ever lower levels of RF/MW radiation (and/or ELF fields). The phenomenon thus represents *injury* into an ongoing condition, and is not merely a set of isolated symptoms.

25. Because EHS is induced by exposure, there is a growing population worldwide that is adversely affected by lower-intensity electromagnetic frequencies. The World Health Organization (WHO) defines EHS as:

\* \* \* [a] phenomenon where individuals experience adverse health effects while using or being in the vicinity of devices emanating electric, magnetic, or electromagnetic fields (EMFs) \* \* \* EHS is real and sometimes a debilitating problem for the affected persons, while the level of EMF in their neighborhood is no greater than is encountered in normal living environments. Their exposures are generally several orders of magnitude under the limits in internationally accepted standards.

26. Symptoms of EHS include cognitive dysfunction (in memory, concentration, problem-solving); balance, dizziness and vertigo; facial flushing, skin rash; chest pressure, rapid heart rate; depression, anxiety, irritability, fatigue, poor sleep; body aches, headaches; ringing in the ear (tinnitus) and more. It is estimated that three percent of the adult population is severely affected and another 35 percent has moderate symptoms. Since prolonged exposure to RF/MW and ELF can result in sensitization and EHS, it is imperative that children's exposure to RF/MW radiation, such as from WI-FI, be minimized, particularly at school, given the many hours per year that attendance is required.

27. Mount Tabor Middle School, with a population of approximately 600 children, may already have 18 (3 percent of the school population) or more who are severely affected by RF/MW radiation and up to 210 children (35 percent) who have moderate symptoms. This does not include those children who are not specifically sensitized into EHS, but do have symptoms. These consider that the percentages of children with EHS would be the same as those in adult populations. Since the percentages might actually tend to be higher in children, these numbers are conservative. The Portland schools should look to identify those children, whether with EHS or not, who suffer symptoms in response to WI-FI. In so doing, administrators and teachers may, in then accommodating these students, find improved school work, cognitive and social functioning.

### **Children**

28. Children are more sensitive to environmental contaminants, and these include RF/MW radiation. The Stewart Report (2000) recommended that children not use cell phones except for emergencies. The cell phone exposes the head to pulse-modulated (PM) MW radiation. A wireless computer (WI-FI) exposes the entire upper body to PM MW radiation; and if one has the computer on one's lap, it exposes reproductive organs as well. Certainly this is not

desirable, especially for younger children and teenagers. For this reason adults need to discourage the use of wireless technology by children. That does not mean that students cannot go on the Internet. It simply means that access to the Internet needs to be through wires rather than through the air.

29. Children generally are very susceptible to MW radiation; as they do not have developed nervous or immune systems. As well, their skulls are thin and their bones (which are producing stem cells that make their immune systems and all other parts of their bodies) are soft, allowing microwaves to penetrate easily (Cherry 1999, <http://www.emfguru.org/EMF/genotoxic/Genotoxic-EMR-paper.htm>, scroll down to figure 45).

30. Some parents in Collingwood (Ontario, Canada), observed their children being exposed to WI-FI and returning from school with headaches, nausea, dizziness, difficulty concentrating, weakness, pressure in the head, and a racing or fluttering heart). These symptoms occur only in classrooms with WI-FI. They do not occur in portables that do not have WI-FI, and they do not occur in homes that do not have wireless technology.

31. The heart palpitations are perhaps the most serious: several students have experienced sudden cardiac arrest. The incidence of this in the Collingwood region seems abnormally high for a small community in Canada; and such symptoms should be extremely rare in children. One student was encouraged to have exploratory heart surgery. However, her parents provided her a MW-free environment at the end of the school year and her symptoms disappeared. No surgery was required.

32. Students and teachers at a private school in Collingwood were encouraged to do research on the best Internet technology for the school. They decided wired Internet access was superior to wireless for many reasons. They now use power line adaptors instead of WI-FI and are satisfied with the results.

## Direct Effect

33. I conducted a study that showed immediate and dramatic changes in both heart rate and heart rate variability associated with microwave exposure to a frequency of 2.4 GHz at levels well below (0.5 percent) federal guidelines ( $1000 \mu\text{W}/\text{cm}^2$ ). Havas *et al.*, *Provocation Study using Heart Rate Variability shows Radiation from 2.4 GHz Cordless Phone affects Autonomic Nervous System*, Eur J Oncol Library, Vol 5 at 28, <http://www.magdahavas.com/wordpress/wp-content/uploads/2010/10/Havas-HRV-Ramazzini1.pdf>; see also, video demonstrating the direct effects of cordless phones on heart rates, [http://www.youtube.com/watch?v=\\_EI9fZX4iww](http://www.youtube.com/watch?v=_EI9fZX4iww).

34.

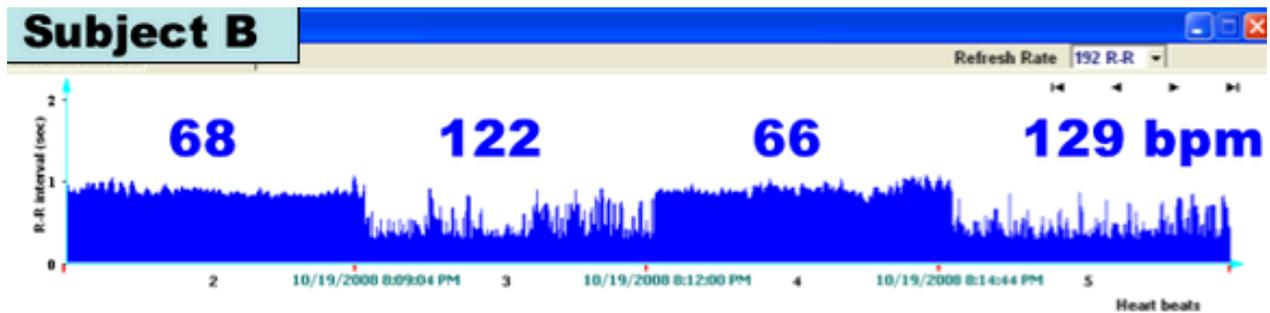


Figure 2. The sympathetic nervous system up regulated and the parasympathetic nervous system down regulated during exposure, which is the typical ‘flight-or-fight’ stress response. Feelings of anxiety as well as pain or pressure in the chest were associated with the rapid or irregular heart beat among some of the participants tested. <http://www.magdahavas.com/2010/10/21/new-study-radiation-from-cordless-phone-base-station-affects-the-heart/>.

35. The study documents that some individuals are hypersensitive to specific frequencies, and supports reports people make when they are exposed to RF/MW radiation. The reactions include heart irregularities, a rapid heart rate, up-regulation of the sympathetic nervous system, and down-regulation of the parasympathetic nervous system. These are biological effects and do not involve heating. One potential outcome is that the body goes into a fight-or-flight response when exposed to very low levels of MW radiation at the same frequency used for

WI-FI. Since children are generally more susceptible to environmental hazards than are adults, I would expect that children's hearts are generally more affected as well. *This video shows a WI-FI router directly affecting an adult heart rate: [www.youtube.com/watch?v=KN7VetsCR2I](http://www.youtube.com/watch?v=KN7VetsCR2I) !*

36. Heart irregularities, including out-of-hospital sudden cardiac arrest, are becoming increasingly common. At least some of these phenomena may be related to increasing exposure to RF/MW radiation from wireless devices and infrastructures, as documented for the first time in this study. A child must not be exposed to a technology that causes tachycardia or arrhythmia. Under certain circumstances with undiagnosed heart problems and with a demand on the heart (during exercise for example) the outcome can be deadly.

37. In addition to heart abnormalities, there is evidence of damage to sperm for males who use a laptop computer in WI-FI mode. WI-FI laptops can affect sperm motility and damage DNA. By allowing MW radiation through WI-FI in schools, adults may be adversely affecting children's ability to reproduce, as well as and the very genetics of future generations.

### **Removal of WI-FI**

38. Most people do not want to live near either cell phone towers or WI-FI antennas because of their MW radiation. Yet when WI-FI (wireless routers) are used inside buildings, many antennas are placed inside as well as outside the building. This is much worse with respect to exposure levels, duration and coercive occupational conditions, since building occupants are closer to the sources of emission and cannot remove themselves from the radiation.

39. Libraries in France are removing WI-FI because of the refusal of MW radiation by the scientific community, library employees and patrons.

40. The Vancouver School Board passed a resolution in January 2005 that prohibits construction of cellular antennas within 1,000 feet from school property.

41. Palm Beach, Florida, Los Angeles, California, and New Zealand have all prohibited cell base stations and antennas near schools by reason of safety, based on the fact that children are more susceptible to pulse-modulated MW radiation. Clearly if antennas do not

belong near schools, they certainly do not belong *inside* schools! The only route to safety is to have wired rather than wireless Internet.

42. The Superintendent of Education, Area 3 (Mr. John Dance) hired a consultant to measure MW exposure in two schools: Mountainview Elementary School (where the children were complaining of ill health) and Collingwood Collegiate Institute (see Muc Report at <http://www.magdahavas.com/wordpress/wp-content/uploads/2011/06/SCDSB-Feb-9-2011-B-F-Use-of-WI-FI.pdf> ). In the Mountainview School, levels above FCC guidelines were measured ( $1,342 \mu\text{W}/\text{cm}^2$  or  $1.342 \text{mW}/\text{cm}^2$ , NOTE: These are the same values expressed by different units); and this intensity of radiation was downplayed because it was close to the computer. Yet this is precisely where children sit and work for many hours per day: close to computers! Fifty percent of the locations measured in these two schools exceeded the radiation levels that affected adult hearts in our cardiac study. Testing at Collingwood Collegiate was after school hours; hence these measurements likely underestimate real-life exposure levels. The school with levels above federal guidelines is the same school where children were complaining of ill health!

### **Advisories**

43. Advisories to limit cell phone use have been issued by various countries and organizations including the United Kingdom (2000), Germany (2007), France, Russia, India, Belgium (2008) as well as the Toronto Board of Health and the Pittsburgh Cancer Institute (July 2008). While these advisories relate to cell phone use, they apply to WI-FI exposure as well since both use pulse-modulated microwave radiation. Boston public health physicians and scientists (1997) called for a ‘halt’ to pulse-modulated microwave radiation-based cell phone infrastructure based on the ‘biological plausibility of harm.’ WI-FI infrastructure and WI-FI-connected computers expose large parts of the body to this radiation especially when uploading or downloading information. Attached as Addendum ‘B,’ is the Boston Petition.

44. Attached, as Addendum ‘C,’ is a summary of 18 appeals or resolutions released by expert scientific groups around the world since the 1997 Boston Petition, regarding the biological and health effects of both low frequency electromagnetic fields (EMF) associated with electricity and RF electromagnetic radiation (EMR) generated by wireless devices. Anyone who reads these cannot be left with the illusion (or delusion) that this form of energy is without adverse biological and health consequences at levels well below existing guidelines. Children are particularly vulnerable. It is irresponsible of governments to maintain the status quo in light of thousands of studies that have been published and statements by these experts.

### **Conclusion**

45. It is important that children be exposed to the important education, life experiences, and social structures that public education offers, but they must not be risking their health to do so! Children must not be exposed to a constant background of pulsed microwave radiation from WI-Fi (or other sources) while at school. Most parents don’t have the option of home-schooling or finding a school free of WI-FI. Most teachers are discouraged to speak out against school board decisions, and most municipalities are unaware of the growing literature about the harmful effects of this technology. This needs to change. Municipalities must keep their public schools free of WI-FI.

46. Access to the Internet is possible through wires or through the air (wireless). The wireless option (WI-FI) exposes people in that environment to microwave radiation, which is a possible human carcinogen. Wired Internet is available at low cost. At least 3 options currently exist: Ethernet cable, which is present in many schools; fibre optics that offer fast reliable service but may be inappropriate in some districts; and the power line adaptor that is perhaps the most cost-effective option. This last option is faster, more secure, more energy efficient, less expensive than WI-FI and does not exposure people to microwave radiation. Under the

Americans with Disabilities Act, an accommodation is 'reasonable' based on minimal cost. And this 'accommodation' serves not one but all building occupants, so is highly valuable. Innocent children, who are wards of their parents and of the schools, deserve every legal protection from adults who make unwise decisions. Adult decision-makers are both morally responsible for their actions and should also be held legally liable where harm occurs and since wired alternatives to WI-FI are available.

47. Portland Public Schools use of WI-FI will expose young children (and their teachers) to microwave radiation for 6 hours each school day, 5 days a week, for 40 weeks each year. This exposure will be 1200 hours each year, year after year. Never in history have children been exposed to this much microwave radiation. Indeed, if I wanted to conduct such human experiments at Trent University using these levels and durations of exposure to microwave radiation, they would be deemed unethical and I would be denied permission to proceed!

48. In my own work, I use wired Internet access at home and, whenever possible, I use wired Internet access at Trent University, although wireless is available. So we are not limiting access to the Internet if we use wired connections; with wired connections, we are simply flowing the radiation through wires rather than through the air and through the bodies that are in the area.

49. The two most important environments in a child's life are the home (especially the bedroom) and the school. For this reason it is imperative that these environments remain as electromagnetically clean as possible, and therefore as free as possible from MW radiation.

50. It is hard to imagine that Portland parents are required to give permission with signed consent forms for student bus trips and photographs but are not consulted and asked for permission to expose their children to pulse-modulated MW radiation.

51. Based on the evidence that leading scientists have assembled in the past decade, if Portland Public Schools continues to use wireless internet (WI-FI), some students and teachers in its schools (an estimated 3% to 35% of the adult population and possibly a higher percentage of students) will become ill. Heart problems may be aggravated, other internal and external body injuries may be caused, and various pre-existing medical conditions may be worsened. Children and adults with undiagnosed, undetected heart problems may die. All students, teachers and administrators will be affected to some degree, even if their symptoms are not consciously attributed to the exposure or positively diagnosed. Portland Public Schools must be willing to make a decision that protects and does not harm the health and lives of those for whom it is responsible. It should not leave the Board open to legal action from families of children with heart and other MW radiation-related problems. There may be class-action lawsuits; the Board's decisions may jeopardize the long-term financial sustainability of the school board.

52. Submitted herewith as Addendum 'D' is a KeyNote presentation that I will use during my testimony.

53. I will receive \$250 per hour for my time (plus expenses) from this date forward and that money will be used to support research in this area.

54. I reserve the right to amend to add new relevant studies as they may arise and pending analysis, additional testing, and recently received voluminous discovery.

55. The Internet is an important learning device that should not be taken away. I simply urge that its access be made available through wires rather than WI-FI. Surely when it comes to threats of serious or irreversible damage to the health of students and teachers, not to mention privacy matters where students deserve in their formative years freedom from surveillance and hackers, using wired systems is of minimal cost and not too much to ask. There is no place for wireless Internet in schools—especially since wired Internet access is safer, faster, and more secure than wireless.

Dated this 21st day of December, 201

A handwritten signature in black ink, appearing to read 'M. Havas', with a long horizontal stroke extending to the right.

---

DR. MAGDA HAVAS, B.Sc., Ph.D.  
Associate Professor  
Environmental & Resource Studies  
Trent University

## Curriculum Vitae

# Magda Havas, B.Sc., Ph.D.

## 1 BIOGRAPHICAL INFORMATION

### 1.1 Contact Information

University Address: Environmental and Resource Studies,  
Trent University,

**Peterborough, Ontario, Canada, K9J 7B8**

Phone: (705) 748-1011 ext 7882  
FAX: (705) 748-1569  
email: [mhavas@trentu.ca](mailto:mhavas@trentu.ca)  
websites: [www.magdahavas.com](http://www.magdahavas.com) (general)  
[www.magdahavas.org](http://www.magdahavas.org) (academic)

### 1.2 Degrees

B.Sc. Honors Biology, University of Toronto, 1971-1975

Ph.D. Department of Botany & Institute for Environmental Sciences, University  
of Toronto, 1975-1980

### 1.3 Awards, Scholarships, Fellowships

#### *Academic*

NSERC University Research Fellowship, 1983-1988

NSERC NATO Postdoctoral Fellowship, 1981-1983

Ann Wintercorbyn Prize, 1981, Department of Botany, University of Toronto

NRC Graduate Scholarship, 1975-1977, 1978-1979

Gulf Oil Scholarship, 1975

Bell Canada Scholarship, 1975

#### *Nominations for . . .*

Symons Award for Excellent in Teaching: 2002, 2003, 2004, 2005, 2010

Award for Educational Leadership and Innovation: 2010-11

### *Non-Academic*

Certificate of Appreciation, Department of Veterans Affairs, USA in collaboration with Michael E. DeBakey VA Medical Center, Texas, March 31, 2008.

Certificate of Appreciation, Uxbridge Community Care, May, 1989.

## **2 ACADEMIC HISTORY**

### **Employment and Positions**

2002-present	Member, Centre for Health Studies [originally Institute for Health Studies], Trent University, Peterborough, Ontario.
1995-7 & 1992-4	Board of Governors, Trent University, Peterborough, Ontario.
July 1993-1994	Senate, Trent University, Peterborough, Ontario.
Nov 1990-pres	Cross Appointed to Biology Department, Trent University, Peterborough, Ontario.
Aug 1989-pres	Associate Professor, Science Education and Environmental and Resource Studies, Trent University, Peterborough, Ontario.
June 1985-1989	Cross Appointed to Faculty of Forestry, University of Toronto, Toronto, Ontario, Canada.
Sept 1983-1988	NSERC University Research Follow/Assistant Professor, Institute for Environmental Studies, University of Toronto, Toronto, Canada.
Feb 1981-1983	NSERC NATO Postdoctoral Fellow, Section of Ecology and Systematics, Cornell University, Ithaca, New York, USA, in laboratory of Professor G.E. Likens.

## **3 PUBLICATIONS**

<b>Year</b>	<b>#</b>	<b>Reference</b>	<b>Type</b>
2011	134	<b>Havas, M.</b> , D. Stetzer, E. Kelley, R. Frederick, and S. Symington. Compact Fluorescent Light Bulbs, Electromagnetic Emissions, and Health. <i>Science of the Total Environment</i> (accepted with minor revisions).	R

- [8] 133 **Havas, M.** Open Letter to the Honourable Aglukkaq (Federal Minister of Health) and Ms Pieteron (Director-General, Environmental and Radiation Health Sciences Directorate, Health Canada needs to issue warning about wireless baby monitors. October 24, 2011, 6 pp L
- 132 **Havas, M.** Open Letter to Peterborough Mayor Bennett and City Councilors in response to “City council disagrees with cell tower site,” Peterborough Examiner, October 12, 2011. L
- 131 **Havas, M.** and D. Colling. Wind Turbines Make Waves: Why some residents near wind turbines become ill? **Bulletin of Science, Technology & Society, September 2011.** R
- 130 **Havas, M.** School Boards Gaggling Dissent over WiFi, Peterborough, Peterborough Examiner, June 6 (?), 2011. L
- 129 **Havas, M.** Report on Smart Meters Request for input regarding Smart Meters, California Council on Science and Technology (CCST), October 12, 2010, 6 pp G
- 128 **Havas, M.** September 2011 Update regarding: Veronica Ciandre, 2 Regal Road, Toronto, Ontario, September 30, 2011, 2 pp ET
- 127 **Havas, M.** August 2011 Update regarding: Veronica Ciandre, 2 Regal Road, Toronto, Ontario, August 25, 2011, 5 pp ET
- 2010 126 **Havas, M.** Expert Report Re: 411 Saint-Francis Blvd, Chateauguay, Quebec, Rogers vs City of Chateauguay, December 15, 2010, 18 pp. ET
- [6] 125 **Havas, M., J. Marrongelle, B. Pollner, E. Kelley, C. Rees, and L. Tully.** 2010. Provocation study using heart rate variability shows microwave radiation from 2.4 GHz cordless phone affects autonomic nervous system. *European Journal of Oncology, Vol. 2:273-300.* R
- 124 **Havas, M.** Open Letter to Medical Officer of Health about WiFi in Schools. September 29, 2010. L
- 123 **Havas, M.** Re: Veronica Ciandre, 2 Regal Road, Toronto, Ontario, Landlord and Tenant Board Hearing, May10, 2010, 5 pp. ET
- 122 **Havas, M.** Urgent need to revise Safety Code 6 as it does not protect the health of Canadians. Expert Testimony to the House of Commons Standing Committee on Health regarding Radio Frequency Radiation and Health, April 20, 2010, 8 pp. ET
- 121 **Havas, M.** Comparison of Industry Canada measurements on February 18, 2010 and those take by Dr. Havas on February 13, 2010 at 2 Regal Road, Toronto, March 16, 2010, 3 pp, T
- 2009 120 **Havas, M., 2009.** Open Letter to Parents, Teachers, School Boards Regarding Wi-Fi Networks in Schools, 2 pp. L

- [3] 119 **Havas, M.** 2009. Letter to the Editor, Toronto Star, February 1, 2009 response to “Jury’s out on link between migraines, fluorescent tubes.” by Joe Schwarcz. L
- 118 **Havas, M.** 2009. Breast Cancer and Occupational Exposure to Electromagnetic Fields. Response to Request from Heidi Evelyn, Tribunal Counsel Office, Workplace Safety and Insurance Appeals Tribunal, Jan 7&9, 2009; February 9, 2009, 42 pp. ET
- 2008 117 **Havas, M.** 2008. Are Cell Phones Safe? An Ounce. Prevent Cancer Now. Fall 2008, page 1 P
- [11] 116 **Havas, M.** 2008. Breast Cancer and Occupational Exposure to Electromagnetic Fields. Report to the Workplace Safety and Insurance Appeals Tribunal. Expert Testimony, November 18, 2008, 20 pp. ET
- 115 **Havas, M.** 2008. Letter to the Editor, Walrus Magazine, comment on Cellphone Games, September 11, 2008 article by Melinda Wenner. L
- 114 **Havas, M.** 2008. Letter to the Editor, BBC News, UK, RE: The bulb hoarders. L  
[http://news.bbc.co.uk/2/hi/uk\\_news/magazine/7480958.stm](http://news.bbc.co.uk/2/hi/uk_news/magazine/7480958.stm)
- 113 **Havas, M.** 2008. Radio Frequency Readings on Triangle Mt., Colwood, BC, June 25, 2008. 4 pp., Appendix to “Independence of Advisory Bodies,” Environmental Petition, Auditor General of Canada, submitted by Sharon and Dennis Noble, Colwood, BC. G/T
- 112 Rees, C. and **M. Havas.** 2008. Microwave Radiation: The shadow side of the wireless revolution. Post Event Answer and Questions. Commonwealth Club, March 19, 2008. book
- 111 **Havas, M.** 2008. Request that first generation DECT Phones be Banned in Canada, Environment Petition, Auditor General of Canada, 15 pp. G/T
- 110 **Havas, M.** and T. Hutchinson. 2008. Environmental and Health Effects of Compact Fluorescent Lights. Environment Petition, Auditor General of Canada, 15 pp. G/T
- 109 **Havas, M.** 2008. Dirty Electricity Elevates Blood Sugar Among Electrically Sensitive Diabetics and May Explain Brittle Diabetes. Electromagnetic Biology and Medicine, Vol. 27( 2), pp. 135-146. R
- 108 **Havas, M.** and A. Olstad. 2008. Power quality affects teacher wellbeing and student behavior in three Minnesota Schools. Science of the Total Environment, Volume 402, Issues 2-3, 1 September 2008, pp. 157-162 R
- 107 **Havas, M.** 2008. Health Concerns associated with Energy Efficient Lighting and their Electromagnetic Emissions. 11 pages. *Scientific Committee on Emerging and Newly Identified* G/T

- Health Risks (SCENIHR)*. Request for an opinion on “Light Sensitivity”, Sanco-Sc1-Secretariat@ec.europa.eu
- 2007 106 **Havas, M.** 2007. “Stray Voltage” Ground Current Problems, Prepared for Ontario Energy Board Panel on Stray Voltage, November 22, 2007. G/T
- [4] 105 **Havas, M.** 2007. Analysis of Health and Environmental Effects of Proposed San Francisco Earthlink Wi-Fi Network, Commissioned by SNAFU (San Francisco Neighborhood Antenna Free Union) and presented to Board of Supervisors, City and Country of San Francisco, 51 pp. NR
- 104 **Havas, M.** 2007. Supplemental Evidence by Magda Havas, Alberta Energy and Utilities Board Application No. 1478550 by Altalink Management Ltd. (“Altalink”); Proposed Routing for 500 kV Transmission System Reinforcement Project in the Edmonton–Calgary area. May 2007, 7 pp. ET
- 103 **Havas, M.** 2007. Expert Testimony by Magda Havas, Alberta Energy and Utilities Board Application No. 1478550 by Altalink Management Ltd. (“Altalink”); Proposed Routing for 500 kV Transmission System Reinforcement Project in the Edmonton–Calgary area. February 2007, 40 pp. ET
- 2006 102 **Havas, M.** 2006. Electromagnetic Hypersensitivity: Biological effects of dirty electricity with emphasis on diabetes and multiple sclerosis. *Electromagnetic Biology and Medicine*, 25: 259-268, 2006 R
- [8] 101 **Havas, M.** 2006. *Dirty Electricity: An Invisible Pollutant in Schools*. Feature Article for Forum Magazine, OSSTF, Fall, 2006. P
- 100 **Havas, M.** 2006. *Response to: Evaluation of the Stetzer Filters*. Open Letter to Health Canada. October 2006. 5 pp. L
- 99 **Anon.** 2006. *Ground Current Pollution Act, 2006*. Mpp2006.080.e5-CW, Private Member’s Bill, First Reading October 3, 2006. *Helped draft Private Member’s Bill on Ground Current Pollution*. G
- 98 **Havas, M.** and D. Stetzer. 2006. *Electromagnetic Pollution and your Health*. Centre for Health Studies, Trent University, Peterborough, ON September 2006. NR
- 97 **Havas, M.** and M. Bowling. 2006. *Electromagnetic Measurements at Richmond Fire Hall #7, March 8, 2006*. Final Report to Richmond Fire Fighters. 8 pages. T
- 96 **Havas, M.** 2006. Open letter to Mayor and Aldermen, Milwaukee Wisconsin. Health Concerns of WiFi. L
- 95 **Havas, M.** 2006. *Response to Linda Erdreich, Ph.D., Exponent Inc., Tsawwassen Residents Against Higher Voltage Overhead Lines (TRAHVOL)*, British Columbia Transmission Corporation ET

- (“BCTC”) Certificate of Public Convenience and Necessity Application for the Vancouver Island Transmission Reinforcement Project.
- 2005 94 **Havas, M.** 2005. *Response to BCTC (British Columbia Transmission Corporation) information request to TRAHVOL*, British Columbia Transmission Corporation (“BCTC”) Certificate of Public Convenience and Necessity Application for the Vancouver Island Transmission Reinforcement Project, 20 pages, November 10, 2005. ET
- [8] 93 **Havas, M.** 2005. *Response to BCUC (British Columbia Utilities Commission) information request to TRAHVOL*, British Columbia Transmission Corporation (“BCTC”) Certificate of Public Convenience and Necessity Application for the Vancouver Island Transmission Reinforcement Project, 5 pages, November 7, 2005. ET
- 92 **Havas, M.** 2005. *Studies point to concerns about radiation from towers*. Salisbury Post, Salisbury, NC, October 20, 2005. P
- 91 **Havas, M.** *Tsawwassen Residents Against Higher Voltage Overhead Lines (TRAHVOL)*, British Columbia Transmission Corporation (“BCTC”) Certificate of Public Convenience and Necessity Application for the Vancouver Island Transmission Reinforcement Project, Expert Testimony, October 17, 2005. ET
- 90 **Havas, M.** *Health Effects Associated with Radio Frequency Radiation*. Quasi-Judicial Hearing for Z-01-05, Mt. Ulla FM Transmitter. Salisbury, North Carolina, October 13, 2005. ET
- 89 Stetzer, D. and **M. Havas**. High frequency electrical pollution in the homes of residents in South Bend, Mishawaka and Roseland Indiana, Mary 2005. 5 pages plus waveforms. T
- 88 IAFF, Position on the Health Effects from Radio Frequency/Microwave (RF/MW) Radiation in Fire Department Facilities from Base Stations for Antennas and Towers for the Conduction of Cell Phone Transmissions. International Association of Fire Fighters, Division of Occupational Health, Safety and Medicine. 29 pp, March 2005. [**M Havas** contributed to this report] T
- 87 **Havas, M.** Letter: Office of the Secretary, Federal Communication Commission, Washington DC, Proceeding WT Docket No. 04-356 and 02-353. 3 pages, January 24, 2005. L
- 2004 86 **Havas, M.** 2004. *Putting Cell Phone Antennas near schools is too risky*. Washington Post, Fairfax, December 30, 2004, page VA10. P
- [9] 85 **Havas, M.** 2004. *Don’t put cell towers on school property*. Northern Virginia Journal, November 16, 2004, page 12. P
- 84 **Havas, M.** and D. Stetzer. *Dirty electricity and electrical* NR

- hypersensitivity: Five case studies.* World Health Organization Workshop on Electricity Hypersensitivity, Prague, Czech Republic, 25-26 October, 2004.
- 83 **Havas, M.,** S. Shum, and R. Dhalla. *Passenger exposure to magnetic fields on go-trains and on buses, streetcars, and subways run by the Toronto Transit Commission, Toronto, Canada.* Biological Effects of EMFs, 3<sup>rd</sup> International Workshop, Kos, Greece, 4-8 October, 2004, pp.1065-1071. NR
- 82 **Havas, M** and J. Mackay. *Street level magnetic fields within the City of Kingston, Ontario, Canada.* Biological Effects of EMFs, 3<sup>rd</sup> International Workshop, Kos, Greece, 4-8 October, 2004, pp. 318-325. NR
- 81 **Havas, M.,** M. Illiatovitch, and C. Proctor. *Teacher and student response to the removal of dirty electricity by the Graham/Stetzer filter at Willow Wood School in Toronto, Canada.* Biological Effects of EMFs, 3<sup>rd</sup> International Workshop, Kos, Greece, 4-8 October, 2004, pp. 311-317. NR
- 80 **Havas, M.** and D. Stetzer. *Graham/Stetzer filters improve power quality in homes and schools, reduce blood sugar levels in diabetics, multiple sclerosis symptoms, and headaches.* International Scientific Conference on Childhood Leukaemia, London, 6<sup>th</sup>-10<sup>th</sup> September, 2004. NR
- 79 **Havas, M.** *Biological Effects of Low Frequency Electric and Magnetic Fields.* Derek Clements-Croome (Ed.). 2002. Electromagnetism and Health, Taylor & Francis Books, Ltd., London, England. 25 pp. C
- 78 **Havas, M.** *Cleaner power keeps schools healthy.* View from Trent, Peterborough Examiner, Peterborough, ON, February 12, 2004 P
- 2003 77 **Havas, M.** *Health Effects Associated with Power Lines.* Expert Testimony presented at Sumas 2 Hearing in Abbotsford B.C. July 2003. ET
- 2002 76 Woodfine, D.G., **M. Havas,** and J. Acreman. 2002. *Nickel and copper tolerance of phytoplankton isolated from a recovering lake near Sudbury, Canada.* Geochemistry, Exploration, Environment, Analysis, Vol. 2 203-207 R
- [6] 75 **Havas, M.** *Intensity of Electric and Magnetic Fields from Power Lines within the Business District of Sixty Ontario Communities.* Science of the Total Environment 298:183-206. R
- 74 **Havas, M.** *Cell phone headaches, cell tower blues.* View from Trent, Peterborough Examiner, August 9, 2002. P
- 73 **Havas, M.** *Wired and Wireless Energy. An overview of health concerns and a call for action.* Presented to the Environmental Committee on Sustainable Development. House of Commons, ET

- Ottawa, ON. May 21, 2002
- 72 **Havas, M.** *Corporate support can weaken foundation.* View from Trent, Peterborough Examiner, April 12, 2002. P
- 71 **Havas, M.** *Children at risk in hospital from transformer magnetic fields.* The Act, Australia. P
- 2001 70 **Havas, M.** Review of Expert Document *The Workshop Report: Review of Electric and Magnetic Fields (EMFs)*, produced by the Manitoba Clean Environment Commission, March 2001., Winnipeg, Manitoba, letter September 2001. ET
- [5] 69 **Havas, M.** *Electricity's role in cancer an eye opener.* View from Trent, Peterborough Examiner, October 12, 2001 P
- 68 **Havas, M.** *Electromagnetic fields linked to childhood cancer according to two new studies.* View from Trent, Peterborough Examiner, March 9, 2001 P
- 67 **Havas, M.** *Rebuttle, Peter Valberg, Mendota Heights, Public Hearing on Transmission Lines, April 2001.* ET
- 66 **Havas, M.** *Expert Testimony, Xcel Energy, Mendota Heights, Public Hearing on Transmission Lines, April 2001.* ET
- 2000 65 **Havas, M.** and D. Hanna. *Magnetic Fields in Peterborough Schools: the findings and strategies to reduce exposure.* Presented to the Peterborough-Kawartha-Pine Ridge School Board, Health and Safety Committee, October 2000. T
- [4] 64 **Havas, M.** Biological effects of non-ionizing electromagnetic energy: A critical review of the reports by the US National Research Council and the US National Institute of Environmental Health Sciences as they relate to the broad realm of EMF bioeffects. *Environmental Reviews* 8:173-253. R
- 63 **Havas, M.** *Valley of Desolation, no vacation paradise.* View from Trent, Peterborough Examiner, July 28, 2000. P
- 62 Woodfine, D.G., R. Seth, D. Mackay, and **M. Havas.** Simulating the response of metal contaminated lakes to reductions in atmospheric loading using a modified QWASI model. *Chemosphere* 41:1377-1388. R
- 1999 61 **Havas, M.** *People learn in different ways. How do you learn? Answer in simple test.* View from Trent, Peterborough Examiner, August 27 1999 P
- 1998 60 **Havas, M.** *Prof takes aim at academic stereotype.* View from Trent, Peterborough Examiner, November 27, 1998. P
- 1996 59 **Havas, M.** *University Accountability.* View from Trent, Peterborough Examiner, April 1996 P
- 1995 58 **Havas, M.,** D.G. Woodfine, P. Lutz, K. Yung, H.J. MacIsaac, and T.C. Hutchinson. *Biological Recovery of Two Previously Acidified, Metal-Contaminated Lakes near*

- Sudbury Ontario, Canada. *Water, Air and Soil Pollut.* 85(2): 791-796
- [7] 57 **Havas, M.** and B. Rosseland. Response of Zooplankton, Benthos, and Fishes to Acidification: An Overview. [Invited Paper] *Water, Air and Soil Pollut.* 85(1): 51-62. R
- 56 **Havas, M.** and E. Advokaat. Can Sodium Regulation be used to Predict the Relative Acid-Sensitivity of Various Life-stages and Different Species of Aquatic Fauna? *Water, Air and Soil Pollut.* 85(2): 865-870. R
- 55 Woodfine, D.G. and **M. Havas.** Pathways of Chemical Recovery in Acidified, Metal-Contaminated Lakes near Sudbury, Ontario, Canada. *Water, Air and Soil Pollut.* 8 797-803. R
- 54 Regoczei, S. and **M. Havas.** Group Problem Solving: If we could save the earth, how would that be done? Proc. 4th Can. Conf. on Foundations and Applications of General Science Theory. Knowledge Tools for a Sustainable Civilization. Ryerson Polytechnical University, Toronto, June 8-10, 1995, 9 pp NR
- 53 Loney, R.K., P. Northrop, and **M. Havas.** Enviro Mystery Revisited. Eighth Instructional Show & Tell for Ontario Universities and Colleges, May 29, 1995, University of Guelph, Guelph, Ontario. NR
- 52 **Havas, M.** Aluminum. In: Paehlke, R. (Ed.) Environmental Review NR
- 1994 51 **Havas, M.** Recovery and Rehabilitation of Large-Scale Ecosystems: Rapporteurs Report. In: Rapport, D. and P. Calow. Evaluating and Monitoring the Health of Large-Scale Ecosystems, NATO Advanced Research Workshop, Chateau Montebello, Quebec, Canada, October 10-15, 1993, 10 pages. R
- [3] 50 Brakke, D., J.P. Baker, J. Bohmer, A Hartmann, **M Havas,** A. Jenkins, C. Kelly, S.J. Ormerod, T. Paces, R Putz, B.O. Rosseland, D. Schindler, and H. Segner. How does Acidification affect Biota and What are the influences of Biota on the Process of Acidification? In: Dahlem Workshop on Acidification of Freshwater Ecosystems, Berlin, September 27 to October 2, 1992. R
- 49 Hutchinson, T.C. and **M. Havas.** Chapter 22. Ecological Impacts of Acid Deposition on Natural Ecosystems. In: Calvert, J. (Ed.) *The Chemistry of the Atmosphere: Its Impact on Global Change*, American Chemical Society, pp. 297-315. C
- 1993 48 Woodfine, D.G., D. Mackay, and **M. Havas.** Using QWASI NR

- Model to Predict Fate of Copper and Nickel in Two Metal Contaminated Lakes near Coniston, Ontario. In: Nriagu, J.O. and R.J. Allan (eds.), International Conference, Heavy Metals in the Environment (Vol.2), Toronto, September 1993, pp 379-382.
- 47 Havas, M. OMB Hearing regarding Eutrophication of the Indian River, Township of Dummer, Warsaw, Ontario, December 6, 1993. L
- [3] 46 **Havas, M.** Environmental Education: Changing Role of the University. Seminario Internacional Sobre El Ambiente, Toluca de Lerdo, Estado de Mexico, February 22-25, 1993, 16 pp. NR
- 1992 45 **Havas, M.** (Ed.) Packaging, *KEYnotes* 2(2): 16 pp [these newsletters are distributed to every school in Canada, approximately 15,000 copies]. R
- [2] 44 **Havas, M.** (Ed.), Feeding the World's Population, Part 1: Distribution of Food, *KEYnotes* 2(1): 16 pp. R
- 1991 43 **Havas, M.** (Ed.), Environmental Report Card, *KEYnotes* 1(2): 12 pp. R
- 1990 42 **Havas, M.** Recovery of Acidified and Metal-Contaminated Lakes in Canada. In: Norton, S.A., S.E. Lindberg, and A.L. Page (Eds.), Advances in Environmental Science, Acid Precipitation Series, Volume 4, Soils, Aquatic Processes and Lake Acidification, Springer-Verlag, N.Y., pp. 187-205 C
- [5] 41 **Havas, M.** 1990. Chemical Indicators. Environmental Monitoring and Assessment 15:287. R
- 40 Stokes, P., **M Havas**, and T. Brydges. 1990. Public participation and volunteer help in monitoring programs: An assessment. Environmental Monitoring and Assessment 15:225-229. R
- 39 Creed, I.F., **M. Havas**, and C.G. Trick. 1990. Effects of arsenate on the growth of nitrogen- and phosphorus-limited *Chlorella vulgaris* (Chlorophyceae) isolates. J. Phycology 26(6): R
- 38 Loney, R.K. and **M. Havas**. Enviro Mystery: An Educational Computer Game, Third Instructional Show & Tell for Ontario Universities and Colleges, May 29-29, 1990, University of Guelph, Guelph, Ontario. NR
- 1989 37 **Havas, M.** The State of Our Forests. Harrowsmith, December. P
- [4] 36 **Havas, M.** Teeside and Uttersville, Uxbridge Times Journal, Uxbridge, Ontario. P
- 35 **Havas, M.** A Tale of Two Towns, Back Forty, Lindsay, P

- Ontario.
- 34 Adriano, D.C. and **M. Havas** (Eds.), Advances in Environmental Sciences, Acid Precipitation Series, Volume 1: Case Studies. Springer-Verlag, N.Y. 330 pp. B
- 1988 33 **Havas, M.** and T.C. Hutchinson. Tree Watch: Questionnaire on Tree Decline in Canada. Harrowsmith, August. P
- [4] 32 **Havas, M.**, T. Pajos, R. Loney, and V. Timmer. Effect of Aluminum, Drought and Low pH on Sugar Maple Seedlings, Ontario Ministry of the Environment, Final Report. G
- 31 **Havas, M.**, R. Loney, M.G. Scott, and T.C. Hutchinson. Needle Chemistry as an Early Warning Indicator of Decline in Balsam Fir, Red Spruce, and Norway Spruce. Forest Decline Symposium, October 20-21, 1988, Rochester, N.Y. A
- 30 Loney, R. and **M. Havas**. Influence of Climate and Air Pollution on Decline of Sugar Maple in Eastern North America. Forest Decline Symposium, October 20-21, 1988, Rochester, N.Y. A
- 1987 29 **Havas, M.** and T.C. Hutchinson. Aquatic Macrophytes as Bioindicators of Metal Pollution, Smoking Hills, N.W.T., Intern. Conf. Heavy Metals. September, 1987, New Orleans. NR
- [3] 28 **Havas, M.** Does hemoglobin enhance the acid-tolerance of *Daphnia*? *Annl. Soc. R. Zool. Belg.* 117, 151-164. NR
- 27 Creed, I.F., **M. Havas**, and C.G. Trick. 1987. Mechanisms of arsenate tolerance in the green alga, *Chlorella vulgaris*. Abstract. American Society for Limnology and Oceanography, University of Wisconsin-Madison, Madison, Wisconsin, June 14-18, 1987 A
- 1986 26 **Havas, M.** A hematoxylin staining technique to locate sites of aluminum binding in aquatic plants and animals. *Water, Air, and Soil Pollution* 30:735-741. R
- [8] 25 Hutchinson, T.C. and **M. Havas**. Recovery of previously acidified lakes near Coniston, Canada following reductions in atmospheric sulphur and metal emissions. *Water, Air, and Soil Pollution* 28:319-333. R
- 24 **Havas, M.** and J. F. Jaworski (Eds.), Aluminum in the Canadian Environment, National Research Council of Canada, Associate Committee on Scientific Criteria for Environmental Quality, 331 pp. B
- 23 **Havas, M.** Effects of acid deposition on aquatic ecosystems. In: Stern, A. (Ed.), Air Pollution, Volume VI, Academic Press, pp 351-389 . C
- 22 **Havas, M.** Aluminum chemistry of inland waters. In: C

- Havas, M. and J.F.Jaworski (Eds.), Aluminum in the Canadian Environment, National Research Council of Canada, Associate Committee on Scientific Criteria for Environmental Quality, pp 51-77.
- 21 **Havas, M.** Effects of aluminum on aquatic biota. In: Havas, M.and J. F. Jaworski (Eds.), Aluminum in the Canadian Environment, National Research Council of Canada, Associate Committee on Scientific Criteria for Environmental Quality, pp 79-127. C
- 20 **Havas, M.** Groundwater quality and acid-sensitivity in south-central Ontario. Contract No. 1325, Health and Welfare Canada, 176 pp. G
- 19 **Havas, M.** and G.E. Likens. Aluminum uptake and toxicity to *Daphnia magna* in soft water at low pH. In: Geen, G.H. and K.L. Woodward (Eds.), Proceedings of the Eleventh Annual Aquatic Toxicity Workshop, November 13-15, 1984, Vancouver, B.C., pp 71. A
- 1985 18 **Havas, M.** and G.E. Likens. Toxicity of aluminum and hydrogen ions to *Daphnia catawba*, *Holopedium gibberum*, *Chaoborus punctipennis*, and *Chironomus anthrocinus* from Mirror Lake, New Hampshire. *Can. J. Zool.* 63:1114-1119. R
- [6] 17 **Havas, M.** Aluminum bioaccumulation and toxicity to *Daphnia magna* (Straus) in soft water at low pH. *Can. J. Fish. Aquat. Sci.* *Can. J. Fish. Aquat. Sci.* 42:1741-1748. R
- 16 **Havas, M.** and G.E. Likens. Effects of aluminum on sodium regulation by *Daphnia magna* at low pH in soft water. *Proc. Nat. Acad. Sci.* 82:7345-7349. R
- 15 **Havas, M.** and D.W.H. Walton. Fate and transport of radionuclides in freshwater ecosystems. In: Harwell, M.A. and T.C. Hutchinson, The Environmental Consequences of Nuclear War. Volume II, J. Wiley & Sons Ltd., Chichester, pp 3-50 to 3-56. C
- 14 **Havas, M.**, T.C. Hutchinson, and G.E. Likens. 1985. Acid rain research. *Environmental Science and Technology* 19:4-26. L
- 13 **Havas, M.**, T.C. Hutchinson, and G.E. Likens. 1985. Comment on "Red Herrings in Acid Rain Research" *Environmental Science and Technology* 19:646-648. L
- 1984 12 **Havas, M.**, T.C. Hutchinson, and G.E. Likens. Red herrings in acid rain research. feature article *Environmental Science and Technology* 18:176A-186A. R
- [3] 11 **Havas, M.**, T.C. Hutchinson, and G.E. Likens. Effect of low pH on sodium regulation in two species of *Daphnia*. *Can. J. Zool.* 62:1965-1970. R

- 10 Contributed to: *New Perspectives in Ecotoxicology*, Levin, S.A. and K.D. Kimball (Eds.), *Environmental Management* 8:375-442. R
- 1983 9 **Havas, M.** and T.C. Hutchinson. The Smoking Hills: Natural acidification of an aquatic ecosystem. Cover article *Nature* 301:23-27. R
- [2] 8 **Havas, M.** and T.C. Hutchinson. Effect of low pH on the chemical composition of aquatic invertebrates from tundra ponds at the Smoking Hills, N.W.T., Canada. *Can. J. Zool.* 61:241-249. R
- 1982 7 **Havas, M.** and T.C. Hutchinson. Aquatic invertebrates from the Smoking Hills, N.W.T.: Effect of pH and metals on mortality. *Can. J. Fish. Aquatic Sci.* 39:890-903. R
- [4] 6 Sheath, R.G., **M. Havas**, J.A. Hellebust, and T.C. Hutchinson. Effects of long-term natural acidification on algal communities of tundra ponds at the Smoking Hills, N.W.T., Canada. *Can. J. Bot.* 60:58-72. R
- 5 **Havas, M.** and T.C. Hutchinson. Long-term consequences of acidification: The Smoking Hills Study. *In*: Johnson, R.E. (Ed.), *Acid Rain/Fisheries*, Proc. Intern. Symp. on Acidic Precipitation and Fishery Impacts in Northeastern North America, Cornell University, Ithaca, N.Y., August 2-5, 1981, pp 352-353. A
- 4 Munn, R.E., D. Mackay, and **M. Havas**. Impacts of coal on natural environmental systems. *In*: Chadwich, M.J. and N. Lindman (Eds.), *Environmental Implications of Expanded Coal Utilization*, Pergamon Press, Oxford, pp 230-272. C
- 1981 3 **Havas, M.** Physiological response of aquatic animals to low pH. *In*: Singer, R. Ed.), *Effects of Acidic Precipitation on Benthos*, Proc. Symp. Acidic Precipitation on Benthos, 1980, North American Benthological Society, Hamilton, N.Y., pp 49-65. C
- 1980 2 Hutchinson, T.C. and **M. Havas** (Eds.), *Effects of Acid Precipitation on Terrestrial Ecosystems*. NATO Conference Series, Series 1, Ecology Vol 4, Plenum Press, N.Y. 654 pp. B
- 1978 1 Hutchinson, T.C.. W. Gizyn, **M. Havas**, and V. Zobens. Effects of long-term lignite burns on arctic ecosystems at the Smoking Hills, N.W.T. *In*: Hemphill, D.D. (Ed.), *Trace Substances in Environmental Health XII*:317-332. R

#### 4. CONFERENCES/WORKSHOPS/LECTURES/INVITED TALKS

<b>Year</b>	<b>#</b>	<b>Presentation</b>
2011	265	Havas, M. Wi-Fi in Schools–Is it Safe? Ontario English Catholic Teachers’ Association, Toronto, Ontario, November 3, 2011
[23]	264	Havas, M. Zoomer Radio, Toronto, October 27, 2011.
	263	Havas, M. Symptoms of Electrohypersensitivity. MediConsult Convention 2011, Museum of Contemporary Art, San Diego, California, , October 2, 2011.
	262	Havas, M. Therapeutic pulsed magnetic fields travelogue. MediConsult Convention 2011, Museum of Contemporary Art, San Diego, California, , October 2, 2011.
	261	Havas, M. Electrosensitivity and Electrosmog Exposure, MediConsult Convention 2011, Museum of Contemporary Art, San Diego, California, , October 1, 2011.
	260	Havas, M. The History of RF Microwave Radiation, MediConsult Convention 2011, Museum of Contemporary Art, San Diego, California, , October 1, 2011.
	259	Havas, M. and R. Connolly. Therapeutic pulsed magnetic fields travelogue. MediConsult Convention 2011, Science Centre, Toronto, Ontario, September 25, 2011.
	258	Havas, M. Electrosensitivity and Electrosmog Exposure, MediConsult Convention 2011, Science Centre, Toronto, Ontario, September 24, 2011.
	257	Havas, M. The History of RF Microwave Radiation, MediConsult Convention 2011, Toronto, Ontario, September 24, 2011.
	256	Havas, M. Smart Meters, Broadband and WHO, Milagro, Tucson, Arizona, July 17, 2011.
	255	Havas, M. Workshop on EHS and various diagnostic technologies, Joshua Creek, Oakville, Ontario, July 9, 2011.
	254	Havas, M. and S. Symington. Wi-Fi in Schools, Community Centre, Bobcaygeon, Ontario, May 30, 2011.
	253	Havas, M. 2-hour Lecture on low EMF buildings, course at Fleming College, Peterborough, Ontario, May 18, 2011.
	252	Havas, M. How to minimize your exposure to potentially harmful electrosmog, Peterborough Wellness Expo, Evinrude, Peterborough, Ontario, May 7, 2011
	251	Havas, M. Women’s Business Network, Speakers Group, Peterborough, Ontario, May 5, 2011.
	250	Havas, M. Switzerland, April 25 to 30, 2011

- 249 Havas, Windturbines, dirty electricity, and ground current, Lakeville, Connecticut, April 16, 2011.
- 248 Havas, D. Davis, and S. Sinatra, Panel Discussion, Total Health Show, Toronto, Ontario, April 8-10
- 247 Havas, Taming the Microwave Dragon, How to survive in a Wireless world, Total Health Show, Toronto, Ontario, April 8-10
- 246 Havas, @, Atlanta, Georgia, April 1-4, 2011.
- 245 Havas and Symington, Wi-Fi in Schools, Buckhorn Community Centre, March 1, 2011.
- 244 Havas, Health Committee Toronto, WiFi in Schools: Health Issues, Feb 14, 2011
- 243 Havas, Ground Current, Ripley Ontario, February 11 to 13, 2011.
- 2010 242 Havas, Dirty Electricity, Microwaves and Ground current Joshua Creek, Oakville, December 4, 2010.
- [35] 241 Havas, Workshop, HRV and live blood, Joshua Creek, Oakville, December 4, 2010.
- 240 Havas, 2010, Introduction to Devra Davis, University of Toronto, Toronto, November 23, 2010
- 239 Havas, 2010, History of Microwave Research. San Francisco Commonwealth Club, November 18, 2010
- 238 Havas, 2010, Microwave Exposure in Schools. San Francisco Commonwealth Club, November 18, 2010
- 237 Havas, 2010. Weston A Price Conference, Pennsylvania, November 14, 2010.
- 236 Havas, 2010. Israel, Tel Avive, October 27, 2010
- 235 Havas, 2010. Israel, Tel Avive, October 26, 2010
- 234 Havas, 2010. Israel, Tel Avive, October 26, 2010
- 233 Havas, 2010. Evenrude Centre talk on WiFi in Schools, Peterborough, ON, October 20, 2010.
- 232 Havas, 2010. Kingston Club of the Canadian Federation of University Women, Queens University, Kingston, October 13, 2010.
- 231 Havas, 2010. Montreal, Best Western Europa, September 26, 2010.
- 230 Havas and Cline, 2010. Webinar, September 10, 2010.
- 229 Havas, 2010, LA Cancer Conference, September 5, 2010.
- 228 Havas, 2010. Talk, Los Angeles, California, September 2, 2010.
- 227 Havas, 2010. Barry Trower and History of EMFs, University of Toronto, Aug 24, 2010.
- 226 Havas, 2010. Crystal Beach, Ontario, August 9, 2010.
- 225 Havas, 2010. Webinar with Dr. John Cline in BC via skype. June 11, 2010.
- 224 Havas, 2010. WiFi in Schools. Collingwood, Ontario, June 10.

- 223 Havas, M. 2010. William Rae Conference, Dallas Texas, May 3-6, 2010.
- 222 Havas, M. and C. Rees. 2010. Full Signal. Long Island, NY, May 5, 2010
- 221 Havas, M. and C. Rees. 2010. Full Signal. New York City, NY, May 4, 2010
- 220 Havas, M. and C. Rees. 2010. Electrosensitivity, How do diagnose it. Kinghardt Academy, Madison, NY, May 1, 2010
- 219 Havas, M. and C. Rees. 2010. Full Signal. New York City, NY, April 29, 2010
- 218 Havas, M. and C. Rees. 2010. Congressional Briefing, Washington, DC, April 28, 2010
- 217 Havas, M. 2010. Lecture: Electrosmog and Electro-Sensitivity, Johns Hopkins, Baltimore, Maryland, April 27, 2010
- 216 Havas, M. 2010. HESA House of Commons Committee, Ottawa, presentation via phone, Baltimore, Maryland, April 27, 2010
- 215 Havas, M. 2010. Workshop on Monitoring Electrosmog at Johns Hopkins, Baltimore, Maryland, April 26, 2010
- 214 Havas, M. 2010. Proposed Roger's Antennas on Condominiums in Brampton, Ontario. April 7, 2010.
- 213 Kroh, C. and Havas, M. 2010. Is the government doing enough to protect our health? Panel Discussion. Total Health 10, Toronto Metro Convention Centre, Toronto, March 14, 2010.
- 212 Havas, M. 2010. Mobile Phones, Antennas, Computers, and Compact Fluorescent Lights . . . What you need to know to protect your health. Total Health 10, Toronto Metro Convention Centre, Toronto, March 14, 2010.
- 211 Havas, M. Electro-hyper-sensitivity (EHS): An emerging health issue. University of Ottawa, Ottawa, ON, March 3, 2010.
- 210 Havas, M. 2010. Electrosmog and Electrosensitivity. Health Impacts of Exposure to Wireless Radiation, Lakehead University, Thunder Bay, Ontario, February 22, 2010.
- 209 Havas, M. 2010. Electrosmog and Electrosensitivity: What you need to know to protect your home environment. Electrosmog: Introduction and Training. Toronto, January 23, 2010.
- 208 Havas, M. 2010. Ground Current in Urban Environments. Electrosmog: Introduction and Training. Toronto, January 23, 2010.
- 2009 207 Havas, M. 2009. Electro-hyper-sensitivity and the Nerve Express and Electro-Interstitial Scans. LD Symposium 2009, Miami, Florida, December 10-12, 2009.
- [27] 206 Havas, M. Health Effects of Low Frequency Electromagnetic Fields. RETA, Edmonton Alberta, November 24, 2009.

- 205 Havas, M. Live Blood Analysis. MRS 2000 Meeting, Toronto, Ontario, November 21, 2009.
- 204 Havas, M. Evidence of Harm from Electromagnetic Radiation. Electromagnetic Radiation Impacts on Human Health. EMR Policy Institute Scientific Conference. Colorado School of Mines, Golden Colorado, November 8, 2009.
- 203 Havas, M. and J. Marrongelle. Heart Rate Variability (HRV): A diagnostic tool for detecting chronic fatigue, adrenal exhaustion, and electrical hypersensitivity (EHS). Holistic Health Now Conference, American Holistic Medical Association. Cleveland Ohio, November 6, 2009.
- 202 Havas, M. Live Blood Analysis. A Public Lecture, Frequency Matters. Bridgenorth, Ontario, September 26, 2009.
- 201 Havas, M. Cigarettes and Cell Phones: What do they have in common? Stinson Beach, California, September 20, 2009.
- 200 Havas, M. Cell Phones and Cigarettes. What do they have in common? San Leandro High School, San Leandro California, September 18, 2009.
- 199 Havas, M. and D. Fancy. Conference call with Health Canada regarding Standards. August 31, 2009.
- 198 Havas, M. Public Meeting regarding Rogers Tower. Marmora, Ontario, August 27, 2009.
- 197 Havas, M. and D. Fancy. Meeting with Health Canada regarding Radio Frequency Radiation Standards, Ottawa, Ontario, August 5, 2009.
- 196 Havas, M. The Truth about Wired and Wireless Technology. Royal Roads University, Victoria, BC, July 22, 2009.
- 195 Havas, M. An Inconvenient Truth: Climate Change. Consequences of Convenience: Electrosmog. Gabriola Island, BC, July 20, 2009
- 194 Havas, M. Consequences of Convenience. Langley ,BC, July 17, 2009.
- 193 Havas, M. Transmission Lines and Health. Sto:Lo Nation. BC, July 14, 2009.
- 192 Havas, M. Wireless Technology-the tobacco of the 21<sup>st</sup> Century. Ontario Health Promotion Summer School, University of Toronto, Toronto, Ontario. July 9, 2009.
- 191 Havas, M. Public Health SOS: The Shadow Side of the Wireless Revolution. Ontario Health Promotion Summer School, University of Toronto, Toronto, Ontario. July 8, 2009.

- 190 Havas, M. What Health Care Professionals need to know about Electro-Smog and Electro-Sensitivity. Integrating Biophysics-based Technologies in Clinical Practice, Phoenix Arizona, May 8, 2009.
- 189 Havas, M. What Health Care Professionals need to know about Electromagnetic Pollution and Health. Rural Life and the Healthy Employee, IHLP, Education Symposium, Medical Laboratory Technologists, Stratford, May 6, 2009.
- 188 Havas, M. Our love affair with wireless technology and the consequences. U-Links Centre for Community-Based Research, Haliburton County, April 20, 2009.
- 187 Havas, M. Our love affair with wireless technology and the consequences. Women's Institute Bailieboro-Cavan-Milbrook-North Monaghan, Ontario, April 7, 2009.
- 186 Havas, M. Electrical Pollution on Farms: Poor power quality and stray voltage effects on humans and animals. National Mutual Insurance Convention, Toronto, Ontario, March 26, 2009.
- 185 Havas, M. Electro-smog and Electro-hyper-sensitivity: How to protect yourself, your family, and your community. University Women's Club, Toronto, Ontario, March 12, 2009.
- 184 Havas, M. When "green" is not enough. What do windmills and CFL bulbs have in common? Sir Sanford Fleming College, Lindsay Ontario, January 30, 2009.
- 183 Havas, M. Rapid Aging Syndrome & Electrosmog: Part 2. Physicians Meeting, Renfrew Ontario, January 23, 2009.
- 182 Havas, M. Electrical Sensitivity. University of Ottawa, Ottawa, Ontario, January, 23, 2009
- 181 Havas, M. Wind Turbines & Health: The effect on Individuals, Prince Edward County, Picton Ontario, January 15, 2009.
- 2008 180 Havas, M. Hearing on Breast Cancer and Magnetic Field Exposure, Bell Canada, Expert Testimony, Toronto, Ontario, December 16-17, 2008.
- [31] 179 Havas, M. When "green" is not enough. Lecture, First Year Environmental Science Course (ERSC 100), Trent University, Peterborough, Ontario, December 2, 2008.
- 178 Havas, M. Poor Power Quality & Stray Voltage Effects on Human and Animal Health, Ontario Mutual Insurance, Annual Meeting, University of Guelph, Ridgetown Campus, Ridgetown, Ontario, November 27, 2008.
- 177 Havas, M. Why do residents near wind turbines get sick? Wind Turbines Make Waves. Township Council Public Meeting, Dawn-Euphemia Township, Florescent & District Community Centre, Florence Ontario, November 17, 2008.
- 176 Havas, M. EMFs Electromagnetic fields--an emerging health issue.

- CAUT Health and Safety Conference, Ottawa, Ontario, November 7-9, 2008.
- 175 Havas, M. Electro-smog & Electro-sensitivity: what you need to know to protect yourself. RCEN, Canadian Environmental Network, Annual General Assembly, Richmond Hill, Ontario, October 23-26, 2008.
- 174 Havas, M. Electromagnetic Factors in Health: What do Scientists know about the effects of wireless technologies about humans, animals, and nature? Panel on Health & Environmental Concerns of the Wireless Revolution. Bioneers, Boulder Colorado, October 18, 2008.
- 173 Havas, M. Electrosmog & Electrosmogitis (Electro-hypersensitivity). HRV & EIS Workshop, Mississauga, Ontario, October 9-11, 2008.
- 172 Havas, M. Health Effects of Electrosmog. Round Table Discussion, Budapest, Hungary, September 26-28, 2008.
- 171 Havas, M. Rapid-Aging Syndrome and Electrosmog. Renfrew United Church, Renfrew, ON, 10:30 am, August 29, 2008.
- 170 Havas, M. Electrosmog and Electrohypersensitivity. Ottawa Area Physicians, Kanata ON, 7 pm, August 28, 2008,
- 169 Havas, M. Electromagnetic Fields: Best Kept Secret. Ontario English Catholic Teachers' Association. The Way Forward: Putting the Act into ACTION. Biennial Conference on Health, Safety and the Environment. Toronto, August 13-15, 2008.
- 168 Rees, C. and M. Havas. Meeting with Marc Sorenson regarding design of a Health Spa for those with EHS, Nevada Fitness Institute, Hidden Canyon, Nevada. July 30-Aug 2, 2008.
- 167 Ripple, J., M.Havas, and R. Lear. Meeting with Senator Boxer's Staff--Megan Miller regarding Health Concerns of WiFi and WiMax, Marin County, July 25 2008, noon-2 pm.
- 166 Ripple, J., M.Havas, and R. Lear. Meeting with Assemblyman Huffman's Staff regarding the Banning of Compact Fluorescent Lights. 3501 Civic Center Drive, Suite 412, Marin County, July 25, 2008, 3-4 pm.
- 165 Havas, M. Public Forum, Cell/Transmission Towers, Colwood Pentecostal Church, Colwood, Vancouver Island, BC, June 25, 2008.
- 164 Havas, M. Cell Towers and Your Health. PACT Precautionary Approach to Cell Towers, Richmond Hill, ON, May 12, 2008.
- 163 Havas, M. Wind Farms and Health. Community Centre, Summerside, PEI, noon, May 3, 2008.
- 162 Havas, M. Transmission Lines and Health, Duffy Theatre, University of PEI, Charlottetown, PEI, 7 pm, May 2, 2008,
- 161 Havas, M. Transmission Lines and Health, Members of the

- Legislative Assembly, Charlottetown, PEI, noon, May 2, 2008,
- 160 Havas, M. Transmission Lines and Health, French School, Summerside, PEI, 7 pm, May 1, 2008.
- 159 Havas, M. A Tale of Two Pollutants: Dirty Electricity & WiFi. Natural Building, Health Building, Building Biology Conference, Nashville, TN, April 19-20, April 19, 2008.
- 158 Havas, M. Electromagnetic Pollution & Health. Natural Building, Health Building, Pre-Conference Seminar, Building Biology Conference, Nashville, TN, April 19-20, April 18, 2008.
- 157 Havas, M. Best Kept Secret. Women's institute, Warsaw Town Hall, Warsaw, ON, April 16, 2008.
- 156 Havas, M. Dialogue on Electromagnetic Fields and Health. THINK<sup>2</sup>: A Symposium on Academic Safety and Risk, Brock University, April 8-9, 2008.
- 155 Havas, M. Cell Towers and Schools: Tip of the Iceberg. Coalition for Healthier Schools, 90-minute Conference Call, April 4, 2008.
- 154 Havas, M. Electro-hyper-sensitivity (EHS): An Emerging Public Health Issue. Michael, E. DeBaakey Veterans Affairs Medical Center, Houston Texas, March 31, 2008.
- 153 Lai, H., S. Milham, M. Havas, and L. Kelley. We are all exposed! Biological and Health Effects of Electromagnetic Fields (EMF), Radio Frequency Radiation (RFR), and Dirty Electricity (DE). City Club, San Francisco, Breakfast Meeting Panel Discussion, Sponsored by Council on Wireless Technology Impacts, March 21, 2008.
- 152 Havas, M., C. Sage, D. Carpenter, C. Rees. The Shadow Side of the Wireless Revolution. A Health Policy Discussion on an Emerging Global Public Health Issue. Panel Discussion, Commonwealth Club, San Francisco, California, March 19, 2008.
- 151 Havas, M. Electromagnetic Radiation, Peterborough, March 3, 2008.
- 150 Havas, M. An Inconvenient Truth, Part 2: Our Love Affair with Wireless Technology, Lecture Sponsored by The Lewis School, Princeton Public Library, New Jersey, February 12, 2008.
- 2007 149 Newton, J. and M. Havas, Meetings with Congressional and Senate Staff about EMR Regulations and Guidelines. Washington DC, December 3-7, 2007.
- [17] 148 Havas, M. Health Concerns associated with Electromagnetic Pollution. Gave talks at 5 Churches, Jamaica, October 29-30, 2007.
- 147 Havas, M. Radio Frequency Radiation & Health. New Mexico Bioneers Conference, Santa Fe, New Mexico, College of Santa Fe, October 19-21, 2007.
- 146 Newton, J. and M. Havas. Meetings with Congressional and Senate Staff about EMR Regulations and Guidelines. Washington, DC, October 15-18, 2007.

- 145 Havas, M. 2007. Ground Current on Farms, Ecological Agriculture Course, Trent University, Peterborough, ON, October 4, 2007.
- 144 Havas, M. 2007. The link between cancer and exposure to electromagnetic energy. Cancer Conference, Ottawa, Ontario. May 25-26, 2007.
- 143 Havas, M. 2007. Panel Discussion on WiFi, RFR, and our Health. World Congress on Integrated Medicine, Sante Fe, New Mexico, May 4-6, 2007.
- 142 Havas, M. 2007. Electromagnetic Hygiene in Schools. Pegasus School, California, April 23, 2007.
- 141 Havas, M. 2007. Ground Current Pollution Act Bill 154: Why should we care? Chattam, Ontario, April 18, 2007.
- 140 Havas, M. Radio Frequency Radiation, Cell Phone Towers and your Health. Public Meeting, Charlottetown, PEI, April 17, 2007.
- 139 Havas, M. Electromagnetic Hygiene in the Home. Holistic Health, SSF, March 20, 2007.
- 138 Havas, M. Radio Frequency Health Concerns and WiFi at Trent. Committee on Technology for Teaching and Learning (COTTL), Trent University, March 8, 2007.
- 137 Havas, M. 2007. Shifting Paradigms: Flat earth/round earth and our concept of electromagnetic power. Ontario College of Art and Design, Toronto, March 7, 2007.
- 136 Havas, M. 2007. Dirty Electricity in Schools. Teacher Education Program, Trent University, March 7, 2007.
- 135 Havas, M. 2007. Is the electricity in your home making you sick. Health Freedom Expo, Long Beach, California, March 2-4, 2007.
- 134 Havas, M., B. Fraser, and R. Frederick. 2007. Ground Current Pollution Act 154, Council Chamber, Toronto City Hall, Toronto, Ontario, January 29, 2007.
- 133 Havas, M. Gilbert, F, Macfarlane, R., and R. Bradley. 2007. Panel discussion on WiFi. Wireless Communities Summit, Toronto, Ontario. January 23 & 24,
- 2006 132 Havas, M. Radio Frequency Health Concerns and WiFi at Trent. COTTL, Trent University, December 18, 2006
- [19] 131 Havas, M. 2006. *Electromagnetic Pollution and Your Health*. Bermuda, October 14, 2006.
- 130 Havas, M. 2006. *Ground Current on Farms*. Guest Lecture: Ecological Agriculture, Trent University, Peterborough, ON, October 5, 2006.

- 129 Havas, M. 2006. Health Effects of Dirty Electricity. Dane County Chapter, Save Our Unique lands Coalition Against Electromagnetic Pollution, Pitchburg, Wisconsin, July 27, 2006.
- 128 Havas, M. 2006. Electromagnetic Pollution and Your health. Trent/Shad Valley Program, Trent University, Peterborough, ON July 6, 2006.
- 127 Havas, M. 2006. Electromagnetic Pollution and Electrical Hypersensitivity. American Society of Dowsers, Vermont, June 22, 2006.
- 126 Havas, M. 2006. Electromagnetic pollution: What can you do to have a cleaner environment and protect your health? Aurora, ON, June 14, 2006.
- 125 Havas, M. 2006. Health Effects of Dirty Electricity. Nassau, Bahamas, June 8, 2006.
- 124 Havas, M. 2006. Radio Frequency Antennas. Simcoe, Ontario, June 6, 2006.
- 123 Havas, M. 2006. Simcoe Cell Tower Rogers, Simcoe, ON. Public Meeting, Town Hall, April 19, 2006.
- 122 Havas, M. 2006. Part 2: No Place to Hide: Wireless Technology. Total Health Show, Toronto, ON, April 1, 2006.
- 121 Havas, M. 2006. Panel Discussion: Energy Medicine. Total Health Show, Toronto, ON, April 1, 2006.
- 120 Havas, M. 2006. Part 1: Electromagnetic Hygiene: Dirty Electricity in homes and schools. Total Health Show, Toronto, ON, April 1, 2006.
- 119 Havas, M. 2006. Biological Effects of Dirty Electricity with Emphasis on Diabetes and Multiple Sclerosis. Precautionary EMF Approach: Rationale, Legislation and Implementation, 5<sup>th</sup> ICEMS International Workshop, Benevento Italy, 22-25, 2006.
- 118 Havas, M. 2006. Biological Effects of Dirty Electricity. Peterborough Public Library, Peterborough, ON, February 16, 2006.
- 117 Havas, M. 2006. Electromagnetic Pollution: No place to hide! Markham ON, February 15, 2006.
- 116 Havas, M. 2006. Dirty Electricity, Electrical Hypersensitivity and your Health. Toronto, ON, February 13, 2006
- 115 Havas, M. 2006. Electromagnetic Pollution and Your Health. Sir Sanford Fleming College, Peterborough, ON, February 6, 2006.

- 114 Havas, M. 2006. *Dirty Electricity, Diabetes and Multiple Sclerosis*. Centre for Health Studies Research, Trent University, Peterborough, ON, January 25, 2006
- 2005 113 Havas, M. 2005. *Electrical Pollution & the Need for Better Health Guidelines*. Meeting with Belinda Stronach, **Aurora, Ontario**, December 14, 2005.
- [29] 112 Havas, M. 2005. *Electromagnetic Sensitivity and Electromagnetic Pollution*, Faculty of Medicine, University of Toronto, **Toronto, Ontario**, December 9, 2005.
- 111 Havas, M. 2005. *Dirty Electricity, what it is, what it does, and what we can do to protect ourselves*. Nutritionists Network Group Meeting, **Richmond Hill, Ontario**, November 15, 2005.
- 110 Havas, M. 2005. *Cell Tower Radiation and Fire Fighter Exposures*. Health and Safety for the Professional Fire Fighter, The IAFF John P. Redmond Foundation Symposium on the Occupational Health and Hazards of the Fire Service. **Honolulu Hawaii**, October 23-27, 2005.
- 109 Havas, M. 2005. Health and Safety Round Table Question Period, Health and Safety for the Professional Fire Fighter, The IAFF John P. Redmond Foundation Symposium on the Occupational Health and Hazards of the Fire Service. **Honolulu Hawaii**, October 23-27, 2005.
- 108 Havas, M. 2005. *Dirty Electricity, Diabetes, Multiple Sclerosis, Electrical Hypersensitivity and Sick Building Syndrome . . . Is there a connection?* Occupational Hygiene Association of Ontario, **Toronto**, October 20, 2005
- 107 Havas, M. 2005. *Electrical Pollution: No Place to Hide*. SWEEP, Safe Wireless Electromagnetic and Electrical Policy, Breast Cancer Research and Education Fund and the Niagara Healthy Environment Initiative, **St. Catharines, Ontario**, October 15, 2005.
- 106 Havas, M. 2005. *Radio Frequency Radiation and Adverse Biological Effects*. **Salisbury, North Carolina**, October 13, 2005.
- 105 Havas, M. 2005. *Earth Energy, Life Energy, and Techno Energy Interactions. How is electromagnetic Technology affecting Life on our Planet? It's a Shocker!* Toronto Dowsers, Latvian Centre, Credit Union Drive, **Toronto**, October 11, 2005.
- 104 Havas, M. 2005. *Electromagnetic Pollution*. Ontario Ministry of Health, **Toronto**, September 20, 2005
- 103 Havas, M. 2005. *Health Effects of Dirty Electricity*. **Bermuda**, September 3, 2005.
- 102 Havas, M. 2005. *Radio Frequency Radiation: Cell Phone and Cell Towers*. **Bermuda**, September 3, 2005.
- 101 Havas, M. 2005. *Cell Phones, Electricity and your Home*. Trent-Shad Valley Program, Trent University, **Peterborough, Ontario**, July 18, 2005.

- 100 Havas, M. 2005. *Effects of Electrical Pollution and Radio Frequency Radiation*. STOP (Stop Transmission lines Over People), Parent Information Session, St. Justin Martyr Parish Hall, **Markham, Ontario**, June 20, 2005.
- 99 Havas, M. 2005. *Health Effects of Dirty Electricity*, Public Lecture, St. Johns Church, **Peterborough, Ontario**, June 16, 2005.
- 98 Havas, M. and A. Olstad. 2005. *Dirty Electricity Study at Fillmore-Central Elementary, Middle & High School*. **Minnesota**, June 2, 2005.
- 97 Havas, M. 2005. My research with Dirty Electricity. Dr. Tel-Ore, **Minneapolis Minnesota**, May 31, 2005.
- 96 Havas, M. 2005. *Electrical Pollution: A Serious Environmental Problem*. Breast Cancer Research and Education Fund and the Niagara Healthy Environment Initiative, **Port Dalhousie, Ontario**, April 30, 2005.
- 95 Havas, M. 2005. *Electrical Pollution in the Home*, Sir Sanford Fleming College, **Haliburton, Ontario**, April 29, 2005.
- 94 Havas, M. 2005. Dirty Electricity. United Church, **Peterborough, Ontario**, April 26, 2005.
- 93 Havas, M. 2005. *Electrical Pollution in the Home*. Healthy Buildings Conference, **Cambridge, Ontario**, April 6-7, 2005.
- 92 Havas, M. 2005. *Electrical Pollution: Part 1. Electromagnetic Fields*. Medical Officer of Health, **Newmarket, Ontario**, April 1, 2005
- 91 Havas, M. 2005. *Dirty Electricity and Graham/Stetzer Filters*. Naturopathic Doctors, **Peterborough, Ontario**. March 10, 2005.
- 90 Havas, M. 2005. *Electrical Pollution*. Deputy Minister of Rural Affairs, **Toronto, Ontario**, February 24, 2005.
- 89 Havas, M. 2005. *Electrical Pollution*. Task Force, **Markham, Ontario**, February 23, 2005.
- 88 Havas, M. 2005. *Environmental Contaminants and Health: Dirty Electricity and Electrical Hypersensitivity*. Sir Sanford Fleming College, **Peterborough, Ontario**, February 14, 2005.
- 87 Havas, M. 2005. *Health Effects of Dirty Electricity*. Bio Ag. Conference, **Wellesley, Ontario**, January 27, 2005.
- 86 Havas, M. 2005. *Health Effects of Dirty Electricity*. Barbados Radiation Conference, Sherbourne 2005. Conference Centre, **Barbados**, January 18, 2005.
- 85 Havas, M. 2005. *Radio Frequency Radiation: Cell Phone Antennas*, Barbados Radiation Conference, Sherbourne Conference Centre, **Barbados**, January 18, 2005.
- 2004 84 Havas, M. 2004. *Health Concerns Associated with Part 1. Radio Frequency Radiation, Part 2. Magnetic Fields (ELF), Part 3. Dirty*

- Electricity*. Public Seminar, **Tobago**, November 20, 2004.
- [10] 83 Havas, M. and D. Stetzer. 2004. *Health Concerns Associated with Dirty Electricity and Power Frequency Fields*. Public Seminar, Port-of-Spain, **Trinidad**, November 17, 2004
- 82 Havas, M. 2004. *Health Concerns Associated with Radio Frequency Radiation*. Public Seminar, Port-of-Spain, **Trinidad**, November 17, 2004
- 81 Havas, M. 2004. *Dirty Electricity and Electrical Hypersensitivity (EHS): Five Case Studies*, Bio-Ag Conference, **Wellesley, Ontario**, November 10, 2004.
- 80 Havas, M. 2004. Dirty Electricity and Multiple Sclerosis, MS Society **Pickering, Ontario**, November 2, 2004.
- 79 Havas, M. 2004. Dirty Electricity and Multiple Sclerosis, MS Society **Oshawa, Ontario**, November 2, 2004.
- 78 Havas, M and J. Mackay. *Street level magnetic fields within the City of Kingston, Ontario, Canada*. Biological Effects of EMFs, 3<sup>rd</sup> International Workshop, Kos, **Greece**, 4-8 October, 2004.
- 77 Havas, M., M. Illiatovitch, and C. Proctor. *Teacher and student response to the removal of dirty electricity by the Graham/Stetzer filter at Willow Wood School in Toronto, Canada*. Biological Effects of EMFs, 3<sup>rd</sup> International Workshop, Kos, **Greece**, 4-8 October, 2004.
- 76 Havas, M. and D. Stetzer. 2004. *Graham/Stetzer Filters Improve Power Quality in Homes and Schools, Reduce Blood Sugar Levels in Diabetics, Multiple Sclerosis Symptoms, and Headaches. Children with Leukemia* International Conference in **Westminster, London**, September 6-10, 2004.
- 75 Havas, M. 2004. *Wireless Communication Antennas on Fire Halls: Dumb and Dangerous!* International Association of Fire Fighters Conference, **Boston**, August 2004.
- 2003 74 Havas, M. *Health Effects Associated with Power Lines*. Expert Testimony. National Energy Board Hearing regarding Sumas Energy, **Abbotsford, BC**, July 2003
- 2002 73 Havas, M. National Research Policy Conference, Ottawa, ON., October 22-25, 2002
- [15] 72 Havas, M. *Cell Phone Towers and their Biological Effects*. Behind the Scenes, Trent University, **Peterborough, Ontario**, October 19, 2002
- 71 Havas, M. *Electromagnetic Fields in Schools: What can be done to reduce exposure*. Health and Safety Conference, **Toronto, Ontario**, August 15, 2002.
- 70 Havas, M. *How to reduce your exposure to wired and wireless electromagnetic energy*. Invited Speaker, Presented at People and the

- Planet Conference, Sierra Club of Canada, Queen's University,  
**Kingston, Ontario**, June 3-9, 2002
- 69 Havas, M. Health Concerns Associated with Wireless  
Telecommunication.. Invited Speaker, Public Lecture, Caledonia,  
PEI, May 29, 2002.
- 68 Havas, M. *Mapping Magnetic Fields in the School Environment*.  
**Guelph Ontario**, May 24, 2002
- 67 *Electromagnetic fields (EMF) and Electromagnetic Radiation (EMR):  
An overview of Health Concerns and a Call for Action*. Presented to  
the Standing Committee on Environment and Sustainability,  
**Parliament Hill, Ottawa, Ontario**, May 21, 2002
- 66 Havas, M. *Biological Effects of Low Frequency Electromagnetic  
Fields*, **London, England**, May 16-17, 2002
- 65 Lund-Lucas, E., R. Silvestri, M. Havas, D.J. Cunningham, and L.  
Thomas. 2002. Everything students should know about Thinking and  
Learning. Destination Success 2002: Building Accessible Learning  
Communities, Sponsored by Learning Opportunities Task Force,  
Ministry of Training, Colleges & Universities, Government of Ontario  
& Georgian College; **Barrie, Ontario**, May 6 & 7, 2002.
- 64 Havas, M. *Electromagnetic Fields in a School Environment, the Need  
for Mapping*. Presented to School Health and Safety Officers,  
**Mississauga, Ontario**, May 3, 2002.
- 63 Havas, M. *Sources of electromagnetic fields in the home*. Presented to  
Environmental Homes, **Grand Valley, Ontario**, April 27, 2002.
- 62 Havas, M. *Corporatization of the University*, Smith Conference  
Room, Trent University, **Peterborough, Ontario**, April 6<sup>th</sup>.
- 61 Havas, M. *Electromagnetic fields in the home and childhood cancers:  
An overview from Wertheimer to Wartenberg*. Presented at the  
International Centre for Electromagnetic Biocompatibility (ICEB)  
Conference, **Montreal, Canada**, March 6-8, 2002
- 60 Havas, M. Rapporteur, Simply Water? Workshop, Trent University,  
**Peterborough, Ontario**, February 18-20, 2002
- 59 Havas, M. Expert Testimony on the health effects of power line  
electromagnetic fields. Mendota Heights, Public Meeting, Planning  
Commission, **Minnesota**, January 2002.
- 2001 58 Havas, M. *Electromagnetic fields and breast cancer*. Eyes Wide  
Open, Conference on Breast Cancer, **Peterborough, Ontario**.  
October 2001.
- 2000 57 Havas, M. Toronto Round Table on Cell Phone Towers, RFR, Public  
Meeting with Panel Discussion, City of Toronto Department of  
Health, **Toronto, Ontario**, February 7, 2000
- [2] 56 Havas, M. Expert Testimony of the Biological Effects of Power Line  
electromagnetic fields, **Mendota Heights, Minnesota**, Public

- Meeting, January, 2000.
- 1999 55 Havas, M. Power lines on London Street Peterborough and the  
[1] Literature on Health Effects. Presented to the PUC, **Peterborough, Ontario**, June 22, 1999.
- 1995 54 POSTER: Acid Reign '95 Conference, **Gothenburg, Sweden**, June  
1995. 1) Can Sodium Regulation be used to Predict Relative Acid  
Sensitivity of Aquatic Fauna?; 2) Biological Recovery in Two  
Previously Acidified, Metal-Contaminated Lakes, near Sudbury,  
Ontario, Canada; 3) Chemical Response of Two Previously  
Acidified, Metal-Contaminated Lakes, near Sudbury, Ontario,  
Canada.
- [3] 53 PLENARY SPEAKER: Acid Reign '95 Conference, **Gothenburg, Sweden**, June 1995.
- 52 LECTURE: at the KEY Workshop on Biodiversity in Ontario,  
August 1995. Solving Environmental Problems: A framework.
- 1994 51 INVITED SPEAKER: conference in **Kathmandu, Nepal**, March  
1994. Environmental Education in Developing Countries.
- [4] 50 LECTURE: at the KEY Workshop on Chemicals in the  
Environment, **Regina**, July 1994. Environmental Science and  
Decision Making
- 49 LECTURE: at the KEY Workshop on Biodiversity, **Ontario**,  
August 1994.  
Solving Environmental Problems: A framework.
- 48 PARTICIPANT: First International Symposium on Ecosystem  
Health and Medicine: Integrating Science, Policy and Management.  
**Ottawa, Ontario**, June 19-23, 1994.
- 1993 47 PARTICIPANT: Evaluating and Monitoring the Health of Large-  
Scale Ecosystems, NATO Advanced Research Workshop,  
**Montebello, Quebec**, October 10-15, 1993.
- [4] 46 POSTER: International Conference on Heavy Metals in the  
Environment, in **Toronto**, September 1993.
- 45 LECTURES: at the KEY Workshop on Chemicals in the  
Environment, Regina June 1993, **Sarnia** August 1993; 1) DDD: A  
Case Study; 2) Environmental Decision Making; 3) Solving  
Environmental Problems: A framework.
- 44 INVITED SPEAKER: conference in **Toluca, Mexico**, February,  
1993.
- 1992 43 LECTURES: at the KEY Workshop on Chemicals in the  
Environment, **Regina** July 1992, **Sarnia** August 1992.
- [2] 42 LECTURES: at the KEY Workshop on Chemicals in the  
Environment, **Regina** July 1992, **Sarnia** August 1992; 1) DDD: A  
Case Study; 2) Environmental Decision Making; 3) Solving  
Environmental Problems: A framework.
- 1991 41 LECTURES: at the KEY Workshop on Chemicals in the  
Environment, August 16-25, 1991. 1) View of Environmental Issues

- 1990 40 from a Scientist's Perspective; 2) DDD: A Case Study  
 SEMINAR: "Science Reporting and Journalism", Campbellford  
 District High School, Your Science Future, **Cambellford, Ontario**,  
 November 14, 1990.
- [4] 39 LECTURES/DISCUSSIONS: at the KEY (formerly SEEDS)  
 Workshop on Chemicals in the Environment, August 18-25,  
**Mississauga, Ontario**, 1) Environmental Problems: An Overview;  
 2) Acid Rain: An Historical Perspective; 3) DDD: A Case Study;  
 4) Agricultural Practices: synthetic vs organic chemicals  
 38 CONFERENCE PRESENTATION: Enviro Mystery: An  
 Educational Computer Game, Third International Show & Tell for  
 Ontario Universities and Colleges, May 28-29, 1990, oral  
 presentation and computer demonstration, with Robert Loney;  
**Guelph Ontario**.
- 37 SEMINAR: Scientific Research in the Canadian Arctic, Science  
 Day, Trent University, **Peterborough, Ontario**, April 10, 1990.
- 1989 36 LECTURE: Science in the Canadian Artic. Environmental and  
 Resource Studies, Trent University, **Peterborough, Ontario**, July  
 1989.
- [3] 35 LECTURES: at the SEEDS Workshop on Chemicals in the  
 Environment, August 5-12, **Kingston, Ontario**, 1) Acid Rain: An  
 Overview; 2) DDD: A Case Study  
 34 TELEVISION INTERVIEW (TVO): Panel Discussion on  
 Sustainable Development, **Toronto, Ontario**. May 1989.
- 1988 33 POSTER PRESENTATION: Needle Chemistry as an Early Warning  
 Indicator of Decline in Balsam Fir, Red Spruce, and Norway Spruce.  
 Forest Decline Symposium, October 20-21, 1988, **Rochester, N.Y.**  
 (with R. Loney, M. Scott, and T.C. Hutchinson)
- [4] 32 POSTER PRESENTATION: Influence of Climate and Air Pollution  
 on Decline of Sugar Maple in Eastern North America. Forest  
 Decline Symposium, October 20-21, 1988, **Rochester, N.Y.** (with R.  
 Loney)
- 31 THREE LECTURES: at the SEEDS Workshop on Chemicals in the  
 Environment, August 12-21, 1988, **Sarnia, Ontario**. 1) Chlorinated  
 Hydrocarbons-Friend or Foe? A Case Study; 2) Principles of  
 Chemistry as they Pertain to the Environment; 3) Principles of  
 Ecology as they Pertain to Chemicals in the Environment  
 30 INVITED LECTURE: Later Life Learning: "Scientific  
 Developments and Inventions at the University of Toronto, Topic  
 was "Acid Rain in the Canadian Artic", March 10, 1988, Innis  
 College, U of T, **Toronto, Ontario**.
- 1987 29 ORAL PRESENTATION: Can Aquatic Mosses and Macrophytes be  
 used as Bioindicators of Metal Pollution? Intern. Conf. Heavy  
 Metals. September, 1987, **New Orleans**.

- [5] 28 LECTURE: Use of DDD in Clear Lake-a Case Study. SEEDS  
Workshop on Chemicals in the Environment, August, 1988, **Sarnia,  
Ontario**
- 27 LECTURE: Science Careers for Women. Open Doors for  
Tomorrow, Peel's Career Conference for young women, Glenforest  
Secondary School, **Peel County, Ontario** May 9.
- 26 ORAL PRESENTATION: Does hemoglobin enhance the acid  
tolerance of aquatic invertebrates? International Symposium on  
Ecophysiology of Acid Stress in Aquatic Organisms, Jan 13-16,  
1987, **Antwerp, Belgium**.
- 25 ORAL PRESENTATION: Effects of calcium and pH on aluminum  
toxicity and bioaccumulation by *Daphnia magna*. International  
Symposium on Ecophysiology of Acid Stress in Aquatic Organisms,  
Jan 13-16, 1987, **Antwerp, Belgium**.
- 1986 24 ORAL PRESENTATION: Chemical recovery of 2 lakes near  
Coniston, Ontario. SLANT/TRESLA meeting, April 11-13, 1986,  
**Peterborough, Ontario**.
- [3] 23 SEMINAR: Aluminum toxicity in aquatic invertebrates, Department  
of Biology, Trent University, **Peterborough, Ontario**, February 28,  
1986.
- 22 ORAL PRESENTATION: Aluminum toxicity and salt regulation in  
aquatic invertebrates, Society of Canadian Limnologists (SCL),  
Conference held in **Ottawa, Ontario**, January 7 & 8, 1986.
- 1985 21 POSTER PRESENTATION: "Aluminum localization in aquatic  
plants and animals", **Muskoka** Acid Rain Conference, Sept 15-20,  
1985.
- [5] 20 POSTER PRESENTATION: "Recovery of acidic metal-  
contaminated lakes near Coniston Ontario", with T.C. Hutchinson,  
**Muskoka** Acid Rain Conference, Sept 15-20, 1985.
- 19 SEMINAR: "Aluminum toxicity, uptake and localization in aquatic  
invertebrates", Department of Biology, McMaster University,  
**Hamilton, Ontario**, August 29, 1985
- 18 PARTICIPANT: Impact of Nuclear Winter on Natural Ecosystems,  
Workshop, SCOPE, **Toronto**, March 1985.
- 17 ORAL PRESENTATION: "Does hemoglobin enhance acid  
tolerance of aquatic invertebrates?", SLANT/TRESLA Conference,  
**Quebec**, April 12-15, 1985.
- 1984 16 ORAL PRESENTATION: "Aluminum uptake and toxicity to  
Daphnia magna at low pH in soft water." 11th Annual Aquatic  
Toxicity Workshop, **Vancouver, B.C.**, November 13-15.
- [3] 15 INVITED SPEAKER: Physiological effects of acidity and  
associated water chemistry (aluminum) on freshwater invertebrates  
Department of Biology, Dalhousie University, **Halifax, Nova Scotia**,  
October 18.
- 14 INVITED SPEAKER: Acid rain and the future of Ontario Lakes  
Dallington Public School, **Toronto**, Ontario, April.

- 1983 13 INVITED SPEAKER: Natural and Manmade Acid Rain Audubon Society, Darien, **Connecticut**, U.S.A., February 3.
- [2] 12 INVITED SPEAKER: Aluminum toxicity to aquatic invertebrates Norwegian Institute for Water Research, **Oslo, Norway**, May.
- 1982 11 INVITED SPEAKER: Causes of Acid Rain and Acid Deposition Conference on Acid Rain, Pennsylvania Environmental Council, 14th Annual Meeting, Lock Haven State College, , **Pennsylvania**, October 21.
- [4] 10 INVITED SPEAKER: Effects of acid rain on aquatic animals Acid Rain Effects Workshop, JASON MITRE Corporation, Cornell University, **Ithaca, N.Y.**, Sept 30 to Oct. 1.
- 9 LECTURES: Neutron Activation Analysis as an Analytical Tool. Section of Ecology and Systematics, Cornell University, **Ithaca, N.Y.**
- 8 LECTURE: Response of aquatic invertebrates to acidification Aquatic Entomology Course, Cornell University, **Ithaca, N.Y.**
- 1981 7 PARTICIPANT: Ecotoxicology Workshop, Ecosystem Research Center, Cornell University, **Ithaca, N.Y.**, November 2-5.
- [5] 6 POSTER PRESENTATION: Acid/Rain Fisheries Symposium, Northeastern Division of the American Fisheries Society, Cornell University, **Ithaca, N.Y.**, August 2-5.
- 5 SEMINAR: The Smoking Hills and Sudbury: Two case studies Department of Biology, State University of New York College, **Cortland, N.Y.**, April
- 4 SEMINAR: Does hemoglobin reduce acid-stress of *Daphnia magna*? Entomology Seminar, Cornell University, **Ithaca, N.Y.**, March.
- 3 SEMINAR: Extreme acidification at the Smoking Hills: Chemical and Biological Consequences Section of Ecology and Systematics, Cornell University, **Ithaca, N.Y.**, February.
- 1980 2 PARTICIPANT: Effects of sulphur and nitrogen oxides on plants International Workshop on Environmental Implications and Strategies for Expanded Coal Utilization, UNEP/Beijer Institute, **Moscow, USSR**, October 20-24.
- [2] 1 SEMINAR: Toxicity of metals at low pH to aquatic invertebrates. Department of Botany, University of Toronto, **Toronto**.

## 5 WEBSITE ARTICLES

I have two websites [www.magdahavas.com](http://www.magdahavas.com) and [www.magdahavas.org](http://www.magdahavas.org). The dot com website is an educational website designed to inform the public about electrosmog and electrosensitivity. The dot org website is a more formal website that provides a list of my publications. Both websites went live on October 14, 2009.

Below is a list of articles (blogs) on the website in reverse chronological order.

DATE	#	TITLE
Dec 2011	140	Dr Oz on PEMF therapy and pain relief, in prep.
Oct 2011	139	Want to learn more? Course on Electrosmog & Electrosensitivity
[4]	138	Health Canada needs to issue warning about Wireless Baby Monitors
	137	Peterborough City Council disagrees with cell tower site
	136	Advice for Health Canada regarding Wi-Fi, cell phone antennas, and other forms of radio frequency emitting devices
Sept 2011	135	Ontario School replaces Wi-Fi with Wired Internet
Aug 2011	134	Open Letter to Steve Jobs
[3]	133	Cell Phones and Head Blemishes in Adolescents: Is it Melanoma?
	132	How to properly read a scientific paper–Adolescent brain tumours and mobile phones.
July 2011	131	Mercury in broken CFL bulbs can exceed safe exposure levels for humans!
[3]	130	Conflict of Interest: The Wireless Industry and ICNIRP
	129	Health Canada confused about WHO Classification
June 2011	128	International Experts' Perspective on the Health Effects of Electromagnetic Fields (EMF) and Electromagnetic Radiation (EMR)
[5]	127	KPRD School Board silences opposition to WiFi in Schools
	126	Workers Health and Safety Centre, Radiation from Cell Phones
	125	School boards gagging dissent over WiFi, Peterborough
	124	WHO's new classification of RFR: What does this mean for Canada?

May 2011	123	May 2011: A month in review–IARC, WHO radio frequency possible human carcinogen; PACE dangers of electromagnetic fields
[2]	122	CN Tower Edgewalk: Thrill seekers may get more than they paid for. Pick of the Week 26
Apr 2011	121	Pick of the Week 25: Review of International Microwave Exposure Guidelines form 1957 to 1968
Mar 2011	120	Multiple Sclerosis and Dirty Electricity
[3]	119	Pick of the Week 24: Microwave Radiation affects the Heart
	118	Cell phones affect brain–what about cell towers?
Feb 2011	117	Cell Phone Study Warning
[9]	116	Musing #2: Truth Speaking vs Fear Mongering
	115	Musing #1: WiFi in Schools–a Ticking Time Bomb
	114	Pick of the Week 23: Research on Biological effects of Radio Frequency Radiation in Eurasian Communist Countries, 1976
	113	Pick of the Week 22: A Very Important Symposium!
	112	Pick of the Week 21: Physical Basis of Electromagnetic Interactions with Biological Systems
	111	Pick of the Week 20: Early Research on the Biological effects of Microwave Radiation: 1940-1960
	110	Pick of the Week 19: Index of Publications on Biological Effects of Electromagnetic Radiation (0-100 GHz)
	109	Oregon introduces cellphone radiation legislation
Jan 2011	108	Swiss Government’s advice about Mobile Phone Use
[4]	107	Multiple Sclerosis and Electrohypersensitivity
	106	Havas Report on Smart Meters for CCST
	105	Population Control and Microwave Radiation
Dec 2010	104	Taming the Microwave Dragon
[7]	103	WiFi in Alberta Schools: A debate
	102	Science 101: Weight-of-Evidence and Weight-of Warning
	101	Canada House of Commons Microwave Radiation now Available
	100	Smart Meter Installation Challenged
	99	Are Wireless Smart Meters Safe?
	98	Pick of the Week #18: Effect of Microwaves on the Central Nervous System 1965–German translation

	97	Wireless Smart Meter Kills Plant
Nov 2010	96	School Board threatens to fine Parents and expel Students because of WiFi concerns
[9]	95	If WiFi harms trees, what about children?
	94	Wireless internet via LED “Smart” Lighting
	93	Pick of the Week #17: Power Frequency Electromagnetic Fields
	92	Brain Tumour risk and Mobile Phone use
	91	DECT Baby Monitors may be Dangerous
	90	Non-thermal Effects and Mechanisms between EMFs and Living Matter
	89	Important Review on Biological Effects of Antennas by Levitt and Lai 2010
	88	Pick of the Week #16: Russian Translation Microwave Radiation influence on Man and Animals (1970)
Oct 2010	87	New Study: Radiation from Cordless Phone Base Station affects the Heart
[6]	86	Free Fiber for Swiss Schools–WiFi Warnings
	85	Pick of the Week #15: Russian Translations on Biological Effects of Magnetic Fields and Radio Frequency Radiation.
	84	Pick of the Week #14: Proposal for Legislation: Non-ionizing Radiation (1979)
	83	Is induction Cooking Safe?
	82	Pick of the Week #13: Microwave Studies with Human Subjects, 1966.
Sept 2010	81	Open Letter to Medical Officer of Health about WiFi in Schools
[12]	80	Disconnect–The Corruption of Science
	79	Pick of the Week #12: Why Pulsed Microwave Frequencies are more Harmful.
	78	Is What Space Super WiFi Dangerous?
	77	OAHPP Comments on WiFi and Health
	76	Pick of the Week #11: Potentially Harmful Radio Frequencies used in the Packaging and Food Industry
	75	Lady Gaga–Lupus and Electrosensitivity?
	74	Pick of the Week #10: Navy Tested Microwaves on Military Volunteers

	73	Cell Phones and WiFi are Safe = Not
	72	Pick of the Week #9: 0.95 and 2.45 GHz most Lethal Microwave Frequencies
	71	WHO admits “conflicts of interest”
	70	Pick of the Week #8: Repacholi Revises Safety Code 6
Aug 2010	69	Barrie Trower speaks about Microwave Radiation
[7]	68	Real estate devalues when cell towers are erected.
	67	Pick of the Week #7: Hazards of Microwave Radiations–Review from 1960
	66	Digital portable phones affects the Heart!
	65	Pick of the Week #6: Clinical and Hygienic aspects of exposure to Electromagnetic Fields
	64	WiFi in Schools and the Health Effects of Microwaves
	63	Pick of the Week #5: Why the double standard?
July 2010	62	Study finds Vatican Radio causes cancer
[7]	61	WiFi “Laptops” affect male fertility
	60	Pick of the Week #4: Cancer Mortality near Air Force Bases
	59	Adding light to heat of WiFi debate
	58	Pick of the Week #3: 1967 EMR Review, copy 5/15
	57	Pick of the Week #2: Origins of 1966 U.S. Safety Standards for Microwave Radiation
	56	Pick of the Week #1: More than 2000 Documents prior to 1972 on Bioeffects of Radio Frequency Radiation.
June 2010	55	New iPhone 4 reception problem is good news.
May 2010	54	Lessons from the Interphone Study
[2]	53	Interphone Study: It’s not just brain tumors!
April 2010	52	Moore’s Cancer Centre Doctor discusses cell phone tumour link
[5]	51	How to BRAG Rate your School
	50	CBC Podcast on the dangers of wireless technology
	49	BRAG School Report–Media Advisory
	48	Welcome to Planet Irth
March 2010	47	Live Blood Cells and Electrosmog
[4]	46	Diabetes and Electrosensitivity
	45	Wireless Concerns at Lakehead University

	44	Dr. Havas lectures at Total Health Show in Toronto
Feb 2010	43	From Zory's Archive
[4]	42	What do dancing cows and zapped dogs have in common?
	41	Cell phone antennas on apartment buildings?
	40	Google offers alternative to WiMax
Jan 2010	39	EM Hypersensitivity Awareness Month, Harbour Grace, NFL
[5]	38	Mobile-Boro Man
	37	Cell Phone Antennas and Cost of Electricity
	36	Open Letter–WiFi in Libraries
	35	Open Letter–WiFi in Schools (#2)
Dec 2009	34	University says “NO” to WiFi and Cellular Antennas
[6]	33	What is Dirty Electricity?
	32	Prevention exposes Dirty Electricity
	31	Dirty Electricity and GS Units
	30	Electrification causes “disease of civilization”
	29	New EMF website by Dr. Mercola
Nov 2009	28	Don't stand in front of the microwave
[8]	27	Power Line Protest
	26	Thousands turn up for the Power-Line Protest
	25	Residents Fight Proposed Power Expansion
	24	Edmonton Power Line Protest
	23	Prevention Magazine on CFL Bulbs
	22	Heart murmur and Portable Digital Phones
	21	Cell Phones & Cigarettes: What do they have in common?
Oct 2009	20	Open Letter: WiFi in Schools (#1)
[20]	19	WiFi Proposal for San Francisco
	18	Expert Testimony Broadcast Antenna
	17	Dirty Electricity in Schools
	16	Expert Testimony High Voltage Transmission Line
	15	Cell Tower Blues
	14	Mechanisms of Action, Dr. Andrew Goldsworthy
	13	Cell Transmission Towers

12	CWTI: Libby Kelley and Magda Havas
11	Conference: Holistic Health NOW, AHMA, Ohio, Nov 2009
10	Epilepsy 360 degrees
9	Electromagnetic Sensitivity Awareness Month
8	The Dark Side of CFL Bulbs
7	Dr. Martin Blank Lecture on EMF and Cancer
6	Rethink Breast Cancer
5	EHS Quiz
4	Cell Phones
3	Wind Power and Dirty Electricity
2	Conference: EMF Impacts on Human Health, Colorado, Nov 2009
1	Global TV–dirty electricity

---

6. YOUTUBE VIDEOS
-------------------

<b>Date uploaded</b>	<b>#</b>	<b>Title</b>	<b>Duration</b>	<b>Views</b>
Mar 23, 2011	13	Multiple Sclerosis and Dirty Electricity (with Don Garbutt)	5:42	2,765
Jan 10, 2011	12	Conspiracy Theory: Population Control & Microwave Radiation	7:59	3,820
Jan 5, 2011	11	Taming the Microwave Dragon	7:12	41,039
Dec 23, 2010	10	Planet Irth	8:42	1,518
Oct 19, 2010	9	Microwave Radiation Dangers in your Home	6:20	205,570
Apr 27, 2010	8	WiFi in Schools and Health Effects of Microwave Radiation (with Bob Connolly & Rodney Palmer)	5:33	17,340
Mar 23, 2010	7	DECT Phone affects the Heart (with Jeff Marrongelle)	6:49	21,628
Mar 21, 2010	6	Diabetes and Electrosensitivity	7:12	43,160
Mar 21, 2010	5	Live Blood Analysis & Electrosmog	2:32	31,197
Feb 17, 2010	4	Cell Phone Antennas on Apartment Rooftops and their Health Effects (with	1:50	4,957

			Bob Connolly)		
Feb 17, 2010	3		Dancing Cows become Sick due to Ground Current on Dairy Farms (with Bob Connolly)	0:32	2,527
Dec 5, 2009	2		What are GS Units? (with Ralph Frederick)	8:22	11,168
Nov, 2009	1		Cell Phones & Cigarettes: What do they have in Common?	7:39	59,881

7 VIDEO LINKS to Talks and Interviews (*incomplete list*)

Videos of some of my **talks** and **interviews** are available on the internet. Below is an incomplete list with number of views as of November 25, 2011.

Date	#	Type	Title & URL	T	Views
Jul 27, 2011	17	Interview BC	Green Party Opposes BC Hydro's New Smart Meters, <a href="http://www.youtube.com/watch?v=WM9-q62Hglw">http://www.youtube.com/watch?v=WM9-q62Hglw</a>	2:52	1282
Jul 19, 2011	16	Interview Toronto	Magda Havas Wylde on Health; <a href="http://www.youtube.com/watch?v=9LbQcxqf-8s">http://www.youtube.com/watch?v=9LbQcxqf-8s</a>	31:17	827
Jun 6, 2011	15	Interview BC	Face to Face with Dr. Magda Havas: The Dangers. <a href="http://vimeo.com/24733700">http://vimeo.com/24733700</a>	30:11	
May 31, 2011	14	Press Conference	Wireless Radiation Safety Council Press Conference, April 19, 2011, part 3, <a href="http://www.youtube.com/watch?v=6xeRWC-K1_Q">http://www.youtube.com/watch?v=6xeRWC-K1_Q</a>	6:13	53
Apr 17, 2011	13	Talk Toronto	Unsafe Levels in Schools, <a href="http://www.youtube.com/watch?v=MQXJImqHhvo">http://www.youtube.com/watch?v=MQXJImqHhvo</a>	1:25	
			Microwaves and the Heart, <a href="http://www.youtube.com/watch?v=sv1E9IXUd6M">http://www.youtube.com/watch?v=sv1E9IXUd6M</a>	3:43	
Jan 14, 2011	12	Interview	Dr. Magda Havas, Wi-Fi Dangers; 16 by 9, Global, <a href="http://www.youtube.com/watch?v=Mxrjhu1R2BE">http://www.youtube.com/watch?v=Mxrjhu1R2BE</a>	14:32	517
Nov 18, 2010	11	Talk San Francisco	Commonwealth Club, 11-18-10 Panel I-Magda Havas, PhD, <a href="http://vimeo.com/17270263">http://vimeo.com/17270263</a>	14:14	
			Panel I-Q&A <a href="http://vimeo.com/17268032">http://vimeo.com/17268032</a>	15:27	
			Panel III- <a href="http://vimeo.com/17263893">http://vimeo.com/17263893</a>	14:14	
Nov 17, 2010	10	Interview	The Concerned with Wi-Fi in Alberta Schools <a href="http://albertaprimetime.com/Stories.aspx?FlashVars=Video/PTR_111710.flv&amp;pd=1698">http://albertaprimetime.com/Stories.aspx?FlashVars=Video/PTR_111710.flv&amp;pd=1698</a>	14:21	
Sept 6, 2010	9	Talk, Burbank California	Wireless Dangers: Havas/Kelley 1 of 7; 1 <a href="http://www.youtube.com/watch?v=PzSDF1Q3_jk">http://www.youtube.com/watch?v=PzSDF1Q3_jk</a>	1-15:00	
			2 <a href="http://www.youtube.com/watch?v=bbemtlMSVfk">http://www.youtube.com/watch?v=bbemtlMSVfk</a>	2-14:47	
			3 <a href="http://www.youtube.com/watch?v=cjL-gpauVEg">http://www.youtube.com/watch?v=cjL-gpauVEg</a>	3-13:28	
			4 <a href="http://www.youtube.com/watch?v=hpsef6fmdSg">http://www.youtube.com/watch?v=hpsef6fmdSg</a>	4-14:22	
			5 <a href="http://www.youtube.com/watch?v=uhTresKaL_Y">http://www.youtube.com/watch?v=uhTresKaL_Y</a>		

			5 <a href="http://www.youtube.com/watch?v=whTpcpKeJ_Y">http://www.youtube.com/watch?v=whTpcpKeJ_Y</a>	5-13:04	
			6 <a href="http://www.youtube.com/watch?v=Bwv1HF-5KAk">http://www.youtube.com/watch?v=Bwv1HF-5KAk</a>	6-13:27	
			7 <a href="http://www.youtube.com/watch?v=B064tGammUM">http://www.youtube.com/watch?v=B064tGammUM</a>	7-10:55	
Aug 31, 2010	8	Interview	Wi-Fi in Schools-Chex TV-Peterborough, Ontario, <a href="http://www.youtube.com/watch?v=uEEnDwOjc7E">http://www.youtube.com/watch?v=uEEnDwOjc7E</a>	2:28	
Dec 30, 2009	7	Talk Colorado	EMR Magda Havas #1, Evidence of Health Harm from Electromagnetic Radiation, <a href="http://www.youtube.com/watch?v=r0yRIrN_fbY">http://www.youtube.com/watch?v=r0yRIrN_fbY</a>	9:23	
Dec 28, 2009	6	Talk	EMR Magda Havas #2.mov; <a href="http://www.youtube.com/watch?v=pPGINNXmOCY">http://www.youtube.com/watch?v=pPGINNXmOCY</a>	9:16	
Dec 9, 2009	5	Talk	EMR Magda Havas #3.mov; <a href="http://www.youtube.com/watch?v=LcZWBF6w9Sw">http://www.youtube.com/watch?v=LcZWBF6w9Sw</a>	8:21	
Dec 19, 2009	4	Talk	Dr. Magda Havas: The Truth about Wired and Wireless Technologies; <a href="http://vimeo.com/8283238">http://vimeo.com/8283238</a> <a href="http://www.youtube.com/watch?v=dYjAAqUfHtE">http://www.youtube.com/watch?v=dYjAAqUfHtE</a>	1:29:02	
Jan 18, 2009	3	Interview	Dirty Electricity-Part 1-Rays of Rash; Global TV, 16:9, The Bigger Picture. <a href="http://www.youtube.com/watch?v=6CVLa_tRslY">http://www.youtube.com/watch?v=6CVLa_tRslY</a>	8:04	57,029
Jan 18, 2009	2	Interview	Dirty Electricity-Part 2-Dirty Energy, Global TV, 16:9, The Bigger Picture, <a href="http://www.youtube.com/watch?v=A55081TOlbQ">http://www.youtube.com/watch?v=A55081TOlbQ</a>	7:17	52,951
Jul 17, 2008	1	Talk	Dr. Magda Havas: Cell/Transmission towers & your Health, <a href="http://www.youtube.com/watch?v=OmK6r0ntroE&amp;feature=gv">http://www.youtube.com/watch?v=OmK6r0ntroE&amp;feature=gv</a>	59:16	

## 8 INTERVIEWS: TV, RADIO, NEWSPAPER *(incomplete list)*

Below is an incomplete list of interviews since 2001.

Year	Interview
2009	<ul style="list-style-type: none"> <li>Interviewed by Nigel Spence for a documentary on Wind Turbines for the BBC to be aired December 2009; Nov 2, 2009</li> </ul>
[18]	<ul style="list-style-type: none"> <li>CBC Radio Interview, Victoria BC, Oct 6, 2009</li> <li>CFRB Radio Interview on Compact Fluorescent Light Bulbs. Sept 2, 2009</li> <li>Radio Interview with Matthew Hoffman, Aug 27, 2009</li> <li>Interview with John Maciel, July 29, 2009</li> <li>Conscious Living Radio Station, BC, July 8, 2009</li> <li>Amy Dove interview, BC, July 7, 2009</li> <li>Phone Interview regarding High Voltage Transmission Lines in Alberta. Jun 14, 2009</li> </ul>

- CBC TV Montreal, Interview with Geeta regarding CFL bulbs. June 5, 2009
- Terri Goveia, Insurance Magazine interview on Dirty Electricity and Stray Voltage. April 28, 2009
- David Baeta, VOLT TV interview on wireless technology. March 5, 2009
- Eva Herr Radio Interview on Dirty Electricity, February 22, 2009
- Podcast Interview, Alberta, Feb 16, 2009
- Bob Lederer radio interview, Feb 14, 2009
- Patrick Timpone Radio Interview, Texas, Feb 12, 2009
- Global TV airing of interview on Dirty Electricity, 16 by 9, Feb 8, 2009
- Global TV airing of interview on RFR, 16 by 9, Jan 18, 2009
- Global TV airing of Interview on CFL Bulbs, 16 by 9, Jan 4, 2009
- 2006 • CHEX TV, Dirty electricity, December 4, 2006.
- [18] • CBC “As it Happens”, Ground Current Bill, November 16, 200
- Global TV, Ground Current, November 16, 2006.
- French documentary, dirty electricity, September 20, 2006.
- Ode Magazine with Kim Ridley, Dirty electricity and Diabetes. phone interview August 21, 2006.
- Reuters News Paper, phone interview, July 10, 2006
- French Radio, phone interview, July 4 2006.
- Chatelaine Magazine, Interview, with Maureen, May 4, 2006.
- Magazine Interview, Greek Magazine with Christina, April 18, 2006
- Book Interview with Jeffrey Fawcett, phone interview, California, June 28, 2006.
- World Tonight, CHQR, Radio Interview, 20 minutes. April 3, 2006.
- Radio Interview 95.7 FM, Halifax, 1 hour interview with Bill Carr. April 3, 2006.
- Radio News 940, Radio Interview, Montreal, April 5, 2006.
- CBC Radio with Roman in Montreal, phone interview, March 30, 2006.
- Canada AM, CTV, Toronto, ON, March 29, 2006.
- Globe and Mail, Martin Middlestat, Does Power Corrupt. interview February 14 for article March 28, 2006.
- Global News, Cell Antennas and Electrical Hypersensitivity, Neil McCartney, Toronto, Ontario, January 29<sup>th</sup>, 2006.
- Wisconsin Public Radio, WiFi in the City of Milwaukee and possible health implications. January 26, 2006
- 2005 • Newspaper interview, The Barbados Advocate, Radiation Risks, Renee Taylor, January 19, 2005
- [15] • Insight with Pam Macdonald, Transmission Lines, Rogers Cable,

- Newmarket, April 6 2005
- CBC NFL Radio interview, Transformers and cancer. April 15, 2005.
  - Vancouver Sun, Newspaper interview, Karen Gram, Dirty Electricity, March 8, 2005,
  - Vancouver Sun, Newspaper interview, Karen Gram, Health Effects of EMFs, May 1, 2005,
  - The Power Hour Radio interview, Electromagnetic Pollution, May 4, 2005.
  - Insight with Pam Macdonald, Ground Current, Rogers Cable, Newmarket, April 11 2005
  - Insight with Pam Macdonald, Dirty Electricity, Rogers Cable, Newmarket, June 15 2005.
- 
- CKVR TV News, Transmission Lines, Markham, Ontario, June 20. 2005.
  - Toronto Star Interview with Tyler Hamilton, Cell Phones, July 12, 2005.
  - Alive Magazine interview, August 1, 2005.
  - Insight with Pam Macdonald, Rogers Cable, Newmarket, October 2005.
  - Toronto Star, Interview with Tyler Hamilton, Distress Signals, November 11, 2005.
  - Wisconsin Public Radio, Ben Merens, Interview on Electronic Pollution with Dave Stetzer
  - Fitchburg Star, Newspaper Interview with Kurt Gutknecht, Is “dirty electricity” making you sick? December 29, 2005, Vol. 30, No. 21.
- 2004
- Patrick Timpone Show, Radio interview with Patrick Timpone, Electrical Pollution, Austin, Texas, August 7, 2004.
- [5]
- Newspaper interview, Dirty Electricity, Bangor Wisconsin, September 1, 2004,
  - Radio interview, phone-in show, 3 hours, Electromagnetic Pollution you’re your Health, Trinidad, November 17, 2004.
  - Newspaper Interview, Trinidad, November 18, 2004.
  - Jackson County Chronicle, Ken Luchterhand, Newspaper Interview, Testing the Current: Researchers look into the affects of electrical pollution on human health. Wisconsin, November 23, 2004.
- 2001
- Toronto Star Interview with Cameron Smith, Electromagnetic Fields in 60 Communities, September 1, 2001.
- [1]

## 9 COURSES AT TRENT UNIVERSITY

### UNDERGRADUATE COURSES AT TRENT UNIVERSITY, 1989 TO PRESENT

**First Year Courses:**

INTRODUCTION TO ENVIRONMENTAL ISSUES, science course for 1<sup>st</sup> year undergraduate students, 1989-2004 and 2005-present; team taught. (Course coordinator 1991-1994.)

THINKING AND LEARNING first year course, 2001-2003, course coordinator, co-taught with instructors from Psychology, Education, English, Anthropology, Native Studies, Special Needs, and Academic Skills.

**Second Year Courses:**

SCIENCE AND POLICY, course for 2<sup>nd</sup> year students, co-taught with Professor Stephen Bocking, 1999-2000.

DISCOVERING SCIENCE, science course for 2<sup>nd</sup> year arts students, 1992-93.

**Third Year Courses:**

BIOLOGICAL EFFECTS OF ELECTROMAGNETIC FIELDS science course for 3<sup>rd</sup> and 4<sup>th</sup> year students, 1995 to present.

POLLUTION ECOLOGY, environmental science course for third and 4<sup>th</sup> year students, 1994-present, co-taught with Professor Tom Hutchinson. Offered alternate years (even-numbered years)

ENVIRONMENTAL SCIENCE, for 3<sup>rd</sup> and 4<sup>th</sup> year undergraduate science students, Science Education, 1989-2008. Offered alternate years (odd-numbered years).

ENVIRONMENTAL COMMUNICATION, (*replaced Communicating Science 2003/4*) for 3<sup>rd</sup> and 4<sup>th</sup> year undergraduate science students, Science Education, 2009-present. Offered annually.

AQUATIC TOXICOLOGY, for 3<sup>rd</sup> and 4<sup>th</sup> year undergraduate students, Environmental and Resource Studies, Trent University, 1990-1991, co-taught with Professor Doug Evans.

WATER POLLUTION, for 4<sup>th</sup> year undergraduate students, co-taught with Professor Jim Buttle, 1989/90.

**Forth Year Courses:**

GROUP PROBLEM SOLVING, arts course for senior undergraduates, co-taught with Professor Stephen Regoczei, 1995 to 2003. Offered alternate years.

HONOURS THESIS, thesis management and communication skills for 4<sup>th</sup> year undergraduate students, 1989-present. Coordinator 2000-2004; 2011-2012

READING COURSE, various topics dealing with the environment or with education, 1989-present

**Graduate Courses:**

WATERSHED ECOSYSTEM GRADUATE PROGRAM, science communication for graduate students, Trent University, 1990-2003.

TECHNICAL SCIENCE WRITING, for senior graduate students, WEGP, half credit course running full year, 2003-2006.

**Guest Lectures in following Trent Courses:**

FIRST YEAR ENVIRONMENTAL SCIENCE, when I am not normally lecturing in this course

BIOREGIONALISM, Wadland and Whillans

HONOURS THESIS (ES401/402): four 2-hour guest lectures annually

ENVIRONMENTAL IMPACT ASSESSMENT AND ECOLOGICAL PRINCIPLES (ER308)

PHILOSOPHICAL APPROACHES TO SCIENCE (WF 500a)

ECOLOGICAL AGRICULTURE, Tom Hutchinson

WASTE MANAGEMENT, Barbara Wallace

**Non-Trent Summer Course for High School Students**

SHAD VALLEY SUMMER PROGRAM for exception high school students, Co-Director; Trent-Bark Lake-Shad Valley, June 1997; Co-Director again in 2005.

**10 COMMITTEES**

**INTERNATIONAL**

- 2011-pres INVITED GUEST EDITOR: Special Issue *Bulletin of Science, Technology and Society*, Electromog, Electrosensitivity, Electrodiagnostics and Electrotherapies.
- 2010-pres SCIENCE ADVISOR: Electromagnetic Radiation Research Foundation of South Africa (EMRRFSA); [www.emrrfsa.org/](http://www.emrrfsa.org/)
- 2006-pres. ADVISOR: Nationaal Platform Stralingscrisico's in the Netherlands  
ADVISOR: HESE, UK  
ADVISOR: EM Radiation Trust, UK  
ADVISOR: Council on Wireless Technology Impacts  
MEMBER: International Commission on Electromagnetic Safety (ICEMS)
- 2004-pres. ADVISOR: EMR Policy Institute, Marshfield Vermont.
- 2003-4 ADVISOR: International Association of Fire Fighters
- 1996-7 ADVISOR: Great Lakes Science Advisory Board Workgroup on Emerging Issues. International Joint Commission, Canada/US.
- 1993-96 ADVISOR: Environmental Science Program for Tribhuvan University,

- Nepal.
- 1988 SCIENCE ADVISOR: Public Focus; BARK (Backyard Acid Rain Kit) Program which is to be used in school across Canada and the United States.
- 1988 SCIENCE ADVISOR: Lakes 2000, on their Great Lakes Public Awareness Program.
- 1981 MEMBER: Forest Sub-Committee, US/Canada Scientific Committee on Acid Rain, Huntington Forest, N.Y., September 1-3, 1981.
- 1980 ADVISOR: Acid Rain Coalition, Joint US/Canadian Committee on Acid Rain, Michigan 1980.
- 1978 CO-ORGANIZER (with T.C. Hutchinson): NATO Advanced Institute Workshop on Effects of Acidic Deposition on the Terrestrial Ecosystem, Toronto, May 21-25, 1978.

---

## NATIONAL

---

- 2010-pres. CO-FOUNDER: Electro Sensitive Society, [www.electrosensitivitysociety.com](http://www.electrosensitivitysociety.com)  
 ADVISOR: Citizens for Safe Technology Society, [www.citizensforsafetechnology.org](http://www.citizensforsafetechnology.org)
- 2009 RETA, Responsible Electricity Transmission for Albertans, Edmonton Alberta, November 2009
- 2006-pres. CO-FOUNDER and ADVISOR: WEEP Initiative, Canada. [www.weepinitiative.org](http://www.weepinitiative.org)
- 2005 Adviser, SWEEP (Safe Wireless Electrical and Electromagnetic Policy), July 2005
- 2002 PEI, Cell Phone Towers, May 2002
- 2002 REVIEWER: National Policy Research Awards.
- 1993-1998 ASSOCIATE DIRECTOR: KEY Foundation (Knowledge of the Environment for Youth).
- 1991-1993 EDITOR: *KEYnotes*, Environmental Newsletter sent to 17,000 educators across Canada.
- 1988 SCIENCE ADVISOR: Trees for Today and Tomorrow on their Tree-Decline School Program
- 1988 SCIENCE ADVISOR: Boy Scouts of Canada on their Tree-Decline Program
- 1985-1993 DIRECTOR: KEY Foundation (Knowledge of the Environment for Youth).
- 1988-1990 MEMBER: Science and Technology Advisory Committee, CBC.
- 1987 COORDINATOR: Twenty-Second Canadian Symposium on Water Pollution Research, University of Toronto, February 19, 1987.

---

**PROVINCIAL**

---

- 2011-present MEMBER: Expert Working Group on Ground Current, Ontario Ministry of the Environmental
- 2006 ADVISOR: Private Member's Bill, Ground Current Pollution Act, Mpp2006.080.e5-CW in Ontario.
- 2005 TRAHVOL, Tsawwassen Residents Against Higher Voltage Overhead Lines, Vancouver, BC. October 2005
- 2004 Adviser, STOP (Stop Power lines Over People), Markham, Ontario
- 1988-1990 MEMBER: Environmental Appeal Board, Ontario.

---

**LOCAL**

---

- 1999-2004 EDITOR: View from Trent, in cooperation with the Peterborough Examiner, fortnightly column written by Trent Faculty. See end of this section for list of articles.
- 1998, 2000 JUDGE: Science Fair, Trent University, Peterborough, ON.
- 1996 MEMBER: Co-ordinating Committee, Conference on Environmental Health and Alternative Medicine.
- 1992 EVALUATOR: Science Fair Competition, Peterborough.
- 1989-1991 MEMBER: Peterborough Committee on Sustainable Development, Mayor's Committee.

---

**TRENT UNIVERSITY (incomplete list)**

---

- 2011-12 Student Awards, ERS
- 2010-11 Hill Tenure Committee, ERS  
Student Awards, ERS
- 2008-9 Curriculum Committee, ERS  
Hill Probationary Reappointment Committee, ERS  
Merit Committee, ERS  
Student Awards, ERS  
Website Committee, ERS
- 2002-pres MEMBER: Institute for Health Studies (now Centre for Health Studies)
- 2002-3 CHAIR: Senate Budget Subcommittee on Graduate Studies
- 2002-3 MEMBER: Senate Budget Subcommittee, Trent University
- 2002-3 MEMBER: Senate, Trent University
- 2002 MEMBER: Management Committee, Oliver Ecological Centre
- 2002 CO-ORDINATING TEAM: Simply Water? Workshop, Trent

University, Peterborough, On, February 18-20, 2002

2000-04 MEMBER: Interactive Learning Centre (ILC)

2000-01 MEMBER: Search Committee for Chair of ERS Program

2000-01 MEMBER: COTTL

2000-01 MEMBER: Indigenous Environmental Studies Program (IESP)  
Steering Committee

2000 ORGANIZER: David Shepperd Family Lecture Series with Dr. Sheela Basur, Medical Officer of Health, Toronto and later Ontario.

1995-97 Board of Governors  
Board of Governors-Development Committee  
Senate  
Faculty Council Steering Committee  
Faculty Board  
WEGP--ERS Representative  
ERS REPRESENTATIVE: Arctic College

1994-2000 MEMBER: Health Research Group Health Research Group

1994-97 Trent International Program Committee

1996 Trent International Program--Recruitment

1995-97 MEMBER: Board of Governors, Trent University.

1995-2004? CO-FOUNDER and MEMBER: TAcTIC, Trent Academic Technological Innovation Centre

1994-2002 MEMBER: Health Working Group, Trent University

1994-98 CO-ORDINATOR: Energy Fields Working Group, Trent University

1994 MEMBER: PEAC, President's Environmental Advisory Committee  
MEMBER: Tenure Committee for Raul Ponce, ERS Program  
MEMBER: Search Committee for Director of WEGS Program  
MEMBER: Search Committee for Chair of ERS  
MEMBER: PPP-CMT, Computer and Technology for Teaching Committee

1992-1994 MEMBER: Senate, Trent University  
MEMBER: Board of Governors, Trent University  
MEMBER: President's Advisory Environmental Committee

1992-pres MEMBER: ERS Personnel Committee

1991-92 MEMBER: Adjusting our Focus Forum, Teaching Methods Subcommittee

1991-1993 MEMBER: Chemistry, First Year Courses Committee  
COORDINATOR: Library Acquisitions for Environmental & Resources Studies.  
COORDINATOR: Environmental Resource Centre

- 1990-93 MEMBER: Committee on Educational Development, (originally known as the Teaching Effectiveness Committee), Trent University Committee  
MEMBER: Visitors Committee, Lady Eaton College
- 1990-92 COORDINATOR: BEGIN newsletter
- 1990 COORDINATOR: Science in Developing Countries, Trent International Program, Trent University, Peterborough, Ontario, March 2 to 30.
- 1989-pres. MEMBER: Watershed Ecosystem Graduate Program.
- 1989-94 COORDINATOR: Library Acquisitions for Science Education.
- 1989-93 COORDINATOR: Library Acquisitions for Science Education.
- 1989-90 MEMBER: Admissions and Scholarships

---

## UNIVERSITY OF TORONTO

---

- 1985-87 COORDINATOR: Drinking Water Working Group (DWWG), Institute for Environmental Studies, University of Toronto.
- 1986-89 COORDINATOR: Ecology Seminar Series, Institute for Environmental Studies, University of Toronto.
- 1983-89 MEMBER: Acid Rain Working Group, Institute for Environmental Studies, University of Toronto.
- 1983-89 MEMBER: Metals Working Group, Institute for Environmental Studies, University of Toronto.
- 1983-89 MEMBER: Forest Decline Working Group, Institute for Environmental Studies, University of Toronto.
- 1987-89 MEMBER: Research Advisory Committee, Faculty of Forestry, University of Toronto.
- 1987 MEMBER: Graduate Studies Advisory Committee, Faculty of Forestry, University of Toronto.

## 11 INITIATIVES IN TEACHING AND COMMUNITY OUTREACH

- 2002-4 EXECUTIVE EDITOR: Trent Times, Newspaper of the Trent University Faculty Association
- 2000-4 COORDINATOR: SPARK, NSERC funded program for student writing about research
- 1997 DESIGNER: Trent Research Map indicates research of Trent faculty around the globe. Also indicates where students come from (International Program)

- 1996 MEMBER: TacTic, Trent Academic Technological Innovation Centre, to design educational software and other educational initiatives
- 1994-6 COORDINATOR: Energy Fields Working Group brought together members of the Peterborough Community with Trent faculty and students to discuss energy fields. Meetings held every other month.
- 1992 PRINCIPLE INVESTIGATOR: Design, Development and Marketing of Education Software DDAMES; computer program development designed to enable students to interact with the virtual world and solve environmental problems.

## 12 REVIEWER: GRANTS AND MANUSCRIPTS

- 2010 The American Journal of Medical Sciences,  
2008 Parlar Scientific Publications, Fresenius Environmental Bulletin,  
Germany,  
2008 Acta Pharmacologica Sinica,  
2007 British Medical Journal, London  
1995 Rutledge Press,  
1992 Environmental Reviews,  
1986 International Association on Water Pollution Research and Control,  
1985 Water, Air and Soil Pollution,  
1985 Hydrobiologia,  
1985 Canadian Journal of Zoology,  
1984 Environmental Science and Technology,  
1984 Canadian Journal of Fisheries and Aquatic Sciences,  
1982 Science,  
1981 National Science Foundation, (Grant Reviewer)

## 13 ENVIRONMENTAL ORGANIZATIONS

I am Co-founder of the **WEEP Initiative** and the **Electrohypesensitivity Society**. Both are non-profit organizations dedicated to helping people who have developed electrohypersensitivity.

I am Co-founder and Past President of the **Uxbridge Conservation Association**, which is a local non-profit organization aimed to promote a deeper understanding of and a greater appreciation for the natural environment and agricultural land. This group act as a liaison between government and local citizens, they organize lectures and field trips, they also co-ordinate projects within our community that contribute to a cleaner, safer, healthier environment for people and wildlife (1988-1991).

I was a member of the Board of Directors of the **KEY** (Knowledge of the Environment for Youth), which is a non-profit organization dedicated to educational excellence in Canada (1985-1994). One of our projects is the *Chemical Literacy Series*, which is aimed at promoting a better understanding of chemicals in the environment and is intended for teachers (kindergarten to high school) and their students across Canada. We organize workshops for teachers and co-ordinate the production of classroom material. In 1992 I became editor of *KEYnotes*, an environmental newsletter that is sent to every school in Canada (13,000) 3 times during the academic year.

## 14 VOLUNTEER WORK

I taught a Creative Writing course called *Writing Your Memoirs* to Senior Citizens through **Community Care** in Uxbridge (1988-92). In 1990 we wrote a “book” called *Capturing Memories*, and in 1991 we wrote a children’s book. The Seniors have continued and have written several more books. They regularly contribute articles to the local newspaper (*Uxbridge Times*); give guest workshops in the Uxbridge High School; visit homes for senior citizens and read form their stories; give advice to other senior groups wanting to start a writers’ group; and have appeared on *CBC Ideas*.

I also worked with chronically ill patients in the **Uxbridge Cottage Hospital** (1988-1991).

## 15 OTHER

For 18 years I lived on a farm and raised heritage breeds (rare in Canada of sheep (Cotswolds), pigs (British Large Black); and chickens (several breeds) along with non-heritage breeds of ducks, geese, and donkeys. We were members of the Rare Breeds Conservancy of Canada and helped maintain important and dwindling pools of genetic diversity of farm animals.

**Shawn E. Abrell**, WSBA No. 41054, *Pro Hac Vice Pending*  
3405 NW 31<sup>st</sup> Circle, Camas, Washington 98607  
Tel.: 503.512.7712; Fax: 503.222.0693  
E-Mail: shawn.e.abrell@gmail.com  
*Lead Counsel for Plaintiffs*

**Tyl W. Bakker**, OSB No. 90200  
621 SW Alder, Suite 621, Portland, Oregon 97205  
Tel.: 503.244.4157; Fax: 503.220.1913  
E-Mail: twbpc@pcez.com  
*Local Counsel for Plaintiffs*

**United States District Court**

**District of Oregon**

**Portland Division**

**Alexandra Helene Morrison**, by and through  
her Guardian *ad litem* and father,  
David Mark Morrison, and  
**David Mark Morrison**, individually,

v.

**Portland Public Schools,**

Defendant.

Civil Action No.

**Declaration of  
Dr. David O. Carpenter, M.D.**

I, Dr. David O. Carpenter, M.D., under penalty of perjury pursuant to 28 U.S.C. § 1746, hereby make the following declaration in support of a preliminary and permanent injunction enjoining Portland Public Schools' use of WI-FI:

1. I am a public health physician, educated at Harvard Medical School. My current title is Director of the Institute for Health and the Environment at the University at Albany and Professor of Environmental Health Sciences within the School of Public Health. Formerly, I was the Dean of the School of Public Health at the University of Albany and the Director of the Wadsworth Center for Laboratories and Research of the New York State Department of Health.

2. I served as the Executive Secretary to the New York State Powerlines Project in the 1980s, a program of research that showed children living in homes with elevated magnetic fields coming from powerlines suffered from an elevated risk of developing leukemia. After this I became the spokesperson on electromagnetic field (EMF) issues for the state during the time of my employment in the Department of Health. I have published several reviews on the subject and have edited two books.

3. I am a Co-Editor and a Contributing Author of the *BioInitiative: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF and RF)*, [www.bioinitiative.org](http://www.bioinitiative.org). It documents bioeffects, adverse health effects and public health conclusions about impacts of non-ionizing radiation (electromagnetic fields including extremely-low frequency ELF-EMF and radiofrequency (RF) /microwave or RF-EMF fields). The public health chapter from this report was subsequently published in a peer reviewed journal.

4. Additionally, I am a Co-Author of *Setting Prudent Public Health Policy for Electromagnetic Field Exposures*, *Reviews on Environmental Health*, Volume 23, No. 2, 2008, attached as Addendum A-2.

5. In addition, in 2009, I was invited to present to the President's Cancer Panel on the subject of powerline and radiofrequency fields and cancer, and have testified on this issue before the United States House of Representatives.

6. I am a public health physician who has been involved in issues related to EMF for a number of years.

7. It is generally accepted within the relevant scientific community and has been established beyond any reasonable doubt that many bioeffects and adverse health effects occur at far lower levels of RF exposure than those that cause measurable heating; some effects are shown to occur at several hundred thousand times below the existing public safety limits, which are set based on the fallacious assumption that there are no adverse health effects at exposures that do not cause easily measureable heating.

8. Exposure to EMF has been linked to a variety of adverse health outcomes. The health endpoints that have been reported to be associated with ELF and/or RF include childhood leukemia, adult brain tumors, childhood brain tumors, genotoxic effects (DNA damage and micronucleation), neurological effects and neurodegenerative disease (like ALS and Alzheimer's), immune system dysregulation, allergic and inflammatory responses, breast cancer in men and women, miscarriage and some cardiovascular effects. The strongest evidence for adverse health effects of EMFs comes from associations observed in human populations with two forms of cancer: childhood leukemia and chronic lymphocytic leukemia in occupationally exposed adults.

9. There is also strong evidence for elevated risk of brain cancer following long use of cell phones, but only on the side of the head where the cell phone is used regularly.

10. There is suggestive to strongly suggestive evidence that RF exposures may cause changes in cell membrane function, cell communication, metabolism, activation of proto-oncogenes, and can trigger the production of stress proteins at exposure levels below current regulatory limits. Resulting effects can include DNA breaks and chromosome aberrations, cell death including death of brain neurons, increased free radical production, activation of the endogenous opioid system, cell stress and premature aging, changes in brain function including memory loss, retarded learning, performance impairment in children, headaches and fatigue, sleep disorders, neurodegenerative conditions, changes in immune function (allergic and inflammatory responses), reduction in melatonin secretion and cancers.

11. There is also strong and consistent evidence for increased risk of leukemia in individuals who live near to high power AM radio transmission towers. This is particularly relevant because like WI-FI, radio transmission towers give continuous whole body radiation, not just to the head. In addition WI-FI transmitters are indoors, where children may be very close to them.

12. Like second-hand smoke, EMF is a complex mixture, where different frequencies, intensities, durations of exposure(s), modulation, waveform and other factors are known to produce variable effects. *Many years of scientific study has produced substantial evidence that EMF may be considered both carcinogenic and neurotoxic.*

13. Sources of concern include, but are not limited to, power lines, cell and cordless phones, cell towers, Portland Public Schools' WI-FI, WiMax and wireless internet.

14. Based on existing science, many public health experts believe, myself included, that it is possible we will face an epidemic of cancers in the future resulting from uncontrolled use of cell phones and increased population exposure to WI-FI and other wireless devices. Thus it is important that all of us, and especially children, restrict our use of cell phones, and limit exposure to background levels of WI-FI.

15. Children are more vulnerable to RF fields because of the susceptibility of their developing nervous systems. RF penetration is greater relative to head size in children, and they have a greater absorption of RF energy in the tissues of the head at WI-FI frequencies because their skulls area thinner, their brains are smaller, and their brain tissue is more conductive than that of adults since it has a higher water content and ion concentrations. The Presidential Cancer Panel found that children 'are at special risk due to their smaller body mass and rapid physical development, both of which magnify their vulnerability to known carcinogens, including radiation.'

16. The exposure of children to RF has not been studied extensively, although one study from Sweden reports that regular use of a cell phone by children increases risk of development of brain cancer by a factor five times greater than that observed in adults. However, the FCC standards for exposure to radiofrequency radiation are based on the height, weight and stature of a 6-foot tall man, not scaled to children or adults of smaller stature. They do not take into account the unique susceptibility of growing children to exposures. Moreover, there is clear and strong evidence that intensive use of cell phones increases the risk of brain cancer, tumors of the auditory nerve, and cancer of the parotid gland, the salivary gland in the cheek by the ear. WIFI uses similar radiofrequency radiation (1.8-2.5 to 5.0 GHz), although the intensity of exposure in the immediate environment is much lower than what one gets from holding a cell phone close to their head. The difference between a cell phone and a WI-FI environment, however, is that while the cell phone is used only intermittently a WI-FI environment is continuous. In addition WI-FI transmitters are indoors, where children may be very close to them. Because radiation is the same as those for cell phones, there is every reason to assume that the health effects would be the same, varying only in relation to the total dose of radiation. There is evidence from Scandinavian studies of cell phone usage that children who use cell phones are about five times more likely to develop brain cancer than if use starts as an adult. Thus, it is especially important to protect children.

17. There is reason to believe that children are susceptible to the effects of EMF exposure since they are growing, their rate of cellular activity and division is more rapid, and are at more risk for DNA damage and subsequent cancers. Growth and development of the central nervous system is still occurring well into the teenage years so that neurological changes may be of great importance to normal development, cognition, learning, and behavior. Prenatal exposure to EMF has been identified as a risk factor for childhood leukemia. Children are largely unable to remove themselves from exposures to harmful substances in their environments. Their

exposure is involuntary.

18. When WI-FI is installed in a school, children and their parents have no choice but to allow the school to expose themselves/their children. In fact, the children will be exposed to as much as 30-40 hours per week of constant digitally encoded WI-FI signals from each wireless device in the child's vicinity. Based upon a review of the Mount Tabor WI-FI Floor Plan, a given child is subject to direct signals from multiple WI-FI transmitters and rooms full of students transmitting numerous laptop or other wireless signals. There is a major difference between an exposure that an individual chooses to accept and one that is forced on an individual who can do nothing about it, especially a child.

19. In biology and medicine there is nothing that is 100 percent proven. We rely on statistical significance and weight of evidence when drawing conclusions about health effects. When one uses these definitions there is strong scientific evidence for adverse health effects of WI-FI in humans.

20. The evidence for adverse effects of radiofrequency radiation is currently strong (beyond just a known controversy) and grows stronger with each new study. Educating by way of the internet via cabled systems does not increase exposure.

21. Based on a high degree of medical certainty, Portland Public Schools' use of WI-FI is causing and will continue to cause Alexandra Morrison, other students, and school staff and faculty adverse health effects and should be discontinued immediately.

Dated this 1<sup>st</sup> day of June, 2011.

*/s/ David O. Carpenter, M.D.*

---

DR. DAVID O. CARPENTER, M.D.  
Director, Institute for Health and the Environment  
University at Albany

## **Wireless Smart Meters and Potential for Electrical Fires**

Commentary by Cindy Sage, Sage Associates and James J. Biergiel, EMF Electrical Consultant July 2010

Typical gauge electrical wiring that provides electricity to buildings (60 Hz power) is not constructed or intended to carry high frequency harmonics that are increasingly present on normal electrical wiring. The exponential increase in use of appliances, variable speed motors, office and computer equipment and wireless technologies has greatly increased these harmonics in community electrical grids and the buildings they serve with electricity. Harmonics are higher frequencies than 60 Hz that carry more energy, and ride along on the electrical wiring in bursts. Radio frequency (RF) is an unintentional by-product on this electrical wiring.

It may be contributing to electrical fires where there is a weak spot (older wiring, undersized neutrals for the electrical load, poor grounding, use of aluminum conductors, etc.). The use of smart meters will place an entirely new and significantly increased burden on existing electrical wiring because of the very short, very high intensity wireless emissions (radio frequency bursts) that the meters produce to signal the utility about energy usage.

There have now been electrical fires reported where smart meters have been installed in several counties in California, in Alabama, and in other countries like New Zealand. Reports detail that the meters themselves can smoke, smolder and catch fire, they can explode, or they can simply create over-current conditions on the electrical circuits.

Electrical wiring is not sized for the amount of energy that radio frequency and microwave radiation have. These unintended signals that can come from new wireless sources of many kinds are particularly a worry for the new smart meters that produce very high intensity radio frequency energy in short bursts. Electrical fires are likely to be a potential problem.

Electrical wiring was never intended to carry this – what amounts to an RF pollutant – on the wiring. The higher the frequency, the greater the energy contained. It's not the voltage, but it is the current that matters. RF harmonics on electrical systems can come from computers, printers, FAX machines, electronic ballasts and other sources like variable speed motors and appliances that distort the normal, smooth 60 hertz sine wave of electrical power and put bursts of higher energy RF onto the wiring.

Wireless smart meters don't intentionally use the electrical system to send their RF signal back to the utility (to report energy usage, etc). But, when the wireless signal is produced in the meter... it boomerangs around on all the conductive components and can be coupled onto the wiring, water and gas lines, etc. where it can be carried to other parts of the residence or building.

It is an over-current condition on the wiring. It produces heat where the neutral cannot properly handle it. The location of the fire does NOT have to be in close proximity to the main electrical panel where the smart meter is installed.

A forensic team investigating any electrical fire should now be looking for connections to smart meters as a possible contributing factor to fires. Every electrical fire should be investigated for the presence of smart meter installation. Were smart meters installed anywhere in the main electrical panel for this building? For fires that are 'unexplained' or termed electrical in nature, fire inspectors should check whether smart meters were installed within the last year or so at the main panel serving the buildings. They should question contractors and electricians who may have observed damage from the fire such as damage along a neutral, melted aluminum conductor or other evidence that would imply an over-current condition. They should also look for a scorched or burned smart meter, or burn or smoke damage to the area around the smart meter. Problems may be seen immediately, with a smart meter smoking or exploding. Or, it may be months before the right conditions prevail and a neutral circuit overloads and causes a fire. The fire may or may not be right at the smart meter.

- Any smart meter installed in a main panel might start an electrical fire in that building; it would not be necessary for the unit itself to have a smart meter. The RF emissions from any smart meter in the main panel might trigger an electrical fire at any location in the building served by this main panel because harmonics can and will travel anywhere on electrical wiring of that building.

Some questions that should be asked include:

- Were smart meters installed in the main electrical panel for this building? Problems may be seen immediately, with a smart meter smoking or exploding. Or, it may be months before the right conditions prevail and a neutral circuit overloads and causes a fire. The fire may or may not be at the smart meter.
- Is there damage at the smart meter itself (burning, scorching, explosion)?
- Was there fire damage, a source, or a suspicious area around the neutral where it connected to the main panel or at the breaker panel?
- Was the damage around a lug at a connection on the neutral conductor in the attic at Xanadu? Was there any indication of heating or scorching or other thermal damage around the neutral in the area of the fire?
- Was aluminum conductor present? Aluminum conductors that were installed in the '70s are today recognized as more of a problem for heating than copper wire. Was the aluminum, if present, showing heat damage or melting?

Even before smart meters were being installed widely in California, people who know something about EMF and RF were expressing concerns that this kind of thing would

likely happen (electrical fires due to overcurrent condition from RF signal). What is already postulated, and of concern, is that the rising use of equipment that put RF harmonics onto the electrical wiring of buildings may overload that wiring. Faulty wiring, faulty grounding or over-burdened electrical wiring may be unable to take the additional energy load.

[1] Advanced Metering Infrastructure; January 2010 Semi-Annual Assessment Report and SmartMeter™Program Quarterly Report (Updated), Pacific Gas and Electric Company.

PUC Docket 2011-262 Friedman on Remand  
Intervener DW et al Evidence 20 Evidence and Testimony from Other Cases  
Court Cases and Public Utilities Commission Cases

Category List Filed last updated 4/9/13, Item No.

Evidence 20 Evidence and Testimony from Other Cases, Court Cases and PUC

This category contains some documents from the original Smart Meter Opt Out Case at the Maine PUC, Elisa Boxer Cook et al 2010-0345, and the consolidated case numbers 2010-289, 2010-398, 2010-400 and 2011-085. It also contains expert testimony from an Oregon WiFi case that is currently proceeding in the Oregon courts. In that case, experts testified regarding RF radiation in the same frequency as our smart meters, and, if money were no object, these same experts could have been brought to Maine to testify by the OPA, the PUC or Interveners. Technology also allows us to Skype, and in this hearing, we should be doing so. This category also contains expert testimony from the Hydro Quebec proceedings on Smart Meters, and an Expert Witness Statement to Standing Committee off the Canadian House of Commons. In this way, the Interveners are presenting additional expert testimony that was not provided by the Complainant or PAO regarding adverse health effects caused by non-thermal radiation. These experts strengthen Intervener's submittals of peer-reviewed studies, as they attest to their value in determining the lack of safety of smart meters that emit at similar frequencies.

In the references below, the author is listed first. The title of the document as the title was entered into the docket is underlined. The actual/real document title is in brackets and bolded and italicized.

20.01 Suzanne Foley-Ferguson et al, ***Letter to Commissioners Urging No Cost Opt Outs***, MPUC Consolidated Docket 2010-345 et al; May 16, 2011. This document argues that any cost or fee for an opt out is discriminatory, unfair and unjust. Complainants point out that CMP identified health and other "Complaints to the Commission" as a High Risk in their Internal Risk Assessment of the approved AMI system. It argues that any cost to opt out of a device that even has the slightest possibility of causing harm to human health is discriminatory. Also discusses overstepping of easement.

[Filed in Docket 03/04/13; Item #375]

20.02 Marcinowski, Frank, Director, Radiation Protection Division, EPA  
ExhibitC\_SAFFcasefile ***Environmental Protection Agency [Letter to Janet Newton***  
***March 8, 2002]*** Summary: This document is a true copy of a response letter 20.03.

[Filed in Docket 03/04/13; Item #375]

20.03 Marcinowski, Frank, Director, Radiation Protection Division, EPA  
ExhibitCeparesponseSAFFcasefile ***Environmental Protection Agency Letter to Janet***  
***Newton March 8, 2002]*** This document combines two letters of the March 8, 2002 and July 16, 2002 in which the Environmental Protection Agency (EPA) replies to Janet Newton regarding the FCC standards. It states that FCC's standards do not apply to chronic, non-thermal exposure situations and that it is considered to be protective of

Category List Filed last updated 4/9/13, Item No.

effects arising from a thermal mechanism but not from all possible mechanisms. The EPA states that “*Therefore, the generalization by many that the guidelines protect human beings from harm by any or all mechanisms is not justified*”. It discusses the adverse effect level of 4W/kg, and points out that the FCC does not claim that their exposure guidelines provide protection for exposures to which the 4W/kg SAR basis does not apply (chronic and non-thermal). This letter was accompanied by a letter written in June of 1999 to Richard Tell of the Risk Assessment Work Group, in which the members of the RFIAWG identified certain issues that they had determined needed to be addressed in order to provide a strong and credible rationale to support RF guidelines. (See 20.04)

[Filed in Docket 03/04/13; Item #375]

20.04 Lotz, Gregory, ***Department of Health and Human Services, [Gregory Lotz, PhD, Chief, Physical Agents Effects Branch, Division of Biomedical and Behavioral Science, National Institute for Occupational Safety and Health, DHHS, June 17, 1999 DHHS Letter to Richard Tell Chair, IEEE SCC28 (SC4) Risk Assessment Work Group ExhibitD-DHHSlettTotell***

This letter outlines the RF Guideline Issues identified by members of the federal RF Interagency Work Group in June of 1999. The RFIAWG members believe that FCC needs to address all of these issues to provide credible rationale for FCC guidelines. Members and their organizations: Robert Cleveland, Senior Scientist, Federal Communications Commission (FCC), Larry Cress, US Food and Drug Administration (FDA), DCRH, Radiation Biology Branch, Robert A. Curtis, OSHA, US Department of Labor, Occupational Safety and Health Administration, Joseph A. Elder, US Environmental Protection Agency (EPA), Norbert N. Hankin, US EPA, Janet H. Healer, NTIA, Department of Commerce, Gregory W. Lotz, NIOSA, Russell D. Owen, US FDA, Chief, Radiation Biology Branch.

The seven-page letter outlines these issues that have yet to be addressed:

1. Biological basis for local SAR limit / dosimetry may not be applicable
2. Selection of an adverse effect level /
3. Addressing acute versus chronic exposures
4. One tier versus two tier guidelines
5. Controlled versus uncontrolled exposures / specific populations
6. Uncertainty factors/ how or if... extrapolate acute to chronic / variations among individuals/ inability for any single study to adequately address all possible adverse outcomes.
7. Intensity or frequency modulated (pulsed)
8. Time averaging / applicability to prolonged or chronic exposures?
9. Lack of peak limits for induced and contact current
10. Transient discharges
11. Limits for exposure at microwave frequencies/ issue of continuous exposure
12. Replication / Validation of studies/ definition should not be so restrictive to disallow reports that are valid but not exact replication of procedures or results.
13. Documentation of the Literature review process.

Category List Filed last updated 4/9/13, Item No.

14. Compatibility of RFR guidelines

[Filed in Docket 03/04/13; Item #375]

20.06a. Suzanne Foley-Ferguson et al, ***Exhibit A; Foley-Ferguson Letter To Dr. Dora Mills, Director of Maine Center for Disease Control (MCDC) and Prevention (MCDC)***. MPUC Docket 2010-345 & 398; November 11, 2010. This letter questions the thoroughness of the review by the Maine CDC because the conclusion of the report does not follow from the data. The MCDC admitted that it was not a comprehensive review, and they only reviewed the data for approximately three weeks. Dr. Bailey testified in this docket after questioning by Foley-Ferguson that it would be difficult to do a thorough review in that timeframe. The letter points out another review that lists the same studies but comes to a very different conclusion. (Misabeled as Evidence 11 should be 20)

[Filed in Docket 03/04/13; Item #375]

20.06b. Havas, Magda, ***Addendum A; Declaration of Expert Witness Dr. Magda Havas, in Portland Division, AHM, by and through her Guardian ad litem and father, David Mark Morrison versus Portland Public Schools***, Civil Action No. 3:aa-cv-00739-MO; U.S. District Court of Oregon, December 2011. This document from a court case in Oregon outlines the studies that Dr. Havas refers to in her expert testimony regarding RF radiation in similar frequencies as the Maine smart meters. She separates them into seven categories. The Interveners in the Maine PUC case, Friedman et al 2011-00262 present this as evidence to strengthen our presentation of studies in our other categories. We have uploaded many of the studies reviewed by Dr. Havas, however, this is an expert testifying that these are valid and good studies, not Interveners in this case simply stating it is so. She presents in this addendum some other studies that are also relevant to this case. [Copy filed in Docket]

20.06c. Havas, Magda, ***Addendum C; Declaration of Expert Witness Dr. Magda Havas, in Portland Division, AHM, by and through her Guardian ad litem and father, David Mark Morrison versus Portland Public Schools***, Civil Action No. 3:aa-cv-00739-MO; U.S. District Court of Oregon, December 2011. This document is relevant because Dr. Havas presents summaries of some “key” International Appeals on RF radiation based on current data. Interveners have listed and presented internet links to the full appeals in another category, but did not provide summaries of them. This seven-page addendum summarizes some of them for the Maine PUC in order for the MPUC to understand the relevance of the documents. [Copy filed in Docket]

20.07 Suzanne Foley-Ferguson et al, ***Exhibit B; Foley-Ferguson Letter to Maine PUC RE: Precautionary Principle***, MPUC Docket 2010-345 & 398; November 17, 2010. This letter explains the elements of the Precautionary Principle, which was, at that time found as the very first link on the Maine.gov site under cell phone information. Foley-Ferguson points out that it is important for the PUC to work under that principle when evaluating its’ decision to use wireless smart meters. Foley-Ferguson points out that new

Category List Filed last updated 4/9/13, Item No.

technology requires a paradigm shift in decision making principles due to the fact that often this technology is not pre-tested for safety. Precaution is required to prevent irreversible harm such as genetic damage from RF radiation in the population. The letter pulls the quotes from the Maine.gov website. It is presented as evidence that governmental commissions in Maine are allowed to determine when it is necessary to use the Precautionary Principle to protect the public. When absolute proof is not a given, and since the PUC “must ensure” safe utility service, then by necessity they need to use this principle. (Mislabelled as Evidence 11 should be 20)

[Filed in Docket 03/04/13; Item #375]

20.08 Suzanne Foley-Ferguson et al, ***Motion To Reconsider Order for Consolidated Cases; Order Part I & Part II; June 2011***, MPUC Docket 2010-345 & 398; July 12, 2011. This is the consolidated complainants motion to the Maine PUC to reconsider the Maine Opt Out Program with its initial charge and ongoing monthly charges. It notes that there is new information because the WHO reclassified RF radiation as a class 2B carcinogen after the deadlines for submission. The motion also argues that the PUC failed to address health effects and the adverse RF radiation effects created by meters other than those on ones own home. Complainants point to the Commission failing to address the legal issues surrounding CMP’s use of ones property to transmit other peoples data resulting in placing an antenna on someone’s home without permission (taking?) and / or charging them for not allowing their home to have the meter attached. It also argues that the initial opt out cost for Repeaters that may or may not even be purchased by CMP (per their statements), but will be paid for by opt out customers, is discriminatory. It also argues that requiring individuals to pay to maintain their long term health or short-term health (pacemakers, DBS) is also a discriminatory practice. Finally, the complainants argue that the opt out program is violating the Terms and Conditions of the easement and service. (Mislabelled as Evidence 11 should be 20)

[Filed in Docket 03/04/13; Item #375]

20.09 Suzanne Foley-Ferguson et al, ***Response to CMP’s Response to Reconsideration Request***, MPUC Docket 2010-345 & 398; August 4, 2011. These comments are pulled from the original opt out case to be included as evidence in this Docket. The letter pulls the quote from the Commission’s Order regarding their omission of determination of safety. The letter argued that one commissioner does have the knowledge to review the literature. Complainants also argued that the number of repeaters should be reconciled with actual numbers, and that the commission should re-visit wired meters. It says that the WHO’s classification and the fact that the EPA wanted to list RF radiation as a “probable carcinogen” in 1993 was “new” information to the docket. (Mislabelled as Evidence 11 should be 20)

[Filed in Docket 03/04/13; Item #375]

20.10 Suzanne Foley-Ferguson et al, ***Complaint to MPUC re: CMP AMI System***; MPUC Docket 2010-345; December 17, 2010. This complaint discusses FCC standards. It asks

Category List Filed last updated 4/9/13, Item No.

the Maine PUC to evaluate the health risks of wireless technology and the benefits of implementing alternatives to wireless AMI. Complainants allege that the original AMI proceedings did not fully evaluate all scenarios in light of possible health effects. This complaint specifically pushed for a wired alternative. It was consolidated with Boxer Cook and others 2010-345. The complainants argued for non-wireless meters in the form of PLC or Fiber Optic, and made the point that every Commission decision made at the conclusion of an adjudicatory proceeding shall include “findings of fact sufficient to apprise the parties and any interested member of the public of the basis for the decision.”(Commission Rules) However, no findings of facts regarding health or hardwiring were reported after original AMI hearing. (In this docket, this was mislabeled, as Evidence 11 should be 20)

[Filed in Docket 03/04/13; Item #375]

20.11 Arthur Fitchenberg & Alan Golden testimony; *in Federal Communications Commission, In the Matter of Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation*, ET-Docket No. 93-62 and Report and Order FCC 96-326, Washington, D.C. 20554. This document is a combination of more than one letter. It includes a letter from Alan Golden, of Seattle Washington to the FCC opposing their rules. The letter attaches documents the FCC Docket (93-62) in the matter that included evaluating changes in the rules for the FCC in 1996 at the time when the current FCC standards were being considered. Mr. Golden points out a number of things including: Section 253 of the Telecommunications Act of 1996 Congress explicitly grants states authority to assure public safety - which includes jurisdiction to set state tort liability and share with the Commission other authority as long as complying with state law would make it impossible to also comply with Commission rules. This document also includes a letter from the EPA to David Fichtenberg in October of 1996 pointing out that the FCC does not claim that their new exposure guidelines provide protection for effects to which the 4W/kg SAR basis does not apply. When they developed their standards, they felt there was sufficient information on thermal exposure effects to develop a base standard, but they wanted more on non-thermal before setting a guideline. The EPA states, “*the effects information is not yet sufficient to be used to develop exposure criteria to protect the public against adverse human health effects*”; thus none were developed. EPA continues, “*The thesis that the 1992 ANSI/IEEE recommendations are protective of all mechanisms of interaction is unwarranted because the adverse effects level in the 1992 ANSI/IEEE standards are based on a thermal effect*”. (Mislabeled as Evidence 11 should be 20)

[Filed in Docket 03/04/13; Item #380]

20.12 Trower, Barry, *Amended Declaration of Expert Witness Barrie Trower, in Portland Division, AHM, by and through her Guardian ad litem and father, David Mark Morrison versus Portland Public Schools*, Civil Action No. 3:aa-cv-00739-MO; U.S. District Court of Oregon, December 2011. This document is the expert witness

Category List Filed last updated 4/9/13, Item No.

testimony of Barry Trower regarding microwaves in a case in Oregon. He explains that knowledge of microwave sickness, which is the same as EHS, was first reported in the 1930's. He cites many early studies on microwaves and health effects including the US Naval document already uploaded by Interveners, and John R. Goldsmith's study of the US Embassy in Russia. He notes that microwave illness / EHS was "well documented" by 1997 with over 100 other documents. He gives the review reference. As an expert, Mr. Trower substantiates evidence provided by the Interveners to this docket.

(Misabeled as Evidence 11 should be 20)

[Filed in Docket 03/04/13; Item #380]

20.13 Trower, Barry, *Addendum A; Declaration of Expert Witness Barrie Trower, in Portland Division, AHM, by and through her Guardian ad litem and father, David Mark Morrison versus Portland Public Schools*, Civil Action No. 3:aa-cv-00739-MO; U.S. District Court of Oregon, December 2011. This document is a drawing of the irreversible damage that is created by MW / RF radiation. Mr. Trower makes the point that genetic damage to female children's ovaries could cause multi-generational irreversible damage due to the fact that women have all of their "eggs" at birth.

(Misabeled as Evidence 11 should be 20)

[Filed in Docket 03/04/13; Item #380]

20.14 Havas, Magda, *Declaration of Expert Witness Dr. Magda Havas in Portland Division, AHM, by and through her Guardian ad litem and father, David Mark Morrison versus Portland Public Schools*, Civil Action No. 3:aa-cv-00739-MO; U.S. District Court of Oregon, December 2011. This document supports the evidence presented by Interveners in this case by presenting testimony from an expert that agrees with Interveners lay testimonies (not yet filed) and evidence uploaded in the form of peer reviewed journals and other reports that low level, chronic RF radiations, similar to smart meter emissions can cause adverse health effects. Dr. Havas includes her CV and references in this declaration. (Misabeled as Evidence 11 should be 20)

[Filed in Docket 03/04/13; Item #380]

20.15 Havas, Magda, *Addendum B to Declaration of Expert Witness Dr. Magda Havas, in Portland Division, AHM, by and through her Guardian ad litem and father, David Mark Morrison versus Portland Public Schools*, Civil Action No. 3:aa-cv-00739-MO; U.S. District Court of Oregon, December 2011. The signatures of these doctors and employees of Boston Medical Center are of significance to this case because the petition substantiates the concern of medical professionals regarding ubiquitous recurring microwave exposures and the "biological plausibility of harm". The petition reads that these doctors want to avert harmful public exposure to pulsed microwave transmissions. In the petition, Boston public health physicians and scientists called for a "halt to the pulsed microwave radiation based cell phone infrastructure. Nearly one hundred doctors and scientists sign the petition. The petition reads in part, "**Due to the plausibility of negative health impacts, particularly to the human nervous system, as well as**

Category List Filed last updated 4/9/13, Item No.

**anecdotal evidence from such exposures in cities where transmission has already been implemented and voluminous medical studies indicating human and ecological harm from microwaves**, we urge the suspension” ...of the implementation of putting cell towers up. The petition supports that there is reason to be concerned about long term exposure to low-level RF. It supports Interveners’ testimony from physician experts. (Misabeled as Evidence 11 should be 20)

[Filed in Docket 03/04/13; Item #380]

20.16 Havas, Magda, *Addendum D to Declaration of Expert Witness Dr. Magda Havas, in Portland Division, AHM, by and through her Guardian ad litem and father, David Mark Morrison versus Portland Public Schools, Civil Action No. 3:aa-cv-00739-MO*. U.S. District Court of Oregon, December, 2011. This is Dr. Havas presentation to the Court in Oregon regarding 2.4GHz Wifi. It is a PowerPoint pdf that includes diagrams and explanations of some specific studies. It supports Interveners evidence that pulsed RF and constant exposure to RF can cause health effects. (Misabeled as Evidence 11 should be 20)

[Filed in Docket 03/04/13; Item #380]

20.17 Carpenter, David, *Declaration of David Carpenter in Portland Division, AHM, by and through her Guardian ad litem and father, David Mark Morrison versus Portland Public Schools, Civil Action No. 3:aa-cv-00739-MO*. U.S. District Court of Oregon, December, 2011. Dr. Carpenter’s testimony in Oregon strengthens Intervener’s testimony and evidence in this case because his opinions, as an expert, coincide with Interveners, and he specifically discusses some of the same studies presented by Interveners. He also discusses FCC standards and standard setting and his CV is included. (Misabeled as Evidence 11 should be 20)

[Filed in Docket 03/04/13; Item #382]

20.18 Dr. David Carpenter Testimony, in *Quebec Energy Board - Docket no. R-3770-2011- Authorization of an Investment by Hydro-Quebec Distribution Advanced Metering Project Phase 1; Referred to in Section 41 of Dr. Carpenter’s Expert Report Cellular and animal studies on of cancer, genotoxicity, neurotoxicity and other health outcomes from RF/MS radiation*, Province of Quebec, District of Montreal, Canada; C-SE-AQLPA-0072, SE-AQLPA-7, Filed May 15, 2012. Dr. Carpenter lists the studies he cites as evidence of adverse health effects of RF/MW radiation. Dr. Carpenter explains that these studies explain the mechanisms of interaction between RF/MW radiation and biologic systems at the cellular level and include: cell membrane recognition process, signal transduction and heat-shock protein release, lipid peroxidation, free radical damage, mRNA and transcription, epigenetic changes, and micronuclei formation, DNA repair disruption, immune response suppression. It is the Interveners’ intent that all seven of the cited studies and full copies, be included as part of this MPUC docket (Sinha, 2008; Nittby H, 2008; Kimmel S; Panagopoulos, 2010; Everaert, 2007; Magras, 1997; Balmori,2009) along with this Expert Report. [Copy filed in Docket]

Category List Filed last updated 4/9/13, Item No.

20.19 Dr. David Carpenter Testimony, in ***Quebec Energy Board - Docket no. R-3770-2011- Authorization of an Investment by Hydro-Quebec Distribution Advanced Metering Project Phase 1; Referred to in Section 44 of David O. Carpenter's Expert Report Mechanisms of Interaction between RF/MW Radiation and Biological Systems at the Cellular Level***, Province of Quebec, District of Montreal, Canada; C-SE-AQLPA-0072, SE-AQLPA-7, Doc. 1.1, parag. 44, 55; Filed on May 15, 2012. Section 44 of Dr. Carpenter's report filed in the referenced court docket are citations for research studies that provide evidence of mechanisms for interaction between RF/MW radiation and biologic systems at the cellular level. It is the Interveners' intent that all thirty one of the cited studies and full copies along with this report be included as part of the subject MPUC docket (Litovitz, 1994; DiCarlo, 1998; Penafiel, 1997; Dicarlo, 1999; Litovitz, 1990; Litovitz, 1997; Litovitz, 1997; Litovitz, 1993; Serban, 1994; Vileno, 2010; Maaroufi, 2011; Nelson, 1994; Alvarez 1989; Devasagayam, 2003; Ozgur, 2010; Gutteridge, 1981; Yan, 2009; Yan, 2008; Simbürger, 1997; Chen, 2010; Migliore, 2009; Tice, 2002; Vijayalaxmi 2009; Sannino, 2009; Brusick, 1998; Belyaev, 2009; Sun, 2006; Lyle, 1983; Elekes, 1996; Dabala, 2008; Surcel, 2009). **[Copy filed in Docket]**

20.20 Dr. David Carpenter Testimony, in ***Quebec Energy Board - Docket no. R-3770-2011- Authorization of an Investment by Hydro-Quebec Distribution Advanced Metering Project Phase 1; Referred to in Section 40 of Dr. Carpenter's Expert Report, Neurologic, immune, endocrine, reproductive and cardiac adverse health effects from low-dose, chronic exposure to RF/MW radiation in humans***, Province of Quebec, District of Montreal, Canada; C-SE-AQLPA-0072, SE-AQLPA-7. Dr. Carpenter's Report includes full copies of studies that show neurologic, immune, endocrine, reproductive and cardiac, adverse health effects from low-dose, chronic exposure to RF/MW radiation in humans. It is the Interveners' intent that all of the cited studies be included as part of the subject MPUC docket (Volkow, 2011; McCarty, 2011; Papageorgiou, 2011; Altpeter, 200; Abelin, 2005; Hutter, 2006; Preece, 2007; Robertson, 2010; Buchner, 2011; Eliyahu, 2006; Barth, 2008; Augner, 2010; Avendano, 2012; Baste 2008). **[Copy filed in Docket]**

20.21 Curtis Bennett, ***Second Amended Declaration of Curtis Bennett; in Portland Division, AHM, by and through her Guardian ad litem and father, David Mark Morrison versus Portland Public Schools, Civil Action No. 3:aa-cv-00739-MO.*** U.S. District Court of Oregon, December, 2011. Mr. Bennett provides a good basic discussion of the underlying plausibility of non-thermal adverse effects caused by RF radiation, and explains based on his knowledge of electricity, how some mechanisms may work. He cites a number of mechanistic studies that the WHO underemphasized: Zhou et al 2011, the study that suggests that intermediate frequency fields allow large segments of the DNA molecule, but not its entire length, to become polarized. This polarizing in turn causes clumping and DNA collapse (Zhou et al., *Collapse of DNA in ac Electric Fields*,

Category List Filed last updated 4/9/13, Item No.

Phys Rev Lett 106, 248103, 2011 and Baan et al, 2011, *EMFs generated by RF sources couple with the body, resulting in induced electric and magnetic fields and associated currents inside tissues*. The most important factors that determine the induced fields are the distance of the source from the body and the output power level. Additionally, the efficiency of coupling and resulting field distribution inside the body strongly depend on the frequency, polarization, and direction of wave incidence on the body, and anatomical features of the exposed person, including height, body-mass index, posture, and dielectric properties of the tissues. Induced fields within the body are highly non-uniform, varying over several orders of magnitude, with local hotspots.

[http://www.natap.org/2011/newsUpdates/062311\\_01.htm](http://www.natap.org/2011/newsUpdates/062311_01.htm). Mr. Bennett also discusses medical equipment interference with apnea monitors, cardiac defibrillators, etc.

[Filed in Docket 03/04/13; Item #382]

20.22 Dr Andrew Goldsworthy, ***Declaration of Dr. Andrew Goldsworthy, BSc, PhD; in Portland Division, AHM, by and through her Guardian ad litem and father, David Mark Morrison versus Portland Public Schools***, Civil Action No. 3:aa-cv-00739-MO; U.S. District Court of Oregon, 2010. Dr. Goldsworthy's testimony is valuable to this case because he is an expert botanist and biochemist. None of the experts presented by the Complainant or CMP hold these credentials. His CV is included. Dr. Goldsworthy, in his testimony, takes RF to the basic level of the cell and membrane potentials. He studied calcium efflux from cell membranes. RF/MW radiation that is far too weak to cause significant heating can remove calcium ions from cell membranes in the brain and elsewhere. He says that voltage gradients allow membranes, which are often only two molecules thick, to rectify themselves and demodulate. He gives an example of an artificially created radio set from a single carbon nanotube having a similar diameter to an ion channel in a membrane. This nanotube works, just as he believes the membranes do. In his testimony in Oregon, he explains a number of studies regarding RF radiation damage resulting from the peroxidation of polyunsaturated lipids in cell membranes and changes to the nucleic acid metabolism of cells. He gives examples of recent studies. Molecular effects caused by cell phone radiation (11 studies cited) DNA repair disruption (3 studies cited), Micronuclei formation, immune response suppression (7 studies cited). Then he discusses mechanisms and explains how the effects can arise, and describes how some of the consequences of Leaky Cell Membranes arise: Blood brain barrier loss of protection, effects on metabolism, cardiac arrhythmia, allergy effects, skin effects, hormonal effects. In his expert opinion virtually all share a common mechanism of "leaky membranes", and the evidence fits together leaving little doubt that reported effects are real and must be taken seriously

[Previously filed in Docket as Evidence 11 on 03/04/13; Item #382]

20.23 Dr. Andrew Goldsworthy, ***Expert Witness Statement***, Standing Committee off the Canadian House of Commons, April 2010. Dr. Goldsworthy notes that there are literally thousands of scientific papers written on the non-thermal effects of weak non-ionizing

PUC Docket 2011-262 Friedman on Remand  
Intervener DW et al Evidence 20 Evidence and Testimony from Other Cases  
Court Cases and Public Utilities Commission Cases

Category List Filed last updated 4/9/13, Item No.

radiation such as that from our smart meters and / or cell phones, and well over half of them show some sort of biological effect. He believes that it is the “biological variability” of human beings, due to their genetic makeup that makes studying the effects of RF/MW difficult. In this testimony he suggest a more realistic approach is to look at frequently reported effects to see common underlying threads that may indicate a common mechanism. He suggests two: cryptochrome, which affects animal navigation, the immune system and circadian rhythms, and calcium efflux from cell membranes.

[Previously filed in Docket as Evidence 11 on 03/04/13; Item #382]

## **Smart Meter Testimony McMillin Hearing 12/2/14, notes taken by Barb Galster**

About 100 citizens were scheduled to speak at the hearing on Smart Meters – I was only able to hear the following testimony. The following information is highlights from my notes only and has misspelled names (I could only write down names to the best of my ability after hearing them spoken).

### **Dee Ann Hilbert - Rochester Hills, RN**

Smart meters are a transmitting device, not a meter, they are a recorder of 2 way communication  
She listed all communities where smart meters have been banned for the committee record

### **David Sheldon – Ferndale, head of Michigan Stop Smart Meters**

Says that the MPSC has never had a hearing that allowed expert testimony regarding the safety of smart meters and the privacy concerns related to them. He says the only hearing MPSC held was regarding rate charges

Reasons to keep analog meter

1. Once digital meter is installed, all transparency is gone as consumer is not able to read meter themselves
2. Analog meters do no cause any health issues and do not invade privacy

He requests that people be able to keep their analog meter without opt out fees and that opt out plan be extended to apartment buildings and small businesses. For example, electro-sensitive people should not have to fear entering their medical doctors offices if the doctors medical building has a smart meter attached.

He submits for the record the expert testimony of 45 doctors and scientists from all over the world stating that smart meter radiation is harmful

### **DTE Reps – Bob Sitkauskas– Joe McCormick—DTE AMI Department**

- Meters are property of DTE – it is against the law to block access to the meters
- Analogs are “no longer being manufactured”
- Question from McMillin – what is the harm in allowing people to keep analog meters
  - answer – this is a business decision, updated technology,
- In answer to another question DTE rep said that the meter can be moved from the home to another location at homeowners expense.
- McMillin statement – seems that DTE has a monopoly that does not offer customers any options other than their approved smart meter

### **Abigail Nobel**

Testimony – there are important principals in governing

1. to secure citizens rights to life
2. to secure safety in citizens own homes
3. to promote health in the community
4. to do everything possible to secure individual rights to health and happiness

[The role of government should not be primarily to care for corporations such as DTE and Consumers](#)

She requests that smart meter installation be placed on hold pending further study

### **Dominic and Lillian Cusmano – synopsis of their experience**

- Nov 2012 Lillian noticed flu symptoms whenever visiting their second home in Oakland county. Only experienced problems there, the symptoms would stop when residing in primary home.
- Someone mentioned that perhaps a smart meter had been installed on their Oakland county home. Sure enough, 800,000 meters had been installed in N. Oakland county, without any notice or authorization.
- DTE refused to remove smart meter. Customer removed meter and within 1 month DTE took them to court. They have been able to represent selves in court since 2012 since DTE only had “implied consent” to install.
- The DTE Opt Out plan is a sham. It is not an opt-out – it is a modification of the smart meter.
- Currently their case is on appeal in circuit court. Lillian Cusmano now has electro-sensitivity due to the smart meter exposure. She has letters from 2 doctors saying that she should not live in a home with a smart meter. She also has an expert list of scientists who give testimony of smart meter health issues.

### **Consumers Energy Rep (did not get name)**

- These meters represent great potential for technological advances
- She is proud of the Consumers Energy program and highlighted their communication with customers.
- **She was unable to answer Representative [Rose Mary Robinson's](#) question regarding what great advances were in store due to the new technology.**
- The consumers energy meters differ from the DTE meters in that they transmit directly to a cell tower. (DTE meters transmit to a hub and then after collecting all the hub data, the data is sent to a tower)
- In addition Consumers opt out meters do not contain a smart chip – All DTE meters have the chip but the chip is turned off for those in the opt out plan

### **Karen Spranger – Warren**

- States that the MPSC report only looked at expert testimony from those who promote smart meters, that they did not allow public testimony related to concerns regarding smart meters
- Since more and more technology – (smart meters, increasingly powerful cell towers, etc) there is a new form of pollution in the air. It is odorless, you cannot hear or feel it, but that it affects cellular structure and cellular DNA.
- Karen states that a persons home should be free from outside sources of pollution that is forced on people with smart meters.

### **Michele Ureste (West Bloomfield Twp Supervisor)**

- This (smart meters) is the most important issue in Lansing – the health and safety of its citizens
- People are already subjected to EMF from utility poles, microwaves, cell phones, wi- fi but to be forced to receive more EMF from smart meters is intrusive and harmful.
- DTE and Consumers are both highly profitable, being a monopoly in MI. Their goal is profit.
- **It is the role of the legislature to protect people's health and safety. It is her opinion that the state should be more concerned about children's health than improved service times the utility companies claim smart meters provide.**

### **Kathy Warras, Bloomfield Hills resident**

- I have lived in my home for 30 years. Came home from Florida last April and all of a sudden could not sleep.
- She was waking up each night around 4AM, then the headaches began. Her physician, Dr. Brownstein (and another, that I did not get name of) said the change could be due to the smart meter installation. She tried the Opt out plan provided by DTE (turn off chip in meter). It took 30 days for DTE to do this. The opt out plan did not improve her symptoms. Now she experiences ringing in the ears and heart palpitations.
- When she leaves her home, her symptoms, stop. She is currently living in a motor home on her property so that she can sleep.
- She requests freedom to have analog meter on her home.

#### **MSPC Rep Mike Byrne**

- Confirms that DTE has the right to disconnect power if not allowed access to the meters
- Other discussion regarding previous MSPC hearings.

#### **Georgetta Livingstone – Clarkston**

- She has 2 masters degrees and a Phd in engineering.
- States that the MSPC has made all cost effective for DTE, but has abandoned consumers
- After installation of smart meter a rash developed over 90% of her body
- She has measured the EMF being emitted from meter
- She approached DTE many times and was ignored. She finally paid an electrician to install a new analog meter and mailed the smart meter back to DTE by certified mail.
- July 10<sup>th</sup> DTE removed the analog meter, blocked access to the meter area and shut off her power. She has no water, no toilet, no shower, no heat, no ability to cook. [She has talked to 15-20 lawyers who are afraid to take her case to court \(she feels they do not want to go up against DTE.\)](#)

#### **David Lonier**

- States that all radiation is harmful to cells. All tests should be done to test the cumulative effects.

#### **Dick Manisseri – Rochester Hills**

- Wonders why a bill exempting Wind turbine companies from future lawsuits related to health could be brought to committee in 2 weeks time, while a bill protecting the health of citizens has been languishing without a hearing.
- He believes that the money contributed to politicians is controlling the legislature not concern for citizens health.

#### **Pam and Andy Wallace**

- Pam has become electro-sensitive. She wishes that were not the case but it is – for the rest of her life she will have to deal with chronic illness caused by this sensitivity.
- DTE is not offering people an option for their health and well being. Renowned scientists and medical doctors from around the world have researched the detrimental effects of smart meter radiation. She submitted data for the committee records.

#### **Andy –**

- has been a teacher for 20 years. He has monitored the emotional behavior of the students he has worked with over the past 8 years. He has noted a higher level of stress and anxiety as well as heightened aggression. At the same time there has been a negative change in teens attention span. He believes that these changes parallel the increased exposure of the students to EMF and RF exposure.
- According to the American Academy of Pediatrics children from 0-2 should have no exposure to EMF.
- Children from 3 – 18 should have limited exposure. He believes that more research and protection standards need to be provided for the safety of children. Children are more susceptible to RF energy exposure.
- Children's heads are inches away from smart meters while they are sleeping in their beds. Smart meters are affecting your children, your grandchildren, the future leaders of our country.
- Andy Wallace asks the legislature – who is going to protect us and our children?

**Laurie Ebaugh – Milford**

- After installation of a smart meter in her home Laurie experienced heart palpitations, insomnia, and ringing in the ears. Medical tests could not determine a medical cause. She tried the DTE opt out plan and did not have any relief of symptoms. She has needed to purchase an expensive EMF shielding canopy to be able to sleep in her own home.
- Her granddaughter's behavior is noticeable more erratic when she visits her grandmother's home where a smart meter has been installed.

**Shawn E. Abrell**, WSB No. 41054, *Pro Hac Vice*  
4614 SW Kelly Avenue, Suite 200, Portland, Oregon 97239  
Tel.: 503.224.3018; Fax: 503.222.0693  
E-Mail: shawn.e.abrell@gmail.com  
*Lead Counsel for Plaintiffs*

**Tyl W. Bakker**, OSB No. 90200  
621 SW Alder, Suite 621, Portland, Oregon 97205  
Tel.: 503.244.4157; Fax: 503.220.1913  
E-Mail: tylbakker@gmail.com  
*Local Counsel for Plaintiffs*

**United States District Court**

**District of Oregon**

**Portland Division**

**AHM**, by and through  
her Guardian *ad litem* and father,  
David Mark Morrison, and  
**David Mark Morrison**, individually,

v.

**Portland Public Schools**,

Defendant.

Civil Action No. 3:11-cv-00739-MO

**Declaration of**  
**L. Lloyd Morgan**  
**Addendum G – Poster –**  
**How Many Brain Tumors**

**IF CELPHONE USE IS A RISK FOR BRAIN TUMORS,  
WHEN AND HOW MANY CELPHONE-INDUCED  
BRAIN TUMORS MAY OCCUR?**

*L. Lloyd Morgan*

L. Lloyd Morgan [bilovsky@aol.com]

1  
Addendum G  
Page 2 of 14

# Brain Tumor Risk: Case-Control Studies to Date

- Early Studies [1-5]
  - No significant risk found
  - Cellphone use too short to expect tumor
- Interphone Studies [6]
  - Finds use of a cellphone *protects* the user from a brain tumor
    - 11 design flaws
      - 8 flaws underestimate risk
- Swedish Studies
  - Risk when cellphones or cordless phone use for 10+ years
  - Findings consistent wireless phone use is a risk for brain tumors
    - The higher the cumulative hours of use, the higher the risk [7]
    - The longer the time since first use, the higher the risk [7]
    - The higher the radiated power, the higher the risk [8]
    - The higher the exposure (ipsilateral use), the higher the risk [9,10]
    - The younger the user, the higher the risk [11]

# Conclusion

- Wireless (cellphones and cordless phones) are a risk for brain tumors

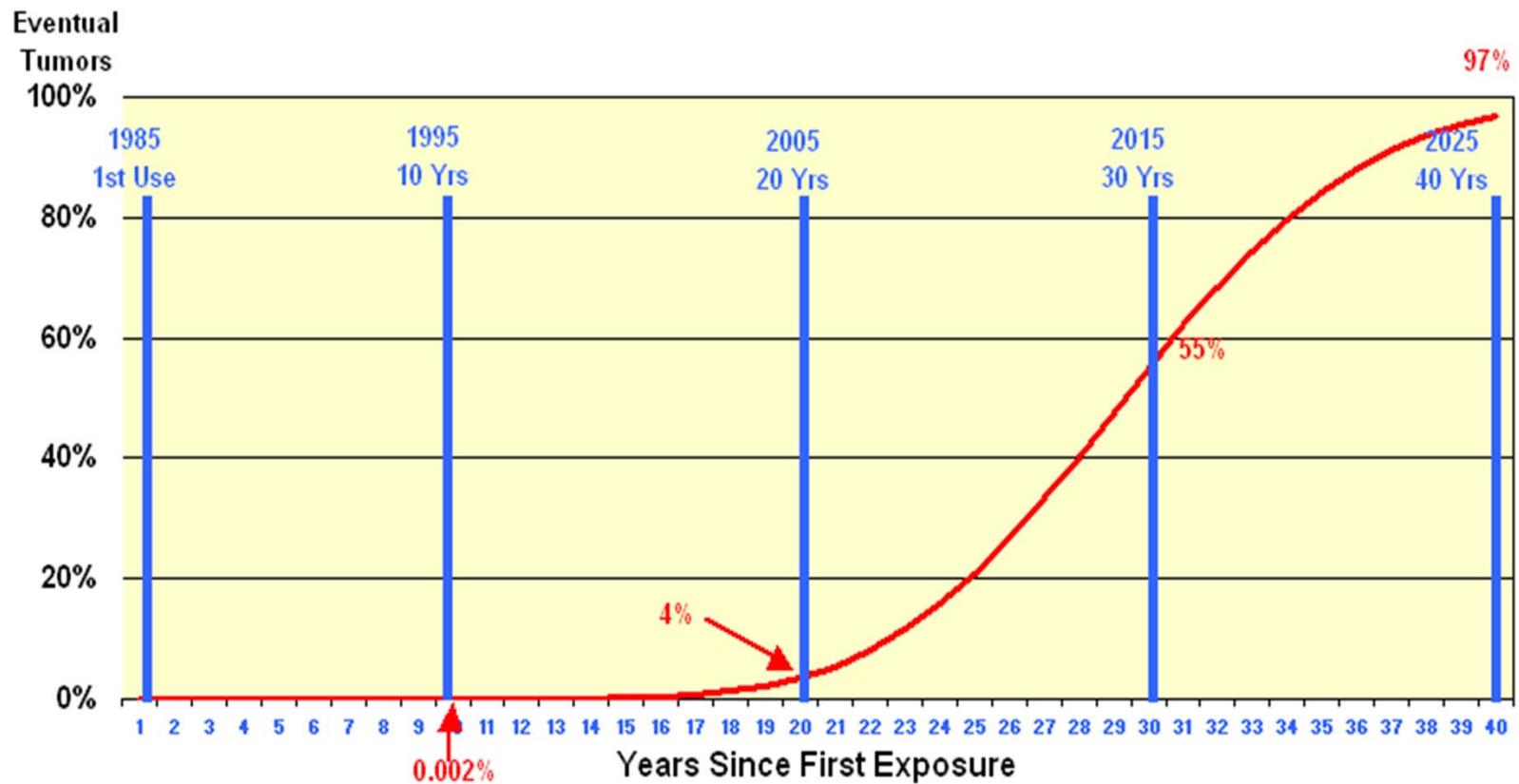
# What factors are important in predicting the number of cellphone-induced brain tumors?

- Latency time & percentage who will eventually be diagnosed with a tumor
  - Ionizing radiation exposure and brain tumors
    - 30 years & 0.9% [12]
  - Tobacco smoking and lung cancer
    - 30 years & 10% [13]
  - Asbestos exposure and mesothelioma
    - 30 years [14] & 28% [15]

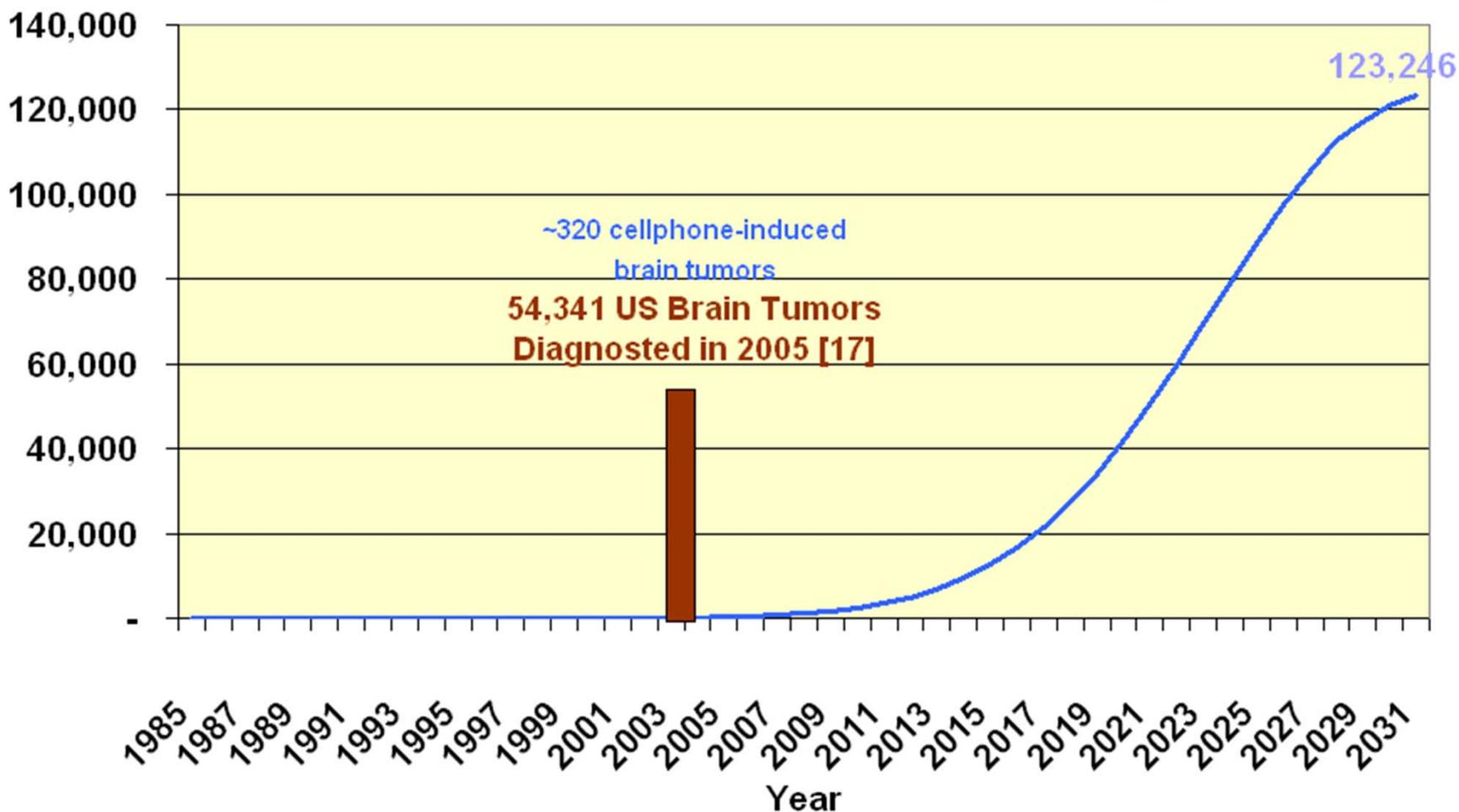
# Materials and Methods

An Excel spreadsheet was used to calculate the number of cellphone-induced brain tumors. The calculation required data for the number of US cellphone subscribers by year (the number of subscribers beyond 2008 was estimated). [16] A Poisson distribution for a 30-year latency was used to provide the probability of a cellphone-induced brain tumor for every year of use. This result was combined with the percent of exposed subjects who are eventually diagnosed with tumors from exposure to the 3 carcinogens to provide an estimate of the number of cellphone-induced brain tumors by year.

# 30-Year Poisson Distribution % of eventual tumor diagnoses

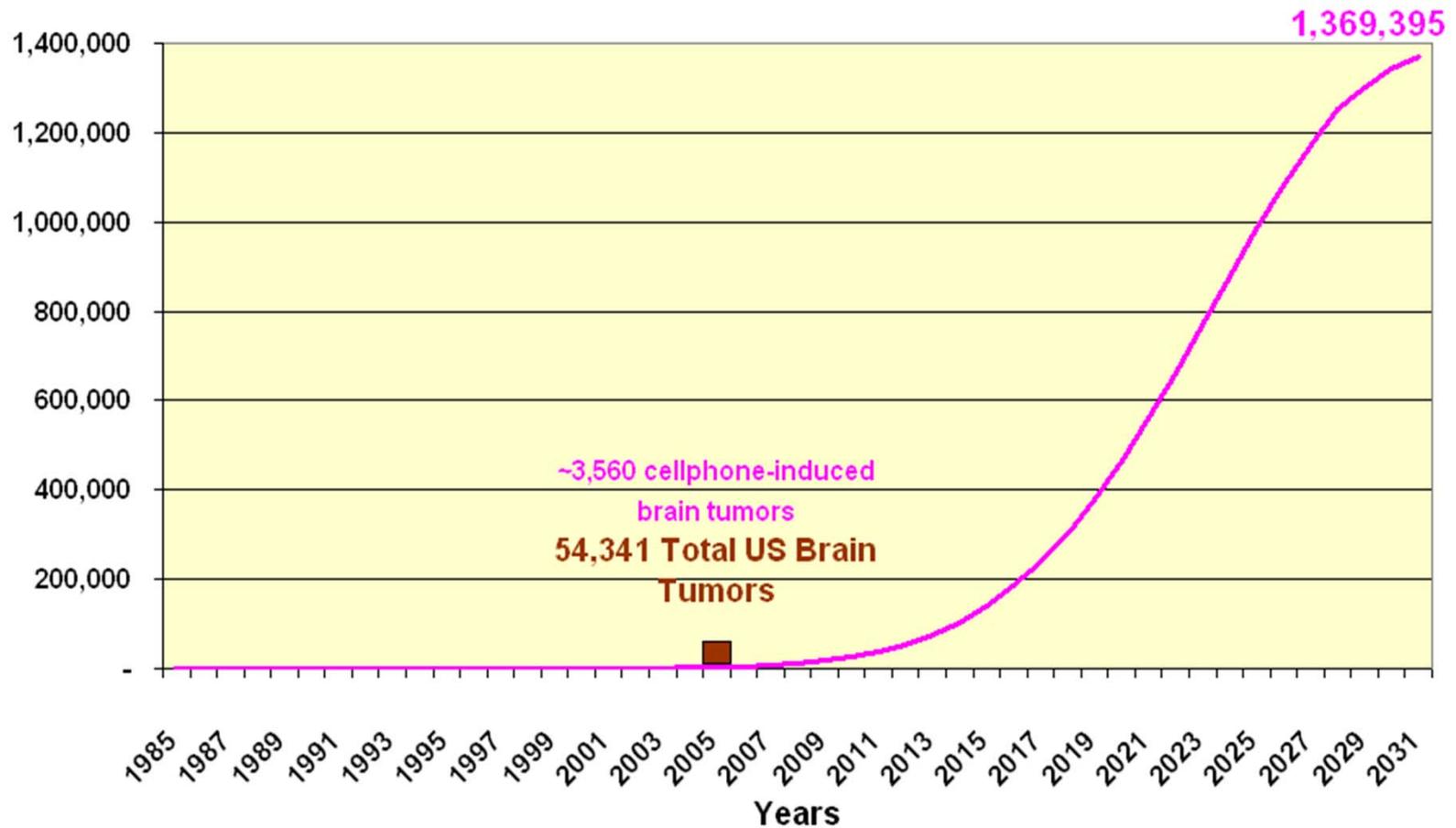


# Potential US Cellphone-Induced Brain Tumors by Year 30-Year Latency If Similar to Low-dose X-Radiation Exposure



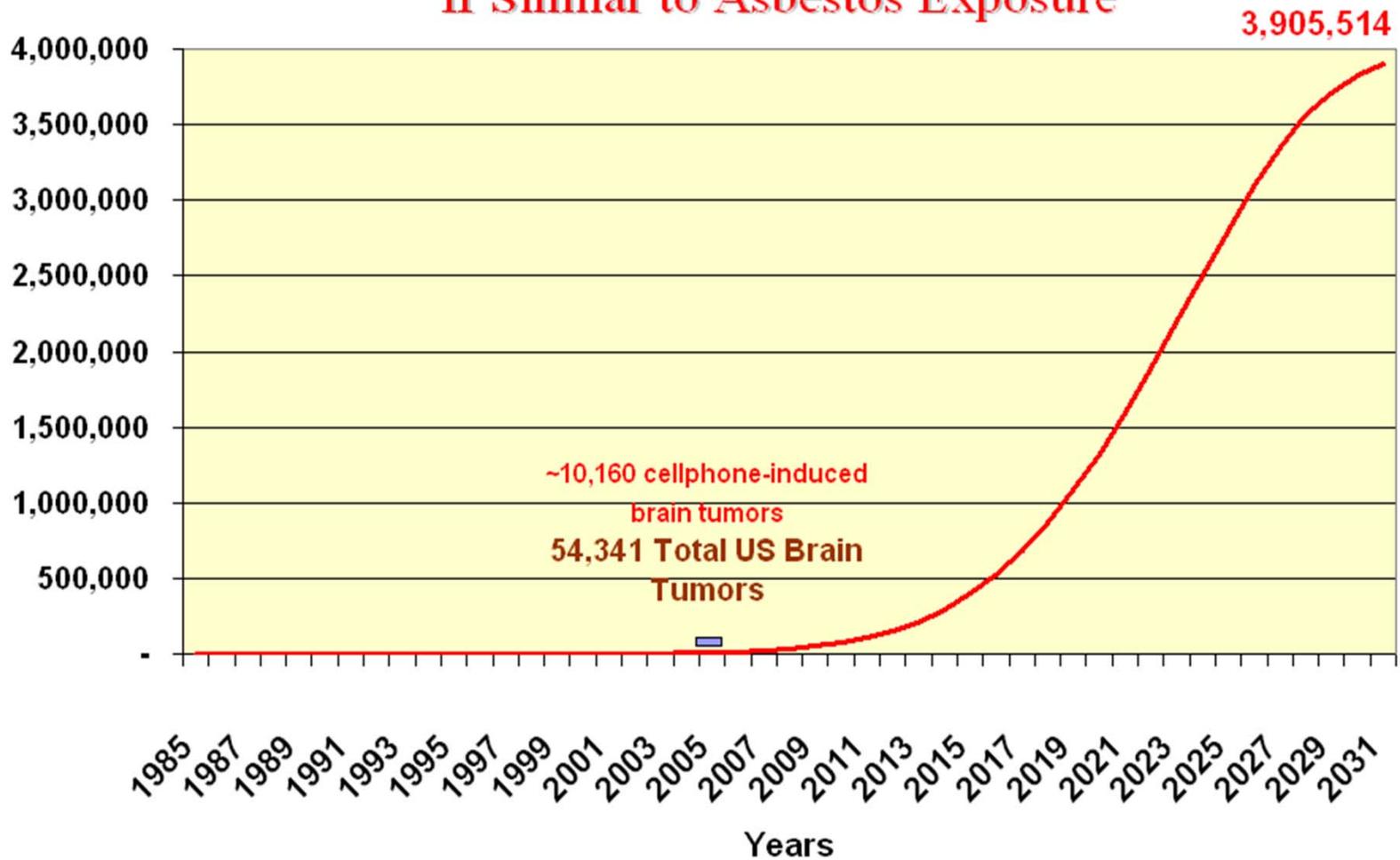
L. Lloyd Morgan [DHOVSKY@aol.com]

# Potential US Cellphone-Induced Brain Tumors by Year 30-Year Latency If Similar to Tobacco Smoking Exposure



L. Lloyd Morgan [bilovsky@aol.com]

**Potential US Cellphone-Induced Brain Tumors by Year**  
**30-Year Latency**  
**If Similar to Asbestos Exposure**



# Conclusion

**If cellphones are a risk for brain tumors,**

**no matter the assumption,**

**there will be a dramatic increase in brain tumors.<sup>1</sup>**

**Given the cost of treating a brain tumor is about \$250,000 per case, the cost to society will be large. [18]**

<sup>1</sup>It is still too early to see any increase in incidence for the entire population, and with a 4-year delay in USA incidence reporting, there will be at least a 4-year delay before it is recognized.

L. Lloyd Morgan [bilovsky@aol.com]

10

Addendum G  
Page 11 of 14

*I Pray I'm Wrong!*

## REFERENCES

- [1] Hardell et al. *MedGenMed*. 2000 May 4;2(2):E2
- [2] Muscat, et al. *JAMA* Vol. 284, No. 23, December 20, 2000.
- [3] Inskip et al. *N Engl J Med*. 2001 Jan 11;344(2):79-86.
- [4] Muscat et al. *NEUROLOGY* 2002;58:1304–1306.
- [5] Auvinen et al. *Epidemiology*. 2002 May;13(3):356-9.
- [6] Morgan, LL. *Pathophysiology*. 2009 Apr 6. [Epub ahead of print]
- [7] Mild et al. *International Journal of Occupational Safety and Ergonomics (JOSE)* 2007, Vol. 13, No. 1, 63–71
- [8] Hardell et al. *Occup Environ Med* 2005;62:390–394.
- [9] Hardell, et al. *Int. J. Oncol.* 28 (2006) 509–518.
- [10] Hardell, et al., *Int. Arch. Occup. Environ. Health* 79 (Sep (8)) (2006) 630–639.
- [11] Hardell et al. *Arch Environ Health*. 2004 Mar;59(3):132-7.
- [12] Sadetzki et al. *Radiation Research* 163, 424-432 (2005).
- [13] Weiss W. *Chest*. 1997 May;111(5):1414-6.
- [14] Bianchi, et al., *Eur. J. Cancer Prev.* 6 (April (2)) (1997) 162–166.
- [15] Selikoff & Rebak. *Br J Ind Med*. 1992 Oct;49(10):732-5.

**REFERENCES (continued)**

[16] CTIA Semi-Annual Wireless Industry Survey (<http://files.ctia.org>)

[17] CBTRUS (2009). (<http://www.cbtrus.org/reports/2009-NPCR-04-05/CBTRUS-NPCR2004-2005-Report-.pdf>) Adjusted as follows: With 98,900 brain tumor over 2 years for 91% of USA population [ $98,900/2/91\%=54,340$ ]

[18] Fisher et al. California Childhood Brain Tumor Study. 2004

**Testimony by WEA Co-Founder, Merry Callahan and WEA Scientist/Researcher contributor, Dr. Martin Pall: at Portland Public Schools Board of Directors meeting, September 2013. Three minutes, only, allowed for contributors...**

**1<sup>st</sup> Speaker:**

**DR. MARTIN PALL, PROFESSOR EMERITUS OF WASHINGTON STATE UNIVERSITY, IN BIOCHEMISTRY AND BASIC MEDICAL SCIENCES. DR PALL SPOKE ON HIS CAREER AND ACHIEVEMENTS INVESTIGATING MULTIPLE CHEMICAL SENSITIVITIES AND HOW THAT HAS LED TO A PUBLISHED REVIEW ON THE “MECHANISM OF HARM” FROM EMF EXPOSURE, INCLUDING MICROWAVES IN WI-FI. DR. PALL DISCUSSED THE WIDE-REACHING SCIENCE THAT AMPLY DISPLAYS CAUSE FOR ALARM, INCLUDING AREAS OF CANCER AND AUTISM IN CHILDREN. DR. PALL’S LATEST PAPER UNDER SUBMISSION FOR PEER JOURNAL PUBLICATION DISCUSSES AUTISM CAUSATION DUE TO EMF EMISSIONS.**

**HERE IS A LIST OF DR. PALL’S AWARDS CREDENTIALLING HIS EXPERTISE ON THE DANGERS OF WI-FI TO CHILDREN:**

2005: Pall was appointed to the Advisory Board of the Environmental Law Center in London.

November 2008: Pall was the only person from outside of Europe, invited to address a special session of the European Union Parliament (“Council of Nations”) on Environmental Medicine.

2009: Pall was chosen from all scientists in the world to write an authoritative review on Multiple Chemical Sensitivity (MCS) for General and Applied Toxicology, 3<sup>rd</sup> Edition.

April 2010: Pall was appointed a “life-time, honorary ambassador and member of the Scientific Advisory Board of the International Society for Applied Preventative Medicine (I-GAP).

May 2010: Pall was the meeting ‘honoree’ at the Fundacion Alborada meeting in Spain, on the second time such an honoree had been chosen.

2011 and onward: Pall was chosen to be a founding faculty member of the new Environmental Medicine Faculty in Italy. He started that function in 2012.

2013: Pall was chosen to be the Jonathon Forman award recipient, the highest award Given by the American Academy of Environmental Medicine (AAEM).

**2<sup>nd</sup> Speaker:**

**MERRY CALLAHAN, CO-FOUNDER WIRELESS EDUCATION ACTION.ORG; THE FOLLOWING IS HER SPEECH REFERRING TO THE CONSTITUTIONAL ARGUMENT FOR PARENTAL RIGHTS, TO REJECT WI-FI IN SCHOOLS, ON WHICH PORTLAND PUBLIC SCHOOLS- AND THEIR AGENTS- SPENT OVER \$200,000 TO DEFEND AGAINST. PPS’S DEFENSE WAS CHOSEN BY THEM INSTEAD OF INVESTIGATING DANGERS OF WIFI, TO CHILDREN, BROUGHT TO THEIR ATTENTION AMPLY AND OVER AN EXTENDED PERIOD, BY A PARENT, DAVID MORRISON.**

**Merry Callahan SCRIPT, Portland Public School Board Testimony, Portland, Oregon:**

I am Merry Callahan, Author of the Constitutional Argument in Morrison v. Portland Public Schools.

I am here to talk about legacy- mine and yours.

My legacy charges me – as a Hanford Nuclear Reservation ‘Downwinder’ survivor...

and as the daughter of a Marine Raider who volunteered to rescue victims of Nagasaki at ground zero...

- *my* legacy charges me with no less duty than the defense of another generation of innocents forcibly exposed to atomic radiation.

You call it ‘Wi-Fi- a cute marketing term. But wireless radiation cannot shed it’s ‘radiation’ identity- because that is what it is.

While a Nuclear Engineering student at Oregon State University I learned what the American Trial Lawyers now stand behind,

that wireless radiation health effects are equatable to the same disease latency as that from nuclear radiation exposure.

In fact, this biggest trial lawyer association in the world- The American Association For Justice- just last week- has thrown down the gauntlet to Federal Agencies and the Wireless industry,

- that Big Telecom and Wireless will go the way of Big Tobacco, of Asbestos and of lead paint litigation.

Meanwhile, players like Cisco, Apple, AT&T... promise any comers on School Boards, in local IT departments, that they *too* can have a personal, legacy-building path.

Just walk with us, they say. That you *too* can have a share of Wireless Pork Barrel kickbacks,

from Big Telecom’s gaming of the US Department of Education’s ‘E’ programs.

All you have to do is:

- turn a blind eye-
- believe the fable of harmlessness,
- ‘sold’ to you as the “Cost/benefit- value add” sales pitch fed to your MBA IT-guy, The Decider...

This Decider- for *all* of you- not only has no bio-sciences, has no health training, but professes in his deposition, on *your* record, that:

- He was never even ‘curious’ about the health effects of wireless radiation-

- and “anyway” he doesn’t ‘believe in it’...

...as if his confession were of some sort of ‘religion for efficiency’, on YOUR balance sheet.

So *this* is your legacy...

Like the *Emperor Who Has No Clothes*, you all have stood on the side-lines in a ‘fable’...

While the Wireless industry has paraded their naked untruths and misinformation-

have trotted out their ‘doubt’ about Wi-Fi health effects on children in schools,

As if Wi-Fi is magic that floats through the air like butterflies.

But WiFi not magic- and the Emperor has no clothes.

It took my Dad 27 years to die from Nagasaki. It took 35 years to figure out about Hanford Downwinders...

And, Wi-Fi radiation is predicted- by those who know,

to follow this same latency and disease period.

*Your* legacy will be to be on the wrong side of science,

- on the wrong side of history,
- on the wrong side, even, of 60,000 pediatricians who have sent a letter begging Congress to stop this exposure of children to a class 2B carcinogen
- this same class agent as DDT, Lead in Paint, and Gasoline fumes.

No kid will escape this Russian Roulette you are playing with their lives... their future.

So why did I come here today?

To talk about legacy....

In three minutes or less ...

*My* legacy will stand on the right side of history. Will *yours*?

**PSC Wireless Meter Case Files with Complaints Regarding Duke Energy and the Dangers of the Smart Grid (Contain Health Complaints, Privacy Violations, Research Documentation, Testimonies, Public Comments, and Environmental Damages caused by installation of Wireless Utility Meters.**

**(There are more Complaints filed in numerous states, but do not have listings of those.)**

**Kentucky PSC: Case Files 2012-00428 , 2016-00394, 2016-00187, 2016-00152, 2016-00370**

**Ohio PSC : Case File 14-1160-EL-UNC, Case MMAI11131500**

**North Carolina PSC: Case File Docket No. E-7 Sub 1115 (Note: This was originally**

**Case File Docket No. E-100, SUB 141)**

**South Carolina PSC: Docket 2017-19-E, Docket No. 2013-59-E , Docket No. 2016-366-E ,**

**Docket No. 2016-354-E**

**(opt-out)**

**Florida PSC: Case File Docket No. 130223**



# Public health implications of wireless technologies

Cindy Sage<sup>a,\*</sup>, David O. Carpenter<sup>b</sup>

<sup>a</sup> Sage Associates, 1396 Danielson Road, Santa Barbara, CA 93108, USA

<sup>b</sup> Institute for Health and the Environment, University at Albany, Rensselaer, NY, USA

Received 18 January 2008; accepted 30 January 2009

## Abstract

Global exposures to emerging wireless technologies from applications including mobile phones, cordless phones, DECT phones, WI-FI, WLAN, WiMAX, wireless internet, baby monitors, and others may present serious public health consequences. Evidence supporting a public health risk is documented in the BioInitiative Report. New, biologically based public exposure standards for chronic exposure to low-intensity exposures are warranted. Existing safety standards are obsolete because they are based solely on thermal effects from acute exposures. The rapidly expanding development of new wireless technologies and the long latency for the development of such serious diseases as brain cancers means that failure to take immediate action to reduce risks may result in an epidemic of potentially fatal diseases in the future. Regardless of whether or not the associations are causal, the strengths of the associations are sufficiently strong that in the opinion of the authors, taking action to reduce exposures is imperative, especially for the fetus and children. Such action is fully compatible with the precautionary principle, as enunciated by the Rio Declaration, the European Constitution Principle on Health (Section 3.1) and the European Union Treaties Article 174. © 2009 Elsevier Ireland Ltd. All rights reserved.

**Keywords:** Wireless technology; Brain cancer; Radiofrequency; Cell phones; Wireless antenna facilities; Childrens' health

## 1. Introduction and background

Exposure to electromagnetic fields (EMF) has been linked to a variety of adverse health outcomes that may have significant public health consequences [1–13]. The most serious health endpoints that have been reported to be associated with extremely low frequency (ELF) and/or RF include childhood and adult leukemia, childhood and adult brain tumors, and increased risk of the neurodegenerative diseases, Alzheimer's and amyotrophic lateral sclerosis (ALS). In addition, there are reports of increased risk of breast cancer in both men and women, genotoxic effects (DNA damage and micronucleation), pathological leakage of the blood–brain barrier, altered immune function including increased allergic and inflammatory responses, miscarriage and some cardiovascular effects [1–13]. Insomnia (sleep disruption) is reported in studies of people living in very low-intensity RF environments with WI-FI and cell tower-level exposures [85–93]. Short-term effects on cognition, memory and learning, behavior, reaction time, attention and concentration, and altered

brainwave activity (altered EEG) are also reported in the scientific literature [94–107]. Biophysical mechanisms that may account for such effects can be found in various articles and reviews [136–144].

The public health implications of emerging wireless technologies are enormous because there has been a very rapid global deployment of both old and new forms in the last 15 years. In the United States, the deployment of wireless infrastructure has accelerated greatly in the last few years with 220,500 cell sites in 2008 [14–16]. Eighty-four percent of the population of the US own cell phones [16]. Annualized wireless revenues in 2008 will reach \$144 billion and US spending on wireless communications will reach \$212 billion by 2008. Based on the current 15% annual growth rate enjoyed by the wireless industry, in the next 5 years wireless will become a larger sector of the US economy than both the agriculture and automobile sectors. The annualized use of cell phones in the US is estimated to be 2.23 trillion minutes in 2008 [16]. There are 2.2 billion users of cell phones worldwide in 2008 [17] and many million more users of cordless phones.

Over 75 billion text messages were sent in the United States, compared with 7.2 billion in June 2005, according to

\* Corresponding author. Tel.: +1 805 969 0557; fax: +1 805 969 5003.  
E-mail address: sage@silcom.com (C. Sage).

CTIA, the Wireless Association, the leading industry trade group [16]. The consumer research company Nielsen Mobile, which tracked 50,000 individual customer accounts in the second quarter of this year, found that Americans each sent or received 357 text messages a month then, compared with 204 phone calls. That was the second consecutive quarter in which mobile texting significantly surpassed the number of voice calls [17].

The Electronics Industries Alliance (EIA) represents 80% of the \$550 billion US electronics industry “that provides two million jobs for American workers.” Its members include companies from the consumer electronics and telecommunications industries, among others [17].

There is intense industry competition for market share. Telecom taxes form an immense revenue generator for the government sector. Sale of the airwaves (auctions selling off wireless bandwidth) is a multi-million dollar industry for governments, and multi-billion dollar global advertising budgets are common. Lobbying dollars from the telecom-related industries are estimated to be \$300 million annually. The media is nearly silent on health issues, perhaps in part because of global advertising revenues that compromise journalistic independence and discourage balanced coverage of health, equity and economic issues.

## 2. Evidence supporting a public health risk

Even if there is only a small risk to health from chronic use of and exposure to wireless technologies, there is the potential for a profound public health impact. RF radiation now saturates the airwaves, resulting in exposure to both users and non-users. The effects are both short-term (sleep disruption, hormone disruption, impairment of cognitive function, concentration, attention, behavior, and well-being) and they are almost certainly long-term (generational impacts on health secondary to DNA damage, physiological stress, altered immune function, electrosensitivity, miscarriage risks, effects on sperm quality and motility leading to infertility, increased rates of cancer, and neurological diseases including Alzheimer’s disease and ALS—at least for ELF exposures). (Chapters 5–12 of the BioInitiative Report [1] and papers in this Supplement.)

There is credible scientific evidence that RF exposures cause changes in cell membrane function, metabolism and cellular signal communication, as well as activation of proto-oncogenes and triggering of the production of stress proteins at exposure levels below current regulatory limits. There is also generation of reactive oxygen species, which cause DNA damage, chromosomal aberrations and nerve cell death. A number of different effects on the central nervous system have also been documented, including activation of the endogenous opioid systems, changes in brain function including memory loss, slowed learning, motor dysfunction and performance impairment in children, and increased frequency of headaches, fatigue and sleep disorders. Melatonin secretion

is reduced, resulting in altered circadian rhythms and disruption of several physiological functions. (Chapters 5–12 of the BioInitiative Report [1] and papers in this Supplement.)

These effects can reasonably be presumed to result in adverse health effects and disease with chronic and uncontrolled exposures, and children may be particularly vulnerable [1,19]. The young are also largely unable to remove themselves from such environments. Second-hand non-ionizing radiation, like second-hand smoke may be considered of public health concern based on the evidence at hand.

### 2.1. Malignant brain tumors

At present, the most persuasive evidence for cancer resulting from RF exposure is that there is a significantly increased risk of malignant glioma in individuals that have used a mobile phone for 10 or more years, with the risk being elevated only on the side of the head on which the phone is used regularly (ipsilateral use) [1,3,4,6–8,18]. While the risk for adults after 10 or more years of use is reported to be more than doubled, there is some evidence beginning to appear that indicates that the risk is greater if the individual begins to use a mobile phone at younger ages. Hardell et al. [18] reported higher odds ratios in the 20–29-year-old group than other age ranges after more than 5 years of use of either analog or cordless phones. Recently in a London symposium Hardell reported that after even just 1 or more years of use there is a 5.2-fold elevated risk in children who begin use of mobile phones before the age of 20 years, whereas for all ages the odds ratio was 1.4. Studies from Israel have found that the risk of parotid gland tumors (a salivary gland in the cheek) is increased with heavy cell phone use [7]. The risk of acoustic neuroma (a benign but space-occupying tumor on the auditory nerve) is also significantly increased on the ipsilateral side of the head after 10 or more years of mobile phone use [1,3]. This relationship has also been documented in some of the published reports of the WHO Interphone Study, a decade-long 13-country international assessment of cell phone risks and cancer [6,8].

Kundi reports that “(E)pidemiological evidence compiled in the last 10 years starts to indicate an increased risk, in particular for brain tumors (glioma, meningioma, acoustic neuroma), from mobile phone use. Considering biases that may have been operating in most studies the risk estimates are rather too low, although recall bias could have increased risk estimates. The net result, when considering the different errors and their impact is still an elevated risk” [19].

The latency for most brain tumors is 20 years or more when related to other environmental agents, for example, to X-ray exposure. Yet, for cell phone use the increased risks are occurring much sooner than twenty years, as early as 10 years for brain tumors in adults and with even shorter latencies in children. This suggests that we may currently be significantly underestimating the impact of current levels of

use of RF technology, since we do not know how long the average latency period really is. If it is 20 years, then the risk rate will likely be much higher than an overall doubling of risk for cell phone users if the peak comes later than 10 years. It may also signal very troubling risks for those who start using cell phones, and perhaps all wireless devices, in early childhood. We may not have proof of effect for decades until many hundreds of thousands of new cases of malignant gliomas are set in motion by long-term cell phone use.

The preliminary evidence that mobile phone use at younger ages may lead to greater risk than for older persons is of particular concern. There is a large body of evidence that childhood exposure to environmental agents poses greater risk to health than comparable exposure during adulthood [20,21]. There is reason to expect that children would be more susceptible to the effects of EMF exposure since they are growing, their rate of cellular activity and division is more rapid, and they may be more at risk for DNA damage and subsequent cancers. Growth and development of the central nervous system is still occurring well into the teenage years so that neurological changes may be of great importance to normal development, cognition, learning, and behavior.

A greater vulnerability of children to developing brain cancer from mobile phone use may be the consequence of a combination of patterns of use, stage of development and physical characteristics related to exposure. In addition to the fact that the brain continues to develop through the teen years, many young children and teenagers now spend very large periods of time using mobile phones. The brain is the main target organ of cell phones and cordless phones, with highest exposure to the same side as the phone is used. Further, due to anatomical reasons, the brain of a child is more exposed to RF radiation than the brain of an adult [22,23]. This is caused by the smaller brain size, a thinner pinna of the ear, thinner skin and thinner skull bone permitting deeper penetration into the child's brain. A recent French study showed that children absorb twice the RF from cell phone use as do adults [24].

In addition to concerns about cancer, there is evidence for short-term effects of RF exposure on cognition, memory and learning, behavior, reaction time, attention and concentration, altered brainwave activity (altered EEG) [95–108], and all of these effects argue for extreme caution with regard to exposure of children. The development of children into adults is characterized by faster cell division during growth, the long period needed to fully develop and mature all organ systems, and the need for properly synchronized neural development until early adulthood. Chronic, cumulative RF exposures may alter the normal growth and development of children and adversely affect their development and capacity for normal learning, nervous system development, behavior and judgment [1,97,102].

Prenatal exposure to EMF has been identified as a possible risk factor for childhood leukemia (1). Maternal use of cell phones has been reported to adversely affect fetal brain development, resulting in behavioral problems in those children by

the time they reach school age [25]. Their exposure is involuntary in all cases. Children are largely unable to remove themselves from exposures to harmful substances in their environments.

## 2.2. Plausible biological mechanisms for a relationship between RF exposure and cancer

### 2.2.1. DNA damage and oxidative stress

Damage to DNA from ELF and from RF cell phone frequencies at very low intensities (far below FCC and ICNIRP safety limits) has been demonstrated in many studies [1,2,26–35]. Both single- and double-strand DNA damage have been reported by various researchers in different laboratories. This is damage to the human genome, and can lead to mutations which can be inherited, or which can cause cancer, or both.

Non-ionizing radiation is assumed to be of too low energy to cause direct DNA damage. However both ELF and RF radiation induce reactive oxygen species, free radicals that react with cellular molecules including DNA. Free-radical production and/or the failure to repair DNA damage (secondary to damage to the enzymes that repair damage) created by such exposures can lead to mutations. Whether it is greater free-radical production, reduction in anti-oxidant protection or reduced repair capacity, the result will be altered DNA, increased risk of cancer, impaired or delayed healing, and premature aging [36–54]. Exposures have also been linked to decreased melatonin production, which is a plausible biological mechanism for decreased cancer surveillance in the body, and increased cancer risk [34,39,44,46,47,49,50,54]. An increased risk of cancers and a decrease in survival has been reported in numerous studies of ELF and RF [55–69].

### 2.2.2. Stress proteins (heat shock proteins or HSP)

Another well-documented effect of exposure to low-intensity ELF and RF is the creation of stress proteins (heat shock proteins) that signal a cell is being placed under physiological stress) [70–80]. The HSP response is generally associated with heat shock, exposure to toxic chemicals and heavy metals, and other environmental insults. HSP is a signal of cells in distress. Plants, animals and bacteria all produce stress proteins to survive environmental stressors like high temperatures, lack of oxygen, heavy metal poisoning, and oxidative stress.

We can now add ELF and RF exposures to this list of environmental stressors that cause a physiological stress response. Very low-level ELF and RF exposures can cause cells to produce stress proteins, meaning that the cell recognizes ELF and RF exposures as harmful. This is another important way in which scientists have documented that ELF and RF exposures can be harmful, and it happens at levels far below the existing public safety standards. An additional concern is that if the stress goes on too long, the protective effect is diminished. The reduced response with prolonged exposure means the cell is less protected against

damage, and this is why prolonged or chronic exposures may be harmful, even at very low intensities.

### 2.2.3. RF-induced gene expression changes

Many environment agents cause diseases, including cancer, not by direct damage to DNA but rather by up- or down-regulation of genes that regulate cell growth and function. Usually there are many genes whose expression is changed, and it is difficult to determine the exact changes responsible for the disease. Both ELF and RF exposures have been shown to result in altered gene expression. Olivares-Banuelos et al. [81] found that ELF exposure of chromaffin cells resulted in changed expression of 53 transcripts. Zhao et al. [82] investigated the gene expression profile of rat neurons exposed to 1800 MHz RF fields (2 W/kg) and found 24 up-regulated genes and 10 down-regulated genes after a 24-h exposure. The altered genes were involved in multiple cellular functions including cytoskeleton, signal transduction pathways and metabolism. Kariene et al. [83] exposed human skin to mobile phone radiation, and found by punch biopsy that 8 proteins were significantly altered in expression, consistent with gene induction. Several other studies have found altered gene expression following RF exposure, although none have been found that explain specific disease states [84].

DNA activation at very low ELF and RF levels, as in the stress response, and DNA damage (strand breaks and micronuclei) at higher levels, are molecular precursors to changes that are believed to lead to cancer. These, along with gene induction, provide plausible biological mechanisms linking exposure to cancer.

The biochemical pathways that are activated are the same for ELF and for RF exposures, and are non-thermal (do not require heating or induced electrical currents). This is true for the stress response, DNA damage, generation of reactive oxygen species as well as gene induction. Thus it is not surprising that the major cancers resulting from exposure to ELF and RF are the same, namely leukemia and brain cancer. The safety standards for both ELF and RF, based on protection from heating, are irrelevant and not protective. ELF exposure levels of only 5–10 mG have been shown to activate the stress response genes (<http://www.bioinitiative.org>, Sections 1 and 7 [1]).

## 3. Sleep, cognitive function and performance

The relationship of good sleep to cognition, performance and healing is well recognized. Sleep is a profoundly important factor in proper healing, anti-inflammatory benefits, reduction in physical symptoms of such as tendonitis, over-use syndrome, fatigue-induced lethargy, cognition and learning. Incomplete or slowed physiological recovery is common when sleep is impaired. Circadian rhythms that normalize stress hormone production (cortisol, for example) depend on synchronized sleep patterns.

People who are chronically exposed to low-level wireless antenna emissions report symptoms such as problems in sleeping (insomnia), as well as other symptoms that include fatigue, headache, dizziness, grogginess, lack of concentration, memory problems, ringing in the ears (tinnitus), problems with balance and orientation, and difficulty in multi-tasking [85–93,99]. In children, exposures to cell phone radiation have resulted in changes in brain oscillatory activity during some memory tasks [97,102]. Cognitive impairment, loss of mental concentration, distraction, speeded mental function but lowered accuracy, impaired judgment, delayed reaction time, spatial disorientation, dizziness, fatigue, headache, slower motor skills and reduced learning ability in children and adults have all been reported [85–108].

These symptoms are more common among “electrosensitive” individuals, although electrosensitivity has not been documented in double-blind tests of individual identifying themselves as being electrosensitive as compared to controls [109,110]. However people traveling to laboratories for testing are pre-exposed to a multitude of RF and ELF exposures, so they may already be symptomatic prior to actual testing. There is also evidence that RF exposures testing behavioral changes show delayed results; effects are observed after termination of RF exposure. This suggests a persistent change in the nervous system that may be evident only after time has passed, so is not observed during a short testing period.

### 3.1. Plausible biological mechanisms for neurobehavioral effects

#### 3.1.1. The melatonin hypothesis

While there remains controversy as to the degree that RF and ELF fields alter neurobehavioral function, emerging evidence provides a plausible mechanism for both effects on sleep and cognition. Sleep is controlled by the central circadian oscillator in the suprachiasmatic nucleus, located in the hypothalamus. The activity of this central circadian oscillator is, in turn, controlled by the hormone, melatonin, which is released from the pineal gland [111]. There is considerable evidence that ELF exposure reduces the release of melatonin from the pineal gland—see Section 12 of the Bioinitiative Report [1]. There has been less study of the effects of RF exposure on melatonin release, but investigations have demonstrated a reduced excretion of the urinary metabolite of melatonin among persons using a mobile phone for more than 25 min per day [112]. In a study of women living near to radio and television transmitters, Clark et al. [113] found no effect on urinary melatonin metabolite excretion among pre-menopausal women, but a strong effect in post-menopausal women.

The “melatonin hypothesis” also provides a possible basis for other reported effects of EMFs. Melatonin has important actions on learning and memory, and inhibits electrophysiological components of learning in some but not all areas of the brain [114,115]. Melatonin has properties as a free-radical scavenger and anti-oxidant [116], and consequently,

a reduction in melatonin levels would be expected to increase susceptibility to cancer and cellular damage. Melatonin could also be the key to understanding the relationship between EMF exposure and Alzheimer's disease. Noonan et al. [117] reported that there was an inverse relationship between excretion of the melatonin metabolite and the 1–42 amino acid form of amyloid beta in electric utility workers. This form of amyloid beta has been found to be elevated in Alzheimer's patients.

### 3.1.2. Blood–brain barrier alterations

Central nervous system effects of EMFs may also be secondary to damage to the blood–brain barrier (BBB). The blood–brain barrier is a critical structure that prevents toxins and other large molecules that are in peripheral blood from having access to the brain matter itself. Salford et al. [118] have reported that a 2-h exposure of rats to GSM-900 radiation with a SAR of 2–200 mW/kg resulted in nerve cell damage. In a follow-up study, Eberhardt et al. report that 2-h exposures to cell phone GSM microwave RF resulted in leakage of albumin across the blood–brain barrier and neuronal death [119]. Neuronal albumin uptake was significantly correlated to occurrence of damaged neurons when measured at 28 days post-exposure. The lowest exposure level was 0.12 mW/kg (0.00012 W/kg) for 2 h. The highest exposure level was 120 mW/kg (0.12 W/kg). The weakest exposure level showed the greatest effect in opening the BBB [118]. Earlier blood–brain studies by Salford and Schirmer [120,121] report similar effects.

## 4. What are sources of wireless radiation?

There are many overlapping sources of radiofrequency and microwave emissions in daily life, both from industrial sources (like cell towers) and from personal items [cell and cordless phones, personal digital assistants (PDAs), wireless routers, etc.]. Published data on typical levels found in some cities and from some sources are available at <http://www.bioinitiative.org> [1,122–124].

Cell phones are the single most important source of radiofrequency radiation to which we are exposed because of the relatively high exposure that results from the phone being held right against the head. Cell phones produce two types of emissions that should be considered. First, the radiofrequency radiation (typically microwave frequency radiation) is present. However, there is also the contribution of the switching battery pack that produces very high levels of extremely low frequency electromagnetic field [125–127].

Cordless telephones have not been widely recognized as similar in emissions to cell phones, but they can and do produce significant RF exposures. Since people tend to use them as substitutes for in-home and in-office corded or traditional telephones, they are often used for long periods of time. As the range of cordless phones has increased (the distance away that you can carry on a conversation is related to the power

output of the phone), the more powerful the RF signal will be. Hence, newer cordless phones may in some cases be similar to the power output of cell phones. The cumulative emissions from cell and cordless phones taken together should be recognized when considering the relative risks of wireless communication exposures.

PDAs such as the BlackBerry, Treo and iPhone units are 'souped-up' versions of the original voice communication devices (cell phones). They often produce far higher ELF emissions than do cell phones because they use energy from the battery very intensively for powering color displays and during data transmission functions (email, sending and receiving large files, photos, etc.) [125–127]. ELF emissions have been reported from PDAs at several tens to several hundreds of milligauss. Evidence of significantly elevated ELF fields during normal use of the PDA has public health relevance and has been reported in at least three scientific papers [125,128,129]. In the context of repetitive, chronic exposure to significantly elevated ELF pulses from PDAs worn on the body, relevant health studies point to a possible relationship between ELF exposure and cancer and pregnancy outcomes [130–133].

We include discussion of the ELF literature for two reasons. As mentioned above ELF activates the same biology as RF, it contributes to the total EMF burden of the body. In addition, PDAs and cell phones emit both radiofrequency/microwave radiation (RF) and extremely low frequency ELF from the battery switching of the device (the power source). Studies show that some devices produce excessively high ELF exposures during voice and data transmission. ELF is already classified as a 2B (Possible) Carcinogen by IARC, which means that ELF is indisputably an issue to consider in the wireless technology debate. ELF has been classified as a Group 2B carcinogen for all humans, not just children. The strongest evidence came from epidemiological studies on childhood leukemia, but the designation applies to all humans, both adults and children [1,25].

Wireless headsets that allow for conversations with cell phones at a distance from the head itself reduce the emissions. Depending on the type of wireless device, they may operate (transmit signal) only during conversations or they may be operational continuously. The cumulative dose of wireless headsets has not been well characterized under either form of use. Substantial cumulative RF exposure would be expected if the user wears a wireless headset that transmits a signal continuously during the day. However a critical factor is where the cell phone is placed. If worn on a belt with a headset, the exposure to the brain is reduced but the exposure to the pelvis may be significant.

Cell towers (called "masts" in Europe and Scandinavian countries) are wireless antenna facilities that transmit the cell phone signals within communities. They are another major source of RF exposures for the public. They differ from RF exposures from wireless devices like cell phones in that they produce much lower RF levels (generally 0.05 to 1–2  $\mu\text{W}/\text{cm}^2$  in the first several hundred feet around them) in comparison to several hundred microwatts per centimeter

squared for a cell phone held at the head. However they create a constant zone of elevated RF for up to 24 h per day, many hours per day, and the exposure is whole body rather than localized at the head. These facilities are the distribution system for wireless voice communications, internet connections and data transmission within communities. They are often erected on free-standing towers. They may be constructed on telephone poles or electrical poles. They may be built into the façade or rooftops of buildings behind wood screening. These are called stealth installations for wireless antenna facilities. Some installations are camouflaged to resemble ‘false trees or rocks’. They emit RF to provide cell service to specific “cells” or locations that receive the signal.

Other forms of wireless transmission that are common in areas providing cell service are wireless land area networks (WLAN), (WiMAX) and WIFI networks. Some cities are installing city-wide WIFI service to allow any user on the street to log into the internet (without cables or wire connections). WIFI installations may have a signal reach for a few hundred feet where WiMAX installations may transmit signal more than 10 miles, so produce a stronger RF emission for those in close proximity. Each type has its particular signal strength and intended coverage area, but what they have in common is the production of continuous RF exposure for those within the area. We do not know what the cumulative exposure (dose) might be for people living, working or going to school in continuously elevated RF fields, nor are the possible health implications yet known. However, based on studies of populations near cell sites in general, there is a constellation of generally observed health symptoms that are reported to occur [85–107]. In this regard it is important to note that children living near to AM radio transmitters have been found to elevated risks of leukemia [134,135]. While AM radio RF fields are lower in frequency than that common in mobile phones, this is a total body irradiation with RF. The fact that leukemia, not brain cancer, is apparent in these studies suggests that leukemia is the cancer seen at the lowest levels of both ELF and RF fields under the circumstances of whole-body exposure.

Commercial surveillance systems or security gates pose an additional source of strong RF exposures. They are ubiquitous in department stores, markets and shops at the entry and exit points to discourage shoplifting and theft of goods. Security gates can produce excessively high RF exposures (although transitory) and have been associated with interference with pacemakers in heart patients. The exposure levels may approach thermal public safety limits in intensity, although no one expects a person to stand between the security gate bars for more than 6 min (safety limits for uncontrolled public access are variable depending on the frequency, but are all averaged over a 6-min exposure period).

RFID chips (radiofrequency identification chips) are being widely used to track purchases and for security of pets, and in some cases to keep track of patients with Alzheimer’s disease and of children. RFID chips are implanted in fabrics, inserted in many types of commercial goods, and can be implanted

under the skin. They create a detectable signal to track the location of people and goods.

## 5. Problems with existing public health standards (safety limits)

If the existing standards were adequate none of the effects documented above should occur at levels to which people are regularly exposed. The fact that these effects are seen with our current ambient levels of exposure means that our existing public safety standards are obsolete. It also means that new, biologically based public exposure standards for wireless technologies are urgently needed. Whether it is feasible to achieve low enough levels that still work and also protect health against effects of chronic RF exposure – for all age groups – is uncertain. Whether we can protect the public and still allow the kinds of wireless technology uses we see today is unknown.

The nature of electromagnetic field interactions with biological systems has been well studied [136–144]. For purposes of standard-setting processes for both ELF and RF, the hypothesis that tissue damage can result only from heating is the fundamental flaw in the misguided efforts to understand the basic biological mechanisms leading to health effects.

The thermal standard is clearly untenable as a measure of dose when EMF stimuli that differ by many orders of magnitude in energy can stimulate the same biological response. In the ELF range, the same biological changes occur as in the RF, and no change in temperature can even be detected. With DNA interactions the same biological responses are stimulated in ELF and RF ranges even though the frequencies of the stimuli differ by many orders of magnitude. The effects of EMF on DNA to initiate the stress response or to cause molecular damage reflect the same biology in different frequency ranges. For this reason it should be possible to develop a scale based on DNA biology, and use it to define EMF dose in different parts of the EM spectrum. We also see a continuous scale in DNA experiments that focus on molecular damage where single and double strand breaks have long been known to occur in the ionizing range, and recent studies have shown similar effects in both ELF and RF ranges [144].

Existing standard-setting bodies that regulate wireless technologies, assume that there are no bioeffects of concern at exposure levels that do not cause measurable heating. However, it has been established beyond any reasonable doubt that bioeffects and some adverse health effects occur at far lower levels of RF and ELF exposure where no heating (or induced current) occurs; some effects are shown to occur a thousand times or more below the existing public safety limits. New, biologically based public exposure limits are urgently needed. New wireless technologies for cell and cordless phones, other wireless communication and data transmission systems affect living organisms in new ways that our antiquated safety limits have not foreseen, nor protected against.

The exposure of children to electromagnetic fields has not been studied extensively; in fact, the Federal Communications Commission (FCC) standards for exposure to radiofrequency radiation are based on the height, weight and stature of a 6-foot tall man, not scaled to children or adults of smaller stature. They do not take into account the unique susceptibility of growing children to exposures, nor are there studies of particular relevance to children.

In addition there is a problem in the consideration of the level of evidence taken into consideration by these bodies. There have not been adequate animal models shown to have cancer as an endpoint, and a perception that no single mechanism is proven to explain these associations. Thus these committees have tended to ignore or minimize the evidence for direct hazard to humans, and believe there is no proof of cause and effect. These bodies assume from the beginning that only conclusive scientific evidence (absolute proof) will be sufficient to warrant change, and refuse to take action on the basis of a growing body of evidence which provides early but consequential warning of risks.

The Radiofrequency Interagency Working Group of the US governmental agencies involved in RF matters (RFI-AWG) issued a Guidelines Statement in June of 1999 that concluded the present RF standard “may not adequately protect the public” [145]. The RFI-AWG identified fourteen (14) issues that they believe are needed in the planned revisions of ANSI/IEEE RF exposure guidelines including “to provide a strong and credible rationale to support RF exposure guidelines”. In particular, the RFI-AWG criticized the existing standards as not taking into account chronic, as opposed to acute exposures, modulated or pulsed radiation (digital or pulsed RF is proposed at this site), time-averaged measurements that may erase the unique characteristics of an intensity-modulated RF radiation that may be responsible for reported biologic effects, and stated the need for a comprehensive review of long-term, low-level exposure studies, neurological-behavioral effects and micronucleus assay studies (showing genetic damage from low-level RF) [145]. This important document from relevant US agencies questions existing standards in the following ways: (a) selection of an adverse effect level for chronic exposures not based on tissue heating and considering modulation effects; (b) recognition of different safety criteria for acute and chronic exposures at non-thermal or low-intensity levels; (c) recognition of deficiencies in using time-averaged measurements of RF that does not differentiate between intensity-modulated RF and continuous wave (CW) exposure, and *therefore may not adequately protect the public*; (d) having standards based on adult males rather than considering children to be the most vulnerable group.

## 6. Prudent public health responses

Emerging environmental health problems require preventative public health responses even where scientific and

medical uncertainties still exist, but where policy decisions today may greatly reduce human disease and societal costs tomorrow.

Policy decisions in public health must address some amount of uncertainty when balancing likely benefits and estimated costs. Although new insight will allow better appreciation of difficult issues, such as those occurring in environmental and occupational health, an expanded perspective may also enlarge the list of problems that need to be managed. Ignoring the problems carries its own costs (as deferring a decision is a decision in itself). With environmental and other public health problems becoming increasingly complex and international in scope, scientific documentation alone rarely justifies simple solutions [146].

Social issues regarding the controversy over public and occupational exposures to ELF and RF center on the resolute adherence to existing ICNIRP and FCC/IEEE standards by many countries, in the face of growing scientific evidence of health risks at far lower levels [10]. The composition of these committees, usually with excessive representation of the physics and engineering communities rather than public health professionals, results in a refusal to adopt biologically based exposure standards. Furthermore, there is widespread belief that governments are ignoring this evidence and there is widespread distrust of and lack of confidence in governments and their health agencies. The basis on which most review bodies and standard-setting agencies have avoided the conclusion that the science is strong enough to warrant new safety limits for ELF and RF is to require a demonstration of absolute proof before taking action. A causal level of evidence, or scientific certainty standard is implicit in nearly all reviews of the ELF and RF science, although this runs counter to good public health protection policies.

There is no question that global implementation of the safety standards proposed in the Bioinitiative Report, if implemented abruptly and without careful planning, have the potential to not only be very expensive but also disruptive of life and the economy as we know it. Action must be a balance of risk to cost to benefit. The major risk from maintaining the status quo is an increasing number of cancer cases, especially in young people, as well as neurobehavioral problems at increasing frequencies. The benefits of the status quo are expansion and continued development of communication technologies. But we suspect that the true costs of even existing technologies will only become much more apparent with time. Whether the costs of remedial action are worth the societal benefits is a formula that should reward precautionary behavior. Prudent corporate policies should be expected to address and avoid future risks and liabilities, otherwise, there is no market incentive to produce safe (and safer) products.

The deployment of new technologies is running ahead of any reasonable estimation of possible health impacts and estimates of probabilities, let alone a solid assessment of risk. However, what has been missing with regard to EMF has been an acknowledgement of the risk that is demonstrated by

the scientific studies. There is clear evidence of risk, although the magnitude of the risk is uncertain, and the magnitude of doing nothing on the health effects cost to society is similarly uncertain. This situation is very similar to our history of dealing with the hazards of smoking decades ago, where the power of the industry to influence governments and even conflicts of interest within the public health community delayed action for more than a generation, with consequent loss of life and enormous extra health care costs to society. New standards are warranted now, based on the totality of scientific evidence; the risks of taking no-action, the large population at risk, costs associated with ignoring the problem in new and upgraded site selection and construction, and the loss of public trust by ignoring the problem.

Direct medical and rehabilitative health costs associated with treatment for diseases that are reasonably related to wireless technologies may be very large. Although there is uncertainty involved in how much disease is related to wireless exposures, the mere scale of the problem with several billion users of cell phones and even larger impacts on bystander populations (from cell site exposures, from other WI-FI and wireless exposures in-home and commercial use, etc.) the associated public health costs will likely be monumental. Furthermore the costs to families with cancers, neurological diseases or learning disabilities in children related in part or in whole to wireless technologies extend beyond medical costs. They may reasonably extend to family disruption and family psychological problems, losses in job productivity and income loss.

The history of governments and their official health agencies to deal with emerging and newly identified risks to health is not good [147–149]. This is particularly true where industry investments in new products and technologies occur without full recognition, disclosure or even knowledge of possible health consequences. Large economic investments in polluting industries often make for perilously slow regulatory action, and the public health consequences may be very great as a result [150,151].

Free markets do not internalize the costs to society of “guessing wrong”. Unexpected or hidden health costs of new technologies may not be seen for many years, when the ability to recall or to identify the precise exposures related to disease outcomes is difficult or impossible. The penalty nearly always falls to the individual, the family or the taxpayer and not to the industry that benefits economically—at least in free-market economies. Thus, the profits go to industry but the costs may go to the individual who can suffer both diminished quality of life and health and economic disadvantage. If all disease endpoints that may be reasonably related to chronic exposure to electromagnetic fields are considered even a small attributable fraction for one or more industries, it will have enormous global impact on public health. The public health implications are immense. But they can be reduced by strong government and public health interventions providing information on alternatives to wireless technologies, public education campaigns, health advisories,

Table 1

Public health implications of wireless technologies argue for change in governmental and health agency actions.

---

Secure US and EU legislative mandates for safer technologies for communication and data transmission, for security and surveillance needs.
Promote wired alternatives for voice and data communication (cable, fiber-optic)
Discourage or ban use of cell phones by children and young teen-agers
Provide permanent (unremovable) labels on cell phones “Not for use by children under the age of 16”
Implement national public education campaigns on health issues (cell phones, cordless phones, PDAs, wireless internet, city-wide WI-FI, WLAN and WiMAX exposures
Promote industry redesign for safer products: support innovation for alternatives and solutions
Slow or stop deployment of wireless technologies to discourage reliance on wireless technologies for communication and security needs
Put the burden of proof on industry to show “new wireless tech” is safe before deployment
Adopt and enforce restricted use areas for sensitive or more vulnerable segments of society including low-EMF environments in public areas and “No Cell” zones in airports, hospitals, schools
Acknowledge FCC and ICNIRP thermal safety standards are obsolete for wireless technologies
Appoint new standard-setting bodies familiar with biological effects to develop new guidelines for public safety limits.
Develop new biologically based standards that address low-intensity, chronic exposures
Require standard of evidence and level of proof = public health
Reject “causal” standard of evidence for taking action on science
Make industry financially liable for “guessing wrong” and ignoring health risks

---

requirements for redesign of wireless devices, proscription of use of wireless devices by children and teenagers, strong and independent research programs on causes and prevention of EMF-related diseases, and consultation with all stakeholders on issues relating to involuntary exposures (bystander or second-hand radiation exposures from wireless technologies) (Table 1).

The scientific information contained in this Supplement argues for thresholds or guidelines that are substantially below current FCC and ICNIRP standards for localized exposures to wireless devices and for whole-body exposure. Uncertainty about how low such standards might have to go to be prudent from a public health standpoint should not prevent reasonable efforts to respond to the information at hand. No lower limit for bioeffects and adverse health effects from RF has been established, so the possible health risks of wireless WLAN and WI-FI systems, for example, will require further research. No assertion of safety at any level of wireless exposure (chronic exposure) can be made at this time. The lower limit for reported human health effects has dropped 100-fold below the safety standard (for mobile phones and PDAs); 1000–10,000-fold for other wireless (cell towers at distance; WI-FI and WLAN devices). The entire basis for safety standards is called into question, and it is not unreasonable to question the safety of RF at any level.

It is likely that for both ELF and RF, as for other carcinogens, there is no threshold of exposure that is without risk, but the magnitude of the risk increases linearly with the level of exposure. Our society will not go back to the pre-electric and pre-wireless age, but the clear evidence of health hazards to the human population from exposure mandates that we develop ways in which to reduce exposure through education, new technologies and the establishment of biomedically based standards.

## 7. Conclusions and recommended actions

New ELF limits are warranted based on a public health analysis of the overall existing scientific evidence. These limits should reflect environmental levels of ELF that have been demonstrated to increase risk for childhood leukemia, and possibly other cancers and neurological diseases. ELF limits should be set below those exposure levels that have been linked in childhood leukemia studies to increased risk of disease, plus an additional safety factor. It is no longer acceptable to build new power lines and electrical facilities that place people in ELF environments that have been determined to be risky. These levels are in the 2–4 milligauss (mG) range (0.2–0.4  $\mu$ T), not in the 10 s of mG or 100 s of mG. The existing ICNIRP limit is 1000 mG (100  $\mu$ T) and 904 mG (90.4  $\mu$ T) in the US for ELF is outdated and based on faulty assumptions. These limits are can no longer be said to be protective of public health and they should be replaced. A safety buffer or safety factor should also be applied to a new, biologically based ELF limit, and the conventional approach is to add a safety factor lower than the risk level.

While new ELF limits are being developed and implemented, a reasonable approach would be a 1 mG (0.1  $\mu$ T) planning limit for habitable space adjacent to all new or upgraded power lines and a 2 mG (0.2  $\mu$ T) limit for all other new construction. It is also recommended that a 1 mG (0.1  $\mu$ T) limit be established for existing habitable space for children and/or women who are pregnant (because of the possible link between childhood leukemia and *in utero* exposure to ELF). This recommendation is based on the assumption that a higher burden of protection is required for children who cannot protect themselves, and who are at risk for childhood leukemia at rates that are traditionally high enough to trigger regulatory action. This situation in particular warrants extending the 1 mG (0.1  $\mu$ T) limit to existing occupied space. “Establish” in this case probably means formal public advisories from relevant health agencies. While it is not realistic to reconstruct all existing electrical distribution systems, in the short-term; steps to reduce exposure from these existing systems need to be initiated, especially in places where children spend time, and should be encouraged. These limits should reflect the exposures that are commonly associated with increased risk of childhood leukemia (in the 2–5 mG (0.2–0.5  $\mu$ T) range for all children, and over 1.4 mG (0.14  $\mu$ T) for children age 6 and younger). Nearly all of

the occupational studies for adult cancers and neurological diseases report their highest exposure category is 4 mG (0.4  $\mu$ T) and above, so that new ELF limits should target the exposure ranges of interest, and not necessarily higher ranges.

Avoiding chronic ELF exposure in schools, homes and the workplace above levels associated with increased risk of disease will also avoid most of the possible bioactive parameters of ELF discussed in the relevant literature.

It is not prudent public health policy to wait any longer to adopt new public safety limits for ELF. These limits should reflect the exposures that are commonly associated with increased risk of childhood leukemia (in the 2–5 mG (0.2–0.5  $\mu$ T) range for all children, and over 1.4 mG (0.14  $\mu$ T) for children age 6 and younger). Avoiding chronic ELF exposure in schools, homes and the workplace above levels associated with increased risk of disease will also avoid most of the possible bioactive parameters of ELF discussed in the relevant literature.

The rapid deployment of new wireless technologies that chronically expose people to pulsed RF at levels reported to cause bioeffects, which in turn, could reasonably be presumed to lead to serious health impacts, is a public health concern. There is suggestive to strongly suggestive evidence that RF exposures may cause changes in cell membrane function, cell communication, metabolism, activation of proto-oncogenes and can trigger the production of stress proteins at exposure levels below current regulatory limits. Resulting effects can include DNA breaks and chromosome aberrations, cell death including death of brain neurons, increased free-radical production, activation of the endogenous opioid system, cell stress and premature aging, changes in brain function including memory loss, retarded learning, performance impairment in children, headaches and fatigue, sleep disorders, neurodegenerative conditions, reduction in melatonin secretion and cancers (BioInitiative Report Chapters 5–10, 12) [1].

This information now argues for thresholds or guidelines that are substantially below current FCC and ICNIRP standards for whole-body exposure. Uncertainty about how low such standards might have to go to be prudent from a public health standpoint should not prevent reasonable efforts to respond to the information at hand. No lower limit for bioeffects and adverse health effects from RF has been established, so the possible health risks of wireless WLAN and WI-FI systems, for example, will require further research and no assertion of safety at any level of wireless exposure (chronic exposure) can be made at this time. The lower limit for reported human health effects has dropped 100-fold below the safety standard (for mobile phones and PDAs); 1000–10,000-fold for other wireless (cell towers at distance; WI-FI and WLAN devices). The entire basis for safety standards is called into question, and it is not unreasonable to question the safety of RF at any level.

A cautionary target level for pulsed RF exposures for ambient wireless that could be applied to RF sources from cell tower antennas, WI-FI, WI-MAX and other similar sources

is proposed. The recommended cautionary target level is 0.1 microwatts per centimeter squared ( $\mu\text{W}/\text{cm}^2$ ) (or 0.614 V per meter or V/m) for pulsed RF where these exposures affect the general public; this advisory is proportionate to the evidence and in accord with prudent public health policy. A precautionary limit of 0.1  $\mu\text{W}/\text{cm}^2$  should be adopted for outdoor, cumulative RF exposure. This reflects the current RF science and prudent public health response that would reasonably be set for pulsed RF (ambient) exposures where people live, work and go to school. This level of RF is experienced as whole-body exposure, and can be a chronic exposure where there is wireless coverage present for voice and data transmission for cell phones, pagers and PDAs and other sources of radiofrequency radiation. An outdoor precautionary limit of 0.1  $\mu\text{W}/\text{cm}^2$  would mean an even lower exposure level inside buildings, perhaps as low as 0.01  $\mu\text{W}/\text{cm}^2$ . Some studies and many anecdotal reports on ill health have been reported at lower levels than this; however, for the present time, it could prevent some of the most disproportionate burdens placed on the public nearest to such installations. Although this RF target level does not preclude further rollout of WI-FI technologies, we also recommend that wired alternatives to WI-FI be implemented, particularly in schools and libraries so that children are not subjected to elevated RF levels until more is understood about possible health impacts. This recommendation should be seen as an interim precautionary limit that is intended to guide preventative actions; and more conservative limits may be needed in the future.

Broadcast facilities that chronically expose nearby residents to elevated RF levels from AM, FM and television antenna transmission are also of public health concern given the potential for very high RF exposures near these facilities (antenna farms). RF levels can be in the 10 s to several 100 s of  $\mu\text{W}/\text{cm}^2$  in residential areas within half a mile of some broadcast sites (for example, Lookout Mountain, Colorado and Awbrey Butte, Bend, Oregon). Like wireless communication facilities, RF emissions from broadcast facilities that are located in, or expose residential populations and schools to elevated levels of RF will very likely need to be re-evaluated for safety.

For emissions from wireless devices (cell phones, personal digital assistant or PDA devices, etc.) there is enough evidence for increased risk of brain tumors and acoustic neuromas now to warrant intervention with respect to their use. Redesign of cell phones and PDAs could prevent direct head and eye exposure, for example, by designing new units so that they work only with a wired headset or on speakerphone mode.

These effects can reasonably be presumed to result in adverse health effects and disease with chronic and uncontrolled exposures, and children may be particularly vulnerable. The young are also largely unable to remove themselves from such environments. Second-hand radiation, like second-hand smoke is an issue of public health concern based on the evidence at hand.

In summary, the following recommendations are made:

- ELF limits should be set below those exposure levels that have been linked in childhood leukemia studies to increased risk of disease, plus an additional safety factor. It is no longer acceptable to build new power lines and electrical facilities that place people in ELF environments that have been determined to be risky (at levels generally at 2 mG (0.2  $\mu\text{T}$ ) and above).
- While new ELF limits are being developed and implemented, a reasonable approach would be a 1 mG (0.1  $\mu\text{T}$ ) planning limit for habitable space adjacent to all new or upgraded power lines and a 2 mG (0.2  $\mu\text{T}$ ) limit for all other new construction. It is also recommended for that a 1 mG (0.1  $\mu\text{T}$ ) limit be established for existing habitable space for children and/or women who are pregnant. This recommendation is based on the assumption that a higher burden of protection is required for children who cannot protect themselves, and who are at risk for childhood leukemia at rates that are traditionally high enough to trigger regulatory action. This situation in particular warrants extending the 1 mG (0.1  $\mu\text{T}$ ) limit to existing occupied space. "Establish" in this case probably means formal public advisories from relevant health agencies.
- While it is not realistic to reconstruct all existing electrical distributions systems, in the short-term; steps to reduce exposure from these existing systems need to be initiated and should be encouraged, especially in places where children spend time.
- A precautionary limit of 0.1  $\mu\text{W}/\text{cm}^2$  (which is also 0.614 V per meter) should be adopted for outdoor, cumulative RF exposure. This reflects the current RF science and prudent public health response that would reasonably be set for pulsed RF (ambient) exposures where people live, work and go to school. This level of RF is experienced as whole-body exposure, and can be a chronic exposure where there is wireless coverage present for voice and data transmission for cell phones, pagers and PDAs and other sources of radiofrequency radiation. Some studies and many anecdotal reports on ill health have been reported at lower levels than this; however, for the present time, it could prevent some of the most disproportionate burdens placed on the public nearest to such installations. Although this RF target level does not preclude further rollout of WI-FI technologies, we also recommend that wired alternatives to WI-FI be implemented, particularly in schools and libraries so that children are not subjected to elevated RF levels until more is understood about possible health impacts. This recommendation should be seen as an interim precautionary limit that is intended to guide preventative actions; and more conservative limits may be needed in the future.

## References

- [1] C. Sage, D.O. Carpenter (Eds.), BioInitiative Working Group BioInitiative Report: A Rationale for a Biologically-based Public

- Exposure Standard for Electromagnetic Fields (ELF and RF), 2007. <http://www.bioinitiative.org>.
- [2] REFLEX Program. Risk evaluation of potential environmental hazards from low frequency electromagnetic field exposure using sensitive in vitro methods. A project funded by the European Union under the programme Quality of Life and Management of Living Resources, Key Action 4 (2004).
  - [3] L. Hardell, C. Sage, Biological effect from electromagnetic field exposure and public exposure standards, *Biomed. Pharmacother.* 62 (2008) 104–109, doi:10.1016/j.bipha.(2007)12.004.
  - [4] L. Hardell, M. Carlberg, F. Söderqvist, K. Hansson Mild, Meta-analysis of long-term mobile phone use and the association with brain tumours, *Int. J. Oncol.* 32 (2008) 1097–1103.
  - [5] P. Kan, S.E. Simonsen, J.L. Lyon, J.R.W. Kestle, Cellular phone use and brain tumor: a meta-analysis, *J. Neurooncol.* (2007), doi:10.1007/s11060-007-9432-1.
  - [6] E. Cardis, Interphone Study Memo, International Agency for Cancer Research, October 2008.
  - [7] S. Sadetzki, A. Chetrit, A. Jarus-Hakak, E. Cardis, Y. Deutch, S. Dvendevani, A. Zultan, I. Novikov, L. Freedman, M. Wolf, Cellular phone use and risk of benign and malignant parotid gland tumors—a nationwide case–control study, *Am. J. Epidemiol.* (2008), doi:10.1093/aje/kwm325.
  - [8] A. Lahkola, T. Salminen, J. Raitanen, S. Heinavaara, M.J. Schoemaker, H.C. Christensen, M. Feychting, C. Johansen, L. Klaeboe, S. Lonn, A.J. Swerdlow, T. Tynes, A. Auvinen, Meningioma and mobile phone use—a collaborative case–control study in five North European countries, *Int. J. Epidemiol. Adv. Access* (August) (2008), doi:10.1093/ije/dyn155.
  - [9] T. Takebayashi, S. Akiba, Y. Kikuchi, et al., Mobile phone use and acoustic neuroma risk in Japan, *Occup. Environ. Med.* 63 (2007) 802–807.
  - [10] D.O. Carpenter, C.L. Sage, Setting prudent public health policy for electromagnetic field exposures, *Rev. Environ. Health* 23 (2) (2008) 91–117.
  - [11] D.O. Carpenter, C.L. Sage, BioInitiative Working Group, Key scientific evidence and public health policy options, BioInitiative Report at <http://www.bioinitiative.org>, 17 (2007).
  - [12] European Commission, Health and Consumer Protection, Scientific Committee on SCENIHR Report on Emerging and Newly Identified Health Risks—Possible Effects of Electromagnetic Fields (EMF) on Human Health, 2007.
  - [13] World Health Organization, Extremely Low Frequency Fields Environmental Health Criteria Monograph 238, 2007. <http://www.who.int/peh-emf/project/en> and [http://www.who.int/peh-emf/meetings/elf\\_emf\\_workshop\\_2007/en/index.html](http://www.who.int/peh-emf/meetings/elf_emf_workshop_2007/en/index.html).
  - [14] [http://news.cnet.com/Emerging-markets-fuel-cell-phone-growth/2100-1039\\_3-6159491.html](http://news.cnet.com/Emerging-markets-fuel-cell-phone-growth/2100-1039_3-6159491.html).
  - [15] <http://news.softpedia.com/news/2-14-billion-cell-phone-subscribers-in-2005-2120.shtml>.
  - [16] [http://www.ctia.org/media/industry\\_info/index.cfm/AID/10323](http://www.ctia.org/media/industry_info/index.cfm/AID/10323).
  - [17] <http://www.nytimes.com/2008/09/20/us/20messaging.html> and Members Info, Electronics Industries Alliance Website, November, 2000.; Members Info, Electronics Industries Alliance Website, November 2000.
  - [18] L. Hardell, M. Carlberg, K. Hansson Mild, Pooled analysis of two case–control studies on use of cellular and cordless telephones and the risk for malignant brain tumours diagnosed in 1997–2003, *Int. Arch. Environ. Health* 79 (2006) 630–639, doi:10.1007/s00420-006-0088-5.
  - [19] M. Kundi, The controversy about a possible relationship between mobile phone use and cancer, *Environ. Health Persp.* (September) (2008), doi: 101289/ehp.11902.
  - [20] J. Pronczuk–Garbino (Ed.), Children’s Health and the Environment: A Global Perspective, World Health Organization, Geneva, Switzerland, 2005, p. 367.
  - [21] World Health Organization, Children’s Health and Environment: A Review of Evidence: A Joint Report from the European Environmental Agency and The World Health Organization, 2002. <http://www.who.int/peh-emf>.
  - [22] O.P. Gandhi, G. Lazzi, C.M. Furse, Electromagnetic absorption in the human head and neck for mobile telephones at 835 and 1900 MHz, *IEE Trans. Microw. Theory Tech.* 44 (1996) 1884–1896.
  - [23] O.P. Gandhi, G. Kang, Some present problems and a proposed experimental phantom for SAR compliance testing of cellular telephones at 835 and 1900 MHz, *Phys. Med. Biol.* 47 (2002) 1501–1518.
  - [24] J. Wiart, A. Hadjem, M.F. Wong, I. Bloch, Analysis of RF exposure in the head tissues of children and adults, *Phys. Med. Biol.* 53 (2008) 3681–3695; J. Wiart, A. Hadjem, M.F. Wong, I. Bloch, Analysis of RF exposure in the head tissues of children and adults, *Wiart Phys. Med. Biol.* 53 (June) (2008) 2771–2783.
  - [25] H.A. Divan, L. Kheifets, C. Obel, J. Olsen, Prenatal and postnatal exposure to cell phone use and behavioral problems in children, *Epidemiology* 19 (4) (2008).
  - [26] International Commission on Non-ionizing Radiation Protection, Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz). *Health Phys.* 74(4) (1998) 494–522. <http://www.icnirp.de>.
  - [27] Institute of Electrical and Electronics Engineers, Inc (IEEE), Section 4.2 of “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz,” ANSI/IEEE C95.1-1992. New York, NY, 1992.
  - [28] H. Lai, N.P. Singh, Single and double strand DNA breaks in rat brain cells after acute exposure to radiofrequency electromagnetic radiation, *Int. J. Radiat. Biol.* 69 (1996) 513–521.
  - [29] S. Ivancsits, A. Pilger, E. Diem, O. Jahn, H.W. Rudinger, Cell type-specific genotoxic effects of intermittently extremely-low frequency electromagnetic fields, *Mutat. Res.* 583 (2005) 184–188.
  - [30] J. Phillips, et al., DNA damage in molt-4 lymphoblastoid cells exposed to cellular telephone radiofrequency fields in vitro, *Bioelectrochem. Bioenerg.* 45 (1998) 103–110.
  - [31] R.J. Aitken, L.E. Bennetts, D. Sawyer, A.M. Wiklendt, B.V. King, Impact of radio frequency electromagnetic radiation on DNA integrity in the male germline, *Int. J. Androl.* 28 (2005) 171.
  - [32] J.Y. Kim, S.Y. Hong, Y.M. Lee, S.A. Yu, W.S. Koh, J.R. Hong, T. Son, S.K. Chang, M. Lee, In vitro assessment of clastogenicity of mobile-phone radiation (835 MHz) using the alkaline comet assay and chromosomal aberration test, *Environ. Toxicol.* 23 (2008) 319.
  - [33] S. Lixia, K. Yao, W. Kaijun, I. Deglang, H. Huajun, G. Xiangwei, W. Baohong, Z. Wei, L. Jianling, W. Wei, Effects of 1.8 GHz radiofrequency field on DNA damage and expression of heat shock protein 70 in human lens epithelial cells, *Mutat. Res.* 602 (2006) 135.
  - [34] R. Paulraj, J. Behari, Single strand DNA breaks in rat brain cells exposed to microwave radiation, *Mutat. Res.* 596 (2006) 76.
  - [35] M. Mashevich, D. Folkman, A. Kesar, A. Barbul, R. Korenstein, E. Jerby, L. Avivi, Exposure of human peripheral blood lymphocytes to electromagnetic fields associated with cellular phones leads to chromosomal instability, *Bioelectromagnetics* 24 (2003) 82.
  - [36] I.G. Akoev, M.S. Pashovkina, L.P. Dolgacheva, T.P. Semenova, V.L. Kalmykov, Enzymatic activity of some tissues and blood serum from animals and humans exposed to microwaves and hypothesis on the possible role of free radical processes in the nonlinear effects and modification of emotional behavior of animals, *Radiat. Biol. Radioecol.* 42 (3) (2002) 32–330.
  - [37] C. Blackman, et al., The influence of 1.2  $\mu$ T, 60 Hz magnetic fields on melatonin and tamoxifen-induced inhibition of MCF-7 cell growth, *Bioelectromagnetics* 22 (2) (2001) 122–128.
  - [38] D.E. Blask, S.M. Hill, Effects of melatonin on cancer: studies on MCF-7 human breast cancer cells in culture, *J. Neural Transm. Suppl.* 21 (1986) 433–449.

- [39] J.B. Burch, J.S. Reif, C.W. Noonan, T. Ichinose, A.M. Bachand, T.L. Koleber, M.G. Yost, Melatonin metabolite excretion among cellular telephone users, *Int. J. Rad. Biol.* 78 (2002) 1029–1036.
- [40] Girgert, et al., Induction of tamoxifen resistance in breast cancer cells by ELF electromagnetic fields, *Biochem. Biophys. Res. Commun.* 336 (2005) 1144–1149.
- [41] Harland, et al., Environmental magnetic fields inhibit the antiproliferative action of tamoxifen and melatonin in a human breast cancer cell line, *Bioelectromagnetics* 18 (1997) 555–562.
- [42] Harland, et al., Evidence for a slow time-scale of interaction for magnetic fields inhibiting tamoxifen's antiproliferative action in human breast cancer cells, *Cell Biochem. Biophys.* 31 (3) (1999) 295–306.
- [43] A. Ilhan, A. Gurel, F. Armutcu, S. Kamisli, M. Iraz, O. Akyol, S. Ozen, Ginkgo biloba prevents mobile phone-induced oxidative stress in rat brain, *Clin. Chim. Acta* 340 (1–2) (2004) 153–162.
- [44] Ishido, et al., Magnetic fields (MF) of 50 Hz at 1.2  $\mu$ T as well as 100  $\mu$ T cause uncoupling of inhibitory pathways of adenyl cyclase mediated by melatonin 1a receptor in MF-sensitive MCF-7 cells, *Carcinogenesis* 22 (7) (2001) 1043–1048.
- [45] H. Koylu, H. Mollaoglu, F.N. Ozguner, Melatonin modulates 900 Mhz microwave-induced lipid peroxidation changes in rat brain, *Toxicol. Ind. Health* 22 (5) (2006) 211–216.
- [46] R.P. Liburdy, T.R. Sloma, et al., ELF magnetic fields, breast cancer, and melatonin: 60 Hz fields block melatonin's oncostatic action on ER+ breast cancer cell proliferation, *J. Pineal Res.* 14 (1993) 89–97.
- [47] R.P. Liburdy, et al., Magnetic Fields, melatonin, tamoxifen and human breast cancer cell growth, in: R.G. Stevens, B.W. Wilson, L.E. Anderson (Eds.), *The Melatonin Hypothesis—Breast Cancer and Use of Electric Power*, Battelle Press, Columbus, Richland, 1997, pp. 669–700.
- [48] L.I. Loberg, Gene expression in human breast epithelial cells exposed to 60 Hz magnetic fields, *Carcinogenesis* 20 (1999) 1633–1636.
- [49] Luben, et al., Replication of 12 mG EMF effects on melatonin responses of MCF-7 breast cancer cells in vitro, in: Abstract A-1 of the 1996 Annual Review of Research on Biological Effects of Electric and Magnetic Fields from the Generation, Delivery and Use of Electricity, San Antonio, TX, November 17–21, 1996, p. 1.
- [50] Luben, et al., Independent replication of 60-Hz 1.2  $\mu$ T EMF effects on melatonin and tamoxifen responses of MCF-7 cells in vitro, in: Abstract A-3.4, Bioelectromagnetics Society Annual Meeting, St. Pete Beach, FL, June 7–11, 1998, pp. 17–18.
- [51] Morris, In vitro exposure of MCF-7 human breast cancer cells to 60-Hz magnetic fields, in: Abstract p-125A, Bioelectromagnetics Society Annual Meeting, St. Pete Beach, FL, June 7–11, 1998, pp. 204–205.
- [52] F. Oktem, F. Ozguner, H. Mollaoglu, A. Koyu, E. Uz, Oxidative damage in the kidney induced by 900-MHz-emitted mobile phone: protection by melatonin, *Arch. Med. Res.* 36 (4) (2005) 350–355.
- [53] F. Ozguner, G. Aydin, H. Mollaoglu, O. Gokalp, A. Koyu, G. Cesur, Prevention of mobile phone induced skin tissue changes by melatonin in rat: an experimental study, *Toxicol. Ind. Health* 20 (6–10) (2004) 133–139.
- [54] F. Ozguner, A. Altinbas, M. Ozaydin, A. Dogan, H. Vural, A.N. Kisioglu, G. Cesur, N.G. Yildirim, Mobile phone-induced myocardial oxidative stress: protection by a novel antioxidant agent caffeic acid phenethyl ester, *Toxicol. Ind. Health* 21 (9) (2005) 223–230.
- [55] A.W. Guy, C.K. Chou, L.L. Kunz, J. Crowley, J. Krupp, Effects of long-term low-level radiofrequency radiation exposure on rats. US Air Force School of Aerospace Medicine Brooks Air Force Base, Texas TR-85-64 Final Report August 1985, Approved for public release: distribution is unlimited.
- [56] C.K. Chou, Long-term low level microwave irradiation of rats, *Bioelectromagnetics* 13 (1992) 469–496.
- [57] H. Dolk, et al., Cancer incidence near radio and television transmitters in Great Britain, *Am. J. Epidemiol.* 145 (1) (1997) 1–9.
- [58] V. Garaj-Vrhovac, D. Horvat, Z. Koren, The relationship between colony-forming ability, chromosome aberrations and incidence of micronuclei in V79 Chinese hamster cells exposed to microwave radiation, *Mutat. Res.* 263 (3) (1991) 143–149.
- [59] V. Garaj-Vrhovac, A. Fucic, D. Horvat, The correlation between the frequency of micronuclei and specific chromosome aberrations in human lymphocytes exposed to microwave radiation in vitro, *Mutat. Res.* 281 (3) (1992) 181–186.
- [60] V. Garaj-Vrhovac, Micronucleus assay and lymphocyte mitotic activity in risk assessment of occupational exposure to microwave radiation, *Chemosphere* 39 (13) (1999) 2301–2312.
- [61] M. Ha, H. Im, M. Lee, H.J. Kim, B.C. Kim, Y.M. Gimm, et al., Radio-frequency radiation exposure from AM radio transmitters and childhood leukemia and brain cancer, *Am. J. Epidemiol.* 166 (2007) 270–279.
- [62] B. Hocking, et al., Cancer incidence and mortality and proximity to TV towers, *Med. J. Aust.* 165 (11–12) (1996) 601–605.
- [63] B. Hocking, Decreased survival for childhood leukemia in proximity to TV towers, in: Poster Presented at the Annual Scientific Meeting of the Royal Australian College of Physicians in Adelaide, SA, Australia, May, 2000.
- [64] D.E. Foliart, B.H. Pollock, G. Mezei, R. Iriye, J.M. Silva, K.L. Epi, L. Kheifets, M.P. Lind, R. Kavet, Magnetic field exposure and long-term survival among children with leukemia, *Brit. J. Cancer* 94 (2006) 161–164.
- [65] A. Huss, A. Spoerri, M. Egger, Röösl for the Swiss national cohort study, residence near power lines and mortality from neurodegenerative diseases: longitudinal study of the Swiss population, *Am. J. Epidemiol.* (November) (2008) (Epub ahead of print).
- [66] F. Marinelli, D. La Sala, G. Ciccio, L. Cattini, C. Trimarchi, S. Putti, A. Zamparelli, L. Giuliani, G. Tomassetti, C. Cinti, Exposure to 900 MHz electromagnetic field induces an imbalance between pro-apoptotic and pro-survival signals in T-lymphoblastoid leukemia CCRF-CEM cells, *J. Cell Physiol.* 198 (2) (2004) 324–332.
- [67] P. Michelozzi, C. Ancona, D. Fusco, F. Forastiere, C.A. Perucci, Risk of leukemia and residence near a radio transmitter in Italy, *Epidemiology* 9 (Suppl.) (1998) 354.
- [68] M. Repacholi, et al., Lymphomas in  $E\mu$ -Pim1 transgenic mice exposed to pulsed 900 MHz electromagnetic fields, *Radiat. Res.* 147 (1997) 31–40.
- [69] A. Stang, et al., The possible role of radiofrequency radiation in the development of uveal melanoma, *Epidemiology* 12 (1) (2001) 7–12.
- [70] M. Blank (2007). Section 7, pp. 1–40. Evidence for Stress Response (Stress Proteins). In *BioInitiative Report: A Scientific Perspective on Health Risk of Electromagnetic Fields*. Published Online 31 August 2007, <http://www.bioinitiative.org/report/index.htm>.
- [71] C. Daniells, I. Duce, D. Thomas, P. Sewell, J. Tattersall, D. de Pomerai, Transgenic nematodes as biomonitors of microwave-induced stress, *Mutat. Res.* 399 (1998) 55–64.
- [72] D. de Pomerai, et al., Non-thermal heat-shock response to microwaves, *Nature* 405 (2000) 417–418.
- [73] S. Kwee, et al., The biological effects of microwave radiation, in: *Proceedings of the Second World Congress for Electricity and Magnetism in Biology and Medicine*, Bologna, Italy, June, 1997.
- [74] S. Kwee, et al., Changes in cellular proteins due to environmental non-ionizing radiation. I. Heat-shock proteins, *Electro Magnetobiol.* 20 (2001) 141–152.
- [75] D. Leszczynski, S. Oenväära, J. Reivinen, R. Kuokka, Non-thermal activation of the hsp27/p38MAPK stress pathway by mobile phone radiation in human endothelial cells: molecular mechanism for cancer- and blood-brain barrier-related effects, *Differentiation* 70 (2002) 120–129.
- [76] D. Leszczynski, R. Nylund, S. Joenvaara, J. Reivinen, Applicability of discovery science approach to determine biological effects of mobile phone radiation, *Proteomics* 4 (2) (2004) 426–431.
- [77] S. Lixia, Y. Ke, W. Kaijun, L. Dequiang, H. Huajun, G. Xiangwei, W. Baohong, Z. Wei, L. Jianling, W. Wei, Effects of 1.8 GHz

- radiofrequency field on DNA damage and expression of heat shock protein 70 in human lens epithelial cells, *Mutat. Res.* (2006), doi:10.1016/j.mrfmmm.2006.08.010.
- [78] M. Simko, C. Hartwig, M. Lantow, M. Lupke, M.O. Mattsson, Q. Rahman, J. Rollwitz, Hsp 70 expression and free radical release after exposure to non-thermal radiofrequency electromagnetic fields and ultrafine particles in human Mono Mac 6 cells, *Toxicol. Lett.* 161 (2006) 73–82 (Elsevier Science Direct).
- [79] S. Velizarov, The effects of radiofrequency fields on cell proliferation are non-thermal, *Bioelectrochem. Bioenerg.* 48 (1999) 177–180.
- [80] D. Weisbrot, H. Lin, L. Ye, M. Blank, R. Goodman, Effects of mobile phone radiation on reproduction and development in *Drosophila melanogaster*, *J. Cell Biochem.* 89 (1) (2003) 48–55.
- [81] T. Olivares-Banuelos, L. Navarro, A. Gonzalez, R. Drucker-Colin, Differentiation of chromaffin cells elicited by ELF MF modifies gene expression pattern, *Cell Biol. Int.* 28 (2004) 273–279.
- [82] R. Zhao, S. Zhang, Z. Xu, L. Ju, D. Lu, G. Yao, Studying gene expression profile of rat neuron exposed to 1800 MHz radiofrequency electromagnetic fields with cDNA microassay, *Toxicology* 235 (2007) 167–175.
- [83] A. Karinen, S. Heinavaara, R. Nylund, D. Leszczynski, Mobile phone radiation might alter protein expression in human skin, *BMC Genomics* 9 (2008) 77, doi:10.1186/1471-2164-9-77.
- [84] J. Vanderstraeten, L. Verschaeve, Gene and protein expression following exposure to radiofrequency fields from mobile phones, *Environ. Health Persp.* 116 (2008) 1131–1135.
- [85] G. Abdel-Rassoul, O.A. El-Fateh, M.A. Salem, A. Michael, F. Farahat, M. El-Batanouny, E. Salem, Neurobehavioral effects among inhabitants around mobile phone base stations, *Neurotoxicology* 28 (2007) 434–440.
- [86] P. Achermann, Exposure to pulsed high-frequency electromagnetic field during waking affects human sleep EEG, *Neuroreport* 11 (15) (2000) 3321–3325.
- [87] E.S. Altpeter, T.H. Krebs, Study on health effects of the shortwave transmitter station of Schwarzenburg, Bern, Switzerland, University of Bern BEW Publications Study No. 56, The Federal Office of Energy, 1995.
- [88] A.A. Borbely, et al., Pulsed high-frequency electromagnetic field affects human sleep and sleep electroencephalogram, *Neurosci. Lett.* 275 (3) (1999) 207–210.
- [89] R. Huber, T. Graf, K.A. Cote, L. Wittmann, E. Gallmann, D. Matter, J. Schuderer, N. Kuster, A.A. Borbely, P. Achermann, Exposure to pulsed high-frequency electromagnetic field during waking affects human sleep EEG, *Neuroreport* 11 (15) (2000) 3321–3325.
- [90] K. Mann, Effects of pulsed high-frequency electromagnetic fields on human sleep, *Neuropsychobiology* 33 (1996) 41–47.
- [91] G. Oberfeld, The microwave syndrome—further aspects of a Spanish study, in: *Proceedings of the Third International Workshop on Bioelectromagnetic Effects of Electromagnetic Fields*, Kos, Greece, 2004.
- [92] R. Santini, M. Seigne, L. Bonhomme-Faivre, S. Bouffet, E. Defrasne, M. Sage, Symptoms experienced by users of digital cellular phones: a pilot study in a French engineering school, *Pathol. Biol. (Paris)* 49 (3) (2001) 222–226.
- [93] R. Santini, P. Santini, P. Le Ruz, J.M. Danze, M. Seigne, Survey study of people living in the vicinity of cellular phone base stations, *Electromag. Biol. Med.* 22 (2003) 41–49.
- [94] TNO Physics and Electronics Laboratory, The Netherlands, Effects of Global Communication System Radio-frequency Fields on Well-being and Cognitive Functions of Human Beings With and Without Subjective Complaints, Netherlands Organization for Applied Scientific Research (2003), pp. 1–63.
- [95] E.S. Altpeter, T.H. Krebs, Study on health effects of the shortwave transmitter station of Schwarzenburg, Bern, Switzerland, University of Bern BEW Publications Study No. 56, The Federal Office of Energy, Switzerland, 1995.
- [96] S.E. Chia, Prevalence of headache among handheld cellular telephone users in Singapore: a community study, *Environ. Health Persp.* 108 (11) (2000) 1059–1062.
- [97] H. Chiang, et al., Health effects of environmental electromagnetic fields, *J. Bioelectr.* 8 (1989) 127–131.
- [98] H. D'Costa, et al., Human brain wave activity during exposure to radiofrequency field emissions from mobile phones, *Aust. Phys. Eng. Sci. Med.* 26 (4) (2003).
- [99] H.P. Hutter, H. Moshhammer, P. Wallner, M. Kundi, Subjective symptoms, sleeping problems and cognitive performance in subjects living near mobile phone base stations, *Occup. Environ. Med.* 63 (2006) 307–313.
- [100] M. Koivisto, et al., Effects of 902 MHz electromagnetic field emitted by cellular telephones on response times in humans, *Neuroreport* 11 (2000) 413–415.
- [101] M. Koivisto, et al., The effects of electromagnetic field emitted by GSM phones on working memory, *Neuroreport* 11 (2002) 1641–1643.
- [102] A.A. Kolodynski, V.V. Kolodynska, Motor and psychological functions of school children living in the area of the Skrunnda radio location station in Latvia, *Sci. Total Environ.* 180 (1996) 87–93.
- [103] C.M. Krause, L. Sillanmaki, M. Koivisto, A. Haggqvist, C. Saarela, A. Revonsuo, M. Laine, H. Hamalainen, Effects of electromagnetic field emitted by cellular phones on the EEG during a memory task, *Neuroreport* 11 (4) (2000) 761–764.
- [104] C.M. Krause, L. Sillanmaki, M. Koivisto, A. Haggqvist, C. Saarela, A. Revonsuo, M. Laine, H. Hamalainen, Effects of electromagnetic fields emitted by cellular phones on the electroencephalogram during a visual working memory task, *Int. J. Radiat. Biol.* 76 (12) (2000) 1659–1667.
- [105] J. Lass, et al., Effects of 7 Hz-modulated 450 MHz electromagnetic radiation on human performance in visual memory tasks, *Int. J. Radiat. Biol.* 73 (10) (2002) 937–944.
- [106] A.A. Marino, E. Nilsen, C. Frilot, Nonlinear changes in brain electrical activity due to cell phone radiation, *Bioelectromagnetics* 24 (5) (2003) 339–346.
- [107] G. Oberfeld, et al., The microwave syndrome—further aspects of a Spanish study, in: *Proceedings of the Third International Workshop on Bioelectromagnetic Effects of Electromagnetic Fields*, Kos, Greece, 2004.
- [108] A. Preece, et al., Effect of a 915-MHz simulated mobile phone signal on c function in man, *Int. J. Radiat. Biol.* 75 (1999) 447–456.
- [109] S.J. Regel, S. Negovetic, M. Roosli, V. Berdinas, J. Schuderer, A. Huss, U. Lott, N. Kuster, P. Achermann, UMTS base station-like exposure, well-being and cognitive performance, *Environ. Health Persp.* 114 (2006) 1270–1275.
- [110] S. Eltiti, D. Wallace, A. Ridgewell, K. Zougkou, R. Russo, F. Sepulveda, D. Mirshekar-Syahkal, P. Rasor, R. Deeble, E. Fox, Does short-term exposure to mobile phone base station signals increase symptoms in individuals who report sensitivity to electromagnetic fields? A double-blind randomized provocation study, *Environ. Health Persp.* 115 (2007) 1603–1608.
- [111] E.F. Pace-Schott, J.A. Hobson, The neurobiology of sleep: genetics, cellular physiology and subcortical networks, *Nat. Rev. Neurosci.* 3 (2002) 591–605.
- [112] J.B. Burch, J.S. Reif, C.W. Noonan, T. Ichinose, A.M. Bachand, T.L. Koleber, M.G. Yost, Melatonin metabolite excretion among cellular telephone users, *Int. J. Radiat. Biol.* 78 (2002) 1029–1036.
- [113] M.L. Clark, J.B. Burch, M.G. Yost, Y. Zhai, A.M. Bachand, C.T. Fitzpatrick, J. Ramaprasad, L.A. Cragin, J.S. Reif, Biomonitoring of estrogen and melatonin metabolites among women residing near radio and television broadcasting transmitters, *J. Occup. Environ. Med.* 49 (2007) 1149–1156.
- [114] L.M. Wang, N.A. Suthana, D. Chaudhury, D.R. Weaver, C.S. Colwell, Melatonin inhibits hippocampal long-term potentiation, *Eur. J. Neurosci.* 22 (2005) 2231–2237.

- [115] M. Ozcan, B. Yilmaz, D.O. Carpenter, Effects of melatonin on synaptic transmission and long term potentiation in two areas of mouse hippocampus, *Brain Res.* 1111 (2006) 90–94.
- [116] R.J. Reiter, L. Tang, J.J. Garcia, A. Munoz-Hoyos, Pharmacological actions of melatonin in oxygen radical pathophysiology, *Life Sci.* 60 (1997) 2255–2271.
- [117] C.W. Noonan, J.S. Reif, J.B. Burch, T.Y. Ichinose, M.G. Yost, K. Magnusson, Relationship between amyloid beta protein and melatonin metabolite in a study of electric utility workers, *J. Occup. Environ. Med.* 44 (2002) 769–775.
- [118] L.G. Salford, A.E. Brun, et al., Nerve cell damage in mammalian brain after exposure to microwaves from GSM mobile phones, *Environ. Health Persp.* 111 (2003) 881–883.
- [119] J.L. Eberhardt, B.R.R. Persson, A.E. Brun, L.G. Salford, L.O.G. Malmgren, Blood–brain barrier permeability and nerve cell damage in rat brain 14 and 28 days after exposure to microwaves from GSM mobile phones, *Electromagn. Biol. Med.* 27 (2008) 215–229. doi:10.1080\_1536370802344037.
- [120] L.G. Salford, et al., Permeability of the blood brain barrier induced by 915 MHz electromagnetic radiation continuous wave and modulated at 8, 16, 50 and 200 Hz, *Microsc. Res. Tech.* 27 (1994) 535–542.
- [121] A. Schirmacher, Electromagnetic fields (1.8 GHz) increase the permeability of sucrose of the blood–brain barrier in vitro, *Bioelectromagnetics* 21 (2000) 338–345.
- [122] Y. Hamnerius, Microwave exposure from mobile phones and base stations in Sweden, in: *Proceedings of the International Conference on Cell Tower Siting*, sponsored by the University of Vienna & Land-Salzburg, Salzburg, Austria, June 7–8, 2000.
- [123] E.D. Mantiply, Summary of measured radiofrequency electric and magnetic fields (10 kHz–30 GHz) in the general and work environment, *Bioelectromagnetics* 18 (1997) 563–577.
- [124] Sage Associates, 2004. An Overview of Low-intensity radiofrequency/microwave radiation studies relevant to wireless communications and data, *Bioelectromagnetics Society Annual Meeting*, Washington DC, June, 2004.
- [125] C. Sage, O. Johansson, S.A. Sage, Personal digital assistant (PDA) cell phone units produce elevated extremely-low frequency electromagnetic field emissions, *Bioelectromagnetics* 28 (7) (2007) 581–582.
- [126] C. Sage, O. Johansson, Response to comment on personal digital assistant (PDA) cell phone units produce elevated extremely-low frequency electromagnetic field emissions, *Bioelectromagnetics* (July) (2007), 17654541.
- [127] C. Sage, O. Johansson, Response to comment on measuring ELF fields produced by mobile phones and personal digital assistants (PDAs), *Bioelectromagnetics* (July) (2007), 17654536.
- [128] M. Tuor, S. Ebert, J. Schuderer, N. Kuster, Assessment of ELF magnetic fields from five mobile handsets, in: *ITIS Foundation, Conference Presentation, Monte Verita*, 2005.
- [129] T. Linde, K.H. Mild, Measurement of low frequency magnetic fields from digital cellular telephones, *Bioelectromagnetics* 18 (1997) 184–186 (Brief communication).
- [130] B. Armstrong, G. Theriault, P. Guenel, J. Deadman, M. Goldberg, P. Heroux, Association between exposure to pulsed electromagnetic fields and cancer in electrical utility workers in Ontario and Quebec, Canada, and France 1970–1989, *Am. J. Epidemiol.* 140 (1994) 805–820.
- [131] G.M. Lee, R.R. Neutra, L. Hristova, M. Yost, R.A. Hiatt, A nested case–control study of residential and personal magnetic field measures and miscarriages, *Epidemiology* 13 (1) (2002) 21–31.
- [132] K.D. Li, R. Oudouli, S. Wi, T. Janevic, I. Golditch, T.D. Bracken, R. Senior, R. Rankin, R. Iriye, A population-based prospective cohort study of personal exposure to magnetic fields during pregnancy and the risk of spontaneous abortion, *Epidemiology* 13 (2002) 9–20.
- [133] G. Theriault, M. Goldberg, A.B. Miller, B. Armstrong, P. Guenel, J. Deadman, E. Imbernon, T. To, A. Chevalier, D. Cyr, C. Wall, Cancer risks associated with occupational exposure to magnetic fields among utility workers in Ontario and Quebec, Canada and France: 1970–1989, *Am. J. Epidemiol.* 139 (1994) 550–572.
- [134] P. Michelozzi, A. Capon, U. Kirchmayer, F. Forastiere, A. Biggeri, A. Barca, C.A. Perucci, Adult and childhood leukemia near a high-power radio station in Rome, Italy, *Am. J. Epidemiol.* 155 (2002) 1096–1103.
- [135] M. Ha, H. Im, M. Lee, H.J. Kim, B.C. Kim, Y.M. Gimm, J.K. Pack, Radio-frequency radiation exposure from AM radio transmitters and childhood leukemia and brain cancer, *Am. J. Epidemiol.* 166 (2007) 270–279.
- [136] C. Sage, D.O. Carpenter (Eds.), *BioInitiative Working Group BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF and RF)*, 2007. [www.bioinitiative.org](http://www.bioinitiative.org);
- C. Blackman, H. Lai, Chapters 6 and 14 of the BioInitiative Report, 2007.
- [137] A. Chiabrera, B. Bianco, E. Moggia, J.J. Kaufman, *Bioelectromagnetics* 21 (4) (2000) 312–324.
- [138] D.J. Panagopoulos, L.H. Margaritis, in: A.C. Harper, R.V. Bures (Eds.), *Mobile Telephony Radiation Effects on Living Organisms*, 2008, pp. 107–149. ISBN 978:1-60456-436-5.
- [139] W.R. Adey, in: P.J. Rosch, M.S. Markov (Eds.), *Potential Therapeutic Applications of Nonthermal Electromagnetic Fields: Ensemble Organization of Cells in Tissue as a Factor in Biological Field Sensing*, *Bioelectromagnetic Medicine*, 2004, pp. 1–16.
- [140] S. Engstrom, in: P.J. Rosch, M.S. Markov (Eds.), *Magnetic Field Generation and Dosimetry*, *Bioelectromagnetic Medicine*, 2004, pp. 39–50.
- [141] A. Pilla, in: F.S. Barnes, B. Greenebaum, (Eds.), *Mechanisms and Therapeutic Applications of Time-varying and Static Magnetic Fields in Biological and Medical Aspects of Electromagnetic Fields*, third edition, 2007, pp. 351–412.
- [142] M. Blank, R. Goodman, Initial interactions in electromagnetic field-induced biosynthesis, *J. Cell. Physiol.* 199 (2004) 359–363.
- [143] M. Blank, R. Goodman, A biological guide for electromagnetic safety: the stress response electromagnetic initiation of transcription at specific DNA sites, *Bioelectromagnetics* 25 (2004) 642–646.
- [144] M. Blank, *BEMS Soc. Newslett.* (January–February) (2008) 6–7.
- [145] G. Lotz, Letter from Greg Lotz, PhD, Chief Physical Agents Effects Branch, Division of Biomedical and Behavioral Science, National Institute of Occupational Safety and Health to Richard Tell, Chair, IEEE SCC28 (SC4) Risk Assessment Work Group, June 17, 1999.
- [146] P. Grandjean, Implications of the precautionary principle for primary prevention and research, *Am. Rev. Public Health* 25 (2004) 199–223.
- [147] D. Davis, *The Secret History of the War on Cancer*, Basic Books, 2008.
- [148] R. Proctor, *Cancer Wars*, Harper Collins Publishers, 1995.
- [149] European Environmental Agency, *Late Lessons from Early Warnings. The Precautionary Principle 1896–2000*. Copenhagen, Denmark, 2001.
- [150] P. Landrigan, How much do chemicals affect our health? *Discover Mag.* (2008).
- [151] California Air Resources Board, *Appendix III Proposed Identification of Environmental Tobacco Smoke as a Toxic Air Contaminant. Part B—Health Effects*, 2005.

[http://www.naturalnews.com/050918\\_smart\\_meters\\_Big\\_Brother\\_Fourth\\_Amendment.html](http://www.naturalnews.com/050918_smart_meters_Big_Brother_Fourth_Amendment.html)

# Smart Meters are now Big Brother

Tuesday, August 25, 2015 by: J. D. Heyes

Tags: [smart meters](#), [Big Brother](#), [Fourth Amendment](#)



(NaturalNews) There has been a great deal of news over the past few years about how the federal government is increasingly spying on the American people, especially via the National Security Agency and the FBI. But it is becoming increasingly apparent that Americans' privacy is being invaded more frequently, and on a wider scale, by private industry.

Consider just some of the latest technology to hit the market and you can see that we Americans are being watched, monitored, measured and profiled 24 hours a day, seven days a week - and in many ways, we're helping the process:

## "Smart" meters

In recent days, California Gov. Jerry Brown ordered residents of the drought-stricken state to cut water usage by as much as 25 percent. It wasn't a recommendation, per se; officials are serious about implementing it.

As reported by *CBS Los Angeles*, state and local officials are going after "water wasters" [through the installation](#)

of ["smart meters"](#) that gauge water use and report it back to water authorities, wirelessly.

"It collects the data every five minutes, then after midnight, the cellphone that's built in here comes on, makes one call, and calls it in to the database that we and the customer, through a password security system, have online access to their consumption," Long Beach Water Department General Manager Kevin Wattier told the local affiliate. "The accuracy is just incredible, because we get the data the next day."

In February, when water [smart meters](#) were installed around the city, Wattier used the data to catch the owners of local McDonalds restaurant who were said to be over-watering the lawn there.

Wattier went onto say he believes smart meters will increasingly be used to measure [water](#) usage at both homes and businesses throughout Southern California. But no one is talking about getting rid of them once the drought subsides.

## Location-trackers for automobiles

Hyped as a way for parents to "virtually" follow their kids (to make sure they go where they say they are going, for instance) there is a bevy of new tracking technology on the market today. Beginning as early as [2006](#), driver tracking of children has grown in popularity (unfortunately).

"New gadgets can let parents know every time their children drive too fast or visit someone they shouldn't," says an *NPR* story on the subject.

And while it may sound like a good idea, the problem is that we're raising our children to accept living in a society in which every move they make is monitored by someone or something - all the while telling them that they have a "Fourth Amendment right to privacy."

Technology is also being used [to track drivers for the purposes of paying highway tolls](#), and to monitor speeds.

## "The Internet of things"

Even our home appliances, like our televisions, are being used to track our activities. As we have reported, the "Internet of things" is a concept in which home appliances are [linked together wirelessly](#) into systems that can be monitored, hacked or altered.

## Social media

Do you Facebook? Use Google+ forums? Text? Own a smart phone? If so, you are being monitored, [both by the social media companies](#) themselves and [and by government entities](#).

In more ways than we can even imagine, corporations are becoming Big Brother - not just government.

**Sources:**

<http://losangeles.cbslocal.com>

<http://www.npr.org/templates/story/story.php?storyId=5725196>

<http://www.usatoday.com>

<http://www.naturalnews.com>

# All new smart TV emits high radiation – wifi blasts all day long

admin July 15, 2014

I just got a new LG 650 55 inch TV, smart tv, beautiful picture, sound, A perfect package. But what is hidden is that it emitted the high-frequency fields every 5 minutes. I measured the intensity of that emission and it was really strong. Imagine being bombarded with high-frequency fields that are known to be harmful all day long from a freaking TV.

The bad thing is that you can't turn it off! There is no switch whatsoever. All the new smart TVs emit radiation all day long. Some Sony models have the option to turn off the WIFI, but I am not sure which and if it really works. Other models like Samsung, Panasonic, do not...

We have come to the era that is really not respecting our health. We are being bombarded with all kind of wireless emissions all the time. So beware when buying a smart TV..I know Samsung emits WIFI all the time.....

But I took the TV to the LG service and they unplug the wifi emitter inside the TV. But beware, if you do that also your Bluetooth might not work. Because in my TV WiFi and Bluetooth are both joined in one module. So the repairman just disabled the whole module. Now my so-called magic remote does not work anymore, a remote that works like a mouse. But the regular IR remote still works.

Also, be careful that is you have active 3D glasses, that might stop working too. Because freaking glasses from Samsung have inbuilt emitter in glasses. Bt my LG has a passive 3D system, so the glasses do not have any emitter and are just regular plastic 3D glasses.

So now my LG tv is perfectly health friendly, it emits no WIFI radiation and very low-frequency fields, that are not harmful at all.

I am very happy. Nowadays you need EMF meters to check your surroundings all the time. WIFI could be hidden also in baby monitors, and who knows where...

**That is why I put together [EMF home protection DVD](#) guide, to protect yourself against this new man-made dangerous radiation that is causing chronic health problems.**

# Popular electricity smart meters in Spain can be hacked, researchers say

\* Researchers find security flaws in some smart meters

\* Says weaknesses could lead to fraud, blackouts

\* Spain one-third done with nationwide meter upgrade

By Eric Auchard

FRANKFURT, Oct 7 Network-connected electricity meters installed in millions of homes across Spain lack essential security controls, according to two researchers who say the vulnerabilities leave room for hackers to carry out billing fraud or even cause blackouts.

Security experts Javier Vazquez Vidal and Alberto Garcia Illera said in an interview on Monday that so-called smart meters installed by a Spanish utility to meet government energy efficiency goals lack basic safeguards to thwart hackers.

The researchers said flawed code in reprogrammable memory chips enable them to remotely shut down power to individual households, switch meter readings to other customers and insert network "worms" that could cause widespread blackouts.

"You can just take over the hardware and inject your own stuff," Vazquez Vidal said, referring to the threat that hackers could insert malicious code into one box and use it to control nearby meters, and thereby cascade an attack across the network.

Traditionally, energy utilities have kept power plants and mechanical electricity meters safe from cyber attack by keeping them insulated from the open Internet.

Smart meters are connected over power line networks to give customers and utilities instant data about when, where and how much energy households use, enabling energy providers to monitor and adjust energy flows.

The European Union wants more than two thirds of Europe's electricity users to have smart meters by 2020, an initiative it hopes will reduce energy use by three percent.

Over the last decade, most countries in Europe have mandated that smart meters be installed in homes and businesses. But as nationwide deployments have taken place in Italy and Sweden and are now in motion across France, Spain and the United Kingdom, experts have begun to uncover cybersecurity threats posed by some meters.

The two researchers declined to identify the utility or European-based hardware manufacturer of the smart meters found to be vulnerable to attack. They will discuss their findings at the Black Hat Europe hacking conference in Amsterdam next week.

"We are not releasing the exact details; we are not going to say how we did this," Garcia Illera said. "This issue has to be fixed."

The top power utilities in Spain are Endesa, Iberdrola and E.ON. Collectively, 8 million smart meters have been installed, or 30 percent of households.

The researchers said they had identified security flaws only in boxes from one meter manufacturer. Vazquez Vidal said he believes the utility may be able to patch the problem remotely, without being forced to send repair staff to upgrade each box physically.

An expert with Spain's markets and competition regulator, which oversees the smart meter mandate, said the agency was finishing a study on the threat of meter hacking and had not found any evidence it was taking place or at risk of occurring.

## LEAVING THE DOOR OPEN

The security impact of a vast array of connected devices from smart meters to automobile controls to wearables such as smartwatches and health monitors are only now being seriously considered by industry, despite their growing use in daily life.

The Spanish researchers said they hacked the meters by bypassing encryption that was designed to secure their communications.

Vazquez Vidal and Garcia Illera said the meters use relatively easy to crack symmetric AES-128 encryption. The limited security appeared to be designed largely to prevent tampering with billing systems by fraudsters, they said.

Once through this first level of security, they said they could take full control of the box, switching its unique ID to impersonate other customer boxes or turning the meter itself into a weapon for launching attacks against the power network.

"Oh wait? We can do this? We were really scared," Vazquez Vidal said. "We started thinking about the impact this could have. What happens if someone wants to attack an entire country?" he said.

They say they tested the devices in their own lab, where they were able to reproduce various attacks in miniature using several of the smart meters.

The same researchers last year uncovered weaknesses in computer chips found in many automobiles, which they said could boost performance or be used to hotwire a car or cause crashes.

Vazquez Vidal, who said he was "unemployed and bored" at home in Cadiz when he carried out the smart meter research, subsequently was hired by a major European automaker based on his earlier work on car security.

Garcia Illera works for a California-based software maker. The two asked that their employers not be identified because their research projects do not involve their employers.

Mike Davis, a top security researcher with cybersecurity consulting firm IOActive, identified similar threats in U.S. smart meter devices five years ago.

"It was strange. Pretty much none of the utilities deploying smart meters at the time were considering the meters themselves as part of their threat problem," Davis said.

Disclosure of his findings was a wake-up call for U.S. utilities, leading to increased government scrutiny and industry action to better secure the devices against cyberattack.

Davis said the vulnerabilities described by the Spanish research team sounded feasible given the slow response by utilities and meter makers to overhaul their meters' security.

"The industry is starting to be much more intelligent," Davis said. "Although for something that is attached to the side of your house, it still has a ways to go." (Editing by Mark Potter)

# **ELECTROMAGNETIC HYPERSENSITIVITY (EHS)**

## **A PERSONAL CASE STUDY**

**A briefing on EHS for Health Professionals, Research Scientists, Government Officials and concerned members of the Public**

**11<sup>th</sup> April 2014**

**Author: Steven Weller**

Bachelor of Science, Monash University

## Introduction

I felt compelled to write this personal case study because through my own personal experiences I have found that there is a serious lack of understanding of what Electromagnetic Hypersensitivity (EHS), also commonly referred to as Electrosensitivity (ES), is and its cause. For some people EHS can be completely disabling and in some extreme situations can lead to hospitalisation due to aggravation of pre-existing medical condition(s), development of tachyarrhythmia, which at times can result in a loss of consciousness, and other acute effects on the neurological system.

The main problem being faced by people who are suffering from EHS is that they are left in a tenuous position where there is a complete absence of government support. EHS is declared to be “not a medical diagnosis” [1] by the World Health Organisation (WHO) and so sufferer’s symptoms are ignored by government health authorities and often misdiagnosed by the medical profession. This then can lead to the prescription of unnecessary and ineffective medication. Only Sweden recognises EHS as a functional impairment while the Austrian Medical Association has provided guidelines on the diagnosis and treatment of Electromagnetic Radiation (EMR) related illnesses [2]

My hope in writing this case study is to dispel misconceptions some members of the scientific community, government bodies and the general public have on this functional impairment. I also hope that by detailing my own personal experience with EHS that I can help those who may be suffering similar symptoms recognise the cause and help them understand how they can manage their condition, and to some degree, protect themselves.

### Conflict of Interests Declaration:

I would like to declare that I have no conflicts of interests. I stand to make no financial or political gains by writing this personal case study and declaring my sensitivity to EMR. By making such a declaration regarding my sensitivity, there is a real possibility that I am putting my career in IT at risk.

## What is Electromagnetic Hyper Sensitivity (EHS)

EHS, as a functional impairment, has been known by the scientific community for many years. In the 1970’s it was referred to as microwave sickness or radiowave sickness – same symptoms as EHS, just a different name. The website Powerwatch.org.uk lists a total of 130 studies relating to the topic of EHS and has categorised them as follows: 69 studies with positive findings, 27 studies with null findings and 24 studies that offered important insights but were neither a positive or a null finding. Further descriptions of EHS symptoms are provided below.

*“Individuals living within 100 metres of a wireless facility of any kind tend to report symptoms such as dizziness, nausea, memory loss, inability to concentrate, irritability, rise in blood pressure, peculiar pressure behind the eyeballs, joint pains moving around the body, hurt of feet sole, high-pitched noises in their ears, itchy systemic rash and even internal bleeding -- all symptoms of radiowave sickness. Clinics report an immediate increase in respiratory illness: bronchitis, flu, pneumonia and asthma during the first weeks of PCS base station start-up and hospitals become inundated.”*

Source: [http://www.laleva.cc/environment/taskforce\\_eng.html](http://www.laleva.cc/environment/taskforce_eng.html)

### ***The Microwave Syndrome: A Preliminary Study in Spain. Epidemiological Study***

"Insomnia, cancer, leukemia in children, and brain tumors are the clinical entities more frequently described (Dolk et al., 1997; Hocking et al., 1996; Maskarinec et al., 1994; Minder and Pfluger, 2001; Selvin et al., 1992). Moreover, the clinical consequences of being exposed to microwave radiation such as radar has been evaluated from military and occupational studies (Balode, 1996; Garaj-Vrhovac, 1999; Goldsmith, 1997; Johnson-Liakouris, 1998; Robinette et al., 1980).

A specific symptomatology, linked to radar exposure at low levels of RF, has been termed "microwave sickness" or "RF syndrome." (Johnson-Liakouris, 1998) With few exceptions, functional disturbances of the central nervous system have been typically described as a kind of radiowave sickness, neurasthenic or asthenic syndrome. Symptoms and signs include headache, fatigue, irritability, loss of appetite, sleepiness, difficulties in concentration or memory, depression, and emotional instability. **This clinical syndrome is generally reversible if RF exposure is discontinued....**

...There is a large and coherent body of evidence of biological mechanisms that support the conclusion of a plausible, logical, and causal relationship between RF exposure and neurological disease."

Source: <http://www.emf-portal.de/viewer.php?aid=13498&l=e>

### ***"Symptoms of Radio Wave Sickness" excerpt from 'No Place To Hide' April 2001***

**Neurological:** headaches, dizziness, nausea, difficulty concentrating, memory loss, irritability, depression, anxiety, insomnia, fatigue, weakness, tremors, muscle spasms, numbness, tingling, altered reflexes, muscle and joint pain, leg/foot pain, "Flu-like" symptoms, fever. More severe reactions can include seizures, paralysis, psychosis and stroke.

**Cardiac:** palpitations, arrhythmias, pain or pressure in the chest, low or high blood pressure, slow or fast heart rate, shortness of breath.

**Respiratory:** sinusitis, bronchitis, pneumonia, asthma.

**Dermatological:** skin rash, itching, burning, facial flushing.

**Ophthalmological:** pain or burning in the eyes, pressure in/behind the eyes, deteriorating vision, floaters, cataracts.

**Others:** digestive problems; abdominal pain; enlarged thyroid, testicular/ovarian pain; dryness of lips, tongue, mouth, eyes; great thirst; dehydration; nosebleeds; internal bleeding; altered sugar metabolism; immune abnormalities; redistribution of metals within the body; hair loss; pain in the teeth; deteriorating fillings; impaired sense of smell; ringing in the ears."

Source: <http://www.electricalpollution.com/solutions.html>

## What are the key issues?

The main problem faced by EHS sufferers today in many countries around the world is there is a complete absence of government support. In addition, there are a number of other concerns that I have listed below that are by no means the complete story on this issue:

1. The general public as well as the medical profession as a whole appear to lack an understanding of what EHS is and its cause. Medical practitioners neither have the tools nor the methodology (training) to identify or treat those who are suffering. Although my doctor indicated that he had read some material on EHS, he suggested I was most likely suffering a migraine (exhibits similar symptoms – band of pressure around the head) and that I should take Ibuprofen (an anti-inflammatory/pain killer) which in my case is ineffective in treating the symptoms and certainly does not address the cause. Of greater concern is the chance of misdiagnosis and prescription of unnecessary medications that could result in further health complications due to unwanted side effects some medications may have as a result of prolonged usage.
2. There appears to be no consensus within the scientific community on Radio Frequency (RF) safety. Some scientists and scientific bodies are suggesting there is no proof of harm while others such as the WHO and IARC have classified all microwave transmitters as potentially carcinogenic. [3]
3. There is very little research being performed on EHS to validate it as a real condition or to confirm the cause.
4. While scientists debate whether EHS is a psychological and/or a physiological illness and whether sufficient proof can be established to link it to EMR, sufferers are left in limbo without any adequate protection, support or recognition of their health issues. It is unclear why a “diagnosis of exclusion” method cannot be adopted to verify EHS as a health impairment.
5. The burden of proof for the existence of EHS as an impairment, like proof of RF safety in general appears to be set unreasonably high. RF emitting devices are not handled in a manner which is consistent with the handling of other substances that may affect health, including drugs, medications and medical prostheses and devices, where manufacturers have to prove absence of health risk to the population and maintain post-marketing surveillance for years after a drug or device is first marketed.
6. Current testing methodology to verify sensitivity is often not biologically based and typically uses a provocation test, which I will describe in further detail on in this study, has some potentially serious flaws.
7. *‘Positive studies, studies showing effects of EMF, are being analysed in depth for the possible errors that lead to observation of effects. Negative studies are most commonly accepted for their face value and their quality is not being questioned because they provide evidence “as expected.”’* [4]

## My experience with EHS

I am 45 years of age and have been using computers all my adult life. I am an IT professional who has a Bachelor of Science degree in Biochemistry and Microbiology. I have always considered myself as an earlier adopter of technology and discovered quite by accident that I was sensitive to certain Electromagnetic Radiation (EMR) frequencies. My discovery also occurred well before I had learned through my subsequent research that there was a label for my condition, otherwise referred to as EHS or Electromagnetic Hypersensitivity.

My earliest memory of being sensitive to radiofrequencies was in late 2001 when wireless networking was beginning to become popular. I had no preconceived ideas or fears about the technology nor was I aware that RF could be potentially harmful. I was looking forward to the freedom it would afford me. No more wires cluttering the desk, free to do my work on my laptop at the kitchen table while I had breakfast. Being IT savvy, I had decided to buy the most powerful wireless Wi-Fi router available at the time, capable of transmitting 108Mbps per second and having an effective range of 100m+, which was twice as fast and twice the range of the cheaper more common wireless routers at the time. On first using my wireless router I began to feel pressure in my head, pressure in my chest, tingling sensations in my hands and face within a few minutes of use. I also noted (and so did my wife) that my temperament changed from my normally relaxed manner to being more agitated and short tempered when using my Wi-Fi enabled router. After turning off my wireless router I was left with a headache that persisted for several hours. At first, I thought nothing of it and did not immediately associate it to my use of wireless. It was only on subsequent usage that I felt the same symptoms. If I persisted for longer durations I found that on top of the symptoms mentioned above I felt a burning sensation in my intestinal region and the pressure on my chest would sometimes lead to my heart beating irregularly (arrhythmia) followed by stronger than normal heart beats (like my heart was trying to jump out of my chest).

I soon realised that a consistent pattern was developing when using my wireless router and symptoms that I was feeling. This was no placebo effect – it was real, consistent and most unpleasant. It was at this point that I had made a conscious decision to not use a wireless network to connect to the internet.

#### Definition of **nocebo effect**:

Firstly, the word **nocebo** (Latin for "I shall harm") is a harmless substance that creates harmful effects in a patient who takes it. The **nocebo effect** is the negative reaction experienced by a patient who receives a nocebo. These reactions result from a subject's expectations about how the substance will affect him or her. Though they originate exclusively from psychological sources, nocebo effects can be either psychological or physiological. Source Wikipedia

In 2007, I purchased a Sony PlayStation 3 (PS3). I did not use the inbuilt wireless network feature because I had a hard wired LAN that I could connect to. The PS3 controller however is a wireless Bluetooth device operating at 2.4 GHz, same as my router but at a significantly lower power density (the PS3 controller is a class 2 Bluetooth device so it'll only be kicking out a maximum of 2.5mW). I found that I did not get the same feelings that I felt with the router (not completely absent but barely noticeable and easily tolerable). Realising that I could possibly use low powered wireless devices without major issues I decided to purchase a Nintendo Wii for my children for Christmas several years later but after using the Wii a couple of times I had to dispose of it as I will now explain. The Wii controllers also use Bluetooth 2.4GHz (documentation on the internet suggests they operate with a maximum of 3.83mW output) which is the same frequency as the PS3, yet the all too familiar EHS symptoms reappeared and they were not pleasant. The difference in the levels of transmission power could be a potential cause and cannot be completely ruled out but I would say it is very unlikely. Instead, there is a noticeable difference in the amount of data being transmitted. My PS3 controller will only occasionally send information such as when a button is pressed which is a lot more infrequent than a Wii controller which is practically always transmitting as it needs to send telemetry data to indicate the position and movement of the controller through space and time. The amount of information being passed does seem to be a key in my sensitivity because I have a very similar issue with regards to 3G USB modems when compared to 3G mobile phones. A person can be 3 - 5 m away talking on a mobile phone and I do not feel anything significant as compared to someone using a laptop at the same distance that is connected to a 3G USB internet stick downloading streaming video which can be quite

intense. The amount of data being packed onto the signal appears to be a differentiating factor. This of course does not mean I am not sensitive to mobile phones – I most certainly am. I can only use a mobile phone near my head for 30 seconds or so before I find myself swapping the phone to my other ear due to severe discomfort that I feel. Today I rarely use my mobile phone and only keep it for emergencies. I switch it to flight mode most of the time, but if I do need to use it, I operate it using hands free.

Prior to the rollout of smart meters in my street, but subsequent to me finding out that I am sensitive to certain RF frequencies, I took precautionary measures in my home by ensuring that I only used wired connections for internet connectivity and that all wireless capable devices had said features configured to disabled. I was able to function normally and had no major issues with sleep or health. I did not suffer any further headaches or heart palpitations. I could say I was in good health. However in late August/early September 2011, Powercor rolled out wireless enabled smart meters in my street. I resisted the installation of a smart meter. However, not having a smart meter installed on my property did not help me as I became severely affected by my neighbours' 2 smart meters that were installed next to my bedroom 3m away. It was soon after installation that I found I was waking at specific times every night. Sometimes I felt like someone had taken a long sharp needle and quickly pushed it into my head. Once awoken, I found it very difficult to fall back to sleep. The timings were falling in a fairly consistent range in the early hours of the morning. Every morning I would wake up with a serious headache which would last all day and make concentration and performing simple duties quite difficult. On a number of occasions I would wake up with a feeling of pressure on my chest and my heart beating irregularly. I was feeling the very same symptoms that I had previously experienced with my wireless router.

2012 was a very difficult year for me because for 6 months I had to travel interstate every Sunday night to work on an IT project for an interstate customer. I would be put up in hotels that had DECT (Digital Cordless Telephones) that transmit constantly, even when not in use, as well as being irradiated by the hotel wireless internet. The office I worked at was located under a mobile phone tower and also had wireless access points for staff with wireless notebooks to access the corporate network. I would fly with a domestic airline that began to allow their business class passengers to use iPads with wireless enabled. By the time I got home I was in a terrible state which was further exacerbated by smart meter emissions. To make matters worse, I had become sensitised to things that normally did not bother me. Standing near transformers (phone charges, laptop power modules, light dimmers) left me feeling the same very symptoms I felt when exposed to wireless RF. Standing near my electric hotplate and range hood also affected me. I became allergic to my deodorant which I had been using for 10 years without issue and suggests RF was interfering with my immune system. I had constant headaches, felt extremely lethargic and completely lost motivation to do anything with the family. I would wake up feeling just as tired when I got out of bed in the morning as I had before I went to bed. I even found that I had become a rudimentary mobile phone base station detector. I could sense a mobile phone tower well before I even saw it. I can no longer drive through suburbs where smart meters have just been rolled out without developing a serious headache that can last for days. I have been to my local GP many times and he is at a loss to explain what is wrong with me. Blood tests, ECG tests all come back as normal. Of course an ECG will only show heart beat irregularities in my case if I am being exposed to high levels of EMR (but still within ARPANSA's RF Standard basic restrictions), which was absent in the doctor's office at that time. Pain killers were prescribed but offered very little relief. I was referred to a neurologist who indicated he had never heard of EHS, said he did not fully understand wireless technology so could not give me an informed opinion. He suggested I have an EEG and MRI to verify that I do not have any brain disorders or tumours. Of course the results came back negative.

It is important to understand that when I say I feel a headache, it is not a normal headache where sudden movements cause sharp pain such as when you are having a hangover or are dehydrated. Instead, it is a constant pressure and dull ache in my head. My face feels drained like I have been doing a 24 hour shift and sometimes can be accompanied by a prickling feeling over my skin (head and face) when in the presence of microwave RF frequencies.

EHS is not restricted to certain age groups. I was 32 when I determined I was sensitive to wireless. My condition has been getting progressively worse as the amount of man-made RF in our environment increases. I know without a doubt that wireless RF is causing these issues because when I go to remote areas where there is very low EMR I feel fine after several days. A recent trip away from large population centres for a few weeks, proved to me that my health issues were EMR related. It is important to understand that it does take time for the effects to dissipate in some people i.e. there is no instantaneous relief. I have recently painted my house with RF shielding paint and installed RF blocking curtains and my sensitivity has greatly reduced. I can now sleep better, stand near transformers and electric hot plates without feeling off, but mobile phone usage and wireless network usage is still a problem for me and something that I avoid as much as possible.

Despite taking precautionary measures in my own home at great expense, I am deeply concerned at the lack of support, care and understanding by the power utilities and the various government departments that I have contacted over this issue. I am forced to sleep at the back of the house because the master bedroom on the first floor is still getting RF penetration through the floor which is not shielded. Effectively the front parts of my house are denied to me if I don't want my health to substantially decline.

## **What other sufferers have said:**

Case 1: "I feel extremely isolated and marginalized by the community in which I live. My husband and mother both think that I am simply making the symptoms up, or that they are psychosomatic in nature. The condition seems very hard to grasp for people who do not hear the ringing, have the headaches or the sleeplessness, and even when people do have these symptoms."

Case 2: "It was unlike the occasional headache I have experienced in the past where the slightest movement produced a pounding sensation. This headache consisted of a pressure over my entire skull with a tingling sensation on my scalp.....My zest for life faded."

Case 3: "I experience intense ear ringing and burning/searing sensations on sides of my head since moving to our neighbourhood"

Case 4: "Fatigue, Depression, Excessive Sleep, Stress, Sometimes Anger, Aches, Hard to Focus, Inability to Concentrate, Housework also hard to do" [5]

There are countless example cases on the internet all over the world. Stop Smart Meters Australia has been maintaining a EHS register and has documented close to 200 cases as of January 2014.

## How do scientists try to verify whether a person is EHS?

Most scientists will perform what is called a provocation test. The provocation test is performed using a radio transmitting device that is usually operating at a specific frequency i.e. 914MHz to simulate a mobile phone.

Such tests are usually conducted in a double blind fashion. What this means is the scientist performing the test and the person who is subject to the test do not know whether the box is transmitting or not. The box will typically have a readout with some numeric codes that can be recorded and used later by the tester to work out whether the transmitter was active or not and then correlate this with the subject's "feelings".

Limitations of the provocation test are numerous and include:

1. Probably the most important fact that people need to realise is that the provocation test is not a biologically based test, instead it requires the subject to respond with how they feel which of course is very subjective.
2. Some provocation tests require the subject to give feedback as to the severity of the symptoms and rate it against previous exposures (provocation tests are usually conducted as a series of sequential staggered exposure tests) – again this is very subjective and cannot be considered objective as most people cannot remember exactly how something felt hours or days later. If we could remember what pain felt like, along with the intensity, I would seriously doubt women would choose to willingly get pregnant and opt for a natural birth more than once! Pain is a private, emotional experience. Pain intensity cannot be directly measured; responses to putatively painful stimuli can be measured, but not the experience itself.
3. They are set to a specific frequency of operation that the subject may not actually be sensitive to. Testers claim that the device simulates a mobile phone but this is debateable as it is not communicating to one or more cell towers nor is it clear what kind of data is being sent (simulation of a voice call – low data rate vs data/video streaming – high data rate or just a carrier signal), the modulation pattern used to send the data or if even data transmission is simulated at all. My EHS experience has shown that the amount of information being transmitted is a key contributor to my feelings of ill health.
4. Tests often do not simulate the environment that the person claims is affecting them. We are surrounded by EMF's from a variety of sources every day. When I was suffering from my router's RF emissions I was also using a computer which was also emitting RF (from the wireless card and to a lesser extent from the CPU due to its internal clock speed), I was also sitting in front of a 19" CRT monitor, there was also a number of power transformers present in the room. Using these devices without the wireless enabled did not cause me any issues. However the effects of EMR from multiple devices is additive.
5. The test procedure is often poorly defined due in part to those conducting the test not fully understanding the subject's EHS condition i.e. delayed reaction and delayed recovery times not always considered. EHS is not like flicking on a light switch resulting in an instant reaction, although there are some sufferers who can feel emissions shortly after they are switched on. There can be considerable delay times between signal transmission start and onset of symptoms. The same is true for the recovery time which can take hours to several days. One can see where a situation may arise where a subject has not fully recovered from an active signal and is then tested with a sham signal and asked how they feel. Guess what? They will give an answer indicating they are still suffering leading to a conclusion that EHS is not real or at least not related to EMR. Some

provocation test protocols do try to take this into account by having the subject try to rate the intensity against past experiences which is of dubious value as I have previously mentioned (see point 2 above).

6. Each subject is unique (body mass, current health ailments, medications, allergies, age, immune system sensitivity, genetic predisposition etc.) and so a set of standard tests with set exposure times and time intervals between exposures may not be sufficient or appropriate.
7. There is a definite psychological component that is going to influence test results and reinforce the belief that EHS is a Nocebo effect (psychosomatic). An analogy would be to conduct a test with a mouse by connecting electrodes to it and shocking it whenever a light is turned on. After sometime the mouse will be conditioned so that just switching the light on will result in the mouse reacting the same as though it was actually feeling electric shock effects. The same is true with humans. Use a phone a lot and get serious headaches and then present the user with a phone like device and tell them you are testing their sensitivity to mobile frequencies without them knowing whether the transmitter is active or not and you can bet that there is a good chance that they will develop some form of reaction. This reaction is natural and a result of conditioning as we try to avoid situations where we feel uncomfortable/pained by applying learned behaviour through experience as a result of previous painful episodes. Refer to “Nocebo effect or real deal” detailed further in this case study. A similar experiment as described above on mice was reported on the BBC recently and can be viewed by clicking on the link provided <http://www.bbc.co.uk/news/science-environment-23447600>
8. For those who are suffering EHS, the provocation test is a form of torture. It creates unnecessary anxiety which in itself can lead to the onset of similar symptoms that can interfere with the test leading to a confounding result.
9. Depending on where the test is conducted, the results can be contaminated by other EMR sources which can include nearby computers or wireless routers, DECT phones, mobile phone towers, EMR from transformers, fluorescent lights etc. Even the device itself may not actually be emitting RF but while it is powered on it is certainly creating EM fields that can interfere with the test particularly when performing a test with a sham signal.
10. When conducting group studies, people who have to pull out of the test prematurely due to the disabling effects they are experiencing are often not included in the study results.

Current methodology to test sensitivity is inconsistent and often based on poorly defined test protocols. This is partly due to the fact that there appears to be a general poor understanding of people's electrical sensitivity by the scientific community and the fact that most tests are not biologically based - i.e. the provocation test, which we know is very subjective can be manipulated to show inconclusive results.

Even though the provocation test is typically performed as a double blind study – that is the scientist and the study participant are not aware if the device is transmitting or in sham mode – the testing protocol can be set-up such that an insufficient recovery time is allowed before conducting the next test. Subjects can through learned behaviour also affect the results particularly in the case where the testing protocol requires the subject to compare feelings of a current exposure test with previous exposures.

For EHS testing to be meaningful and realistic, scientists should be looking at establishing biological tests that are used in conjunction with a provocation device which can measure heart rate variability, heart palpitations (as Dr Magda Havas recently demonstrated this in 2010 and reconfirmed in a repeat experiment <http://www.ncbi.nlm.nih.gov/pubmed/23675629> ), brain responses (EEG), brain scans, immune response, sleep studies, live blood chemistry etc.

Dr. Dominique Belpomme, Professor of Oncology at Paris Descartes University, is conducting research on electro hypersensitivity with the Association for Research and Treatments Against Cancer (ARTAC) in Paris. The ARTAC group has been following several hundred patients with EHS over the last four years, and has documented that these patients have clear and consistent changes in oxidative metabolism, and also in blood flow to the limbic system (as measured by Doppler studies). Dr. Belpomme considers these changes in the limbic system to directly correlate with many of the cognitive changes (memory problems, difficulty with concentration, etc.) that are experienced by these patients. The ARTAC group expects to publish a series of papers on their findings during the next year (Dart, 2012) [6]. I am looking forward to his research results when they are published, which will demonstrate and confirm that EHS is real and not a nocebo effect as some scientist would have us believe.

The big question I have is whether we need to find biological markers before we accept that this is real? There is enough evidence to make a diagnosis on the symptoms' pattern alone – this is what I believe happens in Sweden. While scientist squabble over test methodology and the industry demands proof, people are left to suffer.

It is also interesting to note that an email I received from an Australian scientist who offered to test me with a provocation test device for EHS indicated the following:

*“I would require you to sign a consent form as the testing is likely to generate symptoms that you would find uncomfortable.”* This to me is a tacit acknowledgment that EHS is likely to be real and linked to EMR.

## Nocebo effect or the real deal

It is readily known by scientists that we learn to withdraw from, or alter our behaviour in response to, a conditioned stimulus.

Definition of conditioned stimulus

*“A previously neutral stimulus that, after repeated association with an unconditioned stimulus, elicits the response effected by the unconditioned stimulus itself.”*

In the context of EHS, an analogy I would suggest is an inactive mobile phone, router or provocation test device (physical object) being considered as the neutral stimulus and RF that it emits when switched on as the unconditioned stimulus which causes pain or results in some form of health impact.

It is therefore very plausible for EHS sufferers, through learned behaviour, to visually and aurally (hearing nearby people talking on a mobile phone or the phone ringing) associate items capable of emitting RF such as a mobile phone, iPad, mobile telephone base station mast and other aerials with their condition and leading to their bodies reacting accordingly. Such behaviour reinforces the belief held by some scientists that EHS is a nocebo affect.

What scientists need to understand is the original mechanism that triggered off this learned behaviour in the majority of cases is real and not a psychologically based induced condition. People only need to review my particular case history to see evidence of this, which is as follows:

1. I work in IT and embrace technological advancements and was looking forward to freedom that wireless offers.

2. I had no pre-conceived ideas and was completely uninformed of potential health impacts when I first used Wi-Fi.
3. The physiological reaction I experience in the presence of Wi-Fi is real and reasonably consistent with each exposure. I say “reasonably consistent” because depending on my state of health (did I have a cold? Did I get a good night’s sleep? Am I still recovering from a previous exposure etc.), the duration and intensity of exposure will see the type of symptoms varying within a common set that I have experienced previously. One hour of exposure does not always induce heart palpitations. But they have only ever occurred when I am exposed to (pulsed) wireless RF.
4. Symptoms disappear when I go to remote locations away from wireless transmitters suggesting that an underlying health issue is not the cause.
5. RF Shielding alleviated my symptoms suggesting other environmental concerns or stress are not a significant factor.

I mentioned “majority of cases” above because I do not doubt that there may be instances where there are some people who have a neurotic disposition, may have read an article suggesting harm, become obsessed and anxious to the point where they experience a real nocebo event. Such cases are the exception rather than the norm.

## Smart Meters and EHS

Unfortunately some authorities assume that because Smart Meter radiation emissions are short in duration and apparently lower in power density than other wireless devices typically found in and around people’s homes, they are therefore safe. What many people are unaware of is the number of times these meters are actually communicating. We are told that the smart meter transmits SMS like messages 4 -6 times a day (depends on your service provider), which may be true for your personal house hold data, but what is not being said is that for mesh networks, the average duty cycle also includes transmissions to maintain the network, time sync and network message management (i.e. pass on other houses’ data). This can lead to anywhere from 10,000 transmissions to 190,000 transmissions or more per day. Nobody sends this many SMS messages on their mobile phone. Many of these devices are situated on a wall/in wall cavities where people spend a significant amount of time (i.e. bedroom/lounge room walls).

It has been shown in a recent Victorian medical report entitled “SELF-REPORTING OF SYMPTOM DEVELOPMENT FROM EXPOSURE TO WIRELESS SMART METERS’ RADIOFREQUENCY FIELDS IN VICTORIA, AUSTRALIA - A CASE SERIES” that smart meters appear to be causing people who were not previously sensitive to RF frequencies to become EHS. Additionally, people who were previously self-diagnosed as being EHS found their condition was made dramatically worse. This medical report has been written by a medical doctor using de-identified data obtained from an EHS register that was being independently maintained by Stop Smart Meters Australia. Close to 200 people have registered their health complaints. The case study only looks at those who were fully identifiable and agreed to have their de-identified data made publically available in a medical report which amounts to a total of 92 people.

As I described in my introduction, I am self-diagnosed as being EHS having identified my sensitivity over 13 years ago. In terms of the medical report findings mentioned above I fit into the second category where my condition (despite being able to manage it previously quite successfully) has been made worse after mesh networked wireless smart meters were installed in my neighbourhood. My condition has also been aggravated by the deployment of other non-consensual microwave transmitters in the community

especially mobile phone base stations with 4G towers being worse in their ability to affect me than 3G, 2G etc.

Below I have listed my specific smart meter EHS symptomatology:

1. Constant headaches - pressure encompassing my head
2. Insomnia – I find it very difficult to get a good uninterrupted night's sleep
3. Lethargy and concentration difficulties
4. Sharp pains like a hot spike being driven into my head and occasionally in my intestinal region
5. Burning pain in intestinal region
6. Joint pain particularly my elbows, fingers and sometimes my knees
7. Irritability and feelings of anxiousness – I find I am more prone to angry outbursts when exposed to smart meter RF. My wife can certainly attest to that!
8. Heart beat irregularities and occasionally heart palpitations when in close proximity to a smart meter for a long duration

The problem I am faced with now is that I have effectively become a prisoner in my own home. To venture out of my house to an environment that has ever increasing EMR leaves me feeling drained, pained and trapped. Moving interstate where there currently are no smart meters is an option, but if there continues to be rollouts of new mobile phone towers, high speed wireless networks as part of the NBN rollout and other states follow Victoria's lead of mandating the rollout of wireless enabled smart meters I will eventually run out of places to go and will become an EMR refuge as I move to increasingly more remote locations. Career options will diminish and my job is already under threat as I struggle to continue working in the IT industry where wireless networks and smart wireless devices are becoming common place. I am being faced with the dilemma of how do I support my family? What kind of life will they have and what kind of opportunities are they missing out on as we move to isolated locations to escape this manmade threat to mine and my families health and wellbeing?

## What measures can you take to protect yourself?

The most important actions one can take to protect oneself from exposure to ubiquitous manmade RF emissions are as follows:

- 1) Turn off all wireless devices in the home – avoidance is the best protective measure. It is important to understand that the effects of wireless are additive when exposed to multiple frequencies and the damage caused is accumulative over a lifetime. ARPANSA's RF standards say "*In situations of simultaneous exposure to fields of different frequencies and depending upon the nature of exposure and the distribution of RF absorption within the body, the combined effects of exposure to multiple frequency exposure sources may be additive.*" (rps3 page 18). [7]  
If you must use wireless enabled devices then at least turn them off before you go to bed at night.
- 2) Replace digital cordless (DECT) phones with corded phones. Most DECT base units transmit all the time irrespective of whether you are on a call or not. Again, if your cordless phone is precious to you then make sure it is not in your bedroom.
- 3) Turn your iPad to flight mode when you do not need internet access. Additionally, do not rest it on your lap when using wireless as "*epidemiological studies of men assessed for infertility were consistent in demonstrating decreased sperm motility associated with use of mobile phones. Most of the in vitro (laboratory) studies, which involved exposing human semen samples to controlled mobile phone RF exposure, generally noted a decrease in sperm motility, among other adverse*

*effects. Similar findings were noted in animal studies of a specific type of rat. Oxidative stress or decreased antioxidants are suggested as plausible mechanisms for these non-thermal effects from RF exposure.*"[8]

- 4) Distance is your friend as the intensity of the wireless signal drops following the inverse square rule i.e. Intensity =  $1/\text{Distance}^2$ . Put as much distance between yourself and transmitters including smart meters. This may mean moving your bed to another room if the smart meter is located on your bed room wall.
- 5) Rooms can be shielded with special carbon based paint and windows can be covered with RF shielding curtains.
- 6) Install bed canopies made of the same RF shielding materials as the curtains mentioned above.
- 7) Fortify your body by doing regular exercise and eating good healthy foods that are high in natural anti-oxidants. This will put less stress on your body giving it a chance to deal with the manmade, potentially damaging, RF emissions. Although the energy from RF is not sufficient to damage DNA directly it has been shown by independent researchers to cause damage through indirect pathways. *"A large body of research has shown that microwave RF causes an increased production of free radicals and reactive oxidant species in living tissues, and that this increased oxidant stress damages DNA. This damage can and does occur at power levels well below those levels that could produce damage by thermal mechanisms."* [6] Special note: damage to DNA can potentially lead to cancer.
- 8) Try to maintain regular sleeping habits by not varying the time you go to bed too much if possible. Ensure that all sources of EMF (including radiofrequency) are not close to the bedhead. This would include clock radios, small appliance transformers, mobile phones, and cordless phones. And remember to turn off electric blankets before you lay down in bed to go to sleep, if used. Do not have the bed located immediately behind or close to where the power meter is installed.
- 9) Despite the medical profession generally not knowing what EHS is or how to treat it, a visit to the doctors is essential to confirm that other possible serious causes of your symptoms are excluded with appropriate medical tests.

In my case, I have no wireless devices in my house. My master bedroom was located at the front of the house on the first floor. My neighbour had 2 smart meters fitted on his garage which is 3m from my bedroom. I moved my bed to back of the house on the ground floor. My home office is also located at the front of the house and was unusable, as an 8 hour shift would see me suffering major headaches, concentration issues and extreme lethargy. To reclaim these rooms I decided to have the front rooms painted with carbon paint. By coupling the carbon paint with RF shielding curtains it is possible to reduce RF penetration into a room to negligible levels. Carbon paint works by reflecting most of the signal. However, shielding paint needs to be applied with caution because it is conductive and so needs to be grounded properly. Another issue is that because of the carbon paint's reflective qualities it is important that you do not use wireless devices in these rooms, otherwise the majority of the RF is not able to escape and will bounce around and will therefore increase your exposure. After taking these protective measures I am able to use my office again but I am reluctant to move in to my master bedroom as the RF emissions from the smart meter can infiltrate my room through the floor which has no shielding (I was living in a 2-story house). Heart palpitations and endless headaches are not something I would want to endure every day of my life.

## What I believe needs to happen

First and foremost, governments need to recognise that EHS is real and can be a serious health impairment, like Sweden does. Furthermore, medical professionals need to be educated on what EHS is, how to diagnose it and how to treat it. Education programs need to be established at Universities that cover this topic. The public also needs to be educated and informed of the risks of using wireless devices clearly and without prejudice or unwanted influence from those who market these devices. The media often portrays those who are suffering in a poor light leading to hurtful comments and ridicule from unformed members of the public, this needs to change. Scientist often weigh in on the argument suggesting that EHS is a psychosomatic illness based on what I believe to be faulty scientific studies that use only the provocation test as the basis for their claims. Further research maybe required but those who are suffering should not be held hostage by wrangling scientists and politician's as they argue the validity of EHS and testing techniques. The symptomology and causative factors of EHS is known and has been known for years.

I urgently request all the World RF Standard Bodies/ Health Advisory Bodies (ICNIRP, FCC, IEEE, WHO, ARPANSA etc.) to take this issue seriously and investigate claims made by people who are self-diagnosed as EHS rather than simply capturing statistics. There should be more funding to research EHS that includes biological tests as well as conducting a post smart meter rollout surveillance study with a focus on health rather than emission levels against a RF Standard or guideline.

It is also recommended that regulatory bodies in each country implement a precautionary principle, especially now that the IARC released its monograph last year justifying why RF is categorised as a Group 2B possible carcinogen. As there has been no research performed since this announcement that seriously contests this finding and Dr Lennart Hardell, one of the scientists whose research was a key contributor to the classification of microwaves as a Group 2B Possible Carcinogen, releasing further studies that re-affirms his original findings, we should apply caution when it comes the rollout of new wireless technologies.

There should be no wireless access points and mobile phone towers located near or within schools, libraries or hospitals. All schools should be required to adopt a wireless free policy and use hard wired inter/intranet connections until Wi-Fi can be proven without any doubt that it is safe. We should not be risking our children's health at any cost.

Governments should provide more funds to independent research scientists (and not those who have ties with the Industry as appears to occur today) to further investigate the potential biological effects RF may have. This is particularly important when leading scientists suggest that there are still gaps in our knowledge with respect to wireless biological effects especially in the area of non thermal interactions. Are they real or are they artefacts of the testing process? Let's make a concerted effort to find out as the future health of billions of people depends on it.

Prior to installation of mobile phone base stations or rollout of smart meters in our towns and cities, a health surveillance study should be conducted that measures the current state of health of householders to create a baseline reference point and to avoid potential issues of recall bias. Further surveillance studies should be conducted after the installation of the radio transmitters at set intervals to determine whether there have been any noticeable changes in public health.

Telecommunication companies should be required to rationalise their deployment of mobile phone base stations such that resources are shared between service providers where capacity is undersubscribed, especially as our neighbourhoods are being ringed by base stations without any due consideration to the

IARC and WHO announcement. Public health should have a higher priority than technological conveniences particularly when there is no proof of safety and lots of people are complaining of insomnia, headaches, neurological disturbances and other disabling symptoms.

***“Strange times are these in which we live when old and young are taught falsehoods in school. And the person that dares to tell the truth is called at once a lunatic and fool.”*** Plato 427 B.C.

## References

[1] WHO | Electromagnetic fields and public health - Electromagnetic hypersensitivity  
<http://www.who.int/peh-emf/publications/facts/fs296/en/>

[2] Guideline of the Austrian Medical Association) for the diagnosis and treatment of EMF-related health  
<http://www.scribd.com/doc/87308119/Guideline-of-the-Austrian-Medical-Association-for-the-diagnosis-and-treatment-of-EMF-related-health-problems-and-illnesses-EMF-syndrome>

[3]IARC Monograph volume 102 Non-Ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields  
<http://monographs.iarc.fr/ENG/Monographs/vol102/>

[4] European experts in disarray over EHS -- electromagnetic hypersensitivity  
<http://communities.washingtontimes.com/neighborhood/between-rock-and-hard-place/2012/apr/1/european-experts-disarray-over-ehs-electromagnetic/>

[5] Latest case history updates <http://www.mast-victims.org/>

[6] BIOLOGICAL AND HEALTH EFFECTS OF MICROWAVE RADIO FREQUENCY TRANSMISSIONS, A REVIEW OF THE RESEARCH LITERATURE – 2013 [http://www.national-toxic-encephalopathy-foundation.org/wp-content/uploads/2012/01/Biological\\_and\\_Health\\_Effects\\_of\\_Microwave\\_Radio\\_Frequency\\_Transmissions.pdf](http://www.national-toxic-encephalopathy-foundation.org/wp-content/uploads/2012/01/Biological_and_Health_Effects_of_Microwave_Radio_Frequency_Transmissions.pdf)

[7] RPS3 - ARPANSA Radiation Protection Standard No. 3  
<http://www.arpansa.gov.au/publications/codes/rps3.cfm>

[8] Radiofrequency Toolkit for Environmental Health Practitioners – BC Centre for Disease Control  
[http://www.bccdc.ca/NR/rdonlyres/9AE4404B-67FF-411E-81B1-4DB75846BF2F/0/RadiofrequencyToolkit\\_v4\\_06132013.pdf](http://www.bccdc.ca/NR/rdonlyres/9AE4404B-67FF-411E-81B1-4DB75846BF2F/0/RadiofrequencyToolkit_v4_06132013.pdf)

Bioeffects modulation electromagnetic fields in the acute experiments (summary Russian research)  
[http://www.bemri.org/component/docman/doc\\_download/78-grigoriev-bioeffects07.html?Itemid=4](http://www.bemri.org/component/docman/doc_download/78-grigoriev-bioeffects07.html?Itemid=4)

The Biological Effects of Weak Electromagnetic Fields - Problems and solutions Professor Andrew Goldsworthy  
<http://www.cellphonetaskforce.org/wp-content/uploads/2012/04/Biol-Effects-EMFs-2012-NZ2.pdf>

CRITICISM OF THE HEALTH ASSESSMENT IN THE ICNIRP GUIDELINES FOR RADIOFREQUENCY AND MICROWAVE RADIATION (100 kHz - 300 GHz) – Dr Neil Cherry  
[http://www.neilcherry.com/documents/90\\_m4\\_EMR\\_ICNIRP\\_critique\\_09-02.pdf](http://www.neilcherry.com/documents/90_m4_EMR_ICNIRP_critique_09-02.pdf)

## Further Reading

Electromagnetic Hypersensitivity - Norbert Leitgeb 2009

<http://diyhpl.us/~nmz787/biological%20radio%20research/Electromagnetic%20Hypersensitivity.pdf>

PUC Docket 2011---262 Friedman on Remand Intervenor DW et al Evidence 11 ElectrohyperSensitivity EHS March 5, 2013 - Contains an alphabetized list of peer reviewed journal articles and their abstracts that have addressed EHS. <http://www.mainecoalitiontostopsmartmeters.org/wp-content/uploads/2013/04/EV11-EHS-List-Revised-4-10-13-PUC-470.pdf>

“Reciprocal Buck Passing – No Care, No Accountability and No Responsibility.” A personal blog that demonstrates the lack of responsible handling by Government officials and Scientists to people claiming to be EHS

<http://stopsmartmeters.com.au/2013/09/13/reciprocal-buck-passing-no-care-no-accountability-and-no-responsibility/>

“When Health Issues are not the responsibility of a Health Department – How Bizarre!” A personal blog of interacting with the Chief Health Officer of Victoria on the topic of EHS 2013

<http://stopsmartmeters.com.au/2013/07/02/when-health-issues-are-not-the-responsibility-of-a-health-department-how-bizarre/>

Electromagnetic hypersensitivity: Fact or fiction? Stephen J. Genuis a, Christopher T. Lipp 2011

<http://media.withtank.com/c05550c3be/ehs-genuis.pdf>

What Are The Symptoms Of Electromagnetic Hypersensitivity?

[http://www.science20.com/florilegium/what\\_are\\_symptoms\\_electromagnetic\\_hypersensitivity](http://www.science20.com/florilegium/what_are_symptoms_electromagnetic_hypersensitivity)

<http://www.electrosensitivity.org.uk/>

<http://www.powerwatch.org.uk/health/sensitivity.asp>

Electromagnetic hypersensitivity: a systematic review of provocation studies.

<http://www.ncbi.nlm.nih.gov/pubmed/15784787>

Rea et al., 1991, Journal of Bioelectricity, 10(1&2), 241-256.

[http://www.aehf.com/articles/em\\_sensitive.html](http://www.aehf.com/articles/em_sensitive.html)

The Force – by Lyn Mclean

“EMR and Health” - quarterly science and news report -

[http://www.emraustralia.com.au/EMR\\_products\\_EMR\\_and\\_health.html](http://www.emraustralia.com.au/EMR_products_EMR_and_health.html)

## Glossary

The majority of the definitions provided in this glossary were sourced from Wikipedia.

<b>Acronym/Term</b>	<b>Definition</b>
2G/3G/4G	Short for second/third or fourth generation wireless telephone technology
ARPANSA	The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) the main government body dealing with ionizing and non-ionizing radiation and publishes material regarding radiation protection
Bluetooth	Bluetooth is a wireless technology standard for exchanging data over short distances using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz) from fixed and mobile devices.
CPU	A central processing unit (CPU) (formerly also referred to as a central processor unit) is the hardware within a computer that carries out the instructions of a computer program by performing the basic arithmetical, logical, and input/output operations of the system
CRT	Cathode ray tube, a type of vacuum tube used for information displays such as computer monitors or TVs.
DECT	Digital Enhanced Cordless Telecommunications (Digital European Cordless Telecommunications), usually known by the acronym DECT, is primarily used for creating cordless phone systems
DNA	Deoxyribonucleic acid (DNA) is a molecule that encodes the genetic instructions used in the development and functioning of all known living organisms and many viruses
ECG	Electrocardiography (ECG or EKG from Greek: kardia, meaning heart) is the recording of the electrical activity of the heart.
EEG	Electroencephalography (EEG) is the recording of electrical activity along the scalp. EEG measures voltage fluctuations resulting from ionic current flows within the neurons of the brain. In clinical contexts, EEG refers to the recording of the brain's spontaneous electrical activity over a short period of time
EHS	Electromagnetic Hypersensitivity is an idiopathic environmental intolerance attributed to electromagnetic fields is a descriptive term for symptoms caused by exposure to electromagnetic fields. Other terms include electro-sensitivity and electrical sensitivity (ES).
EMF	An electromagnetic field (also EMF or EM field) is a physical field produced by electrically charged objects. It affects the behaviour of charged objects in the vicinity of the field.
EMR	Electromagnetic radiation (EM radiation or EMR) is a form of radiant energy, propagating through space via electromagnetic waves and/or particles called photons.
FCC	The Federal Communications Commission (FCC) is an independent agency of the United States government, created to regulate interstate and international communications by radio, television, wire, satellite, and cable.
IARC	The International Agency for Research on Cancer (IARC; French: CIRC) is an intergovernmental agency forming part of the World Health Organisation of the United Nations.

GHz	Gigahertz (GHz), a unit of frequency
ICNIRP	The International Commission on Non-Ionizing Radiation Protection (ICNIRP) is an international commission specialized in non-ionizing radiation protection
IEEE	The Institute of Electrical and Electronics Engineers
IT	Information Technology is the application of computers and telecommunications equipment to store, retrieve, transmit and manipulate data, often in the context of a business or other enterprise.
LAN	A local area network (LAN) is a computer network that interconnects computers within a limited area such as a home, school, computer laboratory, or office building using network media
MHz	Megahertz (MHz), a unit of frequency
Microwave	Microwaves are a form of electromagnetic radiation with wavelengths ranging from as long as one meter to as short as one millimetre, or equivalently, with frequencies between 300 MHz (0.3 GHz) and 300 GHz
PS3	The PlayStation 3 (PS3) is a home video game console produced by Sony Computer Entertainment.
RF	Radio frequency (RF) is a rate of oscillation in the range of around 3 kHz to 300 GHz, which corresponds to the frequency of radio waves. The term "radio frequency" or its abbreviation "RF" are also used as a synonym for radio – i.e. to describe the use of wireless communication, as opposed to communication via electric wires.
RPS3	Radiation Protection Series No. 3 is published by ARPANSA and specifies limits of human exposure to radiofrequency fields in the range 3kHz to 300GHz to prevent adverse effects.
USB	Universal Serial Bus (USB) is an industry standard developed in the mid-1990s that defines the cables, connectors and communications protocols used in a bus for connection, communication, and power supply between computers and electronic devices.
WiFi	Wi-Fi, also spelled Wifi or Wi-Fi, is a technology that allows an electronic device to exchange data or connect to the internet wirelessly using microwaves in the 2.4 GHz and 5 GHz bands.
WHO	The World Health Organization (WHO) is a specialized agency of the United Nations (UN) that is concerned with international public health. It was established on 7 April 1948, with its headquarters in Geneva, Switzerland.

IOWA STATE UNIVERSITY  
Center for Agricultural Law and Taxation

# Stray Voltage and Dairy Farms Can Lead to Large Damage Awards

Mary Francque\*  
May 16, 2018



## History of Stray Voltage Suits

Stray voltage causing damages to dairy farms is a problem that has been facing the dairy industry for year with damages cases dating back to 1984. Stray voltage is caused when a power line's neutral line is "leaking" electrical currents into the ground. A common cause of stray voltage is a neutral wire that is either too small or damaged and allows the current to go into the ground. Even when the stray voltage current is at a low level, specifically anything above 0.5 volt, it can still be harmful to livestock. These currents put stress on the animals, which in turn lowers their immune systems, leading to a variety of issues. Dairy cows have shown to be more sensitive to stray voltage than any other livestock. Voltage has been shown to cause decreased milk production, due to a lowered water intake and in turn a lowered feed intake. Farmers have also noted a range of issues relating to breeding and calving. Dairy farmers have even reported extremely sick cows, some of which have later died.

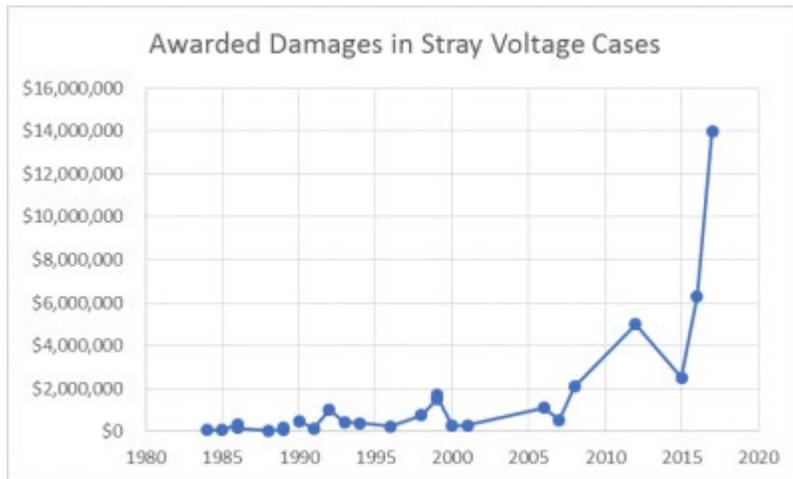
Since the 1980s farmers have been filing a variety claims against electrical utility companies across the United States relating to stray voltage, including claims for trespass, negligence, strict liability, and nuisance. Additionally, dairy farmers have filed suits against milk system suppliers for stray voltage. However, a majority of these suits have been unsuccessful or have resulted in limited relief due to the economic loss doctrine that prevents the

collection of damages when it relates to a loss in profit due to defective goods. A majority of courts have held that unlike milking systems, the utility companies are providing a service rather than a good.

In suits relating strictly to electrical utility companies we have seen an evolution in damages from the 1980s to today. These suits have proven to be successful on multiple occasions and the awarded damages continue to grow.

## Evolution of Damages in Stray Voltage Cases Heard throughout the United States

Since 1984 many farmers have received damages awards. However, those awards have grown from \$36,500 up to \$14 million. While there has been variation in damages awards throughout the years, there has been an upward trend overall. While some of this growth in awarded damages is due to growing farm sizes, a majority of the growth is due to an increase in understanding and research.



Year	Case Name	State	Claims brought	Relief granted to Farmer
1984	Zorn v. Electrical Research & Manufacturing Coop.	Wisconsin	negligence	\$79,786
1985	Schriner v. Pennsylvania Power & Light Co.	Pensylvania	Strict Liability	\$81,374
1986	Public Service Indiana, Inc. v. Nichols	Indiana	Strict Liability	\$343,000
1986	Hensley v. Howell-Oregon Electric Coop.	Missouri	Negligence	\$172,091
1988	Otte v. Dayton Power & Light	Ohio	Negligence	\$36,500
1989	Lipke v. Waushara Electric Coop.	Wisconsin	Negligence	\$70,000
1989	Taplin Farms, Inc. v. Ryder Sales & Service	Wisconsin	Negligence (Co-defendant <i>Northern State Power</i> found negligent)	\$178,684
1990	Fink v. Lafayette Electric Coop.	Wisconsin	Negligence and strict liability	\$500,000
1991	Kolpin v. Pioneer Power & Light Co.	Wisconsin	Negligence, strict liability, and nuisance	\$133,326
1992	ZumBerge v. Northern States Power Co.	Minnesota	Strict liability and negligence	\$1,000,000
1993	Cook v. Goodhue County Coop.	Minnesota	Negligence	\$450,000
1994	Matchey v. Trempealeau Electric Coop.	Wisconsin	Negligence	\$400,000
1996	Vogel v. Grant-Lafayette County Electric Coop.	Wisconsin	Negligence and Nuisance	\$240,000
1998	Vandenberg v. Consumers Power Co.	Michigan	Negligence and Nuisance	\$750,000
1999	James v. Beauregard	Louisiana	Negligence	\$1,500,000
1999	Tipmont Rural Electric Membership Corp. v. Fisher	Indiana	Negligence	\$1,700,000
2000	Scullion v. Wisconsin Power and Light Co.	Wisconsin	Negligence	\$277,500
2001	Iowa Lakes Electric Coop. v. Schmitt	Iowa	Negligence	\$303,022
2006	Muth v. Wisconsin Electric Power Co.	Wisconsin	Nuisance and negligence	\$1,107,289
2007	Gumz v. Northern States Power	Wisconsin	Nuisance	\$532,000
2008	Chapman v. New Mac Electric Coop.	Missouri	Nuisance	\$2,094,184
2012	Bollant v. Scenic Rivers Energy Coop.	Wisconsin	Nuisance and negligence	\$5,000,000
2015	Poppler v. Wright-Hennepin Cooperative Electrical Association	Minnesota	Negligence, nuisance, and trespass	\$2,500,000
2016	Norman v. Crow Wing Power	Minnesota	Nuisance and negligence	\$6,300,000
2017	Haldersons v. Northern States Power	Wisconsin	Nuisance and Negligence	\$14,000,000
2017	Burdick v. Interstate Power and Light	Iowa	Nuisance and negligence	\$500,000

## Recent Stray Voltage Case in Iowa

The Iowa Court of Appeals recently decided in favor of a dairy farm awarding them \$500,000 in damages. Burdicks, a family dairy in Northern Iowa, filed suit against Interstate Power & Light Co. The Burdicks claimed that Interstate was negligent in its maintenance of its system, which caused stray voltage damages to the Burdicks’

dairy herd. They also filed a nuisance claim against Interstate. The jury found for Burdicks on the issue of negligence, awarding them \$500,000. After the trial, Interstate filed a motion for a new trial claiming that Burdicks did not provide enough evidence for the jury to calculate the damages. The district court granted Interstate's motion for a new trial.

The case decided by the Iowa Court of Appeals found that if there is proof a party has sustained damages, then that party can recover, even if there is uncertainty in the amount of the damages. There must just be a basis from which the amount of damages can be inferred. While parties should still aim to provide detailed evidence showing damages, the court here allowed the party to recover even without such evidence.

Burdicks appealed the district court's grant of a new trial. The appellate court found for Burdicks, as Interstate's case-in-chief provided adequate information to support a determination of damages by the jury. In addition, Interstate did not appeal the jury's finding of its negligence. The court has held that "there is a distinction between proof of the fact that damages have been sustained and proof of the amount of those damages."<sup>[1]</sup> The proof of the amount of damages only needs to be presented to a point where the jury can come to an approximate estimate of the loss, not to an exact mathematical conclusion.

Therefore, even though Burdicks failed to present significant evidence that would aid the jury in determining the *amount* of damages, there were no grounds for the court to order a new trial. This was especially true because Interstate's expert witness' testimony and admitted exhibits provide sufficient evidence. Previous courts have shown that the court must look at evidence presented in the whole trial, not just the evidence presented by one side.

Here, Interstate's expert submitted graphs which showed expense figures and other important financial data. This along with his testimony allowed the jury to determine an estimate of the loss. Therefore, the Iowa Court of Appeals upheld the jury's previous holding that Interstate was negligent for \$500,000 in damages.

The case was *Burdick v. Interstate Power & Light Co.*, No. 16-0821 (Iowa Ct. App. October 25, 2017).

---

<sup>[1]</sup> Yost v. City of Council Bluffs, 471 2d N.W. 2d 836, 840 (Iowa 1991).

\*Mary Francque completed her second year of law school at Drake University in May of 2018. She served as an intern for CALT during the Spring 2018 semester.

CALT does not provide legal advice. Any information provided on this website is not intended to be a substitute for legal services from a competent professional. CALT's work is supported by fee-based seminars and generous private gifts. Any opinions, findings, conclusions or recommendations expressed in the material contained on this website do not necessarily reflect the views of Iowa State University.

Center for Agricultural Law and Taxation, 211 Curtiss Hall, 513 Farmhouse Rd., Ames, Iowa 50011, (515) 294-5217, Fax (515) 294-0700

© 2006-2014. All rights reserved

- [Format: Abstract](#)

## [Send to](#)

[PLoS One](#). 2013;8(1):e54376. doi: 10.1371/journal.pone.0054376. Epub 2013 Jan 22.

# Exposure to extremely low-frequency electromagnetic fields modulates Na<sup>+</sup> currents in rat cerebellar granule cells through increase of AA/PGE<sub>2</sub> and EP receptor-mediated cAMP/PKA pathway.

[He YL](#)<sup>1</sup>, [Liu DD](#), [Fang YJ](#), [Zhan XQ](#), [Yao JJ](#), [Mei YA](#).

## [Author information](#)

### Abstract

Although the modulation of Ca(2+) channel activity by extremely low-frequency electromagnetic fields (ELF-EMF) has been studied previously, few reports have addressed the effects of such fields on the activity of voltage-activated Na(+) channels (Na(v)). Here, we investigated the effects of ELF-EMF on Na(v) activity in rat cerebellar granule cells (GCs). Our results reveal that exposing cerebellar GCs to ELF-EMF for 10-60 min significantly increased Na(v) currents (I(Na)) by 30-125% in a time- and intensity-dependent manner. The Na(v) channel steady-state activation curve, but not the steady-state inactivation curve, was significantly shifted (by 5.2 mV) towards hyperpolarization by ELF-EMF stimulation. This phenomenon is similar to the effect of intracellular application of arachidonic acid (AA) and prostaglandin E(2) (PGE(2)) on I(Na) in cerebellar GCs. Increases in intracellular AA, PGE(2) and phosphorylated PKA levels in cerebellar GCs were observed following ELF-EMF exposure. Western blottings indicated that the Na(V) 1.2 protein on the cerebellar GCs membrane was increased, the total expression levels of Na(V) 1.2 protein were not affected after exposure to ELF-EMF. Cyclooxygenase inhibitors and PGE(2) receptor (EP) antagonists were able to eliminate this ELF-EMF-induced increase in phosphorylated PKA and I(Na). In addition, ELF-EMF exposure significantly enhanced the activity of PLA(2) in cerebellar GCs but did not affect COX-1 or COX-2 activity. Together, these data demonstrate for the first time that neuronal I(Na) is significantly increased by ELF-EMF exposure via a cPLA2 AA PGE(2) EP receptors PKA signaling pathway.

PMID:  
23349866

PMCID:  
[PMC3551899](#)

DOI:  
[10.1371/journal.pone.0054376](#)

Published on *East County Magazine* (<https://www.eastcountymagazine.org>)

[Home](#) > ROBERT KENNEDY, JR.'S LEGAL TEAM SUES FCC OVER WIRELESS HEALTH GUIDELINES

---

# **ROBERT KENNEDY, JR.'S LEGAL TEAM SUES FCC OVER WIRELESS HEALTH GUIDELINES**

**Robert Kennedy Jr.'s Legal Team Sues FCC – The team includes RFK, Jr., IRREGULATORS' Attorney Scott W. McCollough & Dafna Tachover, CHD's Director of Stop 5G & Wireless Harms**

Reprinted with permission from Children's Health Defense, Inc.

February 18, 2020 (San Diego's East County) -- Robert Kennedy, Jr., Chairman of Children's Health Defense (CHD), is committed to be proactive on the concerns regarding excessive exposure of our children to 5G and wireless radiation. To fulfill this promise, CHD submitted a lawsuit on February 2, 2020 against the FCC for its December 4, 2019 decision to decline to review its 1996 guidelines, and for its determination that the guidelines are protective of human health.

To have the best chances of succeeding, they have assembled a team of attorneys to lead this case. Each one brings different strengths to the case:

**Robert F. Kennedy Jr.**, CHD's Chairman, is a leading Environmental Attorney who has been involved with many groundbreaking lawsuits including the recent successful cases against Monsanto. He was a senior attorney for the NRDC and now leading cases for the protection of children's health rights.

**Scott W. McCollough** is the Attorney who is representing the **IRREGULATORS** in their lawsuit against the FCC, a case that will help expose a multi-billion-dollar fraud by Telecom companies. Scott has decades of experience as a Telecommunications and Administrative Law Attorney, leading the type of lawsuits we are submitting against the FCC.

**Dafna Tachover** is an expert on wireless and 5G health effects and has recently been brought on board at CHD to spearhead the Stop 5G effort. Dafna brings specialized knowledge and experience for this case. She is an Attorney, and holds a MBA, and has a Telecommunications background. She has been involved in cases focusing on wireless harms including a Supreme Court case in Israel against Wi-Fi in schools, a case that led to the first limitations on Wi-Fi worldwide!

## **About The Case**

On December 4, 2019, the FCC adopted an [order](#) affirming the adequacy of their 1996 wireless radiation exposure safety guidelines. These guidelines are at the core of the fraud perpetrated on the public that wireless technology is safe. Their guidelines ignore the overwhelming evidence of harm, scientific and human. By adopting and maintaining irrelevant guidelines, the FCC has enabled and forced the uncontrolled proliferation of wireless technology and now 5G. This has led to a growing epidemic of sickness among children and adults, and it has caused harm to animals, plants and the ecosystem at large.

In 2012, the General Accountability Office of Congress published a [report](#), recommending that the FCC reassess its 1996 guidelines. As a result, in 2013, the FCC opened [docket 13-84](#) asking for public comment. This docket was open for 6 years. On December 4, 2019, the FCC officially closed the docket and affirmed the adequacy of its guidelines without proper assessment.

Now that the docket is closed, they [are] suing the FCC under the Administrative Procedure Act (APA). The petition will ask the court to set aside the FCC order, asserting that the order is arbitrary, capricious and an abuse of discretion. **The case had to be submitted by February 3rd.**

# Summary of Evidence on Smart Meter Fires



In California and around world, smart meters have been linked to fires, explosions, and damaged appliances. For every fire started at the meter, in an appliance, or on wiring, smart meter causality should be suspected.

In 2012 a Pacific Gas and Electric (PG&E) whistleblower Pat Wrigley, who worked as a meter reader for 9 1/2 years testified at California Public Utilities Commission judicial hearing:

- **Smart meters cause fires**
- **PG&E is covering up the risk**

<https://youtu.be/EnxIoltNUek>



Matt Beckett, a California fire department captain stated, *“Two years ago PG&E replaced that meter [analog] with a “Smart Meter”. Immediately following we noticed power surges in the form of our refrigerator motor intermittently speeding up simultaneously with our lights becoming brighter. As a seventeen year veteran and current Fire Captain this caused me to become very concerned.”* The Smart meter on his house was replaced with an analog, and there were no problems, until a new Smart Meter was reinstalled. This time he had two surge protectors burn out. <http://emfsafetynetwork.org/fire-captain-finds-hazardous-power-surges-follow-smart-meter-installations/>

Another California fire captain, Ross writes, *“I was at home doing yard work in the late afternoon when my wife came outside and told me that “half the power was off again”. This had been happening on and off for about two weeks ... I then went outside to*

where my meter was and I could instantly smell the burnt electrical smoke. As I was looking at the meter I inadvertently placed my hand on the meter itself and almost burned my hand...the metal box into which all the home's wiring from the meter is stored was also too hot to touch with a bare hand." <http://emfsafetynetwork.org/smart-meter-arcing/>

## California Public Utilities Commission, and PG&E's response

**In 2009 PG&E reported to the California Public Utilities Commission (CPUC) smart meters interfered with AFCI's and GFI's** *"During the second quarter of 2009, PG&E discovered a limited number of cases of SmartMeter™ radio interference with customer electronics, including ground fault circuit interrupters (GFCI) and arc fault circuit interrupters (AFCI). Pages 6-7 Advanced Metering Infrastructure; January 2010 Semi-Annual Assessment Report and SmartMeter™"*[http://emfsafetynetwork.org/wp-content/uploads/2010/03/Updated-Semi-Annual-AMI-Report\\_Jan\\_2010-12.pdf](http://emfsafetynetwork.org/wp-content/uploads/2010/03/Updated-Semi-Annual-AMI-Report_Jan_2010-12.pdf)

**January 2011:** PG&E, The Utility Reform Network, CPUC Office of Ratepayer Advocates, California Energy Commission, CPUC Energy Division and others discussed "smart meter incidences involving fires..." Meeting agenda: [http://emfsafetynetwork.org/wp-content/uploads/2016/01/TAP-Agenda-1282011-inc-smart-meter-fires-SB\\_GTS\\_0652075.pdf](http://emfsafetynetwork.org/wp-content/uploads/2016/01/TAP-Agenda-1282011-inc-smart-meter-fires-SB_GTS_0652075.pdf)

2.	Provide insight (incident rates) on TURN-identified issues: smartmeter incidences involving fires and electrical shorts; interference (900MHz, garage and consumer devices) and 'dead sockets' (Dec meeting)	Jim Meadows	January meeting
----	--	-------------	-----------------

**2013: PG&E Data Response on smart meter fires.** <http://emfsafetynetwork.org/wp-content/uploads/2010/03/Data-Response-PGE-smart-meter-fires.pdf> Much of the document is redacted, and PG&E states, *"In no instance has PG&E found that a SmartMeter™, either gas or electric, has caused a fire."* However, PG&E now monitors temperature and voltage readings of smart meters for hazardous conditions. *"PG&E issues field orders to perform safety inspections at potentially overloaded and or high temperature sites. The data has led to panel inspections at customer premises that have found undersized wiring, physical panel damage, and overloaded conditions."*

**The CPUC is charged with overseeing utility safety.** In the CPUC's Annual Report to the Governor and the Legislature May 2014, they state, *"There was some concern regarding fires in smart meters but this was investigated by CPUC staff in 2013. Staff determined that, of reported fires involving smart meter installation, none were actually caused by the smart meter."* (p.5) **EMF Safety Network sent a records act request in December 2014 for the details of that investigation, however the CPUC has not provided any details.** <http://emfsafetynetwork.org/wp-content/uploads/2016/01/Smart-Grid-Annual-Report-2013-.pdf>

## Smart meter fires, surges, exploding meters, and damaged appliances in California and around the world



**Bakersfield, California, Smart Meter Blows Up At Business (2009):** “employees at Henry M.M. Engines said their Smart Meter caught fire, which sparked concern and questioned the safety of these new meters. On Wednesday, a PG&E technician was called out to replace the meter after employees found the device burned up and lying on the ground.” “Basically it was an explosion. I saw the meter on the ground and the face plate was blew off and the whole meter was blackened. Even the breaker box that housed the meter was blackened by what

seemed to be an electrical short,” said Vernon Nelson, an employee.” <http://www.turnto23.com/news/your-neighborhood/north-river-county/smart-meter-blows-up-at-business>

**Berkeley California Fire Department report (2010)** states, “Investigation revealed the newly installed PG&E Smart Meter in the kitchen was hot to touch and smoking, with a orange glow inside the meter housing” <http://emfsafetynetwork.org/wp-content/uploads/2010/07/Berkeley-Smart-Meter-Fire.pdf>



**Stockton California (2015):** Dozens of smart meters exploded and caught fire after an electrical surge cut power to about 5800 homes near Stockton CA. CBS News reports, “A power surge left thousands without power for most of the day in Stockton after smart meters on their homes exploded on Monday.” “Neighbors in the South Stockton area described it as a large pop, a bomb going off, and strong enough to shake a

house.” <http://emfsafetynetwork.org/dozens-of-smart-meters-explode-from-power-surge/>

**Santa Rosa, California (2011):** Three smart meters explode at a shopping mall. According to the incident report from the Santa Rosa Fire Department firefighters found the electrical room at the Santa Rosa Mall “charged with smoke” and “upon investigation found 3 PG&E meters that had blown off the electrical panel causing damage to the interior wiring of the electrical panel. A fire was still smoldering...” <http://emfsafetynetwork.org/3-pge-smart-meters-explode-at-santa-rosa-mall/>

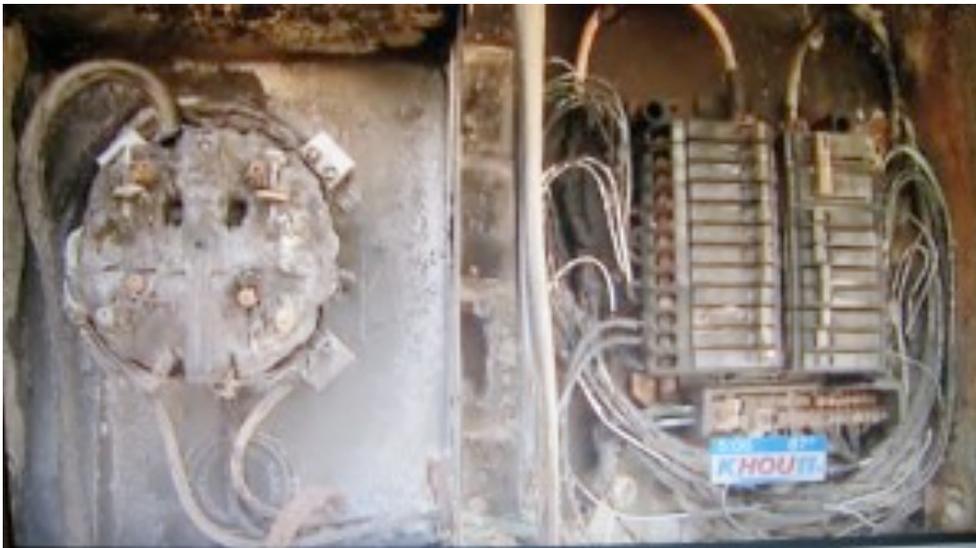
**Palo Alto** (2011): 80 PG&E smart meters caught on fire and burned out after a power surge. The incident raised questions for residents and utilities officials about smart meter safety. *“Mindy Spatt, communications director for The Utility Reform Network (TURN), said the utility-consumer advocacy group received many complaints about surges damaging appliances when the SmartMeters were first installed. Comparing analog to the new meters, she added, “In the collective memory of TURN, we have not seen similar incidents with analog meters.”* <http://www.paloaltoonline.com/news/2011/09/04/power-surge-raises-questions-about-smartmeters>

**Power mishap damages appliances for Livermore residents** (2012): 28 smart meters were replaced by PG&E when a power line replacement caused a power surge which fried appliances, TVs and air conditioners. *“The surge of electricity ripped through 28 homes on Hudson Way in Livermore.”* <http://abc7news.com/archive/8770840/>

**Nevada** (2014): Reno and Sparks fire chiefs call for smart meter fire investigation, *“in the wake of a troubling spate of blazes they believe are associated with the meters, including one recent fire that killed a 61-year-old woman.”* <http://www.rgj.com/story/news/2014/09/13/reno-sparks-fire-chiefs-call-smart-meter-probe/15580069/>

**Florida, News Investigative report** (2011): *“I went over to the FPL meter and it had caught on fire, it was all black smoke and charred,”* <http://www.wptv.com/news/region-c-palm-beach-county/some-homeowners-concerned-about-meter-installation#ixzz1d3MvQ4r5>

**Chicago Illinois** (2012): 2012 ComEd confirms smart meter fires. [http://articles.chicagotribune.com/2012-08-30/business/chi-comed-confirms-smart-meters-involved-in-small-fires--20120830\\_1\\_smart-meters-comed-customers-poor-connection](http://articles.chicagotribune.com/2012-08-30/business/chi-comed-confirms-smart-meters-involved-in-small-fires--20120830_1_smart-meters-comed-customers-poor-connection)



**Philadelphia Pennsylvania (2012):** utility PECO suspended smart meter installation due to fires. <https://youtu.be/g8nwrRchtuk>

**Texas (2012):** Customers of Centerpoint report smart meter fires. <http://www.khou.com/story/news/2014/07/21/11803806/>



Oncor Changing Smart Meter Installation After Fires « CBS Dallas / Fort Worth: *“The Chief Executive Officer of Oncor says the company has a new procedure for installation of smart meters after two house fires in Arlington last week. Robert Shapard says old wiring in two homes could not support the new smart meters.”*

<http://dfw.cbslocal.com/2010/08/24/oncor-changing-smart-meter-installation-after-fires/>

**Canada:** Nanaimo mother of two left without power for two days after smart meter smoked and caused a power outage <https://youtu.be/9NO6wIx8UFc>

**New Zealand:** Fire Prone Meter boxes causing concern. *“Front line firefighters are concerned about the number of household power meter boxes that are bursting into flames. There have been 67 callouts in Christchurch to electrical malfunctions so far this year, and new smart meters have*

*been involved in three in the last five days.”*<http://www.3news.co.nz/nznews/fireprone-meter-boxes-causing-concern-2010060317#axzz3vYE7LXcr>

#### **Australia:**

- **“Smart Meter Disaster”** is a 2012 Australian TV news report on smart meter hazards, including fires. [https://youtu.be/4e71qAr\\_qGk](https://youtu.be/4e71qAr_qGk)
- **Smart meter shock: electrical hazards found in 3500 homes** *“Victoria's energy regulator has conceded smart meter contractors might lack required skills and is reviewing the qualifications of workers rolling out the \$2 billion scheme.”* *“smart meter installers have identified dangerous and possibly life-threatening electrical hazards in 3500 Victorian homes.”* [http://www.theage.com.au/victoria/smart-meter-shock-electrical-hazards-found-in-3500-homes-20110212-1are0.html?from=age\\_sb](http://www.theage.com.au/victoria/smart-meter-shock-electrical-hazards-found-in-3500-homes-20110212-1are0.html?from=age_sb)
- **Smart meter blasts covered up 2012:** A whistleblower claims power companies know smart meters are exploding and are lying to consumers to cover it up. 'John' works for Jemena and claims at least six smart meters have exploded in and around Pascoe Vale, since Christmas. John was installing a meter yesterday which burst into flames in front of him. He's told Neil Mitchell under strict anonymity power companies are misleading the public and smart meters are dangerous. <http://www.3aw.com.au/blogs/breaking-news-blog/smart-meter-blasts-covered-up/20120222-1tmqr.html>

## Thousands of smart meters replaced due to fire risk

- Portland General Electric Oregon replaced 70,000 smart meters due to fire risk. [http://www.oregonlive.com/business/index.ssf/2014/07/pge\\_replacing\\_some\\_electricity.html](http://www.oregonlive.com/business/index.ssf/2014/07/pge_replacing_some_electricity.html)
- Lakeland Florida replaced 10,657 smart meters due to fire risk: <http://www.theledger.com/article/20140826/NEWS/140829388/1410?Title=Overheating-Concerns-Lakeland-Electric-to-Replace-10-657-Residential-Smart-Meters->
- In Canada SaskPower replaces 105,000 smart meters due to fire risk. <http://www.cbc.ca/news/canada/saskatchewan/saskpower-to-remove-105-000-smart-meters-following-fires-1.2723046>
- Ontario, Canada Thousands of smart meters in Ontario to be removed over safety worries: “Some 5,400 of Ontario’s 4.8 million smart meters are being removed and replaced because of a risk they could heat up, cause an electrical short and possibly spark a fire.” <http://www.thestar.com/news/queenspark/2015/01/22/thousands-of-smart-meters-in-ontario-to-be-removed-over-safety-worries.html>

### Industry and expert commentary



**IEEE** [professional technological association]: “Obviously all companies with smart meter programs, and all their suppliers and sub-contractors, are going to have to take a close look at the issue of fire hazards. This is just the beginning of a difficult story.” <http://spectrum.ieee.org/energywise/energy/the-smarter-grid/smart-meter-fire-reports>

**TESCO:** According to research by TESCO smart meters are more prone to “hot socket” than analog meters. Failure modes include catastrophic (expected) “Catastrophic failure” is defined as “a meter which has burnt, melted, blackened, caught fire,

arced, sparked, or exploded.” See: <http://smartgridawareness.org/2015/11/03/catastrophic-failures-expected-with-smart-meters/> See also: <http://emfsafetynetwork.org/wp-content/uploads/2010/03/TESCO-Lawton-on-Hot-Sockets.pdf>

**Wireless Smart Meters and Potential for Electrical Fires.** Commentary by Cindy Sage, Sage Associates and James J. Biergiel, EMF Electrical Consultant July 2010: Smart meters can create an over-current condition on the wiring and produce heat, which the neutral cannot properly handle, which can lead to fires.

- “The use of smart meters will place an entirely new and significantly increased burden on existing electrical wiring because of the very short, very high intensity wireless emissions (radio frequency bursts) that the meters produce to signal the utility about energy usage.”
- “The location of the fire does NOT have to be in close proximity to the main electrical panel where the smart meter is installed.”
- “A forensic team investigating any electrical fire should now be looking for connections

*to smart meters as a possible contributing factor to fires.”*

- <http://emfsafetynetwork.org/wp-content/uploads/2011/06/Smart-Meters-Risk-for-fire.pdf>

**Ontario Fire Marshall Report:** *“During our initial research of the new meters we encountered an unusual amount of fire incidents involving smart meters. “Anecdotal information supported [the fact that] problems occurred after the old analog meters were updated to the new digital smart meters.” The report noted the possibility of a fire resulting from “a loose connection in the meter base.”*

*“What could be the reason for this? The old meter base connections may not have been in a condition for seamless exchange to a new meter. New meters may have defects that cause electrical failures or misalignment with old meter base. Careless installation during changeover.”*

<http://www.oafc.on.ca/article/unusual-number-fires-smart-meters-linked-ontario-fire-marshall-says-faulty-base-plates-could>

**American Electric Power (AEP) How hot are your meters? 2015:** *“Today’s meters are light. The old ones were heavy and dissipated heat a lot better, actually,” said Ken Dimpfl, of American Electric Power (AEP). In 2010, they started seeing smart meter failures due to high temps or thermal overload. “This began our journey of looking at ‘hot sockets,” Dimpfl said. “Over the course of a two-year period, AEP analyzed roughly 25 meters that failed. Post event analysis concluded that the root cause was a poor connection at the meter.”*

<http://www.intelligentutility.com/article/15/10/how-hot-are-your-meters>

**Hydro Quebec requires 3 meters distance between a smart meter and gas tank**

<http://ofsys.hydroquebec.com/T/OFSYS/SM2/2/S/F/4947/13087532/Dnm3qyNW.html>

**Norm Lambe, an insurance claims adjustor, contends the utility companies are tampering with the evidence by immediately removing smart meters when there’s a fire.** *“A dangerous precedent is being followed in the insurance industry concerning the investigation of smart meter fires... When the local electrical utility arrives and determines that a smart meter is the issue, they have been removing the meter, and preventing the inspection of the meter by the experts... This is a serious situation, as the utility company, upon removal of the meter is tampering with what is evidence concerning the cause of the fire and can be held criminally responsible.”* <http://www.examiner.com/article/are-insurance-companies-avoiding-the-smart-meter-problem>

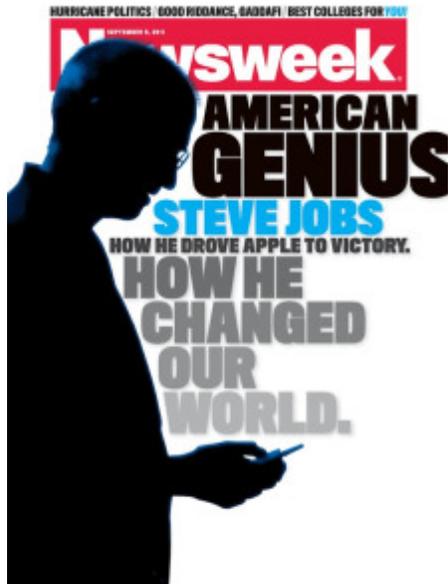


*Summary of Evidence on Smart Meter Fires compiled by Sandi Maurer, EMF Safety Network Director, January 2015. Sandi Maurer has intervened on smart meter proceedings at the CPUC since 2010. See also EMF Safety Network Smart Meter Fires and Explosions: <http://emfsafetynetwork.org/smart-meters/smart-meter-fires-and-explosions/>*

<https://emfguy.wordpress.com/2011/10/07/technology-killed-steve-jobs/>

# Technology Killed Steve Jobs

Posted on [October 7, 2011](#) | [13 Comments](#)



Technology Killed Steve Jobs

That's not Steve Jobs "killed technology" or spawned "killer technology" *in the awesome, sick, hot, cool product sense.*

[Though iTunes and Steve Jobs killed the record & CD industry.](#)  
**killed Steve Jobs in a quite literal sense.**

***Rather, it was technology***

Steve Jobs replied to my email years ago in Silicon Valley. I asked him why he's not touting Apple's great security. He replied he just didn't want to draw publicity to it for fear hackers may focus on Apple products. *Always a step ahead.*

The world could've used 25 more years of his pig-headed brilliance, this 'Future by Steve Jobs'.

I wish to draw attention to what killed him. **Technology is the killer.**  
nano-robots or mutant bacteria?

Was it a remote death ray,  
No, nothing like that. Well, *almost* nothing like that.

We're killed by the things we love; addiction to cigarettes, alcohol, gambling, McDonald's and the list. We pick our poisons and go to the well, habitually. One who loves violence may die by the sword. Lovers die by the object of their affections.

*If you want to learn what kills us, find out what we love.*

Far from junk food, Steve Jobs was meticulous about what he ingested as a pescetarian (vegetarian + fish). He kept his own fresh food garden. And as a Buddhist, he likely cultivated discipline while avoiding most bad lifestyle choices. One may expect Steve to live a long, healthy life. ***One ‘addiction’ Jobs would never shake was technology.***

Steve Jobs loved technology. These warm and fuzzy technology things – the Mac, iPod, iPhone and iPad – are things he loved. They’re the things we all love. They’re why we loved Steve.

The iPhone (slash iPad) is the technology that absorbs our lives.

Researchers contend brain scans show it’s far more than mere brand recognition (New York Times, “You Love Your iPhone. Literally”).

The iPhone was a game-changer.

***It was also a game-changer in terms of man-made radiation.***

*The iPhone emits more electromagnetic radiation than any other smartphone in the world.* It’s always ‘talking’ to other iPhones. You can ‘bump’ iPhones to exchange e-cards. ***It’s so cool!***

*And it’s so deadly.* Like a bunch mini-transmitters, it’s radiation is “always-on” and all around. We’re swimming in electromagnetic fields ***which have increased a million-fold in the past 40 years.***

*iPhone takes this radiation exposure to a whole new level.*

Not so cool.

We’ve welcomed this ubiquitous hazard into our lives this past century. *The scientific case is not herein with copious links to distract our radiation-addled brains.* Ask your mother or grandmother. Mine once said about TV, ‘*Stay back from that thing, it can’t be good for you*’. ***Turns out, TVs once emitted X-rays!***

Anyway, go look it up. What am I, your mother?

Let me get off our fav devices (er, ‘loved ones’) and instead focus on Steve Jobs.

Steve Jobs reputedly had a hand in every design detail, his obsession with interface and usability means *he was immersed in electromagnetic field radiation.* Not like you or me or even the bench engineers at Apple.

In terms of humans on the planet and without benefit of environmental audit, *it’s safe to say he was in the 99.9th percentile of exposure to this radiation.* ***Steve Jobs was Guinea Pig Number One.***

[ *Actually, Dr. Robert Kane, Motorola’s top patent holder/cellphone tester – wrote the book, ‘Cellular Telephone Russian Roulette’ in 2001 and died of a brain tumor – was likely ‘Number One’* ]

***Technology is addictive*** – not just in the better-known psychological sense of reinforced behavior and subsequent triggering of endorphins, dopamine and all these neurotransmitters involved in addiction.

Beyond this, *the radiation itself is addictive.* Electromagnetic radiation – *independent of other factors*– triggers endorphins, impacts dopamine, serotonin, norepinephrine, epinephrine, GABA – the addiction keys.

This covert, man-made radiation we heartily embrace affects our mental health and then directly impacts our physical health. Cancer is one of the troubling by-products. ***Technology kills... in a warm & fuzzy way.***

***What of pancreatic cancer and Steve Jobs?*** He first got pancreatic cancer in 2004. Those chemo treatments doubtless resulted in the liver toxicity which necessitated a liver transplant. The liver’s ‘the General’ in this war as they say in Chinese medicine. Without the liver, no chance. Oncologists agree.

After pancreatic cancer in 2004, *rather than quit and concentrate on getting healthy, Steve Jobs was just getting started.* Then came the liver transplant in 2009. *That's the heroic part.* We think it's all great fun designing the future. Sometimes, one expects it's hellish hard work.

Steve Jobs made technology accessible and indispensable and the object of all our affections. No longer stuck in the realm of 'need' Steve Jobs made technology a matter of 'want'. Technology became happy and helpful and mostly... *Simple.*

Like the genius Nikola Tesla and his alternating current, Jobs brought wondrous technology into our lives. Electricity is the backbone of our technological advance. *Ironically, with its own hazardous radiation, electricity is the unindicted toxic co-conspirator lurking.*

Technology... for good or evil. The good, we all know.  
The evil? Well, that's right now being discovered.

*Steve Jobs killed technology and technology killed Steve Jobs.*  
It's tantamount to being attacked by gummy bears (for some of us).

*This thing we love turned against us. And who'd think to blame gummy bears anymore than people would blame their various and sundry iStuff.*

Steve Jobs gave his life to give you this technology.  
He didn't know it.

And frankly, the collective "we" won't know it for a while yet.

*On technology and health, we need to think anew and act anew and all that jazz.*

Like Steve.

*This Blog is now officially open  
further inspired by Steve Jobs.*

Thanks.

# Embedded Wireless Solutions

## The Connected Hospital

A vision for a fully integrated hospital

[Home](#) » [Solutions](#) » [Embedded Wireless](#) » What is the Connected Hospital?

- **Solutions**

- [Connected Vehicle Solutions](#)
- [EMI Shielding and Gaskets](#)
- [Embedded Wireless](#)
- [Power Solutions](#)
- [Precision Metals](#)
- [RF & Microwave Absorption](#)
- [Signal Integrity](#)
- [Thermal Management](#)

## What is the Connected Hospital?



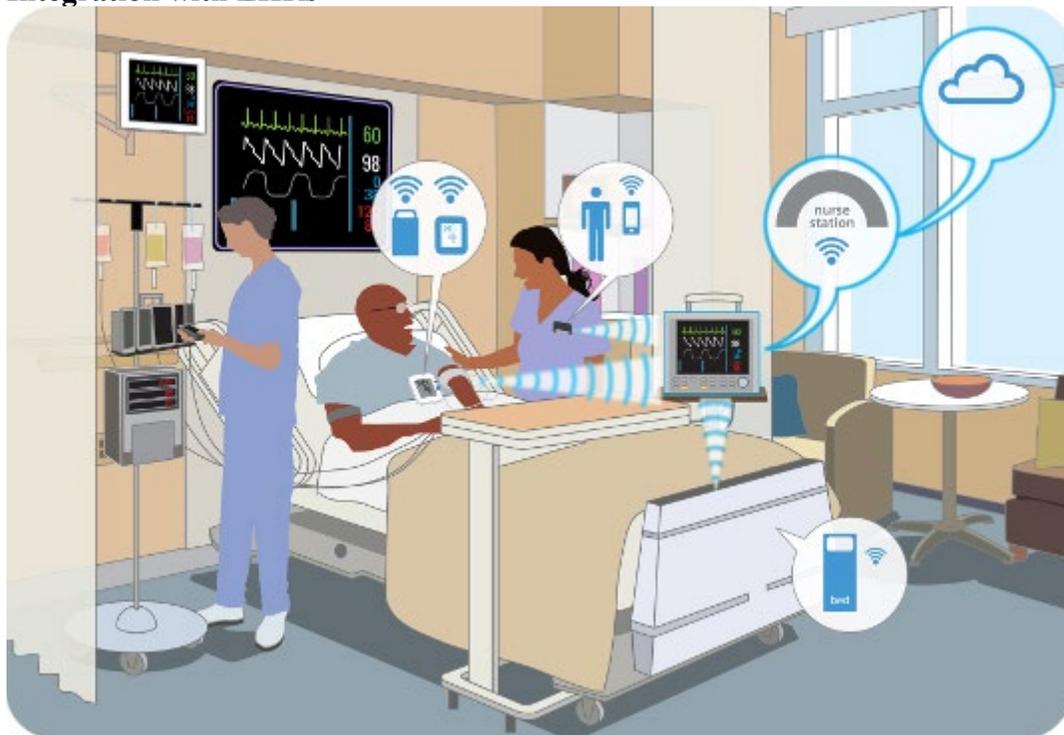
The Connected Hospital is a vision of a fully integrated hospital where wireless technology allows caregivers and patients to roam throughout the hospital while providing accurate and timely monitoring. In a Connected Hospital caregivers can focus on providing the best quality of care to their patients, instead of on administrative tasks. The vision of a connected hospital stems from the progression of an increasing number of wireless medical devices in a hospital. Connecting medical devices to Electronic Health Record (EHR) systems has reduced the time it takes to enter vitals from 7 to 10 minutes to less than one minute per patient. As the number of patients per nurse will unfortunately grow due to ever increasing nurse shortages, these gained efficiencies will be crucial to providing quality patient care. Wireless technology

won't just be used to connect existing medical devices, entire new waves of medical devices are being created to take advantage of the connectivity that wireless technology provides. Real-Time Location Systems (RTLS) are now used to quickly find usable equipment for treatments. Advanced bed and fall monitors can monitor patient movements and alert staff as soon as there is an issue. Mobile medical devices will allow patients to take home their medical devices so they can be monitored even after they leave the hospital. All of these technologies are being enabled by the underlying robustness of the wireless connection.

Patient safety, data accuracy, and mobility will all be fueled by wireless technology. In the Connected Hospital, every device is connected and communicating with the EHR (Electronic Health Records) for accurate patient records and real-time data analysis. Within the Connected Hospital, nurses can monitor many patients remotely from one main station, receiving alerts and observing data captured each second on the patients' health. Doctors can make more informed decisions with accurate and up-to-date patient information, leading to better patient outcomes. Patients and their family can feel safe, knowing that they will always receive the correct dosage of the right medication, will always receive the greatest care from medical staff, and will feel more comfortable not being tied down by wired medical devices. Read on to discover further benefits and challenges of the Connected Hospital.

## What are the Drivers and Benefits of the Connected Hospital?

### Integration with EHRs



Recent government regulations such as HIPAA, HITECH, and the Affordable Care Act provide incentives for hospitals to adopt EHR systems. Those that do not adopt an EHR may be susceptible to penalties down the line. In addition to the financial incentive, wireless medical devices communicating with the EHR ensure accurate patient information and more streamlined billing processes for hospitals.

### Prevent Hospital Readmissions

Hospital readmissions are a key driver for the Connected Hospital due to the Affordable Care Act. Medicare will not reimburse hospitals for readmissions within 30 days for the same cause. The Connected Hospital will prevent patient readmission by providing better patient care including educating patients on ways to improve and monitor

their health at home and ensuring a follow-up appointment before discharge. In addition, once patients are home, doctors can monitor their progress through remote home health monitoring.

### **Saving Nurses' Time**

Each patient within a hospital has on average 3-6 devices attached to them. If it takes a nurse approximately 5-15 minutes to visit each patient and check all vital signs, he or she can only visit approximately 4-12 patients per hour. This manual documentation of vital signs and changes can occupy a good portion of a nurse's day, especially when he or she has over 12 patients to monitor. Movements such as National Nurses United, Safe Patient Ratios, have organized to ensure safe nurse to patient ratios. In addition to safe nurse to patient ratios, remote monitoring can help immensely in reducing the amount of time spent manually entering patient information. According to the report from Transparency Market Research, Medical Device Connectivity Market, the current workflow for a nurse's round is:

- Nurse goes to patient room at scheduled intervals
- Checks each device that a patient is connected to (3-6 devices)
- Notes down any changes and vital signs
- Locate the patient's EHR
- Transcribes value
- Submits the info to EHR

Medical device connectivity solves this problem by automatically sending data from devices to the EHR, saving nursing time to increase productivity and allow for better patient care.

### **Improved Patient Outcomes**

In addition, the Medical Device Connectivity Market report states that various locations that have implemented CPOE (Computerized Physician Order Entry) systems have demonstrated a 20% decrease in hospital wide mortality rates. Automating the data transfer from medical devices to the EHR improves communication of accurate and up to date medical information, allowing medical staff to make proper diagnostic decisions. This frees up nurses' and clinicians' time to spend on improving patient care, rather than documentation of data.

### **Increased Need for Workflow Automation:**

Workflow automation helps with the following:

- Minimize transcription errors at point of care
- Remotely configure and monitor patient's dose and other key information
- Facilitates data analysis by doctors
- Improved patient outcomes due to complete picture of patient's conditions
- Automatic billing to prevent loss of revenue
- Provides clinical analytical capabilities for strategic decisions within a hospital

## **What Issues Should Hospitals and IT Administrators Keep in Mind When Implementing the Wireless Hospital?**

A hospital is a complex and often challenging RF environment with large multi-floor campuses and several obstructions such as human bodies, medical equipment, and liquids. It also deals with huge amounts of data, including critical and sensitive patient information. Much of that data is generated by the thousands of medical devices that operate in a hospital. Along with medical devices, a hospital also has to deal with interference from the increasing number of wireless devices being used by both hospital staff and guests.

For a hospital to function smoothly while delivering the highest quality patient care, its medical devices must operate reliably at all times. This means connecting anywhere, anytime. Medical devices must also ensure the highest level of security for their patients' safety and privacy.

### **Lack of Standards for Interoperability**

One path to making the connected hospital a reality is to join together a variety of perspectives from:

- Medical device manufacturers
- Wireless module manufacturers
- Infrastructure providers
- IT personnel

These organizations and personnel can lead the industry in generating guidelines and interoperability standards for wireless technology in hospitals. Once everyone is on the same page on how to create a secure and reliable network, it will make the vision of a fully connected hospital a reality that much sooner.

### **Security**

A hospital requires the highest level of security for their patient's safety and privacy and this especially applies to wireless medical devices. Medical devices must be protected by WPA2-Enterprise Security and FIPS 140-2. For more information about wireless security in hospitals, read our white papers below.

- [BLE Guide to Security and Privacy](#)
- [FIPS 140-2 and Wi-Fi Client Devices](#)

### **Lack of Wireless Adoption**

Despite the growth in wireless technology, hospitals are reluctant to adopt wireless medical devices due to uncertainty and distrust. It is understandable to be wary due to security and patient safety concerns. However, the opportunities for growth are increasingly outweighing the challenges associating with adopting wireless technology. Today there are a multitude of incentives, documentation, and assistance for hospital IT to make informed decisions by joining an entire ecosystem of medical device manufacturers, wireless module manufacturers, and infrastructure providers. Hospitals do not have to do it alone.

Visit our [Medical page](#) for more information about wireless in healthcare, the benefits of using Laird embedded wireless solutions in healthcare, and product suggestions for various applications.

# The Man Who Was Allergic to Radio Waves

Your cellphone does not in itself cause cancer. But in the daily sea of radiation we all travel, there may be subtler dangers at work, and science is only just beginning to understand how they can come to affect people like Per Segerbäck so intensely

By James Geary March 4, 2010



Per Segerbäck's Nearly Electricity-Free Home

The photographer shot on film, using daylight, to avoid setting off Segerbäck's hypersensitivity.

Jonathan Worth

Per Segerbäck lives in a modest cottage in a nature reserve some 75 miles northeast of Stockholm. Wolves, moose and brown bears roam freely past his front door. He keeps limited human company, because human technology makes him physically ill. How ill? On a walk last summer, he ran into one of his few neighbors, a man who lives in a cottage about 100 yards away. During their chat, the man's cellphone rang, and Segerbäck, 54, was overcome by nausea. Within seconds, he was unconscious.

Segerbäck suffers from electro-hypersensitivity (EHS), which means he has severe physical reactions to the electromagnetic radiation produced by common consumer technologies, such as computers, televisions and cellphones. Symptoms range from burning or tingling sensations on the skin to dizziness, nausea, headaches, sleep disturbance and memory loss. In extreme cases like Segerbäck's, breathing problems, heart palpitations and loss of consciousness can result.

A cellphone has to be in use -- either making or receiving a call, or searching for a signal, when radiation levels are highest -- for it to have this kind of effect on Segerbäck. Phones that are on but neither sending nor receiving usually don't produce enough radiation to be noticeable. But it's not the sound of the phone that sets him off. Once, while on a sailboat with friends, he recalls, he was on the front deck when, unknown to him, someone made a call

belowdecks. Headache, nausea, unconsciousness. When Segerbäck is within range of an active cellphone (safe distances vary because different makes and models produce different radiation levels), he experiences the feeling that there is "not enough room in my skull for my brain."

Sweden is the only country in the world to recognize EHS as a functional impairment, and Segerbäck's experience has been important in creating policy to address the condition. Swedish EHS sufferers -- about 3 percent of the population, or some 250,000 people, according to government statistics -- are entitled to similar rights and social services as those given to people who are blind or deaf. Today, local governments will pay to have the home of someone diagnosed with EHS electronically "sanitized," if necessary, through the installation of metal shielding.

## **SEA OF RADIATION**

Electromagnetic fields (EMFs) are inescapable. We are constantly exposed to them, mostly in the form of either extremely low-frequency (ELF) radiation from things like domestic appliances and power lines or radio-frequency (RF) radiation from things like cellular and cordless phones, telecom antennas, and TV and radio transmission towers. Our bodies even produce faint EMFs of their own, from the electrical activity in the brain and heart.

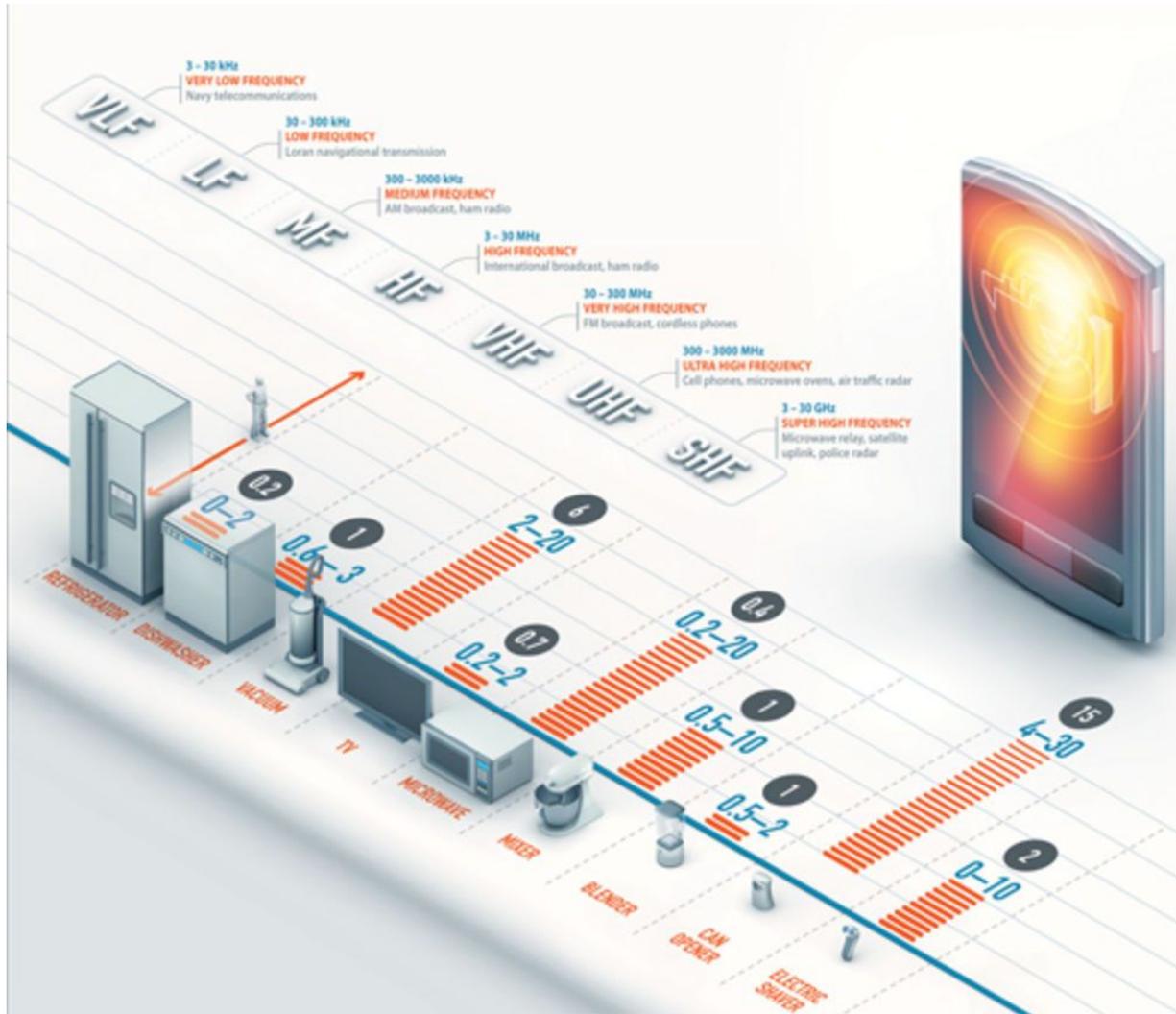
Ionizing radiation -- the kind produced by x-rays, CT scans and nuclear bombs -- can do terrible damage to the body. It is classified as a carcinogen. But ELF and RF are types of non-ionizing radiation, which is thought to be nearly harmless. Non-ionizing radiation isn't powerful enough to break molecular bonds, so it cannot directly cause the cellular damage that leads to disease. This type of radiation is everywhere. "We are bathed in a sea of non-ionizing radiation," says John Boice, a professor of medicine at Vanderbilt University School of Medicine and scientific director of the International Epidemiology Institute, a biomedical research firm in Rockville, Maryland.

This sea, most scientists agree, is harmless. Cellphones are safe and conditions like EHS cannot exist, they argue, because the EMFs involved are too weak to have any health effect. The non-ionizing radiation from cellphones has almost no known influence on the human body. In fact, the only universally recognized effect of non-ionizing radiation is a very minor heating of nearby tissue. The Federal Communications Commission sets EMF limits for cellphones -- measured as "specific absorption rates" (SARs) -- below which significant heating does not occur. Segerbäck's symptoms and those of other EHS sufferers, according to many researchers, may be either misdiagnosed or imaginary. Some experts suggest that people like Segerbäck perhaps suffer from a psychological disorder, or that their cases may illustrate the "nocebo" effect, in which the expectation that something will make you sick actually does make you sick. A review published last year in the journal *Bioelectromagnetics* found no evidence that hypersensitive individuals had an improved ability to detect EMFs, and the study found evidence of the nocebo effect in those same people.

The cellphone industry's position on the subject is clear. "The peer-reviewed scientific evidence has overwhelmingly indicated that wireless devices do not pose a public-health risk," says John Walls, vice president of public affairs at CTIA -- The Wireless Association, the international industry body. "In addition, there is no known mechanism for [EMFs] within the limits established by the FCC to cause any adverse health effects." A host of major institutions -- including the U.S. Food and Drug Administration, the International Commission on Non-Ionizing Radiation Protection (ICNIRP), the American Cancer Society and the World Health Organization -- agree with this assessment. (Although the ICNIRP says scientific assessment of the health aspects of wireless devices should continue as the technology becomes more widespread.)

Boice points out that data from cancer registries, such as the National Cancer Institute's SEER program, shows that brain-cancer rates haven't gone up since the early 1990s. The trends are also relatively flat from the mid-1970s to the early 2000s in Denmark, Finland, Norway and Sweden, where cellphones have been in use longer than in the U.S. If cellphones were causing brain cancer, an obvious uptick in reported cases would be expected. "If you look

at the totality of biological and experimental studies," Boice says, "the vast amount of evidence is that there is no association between cellphones and malignancies."

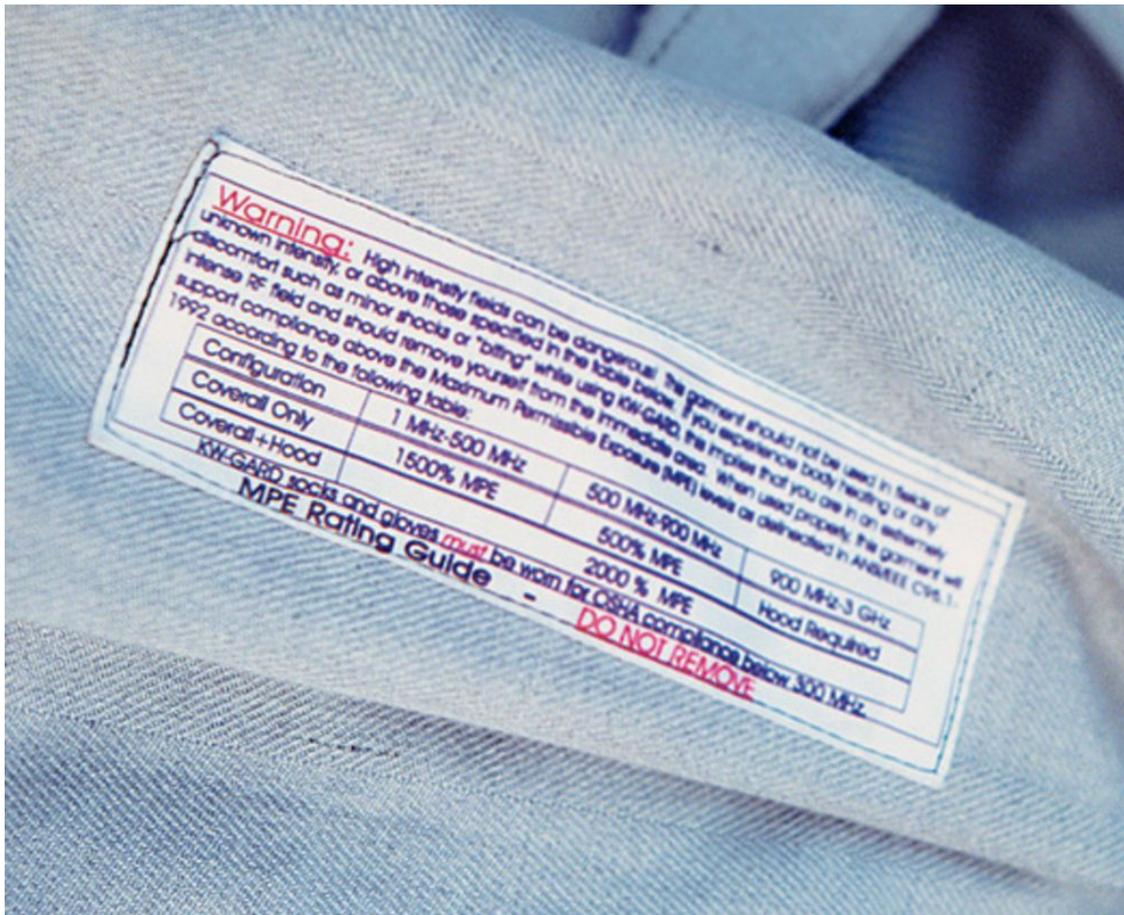


## Signal Strength

Cellphones are one of a number of household items that give off electromagnetic radiation

[Davvi.com](http://Davvi.com)

- Your cellphone gives off radiation largely through the antenna when you make and receive calls and when it searches for a signal.
  - Cellphones operate in the radio-frequency range of the spectrum, along with radar and FM radio broadcasts.
  - Daily life exposes us to radiation from many sources, and electromagnetic fields vary [the circled number is the median field strength]. The combined effect is difficult to determine.



Warning Label

Jonathan Worth

## WHAT IT FEELS LIKE

Segerbäck was once an elite telecommunications engineer. He worked for Ellemtel, a division of the Swedish telecom giant Ericsson, for more than 20 years, leading an engineering group that designed advanced integrated circuits for prototype telecommunication systems. He used the newest and most advanced computer and telecom equipment available, the kind of stuff only Ericsson and the Swedish military had access to. He was, as a result, up to his eyeballs in a non-ionizing radiation bath, from computers, fluorescent lights and the telecom antenna located right outside his window.

He noticed his first symptoms -- dizziness, nausea, headaches, burning sensations and red blotches on his skin -- in the late 1980s, a decade into his telecommunications research work. All but two of the 20 or so other members of his group reported similar symptoms, he says, although his were by far the most severe. His EHS worsened and now, he says, even radar from low-flying aircraft can set it off. Segerbäck is convinced that the perfect storm of EMFs in his office, combined with potentially toxic fumes from his brand-new computer, were responsible for his condition. "The company doctors didn't understand what was going on," he says.

Agne Fredriksson, who managed Segerbäck's group at Ellemtel and retired from Ericsson in 2006, says a commonly reported symptom was "a feeling of heat in the face," which everyone attributed to the new computer workstations. When members of Segerbäck's group started calling in sick and people from other departments began

reporting similar symptoms, Fredriksson recalls, "that's when we started to look into what could be done about it. There was a lot of worry from the groups in which people reported the most symptoms."

A new office space was created for the worst-affected employees; about half a dozen people shared this fully shielded room. Others switched to different computer workstations, while others managed by spending less time in front of their screens. No one had ever encountered anything like it before. "Why are we so special?" Fredriksson remembers wondering. He later learned that other companies faced similar situations at the time, although that information remained internal.

Ericsson went to great lengths to keep Segerbäck, a key member of the firm's design team, on the job. In the early 1990s, the company installed metal shields around his bedroom and study at home so he could sleep and work without radiation exposure. To enable him to go outside, medical authorities gave Segerbäck an EMF-resistant suit like the ones worn by engineers working in close proximity to live telecom towers and high-voltage power lines. The firm even modified a Volvo so he could travel safely to and from work. His commutes ended when cellphone towers began to spring up around Stockholm in the mid-1990s, eventually forcing his retreat to the woods.

In 1993 Ericsson produced a report, "Hypersensitivity in the Workplace," about what happened at Segerbäck's lab. In the foreword, Ellemtel's vice president Örjan Mattsson and administrative chief Torbjörn Johnson wrote: "A new problem in the work environment has appeared: hypersensitivity. When dealing with traditional occupational injury, as a rule you can establish a cause and effect relationship. Not so with regard to hypersensitivity. When the first serious cases occurred at Ellemtel at the end of the 1980s, we were not prepared. Soon, we came to look upon hypersensitivity as a serious threat to the company business. . . . We started wondering if we were faced with a modern-day scourge."



EMF-Resistant Suit

Segerbäck's employers installed shielding in his home, and medical authorities issued him this EMF-resistant suit.

Jonathan Worth

A year later, Ericsson closed the lab in which Segerbäck and his group worked. The company dismissed Segerbäck in 1999. "He could not perform the work he was employed to do," according to an Ericsson spokesperson. Segerbäck challenged the dismissal in a Swedish labor court and lost. He admits that there is no way to prove what caused his condition. "It's hard to know what is causing what," he says. "No one can say what made us feel ill." And it is impossible for him to seek treatment in a medical facility. A trip to the hospital, with all its electronic equipment, would probably kill him, he says.

Ulrika Aberg, a Swedish physician specializing in EHS who treated Segerbäck in the early days of his condition, has worked with more than 800 hypersensitive patients. She says she's seen a sliding scale of symptoms, from sleep disturbance and dizziness on one end to the more severe effects experienced by Segerbäck on the other. "There is electrical activity going on in all cells all the time, so it's no wonder the whole body [of an EHS patient] is affected," she says.

For those reporting milder symptoms, Aberg suggests removing any wireless electronics from the home, including cell and cordless phones and wireless Internet connections. But that still leaves people exposed to the wireless devices of others. There are several hundred EHS "refugees" in Sweden, she says, people who have had to move, some more than once, to escape the effects of EMFs. She describes one hypersensitive couple that lives in a mobile home so they can quickly relocate if their symptoms worsen. "EHS is a controversial diagnosis, and many people don't know or care about it," Aberg says. "But many [EHS sufferers] can't feel safe where they live. We shouldn't produce more and more EMFs without taking account of how people react to them."

## **WHAT WE KNOW**

The main source of EMFs from cellphones is the antenna, located inside the handset. When sending signals and held against the side of the head, the phone produces radiation that can penetrate into the brain. The precise depth depends on the frequency of the EMFs; the higher the frequency, the lower the depth of penetration. Cellphones typically operate in a range of frequencies between 800 and 2,200 megahertz. Radios and TVs operate at slightly lower frequencies, and microwave ovens and radar operate at higher frequencies.

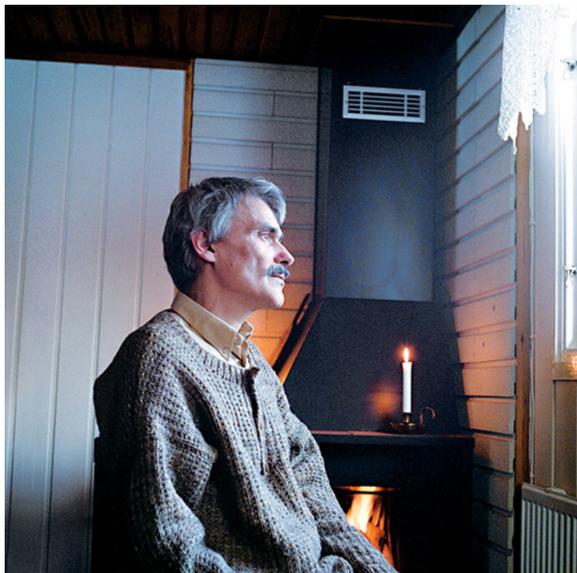
Research into the health effects of EMFs started in the 1950s, when scientists began studying medical applications and radar. As microwave ovens started appearing in kitchens in the 1960s, EMF research entered the mainstream, and with the proliferation of computer display terminals in the 1970s and cellphones in the 1980s, the research really took off. "With every new device, people worry," says Michael Repacholi, the former coordinator of the World Health Organization's Radiation and Environmental Health Unit and now a visiting professor at the University of Rome. Repacholi launched the WHO's International EMF Project in 1996 in response to growing public concern. That group's conclusion: There is no evidence to indicate any health effects from cellphone EMFs. There was a clutch of lawsuits in the mid-1990s alleging that cellphones had caused brain cancer in specific individuals; none succeeded.

The Interphone project, a collaboration among 13 countries that carried out studies between 2000 and 2005 coordinated by the WHO's International Agency for Research on Cancer, was set up to settle the matter of whether cellphones cause brain cancer. It, however, has been plagued by controversy over methodology, bias and contradictory results. Interphone spans a period during which cellphones and their use have changed greatly. Children were not included in the study, for instance, because cellphone use by kids was low when it began in 2000.

Bias is a concern for all studies of this type, says the head of the Interphone study, Elisabeth Cardis of the Centre for Research in Environmental Epidemiology in Barcelona, Spain. "We have from the beginning made efforts to minimize bias as much as possible, to identify and quantify any remaining bias, and to try and take it into account in the most scientific way," she says.

The results are inconclusive. A Danish Interphone study of 106 cases of acoustic neuroma, a kind of brain tumor, showed no elevated risk from long-term cellphone use, although only two cases were long-term users. A Swedish Interphone study of 148 cases found a slightly elevated risk.

When the Interphone results are finally released, after years of closed-door debate, they are not expected to settle anything. In the end, Cardis says, "further studies will be needed to confirm the Interphone results, particularly with regard to the use of phones by children."



Cause Vs. Promoter

Jonathan Worth

## **CAUSE VS. PROMOTER**

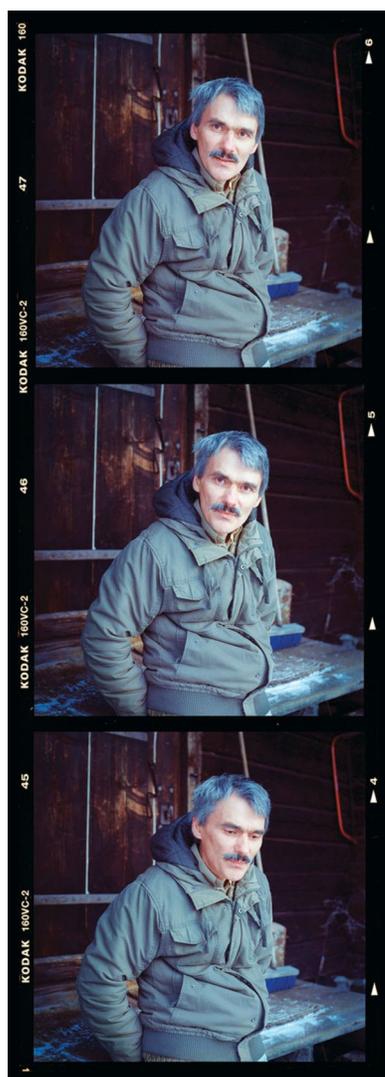
Let's be clear: Cellphones are not like cigarettes. There is a proven mechanism by which cigarettes cause cancer, even if you live an otherwise healthy life. There is as yet no proven mechanism by which cellphones do the same. Most experts say there is no such mechanism. "There is no dramatic evidence of a health effect," says Michael Kundi of the Institute of Environmental Health at the Medical University of Vienna. "Otherwise, we all would be terribly sick." But, he says, there is another crucial distinction to understand. Even though EMFs are in all likelihood not cancer initiators -- they don't cause cancer the way that tobacco does -- the radiation might well be a cancer promoter, allowing precancerous cells time to grow and metastasize, especially in concert with other factors.

While most of the rest of the scientific community argue that cellphones pose no health risks at all, Kundi and others suspect that radiation from prolonged cellphone use may indeed lead to an increased risk of brain cancer. As to electro-hypersensitivity, among the limited studies of EHS sufferers (who are reluctant to subject themselves to hours in an electronics-laden facility), some have shown that cellphone-frequency EMFs do produce physiological

effects in some people, both those who report EHS symptoms and those who do not (although the EHS patients performed no better than chance when asked whether they were being exposed).

A growing number of studies show that we may not understand the effects of EMFs at all, especially the ones that emanate from cellphones. We may have been asking the wrong question. Research is beginning to shift from asking, "Do cellphones cause cancer?" to asking, "What mechanism, if any, could cause an adverse health effect?"

In 2001, doctors diagnosed Catherine Woollams, a 22-year-old Briton, with a glioblastoma, a brain tumor of the type studied in connection with EMF radiation. Her father, Christopher, had studied biochemistry at Oxford, specializing in viruses and cancer, before going into advertising. In the early 1990s, he helped develop the launch campaign for Mercury One-2-One, one of the first digital cellphone services in Great Britain. After Catherine's diagnosis, he founded CANCERactive, a charity that provides information on cancer treatments. Catherine died in 2004.



Per Segerbäck

Jonathan Worth

Woollams has a surprisingly measured opinion of the cancer risk in cellphone use. He says his daughter smoked cigarettes, didn't eat well, and lived on her cellphone. Are cellphones responsible for her death? "I don't think it helped," he says, "but there is no single cure for or single cause of cancer."

He argues that research should not focus solely on brain cancer. "It is very, very hard to prove a direct link," he says. "The evidence is tenuous at best." Woollams believes researchers should also pursue the possible mechanisms by which EMFs might impair the body's overall defenses. He suggests that the daily sea of EMFs -- combined with other environmental factors, such as toxic chemicals and poor nutrition -- may have a collective influence on our health. "I am far, far more worried about how [cellphones] could lead to a diminution of the immune system," he says. "Mobile phones add to the problems that bring about brain tumors. Phones should carry a warning, the same as cigarettes."

Investigating the relation between cellphones and health risks remains terribly difficult and inconclusive. Brain-cancer studies are particularly hard to conduct -- the tumors are rare and can take decades to develop -- but they do exist. Most studies have addressed either malignant tumors such as glioma or benign tumors such as meningioma or acoustic neuroma. Some studies have also focused on salivary gland tumors. The majority have found no link between cellphones and these types of cancer. But a few have. Lennart Hardell of the department of oncology at University Hospital in Örebro, Sweden, found increased risk for glioma and acoustic neuroma after 10 or more years of regular cellphone use. He concluded that current radiation limits for cellphones are unsafe.

Other developments are also unsettling. According to a 2004 report from the U.K. Office of National Statistics, the rate of childhood brain and spinal-cord tumors in Britain rose from just under 20 per million in the early 1970s to just under 30 per million in the late 1990s. Citing concern over "continuing uncertainties about possible health risks" of EMFs, the European Parliament has suggested an awareness-raising campaign geared toward young people between the ages of 10 and 20; the French Ministry of Health, Youth and Sports has warned against "excessive" cellphone use among youngsters; and U.S. senator Arlen Specter of Pennsylvania, who survived a brain tumor, has held Senate hearings on the issue. State legislators in Maine are debating whether cellphones sold there should display warnings about brain cancer, and the municipal government in San Francisco is considering requiring information about radiation levels on cellphone packaging.

Study results are invariably criticized for methodological failings, such as insufficient sample size (many people need to be studied to get a meaningful result) or recall bias (people often incorrectly remember their past cellphone use). A recent review of 23 cellphone/cancer papers found that studies the authors rated as of the highest methodological quality (mostly by Hardell) reported an increased risk of tumors in long-term cellphone users, whereas in studies the authors rated as of lower methodological quality the results actually showed a decreased risk among cellphone users. Yet a different review singled out Hardell's results as most likely the result of poor methodology.

## **POSSIBLE THREATS**

What, then, should we study? Kundi points out that according to current research, cellphone radiation does have "non-thermal effects" -- biological effects beyond the mere heating of tissue -- that could influence human health. Identify the mechanisms behind these effects, he urges, and design phones that don't produce them. There are three main lines of investigation into non-thermal effects: the potential influence on melatonin production, gene expression and intracellular signaling.

### **Melatonin**

Melatonin is mostly known as an antidote to jet lag. Produced in the pineal gland of the brain, the hormone regulates much of our sleep-wake cycle. But it also has a crucial role as an antioxidant, protecting against the DNA

damage that can lead to cancer and the neurological damage that can lead to diseases like Alzheimer's. EMFs have been shown to suppress melatonin production in rats. If suppression also occurs in humans, one of the body's defenses would be weakened.

Epidemiological studies have found an increased risk of leukemia in people living near high-voltage power lines. The IARC now classifies extremely low-frequency EMFs (such as those from power lines) as a possible human carcinogen. Denis L. Henshaw, a physicist at the University of Bristol in England, cites evidence that power-line EMFs disrupt melatonin production, thereby impairing the immune system's ability to prevent and repair genetic damage.

Power lines operate at lower frequencies (around 50 hertz) than cellphones. But cellphones produce regular pulses that fall in the extremely low-frequency range of 1 to 300 hertz. It is therefore possible, according to Henshaw, Kundi and others, that cellphone EMFs could also have an effect on human cells and, potentially, on melatonin production.

While acknowledging that some researchers have found alterations in melatonin levels, former WHO coordinator Repacholi says, "It must be something else, because [power-line EMFs] hardly penetrate into the body. There is no mechanism by which the fields could cause melatonin change." Counters Henshaw, "There are thousands of papers documenting the effect of power-line EMFs. We don't know yet if this is true for cellphones, but for power-line EMFs there clearly are non-thermal effects."



### Electro-Magnetic Model

Electro-magnetic waves from the phone's antenna penetrate the brain several centimeters deep.

Paul Wootton

### Gene Expression

Research by Igor Belyaev, an associate professor in the Department of Genetics, Microbiology and Toxicology at Stockholm University, has shown that EMFs can affect gene expression -- the mechanism by which genes are activated and "speak out" -- in human and animal cells. Belyaev exposed human lymphocytes, a type of white blood

cell involved in the body's immune response, to EMFs at 915 megahertz, a common cellphone frequency. The samples were taken from healthy people and those reporting EHS symptoms. In cells from both types of subjects, Belyaev observed a stress response that altered gene expression. The stress response induced by EMFs at 915 megahertz disrupted the body's DNA-repair machinery, he concluded, thus making it harder to fix the kind of cellular damage that can lead to cancer. In other research, Belyaev has found that cellphone-frequency EMFs inhibit DNA repair in stem cells; DNA breaks in stem cells are critical to the onset of leukemia and some tumors, including gliomas.

Stress response does indeed cause changes in gene expression; however, says Repacholi, "lots of experiments can find effects, but that doesn't translate into the whole organism, because the whole organism compensates. The gap between a biological effect and an adverse health effect is a big one."

### **Intracellular Signaling**

Rony Seger of the Weizmann Institute of Science in Rehovot, Israel, has found that EMFs in the 900-megahertz range also influence intracellular signaling pathways -- how cells talk to each other. Working with rat cells, Seger and his colleagues found that cellphone radiation changes the activity of certain enzymes, prompting them to start producing free radicals. Free radicals are rogue atoms that can cause damage when they interact with DNA and other crucial cellular components.

Seger emphasizes that the effect "produces a small amount of free radicals, which in themselves are not harmful." But he also says that intracellular signaling could be part of a more general cancer-inducing mechanism that is not yet understood. "It is possible that this system could cause the activation of another system," he says, which could in turn create a cascade of intracellular events whose cumulative effect could be harmful. He cautions, though, "The amplification [of the free radicals] has to be much stronger in order to induce these adverse effects." Boice points out that free radicals are produced all the time as a by-product of our metabolism. "The body has processes that take care of them," he says. "You can't extrapolate from a petri dish to humans."

### **WHAT WE DON'T KNOW**

Henshaw, Belyaev and Seger do not argue that their work proves that EMFs either initiate or promote cancer. They do insist, however, that these non-thermal effects cannot be dismissed and that they merit further study. "We need to decide now if there is a risk," Kundi says. "If we know the mechanism, then we can design phones not related to increased risk."



## The Disconnected Life

Jonathan Worth

Boice believes there is a need for continued research into cellphones and EMFs. "We should never just assume, 'Oh, it's non-ionizing radiation, so there is no need for further research.' But," he adds, "we have conducted studies, and the studies show there is nothing going on."

Another study, the International Cohort Study of Mobile Phone Users (COSMOS), might help determine what, if any, future research is needed. COSMOS will be monitoring some 250,000 Europeans over the next 20 to 30 years, looking at potential links between cellphones and brain tumors as well as EHS-like symptoms such as headaches, sleep disorders, and neurological and cerebro-vascular diseases. But results are not due until 2029 at the earliest, and between now and then, the technology will change and proliferate in ways we cannot predict. A study under way at the IIT Research Institute in Chicago, examining the effects of EMF exposure on rats and mice over several generations, should also provide important evidence. A similar experiment, in which mice were exposed to cellphone EMFs 24/7 across four generations, found no harmful effects on the animals' fertility or development. "If [the IIT Research Institute in Chicago study] doesn't find an effect, then we're unlikely to find anything at all," Repacholi predicts.

In a recent report on EMFs and health effects, the ICNIRP concluded, "Whilst it is in principle impossible to disprove the possible existence of non-thermal interactions, the plausibility of the non-thermal mechanisms . . . is very low." Still, Seger says, "there are more and more indications that [non-thermal effects] must be real. What is the mechanism? No one knows. If there is an effect, the mechanism is absolutely new to science. We have to start thinking about it in a different way."

## THE DISCONNECTED LIFE

Segerbäck is convinced that cellphones are dangerous. "I'm an engineer, and even I don't know how to design a phone that doesn't affect health," he says. Radiation limits "are all based on thermal effects, and that's wrong." In the early stages of his condition, Segerbäck was still able to lead a fairly normal life. His daughter, Anna, was just a

child when he became ill. She used to run ahead of him at home switching off all the lights in every room before he entered. It is everyday family life that Segerbäck misses the most, something as simple as the chat and laughter on the morning drive to school.

Today he cooks all his meals on a wood-burning stove. The fireplace is his only source of heat. He has electric lights, a phone and a computer, but their power source -- a 12-volt battery -- is buried in an underground cellar about 30 yards from his house, far enough away that the EMFs can't reach him. His computer and his mouse are both surrounded by metal plates so no radiation escapes. His neighbors all know about his condition and (with occasional, painful exceptions) know not to carry cellphones near his house.

Segerbäck is surprisingly sanguine about his situation. "Of course it's a very sad thing that happened to me," he says, "but it can only be regarded as an accident. I am a positive person, from a line of very stubborn people able to survive under tough conditions." He is determined, in his affable, soft-spoken way, to gain greater recognition and greater credibility for EHS. Not by banning cellphones -- he's still too much a telecom engineer for that -- but by somehow making cellphones safer. In fact, he even takes some responsibility for being part of an industry that designed devices he now believes are hazardous to people's health. "Guys like me were so far ahead of society," he says. "We didn't know medicine. We didn't think what we were developing could harm anyone. It's hard to admit we've been wrong for so long."

**How about the researchers? Do the people who study cellphone radiation use their phones with caution? On the next page.**

## **Cellphone Habits of the Experts**

### **Rony Seger**

*Weizmann Institute of Science*

"I try not to exceed a half hour or an hour a day," Seger says of his cellphone use. "Everything is a matter of dosage." He suggests keeping cellphones at least 12 inches from the body and using the speakerphone.

### **Christopher Woollams**

*Founder and CEO of CANCERactive*

Woollams uses his cell sparingly and puts it on speakerphone. His older kids -- aged 14, 23 and 26 -- "are encouraged to only text at most. I don't want them to carry the phone on their bodies when they are on."

### **Michael Repacholi**

*Former coordinator of the WHO's Radiation and Environmental Health Unit*

Repacholi owns two cellphones and says he has no concerns about using them. For those who do, he recommends using a hands-free kit, which can reduce exposure levels by a factor of between 10 and 100.

### **John Boice**

*Vanderbilt University School of Medicine and the International Epidemiology Institute*

Boice makes approximately five cellphone calls a day. He uses a wired earpiece -- not for fear of EMFs but because "I'm getting older and don't hear so well anymore," he says.

## **Ulrika Aberg**

*Electro-hypersensitivity specialist*

Aberg removes her phone's battery when she visits patients. She advises against wireless phones and wireless computer connections at home because, she says, "you are exposed to EMFs all day and all night."

## **Elisabeth Cardis**

*Centre for Research in Environmental Epidemiology and head of Interphone*

Cardis is not a heavy talker ("I have little time!") but says, "If consumers are worried about a possible risk, the use of hands-free kits or earpieces is a very good way to reduce exposure."

## **Michael Kundi**

*Institute of Environmental Health, Medical University of Vienna*

Kundi dials on a landline whenever available and suggests not using cellphones where reception is weak, because they boost their signal to maintain connectivity, thus increasing EMF exposure.

## **Voices on the Line**

*Opinions from the researchers, interviewed by Christopher Ketcham*

"We really cannot say for certain what the adverse effects are in humans, but the indications are that **there may be—and I use the words 'may be'**—very serious effects ... The biggest concern about cellphones is the evidence coming out of studies in Northern Europe, where cellphones were invented and where they have been used for a longer period of time than in the U.S. These studies are pretty consistent in showing **an increased risk of brain cancer and tumors** of the auditory nerve in individuals who have used cellphones for more than 10 years, but **only on the side of the head where the cellphone is used**. Studies from Israel have also found tumors of the parotid gland, the salivary gland in the cheek, but again only on the side of the head where the cellphone is used."

—**David Carpenter** is director of the Institute for Health and the Environment and founding dean of the School of Public Health at the State University of New York at Albany. He co-edited the 2008 Bioinitiative Report on cellphone risks.

"The Interphone study was initiated by the WHO agency, the International Agency for Research on Cancer, to have 16 case-control studies conducted in 13 countries to determine whether use of mobile phones is associated with head or neck cancers. Until the Interphone study results are published, the best indicator of the likely result is shown in the combined British and Nordic country study, which has over 60 percent of all the cases and controls that the full Interphone study has. In this study, **they found little evidence of any head or neck cancers among people who have used their phones for less than 10 years** ... It is not possible to make any conclusions at present about the risks of mobile phones for more than 10 years."

—**Michael Repacholi** was coordinator for the Radiation and Environmental Health Unit at the World Health Organization from 1996 to 2006.

"When a nerve is stimulated—say, the optical nerve stimulated by light—all sorts of electrical activity goes on. **The nervous system uses electrical fields to function**. It would be expected that certain extraneous electromagnetic fields would affect the nervous system. **If you apply a correctly tuned EM field**, you're going to affect nervous-system function, which is going to affect all sorts of functions and behaviors. Some of my research in the 1970s

found that when you expose a frog's heart to EM frequencies that were modulated just so, **you can produce arrhythmias in those hearts and even stop the hearts.** I also showed that EM frequencies could open the blood-brain barrier. This means that substances in the blood can leak into the highly stabilized systems in the brain."

—**Allan Frey** is a neuroscientist formerly with the GE Advanced Electronics Center at Cornell University who conducted some of the first experiments showing the biological effects of radio-frequency radiation.

"In the 1940s, kids' shoe shops were equipped with shoe-fitting machines that used strong x-rays, and wristwatches in the 1950s glowed in the dark because they were coated with radioactive paint. At the same time, scientists and doctors started to realize that the warm and beautiful sunshine actually can harm our cells and their DNA, leading to the development of skin cancer ... **We don't know what will happen when, 24 hours around the clock, we allow ourselves and our children to be whole-body irradiated by new, man-made electromagnetic fields for the rest of our lives.** This question is more valid and important than ever, and it is up to our society, with its governments, parliaments and authorities, to answer it."

—**Olle Johansson** is an associate professor at the Karolinska Institute and the Royal Institute of Technology in Sweden and has been investigating the health effects of man-made electromagnetic fields since the 1980s.

# Barrie Trower – The Truth about 5G and Wi-Fi

## Part 1

Part 1 of the lecture '[The Truth about 5G and Wi-Fi](#)', held on February 3, 2020, by physicist Barrie Trower, in which he revealed his findings on 5G, ICNIRP, WHO, 5G-alike radiation experiments in Russia in 1977, top secrets, military, industry, governments, Wi-Fi, cell phones, children at risk, schools, trees, birds, bees, fishes, and... the abyss, if 5G will not be stopped.

Video: [Lecture](#). Transcript: Antoinette Janssen / Multerland blog

- *Lecture part 1 - 01:05 - 48:26*
- *Lecture part 2: 48:26 - 1:32:03*
- *Questions and Answers: 1:33.00 – 1:50:46*
- [Video](#)

01:05

Anything I say I have evidence documentary for, in total 1700 papers. I do not say a single word, unless I have documentary evidence.

Between 1949 and 1962 everything we needed to know about microwaves was known and published. By 1962 all of the dangers, all of the hazards, everything was known. When I say "all of them": between the super powers and us[Britain, Admin], the brain at that time had been studied for brainwaves and microwaves could be used to penetrate the brain and cause behavioural changes. By 1962, with the resonance frequencies of the organs, the brain, the cyclotron frequencies, the circadian frequencies, a statement was made in 1962 by the governments that all birth-defects, organs, whole organisms, all cells, brain-functions, all moods, could be altered, changed and destroyed. By 1962. Microwaves then, as now, were used as stealth weapons, before they became cellphones.

In 1965 cellphones were used by the military, I had them. By 1965 the prospects of cellphones and everything from cellphones was seen as a really, really lucrative market for the general public. And, knowing the dangers that cellphones could cause -the military are exempt[free from obligation, Admin]: you do not have, in the military, when you sign, any danger that comes your way for using whatever, you don't have any recourse for that. But the general populations do. The military, and the industry of several countries: the United States, Canada, us[Britain, Admin], some of the NATO countries, Australia and New Zealand, the people got together and they knew that cellphones and all the other gadgets you have today, they knew they would not be allowed under current safety limits. We needed a safety limit that could never be taken to court and never challenged if these things were to progress.

In 1965 they adopted an old 1953 thermal level by an engineer by the name of [Schwan](#) and in order to prevent to be taken to court the industries and the people who are making decisions they adopted the Schwan 1953 level which basically says: "If a certain weight of your tissue does not heat up by a certain temperature in 6 minutes then everything will be deemed for a lifetime exposure for adults, men, women, children,

pregnant women, everybody. The 6 minute level is the one that is still used today.

They totally ignored and put aside the electromagnetic vectors of the wave and the harm that the electromagnetic vectors can do. They interfere with the electrical conductivity of the cells, the electromagnetic conductivity of the neurons, the electromagnetic conductivity of the brain. They interfere with the resonant frequency of the circadian resonant cells the electronic ions, they interfere with everything.

All of these were brushed aside. We stuck with the 6 minutes thermal limit. Sometimes they extended to 30 minutes, but basically it is 6 minutes and that is what is enforced today in 42% of the planet, of what we are in that part today.

You have really no protection against the electromagnetic vectors. That is enforced today. That comes from the International Non Ionizing Radiation Protection[ICNIRP, Admin] who advise our, what was the government scientists, now [Public Health England](#), who advise governments, who advise councils, and it comes all the way down, and it is still in force today.

08:34

[Top-Secret Document 1 / Military, Admin] 5G is not new. 5G was causing a nuisance in 1972. The only thing new is its name, fifth generation. That's it. That is the only thing new. It is well documented, there are many research papers on it, and finally, in 1972, sorry, in 1971, cancer was proven to be caused by low-level microwave radiation and has been kept secret ever since along with all the other illnesses and diseases. In the early seventies this document was published, it was by the American military, it is top-secret, classified top-secret, and it lists 2000 research papers, 2000, and each of those took many many years to construct. Two thousand research papers—in that days the military did the research within the universities—and it covers all of the illnesses which you can expect to get and die from, from low-level radiation.

10:19

[Top-Secret Document 2 / World Health Organization, Admin] This is I think the *most shameful* document ever to be published. It is by the World Health Organization. We pay *them* to protect *us*. And we trust them to protect us. In 1973 the WHO had a conference in Warsaw: biological effects and health hazards of microwave radiation below thermal radiation, which you have in your cellphones. 350 pages documenting *harm* to the ordinary person. 107 different chapters. Chapter 40 deals with cancer, I think 28 reproductive forms, but instead of telling the world, I don't know who made them make the decision, instead of telling the world it was stamped "Top Secret", with a big red top secret stamp, and it still is, and it still will not be told about it, they will not admit to it, until today.

11:40

[Top-Secret Document 3 / US Defense Intelligence Agency, Admin] The second *most shameful* document is, I think is this one. this was published between 1972 and 1976, the final part was 1976, it is from the US Defense Intelligence Agency and the document says: "If the more advanced nations of the West are strict in the enforcement of exposure standards there could be unfavourable effects on industrial output— industrial output is profit—and military function."

In other words, what they wanted us to do was: "Set a level of radiation for the NATO

countries, set a level of radiation that would not be strict." Hence, we came in with the 6 minute thermal level that is still in place today and what councils are advised to adhere to.

13:01

[Top Secret Document 4 / World Health Organization, Admin] At that time the WHO again what they did not tell you, on their website, or what they had in these days, 80% of the published papers linked cancer to low level microwaves. And the others, you had neurological damage, birth defects.

There was no secret among the decision makers then.

13:41

And every so often, generally when a new "G" comes out, one of the new makes of the cellphone, the International commission for Non-Ionizing Radiation Protection put out an addendum to their original report, which clears the way for whatever generation is coming out. There's a new one coming out in a couple of days to clear the way for 5G[the lecture is from February 3, 2020, Admin].

This is the original[Barrie Trower shows document, Admin], or a copy of the original International Commission document, and it is of interest to decision makers, all decision makers, because I think I am not legally trained and I cannot understand people when they talk to me who are legally trained, but I will give you my interpretation of this, and this is for council decision makers and all other decision makers. they actually say in this that their recommendations are guidelines. They are not law. You do not have to adhere to them. They are guidelines. They say they only consider involving the heating of tissue. They go on to say for example: children, the elderly and some chronicle ill people, may have a lower tolerance for one or more forms of these microwaves than the rest of the population. They will be deemed sensitive. And then they say on page 574: "In practice the critical steps in applying these general procedures may differ across the spectrum. Several steps in these procedures require scientific judgements. For example: on reviewing the scientific literature and determining appropriate reduction factor." In other words in my simple brain: If you are told that something is dangerous, as a decision maker, you have the authority to say: "This says this level will cause this. I am instructed to reduce the levels to a point that is deemed safe."

You do not have somebody walk into your school or somewhere and say: "Sign here, these are radio waves, we've had radio for a hundred years, no problems, and then, zonk, a transmitter, and you come back a week later and like Lego some other people have gone dong dong dong dong and you've a mess of things that you don't understand and nobody will tell you what they are anyway.

17:31

I brought a couple of books along not because I get any money if they are sold or anything like that, but, along with the whistleblowers of which I am one, I have known for many many many many years a captain who is an electronics warfare specialist captain, he worked at the Canadian military government and CIA, and he published a book and in this book, and I can give you the title and he has updated it -[this is the original](#)- he has updated it for 5G - [Captain Jerry G. Flynn - [Hidden Dangers 5G: How governments, telecom and electric power utilities suppress the truth about the known hazards of electro-magnetic field \(EMF\) radiation](#), Admin] and in it, whereas Snowden,

the whistleblower of a few years ago, put everything on the internet, he has put all of the top-secret papers into a book, given the websites where you can download them if you are a decision maker and you want proof of something—he includes our government, the International Commission—and he has put them all in the book under different categories, everything to do with cellphones, Wi-Fi, 5G, government, and all that.

The reason I want to quote this one is because he has quoted that before this bubble bursts, with children and everybody running around with everything stuck to the side of their head:

19:16

"It is expected and anticipated, there will be two billion deaths."

Now, I questioned that in my own mind, and I thought: "That's a lot." And in my simple Janet and John brain I could not work out what two billion deaths actually means. But it is, if you imagine everybody who died in WWII, it is 28 times that number. And that is a lot. But when I started looking into this I thought, well, I remember when I was teaching and I remember the time in the early eighties, when I said to my science class: "We have just passed the one hundred thousand deaths a year rates in this country, for smoking related deaths. And then you start looking around the world for smoking. Smoking was linked to—they didn't know of the name then, but they knew you had left a lung congestion and died, with big black ugly bits—in 1870, smoking was linked to cancer and death. In 1939 all of the science was in place to have it stopped. The government scientists and industry scientists—who are often one and the same person—step in and they delay things for 50, 60 years which is what happened with smoking exactly, the same with led in petrol, and there are many other examples. So, when I looked at this and I thought, well, smoking is probably comparable to two billion by now, led in petrol certainly will be. I looked around a few figures, and a 10-year old international study around the world in various countries had many many thousands of miscarriages, suicides, deaths, around transmitters.

21:48

Lima, Peru, the country, is known as cancer city where it is unregulated—just two provinces in India, they have 50,000 brain tumours in children, and a +hundred-thousand in the provinces attributed to mobile phone masts and so it goes on.

When you start looking at examples like this in a paper I wrote—and anyone could come out to my house and read it and copy it—in a paper I wrote there was a survey done—I am trying to think, probably about 15 years ago—of some of the schools in France and Spain, and they found 200 schools with cancer clusters with eight or more different types of cancer, attributed to the transmitter in the playground.

I was involved in eleven children under 11 with leukaemia after a transmitter went up—they all died—it was taken to Parliament, the MP put forward a very very good case, it took 18 months to get to Parliament, and the MP Minister stood up and said: "We are in international guidelines." And sat down. And that was it.

In fact the minister lied: we are not within international guidelines.

There are, and I am not going to dwell on these, but just for the decision makers, I will just run through a couple of these....

23:51

There are already deaths from Wi-Fi in class from here to New Zealand. There are 136 studies of harm in schools, proper studies, from Wi-Fi and transmitters in schools. There are 48 studies on child suicide. It's going up around 4% every year. It is the pulses or modulations from the frequencies. Professor ..., of the [King Saud University](#), he has shown especially in a child's brain where the tissue is particularly soft. He has shown that the microwaves penetrate deep into all areas of a child's brain. and a scientist [cannot hear the exact words and name, Admin] in 97, he listed now a list of 1 to 600 pulse frequencies that could cause neurological and physiological damage in the body. In the paper I had there from the military they list all of the symptoms that you can be warned about if you are taken to court, and the last one is severe neurological damage, including death.

25:54

The five most common ESTs [probably an abbreviation of Electro Sensitive Types, but the web does not offer any matching research result, Admin] from microwaves going into the brain—and I am not a neurosurgeon, I just know from experience—the five most common ESTs are the same symptoms, the same symptoms that you would receive from morphine or marijuana: 1. hunger, excessive hunger 2. aggression 3. and if the pulse frequency is a certain frequency—which I won't say on camera—the aggression manifests itself as sexual aggression. So you can get aggressive from the microwaves and particular port frequency will manifest itself as sexual aggression, particularly from men. The last one, I am not a medical doctor, I describe it as the same symptoms as lead arsenide poisoning, where you just want to go to bed and die and if somebody would come in with a bag and said here's a million pound, and spend it, you wouldn't be bothered. These are the most common ESTs, symptoms that you get from microwaves in the brain at varying degrees, and any neurologist here can take a look in these papers if you wish.

27:50

Pregnant women are particularly vulnerable because the womb of course is mostly fluid and microwaves are attracting and stay in and rearrange the chemical structures of the fluid in many ways. there is a 20-fold higher concentration of damage within the womb. A paediatrician with a neurologist, a medical neurologist, went into a school—I don't know the size of the school—but he found 31 children with physical and neurological damage related to the transmitter. The WHO published a paper that showed that a level of microwave irradiation for a pregnant woman can reach 47,7% as a miscarriage, [stillbirth](#) or genetically damaged child rate. A paper, published a few years ago, by the [European Academy for Environmental Medicine](#), who are an incredibly talented bunch of doctors and clever people, they looked at their own research and came up with 48% for school children.

I have taught pregnant school children and I have worked with pregnant teachers. For school children you can add a risk factor of between 10 and 20% more—I don't know exactly, and I don't know anybody who does.

Due to the increased electrical conductivity in their bodies, the absence of a full working immune system—there isn't really up and running till they are 18 or so—the absence of the hardness of the bones and the easiness of the microwaves to penetrate the bones which are not really fully developed till they are around 27, the last being the [clavicle](#), and of course in the bones you have the bone marrow, which helps with the

immune system—so, children are particularly vulnerable between 40 and 60 percent.

30:46

When I am talking to governments, or royalty, or people like that abroad, the one question I say to them is: If you do nothing—and a lot of them are, this isn't all bad news, 58% of the world are doing a lot. We're not [Britain, Admin]. But 58% of the world are—and my aim is to get us [Britain, Admin] doing something—if we'll not say to them: if you do nothing, just look at the let's take an average of 50%.... the mathematics is relatively simple. It is like a [decay curve](#), a nuclear decay curve.

In one generation of exposed children, let's say 20 years, a half of your newborns are going to have some sort of defect—if they are alive. Another 20 years we are down to a quarter, another 20 years you are down to an eighth. So, in 60 years, I say to them—and this isn't MY work, this is the work of proper real professionals doing this job—in 60 years only 1 in 8 of your children can be born, or expected to be born, healthy.

How are you going to run your infrastructure, how are you going to run your health service, who's going to pay for it, where are the taxes coming from, who's going to man the factories, where are they coming from? The only answer to this is mass immigration. That is the only answer if you wish to survive as a country.

I will come to the trees and animals later but it is worth mentioning it here while I think about it. The scientists will know this, but we all have the same four chemical basis in our DNA. Any tree can read your DNA sequence. The [nucliotides](#) won't do it any good because it doesn't interest a tree because a tree doesn't do what we do, but any tree can read your DNA sequence. Anything that damages our DNA—and if there are any professionals here who would like to know the sequence through the cell or happily give it to—anything that will damage our DNA will damage all other living species' DNA, all of them. Plants, animals. The figures are showing this, and as far as I know there are only three living things on the planet that seem impervious to microwaves. [Later in the lecture Barrie Trower mentions bacteria, Admin]

33:59

There are 48 papers in childhood suicide which manifests itself quite a lot with cellphones. There are as many papers on breast cancer—and I can't go into the breast cancer now, it's a mammoth topic, but I can do questions—. I have a picture here—which I won't show but you are welcome to have a look if you wish—of a lady who tucked a cellphone into her bra. Breast cancer is phenomenally high rating among people who carry cellphones in their handbags or have the metal stains in the bra. And finally on this little section: a surgeon from Plymouth, a brain surgeon, questioned why the amount of brain tumours he was seeing did not match the amount he was doing, the operations he was carrying out. The brain surgeon challenged to these statistics and we looked into this—I had a letter from him and I wrote to him, and I sent him a copy of this and our statistical office, office of statistics or whatever it is, they take, or they did then and it's as far I know still going—they are taking 40.000 brain tumours off these statistics every single year. 40.000. It is justified. What they are saying is, aha, the endocrine glands in the brain are not actually grey or white matter, we associate the brain with grey and white matter. Therefore they're not really brain, therefore the tumours of the endocrine glands are not brain so we can take off the 40.000 endocrine cancers a year.

And this is how it goes on, and this is how you get your figures down. But I did say to the doctor: "Surgeon, you work for the [NHS](#), if you try and raise this, I have known to Health Authority—whatever the chief person is called, the chief of the Area Health Authority—I have known one be threatened that she would lose her job in one half of one day if she brought this to anybody's attention and the other one that the best thing he could do was to keep quiet and stick to other things.

37:39

We put Wi-Fi on schools, you can go virtually into any state primary school and they will have twenty Wi-Fi's in the class, plus the routers on the ceiling, plus a transmitter, and there will be probably iPads as well. And they are all microwaves. What you are NOT told—and if you are a school governor, or a decision maker—what you are not told: when you put these in front of our five-year olds, or even four-year olds these days, what you are not told is that the Wi-Fi in your classroom, or your children's or grandchildren's classroom or their bedroom: Wi-Fi is in the same category for danger according to the WHO International Research on Cancer: they are in the same category, exactly the same, as mercury, led, DDT, benzene, which is the smell from petrol you get, exhaust fumes from cars, HIV type 2, and chloroform. If I walked into anybody's school with any of those, and said: "Hey, you can play with this for a day!", I would be certified sectioned, and jailed. And yet, we've got children with this on their laps. I think somebody worked out for 13 hours for a school lifetime or something.

39:42

But: the good news. The International Commission for Non-Ionizing Radiation Protection[ICNIRP, Admin] they have a very very tightly guarded body [secretive](#):

- you can't join them
- you have to be invited to join them
- they don't answer to anybody
- they are not elected
- and they have a very very close community.

But. Just Saturday—they are based in Germany[see [article](#), Admin]—on Saturday we have a [defector](#), and with 5G coming he is not prepared to do what they are doing, or be a member of their gang any more.[Barrie Trower probably refers to a publication on January 27, 2020, by Dr. James Lin, see [article](#), Admin] This arrived from Germany on Saturday[February 1, 2020, Admin] for me and he has said and he has gone public: "There are now two large well executed and solid studies that point in the same direction: cancer from exposure from all of these technologies. The data in the large study which found clear correlation between exposure to mobile radiation and cancer rates shows even greater cancer risks than revealed in the first reports. Therefore WHO hazard class 1 instead of today's class 2. It is an air-tight argued conclusion, which supports an overwhelming amount of research. He is asking the world to upgrade the cancer certification from grade 2 -which is mercury and led and benzene - up to grade 1. He said, the research substantiates that.

42:50

I am not alone running around the world to do this. There are a lot of people doing lots of things. We have some good news here. The industry themselves in the year 2000 studied the top, 220 research articles, and said that what they are putting out actually

does cause cancer. The Council of Europe, 47 countries, 800 million people, suing simple statements: ban Wi-Fi in schools. Dr. Annie Sasko, 22 years WHO cancer department: mobiles, cellphones and Wi-Fi will cause cancer. Switzerland, France, Germany, Belgium, England—this is not the state of course—have started to remove Wi-Fi from schools. UNICEF, the big children's charity who care for children, decided to look into this and they did their own study, nobody interfered, and they came up with their own conclusion: they found there was an 85% risk of brain and heart damage.

In fact in Canada I think it is, in the schools they've had heart attacks from children from Wi-Fi and now the classrooms have defibrillators in.

- 85% brain and heart damage,
- 36% epilepsy,
- 11% neurological harm,
- 82% blood-, immune- and foetal damage.

Iceland, Cyprus, Italy, Canada, Russia, USA are either removing or starting to remove Wi-Fi from schools.

45:37

I think this lady, internationally she is renowned for being particularly clever and I would like to read what she wrote here, she is a paediatric neurologist: Dr. Maier Cline [?], and she has said:

"Pregnant women deserve to know that wireless radiation can have an impact on the developing brain. We're seeing alarming increases in the number of children diagnosed with neurological disorders over the past decade.

And finally here a very large article published in a science journal and because he was so worried and with no disrespect to some of the people here, and I know some of the people here, are recognized nationally and internationally for their knowledge. With no disrespect to the people here, professor Yuri Grigoriev—who is chair of the Russian Federation for nuclear and atomic sciences and probably the most knowledgeable person on the planet concerning microwaves and harm—he came over here for one specific purpose. He wanted this article published, which it was, and he gave a lecture and he wanted to warn our governments: "Do not put microwaves in schools. Do not put Wi-Fi in schools. Wi-Fi will have severe neurological damage and physical damage to our children."

He came all over here just to say that and to warn us. Anyone who wants to see the article you can come to my house and read it and photograph it.

End part 1.

## Part 2. Barrie Trower – Lecture: ‘The Truth about 5G and Wi-Fi’

Part 2 of the lecture ‘[The Truth about 5G and Wi-Fi](#)’, held on February 3, 2020, by physicist Barrie Trower, in which he revealed his findings on 5G, ICNIRP, WHO, 5G-alike radiation experiments in Russia in 1977, top secrets, military, industry, governments, Wi-Fi, cell phones, children at risk, schools, trees, birds, bees, fishes, and... the abyss, if 5G will not be stopped.

Video: [Lecture](#). Transcript: Antoinette Janssen / Multerland blog

- *Lecture part 1 - 01:05 - 48:26*
- *Lecture part 2: 48:26 - 1:32:03*
- *Questions and Answers: 1:33.00 – 1:50:46*
- [Video](#)

48:35

[Important note: From 48:35 to 48:58 Barrie Trower mentions two books written by Captain Jerry G. Flynn: [Hidden Dangers 5G](#), published November 13, 2019, and [Hidden Dangers](#), published September 25, 2018.

However, Barrie Trower mentions Amazon, where these books are available, but since Amazon is already orbiting 5G satellites into low orbit and is going to orbit thousands more, next to Elon Musk's Starlink 5G satellites, I have decided to leave this part away, and to ask you friendly to try to order the recommended books in an ordinary bookshop, as an honourable, conscious act to stop 5G. More about the emergency to stop orbiting 5G satellites: number 16 in the list of EMF links: [Satellites](#).Admin]

### Lecture, part 2

48:58

I bought [this book](#) specifically because there is a chapter here for decision-makers, counsellors decision-makers. I just want to read this bit here and everything in here you have the websites and everything you need to get it. This is for decision-makers from 2015 and it says:

"School districts boards, medical health officers, now know [Lloyds of London](#) will not provide liability coverage for injuries, directly or indirectly arising out of, resulting from, or contributed to, by electromagnetic fields, electromagnetic radiation, radio-waves, noise, this applies to Wi-Fi, and all wireless devices in schools."

50:01

And I believe, I don't know if I am correct, I believe Lloyds insure other insurance companies and if I were a decision-maker, one thing I would ask for in writing, because apart from the harm—which my brain can't even contemplate—apart from the harm: if you are taken to court over the death or injury of a child, and you have no insurance, no

insurance cover, and I have had parents and people come to me and say, what do I do about injury, and I say well, there will be insurance or there will not be insurance, it's depending on—ask your school people or your counsel, or whoever, for the specific sentence, in their policy, that says we will cover your child whatever from electromagnetic illness. There should be a specific sentence there that says. If there is not then I don't know the law, if as a decision maker you are taken to court .... I have spent a whole day in court being cross-examined by an incredibly ambitious tenacious [barrister](#), and I was defending a girl who did not want to have an unhealthy child and wanted Wi-Fi taken out of school. And I thought after that—Andrew Goldsworthy who works with [ES UK](#) as an advisor, he was the medical expert—and I thought: I am glad I was on my side because I can stand my ground, and I thought, if I were a decision-maker, against such a barrister, I would be taken to pieces with the information that is there. And I think it's something that decision-makers just need to bear in mind.

52:38

Trees. I'm quoting this from the magazine [ES UK](#), which I think - there are some copies over there—but it's quarterly or four times a year—and they do cover lots of legal aspects and they have their doctors, scientific advisors and it is well worth getting, and it is not expensive.

In [ES UK](#) there is an article here on trees, subjected to low-level microwave irradiation, 29 pages, the red oak, cherry, willow, black poplar, and all trees suffer the same. They all start losing their immune system once you bombard them with communications microwaves.

53:42

Trees are designed to pick up radiation, they are not designed to pick up microwaves, they do not like microwaves, even children in school do experiments with [watercress](#), near cellphones or microwaved water.

It is patently obvious that not any tree likes microwaves and the moment you start microwaving a tree two things happen.

First is: the tree starts to lose its immune system and secondly—there were three species on earth that I know of that are impervious to microwaves one of them is [bacterium](#), microorganisms, they seem to thrive under the energy from microwaves, I don't know why, it is explained to me by a professor but I couldn't understand what he was saying—but two things happen with trees: first the bacterium start to thrive and invade the tree and secondly the tree starts to lose its immune system and it is only a matter of time.

55:01

Where 5G is going up, all around the world where 5G is going up trees are coming down. The reason is: trees [inhibit](#) the progress of 5G. 5G is not a big around circular wave that you get from transmitters. 5G is a beam, a sort of a cross between the torch and a laser. It is a beam, and that beam has trouble going through a tree trunk or the density of leaves especially if they're wet. And especially along roads. I have had calls from all over the world saying: "Barrie, why are they cutting our trees down?" and I say: "Is 5G going up?" Yes, there is your answer.

In Malta, the lady that rang me, said: "They're cutting the trees down and the reason is that motorists can see better." In the USA they're not just giving an explanation, they're just cutting them down. Sydney is the only place I know, Sydney, Australia where they're telling the truth and the application into the government is the submission to the

government, 5G inquiry. Sacrificed trees for network performance and overwhelming numbers of small cells. In Australia they've just said: "If you want 5G we cut the trees down." Simple as that.

56:50

Here our local paper, or my local paper, [?.] Bovey Tracey, the advertiser here: "We are culling,"—now the reason given to us—"...we are culling in Tunbridge area[Note: it is very difficult for a not Brit like me, to analyse the sound of the name that is mentioned. I came finally to maybe Tunbridge (Wells) and when checking for it on the web, it seems to be a tree-rich area, and indeed 3G, 4G and even 5G are covered there, see website: [here](#), so I name this city in the following sentences as well, Admin] , I come under Tunbridge, 90.000 trees for, or to stop the prevention of dieback." I don't know what [dieback](#) is, I am not a tree expert, but we are cutting down 90.000 trees and we are also cutting down, it is 440.000 trees along the road, so that they don not pose a danger to motorists.

Now. I wrote a letter to the newspaper along with a lot of other people, and I've said: "Is it a coincidence that we have to cut down 440.000 trees suddenly posing a danger at the exact location that 5G needs to go up on the lamppost?" 5G has to go up every hundred, hundred and fifty meters.

56:18

Magazines—I am not the only one with research—there is an article here, that birds, bees, insects, trees, the migration of animals, colony collapse, a big study on aspen trees, there are twenty studies here, proper university studies on all of these, and it is the same thing really, all of those ... you suppress the immune system and for the animals, the navigating animals, the ones that use the sun or the earth's magnetic field, even the creepy crawlies that go along the ground, they use navigation from the earth and from the sun, but, for the scientists here: I'm talking about the [cryptochromes](#) pigments, double electron absorption system, that has been published in "[Nature](#)" for [robins](#)—we know the birds have it, the other animals have it—animals lose their immune system, all animals, and those that use the sun or the earth's magnetic field they become disoriented. Migrating birds get lost, butterflies get lost, and you have quite a lot of harm particularly on insects. They have a large surface area to body volume. Their surface area absorbs more radiation than the body can hold.

1:00.32

It's known that one of the 5G frequencies, when it was tested on a bee, just absolutely [saturated](#) the bee, the bee lost its immune system and the whole thing turned to [pus](#) inside.

1:00:50

I'm going to mention just a couple of studies here. Two studies costing 30 million euros over a good 10, 12 years, found an increased cancer tumour in animals exposed to phone mast radiation.

1:01:39

Animals, facing extinction, have been reported in India, Netherlands, Japan, up to 40% of hives lost, insects extinction, from, in Germany, from studies by entomologists, and so it goes on. Nobody is immune from this.

I have given two of the [Glastonbury Festival](#) environmental lectures—you're welcome to come around and get them if you wish—but one of them has over 8000 research articles on animals, and a 20-page laboratory study citing the suppression of the immune system from ordinary low level microwaves on cows, cats, dogs, hamsters, whales, birds, birds, bees, bats, butterflies. Over 8000 studies there.

The second one I gave—the first one was predominantly bees—the second one was animals from all species, I quoted 14 properly independently peer-reviewed university studies, saying the same, and this isn't a UK problem.

1:03:52

A lovely gentleman here sends me a picture of his hives every year, he is a priest, living up in the mountains, the Rockies in the [Colorado mountains](#), and he sends me a letter every January with all of his hives, and to show this is not just an English or UK problem, they are fighting a battle. The beekeepers are fighting a battle and every year he tells me what he is doing. They're putting special protecting coating on or doing this or doing that or moving them, but he sends me a note saying what he is doing to try to protect his bees along with all the other United States bee keepers.

1:04:39

Now I want to come finally on animals to a study here, this is probably the biggest and comprehensive and legal study, this is a 15-year study, hundreds of papers, [Mount Nardi](#) / [Mount Matheson](#) World Heritage Sites in Australia—the study was for, and it was a legal study—for the United Nations Educational Scientific and Cultural Organization, [UNESCO](#), the [International Union for the Conservation of Nature](#) and the conclusion over [Mount Nardi](#), [Mount Matheson](#)—they only had a hundred and five transmitters, which isn't that many over 15 years, and I have never seen anything described like this, before—they said: [[See the PDF](#), page 36/39, conclusion]

1:06:16

"Over the last 15 years this affects not only the top of the life chain species but they are devastating the fabric of the community of the world heritage causing genetic deterioration in an insidious massive and ever escalating scale. To truly understand what these studies reveal is to stare into the abyss."

I have never seen the word abyss in a scientific paper and I thought I'll just look it up in my Oxford Dictionary to get the proper meaning—because this is coming here, with our nature, this is coming here—and under my Oxford Dictionary under "abyss", it is: an abyss of despair, a catastrophe, primal chaos, hell, and a bottomless [chasm](#). Now, you can choose any of those, but it doesn't look good.

1:07:34

Now, I summarized the whole of the document, and I summarized the document down here but these are groups of species, these are not species. Some of these are 66 and 86 species. and when you run down this whole list of species the common words appear. They either migrate and won't come back, they exhibit unnatural behaviour, and you have gone, gone, gone, gone, retreated to another area, rarely heard, gone, gone, moved to the valleys, and we're going right down with birds, butterflies, wasps, ants, termites, bees, frogs, you name it, they're all there. Those that haven't gone is that the ants have become aggressive, but the moths, butterflies, ants, bees, flies, they are down 80% and some of the other creatures here, like the [grey thrush](#), they list as "rare", and there are

several "rare"s but the problem is not whether they're rare but whether you have enough species to regenerate and this is before the 5G satellites start coming overhead and beaming down on them.

1:09:24

All of what I'm doing now is 5G and I have an important quote here—because I think it can be useful—from [Bug Life](#) and I want to tie it in because there may be a solution to this. This is published in 2018. However the charity Bug Life warns that despite good evidence of the harms there was little research on going to assess the impact or apply pollution limits: that is not true, actually. I've quoted nearly 40,000 research papers. ES-UK magazine publishes animal studies every time it comes out. There is generally one a day. But I'm not criticizing Bug Life because I think one of the answers to this—and I thought about that, so, only yesterday I thought how can we sort of solve this here[UK, Admin]? I have no authority, and not status and whoever I try and reach will never reply to my letters and I can't get through to them, but charities like Bug Life and the charities that control birds and the charities that look after the woodlands, they have—I don't know what you call them but people who control, what's the word I'm looking for, they, who, the people, who, like Prince Harry and all those— [From the audience sounds: "Patrons!"] —patrons, that's the word, thank you, they have patrons, and if, and this will be going out, if the people who have animal charities and tree charities, if they go to their patron, and they can ask their patron for me to come to them—I don't care where I go, my own expense—if I can go to the patron just for an hour, the patron, although the patron may not be able to do anything, the patron may be able to meet somebody at a social event that I would never even be letting the gate to, but he would meet somebody at social events and say "Hey, we've got this [bloke](#) here and you really want to talk to him." And we may be able to get a decision made. That's the only way. We, I think we can actually get a handle on this because the industry is immensely powerful, they stand aside for nobody, they have the money, they have tens of trillions of dollars, they can buy anybody, they can buy the scientific results they want.

1:12:33

And finally the last thing on trees. I think it is immensely important because the moment this went up we started to lose our trees and I haven't seen the research but I bet if anybody starts looking you will see that tree diseases are slowly creeping up over the last 20, 25 years. They have to. But what people don't understand about trees.... and I'm going to put this very briefly:

1:13:16

70% of a fish is tree. The reason is: when the trees shed the leaves, all of the broken down goodness gets washed into the streams, the rivers, the sea. It is fed on by microorganisms, bacterium, and they get on by bigger things, the food chains, the food webs, and into the fish. And any fish, any 70% of a fish is generally tree, or the goodness from a tree. But, there is a very important fact here. Among this enormous chain of microorganisms you have tiny little microorganisms called [Coccolithophores](#), and they do their share of feeding, and they are fed on, but they produce one important molecule. Coccolithophores produce a molecule called [dimethyl sulfide](#). It is the only molecule known at this point in time, the only molecule known, because it drifts out of the water into the air and this is the only molecule known to take part, and that is necessary: in cloud formation.

Now, if you go and cut down all of the trees in—I think we're going to cut down 70 million or something. You cannot replace 70 million trees with 70 million [saplings](#). The

average age will be about 100 years and the saplings will not do the same job. They will not absorb the [carbon dioxide](#) from the [atmosphere](#) for a start.

If you cut down the trees you are cutting down the formation of clouds in the atmosphere, which means you will get [droughts](#). It is as simple as that. We cannot go around cutting down that many trees if it isn't necessary and the only way to have 5G is to cut down trees. So, there is a balance there and it needs to be known to somebody.

1:15:38

Now with 5G, I'll go to finish on 5G, when I spoke in [Totnes](#) not too long ago, just before Christmas[2019, Admin] somebody was disagreeing with me, saying, we don't have that, we don't have that, and no, we don't, but it doesn't say that we will not have it. There's a lot more to 5G than just putting up little boxes on lampposts.

5G is the new generation. It is not a wave, it is a beam. It is going to be used by around 53 organizations in this country[Britain, Admin], plus the secret services, plus the military, plus the American bases, and their frequencies. There are quite a lot of frequencies that people don't know about that are going up when you have 5G transmitters and most of them are secrets. In fact there are a lot.

And 5G is going to merge. When I look at the frequencies, the spectrum across the whole range, 5G is going to merge basically with [Wi-Fi 6](#), and they're already producing [6G](#). 5G and Wi-Fi 6 are getting very very close together. They are going to be used in [UNISON](#).

For decision makers: two of the world's leading professors, in this area, wrote a letter to all of the Nordic prime ministers. It is a brilliant letter. I wish I had the skill to write this letter. I certainly don't. It is a brilliant letter. But before the letter, I just want to read the legal opinion from an international attorney at law office regarding 5G. This is for decision makers, and it says— and you're welcome to pop up at my house and get all this stuff—it says:

1:18:45

[Lee, an International law firm](#), it is the conclusion of this legal opinion that establishing and activating a 5G network, as it is currently described, would be in contravention of the current human and environmental laws enshrined in the [European Convention of Human Rights](#), the [UN convention on the rights of the child](#), [EU regulations](#), and the [Bern and Bonn conventions](#).

Going through documents I have found, and these mean absolutely nothing to me: The [UN convention 1989](#), each state— and we[Britain, Admin] come under the United Nations—each state has a legal responsibility to protect children to ensure maximum developments. Articles 19 and 6. If you want to go to your [score on school](#), quote the law, the Children's Act 1989 part 3, section 17.

1:20:09

There's a legal obligation on local authorities to protect children against harm or the risk of. This stands apart as a likelihood or perceived risk is all that is necessary. It does not need proof. I believe, that this only applies, and I'm not sure to children who are in care, children who are fostered or adopted, but every school has one of those anyway, I would imagine. You have the [Nuremberg code UN 1950, article 7](#), prohibits any experiment without consents. 5G is an experiment. In fact all of them are experiments. [Tetra air wave](#) is an experiment, but under the Nuremberg code any experiments that affects you body or your health is illegal unless you give your consent. There is only one exception and I've only known it to be done once: any doctor can experiment on his or her self.

That is the only exception. That's part 5.

Under EU law a strategic environmental—now whether we are agree whilst we [Britain, Admin] were under EU law, I don't know—a strategic environmental assessment should be carried out before 5G, and if there is a problem, and it wasn't carried out, the polluter—in other words the decision-maker—pays the principle or the costs for the clean-up and that can be millions.

A legitimate government must preserve the right to life, liberty, health, of all of its citizens. That is the treaties of civil government. Second treaties chapter 2.

And finally the [health and safety acts 588 law](#) in this country [Britain, Admin], 1st of July, 2016: employers must protect those of higher susceptibility, monitor health for electromagnetic radiation both thermal and non-thermal, for example auditory sensory disturbance, change in brain function. That is the law.

1:23:00

The letter from the two professors to Nordic populations, that it is a mistake to assume that the populations are guinea pigs for the largest-ever biological experiment on humans. Such experiments are totally unlawful according to the Nuremberg code, the Declaration of Human Rights, the Declaration of Children's Rights. According to "the polluter pays the principle, has to pay for all harm they have caused to humans".

1:24:02

Now an experiment was carried out on 5G. An experiment was carried out in Russia. In 1977, I have the paper, an experiment was carried out on animals and humans using 5G [Barrie Trower explained earlier in this lecture that the there used radiation levels and frequencies used are similar with what we name now 5G, Admin]. I won't go into the units but the radiation level unions, the humans [volunteering humans, Admin] and the animals were subjected to was at a level of 62. They were subjected to a level of 62 for 15 minutes a day, for 60 days. In other words: 15 hours. That's it.

1:25:05

You can legally, under the International Commission [ICNIRP, Admin] and our government, under the thermal regulations, you, and all of the animals and all of the trees, if 62, and I am going to list the illnesses caused from a level of 62 you can legally be given for 24 hours a day, non-stop, for ever, a level of 140: more than twice.

1:25:31

The professors listed damage to the skin, liver, heart, brain, adrenal glands, blood, the foetus, children, stem cells, human sperm, honeybee. and that was just from one paper. There's the paper [Barrie Trower shows a paper, Admin], it's a top-secret paper from Russia that I had sent to me.

1:26:09

So, with 5G on as I hold it up to show you, on the right is a normal transmitter, and on the left you have the pulses of the 5G signal [Barrie Trower shows paper, Admin]. And you can, if you want, there is an excellent article on 5G, this is from ES-UK magazine which you can download from the internet, this is really good because it goes into the frequencies and everything, if you want it, it is the [ES-UK magazine, summer 2019, volume 17, number 2](#).

And if you can't remember that give me ring tomorrow and I'll have it by the phone and

I'll tell you.

1:27:27

And one last thing about 5G, and this isn't known by most people: two things. One is: there is a paper by the World Health Organization, that one of the 5G frequencies is known to cause eye-damage, and skin cancer. That is published. There is something which is being tried—I get lots from the universities, because, believe it or not, the university people developing this are more scared about what they are doing, whereas "I'm prepared to take the risk"—the mathematicians and physicists will know this: it is called the [Brillouin Precursor](#), it's what is being tried out.

It is a one-second pulse that will precede the laser beam, to say one-second pulse, that will precede the laser beam, up to 10 gigabyte in strength and you really, really don't want anything like that flushing across your eyes or your skin. Nothing does. That is being tried out through, as a burst of energy, so that you can download a whole movie or whatever[on your cellphone, Admin].

1:29:05

I am just to finish off. There it's not all gloom and doom. There's a very simple answer to this, all of this. There is a solution. All you have to do is: run cables[named ethernet cables, Admin].

Many countries don't have smart meters that use Wi-Fi. All of the smart meters run on cable. All of the cables into the schools, all of the Wi-Fi in schools that's not Wi-Fi, that's cable from source, there are no microwaves in the air.

If we took the trouble to run cables, just like telephone cables, everybody could have everything they wanted, even better, more secure and better and faster. But we[Britain, Admin] have 500 companies that are immensely powerful. They are pushing the Wi-Fi because they're getting as much money as they can and this is how they are progressing. But the easy answer is just to have cable. If we run a cable along a forest the trees are happy, the animals are happy, everybody is happy, you can have them in schools, and if we turn down all of the transmitters just turn them down so that only the emergency services need them if you're in a car and you break in the middle of [Dartmoor](#) you can ring. If we just had that system, which is what it was originally designed for, there would be no problem. But the problem is, and was unforeseen in the 70s, this system has been hijacked by children and addicts, and everybody else, and the use was not thought-up before they released this.

And they are chemically and physically addictive, and I have articles from [Scientific American "Mind"](#), that show that children will demonstrate severe aggression, where a child has threatened to murder her parents if they so much as touched her equipment and a child has punched the mother in the face for touching the equipment. We're getting to that stage.

But there is a solution. But the problem with the solution, and we go right back to the very first document: you will lose profits.

And this really all comes down to money.

End part 2.

## Part 3. Barrie Trower – Lecture / Questions and Answers

**Questions and Answers** - part 3 of the lecture '[The Truth about 5G and Wi-Fi](#)', held on February 3, 2020, physicist Barrie Trower revealed his findings on 5G, ICNIRP, WHO, top secrets, military, industry, governments, Wi-Fi, cell phones, children at risk, brain cancer, heart attacks, schools, trees, birds, bees, fishes, and... the abyss, if 5G will not be stopped.

Video: [Lecture](#). Transcript: Antoinette Janssen / Multerland blog

- [Lecture part 1: 01:05 – 48:26 – Transcript, PDF](#)
- [Lecture part 2: 48:26 – 1:32:03 – Transcript, PDF](#)
- [Lecture part 3: Questions and Answers: 1:32:44 – 1:50.46](#)

### Questions and Answers

1:32:44

#### Barrie Trower:

There is a gentleman who asked very very early, he gas a desperate question—Jonathan—to do with eyes.

#### Jonathan:

It's about the 5G infrastructure and part of that is going to be LED street lighting. There is in America a research and lighting design mathematician who says that LED in the form of new street lights and car headlights is going to cause irreparable damage to anyone's eyesight because LED light is rather like a laser light, generated from a flat projector and have a beam like capability. Could you talk about the health concerns in respect of LED light and how it might affect the optics?

#### Barrie Trower:

Well, I will go as far as I can. Yes, to eye damage, yes to skin-cancer. that's documented. Blue light: I'm assuming the blue light you're looking at is 450 to 500 [nanometres](#). There are radiation sensors, [ganglions](#), on the sides of the eyes. The full function isn't fully understood but it is known they pick up radiation and they send it back to the brain.

Blue light is also known to go to the [retina](#) at the back of the eye. It is known to go to the [hypothalamus](#). The hypothalamus has special [enzymes](#). The enzymes in the molecules or the cells in the hypothalamus in the brain—it is known that when, under normal conditions without blue lights, they travel to the outside of the molecule, or the outside of the cell, there's a chemical reaction, I don't know what it is, but then they come back. The complete cycle takes 24 hours.

Blue light is known to slow this down by up to 2 hours a day. The hypothalamus controls the internal [circadian resonant frequencies](#), our internal clocks. The hypothalamus is also connected to the [pituitary](#) which releases hormones and can be responsible for behaviour. That is as far my knowledge goes, but I'm just going to throw this out: are there any medical professionals here, I would like to know, if you slow down the hypothalamus for up to 2 hours a day and and it is continuous, is there any medical professional here that could enlighten me and everybody, on any [knock-on](#)

[effect](#) for organs or whatever it is I don't know about?

**Person 2:**

I am doing mental health studies in Malta and they did various studies and we had what we call blue rooms, mood rooms, which you were stating there with a [mitochondrial](#) and pituitary gland and around that area, and they found that there was mood suppressor and people got not depressed but you could stabilize the mood but it slowed also the functions of the mind.

**Barrie Trower:**

So what we're saying, because they couldn't hear us back, it will change moods and suppress processes in the mind.

**Person 2:**

Yes.

**Barrie Trower:**

Could ask something else sir, please, how—we're all adults and we have mechanisms—how could that affect sort of an ... I'm thinking of a teenager who is adolescence and probably is not in full control of her emotions or moods. Could you guess or give a professional opinion of how that would affect an adolescent?

**Person 2:**

I'm not quite on that level and I'm going back five years study.

**Barrie Trower:**

But it certainly would affect the stability of the mind anyway.

**Person 2:**

It does. My son is eight years old he next week [...] primary school. I have noticed mood change due to Wi-Fi activity there. [...]impossible to detect and analyse the words...]

**Barrie Trower:**

Can I just add one thing to that? I do know that in China they have opened up medical blocks now for this specific thing. For children and mood changes. And the professor has written a brilliant paper, I can't remember his name, and in the clinics right across China, the youngest child he is treating is two, for addiction and mood behaviour.

**Person 3:**

To the audience: put your hands up if you are now suffering from [tinnitus](#). Now, we weren't five years ago, but you're now suffering from tinnitus. Put your hands up. Right. Everyone can look around, how many people is that? That's 20%, 30% of the audience.

**Person 4:**

I have two questions. You said there were three organisms that were immune for electromagnetic radiation and you said one was bacteria, what were the other two?

**Barrie Trower:**

Ah! They're called [tardigrades](#). NASA has beamed them into space and brought them back and they've just come out of their little cocoon and thought, well, that was a nice rest. They seem [impervious](#) to everything and the other, bacterium thrive, and the other was scorpions.

**Person 4:**

The other thing was, the microwave technology, was it actually being [...] in the 50s and 60s, was it worked on by [ARPANET](#), US ARPA net, the defense, the defense people?

**Barrie Trower:**

I'm sorry I can't understand the question. In the 50s and 60s it was worked on by?

**Person 4:**

ARPANET.

**Barrie Trower:**

What! ARPANET?

**Person 4:**

ARPA, they were, did the defense....

**Barrie Trower:**

I don't know I am sorry.

**Person 4:**

You told you were working at the cold war microwave—

**Barrie Trower:**

By 1949 they knew the brain frequencies and they were changing behaviour, just by beaming microwaves into animals and human brains. The only organizations I know are the Soviets, the CIA, we[Britain, Admin] but I don't know that particular [acronym](#), sorry.

**Person 5:**

Thank you for the evening presentation. I just wonder, is there any truth in the idea that this is also not just about money but a weapon of war and an idea of depopulation, which is their intent?

**Barrie Trower:**

That is a particularly... is it a deliberate method of depopulation or a method of war. You've heard of [HAARP](#), in Alaska, that can be used, I'm not saying it is or has, it *can* be used, because the microwaves can be any frequency and they only need to turn it in, to tune it to a brain frequency and it can be bounced or reflected off of the [ionosphere](#)[part of the atmosphere where the tens of thousands of [5G satellites](#) are being orbited, Admin], which is [hydrogen](#) and [helium](#), down to any part of the planet. There isn't 1 HAARP, there are 16 around the planet. They can be used to change weather,

they can be used for bacterial warfare. I can't go into how and why now: they can be used to cause illness, but yes they have been used, the Soviet microwaves and the Americans, recently in one country: the [American Embassy was microwaved in Cuba](#). We [the British army, Barrie Trower is a former Royal Navy Microwave Weapons Expert and former cold-war captured spy debriefer for the UK Intelligence Services, Admin] have microwaved the Catholics in Northern Ireland [Statement by Barrie Trower, [video](#), Admin]. [The Americans microwaved the ladies at Greenham Common](#), to give them cancer, to make them sick.

But now, and I am not going to mention the country or the countries—why I like this: because I would like this to go out and I would like the people to take notice in these countries. I know one country from my travels where there is a very heavy, I think there are about two million, Muslim populations, the density of Muslims and the concentration of towers is within there. There are other areas of the planet where the extremely wealthy—and I'm not trying to start a civil war here—but they are [exempt](#) microwaves in their areas. There are areas of the planet where particular densities of poor—and I've been to them and I've fought a case for them and we won, and I have the King backing me—where the transmitters were always put in the poorest densest areas. So, you could argue that, but whether it is deliberate: I'm not in the mind of the decision-maker.

#### **Person 6:**

speaks to the audience: You know they're doing small cells, 5G small cells every hundred, every [...] and if you thought of it the other way, not the faster downloads speeds, so if you thought of it you had an AK-47 [known as a Kalashnikov, Admin] on every street corner, you might think again about 5G.

#### **Person 7:**

I was living in Bristol which is a 5G test city, and it gave me cancer on my skin and I nearly lost my vision. It made me extremely fatigued over and over in years and I tested the environment with a calibrated device and it's exposure levels are horrendous. So I left my whole life behind. My question to you would be: how do we protect ourselves from this stuff. I mean, I'm seeing a lot of products on the market like Blushield and stuff like that, but these things actually work, and first areas they're nothing to save from 5G, if we don't get it stopped.

#### **Barrie Trower:**

Protection. It can be very, very costly. As far as we know at the moment —and they all say—well that is a brilliant question, and I only had the information, some of the information, yesterday, from China. The new 5G, whether it is 5G or 6G, and I can't get my brain around why they're doing this at the moment, but a university has developed the 5G beam that will penetrate the metal casing on a cellphone. And my first thought was, well, if it can do that to the casing of a cell phone, what will it do to your eyes or your skin, and what is the purpose behind it.

But at the moment 5G: you won't pick up on any of your [Acoustimeters](#) anyway [Dr. Martin L. Pall explained in [this interview](#) that it is impossible to measure 5G radiation, because not any device to measure it exists, and if, once, it will be too expensive, Admin]. The mathematics for the beam is so complex that I don't know a mathematician in the world that can actually decipher what is actually inside the beam. There are many hundreds of frequencies being tested and tried. I don't know a single safe one. I can't

think of any form of screening that will stop 5G, unless.... Again, [ES-UK](#), they have a directory of I think 350 items, something like that, on their website that may stop different G's, I don't know. 5G will not penetrate far into the house. It can be stopped by walls unless they put a metal bid in, but 5G is having a carrier wave that will take it further. It's penetrative power is not strong when it comes to buildings and trees, but they are using carrier waves namely 3G or 4G, 700 megahertz, to bring it further into the house. But it is designed to marry up and work with smart meters, and the Wi-Fi, and everything else. So, at the moment, until 5G is established, we don't know how to block it. Because they haven't produced it. It's like saying: we want a bulletproof jacket but we haven't made the bullets. Until you've made the bullets, you won't know what works.

**Person 8:**

[It is impossible to detect and analyse the words, Admin].

**Barrie Trower:**

If I were a decision maker, a counsellor or school gov—I'm thinking of me—and somebody said: I want you to sign here. because this is coming on your land, your territorial property, I would say, very simply: "Give me the research paper. If I'm the signatory, I take responsibility and under this law it is the principle who pays the costs. If I'm signing for this, give me a research paper that says pregnant women, the animals, the trees, children, will be unharmed for the duration that they are in front of it. Give me one research paper. I will send it for independent peer-review to [Nature](#) publications or a top-rate journal and I will see what their reply is. And they will come back and say this: "There is no safe level for a child, ever." But I would safeguard myself, and I am not saying this as a threat, but I get a lot of counsellors and legal people coming to my house saying: "Can we take the council[could also be counsel, Admin] to court under civil law?" And I don't know, but the pot is boiling and if I were a decision maker I would want something cast iron[rock solid, Admin] to give this to me. I will make my own decision. I will not be bullied.

# Donald Trump victory used to hide holes in government's smart-meter roll-out

[Lucy Tobin](#) Tuesday 15 November 2016 11:28 GMT



Timing: New forecasts for the smart meter programme were published on the same day Donald Trump triumphed in the US election REUTERS

The Government has quietly chopped £500 million of forecast benefits off its flagship £11 billion [smart-meter](#) scheme — and the energy industry tried to bury the news in the aftermath of the [US election](#).

Ministers set out plans nearly a decade ago, when Gordon Brown was chancellor of the exchequer, to install smart meters in every UK home, claiming the roll-out would cost as little as £7 billion and save £11.8 billion, including £4 billion in cheaper bills for users.

However, a new, 12,000-word report from the Department for Business, Energy and Industrial Strategy — written in August yet published on the Government's website just hours after [Donald Trump](#) was declared president — dramatically reins in previous promises.

Total costs have shot up by £54 million since the previous forecast just two years ago, and benefits are now £415 million lower — just £11 per household in 2020, less than half the £26 estimated previously. BEIS could not be reached for comment.

The total value of rolling out smart meters across all UK homes and small and medium-sized business is now put at £5.75 billion — or £469 million less than earlier ministerial claims.



## **Li Ka-shing eyes £1bn deal for UK smart-meter firm Calvin Capital**

Big Six providers — which are being forced to pay for most of the roll-out, and are using the scheme as a way to try to boost their damaged reputations — have seemingly been trying to keep a lid on the diminished benefits.

One industry insider suggested to colleagues, in an email seen by the Standard, that the figures had been slipped out after the US election “in a very busy news week” to try to keep them under the radar.

The roll-out of smart meters — which work by recording gas and electricity consumption every 30 minutes and are supposed to encourage households to use less energy — has been the focus of a large publicity drive, with Sir Bob Geldof voicing ads of “out of control” cartoon characters Gaz and Leccy.

<http://thermoguy.com/category/smart-grid/>

## [Democratic Pennsylvania Attorney General Convicted On All Counts](#)

[September 10, 2016](#) [Cellular \(Phones\)](#), [Climate Change](#), [EMF](#), [GHG Emissions](#), [Global Warming](#), [News and Updates](#), [Pacemaker](#), [Radiation](#), [Safety Code 6](#), [Smart Grid](#), [smart meter fires](#), [Smart Meters](#), [WiFi](#), [WirelessThermoguy](#)

This is disgraceful to once again have political party interests take precedence over the people they were elected to represent. **This criminal was convicted, should be jailed without bail and sentenced longer for the abuse of power for what they did in that important office.** Then they should pay back **all** taxpayer dollars and all cost that were spent during their crimes. That includes the gas, oil and maintenance of every vehicle used, all man hours and literally every cent taxpayers spent. <http://www.nytimes.com/2016/08/16/us/trial-kathleen-kane-pennsylvania-attorney-general.html>

Is it true she was smiling leaving the courthouse? Why was this criminal allowed to resign?? The US Attorney General or Obama himself should have fired them and escorted them out of the building. If it were a Republican lawyer, would this Democrat President have allowed them to resign? Do you think Trump asks people who undermine his companies to resign? It doesn't reflect her undermining the office, government, people who elected them and their country.

What else did they get away with while undermining their office, state and country? Then I watch the commercials of the politicians slamming Trump and that he can't be trusted in office?? Do you think Donald allows people on his payroll of 1000s to perform like that? Do you think Warren Buffet, Bill Gates or any private company allows this? Would I hire a staff of political opposition to the direction of my company? The second I found out what they were I would fire them, kick their ass and then hold them liable to the full extent of the law.

CNN runs programs like "Why do they hate us"? How about when the people in power related to justice of the country are criminals. They didn't have leaders in industry globally come to them, it was a military directed by a political agenda. That isn't to blame the military, politics and special interest have no business directing policing or the military. Politicians and special interests should be lobbying behind the scenes on their dollars. I am a science professional specific to energy, engineering and a professor lecturing accredited medical education. I don't and can't trust any politicizing of electricity or any sciences or there would be liability.

I am one of the governments and industries science professional with no options but to perform to the highest standard or I am liable. I have had to carry errors and omission insurance for many millions of dollars per occurrence. That doesn't excuse me for criminal liability for being reckless or negligent. We are codes and standards where there are no politicians or opinion from them. This pisses me off because right now as this is going on, we are dealing with the reality Federal Governments(US Department of Energy) provided stimulus packages for the mass deployment of wireless smart meters that are supposed to save energy.

Not only are the meters not going to save 1 watt of energy, they have RF EMFs in them that are radiating populations, undermining economy, health, all industries, environment, climate change agenda of President Obama, National Security and all the United Nation's Members. The United Nation Climate Change Meeting in Paris came back with a global science consensus(not politics) that a 3.6 deg. F rise in atmospheric temperature would be globally catastrophic. That means man heating the atmosphere the whole world shares. The stimulus package for wireless smart meters and the required smart grid blanketing cities, states, provinces, countries will heat the atmosphere by themselves. When you blast high speed RF EMFs atmospherically, those high speed EMFs will oscillate billions of times per measurable second 24 hours a day. Exponent Inc's Electrical Engineer Yakov Shkolnikov admitted under direct cross examination in BC Government transcripts while under oath that the 900 MHz antenna in smart meters will oscillate 1.8 billion times PER second, the 2.45 GHz antenna for Wi-Fi 4.9 billions times PER second. That creates heat that can not be destroyed, it will mix globally. The stimulus packages of the U.S. and Canadian Government's provided money to states and provinces to mass install smart meters. Electricians can not mass install meters as meter bases can be decades old with very fragile electrical connections. Electrical connections are the weakest point in an electrical circuit and connections are usually maintained regularly.

Utilities in states and provinces used people not qualified to touch electrical as well as no legal authority to trespass to install meters. The utility has no authority or jurisdiction to work on a meter base, that is electrician's jurisdiction and the building owner's property. Now the utilities in states and provinces have created REAL fire issues as well as causing buildings to be non compliant with building codes.

This Attorney General did not protect the citizens of Pennsylvania against the assault with a deadly weapon created by Smart Meter RF EMFs or their properties that are no longer compliant with Building Codes. This Attorney General didn't represent to municipal governments and their critically important Building Inspection that the Specific Absorption Rate Test used to bypass Building Codes is a plastic body part with water in it. When buildings are not compliant with Building Codes, there is no mortgage, insurance, occupancy, no taxes for services and millions of buildings damaged. Pennsylvania and the federal government loses billions in taxes, no one is paying tax on an illegal building they can't live in or sell. The properties will revert back to the lender who will not be insurable.

Just as you see in this article by the NY Times, this Attorney General's actions show what happens when political interests weaken the professional gene pool. **If Obama and Hillary think Donald Trump is out of control, wait till they see what he does when he finds out they put meters on his own properties that will cause accelerated erosion and corrosion of his investments as well as adversely affect the health of his family and people within his investments. Trump will be liable and he will be passing on that liability. If Hillary or Obama think it isn't so, the federal government's lawyers will have to defend a plastic head as science when it should be an aquarium. Making it worse is the US Department of Energy literally blind to the energy they are trying to save and being reactive when they could create millions of taxpaying jobs immediately producing IMMEDIATE energy/emission reduction.**

While some reading this may think it is controversial, the Specific Absorption Rate Test the federal government, FCC, utilities are relying on for safety is a plastic head or body part with water in it. The following link is evidence of the British Columbia Government's BC Utilities Commission calling for the suspension of the smart meter programs. You can see the real energy losses and the U.S., Canada and beyond is wasting trillions of watts per hour reacting to the symptoms of solar EMFs interacting with building development. The UN Member's consensus was 3.6 deg. F rise in atmospheric temperature as globally catastrophic, look at page 18 and 19. It is an 85 deg. F day

and solar exposed building development is as hot as 197.7 deg. F. That means there is atmospheric warming 108 deg. F hotter than the 3.6 deg. F.

Brown outs, power demand wasting trillions of watts per hour and massive natural resource waste reacting to the symptoms of solar interaction making them non compliant with Building Codes. Look at page 19 and shade effect right after sunrise. [http://www.bcuc.com/Documents/Proceedings/2012/DOC\\_32604\\_C19-6\\_WKCC-Submission-RDCK-Nelson-Creston\\_Suspension.pdf](http://www.bcuc.com/Documents/Proceedings/2012/DOC_32604_C19-6_WKCC-Submission-RDCK-Nelson-Creston_Suspension.pdf)

Solar EMFs are interacting with absorbent exterior finishes and buildings are generating heat close to boiling temperature. Is that more than 3.6 deg. F? Any Nuclear Power Plants in Pennsylvania? These RF EMFs will cause accelerated erosion and corrosion of Nuclear Power Plants. Here is our unpopular submission to the Canadian Nuclear Safety Commission on the accelerated corrosion and the power plant NOT being compliant with Building Code. The first submission was politically and administratively rejected until the CNSC was informed of their liability. <http://thermoguy.com/submission-for-canadian-nuclear-safety-commission-on-rf-emfs-causing-accelerated-corrosion-making-the-power-plants-non-compliant-with-building-codes/>

Globally, what happens when there are nuclear failures within borders? This won't be popular but this is the real tradeoff. This former Attorney General better stop smiling, this is a very serious problem not being addressed.



# United States Department of the Interior

OFFICE OF THE SECRETARY  
WASHINGTON, D.C. 20240

**FEB - 7 2014**



In Reply Refer To: (ER 14/0001) (ER 14/0004).

Mr. Eli Veenendaal  
National Telecommunications and Information  
Administration  
U.S. Department of Commerce  
1401 Constitution Avenue, N.W.  
Washington, D.C. 20230

Dear Mr. Veenendaal:

The Department of the Interior (Department) has reviewed the above referenced proposal and submits the following comments and attachment for consideration. Because the First Responder Network Authority (FirstNet) is a newly created entity, we commend the U.S. Department of Commerce for its timely proposals for NEPA implementing procedures.

The Department believes that some of the proposed procedures are not consistent with Executive Order 13186 Responsibilities of Federal Agencies to Protect Migratory Birds, which specifically requires federal agencies to develop and use principles, standards, and practices that will lessen the amount of unintentional take reasonably attributed to agency actions. The Department, through the Fish and Wildlife Service (FWS), finds that the proposals lack provisions necessary to conserve migratory bird resources, including eagles. The proposals also do not reflect current information regarding the effects of communication towers to birds. Our comments are intended to further clarify specific issues and address provisions in the proposals.

The Department recommends revisions to the proposed procedures to better reflect the impacts to resources under our jurisdiction from communication towers. The placement and operation of communication towers, including un-guyed, unlit, monopole or lattice-designed structures, impact protected migratory birds in two significant ways. The first is by injury, crippling loss, and death from collisions with towers and their supporting guy-wire infrastructure, where present. The second significant issue associated with communication towers involves impacts from non-ionizing electromagnetic radiation emitted by them (See Attachment).

In addition to the 147 Birds of Conservation Concern (BCC) species, the FWS has listed an additional 92 species as endangered or threatened under the Endangered Species Act. Together with the bald and golden eagle, this represents 241 species of birds whose populations are in trouble or otherwise merit special protection, according to the varying criteria of these lists. The Department suggests that FirstNet consider preparing a programmatic environmental impact statement (see attachment) to determine and address cumulative impacts from authorizing FirstNet projects on those 241 species for which the incremental impact of tower mortality, when

added to other past, present, and reasonably foreseeable future actions, is most likely significant, given their overall imperiled status. Notwithstanding the proposed implementing procedures, a programmatic NEPA document might be the most effective and efficient method for establishing best management practices for individual projects, reducing the burden to individual applicants, and addressing cumulative impacts.

#### *Categorical Exclusions*

The Department has identified 13 of the proposed categorical exclusions (A-6, A-7, A-8, A-9, A-10, A-11, A-12, A-13, A-14 A-15, A-16, A-17, and A-19) as having the potential to significantly affect wildlife and the biological environment. Given this potential, we want to underscore the importance of our comments on FirstNet's procedural guidance under Environmental Review and Consultation Requirements for NEPA Reviews and its list of extraordinary circumstances in Appendix D.

#### *Environmental Review and Consultation Requirements for NEPA Reviews*

To ensure there are no potentially significant impacts on birds from projects that may otherwise be categorically excluded, the Department recommends including the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act to the list of requirements in this section.

#### *Extraordinary Circumstances*

To avoid potentially significant impacts on birds from projects that may otherwise be categorically excluded, the Department recommends including species covered under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act to the list of environmentally sensitive resources. Additionally, adding important resources to migratory birds such as sites in the Western Hemisphere Shorebird Reserve Network and Audubon Important Bird Areas to the paragraph on areas having special designation or recognition would help ensure their consideration when contemplating use of a categorical exclusion.

#### *Developing the Purpose and Need*

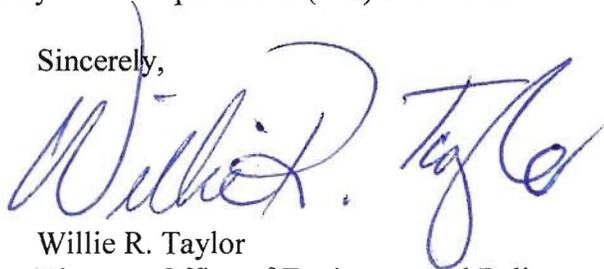
The Department recommends inclusion of language that would ensure consideration of all other authorities to which NEPA is supplemental as opposed to simply the FirstNet mission. As currently written, the procedures are limited to ensuring the purpose and need considers the FirstNet mission. If strictly applied, this approach would severely limit the range of reasonable alternatives, and likely preclude consideration of more environmentally benign locations or construction practices.

#### *Environmental Review Process, Apply NEPA Early in the Process, Where Action is by Non-Federal Entity*

The Department recommends that FirstNet be required to coordinate with federal agencies having jurisdiction by law or special expertise on construction and lighting of its network of towers.

Thank you for the opportunity to comment on the draft document. If you have any questions concerning the comments, please contact Diana Whittington, NEPA Migratory Bird lead, at (703) 358-2010. If you have any questions regarding Departmental NEPA procedures, contact Lisa Treichel, Office of Environmental Policy and Compliance at (202) 208-7116.

Sincerely,

A handwritten signature in blue ink, appearing to read "Willie R. Taylor". The signature is fluid and cursive, with the first name "Willie" being the most prominent part.

Willie R. Taylor  
Director, Office of Environmental Policy  
and Compliance

Enclosure

### **Literature Cited**

- Longcore, T., C. Rich, P. Mineau, B. MacDonald, D.G. Bert, L.M. Sullivan, E. Mutrie, S.A. Gauthreaux, Jr., M.L. Avery, R.C. Crawford, A.M. Manville, II, E.R. Travis, and D. Drake. 2013. Avian mortality at communication towers in the United States and Canada: which species, how many, and where? *Biological Conservation* 158: 410-419.
- U.S. Fish and Wildlife Service. 2008. Birds of Conservation Concern, 2008. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, VA. 85 pages. <http://www.fws.gov/migratorybirds>.

## Enclosure A

### Background

The placement and operation of communication towers, including un-guyed, unlit, monopole or lattice-designed structures, impact protected migratory birds in two significant ways.

The first is by injury, crippling loss, and death from collisions with towers and their supporting guy-wire infrastructure, where present. Mass mortality events tend to occur during periods of peak spring and fall songbird bird migration when inclement weather events coincide with migration, and frequently where lights (either on the towers and/or on adjacent outbuildings) are also present. This situation has been well documented in the U.S. since 1948 in the published literature (Aronoff 1949, see Manville 2007a for a critique). The tallest communication towers tend to be the most problematic (Gehring *et al.* 2011). However, mid-range (~400-ft) towers as proposed by the First Responder Network Authority (FirstNet, a newly created entity under the Department of Commerce) can also significantly impact protected migratory birds, as can un-guyed and unlit lattice and monopole towers (Gehring *et al.* 2009, Manville 2007a, 2009, 2013a). Mass mortalities (more than several hundred birds per night) at un-guyed, unlit monopole and lattice towers were documented in fall 2005 and 2011 in the Northeast and North Central U.S. (*e.g.*, Manville 2007a). It has been argued that communication towers including “short” towers do not impact migratory birds, including at the population level (*e.g.*, Arnold and Zink 2011), but recent findings have contradicted that assertion (Manville 2007a, 2013a, Longcore *et al.* 2012, 2013).

The second significant issue associated with communication towers involves impacts from non-ionizing electromagnetic radiation emitted by these structures. Radiation studies at cellular communication towers were begun circa 2000 in Europe and continue today on wild nesting birds. Study results have documented nest and site abandonment, plumage deterioration, locomotion problems, reduced survivorship, and death (*e.g.*, Balmori 2005, Balmori and Hallberg 2007, and Everaert and Bauwens 2007). Nesting migratory birds and their offspring have apparently been affected by the radiation from cellular phone towers in the 900 and 1800 MHz frequency ranges – 915 MHz is the standard cellular phone frequency used in the United States. However, the electromagnetic radiation standards used by the Federal Communications Commission (FCC) continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable today. This is primarily due to the lower levels of radiation output from microwave-powered communication devices such as cellular telephones and other sources of point-to-point communications; levels typically lower than from microwave ovens. The problem, however, appears to focus on very low levels of non-ionizing electromagnetic radiation. For example, in laboratory studies, T. Litovitz (personal communication) and DiCarlo *et al.* (2002) raised concerns about impacts of low-level, non-thermal electromagnetic radiation from the standard 915 MHz cell phone frequency on domestic chicken embryos – with some lethal results (Manville 2009, 2013a). Radiation at extremely low levels (0.0001 the level emitted by the average digital cellular telephone) caused heart attacks and the deaths of some chicken embryos subjected to hypoxic conditions in the laboratory while controls subjected to hypoxia were unaffected (DiCarlo *et al.* 2002). To date, no independent, third-party field studies have been conducted in North America on impacts of tower electromagnetic radiation on migratory birds. With the European field and U.S. laboratory evidence already available,

independent, third-party peer-reviewed studies need to be conducted in the U.S. to begin examining the effects from radiation on migratory birds and other trust species.

## **Discussion**

### ***Collision Deaths and Categorical Exclusions***

Attempts to estimate bird-collision mortality at communication towers in the U.S. resulted in figures of 4-5 million bird deaths per year (Manville 2005, 2009). A meta-review of the published literature now suggests, based on statistically determined parameters, that mortality may be 6.8 million birds per year in Canada and the U.S.; the vast majority in the United States (Longcore *et al.* 2012). Up to 350 species of birds have been killed at communication towers (Manville 2007a, 2009). The Service's Division of Migratory Bird Management has updated its voluntary, 2000 communication tower guidelines to reflect some of the more recent research findings (Manville 2013b). However, the level of estimated mortality alone suggests at a minimum that FirstNet prepare an environmental assessment to estimate and assess the cumulative effects of tower mortality to protected migratory birds.

A second meta-review of the published mortality data from scientific studies conducted in the U.S. and Canada (Longcore *et al.* 2013) strongly correlates population effects to at least 13 species of Birds of Conservation Concern (BCC, USFWS 2008). These are mortalities to BCC species based solely on documented collisions with communication towers in the U.S. and Canada, ranging from estimated annual levels of mortality of 1 to 9% of their estimated total population. Among these where mortality at communication towers was estimated at over 2% annually are the Yellow Rail, Swainson's Warbler, Pied-billed Grebe, Bay-breasted Warbler, Golden-winged Warbler, Prairie Warbler, and Ovenbird. Longcore *et al.* (2013) emphasized that avian mortality associated with anthropogenic sources is almost always reported in the aggregate, *i.e.*, "number of birds killed," which cannot detect species-level effects necessary to make effective and meaningful conservation assessments, including determining cumulative effects. These new findings strongly suggest the need for at least an environmental assessment by FirstNet, or more likely, an environmental impact statement.

### ***Radiation Impacts and Categorical Exclusions***

There is a growing level of anecdotal evidence linking effects of non-thermal, non-ionizing electromagnetic radiation from communication towers on nesting and roosting wild birds and other wildlife in the U.S. Independent, third-party studies have yet to be conducted in the U.S. or Canada, although a peer-reviewed research protocol developed for the U.S. Forest Service by the Service's Division of Migratory Bird Management is available to study both collision and radiation impacts (Manville 2002).

As previously mentioned, Balmori (2005) found strong negative correlations between levels of tower-emitted microwave radiation and bird breeding, nesting, and roosting in the vicinity of electromagnetic fields in Spain. He documented nest and site abandonment, plumage deterioration, locomotion problems, reduced survivorship, and death in House Sparrows, White Storks, Rock Doves, Magpies, Collared Doves, and other species. Though these species had historically been documented to roost and nest in these areas, Balmori (2005) did not observe these symptoms prior to construction and operation of the cellular phone towers. Balmori and Hallberg (2007) and Everaert and Bauwens (2007) found similar strong negative correlations

among male House Sparrows. Under laboratory conditions, DiCarlo *et al.* (2002) raised troubling concerns about impacts of low-level, non-thermal electromagnetic radiation from the standard 915 MHz cell phone frequency on domestic chicken embryos – with some lethal results (Manville 2009). Given the findings of the studies mentioned above, field studies should be conducted in North America to validate potential impacts of communication tower radiation – both direct and indirect – to migratory birds and other trust wildlife species.

### Literature Cited

- Arnold, T. W., and R.M. Zink. 2011. Collision mortality has no discernable effect on population trends of North American birds. *Plos ONE* 6:e24708.
- Aronoff, A. 1949. The September migration tragedy. *Linnaean News-Letter* 3(1):2.
- Balmori, A. 2005. Possible effects of electromagnetic fields from phone masts on a population of White Stork (*Ciconia ciconia*). *Electromagnetic Biology and Medicine* 24:109-119.
- Balmori, A., and O. Hallberg. 2007. The urban decline of the House Sparrow (*Passer domesticus*): a possible link with electromagnetic radiation. *Electromagnetic Biology and Medicine* 26:141-151.
- DiCarlo, A., N. White, F. Guo, P. Garrett, and T. Litovitz. 2002. Chronic electromagnetic field exposure decreases HSP70 levels and lowers cytoprotection. *Journal Cellular Biochemistry* 84: 447-454.
- Everaert, J., and D. Bauwens. 2007. A possible effect of electromagnetic radiation from mobile phone base stations on the number of breeding House Sparrows (*Passer domesticus*). *Electromagnetic Biology and Medicine* 26:63-72.
- Gehring, J., P. Kerlinger, and A.M. Manville, II. 2009. Communication towers, lights, and birds: successful methods of reducing the frequency of avian collisions. *Ecological Applications* 19:505-514.
- Gehring, J., P. Kerlinger, and A.M. Manville, II. 2011. The role of tower height and guy wires on avian collisions with communication towers. *Journal of Wildlife Management* 75: 848-855.
- Longcore, T., C. Rich, P. Mineau, B. MacDonald, D.G. Bert, L.M. Sullivan, E. Mutrie, S.A. Gauthreaux, Jr., M.L. Avery, R.C. Crawford, A.M. Manville, II, E.R. Travis, and D. Drake. 2012. An estimate of avian mortality at communication towers in the United States and Canada. *PLoS ONE* 7(4) 17 pp, Open Access.
- Longcore, T., C. Rich, P. Mineau, B. MacDonald, D.G. Bert, L.M. Sullivan, E. Mutrie, S.A. Gauthreaux, Jr., M.L. Avery, R.C. Crawford, A.M. Manville, II, E.R. Travis, and D. Drake. 2013. Avian mortality at communication towers in the United States and Canada: which species, how many, and where? *Biological Conservation* 158: 410-419.
- Manville, A.M., II. 2002. Protocol for monitoring the impacts of cellular telecommunication towers on migratory birds within the Coconino, Prescott, and Kaibab National Forests, Arizona. Peer-reviewed research monitoring protocol requested by and prepared for the U.S. Forest Service. Division of Migratory Bird Management, USFWS. 9 pp, March 2002.
- Manville, A.M., II. 2005. Bird strikes and electrocutions at power lines, communication towers, and wind turbines: state of the art and state of the science – next steps toward mitigation. Pages 1051-1064 *In* C.J. Ralph and T.D. Rich (eds), *Bird Conservation Implementation in the Americas: Proceedings 3<sup>rd</sup> International Partners in Flight Conference*, U.S.D.A. Forest Service Gen. Technical Report PSW-GTR-191, Albany, CA.
- Manville, A.M., II. 2007a. Comments of the U.S. Fish and Wildlife Service submitted electronically to the FCC on 47 CFR Parts 1 and 17, WT Docket No. 03-187, FCC 06-164, Notice of Proposed Rulemaking, “Effects of Communication Towers on Migratory Birds.” February 2, 2007. 32 pp.
- Manville, A.M., II. 2007b. U.S. Fish and Wildlife concerns over potential radiation impacts from cellular communication towers on migratory birds and other wildlife – research opportunities. Invited Presentation to “Congressional Staff Briefing on the Environmental and Human Health Effects of Radiofrequency (RF) Radiation,” House Capitol 5, Washington, DC. 16 page PowerPoint presentation. May 10, 2007.

- Manville, A.M. II. 2009. Towers, turbines, power lines and buildings – steps being taken by the U.S. Fish and Wildlife Service to avoid or minimize take of migratory birds at these structures. Pages 262-272 in T.D. Rich, C. Arizmendi, D.W. Demarest, and C. Thompson (eds.). *Tundra to Tropics: Connecting Birds, Habitats and People*. Proceedings 4<sup>th</sup> International Partners in Flight Conference, McAllen, Texas.
- Manville, A.M., II. 2011. Estimates of annual human-caused mortality to North American birds (with literature citations). Division of Migratory Bird Management, USFWS, for public distribution. 12 pages.
- Manville, A.M., II. 2013a. Anthropogenic-related bird mortality focusing on steps to address human-caused problems. A White Paper for the Anthropogenic Panel, 5<sup>th</sup> International Partners in Flight Conference, Snowbird, Utah. August 27, 2013. 16 page peer-reviewed White Paper.
- Manville, A.M., II. 2013b. U.S. Fish and Wildlife Service (USFWS) revised guidelines for communication tower design, siting, construction, operation, retrofitting, and decommissioning -- Suggestions based on previous USFWS recommendations to FCC regarding WT Docket No. 03-187, FCC 06-164, Notice of Proposed Rulemaking, "Effects of Communication Towers on Migratory Birds," Docket No. 08-61, FCC's Antenna Structure Registration Program, and Service 2012 Wind Energy Guidelines. Division of Migratory Bird Management, Arlington, VA. 5 pages.
- U.S. Fish and Wildlife Service. 2008. *Birds of Conservation Concern, 2008*. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, VA. 85 pages. <http://www.fws.gov/migratorybirds>.

# Verizon and rfXcel Partner to Protect Pharmaceutical Supply Chain

News Release

## Verizon Joins Forces with rfXcel to Protect Pharmaceutical Supply Chain

*Verizon Intelligent Track and Trace solution leverages the rfXcel Traceability System platform to provide product traceability and real-time monitoring*

**Basking Ridge, NJ and San Ramon, Calif. May 19, 2016** – Verizon and rfXcel have joined forces to deliver the newly available Verizon Intelligent Track and Trace solution, which helps monitor and trace pharmaceutical products in the supply chain and improve overall patient safety.

Leveraging Verizon's Internet of Things platform 'ThingSpace' and its world-class network, the rfXcel Traceability System platform enables pharmaceutical manufacturers to provide real-time monitoring of product temperatures, location and other key product attributes anywhere along the pharmaceutical supply chain. Verizon Intelligent Track and Trace can also create, manage, allocate and store large volumes of individual and hierarchical serial numbers to provide visibility and control and help detect counterfeit drugs more easily.

Verizon's Intelligent Track and Trace solution will help address some of the pharmaceutical industry's biggest issues, such as theft, channel diversion, counterfeiting and safe handling. The World Health Organization estimates 10 to 15 percent of the world's drug supply is counterfeit, with counterfeit drugs in the US approximately 1 percent and in some countries, the estimate is as high as 50 percent. According to American Health & Drug Benefits, the value of the counterfeit drug market is \$75 billion annually, leading to more than 100,000 patient deaths.

The solution delivers a host of benefits to pharmaceutical and healthcare clients, including:

- **Supply chain management:** This IoT technology gives users the ability to monitor, trace and serialize product hierarchies, by pallet, case or individual unit.
- **Improve patient safety:** Attributes such as temperature, light, location, shock and other key attributes can be monitored in real-time and provide valuable alerts if any attribute changes through the course of the supply chain.
- **Facilitate compliance with government regulations:** Verizon Intelligent Track and Trace will provide information that when managed by customer's compliance organization will relate to compliance with government regulations such as the US Drug Supply Chain Security Act (DSCSA).

The Verizon Intelligent Track and Trace cloud-based system is now commercially available and already includes some of the top global pharmaceutical manufacturers as pilot customers.

“The partnership between Verizon and rfXcel delivers tight integration between our products and leverages the vast Verizon network to provide unique benefits and real-time monitoring of product to secure the pharmaceutical supply chain,” said Glenn Abood, Chairman and CEO of rfXcel. “We’re both committed to making the drug supply chain safer and more secure for patients.”

“Our Intelligent Track and Trace solution is yet another example of IoT technology at work to solve real-world issues in a simplified way for customers,” added Tom Villa, Director of Product Development at Verizon. “The rfXcel platform seamlessly addresses the current and impending needs of pharmaceutical industry.”

Beyond healthcare, Intelligent Track and Trace technology can be applied to the serialization of virtually any asset, allowing any business with an asset to track to benefit.

### **About rfXcel**

rfXcel Corporation, headquartered in San Ramon, CA, is a pioneer in creating Product Serialization, Traceability and Compliance private cloud solutions for the Life Sciences industry. Leading manufacturers, distributors, packagers, dispensers and retailers leverage rfXcel solutions to meet global government regulations, track and trace product throughout supply chains, and enhance patient safety.

For more information, please visit [www.rfxcel.com](http://www.rfxcel.com).

### **About Verizon**

Verizon Communications Inc. (NYSE, Nasdaq: VZ), headquartered in New York City, generated nearly \$132 billion in 2015 revenues. Verizon operates America’s most reliable wireless network, with 112.6 million retail connections nationwide. The company also provides communications and entertainment services over America’s most advanced fiber-optic network, and delivers integrated business solutions to customers worldwide.

Verizon Enterprise Solutions helps clients improve customer experience, drive growth and business performance and manage risk. With industry-specific solutions provided over the company’s secure mobility, cloud, strategic networking, Internet of Things and advanced communications platforms, Verizon Enterprise Solutions helps open new opportunities around the world for innovation, investment and business transformation. Visit [www.verizonenterprise.com](http://www.verizonenterprise.com) to learn more.

For more information, please visit [www.verizonenterprise.com](http://www.verizonenterprise.com).

### **Media Contacts:**

For rfXcel:  
Jim Smiley  
925-395-6867  
[jsmiley@rfxcel.com](mailto:jsmiley@rfxcel.com)

For Verizon:  
Adria Tomaszewski

908 809 2382

Adria.tomaszewski@verizonwireless.com

Twitter: @ adriatomasz

# What's Not Being Said About Pfizer Coronavirus Vaccine

13.11.2020 Author: [F. William Engdahl](#)

Column: [Society](#)

Region: [USA in the World](#)



**Bill Gates is actively financing and promoting new untested vaccines supposed to keep us at least somewhat safe from a ghastly death from the novel coronavirus and supposedly allow us to resume somewhat “normal” lives. The Pharma giant Pfizer has now announced what they claim were spectacular results in initial human tests. They use an experimental technology known as gene editing, specifically mRNA gene-editing, something never before used in vaccines. Before we rush to get jabbed in hopes of some immunity, we should know more about the radical experimental technology and its lack of precision.**

The financial world went ballistic on November 9 when the pharma giant Pfizer and its German partner, BioNTech, announced in a company press release that it had developed a vaccine for Covid19 that was “90%” effective. The controversial US head of NIAID, Tony Fauci, rushed to greet the news and the EU announced it had purchased 300 million doses of the costly new vaccine. If you believe financial markets, the pandemic is all but past history.

## Suspicious events

However it seems Albert Bourla, the CEO of Pfizer, doesn't share the confidence of his own claims. On the day his company issued its press release on the proposed vaccine trials, he sold 62% of his stock in Pfizer, making millions profit in the deal. He made the sell order in a special option in August so it would not appear as “insider selling”, however he also timed it just after the US elections and the mainstream media illegitimately declared Joe Biden President-elect. It seems from appearances that Bourla had a pretty clear conflict of interest in the timing of his press release on the [same day](#).

Bourla lied and denied to press that his company had received any funds from the Trump Administration to develop the vaccine when it came out they contracted in summer to deliver 100 million doses to the US Government. Further adding to the suspect actions of Pfizer was the fact the company first informed the team of Joe Biden rather than the relevant US government agencies.

But this is far from the only thing alarming about the much-hyped Pfizer announcement.

## The German Partner

Pfizer, famous for its Viagra and other drugs, has partnered with a small Mainz, Germany company, BioNTech, which has developed the radical mRNA technique used to produce the new corona vaccine. BioNTech was only founded in 2008. BioNTech signed an agreement with the Bill & Melinda Gates Foundation in September, 2019, just before announcement in Wuhan China of the Novel Coronavirus and just before BioNTech made its stock market debut. The agreement involved cooperation on developing new mRNA techniques to treat cancer and HIV. Curiously that press release, “The Gates Foundation sees BioNTech potential to ‘dramatically reduce global HIV and tuberculosis’” 05. September 2019, has now been deleted.

BioNTech also has an agreement with one of the largest drug producers in China, Shanghai Fosun Pharmaceutical Co., Ltd (“Fosun Pharma”) to develop a version of its mRNA vaccine for novel coronavirus for the Chinese market. Ai-Min Hui, President of Global R&D of Fosun Pharma said in an August statement, “Dosing the first Chinese subject with BNT162b1 marks a milestone of the global co-development program in China. We are closely working with BioNTech and regulatory authorities to evaluate the safety and efficacy of BNT162b1 and other mRNA [vaccine candidates](#)...”

This means that the same German biotech company is behind the covid vaccines being rushed out in China as well as the USA and EU. The vaccine is being rushed through to eventual approval in an alarmingly short time.

Both US and EU authorities and presumably also Chinese, waived the standard animal tests using ferrets or mice and have gone straight to human “guinea pigs.” Human tests began in late July and early August. Three months is unheard of for testing a new vaccine. Several years is the norm. Because of the degree of global panic engendered by WHO over the coronavirus, caution is thrown to the wind. Vaccine makers all have legal indemnity, meaning they can’t be sued if people die or are maimed from the new vaccine. But the most alarming fact about the new Pfizer-BioNTech gene edited vaccine is that the gene edited mRNA for human vaccine application has never before been approved. Notably, two year peer reviewed tests with mice fed genetically modified corn sprayed with Monsanto glyphosate-rich Roundup first showed cancer tumors after nine months as well as liver and other organ damage. Earlier Monsanto company tests ended at three months and [claimed no harm](#). A similar situation exists with the gene edited mRNA vaccines that are being rushed out after less than 90 days human tests.

### “Explicitly experimental”

Dr. Michael Yeadon replied in a recent public social media comment to a colleague in the UK, “All vaccines against the SARS-COV-2 virus are by definition novel. No candidate vaccine has been... in development for more than a few months.” Yeadon then went on to declare, “If any such vaccine is approved for use under any circumstances that are not EXPLICITLY experimental, I believe that recipients are being misled to a criminal extent. This is because there are precisely zero human volunteers for...whom there could possibly be more than a few months past-dose safety [information](#).”

Yeadon is well qualified to make the critique. As he notes in the comment, “I have a degree in Biochemistry & Toxicology & a research based PhD in pharmacology. I have spent 32 years working in pharmaceutical R&D, mostly in new medicines for disorders of lung & skin. I was a VP at Pfizer & CEO.... of a biotech I founded (Ziarco – acquired by Novartis). I’m [knowledgeable](#) about new medicine R&D.” He was formerly with Pfizer at a very senior level.

## Human guinea pigs?

The Pfizer-BioNTech vaccine is experimental and far from guaranteed safe, despite the fact that Pfizer, the EU and the notorious Dr Tony Fauci seem ready to roll it out even before year end to hundreds of millions of humans. The experimental technology is based on a rather new gene manipulation known as gene editing.

In a major article in the 2018 New York Council on Foreign Relations magazine, Foreign Affairs, Bill Gates effusively promoted the novel gene editing CRISPR technology as being able to “transform global development.” He noted that his Gates Foundation had been financing gene editing developments for vaccines and other [applications for a decade](#).

But is the technology for breaking and splicing of human genes so absolutely safe that it is worth risking on a novel experimental vaccine never before used on humans? Contrary to what Bill Gates claims, the scientific answer is no, it is not proven so safe.

In a peer reviewed article in the October, 2020 journal Trends in Genetics, the authors conclude that “the range of possible molecular events resulting from genome editing has been underestimated and the technology remains unpredictable on, and away from, the [target locus](#).”

Dr. Romeo Quijano, retired professor of Pharmacology and Toxicology at the College of Medicine, University of the Philippines Manila, noted some of the dangers of the experimental gene editing when applied to human vaccines. Quijano warns of, “the danger that the vaccine might actually “enhance” the pathogenicity of the virus, or make it more aggressive possibly due to antibody-dependent enhancement (ADE), as what happened with previous studies on test vaccines in animals. If that should happen in a major human trial the outcome could be disastrous. This serious adverse effect may not even be detected by a clinical trial especially in highly biased clinical trials laden with conflicts of interest involving vaccine companies. Even when a serious adverse event is detected, this is usually swept under the rug.” He cites the case of another Gates mRNA vaccine candidate, Moderna, where “three of the 15 human experimental subjects in the high dose group suffered serious and medically significant symptoms. Moderna, however, concluded that the vaccine was “generally safe and well tolerated,” which the corporate-dominated media dutifully reported, covering-up the [real danger](#)...”

He notes, “Exogenous mRNA is inherently immune-stimulatory, and this feature of mRNA could be beneficial or detrimental. It may provide adjuvant activity and it may inhibit antigen expression and negatively affect the immune response. The paradoxical effects of innate immune sensing on different formats of mRNA vaccines are incompletely understood.” Quijano adds, “A mRNA-based vaccine could also induce potent type I interferon responses, which have been associated not only with inflammation but also potentially with autoimmunity... and may promote blood coagulation and pathological [thrombus formation](#).”

Quijano writes in the extensively documented article, “among other dangers, the virus-vectored vaccines could undergo recombination with naturally occurring viruses and produce hybrid viruses that could have undesirable properties affecting transmission or virulence. The...possible outcomes of recombination are practically impossible to quantify accurately given existing tools and knowledge. The risks, however, are real, as exemplified by the emergence of mutant types of viruses, enhanced pathogenicity and unexpected serious adverse events (including death) following haphazard mass vaccination campaigns and previous failed attempts to develop chimeric vaccines using [genetic engineering technology](#).”

Bill Gates, the mRNA vaccine makers including Pfizer/BioNTech and Moderna, and their close allies such as Dr. Tony Fauci of the NIAID are clearly playing fast and loose with human lives in their rush to get these experimental vaccines into our bodies. Notably, the same Dr. Fauci and his NIAID owns the patent on a vaccine for dengue fever known as Dengvaxia, marketed by Sanofi-Pasteur and promoted as an “essential” vaccine by Tedros’ WHO since 2016. Robert F. Kennedy jr. noted that Fauci and NIAID “knew from the clinical trials that there was a problem with paradoxical immune response,” but they gave it to several hundred thousand Filipino kids anyway.

**It was estimated that as many as 600 vaccinated children died before the government stopped the vaccinations.**

Clearly the well-established Precautionary Principle—if in serious doubt, don't— is being ignored by Fauci, Pfizer/BioNTech and others in rushing to approve the new mRNA vaccine for coronavirus. Messenger RNA technology has yet to produce an approved medicine, let alone a vaccine.

*F. William Engdahl is strategic risk consultant and lecturer, he holds a degree in politics from Princeton University and is a best-selling author on oil and geopolitics, exclusively for the online magazine "New Eastern Outlook".*

# Meters that Endanger: Shocking Details from a Whistleblower

Posted on [January 20, 2012](#) by [Josh Hart](#)



**Are smart meters just too complex?** Are they veritable blackboxes (well, beige) of assorted electronic components, jury-rigged and thrown together in an off-shore factory, and then slapped onto houses without proper safety testing? Sure, we all have electronic devices in the home, **but through this particular device passes all the electrical current for the house.** That's a set-up asking for trouble.

**From the beginning, smart meters have had problems leading to [fires](#) and other [electrical dangers](#).** News stories have run all over the U.S. and around the world about installations leading to devastating damage. ([Here's a local SF Bay Area fire](#) we'd like to see more fully investigated.)

**A lawsuit made available to us recently detailed just how such faulty equipment could end up attached to the electrical wiring on millions of homes.** In Alabama in 2009, a [Sensus](#) engineering employee named Don Baker was fired for repeatedly alerting his management to the presence of a multitude of dangerous defects in the smart meter they were manufacturing (model [iConA](#)). As he states in the complaint he filed, **this whistleblower reported serious flaws in design and functioning that could lead to electrical danger, overheating, and/or fire.** In fact, the failure rate of the meters was twenty times higher than it was supposed to be, and the engineer contends that at least [two house fires](#) were the result. Sensus meters are used by utilities across the U.S. and in Canada, such as [PECO](#), [Alliant Energy](#), [Alabama Power](#), and [NVE](#).



**In May 2010, Mr. Baker filed [a complaint \[PDF\]](#).** The type of suit is called "[qui tam](#)", where an individual alleges harm to his government. This complaint alleges that the manufacturer and the utility companies received federal monies but provided a defective product. The U.S. Attorney's office in

Alabama declined to pursue the case, because the utility said they had not received federal money for the metering project; **but the allegations about the dangerous defects in the smart meters made in the complaint have not been refuted or even addressed.**

In the complaint Baker relates in detail what makes the meters dangerous, and the allegations are damning—and alarming. A few highlights:

**[Meters] may fail dangerously when subjected to a sudden surge of electricity .... Meters found to contain ‘flux’ or loose solder residue .... Calibration equipment not properly designed .... Electric resistor component defective .... Internal temperatures up to 200° Fahrenheit .... Hot socket alarm .... Drastic overheating to the point of catastrophic failure, melting, and burning....**



Cutting corners in business and manufacturing is hardly something new; the difference here is just what is at stake: this product is installed in every house in a utility service area, and the electrical current for the house runs through it. **Even a half-percent failure rate can result in serious amounts of property damage, or even death, given the total number of “customers”**—though this word implies a voluntary acceptance of the product, when in fact installation of smart meters has been very largely involuntary. Truly optional consumer goods actually get more testing than smart meters.

**The sort of defects and failures enumerated in this suit might well have been caught with an independent safety-certification process such as Underwriters’ Laboratories (UL).** But these Sensus iConA smart meters, and every other type of smart meter, have [never been subjected to such testing.](#)



The suit states: “Mr. Baker has direct personal knowledge that Sensus and Southern Company [the utility] have installed approximately one million iConA meters in Alabama homes **with knowledge that the meters are seriously defective and pose a substantial fire hazard and that at least two Alabama homes have burned as a result....** [They] were well aware that the iConA was defective and the entire project flawed.” *[Emphasis ours.]*

Baker submitted the information he had to the Office of the U.S. Attorney and the FBI in Feb 2010. He contends that the defendants named in the suit, Sensus, Southern Company, and Alabama Power, “perpetuated a fraudulent conspiracy” to obtain \$165 million from federal stimulus funding.

**These meters were never tested—for either for safety or performance—instead they went straight to out for installation.** Then Sensus altered the components and design—again without safety testing. Only one percent of the Sensus meters were tested—for accuracy only—but never on a house while connected to the grid.



**“It quickly became apparent that the meters were fundamentally unsound.”** Baker states in the filing. “[The contract] carried an acceptable failure rate of 0.5%,” but in the first year, the meters were “failing at a rate of 9.0% per year.” Baker made reports to Sensus management about quality and safety issues, **but he was ignored and eventually fired.**

**What was technically wrong with the smart meters that Sensus was producing?** The suit alleges four categories of defects and failures: 1) Electrical Fast Transient Failures; 2) Flux Contamination and Inaccuracy Issues; 3) Faulty Components; and 4) “Hot Meters.” These technical issues are [explained below](#).

The suit goes on to make three charges against the defendants: 1) False Claims; 2) Conspiracy; and 3) Suppression, Fraud, and Deceit. These legal issues are explained in [more detail below](#).



**Corporate recklessness—and lack of regulation to curb it—has remained a core issue in the smart meter debacle.** From the Silver Springs Network antenna which increases the power of the radio over FCC limits ([see page 14 of this CPUC doc](#)), to [arcing problems](#) due to [unprofessional installation](#), to multiple [FCC violations](#), to the [lack of any independent safety testing](#)—it is clear that if there had been effective government regulation, it could have changed the face of this “deployment” dramatically.

If you don’t like the idea of more government regulation, **then how about consumer choice?** If individual customers could choose between utilities, even choose their own meter—again, the landscape would also look very, very different.

**But instead we are saddled with corporate utility monopolies, aided by government collusion, which adds up to a poisonous combination**—whatever your political beliefs might be. It is an arrangement designed to enrich corporations, with impunity.

**Why isn't the public up in arms about these risks of smart-meter fires and explosions?** There have been no comprehensive investigations by major media. Early in 2011, a major news station in the SF Bay Area was doing work on this. They interviewed us several times as part of an investigation into smart-meter fires. What happened? The story never aired, and calls to the investigative reporters were not returned.

Without coverage in the mainstream media, people will be left to find out about this issue through social networks or independent media—or worse, suffer their own fire or property damage from the meter.

This is yet another reason why [the proposed opt-out here in CA](#) is—even with analogs—incomplete and inadequate. Given the growing evidence of fire risk and safety, this is not a device we should be forced to pay to avoid. **Smart meters should not be installed on any home, any where, without a thorough safety investigation.**

---

### **Technical details from the lawsuit about Sensus meter defects:**

**1) Electrical Fast Transient Failures:** The manufacturer and the utility were both aware, the suit alleges, that the smart meters (iConA) were unsafe and could fail dangerously when subjected to a power surge. **[This was certainly evident for another make of smart meter, the [one installed in Palo Alto last October](#).]** One critical test was skipped for the Sensus meters, the Electrical Fast Transient Test (EFT). When this test was performed on a sample of the iConA Sensus meters, **they all failed**. This was after over 80,000 meters were already installed.

**2) Flux Contamination and Inaccuracy Issues.** The complaint states that production of the iConA meters was sloppy. Sensus performed two investigations and found 130,000 meters contained loose solder residue called “flux.” They also found that equipment used by the manufacturer to calibrate was not properly designed, calling into question the accuracy of the meters. This was after 400,000 meters were installed—non of which were recalled for testing. **Baker himself has investigated over-reporting meters, and found individual meters giving readings seven times the actual electrical usage.**

**3) Faulty Components.** Baker alleges Sensus and the utilities had reason to suspect that some components that were going into the iConA meter were faulty, with very high failure rates. Well into the delivery process, it was found that an electrical resistor was defective on **at least 85,000 meters**. **Over 170,000 meters** were also found to contain another faulty component made by Epsom.

**4) “Hot Meters.”** These Sensus meters, the complaint alleges, posed a risk of injury or death. Sensus knew that 19,000 installed meters were reporting a “hot socket alarm”—that is, the internal temperature was getting over 200°F. Sensus received reports of overheating to the point of melting and burning. **The plaintiff Baker documented himself meters reduced to lumps of blackened plastic, while the company insisted a meter couldn't melt at less than 500°F.**

Ultimately it was bringing to the attention of his supervisors a burned meter that resulted in a house fire that ended Don Baker's career at Sensus. **Instead of conducting an investigation, they fired him.**

=====

## Legal details alleged in the complaint:

**1) False Claims.** The defendant in the suit, the plaintiff alleges, presented false or fraudulent claims to the U.S. government that their smart grid project was eligible for [ARRA](#) funds when it was not. The equipment was defective and unfit.

**2) Conspiracy.** The defendants acted with the intent to defraud the U.S. by submitting false records to obtain the funds.

**3) Suppression, Fraud, and Deceit.** The defendants misrepresented or suppressed the fact that the smart meter that formed the basis of their smart grid architecture was dangerously defective.

=====

## Alabama house fires possibly resulting from defective smart meters:

Family Blames House Fire On Georgia Power Meter. <http://www2.wjbf.com/news/2011/jul/06/appling-family-blames-house-fire-georgia-power-met-ar-2074493/> “Sparks started flying from the TV and power box.”

Atlanta house fire, due to power meter; double blow to Haitian family. <http://www.wsbtv.com/videos/news/fire-deals-double-blow-to-haiti-family-in-atlanta/vCRzm/> “Faulty power meter sparked devastating house fire—twice.”

Alabama woman says smart meter is fire hazard. <http://www.wset.com/Global/story.asp?S=13487932>; The letter the city government wrote to Sensus [\[PDF\]](#).

**Related Press:** 2010 Article from Cleburne News (AL), which has since been scrubbed from their website: <http://stopsmartmeters.org/wp-content/uploads/2012/01/CleburneNews-smart-meters-Feb2010.pdf>

2010 Article from Montgomery Advertiser (AL) which has been since scrubbed from their website: <http://stopsmartmeters.org/wp-content/uploads/2012/01/Montgomery-AL-smart-meters-Feb2010.pdf> “The meter was ... replaced five days before their double-wide burned to the ground...”

2009 Article from Georgia new site, since removed: <http://stopsmartmeters.org/wp-content/uploads/2012/01/Electrical-fires-Georgia-Feb2009.pdf> “...Steady stream of complaints about the meters since the devices went into general use ....The firemen

told him they are keeping records and turning in their findings to the electric company.”

Article from Atlanta news site, since scrubbed from website: <http://stopsmartmeters.org/wp-content/uploads/2012/01/Atlanta-fire-smart-meter-Jan2010.pdf> “A power surge ... After firefighters put out the blaze, they said it reignited again hours later.”

Humanity on the BRINK –

Research Report from

Barrie Trower -

Frequencies that KILL . . .

Barrie Trower

September 2013

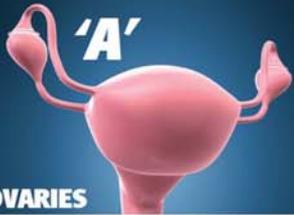
With Deference to all Scientists: this Research Report has  
been written for all students and non-scientists to  
understand.

## **Abstract**

As stated by University Researchers, Government Scientists and International Scientific Advisors; a minimum of 57.7% of schoolgirls exposed to low-level microwave radiation (Wi-fi) are at risk of suffering stillbirth, foetal abnormalities or genetically damaged children, when they give birth. Any genetic damage may pass to successive generations.

---

1



**OVARIES**

- = 400,000 FOLLICLES
- = 400 TO MATURE
- = 14 EACH CYCLE TO PRODUCE EGG(S) WHICH CAN BE FERTILIZED

**CHILD 'A' 5-16 YEARS EXPOSED TO WI-FI IN SCHOOL**  
Possible damage to first and subsequent generations.

Microwave irradiation can cause oxidative and nitrosative stress to mitochondria - this DNA is 10x more susceptible to low level chronic microwave radiation than other DNA.

Low histone protein content i.e. mitochondropathy  $N_2 O_2$  is essential for brain / immune system, any DNA damage is irreparable and can pass to every female hence forth.

57.7%

2



**CHILD 'B' FOETUS FROM CHILD 'A' NOW AS A PREGNANT STUDENT/ADULT**  
With possible DNA damage

- 100 days for follicles to form: no definite structure thence 150+120 d. to mature
- No protein 53 (x4) to fight radiation
- No nuclear core complex (x30) proteins for defence
- No factor 1 protein\* (apoptosis)
- Of 100,000 protein structures only 600 are known

- 7d = 100 Cells
- 28d = Heart
- \*40d = Eye
- 47d = fingers / toes

Body is initially inside out, i.e. major organs are the most irradiated

Woman may not know she is pregnant at this stage: Hence no precautions taken

\* PHOTOSENSITIVE GANGLIONS ABSORB RAD: EFFECT BODY FUNCTIONS

3



**CHILD 'B' IS NOW PREGNANT CHILD 'C'**  
Adult Child C may already have been irradiated

- Every aspect of Child 'C's life has been at maximum risk from stages 1,2 & 3.
- The greatest risk is yet to come. Biggest danger from school wi-fi irradiation on students and teachers

1st 56 days is when all embryos are most vulnerable. During the first 4-6 weeks, the mother may not know she is pregnant, therefore will not shield the embryo from radiation

25+ years

## Wifi – a Thalidomide in the Making – Who Cares?

Professor John R Goldsmith, International / Advisor Consultant for R.F. Communication, Epidemiology and Communications Sciences Advisor to the World Health Organisation, Military and University Advisor, Researcher; wrote concerning the low level exposure of microwave irradiation (below thermal level) incident upon women:

*“Of the microwave-exposed women, 47.7% had miscarriages prior to the 7<sup>th</sup> week of pregnancy...”(1)*

The level of irradiation incident upon the women was stated, as from, five microwatts per centimetre squared. This level of irradiation may seem meaningless to a non-scientist; however, when I say that it is below what most schoolgirls will receive in a classroom of wi-fi transmitters, from the age of approximately five years upwards, this level becomes more meaningful.

A distinction here must be made and a very important one: schoolgirls are not women. Schoolgirls are children and children are both neurologically and physiologically different from adults. A child’s brain tissue / bone marrow has different electrical conductivity properties than adults due to the higher water content (2) (this renders the Specific Absorption Rate obsolete). Children’s absorption of microwave radiation can be ten times higher than adults. Permanent low-level microwave exposure can induce chronic nitrosative and oxidative ‘stress’ thence, damage the cellular mitochondria (mitochondropathy). This ‘stress’ can cause irreversible mitochondrial DNA damage (mitochondrial DNA is ten times more susceptible to oxidative and nitrosative ‘stress’ than the DNA in the cell nucleus). Mitochondrial DNA is irreparable due to its low histone protein content, therefore any damage (genetic or otherwise) can be transmitted to all successive generations through the maternal line. (3)

Hence, we are subjecting each successive female generation to harm. Whether these two ten-fold increases ‘merge’ to become 57.7% or are additional, thence equal 67.7% of those to suffer, is a moot point. Either way we are facing the equivalent of a pandemic. I was invited to present a lecture at Brighton University recently and one Doctor commented on a +60% foetal birth rate damage from exposed farm animals. All mammalian species will of course suffer the same consequence resulting from low-level microwave irradiation. There is very little difference ‘biologically’ between our embryonic cells.

I invite the Reader to peruse my diagram and / or read my simple explanation concerning the microwaving of the ovarian follicles in schoolgirls.

## **Simple Explanation**

Imagine you are five years old, in school and sitting with a wi-fi laptop near your abdomen. Theoretically, your ovaries can become irradiated until you leave school at aged 16-18 years old. When you become pregnant, every one of your follicles (to become eggs) will have been microwaved. Hence, you may or may not deliver a healthy child.

Should you become a pregnant as a student, your embryo (for its first 100 days – if it is female) is producing approximately 400,000 follicles (within its ovaries) for future child-birth.

The problem is that these developing follicle cells do not have the cellular protection of mature adult cells. Consequently your ‘Grandchild’ may have had every single follicle cell irradiated and damaged prior to its conception. Therefore when your child becomes an adult (with its irradiated follicles) there is a greater likelihood of its child (your Granddaughter) suffering the ailments previously mentioned, during conception / embryonic and foetal development stages.

## **Beyond Belief**

The shocking truth is, not only was all of this known and documented long before wi-fi was ever put in front of children, but the dangerous biological effects were concealed (as they are to this day) from the general public, in order to protect the industries profit.

Professor Goldsmith writes:

*“.....effects from exposure to RF radiation in certain populations: reproductive effects.....increased spontaneous abortion.....increased incidence of childhood and other cancers.....” (1)*

Confirming this with more than 2000 references is the Naval Medical Research Institute in their document: ‘Bibliography of Reported Biological Phenomena (Effects) and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation’ highlight ‘.....Altered Menstrual Activity / Altered Foetal Development.....’ (4)

The World Health Organization’s ‘International Symposium’ Research Agreement No. 05-609-04 ‘Biological Effects and Health Hazards of Microwave Radiation’ emphasizes in its 350 pages: Biological effects, health and excess mortality from artificial irradiation of Radio Frequency Microwaves. Section 28 deals with problems concerning Reproductive Function.

This document was classed as ‘Top Secret’ and its contents withheld by WHO and ICNIRP (International Commission on Non-Ionizing Radiation Protection). (5)

Eldon Byrd, a scientist for the Naval Surface Weapon Centre of the US Navy, in one of his 1986 lectures on the effects of low-level microwaves, is referenced as stating:

*'.....we can alter the behaviour of cells, tissue.....cause up to six times higher foetus mortality and birth defects....'. (6)*

Finally, the Mobile Telecommunications Industry carried out a very thorough and exhaustive scientific study on its own product. This industries conclusion was:

Sec. 7 *".....it can be concluded that electro-magnetic fields with frequencies in the mobile telecommunications range do play a role in the development of cancer."*

*".....Direct damage on the DNA as well as influences on the DNA synthesis and DNA repair mechanisms....." (7)*

(Note I have underscored the relevant words here.)

Note: DNA synthesis is essential for healthy embryonic / foetal / child's growth.

With these few of the roughly 8000 research articles showing this phenomena; in order to protect this industries' profit, the United States Defence Intelligence Agency sent a 'document' to 'advanced nations' describing the problem and suggesting 'how to deceive the public'.

It read:

*".....if the more advanced nations of the West are strict in the enforcement of stringent exposure standards, there could be unfavourable effects on industrial output.....exposed to microwave radiation below thermal levels experience more....."*  
(8)

NB: Industrial output is of course...profit. A very relaxed exposure standard also makes it very difficult to take the industry to court.

This (and two other documents with ref. 8) then continues to list many physiological and neurological dangers from low-level: below thermal, microwave irradiation inc: blood disorders, heart problems, psychiatric symptoms and 'menstrual disorders'.

\*Wi-fi is of course, below thermal low-level microwave irradiation.\*

In order to appease the US Government, some Governments adopted the ICNIRP guideline, whereby, the only safety limit is just six-minutes of warming. Which means: if you do not feel too warm in six minutes, wi-fi is deemed to be safe.

No consideration at all has been given to the published 'below thermal' cellular interaction as listed by several countries including the United States; which were (and are) known to cause: cancer, severe neuropathological symptoms, foetal defects and literally hundreds of illnesses related to cellular disorders.

Countries following ICNIRP continue to argue that their six minute warming effect is all that is required regarding microwave irradiation.

Should the Reader be wondering whether I am ‘as mad as a box of frogs’ and thinking ‘no government would ever harm its citizens for money, especially pregnant women’; I invite the Reader to investigate Government decisions behind: smoking, asbestos, BSE (mad-cow disease), lead in petrol, experiments on 20,000 UK serving military personnel serving in the 1960’s, thalidomide and of course Agent Orange sprayed over the food crops in Vietnam. To this day, many global birth defects stem from these Government / Government Scientific / Military decisions: with industrial advisors.

If further evidence is required, I invite the Reader to read documents released under the Freedom of Information Act; namely, Operations: Pandora, MK Ultra, MK Chaos, Cointelpro, MK Delta, MK Naomi, MK Search, Bluebird, Artichoke, Chatter, Sleeping Beauty and Grill Flame.

Here, secret experiments carried out by the Military / Government scientists upon unsuspecting civilians, namely: students, servicemen, psychiatric patients, poor, children over the age of 4 years, pregnant women, Muslims, Catholics, prisoners, handicapped, deaf, blind, homosexuals, single women, elderly, school children, ‘marginal groups’ and dissidents; served to increase their knowledge and understanding of; what is commonly known as...Stealth Warfare.

Progress on the study of illnesses caused by low-level microwave irradiation continues to this day. One current study on cancer and neurological harm continues until 2018 and involves women who could be pregnant. (9)

Progress Reports are also fed back to Governmental Scientists:

*“.....students will understand the nature of RF...bioeffects research, including human / animal studies.....students will become familiar with current state of knowledge on potential health effects RF, such as cancer, memory loss, and birth defects.” (10)*

NB: RF has become a generic term (Radio Frequency) to avoid using the term ‘microwave’. It poses less ‘safety queries’ as the word ‘radio’ itself, which used to refer to ‘long wave radio’ was domestically non threatening.

### **Intentional Ignorance**

Governmental Intransigence forces a moratorium upon the risks of exposure to future generations. Both the Communications Industry and Governmental studies have proved that protein synthesis (the using of chemical structures to ‘build’ the roughly 4050 foetal and 4500 adults designated biological / neurological structures) can be influenced by low-level microwave irradiation. This moratorium seems to spread to organizations either relying on Governmental funding, or for whatever reason; acquiescence. However, not all research departments suppress the truth.

A brilliant paper published by Dundee University confirms that low-level microwave irradiation, unable to cause any heating (thermal) effect, can affect cellular signalling processes. (11)

### **The Main Risks to Children**

These biological processes described as being 'influenced' by low-level microwave irradiation may not just damage foetal growth; relying on the same biological processes are:

Blood Brain Barrier – requires 18 months to form and protects the brain from toxins. It is known to be effected.

Myelin Sheath – requires 22 years to build its 122 layers. It is responsible for all thinking, organ and muscle processes.

Brain – requires 20 years to develop (I can assure you, cell phones do not help in its development).

Immune System – requires 18 years to develop. Bone marrow and Bone Density are known to be affected by low-level microwaves as are the immune systems' white blood cells.

Bones – requires 28 years to develop – as mentioned the moisture content of children makes both the 'soft bones' and marrow particularly attractive to microwave irradiation. Bone marrow produces blood cells.

Clearly, our decision makers are overlooking a child illness pandemic hitherto unknown in our 40,000 generations of civilization; which can involve over a half of the World's exposed mothers / children.

### **The Very Sad Truth**

I have been very honoured to address approximately 40 Royals, Governments, Leaders of Governments, Leaders of Peoples and Government Officials over the years.

My address (text) to one King concerning the numbers of ill children was placed on the internet. (12)

I referenced over 200 cancer / leukaemia clusters in schools (up to the time of data collection) from low level microwave transmitters in schools. There were many different types of cancers, leukaemias, miscarriages and breast cancers of staff. These continue, mostly only recorded locally, to this day.

When this was discussed in the English Parliament (as one of the EU Countries involved), a Minister dismissed it and lied to the House of Commons. My request to prove this lie was denied.

Possibly, the most respected children's charity in the World: UNICEF, joined forces with the World's leading authority on the effects of harm from low-level microwave irradiation:

The Russian National Committee on Non-Ionizing Radiation Protection: in their research document 'Health Effect on Children and Teenagers' found;

85% increase in Central Nervous System Disorders  
 36% increase in epilepsy  
 11% increase in mental retardation  
 82% increase in blood immune disorders and Risk to Foetus. (13)

NB. The Reader may think that the cell phone irradiation is different from wi-fi as it has more power. In fact wi-fi can be more harmful because of its lower power! Low power can enter the body and cause harm. All electromagnetic waves are accumulative. If they are below the body's threshold to cause activation of the necessary proteins required to defend and repair tissues, the damage accumulates very slowly and is undetectable like a cancer. Think of sunbathing on a cloudy day, you can still burn your skin.

### **The Good Guys**

I have a list of nine countries (some of whom I am working with) who are actively, either taking wi-fi out of schools or in the legal argument-stage of this process. I decline to publically name these countries as my actions may interfere with their legal negotiations.

The Parliamentary Assembly (Assemblée Parlimentaire) Council of Europe Document 12608, published on 6.5.2011 in section 8.3.2. states:

*'.....ban all mobile phones, DECTphones or Wi-Fi or WLAN systems from classrooms and schools.....'*

For legal reasons this had to be changed to a 'wired system is preferred'. However, the meaning is clear.

In a translated document, Professor Yuri Grigoriev of the Russian Committee for Non Ionizing Radiation Protection wrote on 19.6.2012

*'.....recommend the use of wired networks and not networks using the wireless broadband access systems, including wi-fi, in schools and educational establishments.'*

A document dated 25.3.2013 (updated from 19.3.2013) by the Executive Committee of the American Academy of Environmental Medicine wrote a letter to the Los Angeles Unified School District with the following recommendation:

*'.....do not add to the burden of public health by installing blanket wireless internet connections in Los Angeles Schools.'*

Just prior to this in December 2012 the American Academy of Pediatrics (representing 60,000 Paediatricians) wrote to Congress requesting more protection from low-level microwave irradiation for children and pregnant women: with regard to wi-fi in schools, they write:

*'.....this is an unprecedented exposure with unknown outcome on the health and reproductive potential of a generation.'* (14)

In 2002, 36,000 Physicians and Scientists etc. signed the 'Freiburg Appeal'. Ten years hence, it has been re-launched. It specifically warns against the use of Wi-fi and the irradiation of children, adolescents and pregnant women. 'Freiburg' is an International Doctors' Appeal.

The Reader will appreciate that collectively there are approximately 100,000 of the World's most knowledgeable professionals expostulating this same warning.

As an aside, should the Reader be wondering why I have not mentioned school-boys and whether they can be affected in a similar way to girls: the answer is 'yes'.

DNA sperm fragmentation from wi-fi levels of irradiation, have been published. (15) It would require many more pages to comment upon this phenomenon and there is already a plethora of data both available and published.

## **Pulsing / Modulations**

During the 'Cold War' conflict, whilst I was collating effects from microwave pulses / modulations caused by brain entrainment, resonance (both cyclotronic and circadian), rectification (at boundaries within the body) generated by electrically induced phase transition; it came to my attention that a list needed to be published for all microwave communication systems. (16)

In this Open Letter, I list 1 to 40 Hz (pulses / modulations per second) and their corresponding neurological / physiological response.

In his most explanatorily descriptive paper, Dr. Andrew Goldsworthy writes.....

*'.....For example, Grigoriev et. Al. (2010) showed that 30 days exposure to unmodulated 2450 MHz microwave radiation triggered a small but significant increase in anti-brain antibodies in the blood of rats.....which could then result in an auto immune attack on the brain and / or nervous system. An example of an auto immune disease of the brain is Graves disease in which the pituitary gland (at the base of the brain) is affected.'* (17)

**NB. 2450 M Hz is the wi-fi frequency.**

If you add the pulse / modulation frequency to the above; fatigue, depression, psychiatric problems (such as anger), loss of appetite and problems with movement can also be induced.

## **The Bad Guys**

With gargantuan profits to be made, it is of no surprise that the English Parliamentary system choose to follow ICNIRP and their well established 'Active Denial' policy.

I became familiar with our 'corruption' when during the late 60's – 70's, I was commissioned to investigate (under a programme initiated by Sir William Melvin (1911)) corruption within the hierarchy of the London Metropolitan Police and the non-elected Members of the English Parliament. Should the Reader be dismissive of such actions, I suggest looking at any of our Sunday newspapers over the past 45 years, including now.

When a Reverend lady wrote to a Minister, Nick Gibb MP, concerning Wi-fi in schools, his standard reply (which I have seen many times) stated:

*".....advice given.....by UK Health Protection Agency..... 'There is no consistent evidence of health effects from RF exposures below guideline levels and no reason why schools and others should not use Wi-fi equipment.'" (18)*

This letter is designed to deceive (and it is very successful). Look to the words 'no consistent evidence'. Let me explain please.

If I were to carry out an experiment on every single person who went through the doors of your main airport on any busy day and told them that they must drink one pint of beer and smoke ten cigarettes a day forever; some would react immediately, especially children. Others would react over days, weeks, months and years (many years in some cases). Then there would be those who would thoroughly enjoy the experiment and probably never be ill. That does not mean that alcohol and cigarettes are safe. It shows that people are not homogenous (all alike / identical). In other words, the conclusion of my experiment would be that there is: 'no consistent evidence'.

Other Ministerial letters usually say: *"most of our research"* or *"most of our scientists"* – both of which are equally meaningless.

What they never say is: Wi-fi is safe.

It will come as no surprise to the Reader to learn that I have been refused permission to have a face-to-face meeting with my MP, Mr Mel Stride. Hence my Member of Parliament has successfully brought the 'shutters down' on any access I may have had to Government. This act by Mr Stride became a 'feature' in our West Country newspaper by leading Journalist Paul James. (19)

During my last attempt to contact my MP, his Secretary, Dominic just hung-up the telephone on me.

Years ago, when I started to 'advise caution' re microwaving children / pregnant women; the Academic Registrar of my own University (Exeter) forbade me from ever communicating with it, ever again. A similar message came from Dr. Jamie Harle of the Open University (Medical Physics), who said: *"Your work is too political."*

Clearly in England, some universities and some parliamentary persons are more afraid of governmental 'reprisals' than telling the truth. Regardless of the consequences.

## **Two Womens' Stories**

The Real Price of Intentional Ignorance and Greed. Those Consequences.

Ten telephone calls a day would not be unusual for me. I even receive calls Christmas Day / Easter Sunday. Two calls which summarize those from women are illustrated below. Both are actual conversations.

- i) ".....my daughter had just died. I am holding her hand. She has just had her 11<sup>th</sup> birthday and she was number 11 to die since the transmitter for Wi-fi was put near her and others' desk....."
- ii) *".....my child is one of several with cancer / birth genetic problems. These only started after the transmitter was turned on. My worries are two-fold and take every second of my life. Will my child ever marry or find a partner and be happy? What will happen when I die? I know I will die worrying. Regardless of who is to blame, it is me, the Mother who carries guilt and responsibility....." (20)*

## **I Ask for Readers' Help, Please.**

Imagine 57.7% of all of the schoolgirls with Wi-fi in their classrooms: all day – all year – all through their school career, in every country using it, in the World!

In just two generations we could have more dead / sick infants than resulted from both World Wars. And, these are not my figures, they come from Government advisors / research.

Advanced requests for this 'Paper' have been received from Royalty, Governmental Officers (outside of the UK) and people I will describe as 'interesting'.

As shutters fall blocking every direction I try to turn, I ask: *"Can the Reader succeed in preventing this 'Pandemic' where I will fail?"*

I have two requests:

- i) Would a Royal or Leading Governmental Official please ask the British Prime Minister, face to face, why he told my MP, Mr Stride, that he is 'too busy' to see me for just one hour to discuss this issue.
- ii) If every Reader sends just two copies of this Paper to people who may be able make a decision (preferably influential women); with mathematical progression – the original 100 advanced requests will soon land on a desk of somebody who can make a difference.

## **International Challenge**

When I am invited to speak in countries, I invariably end up on the radio / TV news / documentary channels. Thence, I issue a challenge:

I ask for any scientist(s) from industry / government to 'humiliate' me live 'on-air' with their expert knowledge by answering one question:

*"What is the safe level of microwave irradiation for the ovarian follicles during the first 100 days development of the embryo?"*

To date, not a single scientist will appear and face me.

I mention this because it is a question the Reader can ask any decision maker, school Principal / Governor etc.

Should any person provide the answer, the next statement is:

*"Fine – we will send it to a Leading Scientific Journal for independent Peer Review."* (With your research). (21)

## **The Solution**

Education need not suffer if Wi-fi is withdrawn world-wide. We have telephone lines – fibre-optic cable.

The argument against these options is the cost. Compared to the future medical costs (forgetting the human cost), phone / fibre-cable shows to be a very cheap option.

Thank you.

**Barrie Trower**  
**3 Flowers Meadow**  
**Liverton**  
**Devon TQ12 6UP**  
**United Kingdom**

**In UK - 01626 821014**  
**World – 00 44 1626 821014**

One Reader may be the person who achieves more to help humanity than any other modern day individual.

September 1<sup>st</sup> 2013

(This Paper is copyright free)

## Epilogue

Please note – I have always worked free of charge and will represent any person in the world without cost.

**PLEASE SEE ADDENDUM**

## Addendum – Recent Publications

Professors' / Doctors' Panagopoulos, Johnsson and Carlo describe in their (June 2013 Published) Paper – how man-made electromagnetic waves (as used in the communications industry) can cause interference, hence induced oscillations, from these polarized waves. This in turn, can induce biological alterations and render the SAR (Specific Absorption Rate) obsolete.

They write:

- *Man-made electromagnetic waves...they are polarized...*
- *....can produce interference effect...This induced oscillation will be most intense on the free particles which carry a net electric charge...a part of its energy...is transferred to the charged / polar molecules of the medium...within biological tissue there will be additional energy absorption by the water dipoles...proteins, lipids or nucleic acids, which will also be forced to oscillate by the applied field.*
- *...man-made EMF's can produce severe biological alterations such as DNA damage without heating the biological tissue...may lead to cancer, neurodegenerative deceases, reproductive declines or even heritable mutations...conductivity varies for different tissues and different field frequencies..The relative permittivity of an adult brain is calculated to be around 40 while the corresponding value for a young child's brain is between 60 and 80 resulting in almost double the radiation absorption and SAR...*
- *...SAR offers no information at all with respect to frequency, waveform or modulation... (Ref (22))*

Dr Dimitris Panagopoulos, Dep. of Biology, University of Athens also writes in his 2013 paper: Electromagnetic Interaction Between Environmental Fields and Living Systems Determines Health and Well Being:

- *Disturbances in the communication between individual body clocks can desynchronize the circadian system, which in turn may lead to unwellness, chronic fatigue, decreased performance, obesity, neuropsychiatric disorders, and the development of different diseases...*
- *...endogenous electrical balance in living organisms cannot occur in the presence of unnatural – man-made – electromagnetic pollution..... GSM mobile phone radiation is found to cause DNA damage on insect reproductive cells (gametes) and adversely affect*

*reproduction for intensities down to 1 microwatt per centimetre squared after only a few minutes exposure..... (Ref (23))*

## References

1. Professor John R. Goldsmith      Possible Effects of Radiofrequency Radiation  
Environmental Health Perspectives  
Sup. 6 Dec. 1997      P. 1580
2. Microwave News      Children's Brains are Different  
May 3<sup>rd</sup>. 2010   P.3
3. Andrea Klein & Barrie Trower      Wireless Laptops and Their Transmitters Using Microwaves in Schools  
P.3      (Undated)
4. NMRI      AD750271 Research Report  
MF12. 524.015-004B  
4-10-1971  
Bethesda, Maryland, USA
5. WHO      Biological Effects and Health Hazards of Microwave Radiation  
International Symposium, Warsaw, Poland (1973)  
With US Dept of Health, Food and Drug Administration  
Document 05-609-04
6. Microwave Mind Control      Mind Control and the UK  
Chapter 4. Tim Rifat  
P.83      2001
7. Hennies – Neitzke - Voight      Mobile Telecommunications and Health Review of Current Scientific Research  
T-Mobile  
Hannover  
April 2007      Section 7
8. US Defence Intelligence Agency      DST – 18105-076-76  
March 1976  
NB: DST-18105-074-76 and ST-CS-01-169-72 also refer to this phenomena
9. Barrie Trower      Most Confidential Report on the TETRA (Airwave) Communication System  
Strictly for the Public and Commercial Services Union (PCS)  
June 2009
10. P. Phillips, L.Brown, B. Thornton      US Electromagnetic Weapons and Human Rights  
Course No. 11 Page 40  
Sonoma State University  
As a study of the History of US Intelligence Community Human Rights Violations and Continuing Research in Electromagnetic Weapons  
Project Censored: Media Freedom Foundation

11. J. Simon C. Arthur MAPK Activation by Radio Waves  
MRC Protein Phosphorylation Unit  
School of Life Sciences  
University of Dundee  
DD4 5EH UK  
Published by Journal of Biochemistry (405) e5 e6 2007
12. Barrie Trower [www.magdahavas.com/wordpress/wp-content/uploads/2010/08/Barrie Trower SA.pdf](http://www.magdahavas.com/wordpress/wp-content/uploads/2010/08/Barrie_Trower_SA.pdf)
13. Electromagnetic Fields from Mobile Phones: Health Effects on Children and Teenagers  
Russian National Committee on Non-Ionizing Radiation Protection  
April 2011
14. Private letters  
(available on internet) as titled and dated in text
15. C. Avendano, A. Mata, C.A Sanchez Sarmienta, G. Doncel Use of Laptop Computers Connected to Internet Through Wi-fi Decreases Human Sperm Motility and Increases Sperm Fragmentation  
Nascentis Medicina Reproductiva, Cordoba, Argentina  
Dept of Obstetrics and Gynaecology, Eastern Virginia Medical School, Norfolk, Virginia (2012)
16. Barrie Trower The Communications Industry is in the Position Where it is Spiralling out of any Person's Ability to Control it  
An Open Letter (undated)
17. Dr. Andrew Goldsworthy The Biological Effects of Weak Electromagnetic Fields – Problems and Solutions  
March 2012 P.14
18. Stuart Gallimore, Director of Children's Services Personal Letter. Nick Gibb MP  
House of Commons, London, SW1A 0AA  
30 August 2011
19. Paul James Physicist: I'm Stopped From Seeing my MP  
Mid Devon Advertiser  
3.5.13 P. 13
20. Personal Conversations  
I am with holding their private telephone numbers for privacy
21. Nature Publications – Nature or Scientific American  
75, Varick Street, 9<sup>th</sup> Floor, New York, NY 10013-1917, USA

22. Dimitris J. Panagopoulos,  
Olle Johansson &  
George L. Carlo      Evaluation of Specific Absorption Rate as a Domestic Quantity for  
Electromagnetic Fields Bioeffects  
4.6.2013      Pages – i) 1 ii) 2 iii) 4 iv) 6  
PLOS ONE      June 2013      Vol 8 Issue 6      e62663
23. Dimitris J. Panagopoulos  
University of Athens      Electromagnetic Interaction Between Environmental Fields and Living  
Systems Determines Health and Well-Being  
Electromagnetic Fields: Principles – Biophysical Effects  
ISBN 978-1-62417-063-8  
Editors M.H Kwang and S.O Yoon  
2013 Nova Sciences Publishers, Inc  
Pages – i) 20 ii) 35

Department of Health:

I wish to submit the letter written by another concerned citizen below as a letter whose concerns are in agreement with mine. Please take in consideration the negative health effects from wireless radiation to our children. Please continue to study this issue and include scientists and doctors whose own concerns have been voiced regarding the negative impacts of wireless technology. Please read the letter attached from well known scientists.

Regards,  
Nancy Morris  
Seattle, WA

=====

Dear Gentlemen and Gentlewomen,

I would like to add my support to Karen Nold's plea for honesty, integrity and accountability in government with regard to the installation of WiFi in schools.

<http://meansforchange.org/Wireless-in-Schools/Correspondence-with-Washington-State>

This is a time when we need government officials and other's in decision making positions to be so aware of both sides of the story, Much is being concealed by industry's push for profits. The long term and even the short term health effects of extended exposure to wireless radiation is proving to be devastating to our health and particularly to the health of our children.

There is no shortage of evidence, both anecdotal and peer reviewed research.

You wrote:

The fields generated by Wi-Fi devices are in the RF part of the electromagnetic spectrum. Cell phones, cell towers, radar, microwaves, and radio and TV broadcasts also generate RF fields. Most studies regarding the health effects of RF fields have evaluated cell phones because the level of exposure from cell phones is far greater than that from other devices, including Wi-Fi. Therefore, cell phones can be used as an indicator for health risks from other RF devices, at least if no evidence of risk is found; if there is no evidence of risk associated with cell phone use, then there is also no evidence of risk from other RF devices.

This first premise, stated in the document "Responding to Wi Fi Safety Concerns in our Schools" is fatally flawed:

:

Please see:

A video of a congressional address. The subject is RF.

B Blake Levitt:

<http://www.youtube.com/watch?v=M43AWNFq8Xs>

Peer reviewed research: Direct links between exposure to RF and tissue damage.

<http://www.nrcresearchpress.com/doi/pdf/10.1139/A10-018>

<http://www.nrcresearchpress.com/doi/abs/10.1139/A10-018#.UxUGO6XjLHg>

The siting of cellular phone base stations and other cellular infrastructure such as roof-mounted antenna arrays, especially in residential neighborhoods, is a contentious subject in land-use regulation. Local resistance from nearby residents and landowners is often based on fears of adverse health effects despite reassurances from telecommunications service providers that international exposure standards will be followed. Both anecdotal reports and some epidemiology studies have found headaches, skin rashes, sleep disturbances, depression, decreased libido, increased rates of suicide, concentration problems, dizziness, memory changes, increased risk of cancer, tremors, and other neurophysiological effects in populations near base stations. The objective of this paper is to review the existing studies of people living or working near cellular infrastructure and other pertinent studies that could apply to long-term, low-level radiofrequency radiation (RFR) exposures. While specific epidemiological research in this area is sparse and contradictory, and such exposures are difficult to quantify given the increasing background levels of RFR from myriad personal consumer products, some research does exist to warrant caution in infrastructure siting. Further epidemiology research that takes total ambient RFR exposures into consideration is warranted. Symptoms reported today may be classic microwave sickness, first described in 1978. Nonionizing electromagnetic fields are among the fastest growing forms of environmental pollution. Some extrapolations can be made from research other than epidemiology regarding biological effects from exposures at levels far below current exposure guidelines.

The American Academy of Environmental medicine has issued a position paper:

For over 50 years, the American Academy of Environmental Medicine (AAEM) has been studying and treating the effects of the environment on human health. In the last 20 years, our physicians began seeing patients who reported that electric power lines, televisions and other electrical devices caused a wide variety of symptoms. By the mid 1990's, it became clear that patients were adversely affected by electromagnetic fields and becoming more electrically sensitive. In the last five years with the advent of wireless devices, there has been a massive increase in radiofrequency (RF) exposure from wireless devices as well as reports of hypersensitivity and diseases related to electromagnetic field and RF exposure. Multiple studies correlate RF exposure with diseases such as cancer, neurological disease, reproductive disorders, immune dysfunction, and electromagnetic hypersensitivity.

[http://aaemonline.org/emf\\_rf\\_position.html](http://aaemonline.org/emf_rf_position.html)

There is a growing number of parents groups opposing both wifi and cell phone radiation in and around schools.

<http://www.indymedia.org.uk/en/regions/world/2003/06/272899.html>

Please read the beautiful story of a courageous and wise woman who listened to her heart and prevented countless tragedies.

[http://en.wikipedia.org/wiki/Frances\\_Oldham\\_Kelsey](http://en.wikipedia.org/wiki/Frances_Oldham_Kelsey)

We need wise and courageous people with a conscience making decisions that may affect millions of children and families. Please make an effort to look more deeply into this issue . At this point only perceived savings, efficiency and corporate profits are on the table.

I would like to call for a full out Ban of wifi in schools given the mounting evidence of its catastrophic effects on human health.

Sincerely  
Sandra Storwick  
Kirkland mother of two girls.



We, the undersigned are a group of scientists and health professionals who together have coauthored hundreds of peer-reviewed studies on the health effects of electromagnetic fields (EMFs). We wish to correct some of the gross misinformation found in the [letter regarding wireless “smart” meters that was published in the Montreal daily \*Le Devoir\* on May 24](#). Submitted by a group [Quebec engineers, physicists and chemists](#), the letter in question reflects an obvious lack of understanding of the science behind the health impacts of the radiofrequency (RF)/microwave EMFs emitted by these meters.

The statement that “Thousands of studies, both epidemiological and experimental in humans, show no increase in cancer cases as a result of exposure to radio waves of low intensity...” is [false \(1\)](#). [In fact, only a few such studies, case-control studies of mobile phone use](#), certainly not thousands, have reported no elevations of cancer, and most were funded by the wireless industry. In addition, these reassuring studies contained significant experimental design flaws, mainly the fact that the populations followed were too small, were followed for a too short a period of time and had used mobile phones for too short a period of time.

Non industry-funded studies have clearly demonstrated a significant increase in cancer cases among individuals who have suffered from prolonged exposure to low-level microwaves, transmitted notably by radio antennas. The effects were best documented in meta-analyses that have been published and that include grouped results from several different studies: [these analyses](#) consistently showed an [increased risk of brain cancer](#) among regular users of a cell phone who have been exposed to microwaves [for at least ten years](#).

### **Brain Cancer Rates**

Furthermore, the argument that brain cancer rates do not indicate an overall increase in incidence is not evidence that cell phones are safe: the latency for brain cancer in adults after environmental exposure can be long, up to 20-30 years. Most North Americans haven’t used cell phones extensively for that long. The evidence of the link between long-term cell phone use and brain cancer comes primarily from Northern Europe, where cell phones have been commonly used since the 1990s.

Children are especially at risk. In May 2012, the [U.K.’s Office of National Statistics reported a 50 percent increase in incidence of frontal and temporal lobe tumors in children between 1999 and 2009](#). This statistic is especially disturbing since in May 2011, after reviewing the published scientific literature regarding cancers affecting cell phone users, [the International Agency for Research on Cancer \(IARC\) classified radiofrequency radiation as a 2B, possible human carcinogen](#). Despite the absence of scientific consensus, the evidence is sufficiently compelling for any cautious parent to want to reduce their loved one’s exposure to RF/microwave emissions as much as possible, as recommended by [various countries](#) such as Austria, Belgium, [Germany](#), [Russia](#) and the [United Kingdom](#).

## **Electrosensitivity**

Public fears about wireless smart meters are well-founded. They are backed by various medical authorities such as those of the [Santa Cruz County](#) (California) Public Health Department. These authorities are worried about the growing number of citizens who say they have developed electrohypersensitivity (EHS), especially since for many of them, the symptoms developed after the installation of such meters (it takes some time for most people to link the two events).

Since the turn of the millennium, people are increasingly affected by ambient microwaves due to the growing popularity of wireless devices such as cell phones and Wi-Fi Internet. Therefore, the mass deployment of smart grids could expose large chunks of the general population to alarming risk scenarios without their consent. According to [seven surveys done in six European countries between 2002 and 2004, about 10% of Europeans have become electrosensitive, and experts fear that percentage could reach 50% by 2017](#). The most famous person to [publicly reveal her electrosensitivity is Gro Harlem Brundtland](#), formerly Prime Minister of Norway and retired Director of the World Health Organization (WHO).

[While there is no consensus on the origins and mechanisms of EHS](#), many [physicians and other specialists around the world](#) have become aware that EHS symptoms (neurological, dermatological, acoustical, etc.) seem to be triggered by exposure to EMF levels well below current international exposure limits, which are established solely on short-term thermal effects (2). Organizations such as the [Austrian Medical Association](#) and the [American Academy of Environmental Medicine](#) have recognized that the ideal way to treat of EHS is to reduce EMF exposure.

Therefore, caution is warranted because the growing variety of RF/microwave emissions produced by many wireless devices such as smart meters have never been tested for their potential biological effects.

## **Well-known bioeffects**

While the specific pathways to cancer are not fully understood, it is scientifically unacceptable to deny the weight of the evidence regarding the increase in cancer cases in humans that are exposed to high levels of RF/microwave radiation.

The statement that “there is no established mechanism by which a radio wave could induce an adverse effect on human tissue other than by heating” is incorrect, and reflects a lack of awareness and understanding of the scientific literature on the subject. In fact, [more than a thousand studies](#) done on low intensity, high frequency, non-ionizing radiation, going back at least fifty years, show that some biological mechanisms of effect do not involve heat. This radiation sends signals to living tissue that stimulate biochemical changes, which can generate various symptoms and may lead to diseases such as cancer.

Even though RF/microwaves don't have the energy to directly break chemical bonds, unlike ionizing radiation such as X-rays, there is scientific evidence that this energy can cause DNA damage indirectly leading to cancer by a combination of biological effects. [Recent publications](#) have documented the generation of free radicals, [increased permeability of the blood brain barrier](#) allowing potentially toxic chemicals to enter the brain, induction of genes, as well as altered electrical and metabolic activity in human brains upon application of cell phone RF/microwaves similar to those produced by smart meters.

These effects are cumulative and depend on many factors including RF/microwave levels, frequency, waveform, exposure time, bioavailability between individuals and combination with other toxic agents.

Clear evidence that these microwaves are indeed bioactive has been shown by the fact that low-intensity EMFs have proven clinically useful in some circumstances. Pulsed EMFs have long been used to successfully [treat bone fractures](#) that are resistant to other forms of therapy. More recently, frequency-specific, amplitude-modulated EMFs have been found useful to treat [advanced carcinoma](#) and chronic pain.

High frequency EMFs such as the microwaves used in cell phones, smart meters, Wi-Fi and cordless “DECT” phones, appear to be the most damaging when used commonly. Most of their biological effects, including symptoms of electrohypersensitivity, can be seen in the damage done to cellular membranes by the [loss of structurally-important calcium ions](#). Prolonged exposure to these high frequencies may eventually lead to cellular malfunction and death.

Furthermore, malfunction of the parathyroid gland, located in the neck just inches from where one holds a cell phone, may actually cause electrohypersensitivity in some people by reducing the background level of calcium ions in the blood. RF/microwave radiation is also known to [decrease the production of melatonin](#), which protects against cancer, and to [promote the growth of existing cancer cells](#).

### **Early warning scientists attacked**

In recommending that the Precautionary Principle be applied in EMF matters, the European Environment Agency’s Director [Jacqueline McGlade wrote in 2009](#): “We have noted from previous health hazard histories such as that of lead in petrol, and methyl mercury, that ‘early warning’ scientists frequently suffer from discrimination, from loss of research funds, and from unduly personal attacks on their scientific integrity. It would be surprising if this is not already a feature of the present EMF controversy...” Such unfortunate consequences have indeed occurred.

The statement in the *Le Devoir* letter, “if we consider that a debate should take place, it should focus exclusively on the effects of cell phones on health”, is basically an acknowledgement that there is at least some reason to be concerned about cell phones. However, while the immediate exposure from a cell phone is of much greater intensity than the exposure from smart meters, cell phone use is temporary.

### **Smart meters**

Wireless smart meters typically produce atypical, relatively potent and very short pulsed RF/microwaves whose biological effects have never been fully tested. They emit these millisecond-long RF bursts on average 9,600 times a day with a maximum of 190,000 daily transmissions and a peak level emission two and a half times higher than the stated safety signal, as the California utility [Pacific Gas & Electric recognized](#) before that State’s Public Utilities Commission. Thus people in proximity to a smart meter are at risk of significantly greater aggregate exposure than with a cell phone, not to mention the cumulative levels of RF/microwaves that people living near several meters are exposed to.

People are exposed to cell phone microwaves primarily in the head and neck, and only when they use their device. With smart meters, the entire body is exposed to the microwaves, which increases the risk of overexposure to many organs.

In addition to these erratic bursts of modulated microwaves coming from smart meters that are transferring usage data to electric, gas and water utilities, wireless and wired smart (powerline communication) meters are also a [major source](#) of “dirty electricity” (electrical interference of high frequency voltage transients typically of kilohertz frequencies). Indeed, some scientists, such as [American epidemiologist Sam Milham](#), believe that many of the health complaints about smart meters may also be caused by dirty electricity generated by the « switching » power supply activating all smart meters. Since the [installation of filters to reduce dirty electricity](#) circulating on house wiring has been found to relieve symptoms of EHS in some people, this method should be considered among the priorities aimed at reducing potential adverse impacts. Indeed, the Salzburg State (Austria) Public Health Department confirms its concern about the potential public health risk when in coming years almost every electric wire and device will emit such transient electric fields in the kilohertz-range due to wired smart meters.

### **Rather be safe than sorry**

The apparent adverse health effects noted with smart meter exposure are likely to be further exacerbated if smart appliances that use wireless communications become the norm and further increase unwarranted exposure.

To date, there have been few independent studies of the health effects of such sources of more continuous but lower intensity microwaves. However, we know after decades of studies of hazardous chemical substances, that chronic exposure to low concentrations of microwaves can cause equal or even greater harm than an acute exposure to high concentrations of the same microwaves.

This is why so many scientists and medical experts urgently recommend that measures following the Precautionary Principle be applied immediately — such as using wired meters — to reduce biologically inappropriate microwave exposure. We are not advocating the abolishment of RF technologies, only the use of common sense and the development and implementation of best practices in using these technologies in order to reduce exposure and risk of health hazards.

### [1. Scientific papers on EMF health effects](#)

### [2. Explanation and studies on electrosensitivity](#)

### [3. Governments and organizations that ban or warn against wireless technology](#)

- [David O. Carpenter](#), MD, Director, Institute for Health & the Environment, University at Albany, USA
- [Jennifer Armstrong](#), MD, Past President, Canadian Society of Environmental Medicine, Founder, Ottawa Environmental Health Clinic, Ontario, Canada
- Pierre L. Auger, M. D., FRCPC, Occupational medicine, Multiclinique des accidentés 1464, Montreal, Quebec, Canada
- [Fiorella Belpoggi](#), Director Cesare Maltoni Cancer Research Center, Ramazzini Institute, Bologna, Italy
- [Martin Blank](#), PhD, former President, Bioelectromagnetics Society, Special Lecturer, Department of Physiology and Cellular Biophysics, Columbia University Medical Center, New York, USA

- [Barry Breger](#), MD, Centre d'intégration somatosophique (orthomolecular medicine), Montreal, Quebec
- [John Cline](#), MD, Professor, Institute for Functional Medicine, Federal Way, WA, USA, Medical Director, Cline Medical Centre, Nanaimo, BC, Canada
- [Alvaro Augusto de Salles](#), PhD, Professor of Electrical Engineering, Federal University of Rio Grande do Sul, Porto Alegre, Brazil
- [Christos Georgiou](#), Prof. Biochemistry, Biology Department, University of Patras, Greece
- [Andrew Goldsworthy](#), PhD, Honorary lecturer in Biology, Imperial College, London, UK
- [Claudio Gómez-Perretta](#), MD, PhD, Director, Centro de Investigación, Hospital Universitario LA Fe, Valencia, Spain
- [Livio Giuliani](#), PhD, Senior Researcher, National Insurance Institute (INAIL), Chief of Radiation and Ultrasounds Research Unit, Rome, Italy
- [Yury Grigoriev](#), PhD, Chair Russian National Committee on Non-Ionizing Radiation Protection, Moscow, Russia
- [Settimio Grimaldi](#), PhD, Director, Institute of Translational Pharmacology (Neurobiology and molecular medicine), National Research Council, Rome, Italy
- [Magda Havas](#), PhD, Centre for Health Studies, Trent University, Canada
- [Lennart Hardell](#), MD, Professor of Oncology, University Hospital, Örebro, Sweden
- [Denis L. Henshaw](#), PhD, Professor of Physics, Head of The Human Radiation Effects Group, University of Bristol, UK
- [Ronald B. Herberman](#), MD, Chairman of Board, Environmental Health Trust, and Founding Director emeritus, University of Pittsburgh Cancer Institute, USA
- [Donald Hillman](#), PhD, Dairy Science, Professor Emeritus, Department of Animal Science, Michigan State University, USA
- [Isaac Jamieson](#), PhD, Environmental Science (electromagnetic phenomena in the built environment), independent architect, scientist and environmental consultant, Hertfordshire, UK
- [Olle Johansson](#), PhD, Professor of Neuroscience (Experimental Dermatology Unit), Karolinska Institute, Stockholm, Sweden
- [Yury Kronn](#), PhD, Soviet authority on physics of nonlinear vibrations and high frequency electromagnetic vibrations, founder of Energy Tools International, Oregon, USA
- [Henry Lai](#), PhD, Professor of Bioengineering, University of Washington School of Medicine, Seattle, WA, USA
- [Abraham R. Liboff](#), PhD, Professor Emeritus, Department of Physics, Oakland University, Rochester, Michigan, USA
- [Don Maisch](#), PhD, Researcher on radiation exposure standards for telecommunications frequency, EMFacts Consultancy, Tasmania, Australia
- [Erica Mallery-Blythe](#), MD, Emergency Medicine Physician, England
- [Andrew A. Marino](#), MD, PhD, JD, Professor of Neurology, LSU Health Sciences Center, Shreveport, LA, USA
- [Karl Maret](#), MD, M.Eng., President, Dove Health Alliance, Aptos, CA, USA
- [Andrew Michrowski](#), PhD, Director, Planetary Association for Clean Energy, Ottawa, Canada
- [Sam Milham](#), MD, former chief epidemiologist, Washington State Department of Health, USA
- [Joel M. Moskowitz](#), PhD, Director, Center for Family and Community Health, School of Public Health, University of California, Berkeley
- [Gerd Oberfeld](#), MD, Public Health Department, Salzburg State Government, Austria
- [Mike O'Carroll](#), PhD, Professor Emeritus (Applied Mathematics), University of Sunderland, UK
- [Jerry L. Phillips](#), PhD, Director, Center for Excellence in Science, Department of Chemistry and Biochemistry, University of Colorado, USA

- [John Podd](#), PhD, Professor of Psychology (experimental neuropsychology), Massey University, New-Zeland
- [William J. Rea](#), MD, thoracic and cardiovascular surgeon, founder of the Environmental Health Center, Dallas, Tx, USA
- [Elihu D. Richter](#), MD, Professor, Hebrew University-Hadassah School of Public Health and Community Medicine, Jerusalem, Israel
- [Leif G. Salford](#), MD, Senior Professor of Neurosurgery, Lund University, Sweden
- [Nesrin Seyhan](#), MD, Founder and Chair of Biophysics, Medical Faculty of Gazi University, Turkey
- [Cyril W. Smith](#), PhD, lead author of “Electromagnetic Man”, retired from Electronic and Electrical Engineering, University of Salford, UK
- [Morando Soffritti](#), MD, Scientific Director of the European Foundation for Oncology and Environmental Sciences “B. Ramazzini” in Bologna, Italy
- [Antoinette “Toni” Stein](#), PhD, Collaborative on Health and the Environment (CHE-EMF Working Group), Co-Coordinator, Berkeley, CA, USA
- [Stanislaw Szmigielski](#), MD, PhD Professor of Pathophysiology, Consulting Expert, former director of Microwave Safety, Military Institute of Hygiene and Epidemiology, Warsaw, Poland
- [Bradford S. Weeks](#), MD, Director, The Weeks Clinic, Clinton, WA, USA
- [Stelios A. Zinelis](#), MD, Vice-President, Hellenic Cancer Society, Cefallonia, Greece

## LETTER TO THE EDITOR

## Illnesses caused by contact currents in showers

Recently, a patient complained of becoming ill in the shower of a vacation home in the California desert, but not in her home in northern California.

There are reports of inappropriate implantable cardioverter-defibrillator shock induced by electromagnetic interference while taking a shower (Fernengel *et al.* 2007). Kavet *et al.* (2000) has written extensively about contact currents that are a characteristic of the residence itself, reflecting its grounding characteristics and electrical supply. The National Institute of Environmental Health Sciences (NIEHS) Working Group 1998 (Kavet *et al.* 2000) associates chronic exposure to contact currents of 18  $\mu\text{A}$  ( $\mu\text{A}$  = microamperes) and above with the development of cancer. The grounded Wye electrical distribution system in North America and the fact that about 70% of neutral return currents now flow down the down ground wire at the transformers assure that most neutral return currents return to the substation via the earth (Final Report of the Science Advisors 1998). This is in violation of the National Electric Safety Code rules 92 D and 215 B, and the California Public Utility Commission Rule 33.2 which forbids the use of the earth for neutral return currents.

Using a Fluke 287 true RMS multimeter with an electrocardiography (ECG) patch over my sternum attached to one lead and the other lead to an outlet ground, I got the following results in the bathroom of my Indio, California residence with the electric service off:

- Sitting on toilet: feet off ground – 4.1  $\mu\text{A}$ 
  - bare feet on floor – 17.3  $\mu\text{A}$
  - hand-touching shower control – 40.5  $\mu\text{A}$
- Showering: hand-touching shower control – 55.0  $\mu\text{A}$

The same pattern of results was present in nearby residences and at the patient's California residence. My California residence is a fourplex built on a concrete slab. All metal connected to the slab, such as door frames and doors, had high contact current levels. The major source of contact current was the natural gas service pipes at the gas meters at each end of the fourplex.

My wood frame home in Olympia WA had high voltage in the down ground and the earth, but no contact currents in the house. The highest reading was 2.5  $\mu\text{A}$ . The floor was supported by vertical 4 × 4s on concrete pads with an asphalt shingle between the wood and concrete. The water and sewer pipes were plastic.

This situation can be remedied by the utilities adding increased current-carrying capacity to their neutral return wires and respecting existing electrical safety codes.

Samuel Milham and David Stetzer

 smilham@dc.rr.com

## References

- Fernengel, A., Schwer, C., Helber, U., et al. (2007). Inappropriate implantable cardioverter-defibrillator shock induced by electromagnetic interference while taking a shower. *Clin. Res. Cardiol.* 96:393–395.
- Final Report of the Science Advisors to the Minnesota Public Utilities Commission. (1998). Minnesota PUC, 121 7th Place East, Suite 350, St Paul Minnesota 55101–2147.
- Kavet, R., Zaffenella, L. E., Daigle, J. P., et al. (2000). The possible role of contact current in cancer risk associated with residential magnetic fields. *Bioelectromagnetics.* 21:538–553.

# Wireless Devices & Wildlife

## The effects of EMR from wireless devices on wildlife

Excerpts and Resources from *An Electronic Silent Spring*

The radiofrequency (RF) signals that cellular antennas, mobile devices and “smart” utility meters require to function are now ubiquitously and continuously emitted.

*How do these signals affect wildlife?*

Scientists report that RF fields emitted by cellular antennas alone potentially cause the decline of animal populations, reduction of some species’ useful territory, and deterioration of plant health. Some species may experience reduction of their natural defenses, problems in reproduction and aversive behavioral responses. (1)

Here are summaries of studies about the effects of RF signals on trees, insects and birds:

### Trees

In a 2010 paper published in the International Journal of Forestry Research, researcher Katie Haggerty explained that the Earth’s natural radiofrequency environment has remained about the same within the lifespan of modern trees. “Before 1800,” Haggerty wrote, “the major components of this environment were broadband radio noise from space (galactic noise), from lightning (atmospheric noise), and a smaller RF component from the sun. (2) ...Plants may have evolved” to use these environmental signals, along with visible light in order to regulate their periodic functions. Therefore, they may be sensitive to man-made RF fields. “The background of RF pollution,” Haggerty continued, “is now many times stronger than the naturally occurring RF environment. From the perspective of evolutionary time, the change can be considered sudden and dramatic. (3,4) ...Growth rates of plants (5) and fungi (6) can be increased or decreased by RF exposure. Exposure to RF signals can induce plants to produce more meristems, (7) affect root cell structure, (8,9) and induce stress response...causing biochemical changes.”(10)

Ms. Haggerty went on to describe her study of the influence of RF signals on trembling aspen seedlings. Seedlings that were shielded in a Faraday cage (a metal container that prevents RF radiation from entering) thrived. Seedlings that were exposed to RF signals showed necrotic lesions and abnormal coloring in their leaves. (11)

According to British biologist Dr. Andrew Goldsworthy, “Trees are now dying mysteriously from a variety of diseases in urban areas all over Europe. They also show abnormal photoperiodic responses. Many have cancer-like growths under the bark

(phloem nodules). The bark may also split so that the underlying tissues become infected. All of these can be explained as a result of exposure to weak RF fields from mobile phones, their base stations, Wi-Fi and similar sources of weak non-ionizing radiation.” (12)

Other scientists have found that trees in areas with high Wi-Fi activity suffer from bleeding fissures in their bark, the death of parts of leaves, and abnormal growth. In 2010, in the Netherlands, 70% of urban ash trees suffered from radiation sickness, including a “lead-like shine” on their leaves, indicating the leaves’ oncoming death. In 2005, only 10% of ash trees suffered radiation sickness. (13)

## **Ants**

Perhaps the first study to demonstrate that insects have an electrical sense came out in 1992. Biologist William MacKay and his colleagues showed that several kinds of ants were attracted to electrical fields. Indeed, ants can damage equipment that produces “attractive” electrical fields. (14)

In 2013, Belgian biologist Marie-Claire Cammaerts and Swedish neuroscientist Olle Johansson exposed ants to common wireless devices. The scientists placed a mobile phone under a tray, then placed ants on the tray. When the phone was off or on standby-mode, the ants’ angular speed increased. Within two to three seconds of the scientists’ turning the phone on (able to receive or send calls), the ants’ angular speed increased and their linear speed decreased.

Exposed to a smartphone, the linear speed of “fresh” ants decreased; their angular speed increased. The ants’ speed changed similarly but more strongly when exposed to a DECT (cordless landline) phone. They had difficulty moving their legs and did not move toward their nest or their food site as usual. The ants were exposed to each of these two phones for three minutes, and took two to four hours to resume their normal behavior.

When Cammaerts and Johansson put a mobile phone on standby mode under the ants’ nest, the ants left their nest immediately, taking their eggs, larvae and nymphs with them. They relocated far from the phone. Once the phone was removed, the ants returned to their original location.

After thirty minutes of exposure to a Wi-Fi router, the ants’ speed changed again, as did their foraging behavior. It took them six to eight hours to resume normal foraging. Several ants never recovered and were found dead a few days later.

When the scientists placed an ACER Aspire 2920 about twenty-five centimeters away, the insects appeared disturbed as soon as the computer was switched on. When the PC was switched on with its Wi-Fi function de-activated, the ants appeared undisturbed.

The researchers concluded that ants can be used as bio-indicators to reveal the biological effects of RF signals from some wireless devices. They also advised users to de-activate the Wi-Fi function of their PCs. (15)

## **Bees**

Bees also have an electrical sense. Bees are positively charged, and flowers are negatively charged. These charges help pollen stick to bees' hair while they pollenate. In 2012, biologist Dominic Clarke and his colleagues showed that bees use their electrical sense to determine whether or not a flower has recently been visited by another bee—and is therefore worth visiting. (16,17)

In *Bees, Birds and Mankind: Effects of Wireless Communication Technologies* (Kentum, 2009), German scientist Ulrich Warnke states, “Bees and other insects, just as birds, use the Earth’s magnetic field and high frequency electromagnetic energy such as light. They accomplish orientation and navigation by means of free radicals as well as a simultaneously reacting magnetite conglomerate. Technically produced electromagnetic oscillations in the MHz range and magnetic impulses in the low frequency range persistently disturb the natural orientation and navigation mechanisms created by evolution.”

In his book, Warnke quotes Ferdinand Ruzicka, a scientist and beekeeper who reported, in 2003, after several transmitters (cellular antennas) were erected in the immediate vicinity of his hives: “I observed a pronounced restlessness in my bee colonies (initially about forty) and a greatly increased urge to swarm. As a frame-hive beekeeper, I use a so-called high floor. The bees did not build their combs in the manner prescribed by the frames, but in random fashion. In the summer, bee colonies collapsed without obvious cause. In the winter, I observed that the bees went foraging despite snow and temperatures below zero, and they died of cold next to the hive. Colonies that exhibited this behavior collapsed, even though they were strong, healthy colonies with active queens before winter. They were provided with adequate additional food and the available pollen was more than adequate in autumn.”

Ruzicka then organized a survey of beekeepers through the magazine *Der Bienen Vater*. All twenty of the beekeepers who replied to his questionnaire had a transmitter within 300 meters of their beehives. Compared to the bees’ behavior before and after the transmitters were in operation, 37.5% observed increased aggression from their bees.

25% found that their bees had a greater tendency to swarm.

65% reported that their colonies were inexplicably collapsing since the transmitters became operational.

Warnke says that monocultures, pesticides, the Varroa mite, migratory beekeeping, dressed seed, severe winters, and genetically modified seeds could also explain the bee colonies’ collapse. However, none of these convincingly explains “the fairly sudden and

country-spanning appearance two to three years ago of the dying bees phenomenon. Should the bees simply be too weak or ill, they should also die in or near the hive. But no ill bees were found in research into this phenomenon.”

In May, 2009, The U.S. Fish and Wildlife Service urged Congress to investigate the potential relationship between wireless devices and bee colony collapse. (18)

## **Frogs**

In 2010, Spanish biologist Alfonso Balmori published his study of a common frog habitat 140 meters from a cellular antenna. The experiment lasted two months, from the egg phase until an advanced phase of tadpole. Balmori placed some of the frogs inside a Faraday cage. These shielded frogs had a mortality of 4.2%. The unshielded frogs – exposed to the antenna’s RF fields–had a mortality of 90%. Balmori concluded that “this research may have huge implications for the natural world, which is now exposed to high microwave radiation levels from a multitude of phone masts.” (19)

## **Bird collisions with telecom equipment**

Albert Manville, PhD, wildlife biologist with the Division of Migratory Bird Management, U.S. Fish and Wildlife Service (USFWS), estimates that up to 6.8 million birds die per year in collisions with communications antennas or their guy-support wires in North America. The impacts of cellular antenna radiation on migratory birds in North America, especially those nesting close to these structures, remain suspect and unknown.

In January 2012, Dr. Manville wrote: *Recent studies from Europe raise troubling concerns about the effects of radiation from cellular communication antennas, especially on resident, breeding migratory birds. These apparent effects include feather deformities, weight loss, weakness, reduced survivorship and death, especially to those birds and their offspring nesting adjacent to cellular antennas. Where Before-After, Control-Impact (BACI) studies were performed during some of the European research, no effects to resident birds were detected prior to construction and operation of cellular communication antennas. Some laboratory studies in the U.S. have documented lethal effects of extremely low levels of radiation to chicken embryos in the frequencies of cellular telephones, (20) but research to better address cause and effect to wild birds in North America has yet to be conducted. To date, only anecdotal reports from instances in North America have been brought to the attention of authorities at the USFWS.*

*If we are to better understand the cumulative effects of human infrastructure on migratory birds—including communication technologies, research needs to be conducted to specifically address how radiation is affecting migratory birds and what resultant lethal and injurious effects are occurring. The explosive growth of hand-held technologies raises further concerns since potential impacts may grow.*

*The unpermitted killing or injury of a migratory bird, is called a “take” under the Migratory Bird Treaty Act (MBTA). The USFWS does not permit the ‘incidental or*

*accidental take' of any of the 1007 migratory bird species protected under MBTA. Therefore, studies need to be undertaken to determine how much 'take' is occurring as a result of radiation, and what steps can be undertaken to "avoid or minimize" future "take." The USFWS continues to suggest to the FCC the need for these North American studies based alone on cumulative effects that must be addressed under National Environmental Policy Act review. The studies need to better tease out how and at what level "takes" are occurring, then determine what conservation measures can be adopted to "avoid or minimize" future "take." Because of the controversial nature of this issue, any studies and outcomes need to be seamless and fully transparent.*

### **The white stork**

During the Springs of 2002, 2003 and 2004, biologist Alfonso Balmori monitored the reproduction of the white stork, a vulnerable bird species that usually lives in urban areas. White stork couples build their nests in pinnacles and other very high places that are now exposed to man-made microwaves. Balmori studied white stork nests within 200 meters of antennas and nests located more than 300 meters from antennas. He found that 40% of the nests within 200 meters of antennas had no chicks, while only 3.3% of nests further than 300 meters of antennas had no chicks. Also, near antennas, white stork couples frequently fought for sticks, their sticks fell to the ground while they tried to build nests, the nests did not get built and hatched white stork chicks frequently died. (21)

Common citizens have also observed changes in birds when technologies that emit EMR are deployed. After transmitting water meters were installed in Renton, Washington in December, 2012, a retired civil engineer who had spent thirty dollars per month on birdseed for years noticed that the feeders in his yard no longer emptied. His neighbors also noticed that immediately after the transmitting water meters were installed, the birds that had frequented their yard (beside a greenbelt) disappeared. (22)

### **Birds, bees and magnetically-sensitive cryptochromes**

*Why would RF signals disturb birds and bees? Here's an answer from biologist Andrew Goldsworthy, PhD: To navigate and also to control their immune systems, birds and bees use magnetically-sensitive substances called cryptochromes. These are pigments found in virtually all animals, plants and many bacteria. Cryptochromes absorb blue-green and ultra-violet light and use this energy to drive photochemical reactions where light energy is converted to chemical energy. Cryptochromes measure light to control and reset animals' and plants' biological clocks. Some animals also use cryptochromes to sense the direction of the Earth's magnetic field.*

*Unfortunately, cryptochromes are badly impaired by man-made oscillating fields that are orders of magnitude weaker than the Earth's steady magnetic field. Such impairment can disrupt insects' and animals' solar and magnetic navigational abilities. It can account for colony collapse disorder in bees, the loss of some migratory birds and butterflies, and immune system weakening in many more organisms.*

*An array of cryptochrome molecules oriented in different directions can be found in the compound eye of an insect, or in the retina of a vertebrate's eye. This cryptochrome found in the eyes is quite distinct from the regular visual pigments (rhodopsins) that are used in normal vision. However, the combination of these pigments gives the animal the potential to "see" the direction of the magnetic field, possibly as an extra color superimposed on its normal field of vision.*

*Robins can navigate in the Earth's magnetic field if they receive light from wavelengths absorbed by cryptochrome. (23) However, exposure to man-made frequencies between 0.1 and 10MHz at field strengths as little as 0.085 mT (about 500 times weaker than the Earth's magnetic field) made the birds completely unable to respond to the Earth's field.*

*Frequencies used by mobile devices, including cell phones, DECT cordless landline phones and Wi-Fi, can blot out "magnetic vision." Even lower field strengths are likely to disturb magnetic navigation, since radiation that is too weak to blot out magnetic vision totally may still be strong enough to distort a bird's perception of the Earth's field, causing the bird or insect to fly in the wrong direction.*

*The sheer number of wireless devices gives birds continuously conflicting navigational data – as if they're constantly bombarded by flashing disco lights. We should not be surprised that birds would leave such areas. Likewise, scientists who put DECT cordless phone base stations next to their beehives found that their bees behaved abnormally and were less likely to return to the hive. (24) (Beekeepers are thereby well advised not to carry their mobile phones when visiting their hives.)*

*Birds, bees and many other animals can also navigate by the sun's position. To do this, they must have an internal clock that adjusts to the sun's changing position throughout the day. Cryptochrome makes this clock sensitive to magnetic fields. A 300 mT steady field can alter the clock's speed or even stop it altogether. (25) Given that sensing light and magnetic fields by cryptochrome uses the same basic mechanics as the internal clock, it's likely that weak alternating fields would also disrupt a clock's normal functions. As a consequence, weak, man-made electromagnetic fields would render animals unable to adjust accurately to the sun's changing position. This leaves the animal unable to use either magnetic or solar navigation. If there were no landmarks to guide it, the animal would be completely lost. This could explain colony collapse disorder, when bees do not return to their hives.*

*Circadian (daily) metabolic rhythms, which occur in virtually all higher organisms, keep us in sync with the Earth's twenty-four hour rotation on its axis. Circadian rhythms are also driven by cryptochrome-containing internal clocks. They enable the organism to anticipate the coming of dawn and dusk, and they modify its metabolism to be ready for the new conditions. Circadian rhythms control the production of melatonin (a sleep hormone); at night, they divert metabolic resources to repair and immune system strengthening.*

*Losing or even weakening of the circadian rhythm – due to a failure of the internal*

*clock's exposure to man-made electromagnetic fields—would have serious consequences. In humans, this would result in tiredness during the day, poor sleep at night, and reduced production of melatonin. All of these effects have been reported in people exposed to continuous, weak, electromagnetic radiation from DECT phone base stations, Wi-Fi routers and cellular antennas.*

*Also, any weakening of the circadian rhythms' amplitudes means that processes controlled by them will never function at maximum power. The immune system may never be able to summon the massive power that is sometimes required to overcome pathogens or destroy developing cancer cells before they get out of control. In part, this could explain epidemiologists' findings that people living near cellular antennas have an increased cancer risk. It could also explain bee colonies' continuing decreased health and ability to resist pathogens.*

Bill Bruno, PhD biophysicist, retired from the Los Alamos National Lab: *Biology is very sophisticated in its ability to make use of electromagnetic fields. Cryptochromes are just one example. Despite centuries of discoveries in biology and advances in medicine, there is so much we don't know. For example, why do our brains, sinuses and other tissues have magnetic magnetite particles?*

*Our bones and collagen are piezoelectric: in an electric field, they expand and contract. What are the implications of that? And what about recent experiments that show that DNA is a semiconductor, and that melanin, including neuromelanin in the brain, is a conductor?*

#### Endnotes

1. Balmori, A., "Electromagnetic pollution from phone masts. Effects on wildlife," *Pathophysiology*, (2009), doi: 10.1016/j.pathophys.2009.01.007.
2. Maslin, N.M., " *HF Communications: A Systems Approach*, Plenum Press, 1987.
3. *ibid.*
4. Sanders, E.H., et al, "Broadband spectrum survey at Los Angeles, California," NTIA Report 47-336, 1997.
5. Petrov, I.Y., et al, "Possibility of correction of vital processes in plant cell with microwave radiation," in *Proceedings of IEEE International Symposium on Electromagnetic Compatibility*, pp. 234-235, December, 1991.
6. Berg, A. and H. Berg, "Influence of ELF sinusoidal electromagnetic fields on proliferation and metabolic yield of fungi," *Electromagnetic Biology and Medicine*, v. 25, no.1, pp. 71-77, 2006.
7. Tafforeau, M., et al, "Plant sensitivity to low intensity 105 GHz electromagnetic radiation," *Bioelectromagnetics*, v.25, no. 6, pp. 403-407, 2004.
8. Bitonti, M.B., et al, "Magnetic field affects meristem cell activity and cell differentiation in *Zea mays* roots," *Plant Biosystems*, v. 140, no. 1, pp. 87-93, 2006.
9. Wawrecki, W. et al, "Influence of a weak DC electric field on root meristem architecture," *Annals of Botany*, v.100, no.4, pp. 791-796, 2007.
10. Roux, D., et al, "Electromagnetic Fields (900 MHz) evoke consistent molecular responses in tomato plants," *Physiologia Plantarum*, v.128, n.2, pp. 283-288, 2006.

11. Haggerty, Katie, "Adverse Influence of Radio Frequency Background on Trembling Aspen Seedlings: Preliminary Observations," *International J. of Forestry Research*, 2010.
12. [www.mastsanity.org/health/research/299-why-our-urban-trees-are-dying-by-andrew-goldsworthy-2011.html](http://www.mastsanity.org/health/research/299-why-our-urban-trees-are-dying-by-andrew-goldsworthy-2011.html)
13. [www.popsci.com/technology/article/2010-11/wi-fi-radiation-killing-trees](http://www.popsci.com/technology/article/2010-11/wi-fi-radiation-killing-trees)
14. MacKay, William, Said Majdi, et al, "Attraction of Ants (Hymenoptera: Formicidae) to Electric Fields," *J. of the Kansas Entomological Society*, 65(1), 1992, pp. 39-43.
15. Cammaerts, Marie-Claire and Olle Johansson, "Ants can be used as bio-indicators to reveal biological effects of electromagnetic waves from some wireless apparatus," *Electromagnetic Biology and Medicine*, 8.30.13.
16. Clarke, Dominic, Heather Whitney, et al, "Detection and Learning of Floral Electric Fields by Bumblebees," *Science DOI: 10.1126/science.1230883*; published online February 21, 2013.
17. Kaplan, Matt, "Bumblebees sense electric fields in flowers," *Nature*, February 21, 2013.
18. <http://electromagnetichealth.org/electromagnetichealth-blog/emf-and-warnke-report-on-bees-birds-and-mankind/>
19. Balmori, A. and C. Navarra, "Mobile phone mast effects on common frog (*Rana temporaria*) tadpoles; the city turned into a laboratory," *Electromagn Biol Med*, 2010, June;29(1-2); 31-5. 59.
20. Di Carlo, A., White, N., Guo, F. et al, 2002, "Chronic electromagnetic field exposure decreases HSP70 levels and lowers cytoprotection," *J. of Cellular Biochemistry*, 84;447-454.
21. Balmori, A., (2005) "Possible effects of electromagnetic fields from phone masts on a population of white stork (*Ciconia ciconia*)," *Electromag. Biol. Med.* 24:109-119.
22. Beckley, Brian, "Are smart meters chasing away birds from Rolling Hills?" *Renton Reporter*, February 22, 2013.
23. Ritz et al, *Nature*, Vol. 429, May 13, 2004, 177-180.
24. Yoshi, et al, <http://tinyurl.com/rans84>
25. Yoshi et al, <http://tinyurl.com/cx7xaa>



## Board of Advisors

### Advisory Board:

- [Gene Barduson](#), Executive Chairman of the Board of Directors, PerfectServe Inc
- [Mike Doherty](#), Global Head of Regulatory Affairs, Strategic Innovation and Policy, Hoffmann-La Roche Ltd & Genentech
- [John D. Doyle](#), Executive Vice President, Ascension Health Alliance; President and CEO, Ascension Health Holdings
- [Michael Farrell](#), President, Americas, ResMed
- [Donald Jones](#), Co-Founder & Chairman, WLSA; Chief Digital Officer of the Scripps Translational Science Institute
- [Bruno Leroy](#), Vice President, Head of Global Access Strategies, Sanofi
- [Linda Myrick](#), Program Director, R&D, Air Liquide
- [Jim Parshall](#), Director of Digital Device Development, Eli Lilly and Company
- [Chris Penrose](#), Senior Vice President, Emerging Devices, AT&T
- [Leslie A. Saxon](#), Chief Division of Cardiovascular Medicine, Keck School of Medicine at USC; Executive Director, USC Center for Body Computing
- [Thomas Schwieterman](#), Medical Director, Midmark Cooperation
- [Ralph Simon](#), Chief Executive Officer, Mobilium Global Limited
- [Eric Topol](#), Director, Scripps Translational Science Institute; Chief Academic Officer, Scripps Health; Professor of Genomics, The Scripps Research Institute
- [Rick Valencia](#), Vice President & General Manager, Qualcomm Life

### Ex Officio Members: WLSA Board of Directors

- [Jeff Belk](#), Founder, Bright Light Management; Venture Partner, OurCrowd; Managing Director, ICT168 Capital LLC
- [M. Wainright Fishburn](#), Partner, Cooley LLP
- [Sharon Henry](#), President, Evolution Health

## Advisory Board:



**Gene Barduson**

Gene Barduson is Executive Chairman of the Board of Directors for Perfect Serve and is an information technology industry expert with a proven, 30-year track record of producing increased sales and profitability in large company, start-up and turnaround situations. Gene started his career with IBM and later became involved in three start-ups during the early stages of the CAD/CAM industry. In 1989, he took an executive position with Shared Medical Systems, Inc. (SMS), now part of Siemens, AG where he served as Senior Vice President for the Western Region and all national accounts. After SMS, Gene was recruited to serve as president and CEO of EDiX Corporation where he guided a turnaround and grew revenue from \$14 million to more than \$100 million over a five-year period. During that time he led the successful sale of EDiX to IDX — and positioned EDiX as the market-leading technology-based medical transcription company in the country.

Gene left IDX to serve as chairman and CEO of Apexion Technologies Inc., a start-up technology company providing health care supply and surgical instrument tracking applications which was acquired by Lawson Software. Prior to Perfect Serve, Gene served as president and CEO of Alteer Corporation, a software service provider to medical practices. While at Alteer, he raised \$20 million of venture capital and engineered a successful turnaround and sale to American Health.

Gene holds a Bachelor of Science in Mathematics from St. Cloud State University and Master of Mathematics from the University of Northern Iowa.

Gene presently serves on the Board of Independa. Gene also serves on the Board of Trustees at Western University of Health Sciences.



**Michael Doherty**

Michael Doherty is the Global Head of Regulatory Affairs, Strategic Innovation and Policy, Hoffmann-La Roche Ltd and Genentech, located in San Francisco. He has been head of Regulatory Affairs, Hoffman-La Roche Ltd. since 2002. He started his career in 1986 in regulatory Affairs in the Cyanamid Company (Lederle), based in the UK working primarily in the field of antibiotics registration with the UK health authority. He then joined Sandoz where he led the regulatory group in the UK undertaking the first European filings under the mutual recognition and centralized procedures with the EU commission. In 1992, he joined Rhone Poulenc Rorer (RPR) and took on global regulatory responsibility for the respiratory and endocrinology portfolios. He later joined Astra (to become AstraZeneca) where he took firstly the head of the Respiratory and Inflammation regulatory team and then became global head of drug development regulatory affairs. In 2002, he joined Hoffman-La Roche as global head, regulatory Affairs based in Basel. Prior to working in the Pharma industry he worked at the University of Manchester UK and Christie Hospital in the regional endocrinology laboratory. He has a BSc in Biochemistry and a

fellowship of the Institute of Medical Sciences, UK and a Diploma in Management studies from the University of Portsmouth, UK.



**John Doyle**

John D. Doyle serves as Executive Vice President, Ascension Health Alliance, the parent organization of Ascension Health. He is also President and Chief Executive Officer of AH Holdings, LLC, a subsidiary of Ascension Health Alliance.

He has responsibility for a portfolio of companies designed to add value to the organization by providing services to the Health Ministries of Ascension Health as well as other health systems in the United States and internationally. Mr. Doyle's, along with other executives, oversees incubation of transformational solutions and innovative relationships that have the potential to accelerate accomplishment of Ascension Health's Strategic Direction. He also serves as Chairman of the Board of TriMedx, a subsidiary of AH Holdings that provides clinical engineering services to healthcare organizations throughout the United States and internationally. He serves on the Board Trimedx International, a joint venture currently providing clinical engineering services in India.

Mr. Doyle previously served as Ascension Health's Chief Strategy Officer and General Manager, Transformational Development. Earlier he was Senior Vice President, Strategic Business Development & Innovation for Ascension Health. Before joining Ascension Health's System Office, he was Executive Vice President for Strategic Development for St. Vincent Hospitals and Health Services, Indianapolis, overseeing strategic planning, network development, managed care, marketing, corporate communications and government affairs.

Mr. Doyle is a former Vice President of Marketing, Public Affairs and Product Line Management for MacNeal Health Network in Chicago and served as director of marketing and public relations for the Educational Services Unit of ITT Corp. He began his career with St. Jude Children's Research Hospital. Mr. Doyle earned a bachelor's degree from Butler University, Indianapolis, and a master's degree from Ball State University, Muncie, Indiana.



**Mick Farrell**

Michael "Mick" Farrell is currently President, Americas at ResMed; he joined ResMed (San Diego, CA – NYSE: RMD) in September 2000. Mick has responsibility for sales, clinical education, customer service, channel marketing, and all commercial activities for North America, Central America, and South America. He previously held roles running a global business unit for ResMed's therapeutic and diagnostic medical devices for sleep apnea, as well as prior roles with responsibility for marketing and business development at the company. Before joining ResMed, Mr. Farrell worked in management consulting and biotechnology, as well as in chemicals and steel manufacturing at Arthur D. Little, Genzyme Corporation, The Dow Chemical Company, Vale and BHP Billiton. Mr. Farrell sits on the Board of Directors of the American Association for Homecare. Mr. Farrell holds a Bachelor of Engineering, with first-class honors, from the University of New South Wales, a Master of Science in Chemical

Engineering from the Massachusetts Institute of Technology, and an M.B.A. from the MIT Sloan School of Management.



**Donald Jones**

Donald Jones is the Chief Digital Officer of the Scripps Translational Science Institute in La Jolla, California, where he works with the Director, Eric Topol, MD and Steve Steinhubl, MD, Director Scripps Digital Medicine, one of the first clinical trial centers focused exclusively on digital health and medicine products.

Through February 2014, Mr. Jones served as Qualcomm Vice President of Wireless Health Global Strategy and Market Development. Mr. Jones is globally recognized as a leader in the field. In 2011, working with XPrize Foundation CEO, Peter Diamandis, and Qualcomm's CEO, Dr. Paul Jacobs, he conceived the \$10M Qualcomm Tricorder Xprize for a consumer device capable of making multiple diagnosis. In 2005, he founded and is Chairman of the Wireless Life Sciences Alliance ([www.wirelesslifesciences.org](http://www.wirelesslifesciences.org)). Mr. Jones is widely asked to speak and recent engagements have included the Milken Institute, Sanofi Executive Committee, J&J Innovations Master Class, MIT Emtech, the MEMS Industry Group, the NIH Directors Leadership Meeting, and the world's largest trade show, CES. He is a member of the Milken Institute Advisory Committee on Biomedical Innovation.

Jones holds a bachelors' degree in biology and bioengineering from the University of California, San Diego, a Juris Doctor from the University of San Diego and an MBA from the University of California, Irvine.



**Bruno Leroy**

Bruno Leroy is Vice-President Global Access Strategies in Integrated Patient-centered Solutions at sanofi. He is an MD, and was previously Assistant Professor in Pediatric Nephrology in Paris before joining the Pharmaceutical Industry in 1993. He has been directly involved in virtually all phases of compound life cycle in R&D and commercial operation, from dose selection to approval, market access and launch phases.

In its current role, his team mandate is to accelerate incorporation of efficient access strategies and innovative customer solutions at sanofi, looking to deliver new sources of value with a patient centric approach. To develop integrated patient-centered solutions, several dimensions of patients' needs are to be considered, including primary cause and symptoms of the disease, its associated symptoms and comorbidities, patient care pathways and disease continuum steps, lifestyle and social impact. This requires in depth, multifaceted insight and mapping of most important and under-addressed patients struggles, as well as evaluation of the health and cost burden of these care deficiencies. The extent of possible care offers should go beyond drugs, and include various services among which digital solutions. Rapidity of innovation and prototyping, identification of new funding and business model, scalability, and joint efforts of several actors in the health care value chain will be key to move from product to patient centric offers.



**Linda Myrick**

Linda is responsible for global R&D programs for Healthcare, Medical Technologies, and Biomarkets including Food, Pharma, Water Treatment and other biological-based processes located in Newark, Delaware. She relocated from Paris, France where she spent 3½ years as the R&D Group Manager for Medical Gases for Air Liquide Santé International. She began working for Air Liquide with the acquisition of Scott Specialty Gases, Inc. in 2007 where she was General Manager for Scott Medical Products in Philadelphia, Pennsylvania. Before joining Scott in 2004, she held general management positions with Rhodia, Inc. and FMC Corporation. Since 2006, she is an independent Director for Innophos, Inc., a NASDAQ- traded specialty phosphates and minerals corporation. She is a Board member of the Air Liquide healthcare affiliate, SEPPIC Inc., and the Advisory Board of the Wireless Life Sciences Association. She previously served as an independent Director for Berwind Pharmaceutical Services, Inc., offering pharmaceutical coatings and excipients. Ms. Myrick earned a B.S. in Chemical Engineering from the University of Delaware, where she is a member of the Alumni Association, the Chemical Engineering Advisory Board, and the Biomedical Engineering Advisory Board. She has an M.B.A. from the Wharton Graduate School of the University of Pennsylvania.



**Jim Parshall**

Jim Parshall is the director of digital device development at Eli Lilly and Company. He joined Lilly in 1999 and has held various technical and leadership roles in manufacturing and product development. Jim's career has been focused on software and technology, where he has developed and led high-performing teams, architected business-critical strategies, designed new and novel manufacturing processes, and partnered internally and externally to deliver multi-million dollar product and manufacturing programs. Recognizing the incredible opportunities with connected health, Jim and his team are focusing on applying mobile technology and cloud computing to medical devices.

Jim earned a bachelor's degree in electrical engineering from Kettering University and a master's degree in electrical engineering from Purdue University. As he can effectively represent and communicate very complex subjects, Jim has spoken and consulted on applications of technology from making ice cream to processing nuclear waste. His book, *Applying S88: Batch Control from a User's Perspective*, a tutorial on modular software for batch manufacturing, has influenced projects, operations, and thinking worldwide.



**Chris Penrose**

Chris Penrose is Senior Vice President of AT&T's Emerging Devices Organization. Penrose leads a team that is responsible for connecting AT&T's wireless network to consumer electronics including tablets, computers, tracking devices, eReaders, mHealth and portable navigation.

With more than two decades of experience with AT&T and its predecessor companies, Penrose has expertise in strategic planning, new product development, sales, marketing, distribution planning and customer service.

Prior to this role, Penrose was Vice President/General Manager of AT&T's South Texas Market, where he had complete P&L responsibility for both wireline and wireless products. He held a similar position with AT&T in Virginia and West Virginia.

Penrose earned a Bachelor of Science in Marketing and a Masters in Business Administration from Indiana University. He is active in the community, having served on the boards of directors of Junior Achievement, the University of Texas at San Antonio, the North Texas Chamber of Commerce and the San Antonio Sports Foundation.



**Leslie Saxon**

Leslie Saxon, M.D., is a Professor of clinical medicine at the USC Keck School of Medicine, specializing in the diagnosis and treatment of arrhythmias in patients with congestive heart failure. After serving as the director of the electrophysiology laboratory and implantable device services at UC San Francisco, Dr. Saxon was recruited to serve as the Chief of Cardiovascular Medicine at USC.

In addition to using state-of-the-art resynchronization devices in patients with arrhythmias, such as modified pacemakers and implantable defibrillators, Dr. Saxon also collaborates with medical device companies to evaluate the latest, most innovative interventional gadgets for patients with difficult-to-treat heart failure.

Dr. Saxon has completed over 75 publications in various medical journals and is an active member of a multitude of organizations, including the American College of Cardiology, the Heart Rhythm Society, The American Heart Association, and the Heart Failure Society of America.

In 2002, Dr. Saxon co-chaired the first Heart Rhythm Society Conference in Cardiac Resynchronization. On October 26, 2007, Dr. Saxon was proud to host the First Annual USC Body Computing Conference, which brought together leading authors and futurists as well as leaders from the fields of medicine, design, entertainment, the FDA, investment banking, and pharmaceuticals for a day of intense discussions about the nascent but exciting field of wireless physiologic monitoring.



**Tom Schwieterman**

Dr. Thomas (Tom) Schwieterman is the Medical Director for Midmark Corporation – the most trusted name in medical, dental and veterinary examination and procedure room equipment, dedicated to helping healthcare providers deliver the most efficient and effective patient care. In this position, “Dr. Tom” supports Midmark’s focus on potential breakthrough technologies and trends as they look toward future markets. His specific focus is on the optimal ways health information technology can improve provider efficiency and patient outcomes.

In his work with SleepView®, Midmark’s innovative solution for diagnosing obstructive sleep apnea (OSA), Dr. Tom has provided expert opinion in the field of OSA and home sleep testing. Dr. Tom’s advocacy activities for advancing sleep medicine include appearances on morning news broadcasts discussing the importance of good sleep, participation in panel discussions, interviews for articles published in industry magazines and research in primary care enabled diagnostics.

Prior to joining Midmark in 2007, Dr. Tom studied family medicine at Providence Hospital in Southfield, Michigan, attaining the role of chief resident and president of the hospital resident staff. After residency, he operated a successful private practice in rural Ohio. Seeing inefficiencies in his workflow, Dr. Tom created a medical software product called “Chartscribe.” This product made a significant impact on the way he practiced medicine. Microsoft Corporation recognized Dr. Tom as a leading innovator in health information technology in 2003.

Dr. Tom holds a Bachelor of Science in software engineering from Miami University, Ohio and a Doctor of Medicine degree from The University of Cincinnati College of Medicine. He remains board certified in family practice, serving as a member of the board of trustees for Compassionate Care of Shelby County (CCSC) and providing direct patient medical care there as a volunteer.

Dr. Tom and his wife, Maria, enjoy three children. He also takes pleasure in classical music, travel and participates on the board for the Miami Valley Council – Boy Scouts of America.



**Ralph Simon**

Ralph Simon is acknowledged as one of the founders of the modern mobile entertainment industry. Over the last 15 years, he has been a prominent global mobile trailblazer and innovator, helping grow the mobile entertainment and content industry, and playing a central role in its impact and presence worldwide.

Simon heads the London-based Mobilium International, which provides high-level strategic advice and guidance to mobile handset makers, telco operators, technology companies, media companies, movie studio & TV networks, global music artists, ad agency groups, brands, and platform providers around the world. Specifically, Simon recommends unique, practical ways to expand a company’s mobile business and achieve profitability by growing

revenues and maximizing impact from the use and distribution of mobile entertainment content, mobile music, messaging, mobile media technology and applications.

Currently, he serves on the boards of several companies, including Hungama Digital Media Entertainment, India's major mobile content producer, and also mobile games maker Tunewiki.com. In addition, Simon works closely with the GSM Association, the global governing body of the mobile phone industry, providing expert advice on the future of mobile use and mobile entertainment. He also has served for the past three years on the Visionary Committee for MIDEM, the international record industry's annual convention that helps shape the global music industry's best practices for use of intellectual property and music.

Ralph Simon is a Fellow of the Royal Society of Arts in the UK, where his "Future of Media" lecture series is popular, and he is a member of the Academy of Recording Arts & Sciences in the US.



**Eric Topol**

Cardiologist, Eric Topol, MD, believes that patients should be fully empowered. He ensures this by sharing information completely and building a partnership with his patients. Dr. Topol is also a believer that each patient is unique and therefore requires a specific care plan tailored to their individual needs. He uses the latest innovations in heart care to treat his patients and only turns to medication when absolutely necessary.

Dr. Topol was voted as the number one Most Influential Physician Executive in the United States in a 2012 national poll conducted by Modern Healthcare. A practicing cardiologist at Scripps Health, Dr. Topol has done much to expand our understanding of how genetics can determine a person's health risks, particularly their risk for a heart attack. He has been a spearhead in the discovery of multiple genes that increase susceptibility for heart attack and continues his research in this area with the Scripps Translational Science Institute. Here, physicians and scientist work together to discover and define the genes that may influence disease. In his productive career as a physician-scientist, he has built an international reputation for his ground-breaking research and expertise. He also started a medical school, with the goal of training future generations of physician-scientists. In addition, he ran the Cleveland Clinic heart program for 14 years, and brought it to the number one ranking by U.S. News and World Report for over 10 years consecutively.

Of special interest to Dr. Topol are genomics, wireless sensors, preventative cardiology (including heart attack prevention), coronary artery disease and preventative medicine. The research that Dr. Topol has done on genomic and wireless digital technologies continues to reshape the future of medicine. Despite his in depth research focus, he continues to see patients at Scripps Clinic, as he believes that research is only as good as what it can do to help others.



**Rick Valencia**

Rick is vice president of Qualcomm and the founder and general manager of Qualcomm Life, a wholly owned subsidiary of Qualcomm Incorporated. He is responsible for day-to-day operations as well as leading the company's product development and technology strategy in the wireless health market. Rick is a true champion of healthcare innovation as evidenced by his efforts at Qualcomm Life and in the broader industry. In addition to running Qualcomm Life, Rick oversees all corporate initiatives that drive innovation in wireless health at Qualcomm, including the strategic partnership with Rock Health and the \$100 million Qualcomm Life Fund. As an advisor to Telcare, Inc., an early-stage health care device manufacturer, Rick helped the company launch the first cellular enabled diabetes blood glucose meter. Rick is currently an active member of HIMSS and mHIMSS, both non-profit organizations, which are advancing the best use of information and technology for the betterment of healthcare.

Previously, Rick founded and served as Chief Executive Officer and Chairman of the Board of ProfitLine, a business he built up from a one-man show into a \$35 million enterprise, with 200 team members and 70 Fortune 1000 clients. ProfitLine made it to the Inc. 500 list of fastest growing companies for three consecutive years. Rick not only built a new business, but was also the driving force behind a lucrative new telecommunications industry. Following this experience, Rick brought his technology expertise and entrepreneurial spirit to HCL Expense Management Services Inc., a \$50 million subsidiary of HCL Technologies, as Chief Executive Officer. In recognition of his proven ability to succeed in business, Rick was awarded the highly coveted Ernst & Young Entrepreneur of the Year Award.

On a personal note, Rick is also a former Chairman and long-time board member of Big Brothers, Big Sisters of San Diego County and a Chairman of the local chapter of the Young Presidents Organization (YPO). Rick currently serves as a mentor at the Founder Institute and on the Executive Committee of the San Diego MIT Enterprise Forum where he helps fellow entrepreneurs launch meaningful and enduring technology companies. Rick earned a bachelor's degree in business administration and finance from California State University Northridge.

## **Ex Officio Members:**



**Jeffrey K. Belk**

Jeffrey Belk is Managing Director of ICT168 Capital, LLC, focused on developing and guiding global growth opportunities in the ICT (Information and Communication Technology space). Formerly, Belk spent almost 14 years at Qualcomm, where prior to his departure in early 2008, he was Qualcomm's senior vice president of strategy and market development, focused on examining changes in the wireless ecosystem and formulating approaches to help accelerate mobile broadband adoption and growth.

From 2000 until 2006, Belk was senior vice president, global marketing, leading a team responsible of all facets of the company's corporate messaging, communications, and marketing worldwide. In 1999-2000, Belk was SVP & GM of Qualcomm Eudora Products, Qualcomm's award winning email client. In 1997, Belk was named VP, marketing of Qualcomm Consumer Products, and initiated the company's global branding and communications efforts. Prior to Qualcomm, Belk spent ten years in the early growth years of the PC industry, primarily with Proxima Corporation. Belk joined the company in 1983, when the company was less than 25 employees, and was with the company through its IPO in the early 90's in several key distribution, product management, and international roles.

Belk is on the Board of Directors of Peregrine Semiconductors, InterDigital Corporation, as well as the Board of the Wireless Life Sciences Alliance. He has a BA in Economics from University of California, San Diego, and an

M.B.A. from the University of California, Irvine. He is known globally as a commentator and writer on wireless, mobile broadband, and technology evolution.



**M. Wainright Fishburn, Jr.**

Wain Fishburn is a founding partner of Cooley LLP's San Diego office and represents high growth technology and life sciences corporations ranging from start-up to public. Mr. Fishburn is an active community leader and has shaped many industry organizations. He is a founding board member of the Corporate Directors Forum, as well as BIOCOM, where he currently serves as Vice Chair of the BIOCOM Board of Directors. He is a member of the Board of Trustees and the Executive Committee of the Sanford-Burnham Institute for Medical Research. He serves on the Board of Directors for the Critical Path Institute, an independent institute created in part by the FDA, dedicated to improving the regulatory path for innovative medical therapies. Mr. Fishburn is a founder of two public companies and prior to law school, worked in the corporate environment assisting with the divestiture of a group of 12 operating companies.

He received his J.D. degree from the University of California, Hastings College of the Law, and has served as President of the Hastings Board of Governors.



**Sharon Henry**

Sharon Henry currently directs wireless initiatives for Emergency Medical Services Corporation (EMSC), the nation's leading provider of ambulance and outsourced physician services. American Medical Response provides the nation's largest emergency and non-emergency ambulance service, while EMCARE is the leading provider of outsourced physician services to hospital emergency departments, inpatient physician services, inpatient radiology management programs and anesthesiology services. EMSC also provides air ambulance service and offshore medical services to oil platforms in the Gulf. EMSC provides services each year to more than 10 million patients in more than 2,000 communities nationwide. Sharon's background in market application and implementation allows EMSC to move further into wireless digital medicine.

Sharon has been in the ambulance service business for thirty years, ten of which were in mergers and acquisitions during the roll-up of ambulance companies to large providers in the late 1990s. She co-founded MedicWest Ambulance in Las Vegas, Nevada which grew from a start-up to becoming a large provider in all of Clark County, including the famous Las Vegas Strip. MedicWest was sold to EMSC in 2007, and is now the sole provider of service in the Las Vegas market. Sharon has managed large national performance based ambulance contracts and 911 emergency call centers.

She has a B.S. Degree from Oregon State University and an M.B.A. from the University of California, Irvine.

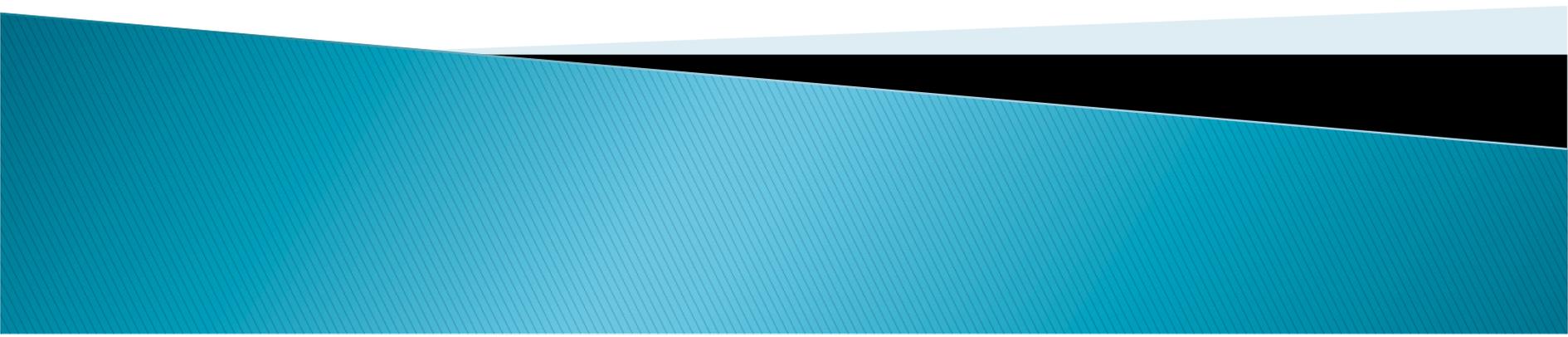
# Wireless Utility Meter Safety Impacts Survey

Final Results Summary

September 13, 2011

Ed Halteman, Ph.D., Consultant

303.818.3679



# Table of Contents

- Objective and Methods Page 3
- Executive Summary Page 4–6
- Demographics Page 7–11
- Wireless Meter Installations Page 12–17
- Wireless Meter Effects Page 18–23
- Complaints to Utility and PUC Page 24–28
- Factors Associated w/Health Symptoms Page 29–31
- Verbatim Comments Page 32–34
- Survey Questions Page 35

# Objectives

- ▶ To investigate reported public health and safety complaints about wireless utility meters.
- ▶ To evaluate the impacts on health and safety due to wireless utility meters.
- ▶ To determine whether further study is warranted.

## METHODS

- ▶ Survey was designed by the EMF Safety Network (Network).
- ▶ The survey was circulated online through various social media outlets including Networks email list, Facebook, and the California EMF Safety Coalition (a discussion group). The survey was also posted on Networks website: [www.emfsafetynetwork.org](http://www.emfsafetynetwork.org) where visitors were invited to take the survey.
- ▶ 443 responses were received from 7/13/2011 through 9/2/2011.
- ▶ Network commissioned Survey Design and Analysis (SDA) to provide this report of the survey findings.

# Executive Summary – Part I

- ▶ Respondent Makeup
  - 93% are over 40 years old and 43% are over 60 years old
  - 73% are women
  - 78% are from California
  - 68% have Pacific Gas and Electric (PG&E) as their utility provider
  - 49% are EMF Sensitive
- ▶ 41% have had a new wireless meter installed in their home; of these . . .
  - 56% have had it installed for at least six months
  - 89% have electric meters, 53% gas meters and 10% water meters
  - 35% saw an increase in their utility bill
  - 26% have experienced some type of interference
  - 8% experienced burned out appliances or damaged electronics including TV, stereo, computer, refrigerator and other.
- ▶ 76% indicated they have wireless utility meters installed in their neighborhood, town or city.
  - 44% near their home
  - 36% in town

# Executive Summary – Part II

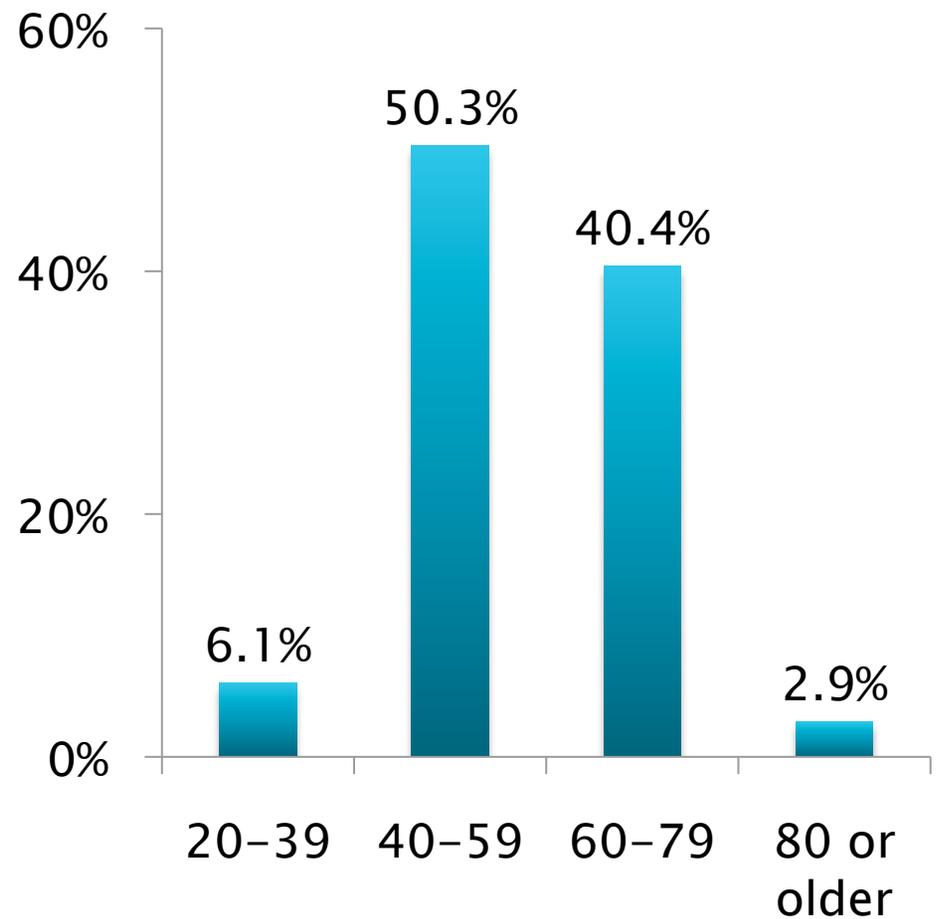
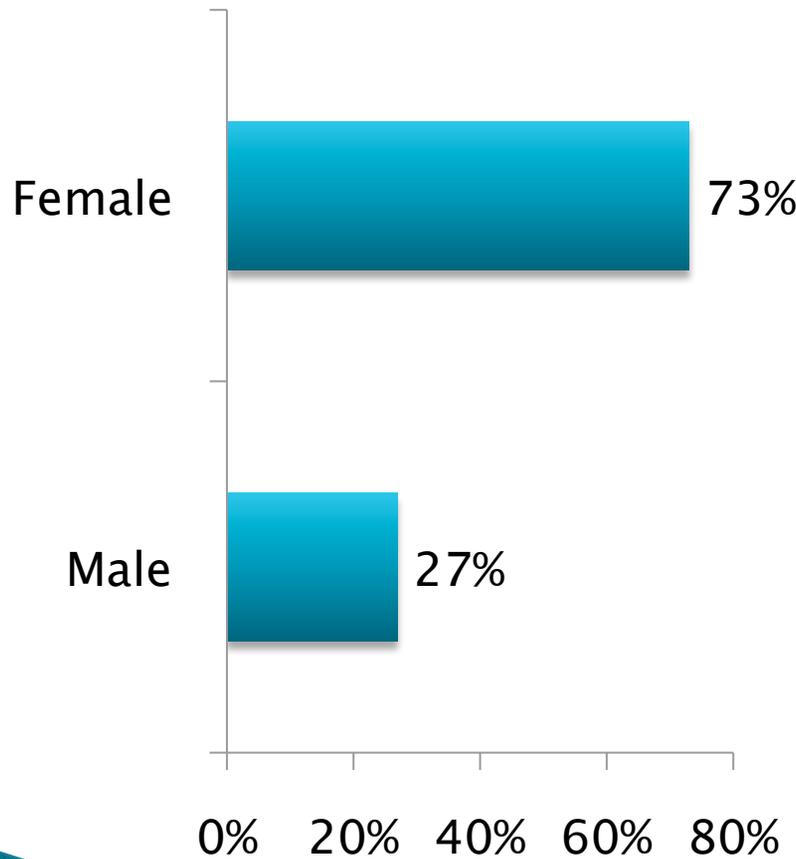
- ▶ Top health issues since new meters installed
  - Sleep problems (mentioned by 49%)
  - Stress, anxiety and irritability (43%)
  - Headaches (40%)
  - Ringing in the ears (38%)
  - Heart problems (26%)
- ▶ 40% (111 people) of those having wireless meters in their homes or community have complained to their utility provider.
  - 96% of these people were either “Unsatisfied” or “Very Unsatisfied” with the handling of their complaint.
- ▶ 32% (88 people) complained to the utilities commission.
  - 96% of these people were either “Unsatisfied” or “Very Unsatisfied” with the handling of their complaint
- ▶ 94% of respondents want to retain or restore their analog meters and 92% of these respondents do not think they should have to pay any additional money.

# Executive Summary – Part III

- ▶ Statistical testing shows the top health symptoms are positively associated with
  - EMF Sensitivity
  - Wireless meters installed in the home

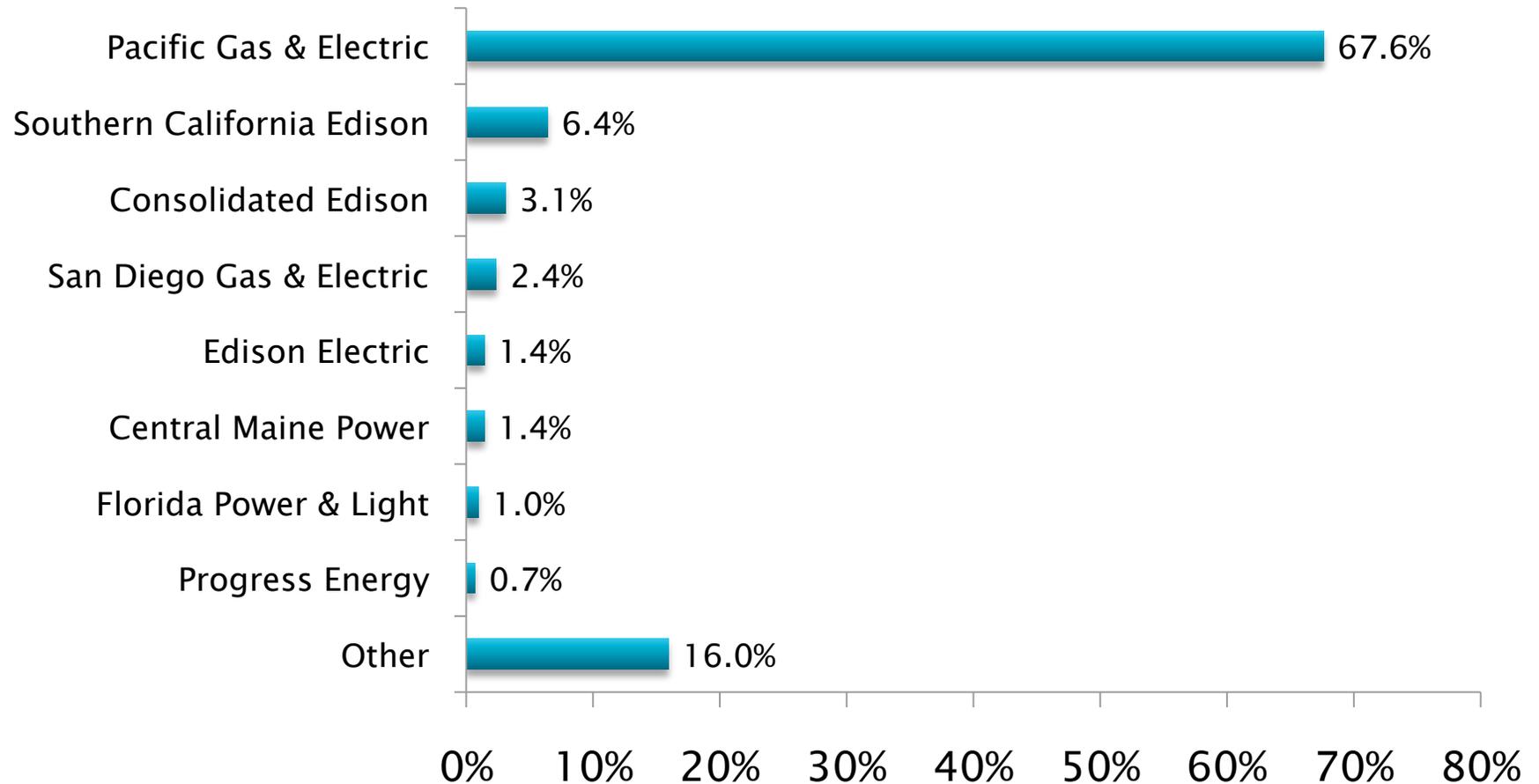
# Demographics

# Respondent Gender and Age



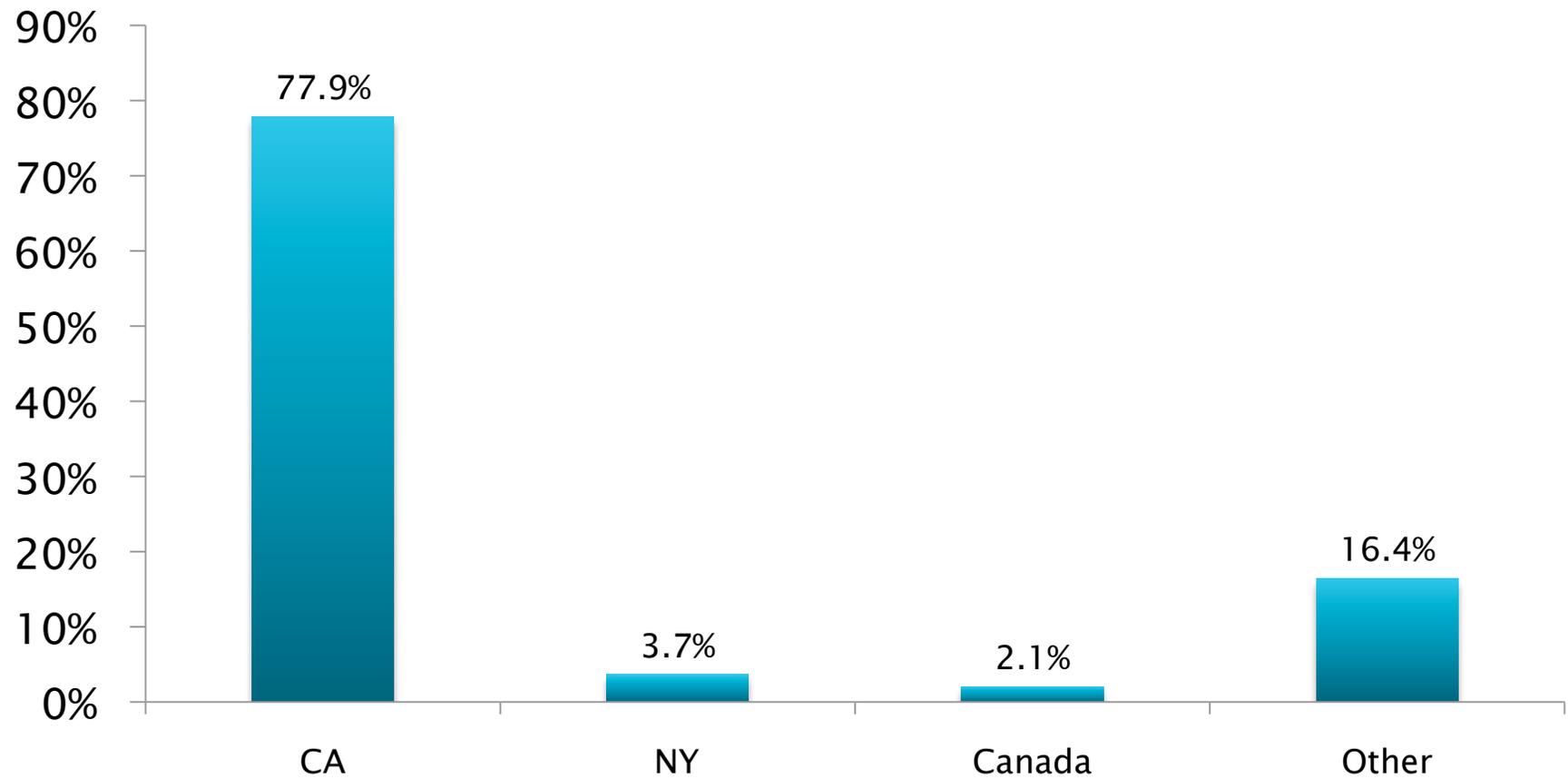
# Utility Provider

Please indicate the name of your utility provider(s). N=420



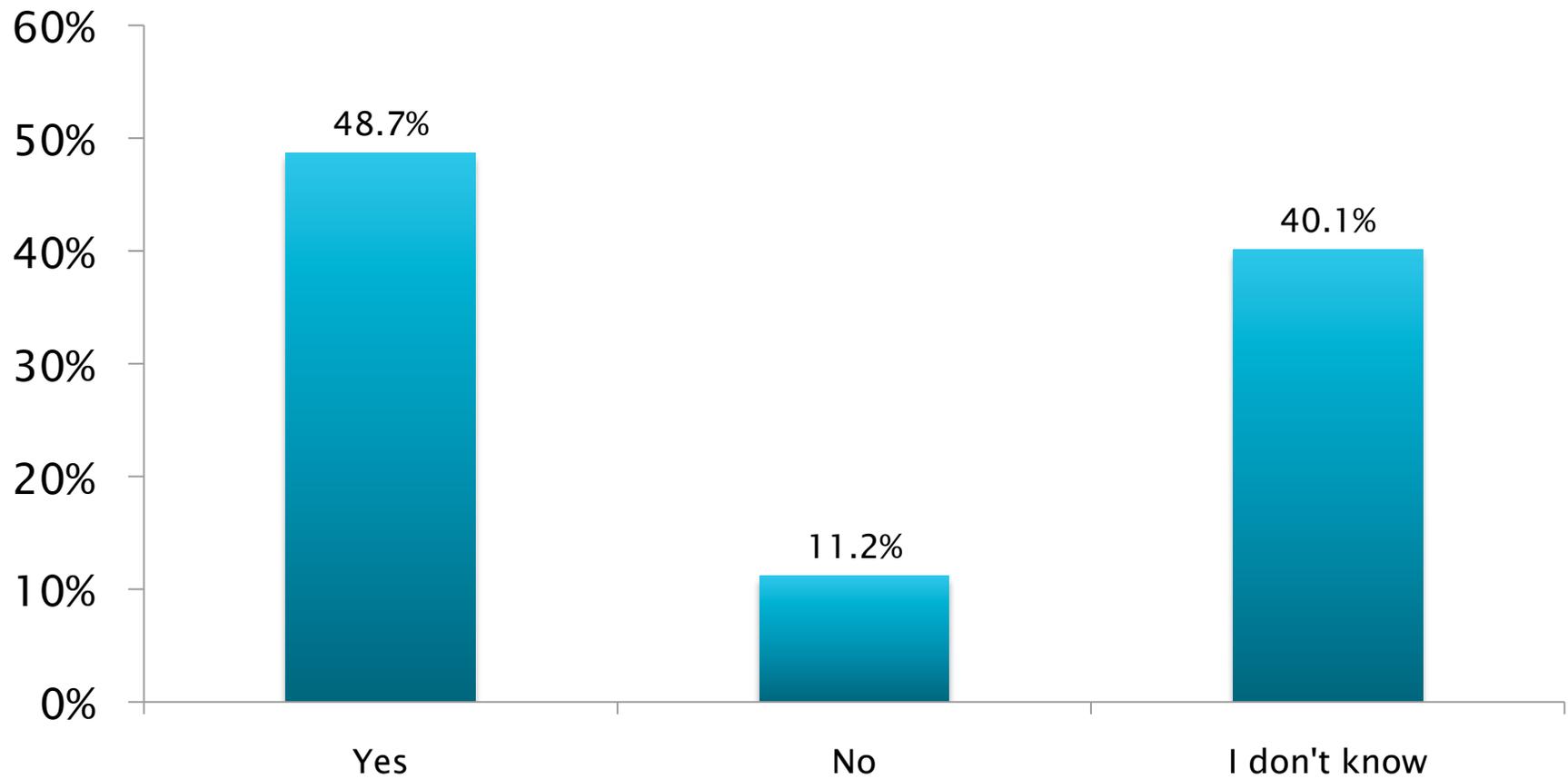
# Place of Residence

Where do you live? N=439



# EMF Sensitivity

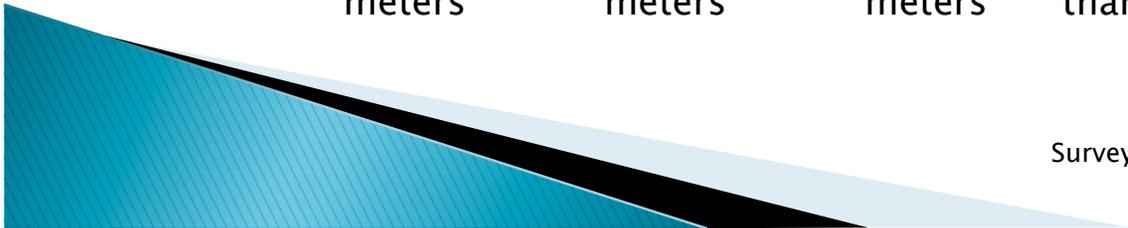
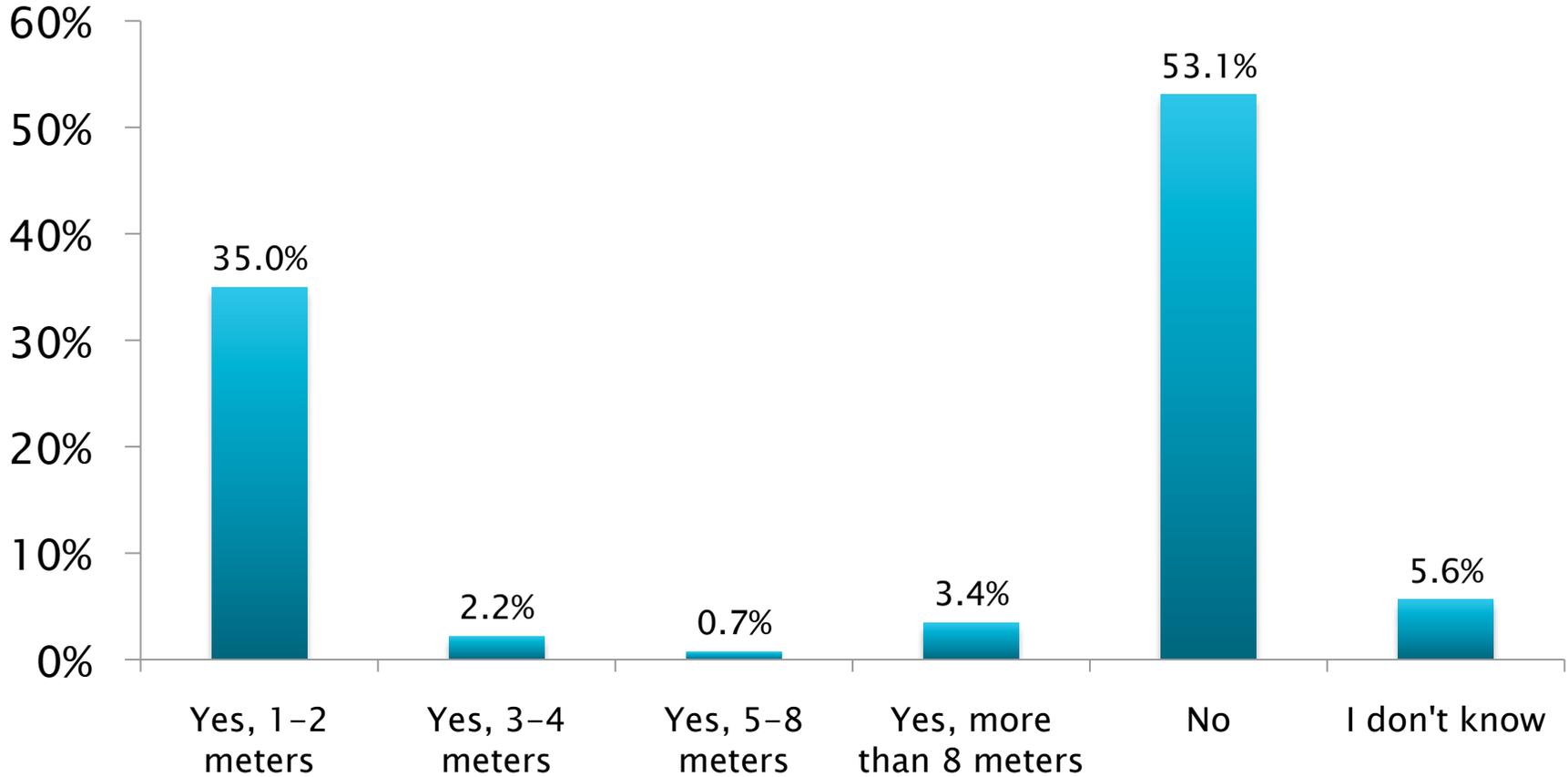
Are you, or is a member of your household, EMF sensitive? N=439



# Wireless Meter Installations

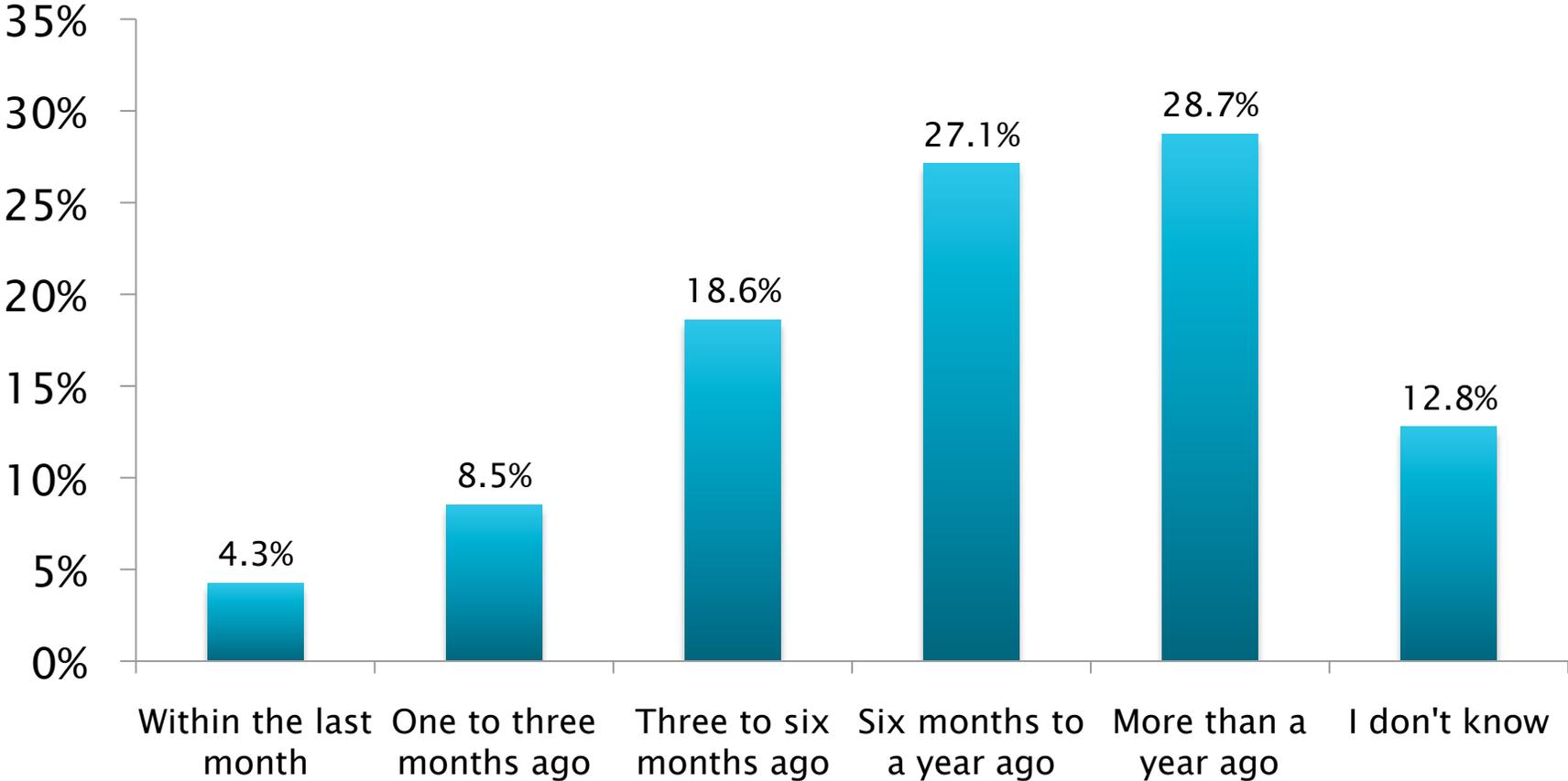
# Wireless Utility Meter Installed in Home

Have you had a new wireless utility meter installed on your home? N=409



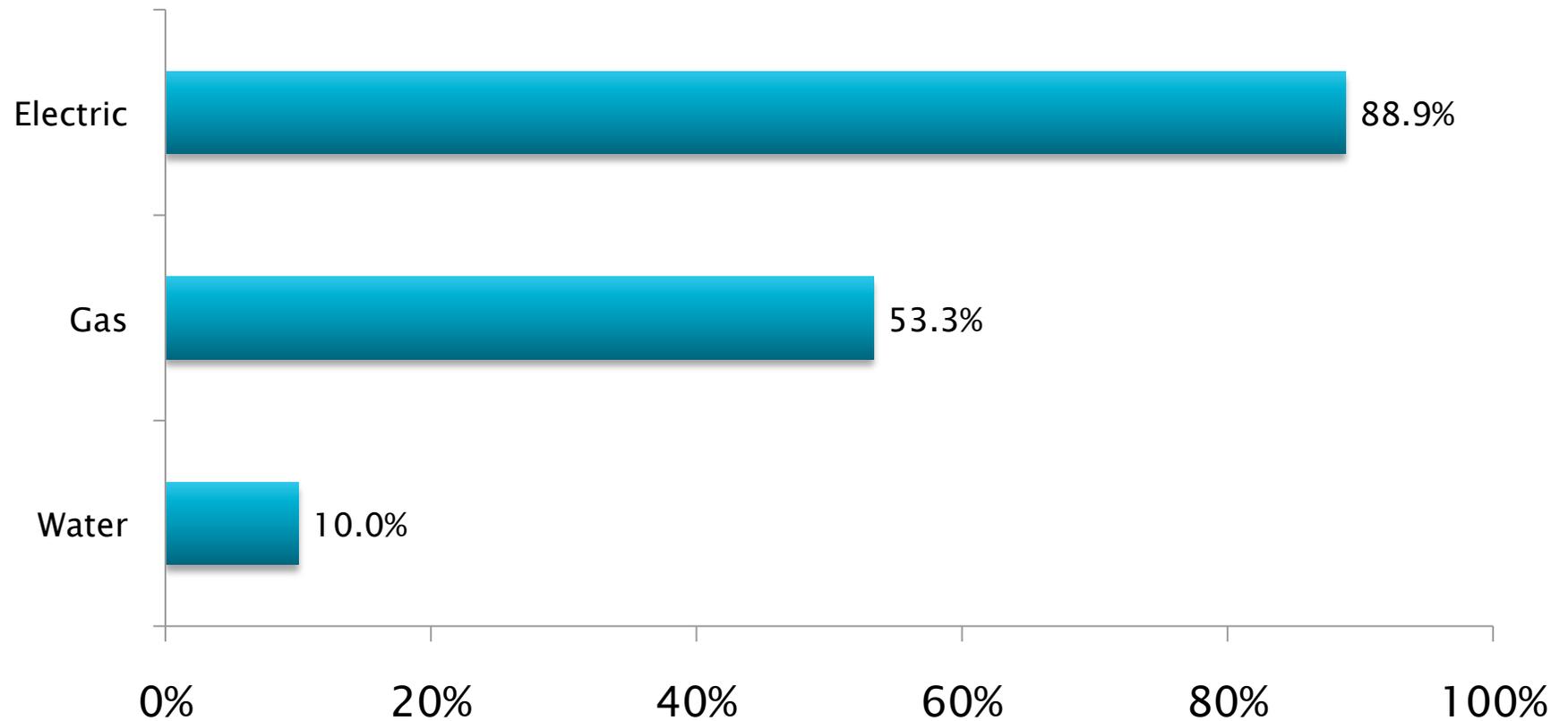
# Wireless Utility Meter Install Time

If yes, how long ago was it installed on your home? N=188



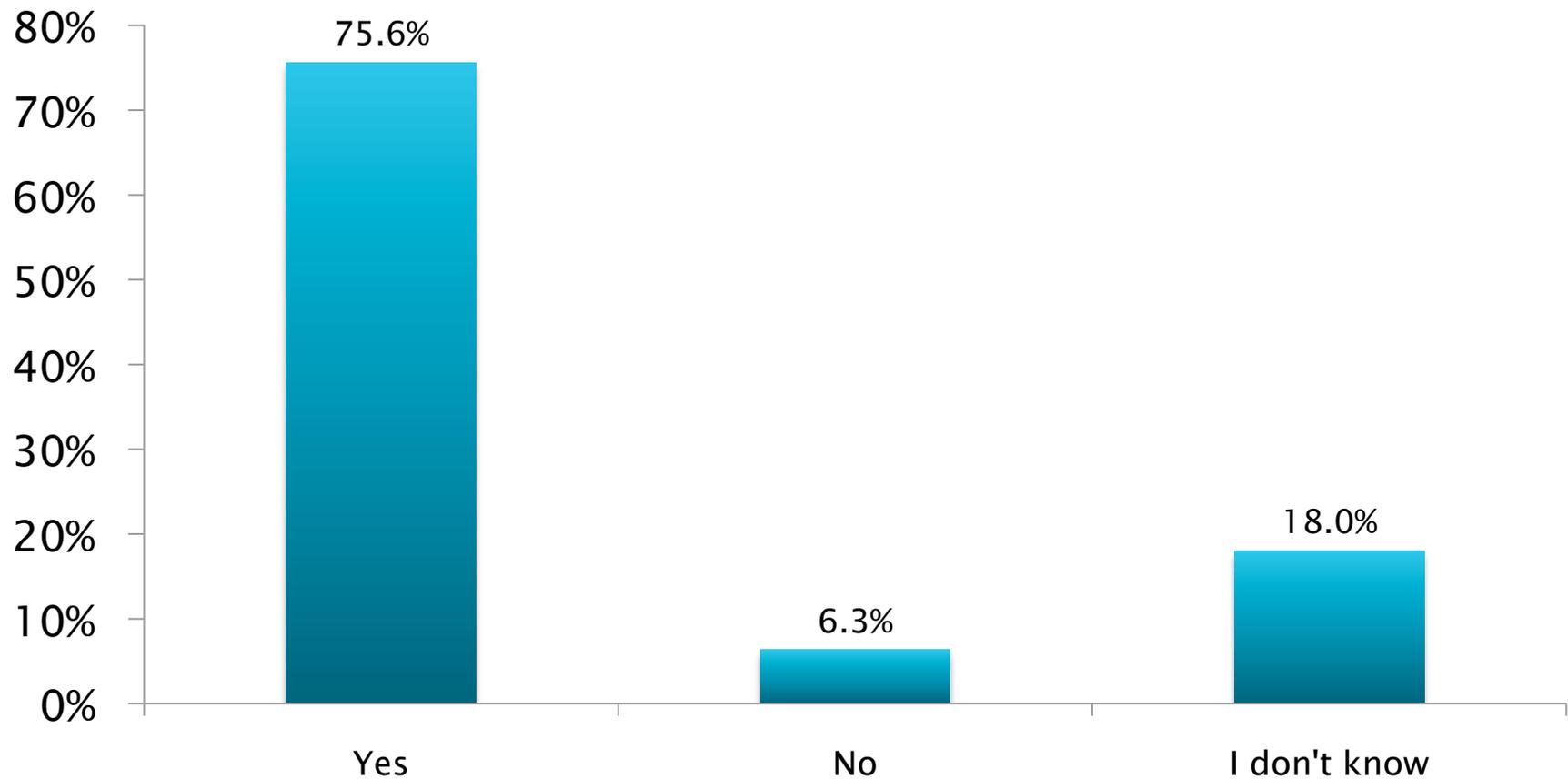
# Type of New Meter Installed

If yes, please indicate the type of new meter installed on your home. (Check all that apply)  
N=160



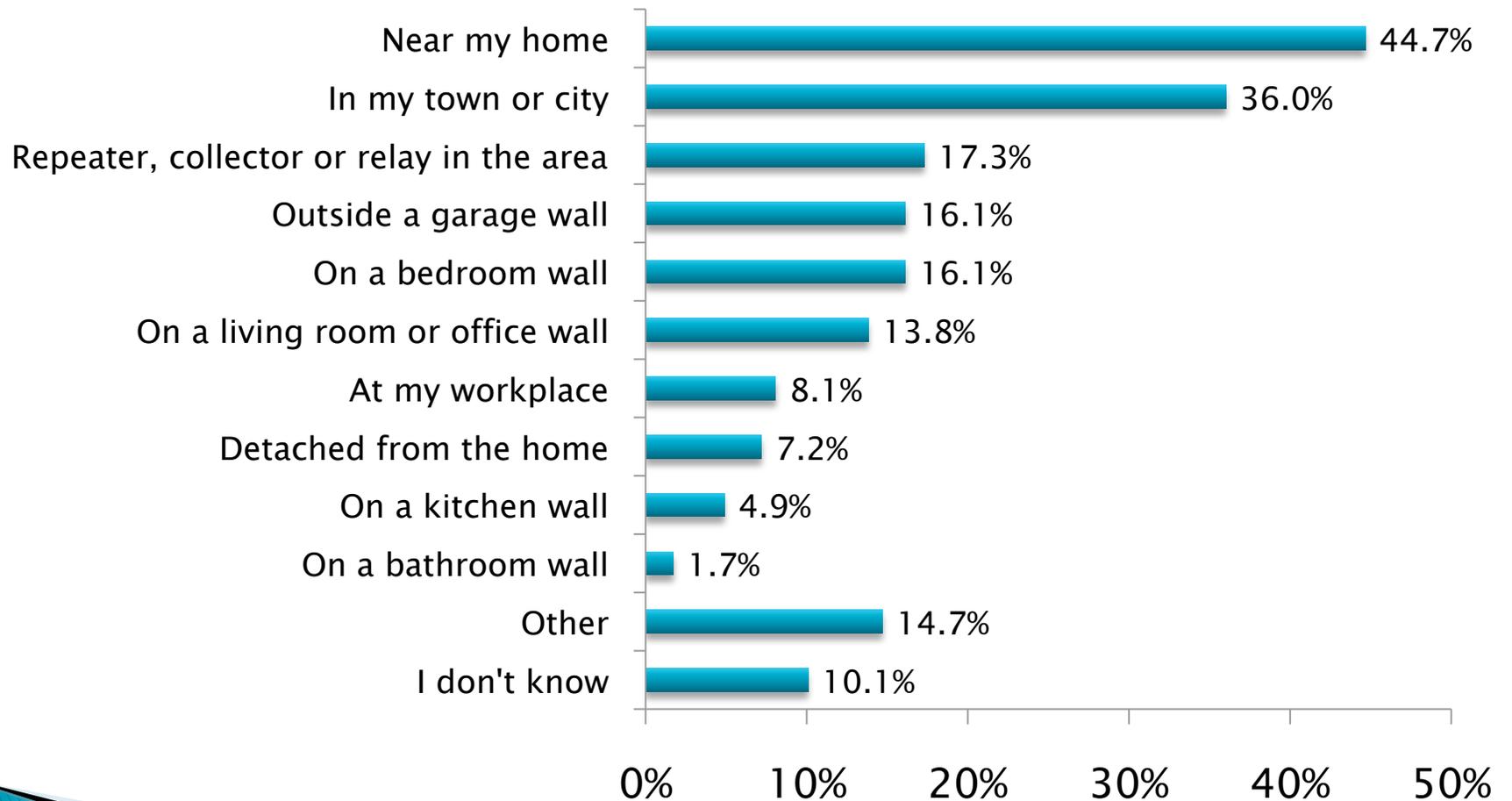
# Wireless Meters Deployed Near By

Do you have new wireless utility meters deployed in your neighborhood, apartment building, area, town or city? N=394



# Meter Placement

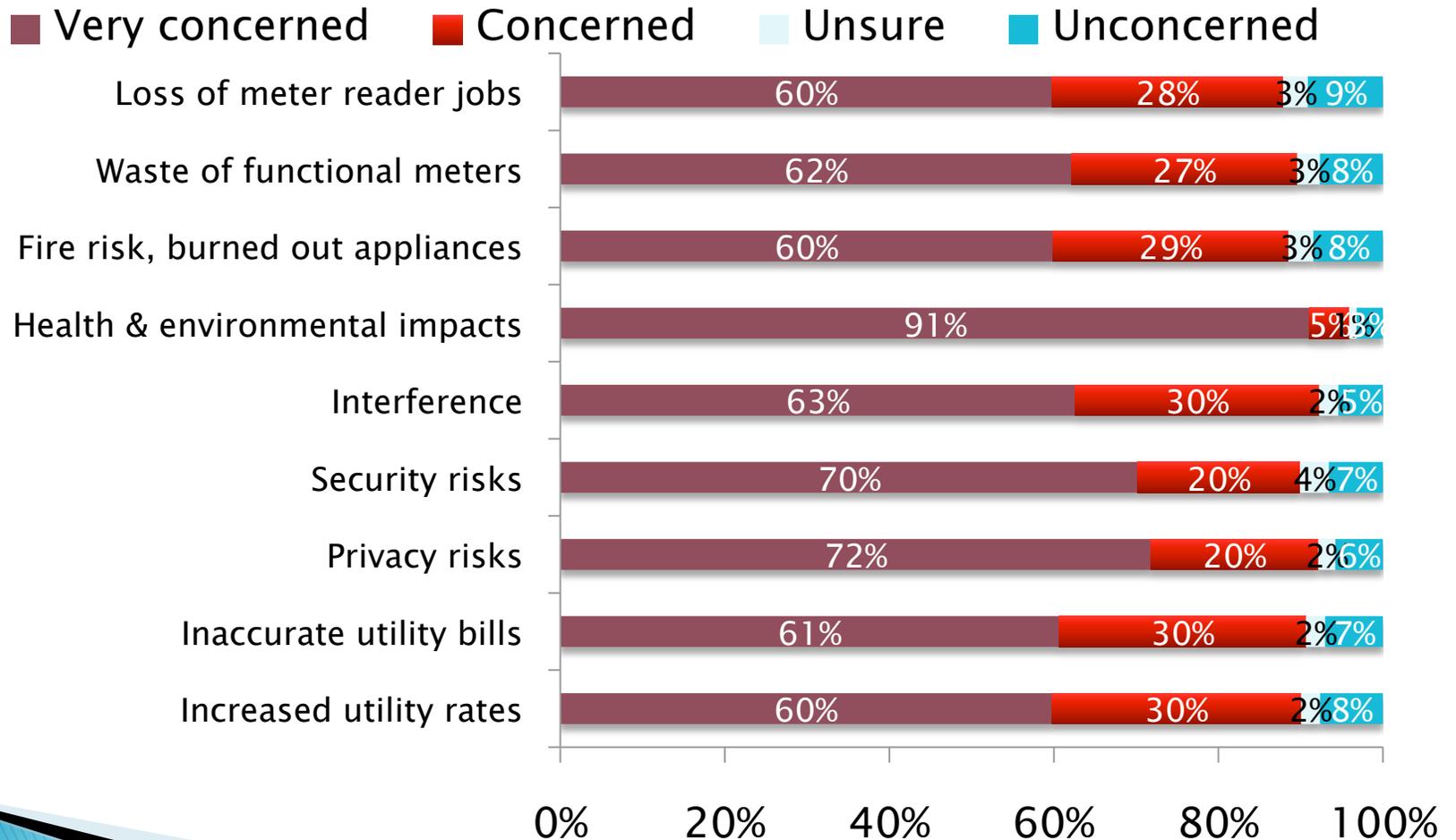
Please describe the placement of the wireless utility meters in relation to where you live.  
(Check all that apply. ) N=347



# Wireless Meter Effects

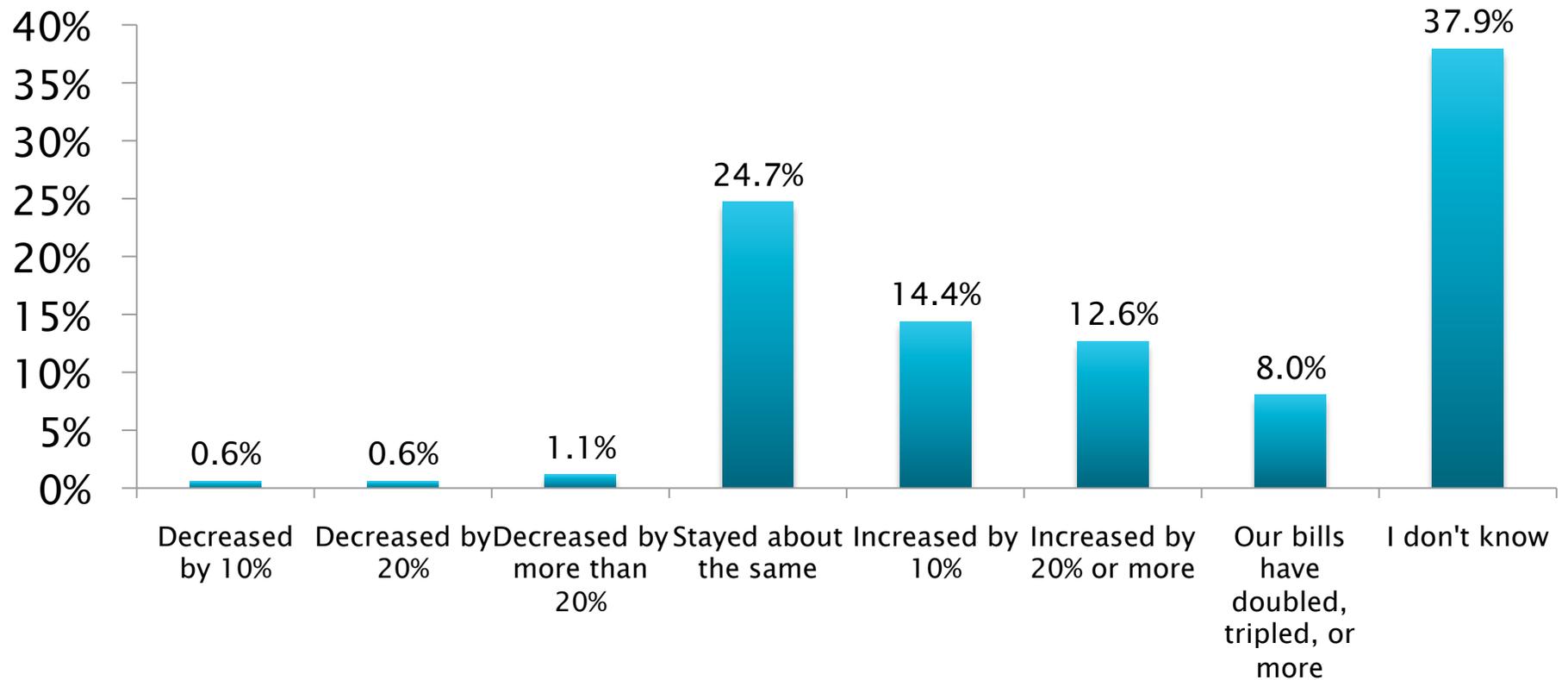
# Concern Over Wireless Utility Meters

How concerned are you about the reported problems with the new wireless Smart Grid utility meters, also known as Smart Meters (AMR, AMI, AED)? Check all that apply. N=425-432



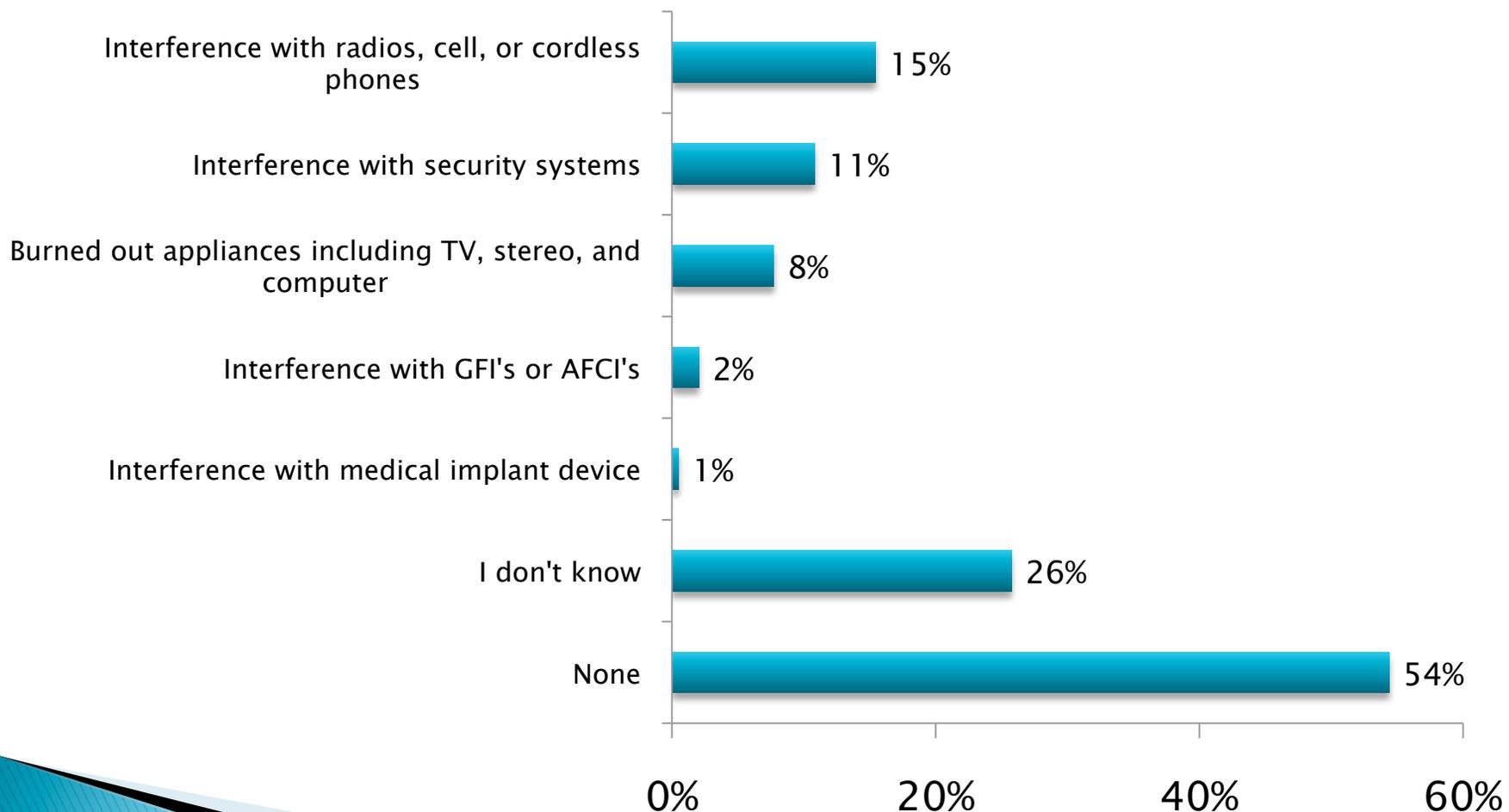
# Change in Utility Bill

If yes, have your bills increased, decreased or stayed about the same? N=174



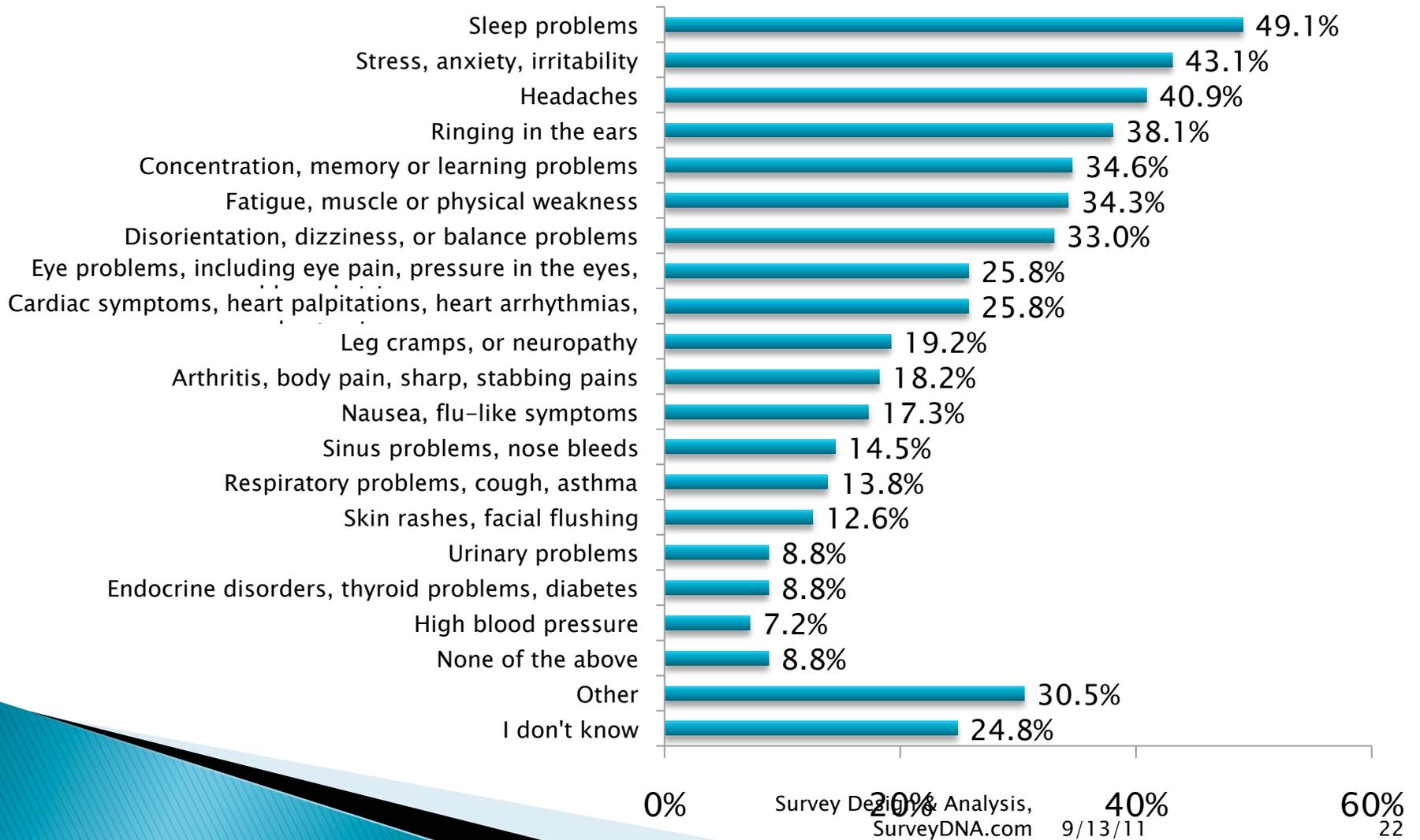
# Interference, Damage or Fire

If yes, have you experienced interference, damaged equipment, or a fire since the new meter(s) has been installed? (Check all that apply) N=194



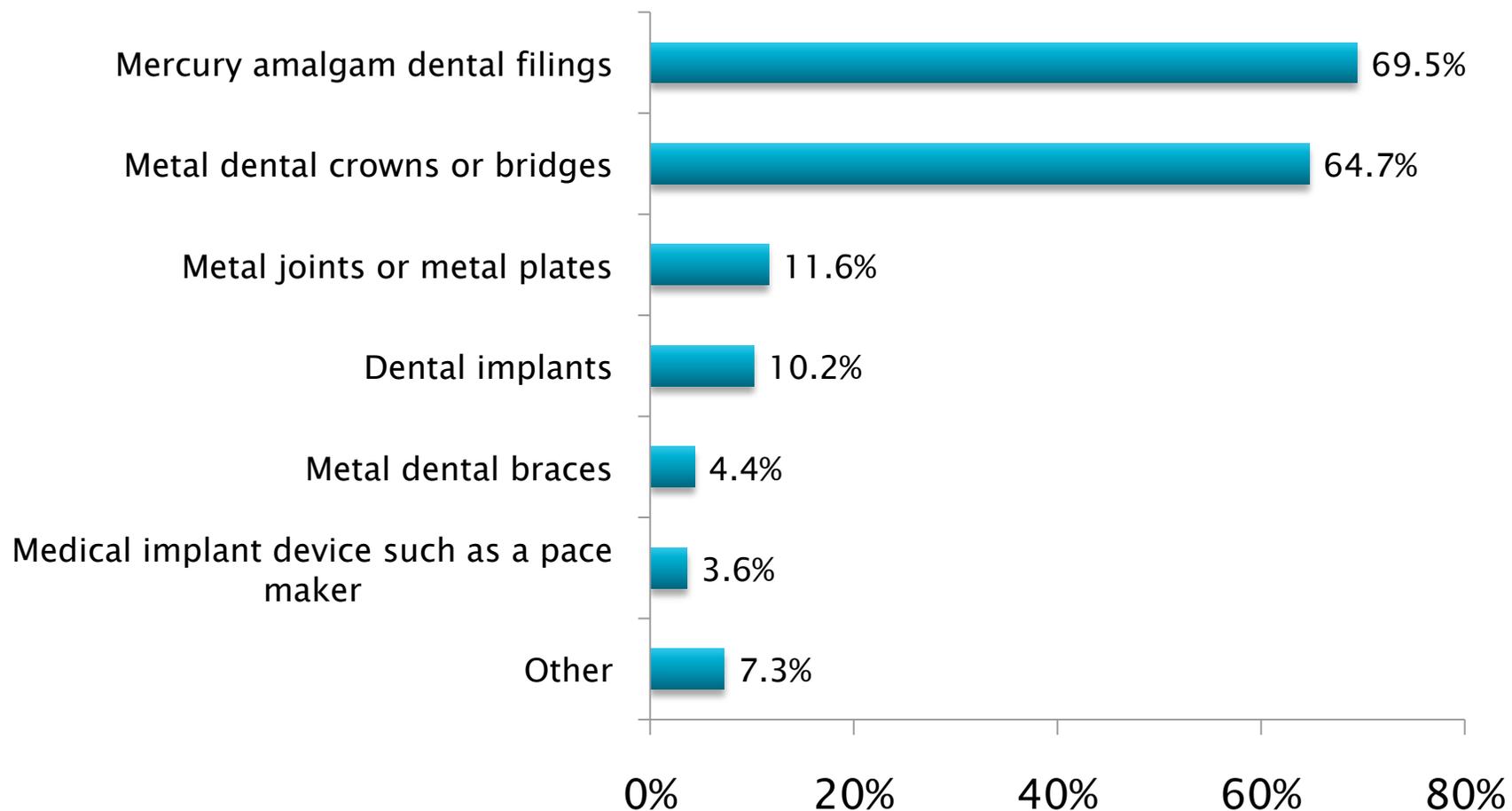
# New/Worsened Health Symptom

Have you, or anyone in your household, experienced new or worsened health symptoms since the new wireless utility meters have been installed on your home, in your neighborhood, apartment building, area, town or city? (Check all that apply) N=318



# Dental Work/ Metal Implants

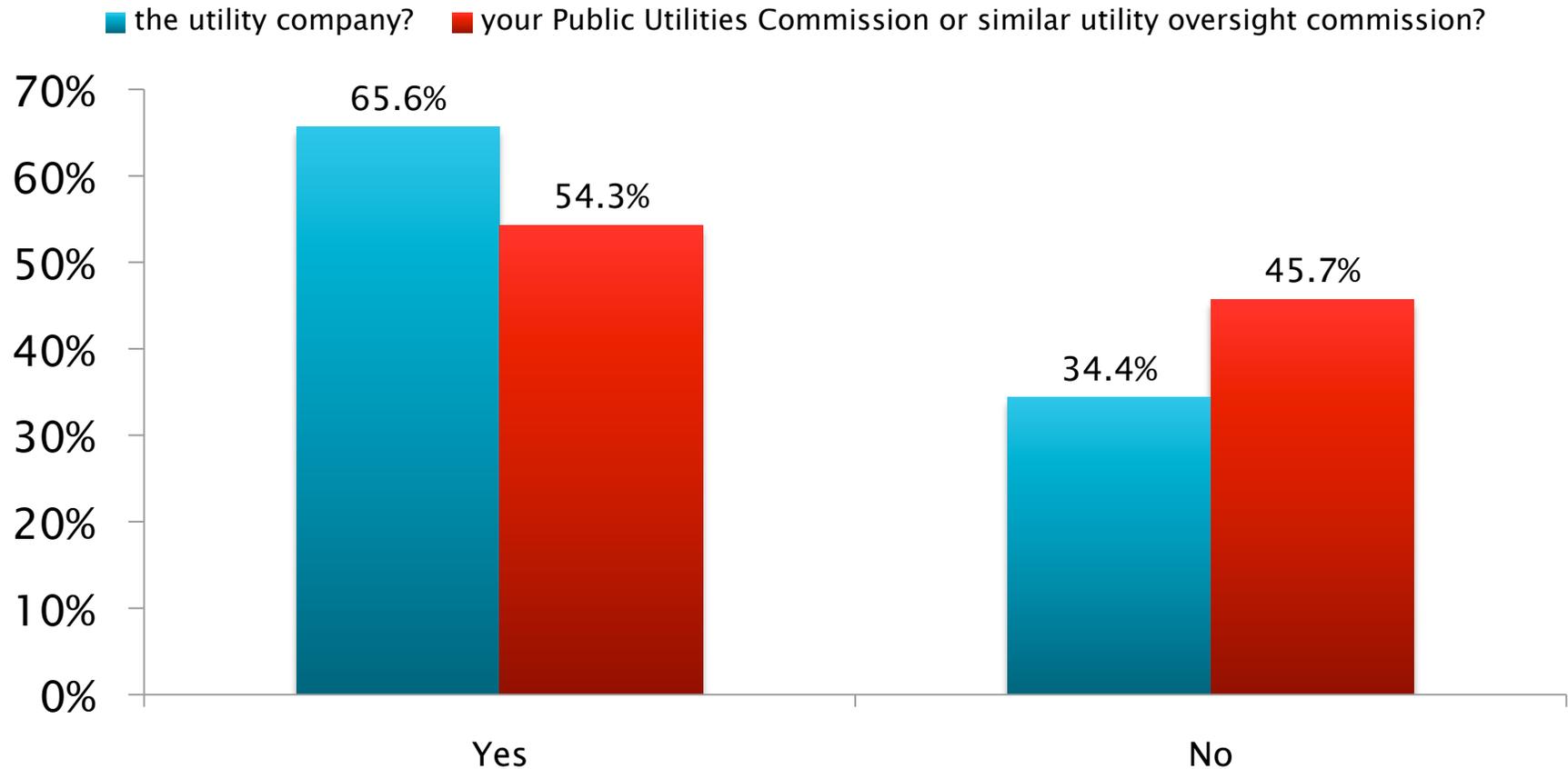
Do you have one or more of the following? (Check all that apply.) N=275



# Complaints to Provider and PUC

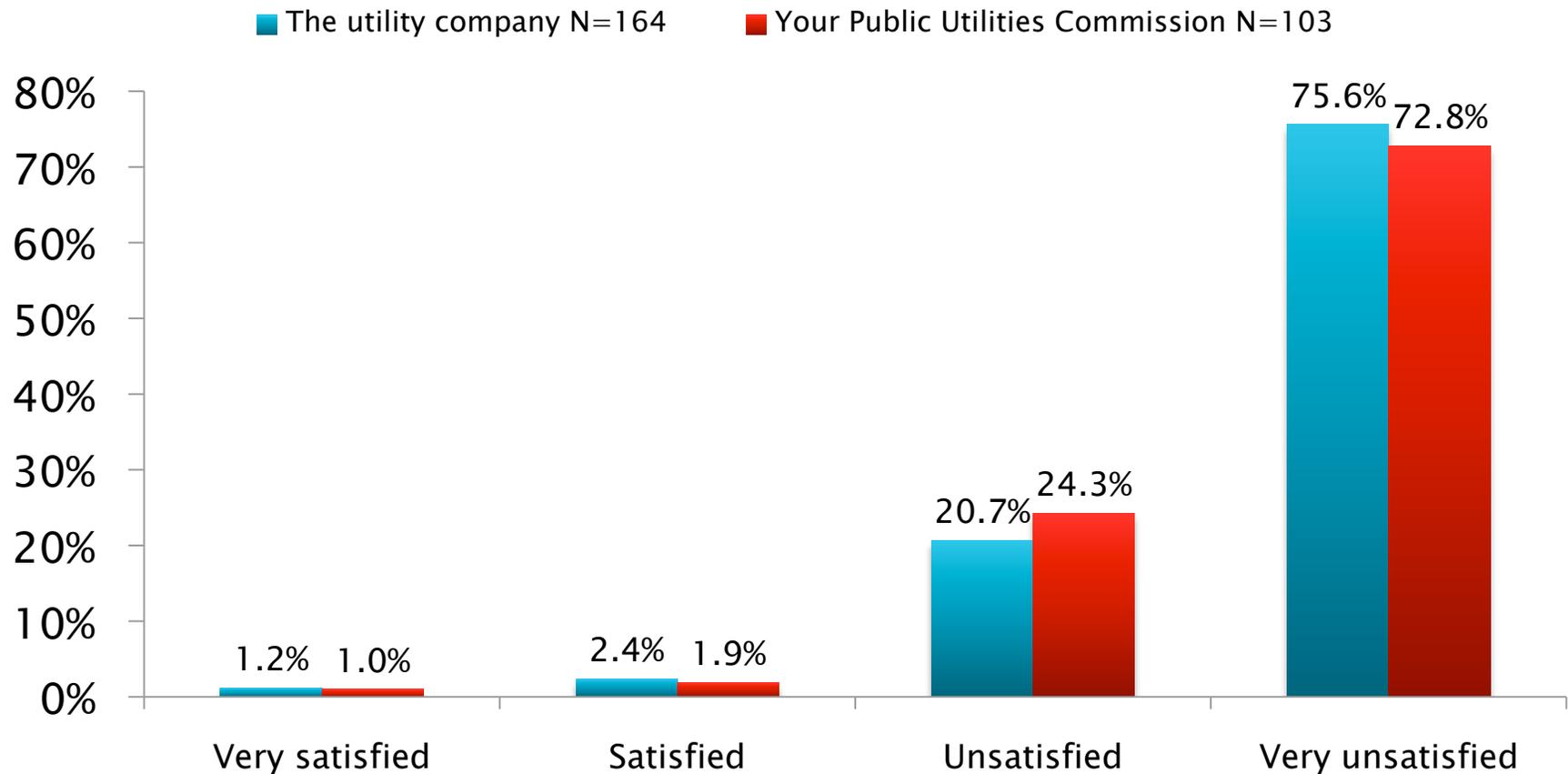
# Complained to Utility Company

If you have experienced problems with the new wireless utility meter(s), have you complained to... N=195



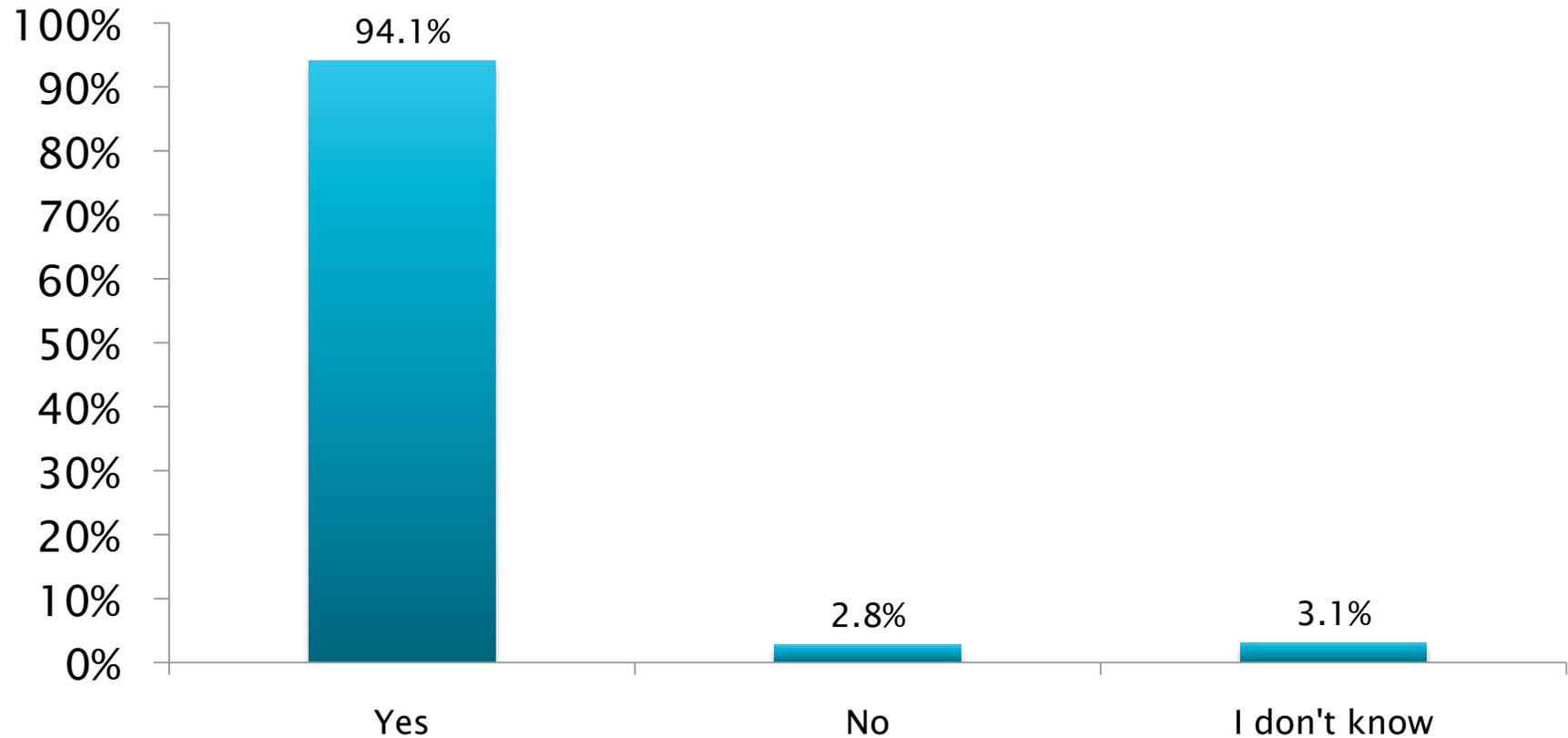
# Satisfaction with Complaint Handling

How satisfied are you about how they handled your complaint?



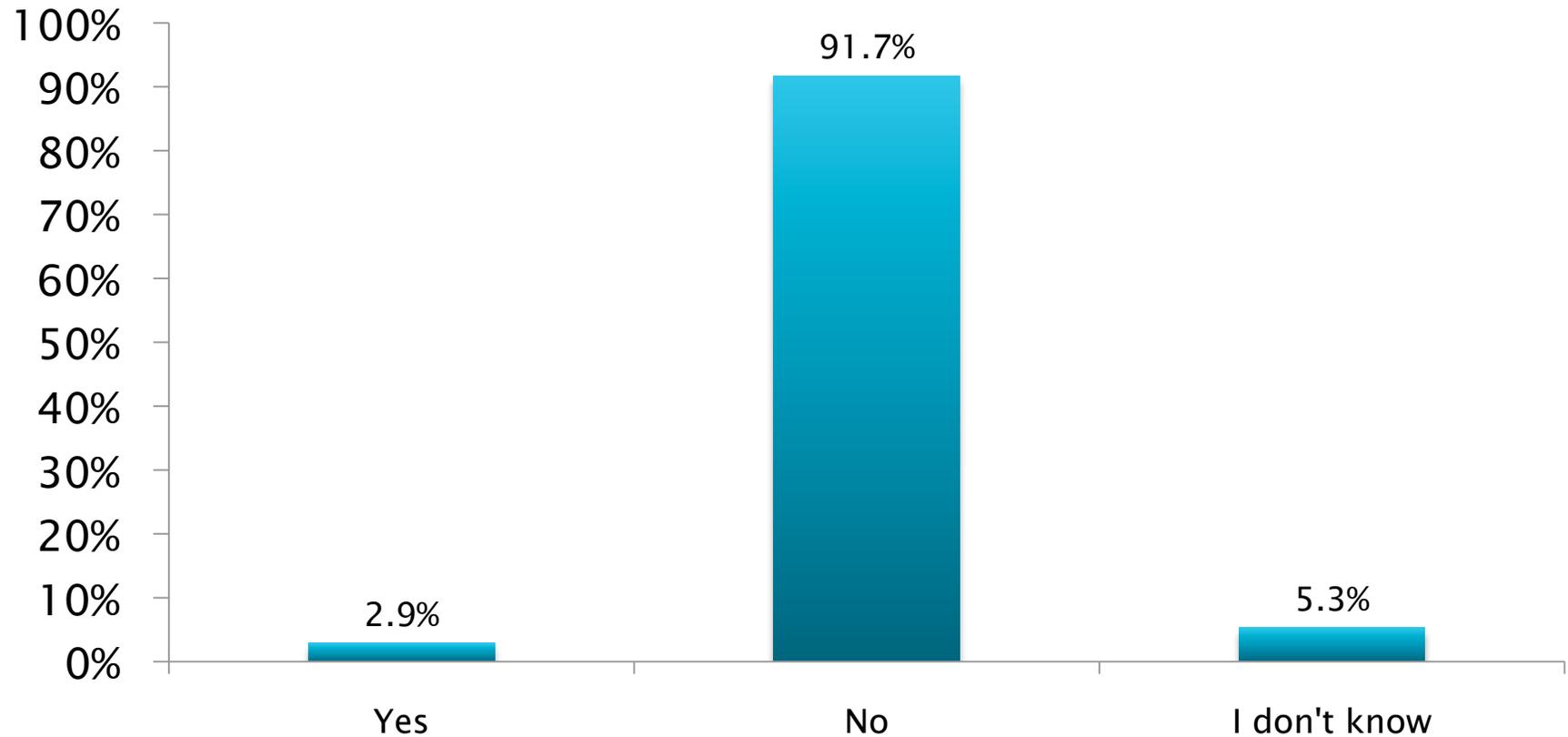
# Prefer to Retain Analog Meters

Would you prefer to retain or restore the analog (also known as electromechanical meter) utility meters and a meter reader? N=387



# Pay Extra for Analog Service

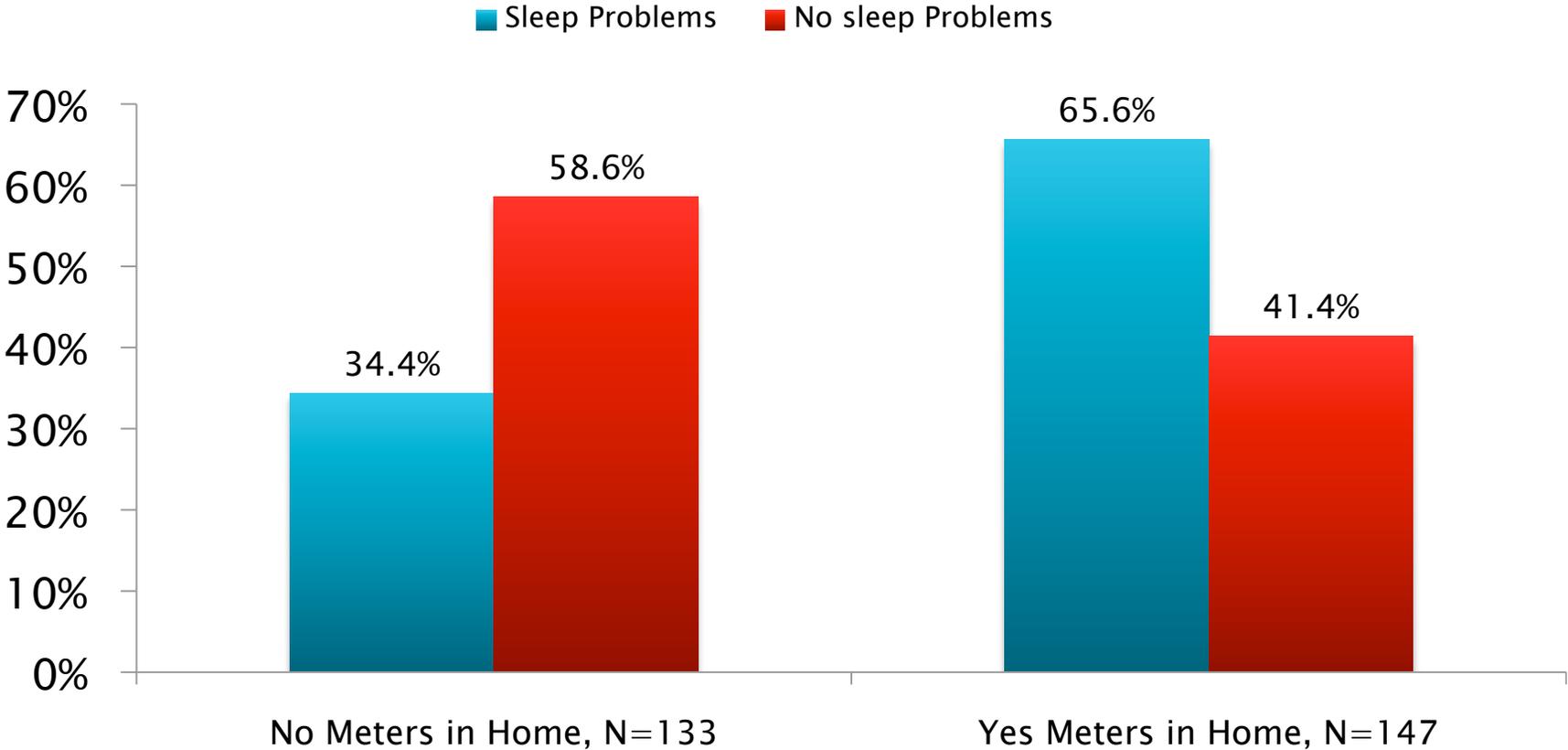
If yes, do you think you should pay more for the analog service? N=374



# Factors Associated with Health Symptoms

# Sleep Problems\* by Meters in the Home

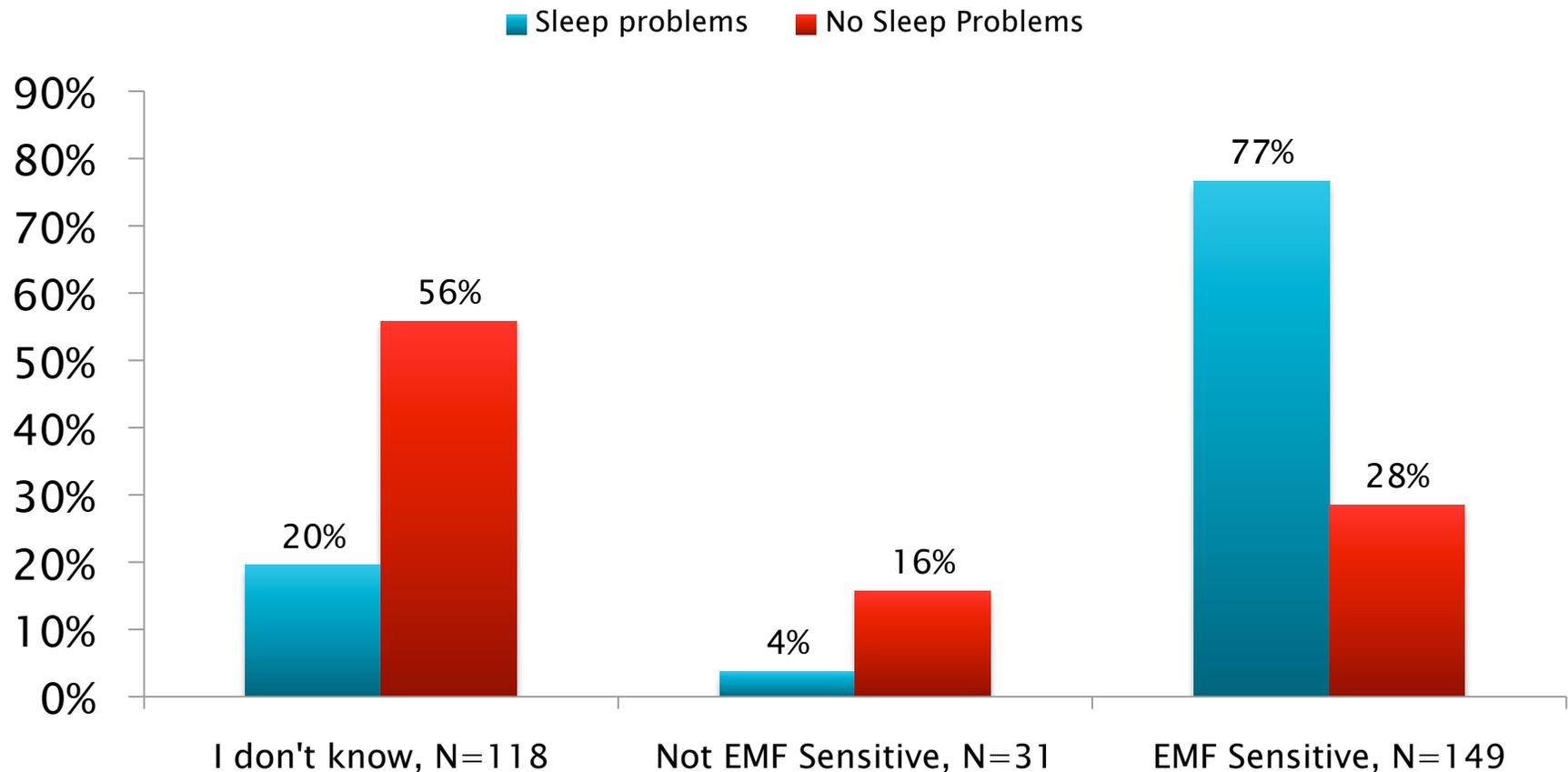
Have you, or anyone in your household, experienced new or worsened health symptoms since the new wireless utility meters have been installed on your home, in your neighborhood, apartment building, area, town or city? (Check all that apply.) N=298



*\* The relationship is the same for the top five Health Symptoms sited.*

# Sleep Problems\* by EMF Sensitivity

Have you, or anyone in your household, experienced new or worsened health symptoms since the new wireless utility meters have been installed on your home, in your neighborhood, apartment building, area, town or city? (Check all that apply.) N=298



# Verbatim Comments I

## Sampled from the 542 Comments Received

- ▶ *“We should not have to pay for NO CHANGE in electric service. We don't pay for not getting cable. We don't pay for not getting satellite. We don't pay for gas if we don't use gas appliances. “*
- ▶ *“I firmly believe that it is ILLEGAL to charge someone for services they are not receiving. I should not have to pay for the "privilege" of retaining my analog utility meter and I should not have my rates increase monthly whether my usage does nor not. That is RIDICULOUS ...”*
- ▶ *“I am almost ready to deny gas and electric service rather than pay for an analog or accept a SmartMeter. Then they would have the freezing death of an old lady on their hands and my kids could sue them.”*
- ▶ *“I am a Doctor of Chiropractic. Several patients have told me they become sick and weak in the presence of wireless devices. They get sicker the closer they are. Some are sensitive even blocks away. These are intelligent, educated, sincere people who ask if I know of anything that can help them mitigate their symptoms, given that such fields are increasingly common.”*
- ▶ *“I see absolutely NO BENEFIT from this expensive, wasteful change-out. I see nothing but trouble ahead, especially once hackers get into the network. I believe that human meter readers are a community benefit and am distressed to see them removed at a time when we need jobs and the extra oversight they provide in our communities.”*
- ▶ *“The electrical companies and investors should be forced to foot the bill on this one and not be allowed to pass the cost on to customers. They deserve to be sued and heavily fined and maybe some people belong in prison over this.”*

# Verbatim Comments II

## Sampled from the 542 Comments Received

- ▶ *“The radio transmissions of the meters could very well be affecting the presence of pollinators in our yards. Bees, hummingbirds and butterflies are small and sensitive creatures that are becoming less prevalent and I am certain it is due to the air wave pollution we are inflicting upon them . . .”*
- ▶ *“We should not have smart meters and their mesh network in our community (in any community) due to non-ionizing wireless RF radiation from these devices being classified by the WHO as a Class 2B carcinogen, on par with DDT. ... Chronic long-term exposure to this type of radiation is stressful on our cells and associated with increased risk of cancer, according to peer-reviewed health studies. ... This should not be mandatory, especially when the Federal government does not mandate these on our homes. This is a gross violation of our civil liberties, and endangers the privacy, security, public safety, health and lives of ourselves and our loved ones, neighbors, friends and family.”*
- ▶ *“I am so worried about these Smartmeters, that I don't want to leave home because the installers will put them on whether you want them or not. ... I do know many people who are suffering terribly from them.”*
- ▶ *“... it effected the equipment in the emergency medical operating unit. The doctor did not know what was causing this, he had the old back up ways before tech in his head, but maybe others do not have this. He almost lost an animal due to this. So I am very frustrated over all this. ... Appliances burned up, blender caught fire, stereo malfunctioned, two shredders burned up, a water fountain no longer works, a popcorn popper caught on fire, ...”*

# Verbatim Comments III

## Responses on utility company complaints

- ▶ *“In the beginning I called all around, talked to many people about my concern. I was told I had no choice – the meters are going in and I have no say. No one addressed my concerns or called me back to address my concerns as I had left messages and asked. Anyone who I spoke with to address my concerns skated right past them and told me the same thing, I have no choice but to have a SmartMeter installed.”*
- ▶ *“My interaction with PG&E has been entirely focused on keeping them from installing meters on my home. Each time I have called, I get only arguments that they are safe, no way to guarantee that we can opt out.*
- ▶ *“I have been thinking of contacting PG&E, but I dread it knowing that it will increase my already elevated stress levels. I'm feeling very frustrated and stuck. I've thought about taking a sledge hammer to the meter at some points.”*
- ▶ *“SCE basically told us that there was nothing they could do to help us. My husband has emailed every executive at SCE and CPUC and nobody will reply back. I even got a letter from my Dr. about my EMF/RF sensitivities and SCE said that they have no contingency plan for people with EMF/RF sensitivities or health problems that are caused by their Smart Meters.”*
- ▶ *“They do not care about the long-term health of their customers. They are a 100% monopoly, and the CPUC is their lapdog. This situation stinks.”*

# Survey Questions

- ▶ How concerned are you about the reported problems with the new wireless Smart Grid utility meters, also known as Smart Meters (AMR, AMI, AED)? Check all that apply.
- ▶ Do you believe wireless devices can cause health problems?
- ▶ Are you, or is a member of your household, EMF sensitive? (EMF sensitivity is also called electrical sensitivity, or electrohypersensitivity)
- ▶ Have you had a new wireless utility meter installed on your home?
- ▶ If yes, how long ago was it installed on your home?
- ▶ If yes, please indicate the type of new meter installed on your home. Check all that apply.
- ▶ If yes, have your bills increased, decreased or stayed about the same ?
- ▶ If yes, have you experienced interference, damaged equipment, or a fire since the new meter(s) has been installed? Check all that apply.
- ▶ Do you have new wireless utility meters deployed in your neighborhood, apartment building, area, town or city?
- ▶ Please describe the placement of the wireless utility meters in relation to where you live. Check all that apply.
- ▶ Have you, or anyone in your household, experienced new or worsened health symptoms since the new wireless utility meters have been installed on your home, in your neighborhood, apartment building, area, town or city? Check all that apply.
- ▶ Do you have one or more of the following? Check all that apply.
- ▶ If you have experienced problems with the new wireless utility meter(s), have you complained to the utility company?
- ▶ If you complained to the utility company about the new wireless utility meter(s), how satisfied are you about how they handled your complaint?
- ▶ If you have experienced problems with the new wireless utility meter(s), have you complained to your Public Utilities Commission or similar utility oversight commission?
- ▶ If yes, how satisfied are you with how they handled your complaint?
- ▶ Would you prefer to retain or restore the analog (also known as electromechanical meter) utility meters and a meter reader?
- ▶ If yes, do you think you should pay more for the analog service?

December 1, 2014

Contact: Tim Stephens (831) 459-4352; stephens@ucsc.edu

## **Study of deadly bat disease finds surprising seasonal pattern of infections**

*White-nose syndrome fungus can infect an entire bat colony during hibernation, but surviving bats are able to clear the infection after they become active again*

EMBARGOED: Not for release until 7:01 p.m. U.S. Eastern Time on Tuesday, December 2

SANTA CRUZ, CA--The deadly fungal disease known as white-nose syndrome has spread to bat colonies throughout eastern North America over the past seven years, causing bat populations to crash, with several species now at risk of extinction. The devastating impact of this disease is due in part to the seasonal dynamics of infection and transmission, according to a new study led by scientists at the University of California, Santa Cruz, and published December 3 in the *Proceedings of the Royal Society B*.

The researchers were surprised to discover that during the winter, when the bats are hibernating, the fungus can infect nearly every bat in a colony. Bats that survive the winter are able to clear the infection during summer when their body temperatures are above the growth limit of the fungus. But the remarkably high rate of infection during hibernation leads to high mortality rates at the time of year when bat populations are naturally at their lowest, before the females give birth in the summer.

"It hits when the population is at its smallest, and by the end of winter nearly 100 percent of the bats in a cave can be infected, which helps explain why it has such large impacts," said Kate Langwig, a graduate student at UC Santa Cruz and first author of the paper.

The study provides the first description of the dynamics of fungal infection and transmission in bats, and the findings are in striking contrast to most infectious diseases, said senior author Marm Kilpatrick, associate professor of ecology and evolutionary biology at UC Santa Cruz. "For many diseases, population density and social interactions play a big role in transmission, but these bats are actually very social and live in dense colonies in both summer and winter," he said. "In this case, transmission is tied to

hibernation and body temperature. When the bats start hibernating, it's almost like they become petri dishes for this fungus to grow on."

The fungus (*Pseudogymnoascus destructans*) thrives in cold environments and grows superficially on exposed skin on the bats' noses, ears, and wings. During hibernation, the body temperatures of bats drop to the cold ambient temperatures of their "hibernacula" (the caves and abandoned mines where the bats hibernate). The fungus proliferates at these temperatures, which range from 2 to 12 degrees Celsius (35 to 54 degrees Fahrenheit). Over the course of the winter hibernation period, which can last more than five months, the infection spreads throughout the colony and on individual bats. Most of the mortality is in late winter, when both infection prevalence (the number of infected bats) and infection loads (the amount of fungus on individual bats) are highest.

"The peak load in late winter is probably what's driving mortality," Langwig said. "Bats that survive the winter can clear the fungal infection once they warm up, so that by mid-summer, when the young of the year are born, almost no bats are infected any more."

The researchers studied six species of bats, testing them for infection with the fungus during three key periods of their annual cycle: fall, when the bats mate outside the hibernacula; winter, when they go into hibernation; and summer, when they migrate to maternity sites and the females give birth.

The researchers began to detect low levels of fungal infection in the fall, probably as a result of bats coming in contact with spores of the fungus inside the hibernacula. "The bats are still active then, so the infections are at a very low level and don't appear to be growing. But as soon as they go into hibernation and their body temperature drops, the infections ramp up really quickly," Langwig said.

The fact that bats are not transmitting the infection during the migratory period is important in limiting the rate at which it is spreading geographically, she added, noting that West Nile virus--which, like white-nose syndrome, was first detected in New York state--spread rapidly throughout most of North America because birds are infected during migration.

The study provides valuable information for planning strategies to manage white-nose syndrome. If scientists can develop an effective treatment, for example, this study indicates that the best time to apply it would probably be early winter, Langwig said. Kilpatrick and coauthor Winifred Frick, an adjunct professor of biology at UC Santa Cruz, are leading efforts to develop a "probiotic" treatment using bacteria to suppress the growth of the fungus. The researchers have isolated several bacterial species that occur naturally on bats and are measuring their ability to suppress the fungus in laboratory tests. Then they plan to use the most promising bacteria as a treatment to see if it can help bats survive through the winter.

"The idea would be to apply the bacteria on bats during hibernation and see if it suppresses the growth of the fungus," Kilpatrick said.

In addition to Langwig, Frick, and Kilpatrick, the coauthors of the paper include Joseph Hoyt and Tina Cheng at UC Santa Cruz; Rick Reynolds of the Virginia Department of Game and Inland Fisheries; Katy Parise, Kevin Drees, and Thomas Kunz of Boston University; and Jeffrey Foster of Northern Arizona University and the University of New Hampshire. This research was funded by the National Science Foundation, Bat Conservation International, and the National Geographic Society.

#####

**Note to reporters:** You may contact Kate Langwig at [klangwig@gmail.com](mailto:klangwig@gmail.com) and Marm Kilpatrick at [akilpatr@ucsc.edu](mailto:akilpatr@ucsc.edu).

For more UCSC news, visit [news.ucsc.edu](http://news.ucsc.edu).

# White-Nose Syndrome

*The devastating disease of hibernating bats in North America*

*August 2014*

## What is white-nose syndrome?

White-nose syndrome (WNS) is a disease affecting hibernating bats. Named for a white fungus that appears on the muzzle and other parts of bats, WNS is associated with extensive mortality of these animals in eastern North America. First documented in New York in the winter of 2006-2007, WNS has spread rapidly across the eastern and midwestern United States and eastern Canada, and evidence of the fungus that causes WNS has been detected as far south as Mississippi.

Bats with WNS act strangely during cold winter months, including flying outside during the day and clustering near the entrances of caves and other hibernation areas. Bats have been found sick and dying in unprecedented numbers in and around caves and

mines. WNS has killed more than 5.5 million bats in the Northeast and Canada. In some areas, 90 to 100 percent of bats have died.

Many non-governmental organizations, universities and state and federal agencies are investigating the cause of the bat deaths. A newly discovered fungus, *Pseudogymnoascus* (formerly *Geomyces*) *destructans*, has been demonstrated to cause WNS. Scientists are investigating the dynamics of fungal infection and transmission and are searching for ways to control it.

## What bats are being affected?

More than half of the 47 bat species living in the United States hibernate to survive the winter. Seven cave-hibernating bats, including two endangered species and one species recently proposed for listing, are confirmed with WNS. The fungus has been detected on additional five species, including one endangered species, with no confirmation of disease.

Bat species confirmed with WNS:

- Big brown bat (*Eptesicus fuscus*)
- Eastern small-footed bat (*Myotis leibii*)
- Gray bat (*Myotis grisescens*) **endangered**
- Indiana bat (*Myotis sodalis*) **endangered**
- Little brown bat (*Myotis lucifugus*)
- Northern long-eared bat (*Myotis septentrionalis*) **proposed for listing**
- Tri-colored bat (*Perimyotis subflavus*)

Bat species on which *Pseudogymnoascus destructans* has been detected with no confirmation of disease:



Ryan von Linder/NYDEC

*Eastern small-footed bat with white fungus on nose, arms and wings*

- Eastern red bat (*Lasiurus borealis*)
- Southeastern bat (*Myotis austroriparius*)
- Silver-haired bat (*Lasionycteris noctivagans*)
- Rafinesque's big-eared bat (*Corynorhinus rafinesquii*)
- Virginia big-eared bat (*Corynorhinus townsendii virginianus*) **endangered**

Federally listed species found in the affected area that have not yet been confirmed with WNS or fungal infection:

- Ozark big-eared bat (*Corynorhinus townsendii ingens*) **endangered**

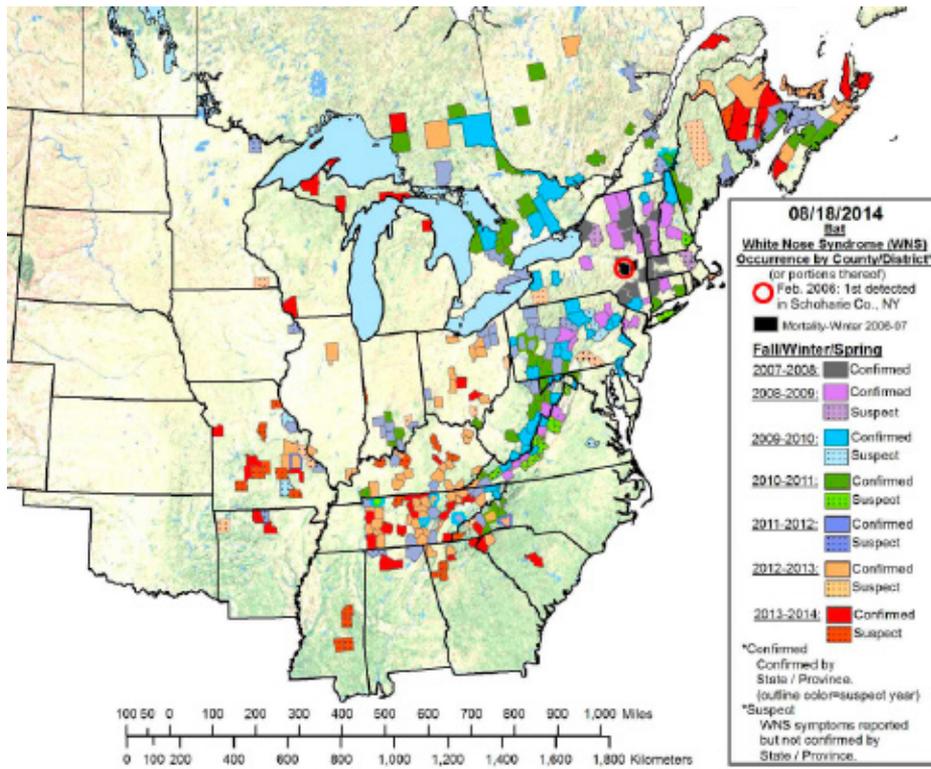
## Where is it now?

White-nose syndrome has continued to spread rapidly. As of August 2014, bats with WNS were confirmed in 25 states and five Canadian provinces:



Jeremy Coleman/USFWS

*Vermont Fish and Wildlife Department biologists remove the gate to conduct a winter survey at Plymouth Cave*



- Alabama
- Arkansas
- Connecticut
- Delaware
- Georgia
- Illinois
- Indiana
- Kentucky
- Maine
- Maryland
- Massachusetts
- Michigan
- Missouri
- New Brunswick, Canada
- Nova Scotia, Canada
- Ontario, Canada
- Prince Edward Island, Canada
- Quebec, Canada
- New Hampshire
- New Jersey
- New York
- North Carolina
- Ohio
- Pennsylvania
- South Carolina
- Tennessee
- Vermont
- Virginia
- West Virginia
- Wisconsin

### WNS National Plan

In 2009 and 2010, the Service led a team of federal and state agencies and tribes in preparing a national white-nose syndrome management plan to address the threat to hibernating bats. The plan is a framework for coordinating and managing the national investigation and response to WNS. *The National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrome in Bats* outlines the actions necessary for state, federal and tribal coordination, and provides an overall strategy for investigating the cause of WNS and finding ways to manage it.

### What have we learned?

- Biologists in New York and Vermont have found up to 50 percent of marked little brown bats at test sites surviving from one winter to the next in recent years, giving some hope that this species might one day be able to recover. Little brown bat populations at these sites remain at less than 10 percent of their pre-WNS size, however.
- Scientists have developed new ways to detect *Pseudogymnoascus destructans* on bats and in the environment, including using UV light and molecular analyses.
- Because of WNS investigation, researchers have discovered new unrelated bat disease agents.
- Researchers have made significant strides in understanding disease

Evidence of the fungus that causes WNS, *Pseudogymnoascus destructans*, has been detected in three additional states:

- Iowa
- Minnesota
- Mississippi

### What is being done?

#### Partnerships

The U.S. Fish and Wildlife Service leads an extensive network of state and federal agencies, tribes, organizations, institutions and individuals in working cooperatively to investigate the source, spread and cause of bat deaths associated with WNS and develop management strategies to minimize the impacts of WNS.

response of hibernating bats and factors that influence bat vulnerability to WNS.

- Studies of natural bacteria and skin chemistry of bats have led to new lines of research for treatments using biological or non-chemical agents for bats at risk of WNS infection.
- Other treatments under investigation include changing temperature and humidity in hibernation areas to slow fungus growth or improve bat survival, and vaccines to boost resistance to WNS.
- Researchers are looking into molecular and genetic tools to reduce the ability of *P. destructans* to cause disease.

### 2014 Research Funding

In 2014 the Service awarded research and state response grants totaling \$4.5 million.

Projects funded by these grants will improve and expand surveillance of the disease and *Pseudogymnoascus destructans*; help to develop a standardized monitoring program for bat populations in North America; and identify and develop non-chemical control options for treatment and prevention of spread of *P. destructans*.

2014 funding builds on approximately \$14 million that the Service has dedicated to WNS research and state capacity between 2008 and 2013.

For more information on recent research developments see [www.WhiteNoseSyndrome.org](http://www.WhiteNoseSyndrome.org)

**Federal Relay Service**  
for the deaf and hard-of-hearing  
1 800/877 8339

**U.S. Fish & Wildlife Service**  
1 800/344 WILD  
<http://www.fws.gov>

August 2014





Welcome. I have a master's degree in engineering and had a successful career in Silicon Valley before I began to experience negative health effects from wireless technology and electrical pollution.

This website will help you quickly reduce the electromagnetic (EMF) pollution in your life. There are also many practical solutions if you are already experiencing the effects of EMF pollution.

[August 18, 2015](#) / [Jeromy](#) / [106 Comments](#)

## Why is Xfinity WiFi Harming People?

- [1529](#)

*Update July 2017: I recently dropped into a Comcast Xfinity store in the San Francisco Bay Area and the company is now offering two different modems with no WiFi capabilities to any customer that asks (possibly because of a [class action lawsuit](#) that has been filed and because many customers want to use their own router). The non-WiFi modem options available are the [Arris model TM722G/NU](#) (which has phone capability) and the [Cisco model DPC3008](#) (which only has internet capability – no phone jack). If your local Comcast provider is giving you a hard time by saying that you must have their Xfinity WiFi Modem/Router, I would simply purchase one of these modems on Amazon (links provided above) and then connect your own router, such as [this Netgear router](#), that has a simple on/off button for WiFi and four Ethernet ports so that you can have a [wired home](#). For a truly low-EMF wired internet set-up that is compatible with Comcast, [this article](#) will show you the steps to take.*

Thus far in 2015, I have been contacted by multiple people who have reported being injured by the new Xfinity WiFi routers. One woman wrote that it felt like she was “being microwaved.” Others have reported headaches, insomnia, brain fog, burning sensations on their skin and heart arrhythmia.

In this article I explain likely reasons why people are experiencing symptoms in response to Xfinity and also provide *some solutions* to this problem.

## First, what exactly is Xfinity WiFi?



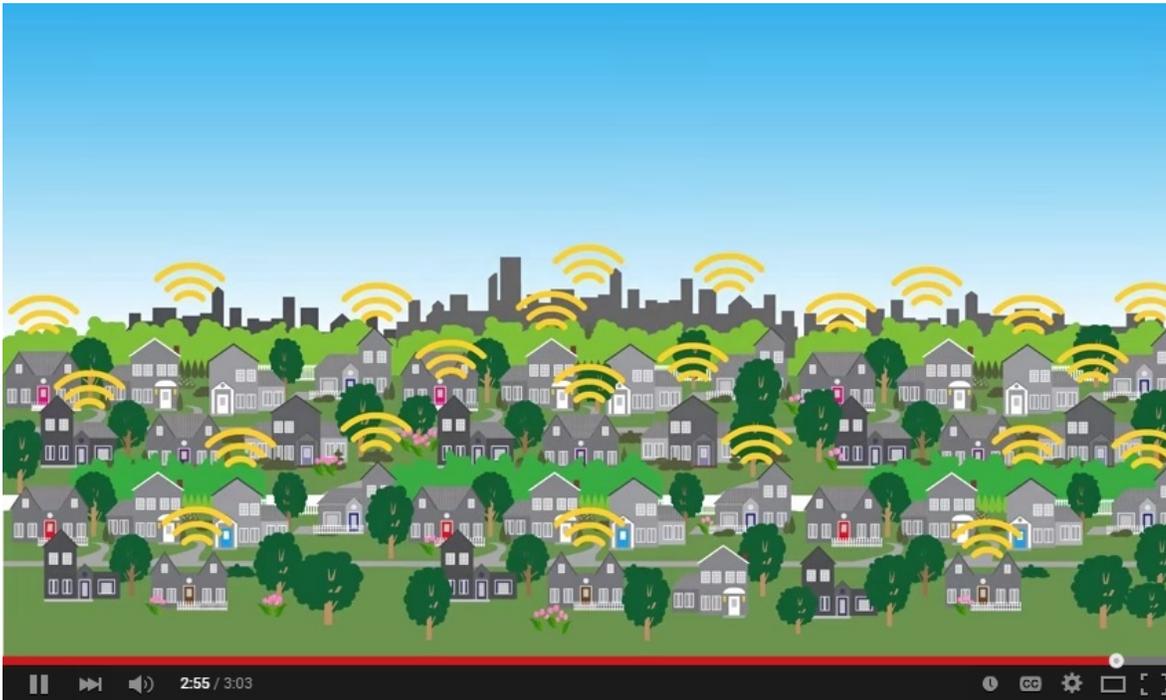
Xfinity is Comcast's new system for delivering content. However, rather than just delivering your internet and cable, Comcast is using your new Xfinity router as a gateway into your "smart home" and to deliver WiFi service to anyone within a few hundred feet of your home. The plan is to turn their customers' homes into public "hot spots" with the result that WiFi is nearly ubiquitous in our communities.

Comcast's stated ambition is to take away some of Verizon's or AT&T's business as people will be able to use Xfinity WiFi rather than the cellular networks for their mobile data. This will also give the company much more personal data on its customers, which has become very profitable for companies.

This is a brilliant business idea – if you believe that microwave radiation is perfectly safe. However, for the rest of us, there is now another layer of microwave radiation in our lives and a "hot spot" right in the center of our homes.

## What does Comcast say about Xfinity?

To be fair, I first want to share Comcast's side of this story. The following [promotional video](#) shows why Comcast believes this system is wonderful because of all the connectivity it will provide to its customers. You can tell how pleased they are with their product when they say "Xfinity will enrich communities – just like trees and flowers." My response to this is: Really? As you will see below, comparing WiFi to flowers and trees is the epitome of corporate greenwashing.



*Promo video via Comcast*

### **Why are people reacting to Xfinity WiFi?**

Every person who has contacted me (independent of one another) states that they were fine with the old Comcast WiFi routers, but they quickly reacted to the new Xfinity WiFi systems. I see three primary reasons for this:

1.) Unlike previous generations of WiFi routers, there are now at least two (possibly four) antennas within the Xfinity routers. One antenna is at the typical WiFi frequency of 2.4 GHz and now a second antenna emits microwave radiation at 5.0 GHz. There are also two channels within in each antenna – a private channel for your home and a public channel for any Comcast customer who is visiting or walking by. Simply put: more antennas and channels mean more microwave radiation exposure for people in the vicinity of the router.

The Business Wireless Gateway produces (4) WiFi networks:  
**1. XFINITY WiFi Hotspot 2.4 GHz and 5 GHz Networks**  
**2. Business Private WiFi 2.4 GHz and 5 GHz Networks**



*Image via Comcast*

2.) There is also evidence that the new Xfinity routers are more powerful than those of previous generations. Multiple EMF consultants have shared with me that when they measure these new routers, the readings are much higher than any consumer router they have ever measured previously. It could be that because Comcast wants to provide public access through your personal router, they have increased the power of the antennas in order to obtain the highest coverage area possible. This may be the only way their business plan of “ubiquitous WiFi” can work.

It is also possible that they have increased the power to the 5.0 GHz antenna because this frequency is more easily blocked by walls (and humans). Perhaps Comcast thinks they can fix the range issue simply by beefing up the power of this second antenna and hoped nobody would notice. I am still collecting information on power output of the Xfinity 5.0 GHz antennas. Please contact me with your router FCC ID# if you have Xfinity service.

3.) The 5.0 GHz transmission from this new antenna is likely particularly harmful to human biology. Basically, a 5.0 GHz frequency has twice as many waves per unit time as the 2.4 GHz channel. Each of these waves (called the “carrier wave”) has pulsed-modulated frequencies within it (this is the “information content” that makes your phone work). The 5.0 GHz channel allows for much faster download speeds because it contains more packets of information content per unit of time (i.e. more pulsed-modulated frequencies).

What is the problem with this configuration? Well, the issue is that [the research points to](#) these pulsed-modulated frequencies as being the dangerous part of wireless technology. These “information content” pulsed-modulated frequencies are likely interfering with fundamental biological processes occurring within the organs of your body – such as your brain. Thus, if the 5.0 GHz channel delivers twice as many pulsed-modulated frequencies as the 2.4 GHz channel, then it may be more harmful to our bodies.

*(Editor’s Note: It’s ultimately the nature of the pulses that is most important – do they penetrate the skin and eyes and do they contain frequencies that are resonant with living tissues? The primary factors that make a microwave radiation source biologically dangerous include: modulation, pulse frequency, resonance condition, duration and the state of the body receiving the dose (hydration, conductivity, permittivity, and the*

like). The sheer complexity of these new WiFi systems and their unknown interplay with our bodies is reason enough for us to shift to wired technology.)

### **If this all sounds complex, can we make a real world analogy?**

In nature, waves (or frequencies) are typically smooth, rhythmic sine waves. This is true for light and energy waves coming from the sun or ocean waves hitting the beach.



However, by analogy, let's substitute the natural waves from the ocean for the new 5.0 GHz Xfinity WiFi.

In this case, the waves would be coming ashore twice as fast as normal. Now imagine some people (or corporations) intentionally filling the water with oil and garbage that washes ashore with each and every wave. This oil and garbage represent the “information content” riding on the carrier wave and it would quickly pollute the beach, making it a stinking, unlivable mess.

It is quite possible that the pulsed-modulated 2.4 and 5.0 GHz WiFi frequency cocktail that Comcast is now exposing its customers to is causing similar damage to our bodies.

Not everyone will feel it right away (in fact, most do not). However, this does not mean that in 5-10 years' time a significant portion of exposed populations will not experience the exact same effects (or worse) as those who are currently affected. [Scientists increasingly say this will happen](#), so it's wise to start taking some basic precautions today.

### **So, what can you do? Here are some solutions when it comes to Xfinity WiFi:**

1.) For your own home, if Comcast is your only choice for internet service, you should be able to program your Xfinity router so that the WiFi component is off. Here are the basic directions which another EMF consultant,

[Oram Miller](#), was able to obtain directly from Comcast. You want to disable the NAT and set it to Bridge Mode by doing the following:

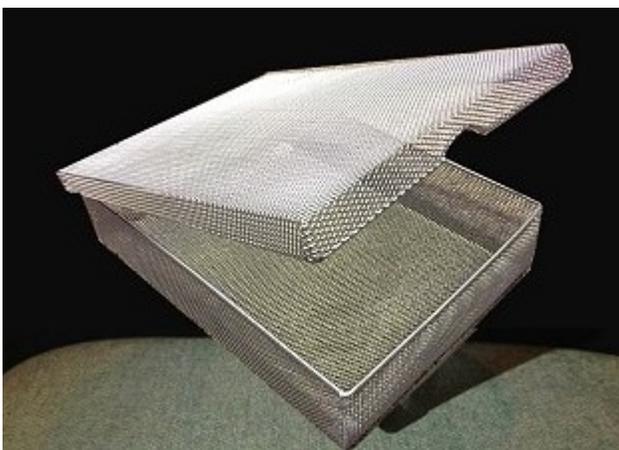
- Go to LAN settings — NAT
- Select Bridge, not “Router with NAT”
- This disables all WiFi.
- The router will then only recognize a hardwired LAN.
- To only disable the public “hot spot” option, here are Comcast’s [instructions](#).

However, please note there are some reports that when Comcast does a system wide reset (approximately once per month), the WiFi component is turned back on for all Xfinity routers. It would be prudent to own a [basic RF meter](#) to check this yourself every month or so. You will have to go through this process each time.

[*Editor’s Note:* The above directions are actually for a Time Warner modem (similar service to Comcast). In dealing with clients that have Xfinity modems, the Comcast tech support was called to disable the private and public WiFi antennas. However, there are still conflicting reports on whether the public hotspot stays off. The only way to know is to have a [basic RF meter](#) to double check. Comcast tech support emailed this link to disable the WiFi in the “My Account” page: <http://customer.xfinity.com/help-and-support/internet/disable-xfinity-wifi-home-hotspot/>]

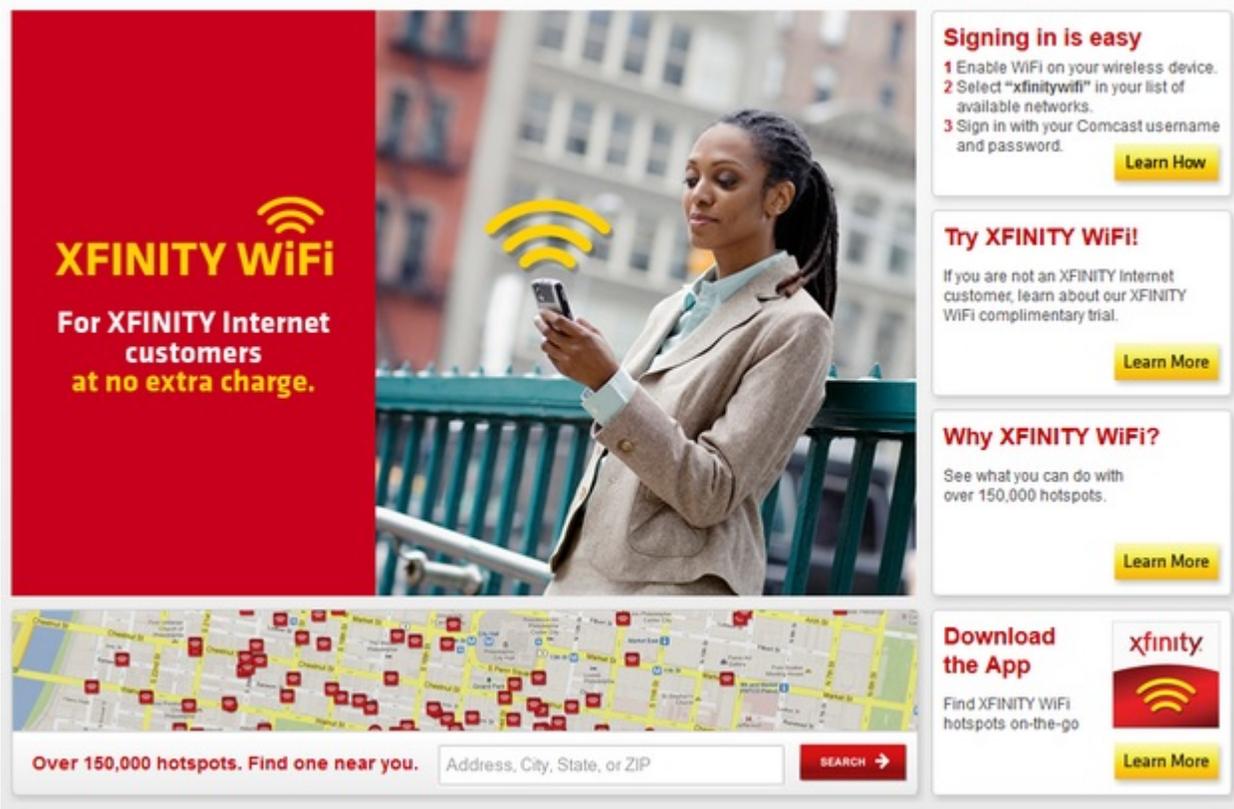
2.) If that sounds like a hassle, an easier route may be to purchase your own modem/router that integrates with Comcast. This will save you the \$10/month rental fee for the Xfinity router. This [article](#) from the San Francisco Chronicle summarizes how to find the right equipment. From my research, I would purchase this [Netgear modem/router combo](#) because it allows for fast internet speeds and has a simple WiFi On/Off button that easily allows you to disable all wireless functions. To add free home phone service, I would use [Ooma](#).

3.) You can also request an older model Arris modem from Comcast. Comcast is aware of this problem (they are even [being sued because of the public WiFi option](#)) and another EMF consultant, Liz Menkes, told me that Comcast has the older Arris modems available at the local offices for people who request it. You should be able to easily un-program any WiFi component in these older models and run safe, secure Ethernet cables.



4.) If you live in an apartment building or dense city, this issue is much more complex. You could have 4 to 8 of these powerful Xfinity routers within 50 feet of where you sleep (hence the insomnia complaints). Some people who have contacted me have had to move from their homes because of this. If moving isn’t an option, you could share this information with your neighbors and, considering the evidence, they may decide to turn off their Xfinity routers and use Ethernet cables. For other neighbors who want to keep their WiFi, you could purchase them a [Router Guard](#), which is a partial Faraday Cage for the router. It will reduce the microwave radiation output by 90% and the distance of the field by approximately 50%. For a typical apartment, this is still much more than is needed for an excellent signal, yet

the [Router Guard](#) will dramatically reduce the exposure within your living space. Having conversations with your neighbors and buying 5 or 6 router guards will likely be much less expensive than moving.



The image is a promotional banner for Xfinity WiFi. On the left, a red vertical bar contains the text "XFINITY WiFi" in yellow, with a yellow Wi-Fi symbol above it. Below this, it says "For XFINITY Internet customers at no extra charge." To the right of this bar is a photograph of a woman in a light-colored blazer looking at her smartphone. A yellow Wi-Fi symbol is overlaid on the phone. Below the photo is a map showing numerous red location pins representing hotspots. At the bottom left of the map area, it says "Over 150,000 hotspots. Find one near you." followed by a search input field with the placeholder text "Address, City, State, or ZIP" and a red "SEARCH" button with a right-pointing arrow. On the right side of the banner, there are four white boxes with rounded corners. The first box is titled "Signing in is easy" and lists three steps: 1. Enable WiFi on your wireless device. 2. Select "xfinitywifi" in your list of available networks. 3. Sign in with your Comcast username and password. A yellow "Learn How" button is at the bottom right. The second box is titled "Try XFINITY WiFi!" and says "If you are not an XFINITY Internet customer, learn about our XFINITY WiFi complimentary trial." with a yellow "Learn More" button. The third box is titled "Why XFINITY WiFi?" and says "See what you can do with over 150,000 hotspots." with a yellow "Learn More" button. The fourth box is titled "Download the App" and says "Find XFINITY WiFi hotspots on-the-go" next to the Xfinity logo and a yellow Wi-Fi symbol. A yellow "Learn More" button is at the bottom right.

*Image via Comcast*

*“Xfinity – The Future of Awesome”?*

Comcast’s tagline for this new system is “Xfinity – the future of awesome.” This may sound like a great marketing pitch, but [everything is not awesome](#). In reality, this is another huge corporation taking advantage of virtually [no safety regulations](#) in order to maximize profits at the expense of human health and the environment. Over one million Xfinity systems have already been installed, with a total of eight million planned. This will add yet another layer of dangerous EMF pollution to our lives.

There is a silver lining in all of this: with each new technology – including cell towers, wireless “smart” meters and the coming “Internet of Things” – more and more people are waking up to this issue. I see this every day as people contact me, unfortunately, with their stories of being injured by EMF pollution.

Another silver lining is that other internet providers, at least for now, do not appear to be emulating Comcast’s business plan. AT&T’s Uverse does not have the “public hot spot” option or the additional antennas that Xfinity uses (perhaps because AT&T is busy expanding its network of cell towers).

Until the tide of public opinion shifts in the coming years and the world wakes up to the danger of pulsed-modulated wireless technologies, the best thing you can do is to protect your family and friends by limiting what you are exposed to. Hopefully this article will give you more insight into how to do this, especially when it comes to Xfinity WiFi.

