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November 29, 2018

RECEIVED

DEC 03 2018

PUBLIC SERVICE
COMMISSION

Ms. Gwen R. Pinson,
Executive Director
Kentucky Public Service Commission
P.O. Box 615
Frankfort, Kentucky 40602-0615

RE: PSC Case No. 2018-00354

Dear Ms. Pinson:

Please find enclosed for filing with the Commission in the above-referenced case Owen Electric Cooperative, Inc.'s Responses to the Commission Staff's First Request for Information dated November 19, 2018.

Please contact me with any questions.

Respectfully yours,

CRAWFORD & BAXTER, P.S.C.

James M. Crawford
Attorney for Owen Electric Cooperative, Inc.

JMC/dmp

Enclosures

cc: Parties of Record

RECEIVED

DEC 03 2018

PUBLIC SERVICE
COMMISSION

COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

FILING OF OWEN ELECTRIC COOPERATIVE, INC.	)	
TO IMPLEMENT AN ADVANCED METERING	)	**CASE NO.**
SYSTEM (AMS) OPT-OUT TARIFF	)	**2018-00354**

CERTIFICATE

STATE OF KENTUCKY)
)
COUNTY OF OWEN)

Jack Scott Lawless, being duly sworn, states that he has supervised the preparation of the response of Owen Electric Cooperative, Inc. to the Public Service Commission Staff's First Request for Information to Owen Electric Cooperative, Inc. dated November 19, 2018, in the above-referenced case, and that the matters and things set forth therein are true and accurate to the best of his knowledge, information and belief, formed after reasonable inquiry.

____

Subscribed and sworn before me on this 3rd day of December, 2018.

Shannon Kaye Chappell
Notary Public

My commission expires April 25, 2019

Owen Electric Cooperative, Inc.

Case No. 2018-00354

December 3, 2018 Response to Commission Staff's
First Request for Information
Dated November 19, 2018

Question No. 1

Responding Witness: Jack Scott Lawless

Q-1. State whether Owen Electric has received any requests from members to opt-out of the Advanced Metering System (AMS). If so, state how many such requests Owen Electric has received and when those requests were received.

A-1. On October 31, 2006, the Kentucky Public Service Commission ("KPSC") granted Owen Electric a Certificate of Public Convenience and Necessity to install an AMS.[1] Upon receiving the CPCN, Owen Electric contracted an outside party to deploy approximately 51,000 single-phase meter services. Contractor work was complete in the fourth quarter of 2008. Afterward, Owen Electric employees began replacing approximately 900 three-phase meter services. The three-phase meter services were fully deployed in the fourth quarter of 2012. At that time, Owen Electric completed full deployment of the AMS.

Since Owen Electric began deployment of the AMS, comment has been received from 12 Members expressing concern that the AMS may interfere with their health and/or privacy. Dialogue with these Members began on, or about, the dates that follow:

[1] Case No. 2006-00314, Application of Owen Electric Cooperative, Inc. for an Order Issuing a Certificate of Public Convenience and Necessity (Ky. PSC Oct. 31, 2006).

Member	Approximate Date of First Contact
1	8/7/2008
2	10/23/2008
3	9/8/20011
4	9/10/2011
5	8/3/2012
6	11/6/2012
7	11/26/2012
8	1/15/2013
9	2/1/2013
10	3/1/2018
11	6/20/2018
12	8/3/2018

After discussion and exchange of information with these Members, Owen Electric expects five will consider participating in the Opt-Out Tariff if approved by the KPSC. Concerns expressed by seven Members appear to have dissipated to the extent they would not participate in the Opt-Out Tariff.

Owen Electric Cooperative, Inc.

Case No. 2018-00354

December 3, 2018 Response to Commission Staff's
First Request for Information
Dated November 19, 2018

Question No. 2

Responding Witness: Jack Scott Lawless

Q-2. State what efforts have been made by Owen, if any, to encourage those members who do not wish to be metered using AMS to acquiesce. If none, explain.

A-2. Owen Electric communicates that its distribution system is constructed using industry best practices and that each component of its distribution system, including its AMS, meets all operational and safety standards established by state and federal regulatory authorities. As such, Owen Electric expresses confidence to Members that its electric distribution system is safe and reliable and has no adverse effects on their health.

In the past, Owen Electric provided concerned Members with copies of published literature aimed at providing facts on the operation of AMS and discussed perceived dangers to the health and privacy of those being served by AMS. Examples of these publications are attached as Exhibit 2-1 of Owen Electric's Response to PSC-1, Question 2.

Currently, Owen Electric distributes to concerned Members a copy of the "Advanced Meter FAQs" that is attached hereto as Exhibit 2-2 of Owen Electric's Response to PSC-1, Question 2. This FAQ provides clear and concise answers to the most commonly asked questions regarding AMS. It has proven to be an effective method to communicate with Members. The last page includes an illustration of the "Public Safety Communication Spectrum Table," which compares the communication frequencies of AMS to those of many common household devices. The entire document is available for review and download on Owen Electric's website at http://www.owenelectric.com/content/advanced-meter-faqs.

Additionally, one Owen Electric Member requested that East Kentucky Power Cooperative ("EKPC") collect electromagnetic field measurements at their single family residential dwelling. After collecting the requested measurements, EKPC prepared a report summarizing its findings that was delivered to the Member. A copy of the report is attached hereto as Exhibit 2-3 of Owen Electric's Response to PSC-1, Question 2. This Member is one of the five Members that Owen Electric expects to participate in the Opt-Out Tariff if approved by the KPSC.

EDF ENVIRONMENTAL DEFENSE FUND™
Finding the ways that work

ENERGY

Source: Silver Spring

What consumers need to know about the smart grid and smart meters

America's outdated energy system is wasteful, expensive, and a huge source of pollution. Over the next 10 years, utilities will have to invest hundreds of millions of dollars to modernize our electricity grid, most of which is past the age of retirement. By making smart investments in a "smart" green grid, we can greatly reduce our use of dirty energy, improve air quality and the health of millions of Americans[1] affected by dangerous air pollution, and advance our energy independence and economic growth.

The diverse benefits of a smart grid

Modernizing our electricity system with information and networking technologies will allow us to diversify energy sources and eliminate enormous waste. The smart grid will be an "energy Internet" that transforms energy as completely as the information revolution transformed telecommunications, bringing us everything from cell phones to YouTube. A properly designed smart grid will help households and businesses reap many economic and environmental benefits, including:

1. **Economic and job growth** — The clean energy industry is one of our fastest growing sectors, with venture capitalists, utilities, and businesses investing billions in domestic solar, wind, energy efficiency, smart grid, and electric vehicle companies and projects. Between 1998 and 2007, clean energy jobs in the U.S. grew by 9.1 percent, while total jobs grew just 3.7 percent. All told, 770,000 people were working in 68,200 fast-growing businesses spread across all 50 states.[2]

2. **Lower utility bills** — With easy-to-use tools—such as simple online displays of the information smart meters provide about use and prices and set-and-forget home energy management tools—consumers will be able to make choices that lower bills and shrink their environmental footprint.

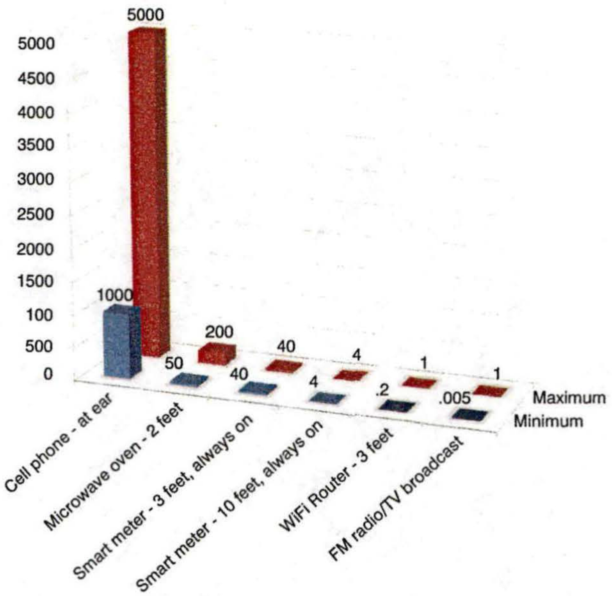
3. **More reliable service through shorter and fewer outages** — A smart grid uses two-way, real-time communication to pinpoint and fix problems, often before they happen. When black-outs do occur, power can be restored quickly, keeping businesses up and running and households comfortable and safe during storms and heat waves.

4. **Cleaner air and improved public health** — The burning of fossil fuels to generate electricity is one of the biggest sources of pollution and a major health threat. Dirty air causes alarming rates of asthma and lung disease, especially among children and the elderly. According to the EPA, the more than 20 million Americans suffering from asthma endure two million visits to the emergency room and 5,000 premature deaths, at annual costs of approximately $14 billion each year.[3] A smart grid will help clear our air, delivering huge benefits for public health.

5. **More clean renewable energy and less dirty fossil fuel** — Because a smart grid can adjust demand to match intermittent wind and solar supplies, it will enable the United States to rely far more heavily on clean, renewable, home-grown energy: cutting foreign oil imports, mitigating the environmental damage done by domestic oil drilling and coal mining, and reducing harmful air pollution. A smart grid will also facilitate the switch to clean electric vehicles, making it possible to "smart charge" them at night when wind power is abundant and cheap, cutting another huge source of damaging air pollution.

COMPARISION OF RADIO-FREQUENCY LEVELS FROM VARIOUS SOURCES IN uW/cm²

Source: CCST January 2011 Report: Health Impacts of Radio Frequency From Smart Meters



> "A well-designed smart grid will improve our quality of life, grow our economy, and drive the clean energy revolution we need."
>
> **MIRIAM HORN**
> Director, Smart Grid Initiative

A person's actual exposure to RFs from any source is a function of signal strength—which diminishes rapidly with distance—and amount of daily exposure. The CCST study found that even if smart meters were on 100 percent of the time, an individual's exposure from ten feet away would be nearly zero.[6] That is 250 - 1,250 times less than the exposure level from holding a cell phone to one's ear, and significantly less than standing next to a microwave.[7] Even if an individual was sitting directly on the other side of the wall from a meter, CCST concluded that he or she would be exposed to a very small fraction (0.03 percent) of the level established as safe by the FCC guidelines.[8]

The technology behind smart meters

Digital "smart" meters—capable of two-way communication between customers and electric utilities—are key to realizing all of these benefits. The only way we'll be able to shift, on a large scale, to clean electricity and clean cars is with a smart network to plug them into. And the only way we will eliminate the huge waste throughout our whole energy system is if customers have real-time information about use and rates, and the power to reduce or shift that use: to cut costs and pollution.

Information flows between meters and utilities using radio frequencies (RF) such as those used by radios, baby monitors, and cell phones.

Putting RFs in perspective

Electromagnetic fields (EMF), including RFs, have been studied for years. The World Health Organization has found no evidence of health impacts from exposure to low-level EMFs.[4] The Federal Communications Commission (FCC) has set guidelines to protect public health by establishing standards for safe levels of RF exposure.[5] And the California legislature has established the non-profit California Council of Science and Technology (CCST) to provide impartial expert advice on scientific and technology-related policy issues, including radio frequency from smart meters.

We need a smarter grid now

A well-designed smart grid will improve our quality of life, grow our economy, and drive the clean energy revolution we need. It will empower consumers to manage their electricity use and save money, help utilities reliably deliver power, increase our energy independence, and help us compete in the global clean energy market—while protecting our air, water, and public health.

1. American Lung Association State of the Air 2010 Report, http://www.stateoftheair.org/, found that more than 175 million people, 58 percent of the US population, suffer from pollution levels often too dangerous to breathe.
2. http://www.pewcenteronthestates.org/uploadedFiles/Clean_Economy_Report_Web.pdf
3. http://www.epa.gov/asthma/about.html
4. http://www.who.int/peh-emf/about/WhatisEMF/en/index1.html
5. CCST Report (Pages 7-8), http://www.ccst.us/publications/2011/2011smartA.pdf, concluding that the FCC guideline is more than adequate to protect from potential thermal effects of RFs, the only effects that have been scientifically-established.
6. CCST Report (Pages 18), http://www.ccst.us/publications/2011/2011smartA.pdf
7. CCST Report (Page 5), http://www.ccst.us/publications/2011/2011smartA.pdf
8. CCST Report (Page 7), http://www.ccst.us/publications/2011/2011smartA.pdf

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TELECOM
COUNCIL

No Health Threat From Smart Meters

by
Klaus Bender. PE
Director of Standards & Engineering
Utilities Telecom Council

As utilities seek to modernize their aging infrastructure and upgrade to a "smart" electric grid, wireless communications will play an ever increasingly important role in the facilitating these enhancements. Several consumer groups have raised concerns about the potential health effects of a two way communications device, the next generation electric meter or smart meter, on their homes.

This article provides a brief review of the safety standards dealing with radio frequency energy and safety and shows that smart utility devices pose no health threat. We compare other household wireless devices to smart meters to show the energy from a meter is actually less than commonly used devices.

Smart grid deployments use devices that fall into the same category as many wireless devices found in the home, such as wireless routers used for internet connectivity and wireless baby monitors. And unlike the laptop or WiFi router in the home that are always transmitting, smart meters transmit for only a fraction of the day for short durations.

Introduction

Smart Grid is a transformed electricity transmission and distribution network or "grid" that uses robust two-way communications, advanced sensors, and distributed computers to improve the efficiency, reliability and safety of power delivery and use. Deploying the Smart Grid became the policy of the United States with passage of the Energy Independence and Security Act of 2007 (Title 13). The Smart Grid is also being promoted by the European Union and other nations.

The smart grid will rely on the use of radio frequencies to provide wireless connectivity to the various components of the new electric distribution system. Wireless communications technology has become ubiquitous in our lives, enabling mobile connectivity with cell phones, wireless internet services and home area networking with WiFi technology and even cooking our food with microwave ovens. Yet there are unsubstantiated concerns that the smart meters being installed around the country and the world will cause ill health effects to members of the household where the meters are installed.

Therefore, we examine the facts about the impact of radio frequency energy on the body, showing that the devices utilities seek to install pose no threat of harm to humans. We show that the type of radio energy used and emitted by smart meters, cell phone, wireless routers and microwave ovens can only damage the body at extremely high levels. While research continues into long term effects, there has been no conclusive evidence that low level RF energy has a long term negative impact. We concentrate on RF energy and acknowledge that electric meters are connected to the power system and unauthorized tampering or dismantling an electric meter could pose electric shock danger to anyone coming in direct contact with energized electric conductors.

Federal Jurisdiction for Safety of Radio Frequency Devices

The Federal Communications Commission (FCC) has jurisdiction over the approval and use of radio frequency devices, whether a license is required for the devices or if unlicensed operation is allowed. FCC regulations are based on standards set by the Institute of Electrical and Electronic Engineers (IEEE) based on years of research by health professionals. The FCC has a twofold role in ensuring safety. First, the FCC has allocated the radio spectrum into a variety of pieces, most of which need coordination and a license before operation is permitted. Examples of this include television, satellite and radio broadcast channels, a variety of cellular and personal communications service frequencies, and microwave frequencies that transmit huge amounts of information from one point to another using dish style antennas. At the same time, the FCC has allocated some frequencies for unlicensed operation, allowing consumers to purchase products at Best Buy or Wal-Mart and install them in their homes. These devices operate at low power levels, enabling communications but posing no threat of health effects to humans. Examples include the WiFi routers already discussed, wireless baby monitors and garage door openers.

The FCC's second role is to approve radio devices for manufacture, import and sale. Regardless of whether the equipment operates on low power unlicensed channels or at higher power operations that require an authorization, each device must be tested to meet FCC standards. The sale of untested and unapproved equipment is a serious offense and the FCC aggressively prosecutes violators.

FCC Mandates on RF Exposure and Impact on Humans

The FCC is required by the National Environmental Policy Act of 1969, among other things, to evaluate the effect of emissions from FCC-regulated transmitters on the quality of the human environment. Several organizations, such as the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers, Inc. (IEEE), and the National Council on Radiation Protection and Measurements (NCRP) have issued recommendations for human exposure to RF electromagnetic fields.

On August 1, 1996, the Commission adopted the NCRP's recommended Maximum Permissible Exposure limits for field strength and power density for the transmitters operating at frequencies of 300 kHz to 100 GHz. In addition, the Commission adopted the specific absorption rate (SAR) limits for devices operating within close proximity to the body as specified within the ANSI/IEEE C95.1-1992 guidelines.

(See Report and Order, FCC 96-326) The Commission's requirements are detailed in Parts 1 and 2 of the FCC's Rules and Regulations [47 C.F.R. 1.1307(b), 1.1310, 2.1091, 2.1093]. The potential hazards associated with RF electromagnetic fields are discussed in FCC's Office of Engineering and Technology (OET) Bulletin No. 56, "Questions and Answers About the Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields."[1]

The FCC also offers OET Bulletin 65 on this topic. The revised OET Bulletin 65 has been prepared to provide assistance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to radiofrequency (RF) fields adopted by the Federal Communications Commission (FCC). The bulletin offers guidelines and suggestions for evaluating compliance.

Understanding the Impact of RF Energy on Humans

RF signals are known to propagate as waves, and one of the key characteristics of the wave is its frequency. Frequency is the most significant control factor in radio transmission and impacts how the waves travel through space, whether they pass through walls or bounce off them, the wave's interaction with foliage, etc. Use of the transit frequency is common knowledge in our society, as commercial radio and television stations often use this parameter as part of the public persona.

Frequency also determines the impact of RF energy on the human body. Only very high frequencies, ultraviolet rays and above, have the capability of mutating living cells to cause cancer and similar illness. This frequency range is known as ionizing radiation because the RF energy creates ions out of living cells by removing or adding electrons at the cellular level.

Non-ionizing radio energy fall below this frequency range and the primary interaction with human cells is to heat them. This is the basis for the microwave oven. Non-ionizing energy, at a high enough level, will heat human cells until they die, but non-ionizing energy is simply incapable of mutating cells and causing diseases like cancer.

Industry research and standards agencies, such as ANSI and IEEE, have compiled the research associated with human exposure of RF energy and created guidelines that the FCC and the Federal Occupational Safety and Health Administration (OSHA) have adopted. The standards incorporate frequency of the energy to define maximum permissible exposure levels (MPE) correlated to frequency. The standards are most conservative at frequencies where the wavelength of the energy is near the size of the average human and have the most potential for whole body impact. The resulting MPE levels incorporated into the requirements include a 10:1 safety ratio to account for variations in size, weight and physical condition of the subject. Therefore, exposure even at 100% of the MPE level will not cause physical harm.

In order to further protect the public from exposure to RF energy, the FCC set the MPE levels discussed above as the "occupational" or "controlled" environment, intended for workers and other professional

[1] http://www.fcc.gov/oet/rfsafety/

previously trained in safety related to RF energy. The FCC then created a "general public" or "uncontrolled" environment criteria that added an additional 5:1 safety factor over the occupational level. Thus the FCC's MPE limit for the general public is 50 times less than the level research shows can actually cause harm. The tables below show the limits for occupational and general public MPE.

Table 1. LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

(A) Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	($900/f^2$)*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6

(B) Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	($180/f^2$)*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

f = frequency in MHz *Plane-wave equivalent power density

NOTE 1: ***Occupational/controlled*** limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2: ***General population/uncontrolled*** exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

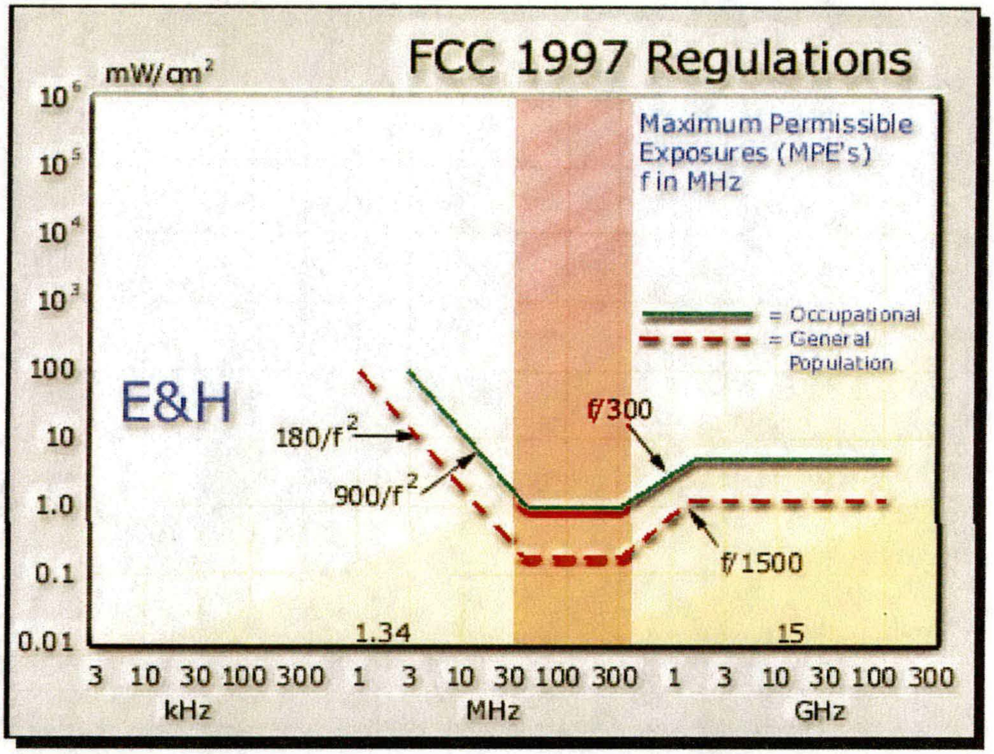


Figure 1. MPE Level by Frequency and Class (Source: Sitesafe, Inc., Arlington VA)

The FCC's OET 65 document also defines concepts like time averaging. As shown in the tables above, the averaging time for occupational/controlled exposures is 6 minutes, while the averaging time for general population/uncontrolled exposures is 30 minutes. It is important to note that for general population/uncontrolled exposures it is often not possible to control exposures to the extent that averaging times can be applied. In those situations, it is often necessary to assume continuous exposure. [2] Since the known danger in RF energy is tissue heating, if the subject moves out of the area of high RF levels, the cells will return to normal temperature. At 100% or less of MPE, there is no danger in continuous exposure. Time average says that if one is an area identified as 200% of the occupational MPE, up to three minutes of exposure is safe as long as three minutes elapse in an area at less than 100% MPE.

In summary, there is no known long term health effect from exposure to RF energy at levels below those designated by the FCC. This energy is all around and the energy associated with smart meters is far less than those of other common services and equipment.

[2] FCC OET Bulletin 65

Comparison of RF Power Density in the Everyday Environment

Device Relative Power Density in microwatts per square centimeter (μW/cm2)

FM radio or TV broadcast station signal	0.005
SmartMeter™ device at 10 feet	**0.1**
Cyber cafe (Wi-Fi)	10-20
Laptop computer	10-20
Cell phone held up to head	30-10,000
Walkie-Talkie at head	500-42,000
Microwave oven, two inches from door	5,000

Source: Richard Tell Associates, Inc.[3]

Meter Reading System Configurations

Residential and industrial electric meters allow utilities to accurately bill for the energy consumed. These devices have been used as long as the electric industry has been in place. Early meters required manual reading, with a utility employee writing down the use data and returning to the office to enter that information into the utility billing system. The use of radio frequencies to interrogate meters began in the early 1980's. These systems used an interrogation signal sent from a utility employee either walking or driving through the area of interest. A radio signal "pings" the meters within range and the devices respond with consumption information, also using radio signals.

As previously noted, the electric infrastructure in the US is going through a major transition, replacing equipment that can be 40 to 50 years old. At the same time, variable renewable energy sources like solar and wind must be integrated into this new grid. Increased communication with consumers that allows customers to adjust their energy usage in response to pricing or reliability based signals. Remote meter reading and cutoff, as well as other smart grid applications are all key components of the smart grid and these capabilities rely on smart meters.

Smart meter systems varying in implementation depending on the utility's needs and the vender selected. Most utilities are electing to install radio based smart meter systems. Radio based systems also vary in configuration, but each system is made up of the following components:

1. Meter: The meter device measures consumption and stores the information for retrieval by the utility.

[3] Pacific Gas and Electric: http://www.pge.com/myhome/edusafety/systemworks/rf/

2. Meter Transceiver: The transceiver is a radio that receives instructions from the utility network and transmits necessary information to the utility. The transceiver is often an integral part of the meter, especially in the case of electric meters. Often, water and gas meters' transceivers are mounted near the device. The meter's radio system can also communicate with home energy management systems used by customers to control and monitor appliance power consumption. The meter transceivers operate on low power unlicensed channels, or in some cases, using cellular radio channels.

3. Data Aggregation Points: The meter transceiver transmits information to nearby collection devices, often called data aggregation points (DAPs). These devices are often mounted on nearby power poles at heights of 20 to 30 feet above ground. The DAPs collect information and transmit that information to the utility. If the utility has high capacity fiber infrastructure, that resource carries information from the DAPs. Typically, the DAP will communicate with center receive stations on radio frequencies in the unlicensed bands, or using cellular technology.

A common misconception about smart meters is that they are always "on" or transmitting. This is far from the case. Until recently, water and gas utilities usually read meters once or twice a month and the time needed to transmit information is less than 1 second. Only recently have gas and water utilities initiated more frequency meter queries. Electric utilities are implementing time-of-use billing structures but rarely need to read the meter more than once every 15 minutes. Again, the time to transmit consumption data is less than 1 second. This means, in this scenario, these low power devices are transmitting approximately 0.11% of the day[4], at short bursts of less than one second. Even if the meter transmits once every 15 seconds, as is the case when no interrogation signal is used, transmission would still only by 6.7% of the day

We know from our discussion of RF exposure, even if the RF levels from these devices would exceed 100% of the FCC MPE, the impact on the body takes time. For the RF signal from a smart meter to be powerful to harm the human, that signal would have to be so powerful the transmission would be on the order of TV or radio broadcast stations. This is clearly not the case for smart meters.

[4] Daily exposure percentage = [(4 seconds/hour)/(24 hours/day*60 minutes/hour*60 seconds/minute)]* 100

Summary

In this article, we defined the concept of the smart grid and the benefits to society. We also highlighted the importance of radio networks to the successful deployment of the smart grid. We discuss the important concepts of RF energy and the impact on humans. Specifically, there is no demonstrated long term impact of low level non-ionizing energy on humans. Ionizing energy, beginning with the ultraviolet component of sunlight, has been demonstrated to have long term impact, but the frequencies citing in this report are hundreds of orders of magnitude below that of sunlight. Therefore, this shows that the often quoted sources in the media expressing concern about the RF safety from smart meters are shown to be based on faulty logic, or faulty "facts" and misrepresentations.

We show that a specific analysis of the component used in this smart grid deployment are significantly below general population MPE and note, again, that FCC limits for MPE of general population are already at least 50 times lower than levels that can cause tissue heating.

An examination of a majority of smart meters being deployed today will show these devices use low power levels associated with unlicensed devices, on the equivalent magnitude as the devices that provide WiFi connectivity in the home. Millions of laptop computers are used in homes every day that transmit at levels similar to the smart meter and the transmitters from these devices are always "on". Some utilities are deploying meter reading systems that use commercial wireless providers to gather data. These meters have the same radio components as cell phones, the same phone consumers raise to their head every day.

So when confronted with complaints that say smart meters cause a variety of health effects, ask the complainant to produce the science to support the claim. The conversation should end shortly thereafter.

#

Appendix – Useful Links

http://www.fcc.gov/oet/rfsafety

http://www.fcc.gov/oet/rfsafety/rf-faqs.html

http://www.fcc.gov/oet/info/documents/bulletins/Welcome.html#56

http://www.fcc.gov/oet/info/documents/bulletins/Welcome.html#65

For more information, please contact:

Klaus Bender, PE
Director of Standards & Engineering
Utilities Telecom Council
klaus.bender@utc.org
+1.202.833.6803

COOPER Power Systems

Understanding Radio-Frequency and Health Impacts

Introduction:

There has been increased concern amongst Cooper Power System's energy consumers regarding the possible health effects of Smart meter radio communication and other wireless technology. Cooper Power Systems takes the customer concerns of our AMI users seriously and, after analysis of the issue, would like to affirm that decades of scientific evidence, reinforced by recent specific radio frequency (RF) exposure evaluations, conclude that RF transmissions of the type associated with Smart meters is highly unlikely to cause adverse health effects.

Evidence:

According to the U.S. Federal Communications Commission (FCC), the organization with oversight responsibility for RF safety guidelines, devices which emit radio energy must be certified to meet maximum permissible exposure (MPE) requirements, as specified in FCC 1.1310. The limits specified by the FCC vary based on frequency and the power density limits are specified as an average value over a 6 minute time period. The power density limit for the 902-928 MHz band in which the Cooper RF AMI products operate (defined as the 915 MHz Industrial, Scientific and Medical band) is 0.6 mW/cm^2. The FCC validates a device using a calculation distance of 20 cm (7.9 in.) and notes RF exposure drops rapidly with distance.

Note 1: The FCC limits for exposure are based on the effects of tissue heating in behavioral studies in animal subjects and afford the public a margin of safety 50-fold lower than the adverse effect exposure threshold[1].

Note 2: Other organizations that recommend exposure limits, including the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the Institute of Electrical and Electronic Engineers (IEEE), have also adopted guidelines consistent with the FCC's.

The California Council on Science and Technology (CCST) an independent organization, sponsored in part by the state's major universities and federal laboratories, conducted a data analysis review, titled "Health Impacts of Radio Frequency from Smart Meters" to assess the potential health effects of smart meter operation. Upon completion of the study, CCST published Table 1 below outlining what the organization believes are the key factors when evaluating exposure to radio frequency form smart meters.

Table 1: Key Factors When Evaluating Exposure to Radio-Frequency from Smart Meters

1. Signal Frequency	Compare to devices in the 900 MHz band and 2.4 GHz band	Frequency similar to mobile phones, Wi-Fi, laptop computers, walkie-talkies, baby monitors, microwave ovens
2. Signal Strength (or Power Density)	Microwatts/square centimeter (μW/cm$_2$)	Meter signal strength is very small compared to other devices listed above
3. Distance from Signal	Signal strength drops rapidly (doubling distance cuts power density by four)	Example: 1 ft. – 8.8 μW/cm2 3ft. –1.0 μW/cm2 10ft.–0.1 μW/cm2
4. Signal Duration	-Extremely short amount of time (2.0---5.0%, max.)	-Often overlooked factor when comparing devices.

[1] A 2009 review of the radio-frequency health literature conducted by the International Commission on Non-Ionizing Radiation Protection concluded, *"The mechanisms by which RF exposure heats biological tissue are well understood and the most marked and consistent effect of RF exposure is that of heating, resulting in a number of heat-related physiological and pathological responses in human subjects and laboratory animals...Whilst it is in principle impossible to disprove the possible existence of non-thermal interactions, the plausibility of various non-thermal mechanisms that have been proposed is very low..."*

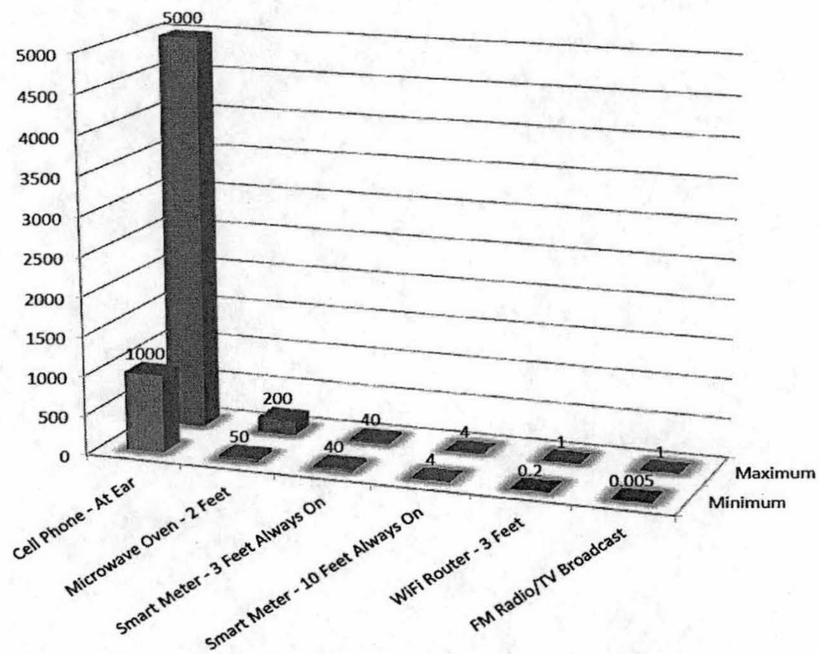
	-No RF signal 95-98% of the time (over 23 hours/day)	-Short duration combined with weak signal strength yields tiny exposures
5. Thermal Effects	Scientific consensus on proven effects from heat at high RF levels	FCC "margin-of-safety" limit is 50 times lower than hazardous exposure level -Typical meter operates at 70 times less than FCC limit and 3,500 times less than the demonstrated hazard level
6. Non-thermal Effects	-Inconclusive research to date -No established cause-and-effect pointing to negative health impacts	Continuing research needed

Source: California Council on Science and Technology, "Health Impacts of Radio Frequency from Smart Meters," January 2011, page 25.

In relation to other commonly used devices, such as cell phones, microwaves, and lap tops, the relative power density of smart meters is minimal and much lower than the FCC standard. Furthermore, in most cases the meter is placed outside of the home (providing additional exposure screening) and operates for shorter periods of time (generally for a few seconds at a time with transmissions occurring at different times throughout the day). The very low duty cycle operation of the meters therefore limits potential exposure and decreases the possible threat to the customer's health.

CCST looked at data showing radio frequency levels from various common household items in comparison to smart meters. The findings are shown below in Figure 1.

Figure 1: Comparison of Radio-Frequency Levels from Various Sources (in µW/cm²)

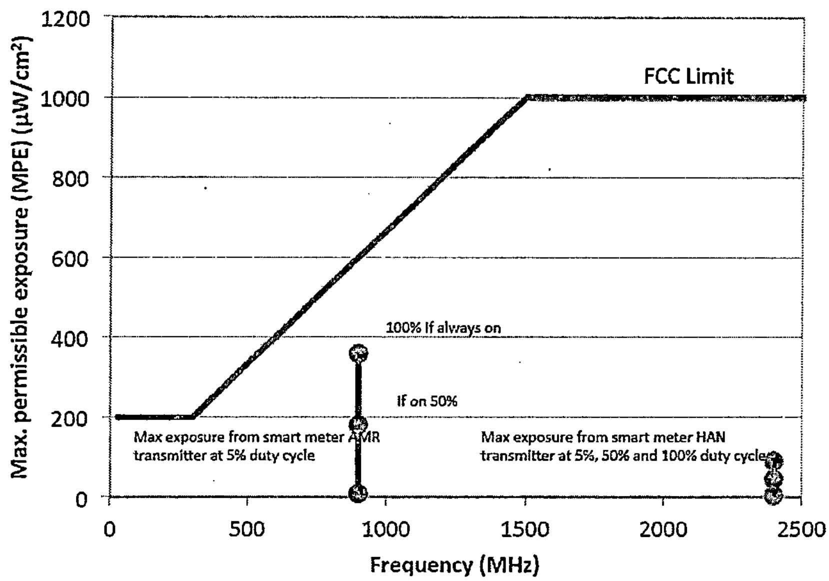


Source: California Council on Science and Technology, "Health Impacts of Radio Frequency from Smart Meters," January 2011, page 20.

This data shows that the maximum RF exposure effects from an **always-on** (100% transmit duty cycle) smart meter at 3 feet is one fifth that experienced from a microwave at 2 feet. The maximum possible transmit duty cycle for a normally functioning RF smart meter is 50% where data transmissions and receptions alternate. The actual transmit duty cycle is dependent on the meter's location within the network – increasing for devices that are closer to the Gateway collectors if they support a large amount of relay traffic. For current deployed networks the average smart meter transmit duty cycle is typically less than 5% and may be as low as 1-2%. The CCST data presented above thus assumes an extreme worst case scenario of a malfunctioning meter that is stuck transmitting continuously with a resulting 100% duty cycle. Even under such an extreme assumption the worst case exposure is still a fraction of that experienced from microwave oven usage. A user will also have far more interactions with a microwave at 2 feet than with continuous presence 3 feet from a malfunctioning (always-on) smart meter.

In figure 2, to further demonstrate the minimal impact of a smart meter, the CCST outlines the FCC's maximum exposure limits in comparison to exposure amounts from a typical smart meter. The graph is indicative of just how safe smart meters really are with regard to RF exposure.

Figure 2: FCC Maximum Exposure Limits and Exposure from a 900 MHz, 1 Watt smart meter 1 ft from the user



Source: California Council on Science and Technology, "Health Impacts of Radio Frequency from Smart Meters," January 2011, page 18

This data is based on a 1-foot distance from the smart meter with a 1 Watt power transmission. One Watt is the maximum FCC permitted 900 MHz ISM band meter transmit power. As previously indicated, the 100% duty cycle is conservative in that it is based on an assumed failure case in which the meter was stuck continuously transmitting. Since the average meter in a Cooper RF mesh network is likely to be operating with a transmit duty cycle less than 5%, the resulting exposure level, even for a user situated as close as 1 foot, will be far below the maximum level permitted by the FCC.

Table 2 provides a tabular representation of the results of the RF exposure assessment from smart meters and other common user devices as cited within the California Council on Science and Technology study. The data is based on measurements conducted at a manufacturer's production and test site as part of a study carried out by the Electric Power Research Institute (EPRI).

As the previous graphic illustrated, the exposure due to smart meters at 3 or 10 feet is indeed a small fraction of that received from other common user devices such as cell phones and microwave ovens.

Table 2: Radio-Frequency Levels from Various Sources

Device	Frequency	Exposure Level (mW/cm^2)	Distance	Exposure Time	Spatial Characteristic
Cell phone[1]	900MHz, 1800 MHz	1-5	At ear	During call	Highly localized
Cell phone base station[2]	900MHz, 1800 MHz	0.000005-0.002	10s to a few thousand feet	Constant	Relatively uniform
Microwave oven[3]	2450 MHz	~5 0.05-0.2	2 inches 2 feet	During use	Localized, non-uniform

Local area networks[(4)]	2.4-5GHz	0.0002-0.001[a] 0.000005-0.0002[b]	3 feet	Constant when nearby	Localized, non-uniform
Radio/TV broadcast[(5)]	Wide spectrum	0.001 (highest 1% of population) 0.000005 (50% of population)	Far from source (in most cases)	Constant	Localized, non-uniform
Smart Meter[(6)]	900MHz, 2400 MHz	0.0001 (250mW, 1% duty cycle) 0.002 (1 W, 5% duty cycle) 0.000009 (250mW, 1%duty cycle) 0.0002 (1 W, 5% duty cycle)	3 feet 10 feet	Only when in proximity during transmission	Localized, non-uniform

Source: Electric Power Research Institute (EPRI), "Radio Frequency Exposure Levels from Smart Meters," November 2010, page 7.

a-wireless router b-client card

(1) Based on a 3-inch, 250 mW antenna emitting in a cylindrical wavefront.

(2) Elliott P, Toledano MB, Bennett J, Beale L, de Hoogh K, Best N, Briggs DJ. 2010. "Mobile phone base stations and early childhood cancers: case-control study. BMJ 340:c3077."

ICNIRP. 2009. "Exposure to high frequency electromagnetic fields, biological effects and health consequences (100 kHz-300 GHz)." International Commission on Non-Ionizing Radiation Protection, Oberschleißheim, Germany, page 14.

Ramsdale PA, Wiener A. 1999. "Cellular Phone Base Stations: Technology and Exposures." Radiat Prot Dos 83:125-130.

(3) ICNIRP. 2009. "Exposure to high frequency electromagnetic fields, biological effects and health consequences (100 kHz-300 GHz)." International Commission on Non-Ionizing Radiation Protection, Oberschleißheim, Germany, page 21.

Tell RA. 1978. "Field-strength measurements of microwave-oven leakage at 915 MHz." IEEE Trans Electromagnetic Compatibility 20:341-346. R.A. Tell, personal communication.

(4) Wireless router based on 30-100 mW isotropic emitter.

Client card based on: Foster KR. 2007. "Radiofrequency exposure from wireless LANs utilizing Wi-Fi technology." Health Phys 92:280-9.

(5) Tell RA, Mantiply ED. 1980. "Population Exposure to VHF and UHF Broadcast Radiation in the United States." Proc IEEE 68:6-12.

(6) Based on spatial peak power density with 6 dB (x4) antenna gain.

Conclusion:

Cooper Power Systems values our energy customers, their service concerns, and their health. Cooper RF products meet and exceed the FCC certification requirements for operating within the ISM band and are further reassured by recent, continued assessments demonstrating the very limited potential RF exposure caused by smart meters. The exposure analyses confirms the very low impact of smart meter RF transmissions relative even to other more prevalent RF-transmitting household devices that are considered safe. Even under the extreme assumption of close user proximity to a malfunctioning continuous transmitting device, the resulting RF exposure does not rise to a level that creates a human health concern.

U.S. utilities have been installing meters with radios for remote meter reading since the 1980's. There are now over 50 million of these devices installed and operating in the US without a documented health issue. Additionally, due to the fact that smart meters emit radio frequencies intermittently and at much lower levels than many other safe RF-emitting devices, there is currently no demonstrated risk to the user. Cooper is committed to continuing to monitor the technical and health assessments associated with smart meter operation and in adhering to the regulatory requirements and certifications to ensure that our products do not pose a health risk to utility customers.

Experts concur (see below)—Smart meters pose less of a health risk than many other household items.

California Council on Science and Technology: "Wireless smart meters, when installed and properly maintained, result in much smaller levels of radio frequency (RF) exposure than many existing common household electronic devices, particularly cell phones and microwave ovens."

Maine Center for Disease Control: concluded there is "no consistent or convincing evidence to support a concern for health effects related to the use of radio frequency in the range of frequencies and power used by smart meters."

Additional Resources:

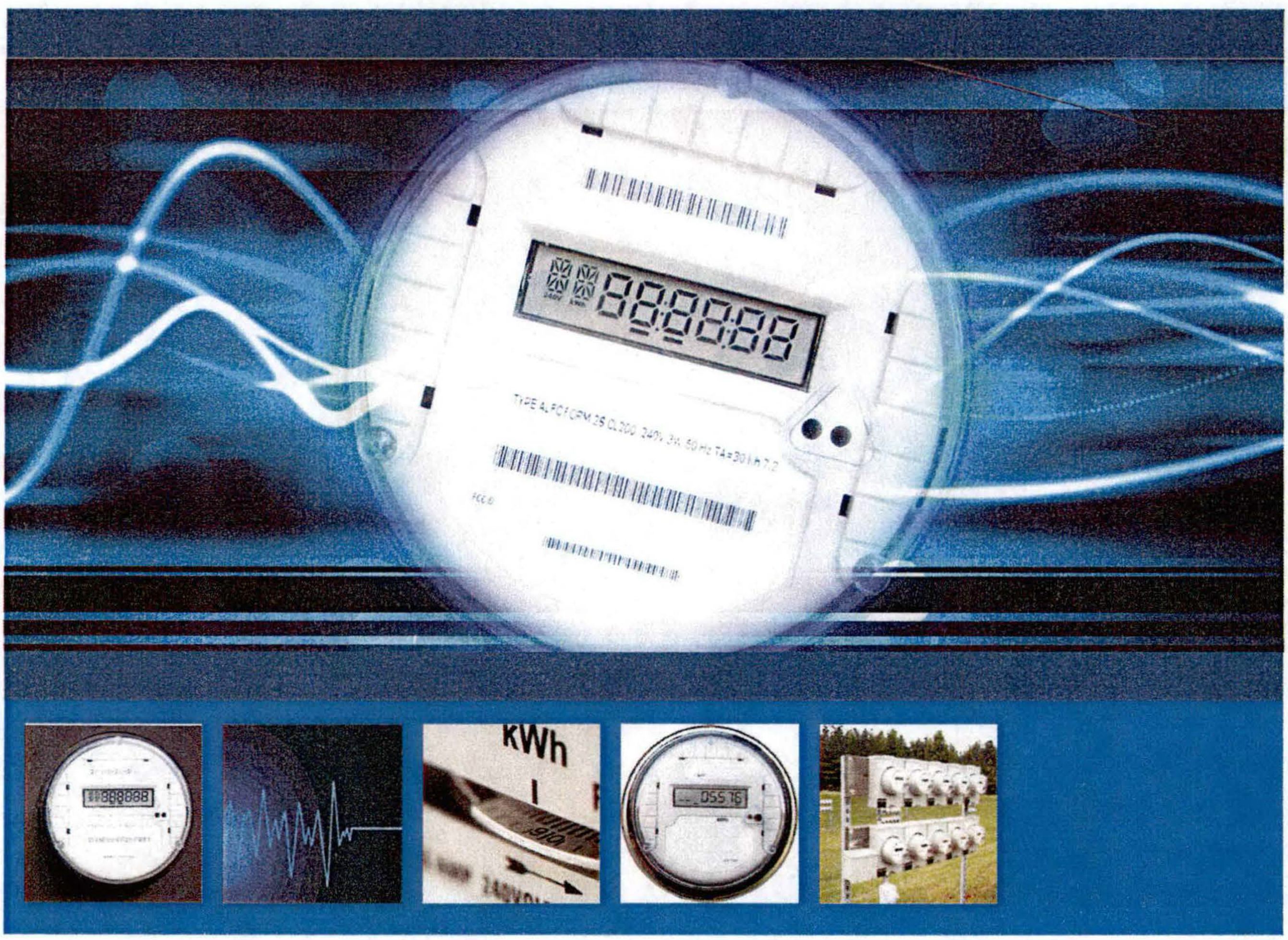
- Health Impacts of Radio Frequency from Smart Meters
- No Health Threat from Smart Meters
- DRSG Radio Frequency & Smart Maters Q&A
- Assessment of Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields
- Electric and Magnetic Fields Associated with the Use of Electric Power Q&A
- FCC Radio Frequency Safety FAQ Website

Sources:
California Council on Science and Technology, "Health Impacts of Radio Frequency from Smart Meters," January 2011
http://www.ccst.us/publications/2011/2011smartA.pdf
Electric Power Research Institute, "Radio-Frequency Exposure Levels from Smart Meters," November 2010
http://www.marbleheadelectric.com/EMF.pdf
Federal Communications Commission: http://transition.fcc.gov/oet/rfsafety/rf-faqs.html, December 2011
Maine Center for Disease Control, "Executive Summary of Review of Health Issues Related to Smart Meters," November 8, 2010,
http://www.maine.gov/dhhs/boh/documents/Smart_Meters_Maine_CDC_Executive_Summary_11_08_10.pdf

ELECTRIC POWER RESEARCH INSTITUTE

Radio-Frequency Exposure Levels from Smart Meters: A Case Study of One Model

February 2011



Introduction

This paper presents results from measurements of radio-frequency (RF) emissions from one specific type of smart meter. These tests were conducted as an initial step in responding to questions from the public concerning RF exposure levels from wireless smart meters. Smart grid technology promises to deliver enhanced reliability and economy of electrical power use. Consumers will be empowered with knowledge about—and with greater control over—their patterns of electricity use. Coincident with such benefits must also be an assurance that these new systems are operating in a manner compatible with human health and safety.

In the real world, smart meters transmit on an unpredictable schedule for very brief periods throughout the day, consisting of individual transmissions milliseconds long in duration, amounting to an average of up to about a minute and a half of transmitting per hour. For a valid RF field characterization with the meters continuously transmitting, it was necessary to conduct the measurements under defined conditions. With the manufacturer volunteering its test facility, measurements were able to proceed producing the data presented in this White Paper, representing the first well-documented study of its type. As there is a great diversity in the kinds of smart metering systems currently in use nationally and internationally, with many brands, architectures, frequencies, power levels, and communication activity levels represented, this study, naturally, may not fully describe all possible exposure values for all systems. Nevertheless, data from this study may be used to gain valuable insight into exposure scenarios for one widely used type of smart meter.

Table of Contents

This white paper was prepared by Rob Kavet and Gabor Mezei of the Electric Power Research Institute (EPRI).

Smart Meters' Role in a Modern Electricity Grid

Advanced Metering Infrastructure (AMI) is instrumental in changing the way electricity is used in industrial, commercial, and residential settings. EPRI's 2008 report, Wide Area Communications for Advanced Metering and Demand Response (1016959), states "...a modern grid requires a communications system with the capacity to support traditional utility functions—and the flexibility to adapt to advanced metering, demand response, distributed generation, and the many other new challenges." As an important component of the smart grid, AMI systems often use wireless communications to provide metering data that can be used to assess how, when, and where electricity is used. Anticipated benefits include enhanced reliability across the grid and pricing options for end users to economize on their electricity consumption.

As an integral component of AMI systems, smart meters are being installed in homes and businesses across the United States and abroad. EPRI's 2010 report, Accuracy of Digital Electricity Meters (1020908), indicates that "residential meters are expected to provide a range of measurements, with some including demand, TOU [time-of-use], or even continuous interval data. Some may also be required to keep a record of additional quantities like system voltage—helping utilities maintain quality of service in a world that includes fast-charging electric vehicles and solar generation."

AMI systems are generally two-way communicating systems and are envisioned to perform a wide-range of applications in addition to simply reading the meter. For example, some utilities envision using the meter as a "gateway" to the home, transmitting energy price signals and load management events to the consumer. Others may be used as distribution system voltage monitors, sending local voltage readings back to a distribution control system in near real-time. Yet others may be used to bring customer consumption data back to a central repository or transmit it into the home in real-time. In the context of wireless AMI systems, the two-way nature of these systems is normally implemented through the medium of so-called mesh networks, in which the meter on one home acts as a router for data coming from one or many other homes.

The Federal Communications Commission established limits for exposure to radio-frequency electromagnetic fields, which are published in FCC OET Bulletin 65 (August 1997), and codified in the Code of Federal Regulations (47 CFR § 1.1310). The FCC rule was adopted from two previous guidelines, one published by the National Council on Radiation Protection and Measurements (NCRP Report No. 86) in 1986, and the other by the Institute for Electrical and Electronic Engineers (IEEE C95.1 1991) in 1991. Both had extensively reviewed the biological and health literature, concluding that the only established effects were associated with tissue heating and no confirmed effects below heating thresholds were identified. The effects associated with heating, so-called "thermal effects", concerned diminished response rates in food-motivated behavioral experiments in laboratory animal subjects (rhesus monkeys and rats) and were accompanied by a rise in body core temperature of about 1° C. The exposure limits specified by the FCC afford the public a margin of safety 50-fold lower than the adverse effect threshold identified in the behavioral studies. Since the FCC rule was promulgated, other organizations concerned with RF health and safety have developed exposure guidelines very similar to the FCC's. These include the International Commission on Non-Ionizing Radiation Protection (ICNIRP) guideline (Health Physics 74:494, 1998) and IEEE Std C95.1™ published in 2005. These have again been based on thorough reviews of the literature, concluding that in the absence of heating, there have been no consistently demonstrated "non-thermal" mechanisms that could lead to adverse biological or health effects. A 2009 review of the radio-frequency health literature conducted by ICNIRP concluded:

> *The mechanisms by which RF exposure heats biological tissue are well understood and the most marked and consistent effect of RF exposure is that of heating, resulting in a number of heat-related physiological and pathological responses in human subjects and laboratory animals... Whilst it is in principle impossible to disprove the possible existence of non-thermal interactions, the plausibility of various non-thermal mechanisms that have been proposed is very low... the recent in vitro and animal genotoxicity and carcinogenicity studies are rather consistent overall and indicate that such effects are unlikely at specific absorption rate levels up to 4 W kg^{-1} [the level associated with behavioral disruption in animal experiments].*

EPRI Perspective

The use of RF-based smart meter technology for the residential sector has raised questions from the public as to potential health and safety risks that may be related to the meters' RF emissions. The Electric Power Research Institute's (EPRI's) EMF Health Assessment and RF Safety program initiated its research in response to these concerns with a preliminary commentary, A Perspective on Radio-Frequency Exposure Associated With Residential Automatic Meter Reading Technology (1020798), which described how wireless smart meters communicate, and provided insights into what kind of exposure levels may result. The EPRI research program has followed up with two ongoing research activities. One is an analysis of the amount of RF energy deposited in persons exposed to smart meter emissions. This study uses computer simulations of anatomically correct models of children and adults exposed under a range of conditions in very close proximity to a smart meter.

A second activity, the main subject of this paper, concerns a measurement study of RF emissions from one type of smart meter, taken under controlled conditions at the manufacturer's facility (as described in the Introduction). The purpose of the study was to take a first step in collecting empirical smart meter emission data. (*An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter*. EPRI Technical Report 1021126, December 2010, www.epri.com). These data could potentially provide insight into the range of exposure levels produced by other wireless smart meter systems. Key results of the study described below were that (1) exposure levels from an individual meter fall off rapidly with distance as one moves away; (2) based on empirical data from two electric utility service territories in California, the meters transmit only a small fraction of the time, and (3) exposure levels—even when one is close to a meter that is continuously transmitting—remain below the FCC exposure limits.

Smart Meter Measurement Study

When deployed across neighborhoods, meters of the type studied operate as part of a "mesh" network. The meters distributed across the mesh network are referred to as "end-point" meters and are the most common. Data from the end-point meters at individual residences are routed to "cell relays" (referred to by some as "collectors") with typically one of the latter installed for every 500 to 750 customers. From the cell relay the data are sent to a central repository over a wireless link that operates in the same manner as a cell phone transmission. The study conducted at the manufacturer's site involved RF emissions from only one type of end-point meter configured to transmit at its rated power level of nominally a quarter watt (W) or 250 milliwatts (mW) in the unlicensed frequency band of 902 to 928 MHz. The cell relay meters for the system tested operate similarly to end-point meters, but at a power level of 1 W. In addition, some utilities are deploying meters with a second radio inside for connection to a wireless Home Area Network (HAN). HANs, which can be either wired or wireless, can be used to provide communication connections between the utility and end-use devices for the purpose of demand response. HAN meters were also characterized in the EPRI study, but as they operate at a lower power level (roughly 60 to 100 mW) compared to the end-point units (and thus with lower exposure levels), the results of the HAN measurements are not covered in this paper; cell relays were studied as well, but only under laboratory conditions, and are not covered here either.

When in actual use in a field application, transmissions from the type of smart meter tested may occur in a somewhat unpredictable manner, for only small amounts of time interspersed throughout the day. Because of this, the manufacturer's cooperation was necessary to program the meters at their test site to allow for measurements taken under well-defined conditions, and thus be readily interpretable. The manufacturer's test site, also known as a "meter farm," contained about 7000 meters across a 20-acre area, and each structure consisted of a rack of 10 meters (see Figure 1). The measurements were conducted over a four-day period.

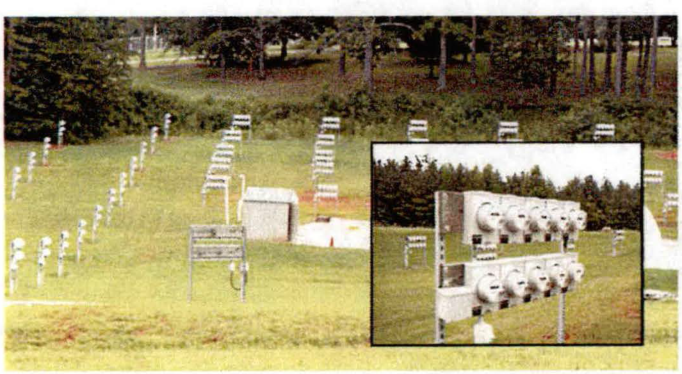


Figure 1 – Meter farm at the manufacturer's facility with a rack of 10 smart meters in the inset.

In order to facilitate the test measurements, the choice was made to take measurements using a single rack of continuously operating meters. The reader should note that, while the meters were specially programmed to operate continuously for the measurement study, when actually deployed they transmit intermittently for very brief periods (see later). To help differentiate the test rack from the background signals emitted across the site, the measurement team split the 10 meters within the test rack into three groups, each with a unique frequency within the unit's operational band of 902 to 928 Megahertz (MHz). In this manner, the rack of 10 meters had a unique fingerprint of emissions at 902, 915, and 928 MHz. As shown in Figure 2, measurements were taken both in front of and behind the meter racks. The exposure values reported were expressed

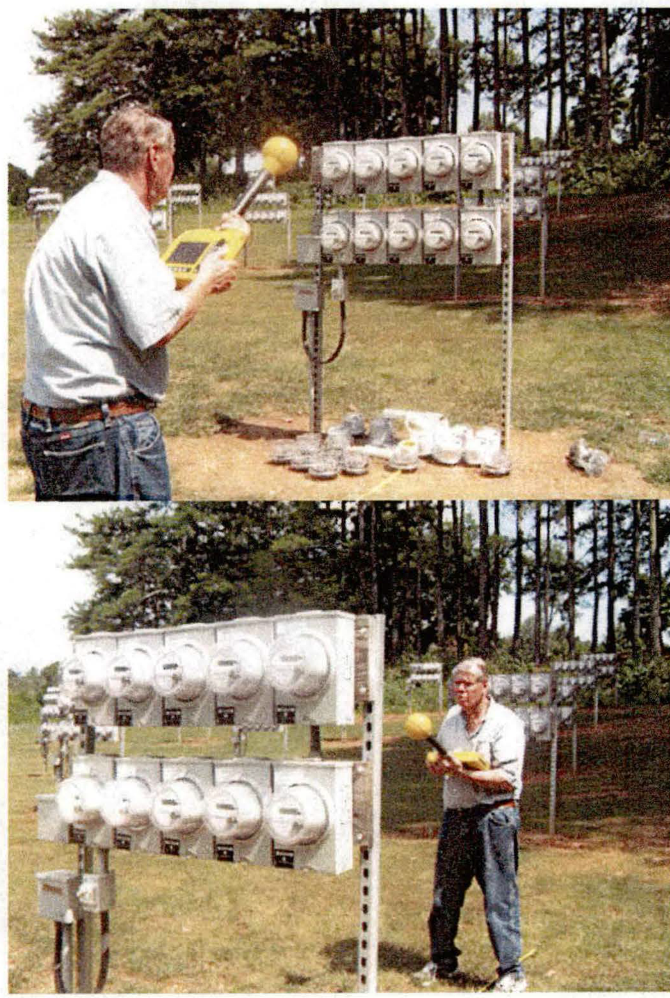


Figure 2 – Reading in front of (left) and behind (right) the rack.

in terms of the percentage of the FCC exposure limit for the general public. At the operational frequencies of the meters, the FCC exposure limits for the general public are equal to the transmitting frequency in MHz divided by 1500, expressed in units of milliwatts per square centimeter (mW/cm^2); the FCC exposure limits thus ranged between power densities of 0.60 to 0.62 mW/cm^2 as applied to the meters within the rack.

It should also be pointed out that while the testing was conducted with end-point meters rated nominally at ¼-watt (~250 mW), the manufacturer's data illustrated in the EPRI Report allow one to estimate, based on a sample of 200,000 meters, that 99.9% operate at powers between 150 and 475 mW, with a possible maximum of 500 mW for no more than 0.05% of units. For the HAN "Zigbee" emitter, one may estimate, again on the basis of a 200,000-unit sample, that 99.9% operate at powers between 35 and 142 mW, with a possible maximum of 160 mW for no more than 0.05% of units. Finally, though comparable statistics are not available for cell relays, as they are provided to the manufacturer by an outside vender, the specifications provided by the vender indicate a maximum power of 1.5 W for cell relays rated nominally at 1 W.

Compliance with FCC Rule: Spatial and Temporal Averaging

Prior to a summary of the results it is important to review the FCC's approach to compliance assessment, which involves averaging exposure across both space and time under the appropriate exposure conditions. FCC's exposure limits, published in "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields" (OET Bulletin 65, Edition 97-01, August 1997) states for spatial averaging (Figure 3) that:

> A fundamental aspect of the exposure guidelines is that they apply to power densities or the squares of the electric and magnetic field strengths that are spatially averaged over the body dimensions. Spatially averaged RF field levels most accurately relate to estimating the whole body averaged SAR [Specific Absorption Rate, the measure of dose to the body, described below] that will result from the exposure and the MPEs [Maximum Permissible Exposure, FCC's term for exposure limit]… (page 10)

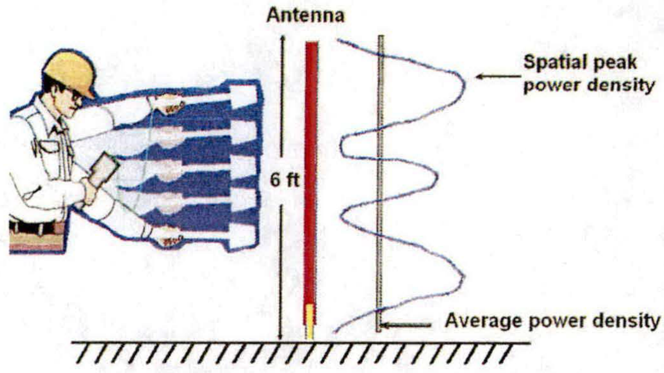


Figure 3 – Depiction of Assessing RF Exposure Across the Body (Source: EPRI Resource Paper 1014950)

With respect to time-averaging, OET Bulletin 65 states:

> …exposures, in terms of power density…may be averaged over certain periods of time with the average not to exceed the limit for continuous exposure…the averaging time for occupational/controlled exposures is 6 minutes, while the averaging time for general population/uncontrolled exposures is 30 minutes. (page 10)

The OET further states:

> Time-averaging provisions may not be used in determining typical exposure levels for devices intended for use by consumers in general population/uncontrolled environments. However, "source-based" time-averaging based on an inherent property or duty-cycle of a device is allowed. (page 74)

Thus, as RF electromagnetic fields associated with smart meters are *source-based*, meaning they can be associated clearly with a specific emitter or set of emitters, time averaging is permitted for such sources. For example, a reading in the study of 0.1 mW/cm^2 from meters operating between 902 and 928 MHz continuously would be about 16.7% of the FCC limit for the general public in that frequency range. When deployed at residences during actual conditions, these units typically operate with a maximum duty cycle of about 5% (*duty cycle* refers to the fraction of time a meter is transmitting). Thus, with this maximum duty cycle, one would then derive that the exposure was 20-fold less or 0.84% of the FCC limit. For a 1% duty cycle, a more typical value, the exposure would be 0.17% of the FCC limit.

Reflections

An additional consideration concerns the fact that certain surfaces can reflect an RF electromagnetic field, which can result in an exposure greater than would be experienced in free space with no reflection (Figure 4). The extent of an added exposure due to reflection depends on the reflectivity of the surface (e.g., metallic surfaces are highly reflective; carpeted and wood floors are more absorptive and less reflective), the antenna's beam characteristics (e.g., its angular width and direction) the angle of reflection, and the distance traveled by the wave to an exposed person. The FCC OET 65 Bulletin states:

> For a truly worst-case prediction of power density at or near a surface, such as at ground level or on a rooftop, 100% reflection of incoming radiation can be assumed, resulting in a potential doubling of predicted field strength and a four-fold increase in (far-field equivalent) power density. (Page 20)

A recent study modeled SAR resulting from a rooftop exposure to a base station antenna, with a highly reflective ground plane and/or highly reflective wall present. At 900 MHz—roughly the frequency of the RF LAN in the wireless smart meter investigated—the study reported that the SAR could increase by as much as a factor of about 3.6 (5.5 dB) on a localized basis in 10 grams of tissue, and by a factor of about 2.8 (4.5dB) on a whole body basis, both of these values being consistent with the FCC OET 65 cited above. At the same time, reflections modeled at 900 MHz may also result in a reduction of SAR compared to the free-space scenario. At lower frequencies (300 and 450 MHz) reflections were slightly greater, and at higher frequencies, including 2,100 MHz (roughly the HAN's operating frequency), the reflections were lower (Vermeeren et al., Phys Med Biol 55:5541, 2010).

Results

Examples of the data readouts over distance from the rack of 10 meters are shown in Figure 5. The top panel taken 1 foot in front of the rack displays the discernible peaks associated with the three pre-programmed operating frequencies as well as the background activity between the peaks from the other meters in the meter farm. By 20 feet from the meter rack, the peaks are sinking into the background, from which they are indistinguishable by 50 feet.

A summary of these measurements in Figure 6 indicates that for continuous operation at 1 foot from the rack, the exposure is about 8% of the FCC limit, with the fitted curve (in blue) indicating that the exposure diminishes roughly as the inverse of the distance from the rack. The dashed green line indicates the percentage of the FCC limit for a meter transmitting for 1% of the time (or with a 1% duty cycle). With a single meter, one would expect exposure to diminish with the inverse square of the distance, meaning that for every doubling of distance the exposure level is quartered. The reason that the power density diminishes more slowly with distance from the rack than it does from any individual meter is because the measurements at the rack were taken on a path leading away from its center, meaning that the contributions from the meters at

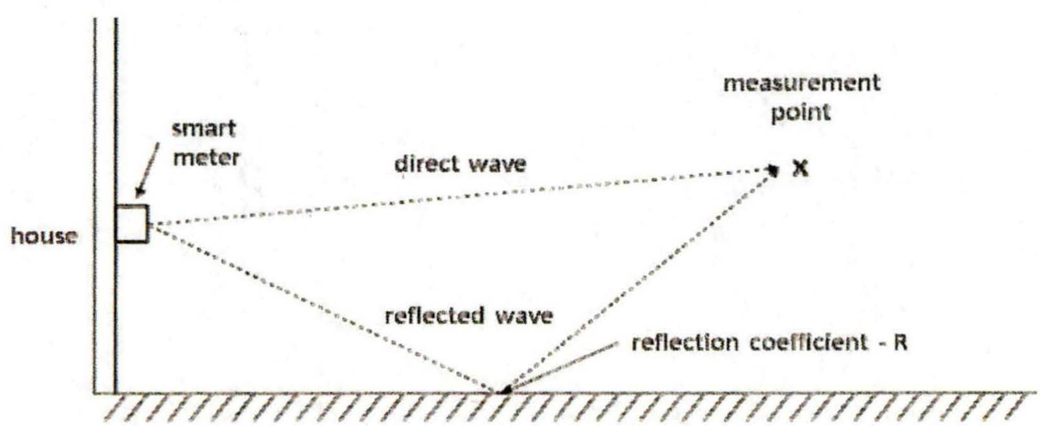


Figure 4 – Schematic view of the combination of a direct wave with a reflected wave.

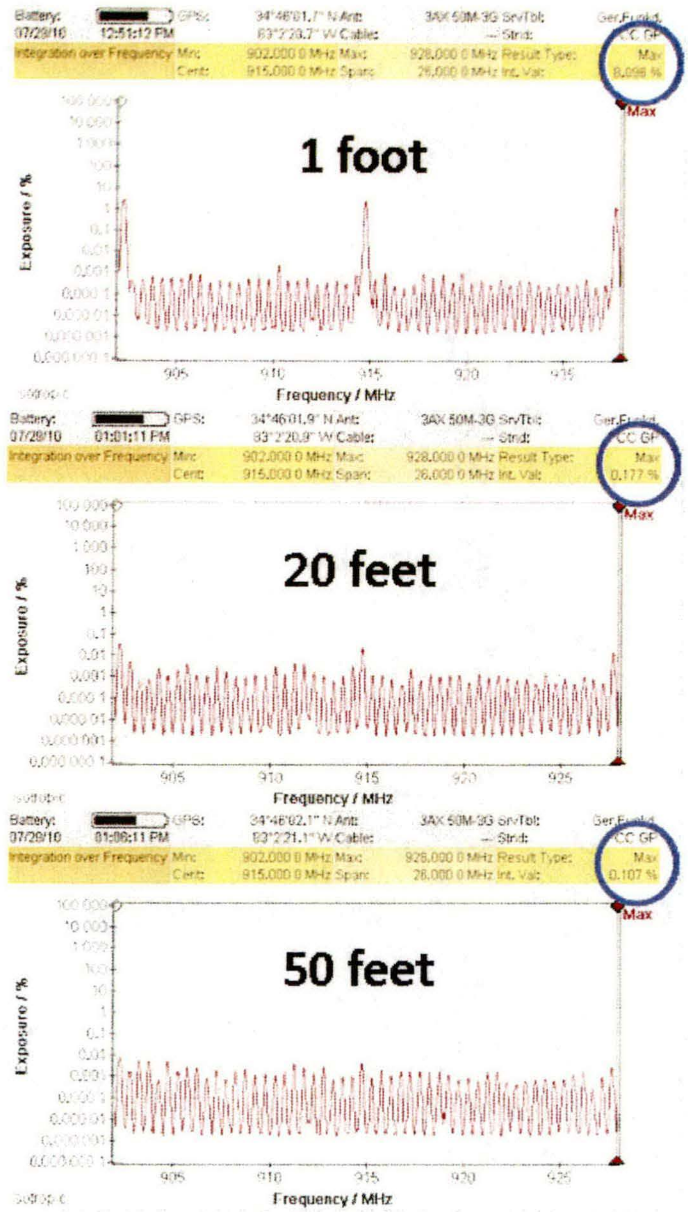


Figure 5 – Readouts of exposure levels at 1, 20 and 50 feet from the front of the rack. Note that the exposure levels are expressed as a percentage of the FCC limit (circled in blue).

the two lateral positions, operating at slightly different frequencies than each other, as well as from the rack's centrally located meters, had mutual phase relationships plus possible ground reflections, all which led the measured field to fall off more slowly with distance compared to the spatial gradient expected from a single meter.

Furthermore, as the distance from the rack increases, the relative contribution from the meter farm background increases. Since the measurements included background emissions in addition to the rack's emissions, the falloff of measured power density with distance is less than if the background sources were silenced.

A question that has also been voiced concerns the possibility of a person located adjacent to the wall immediately behind the meter. Therefore, measurements were also taken behind the meter rack. The readout, shown in Figure 7, indicates that even at 8 inches behind the rack, exposure for continuous operation was about 0.6%

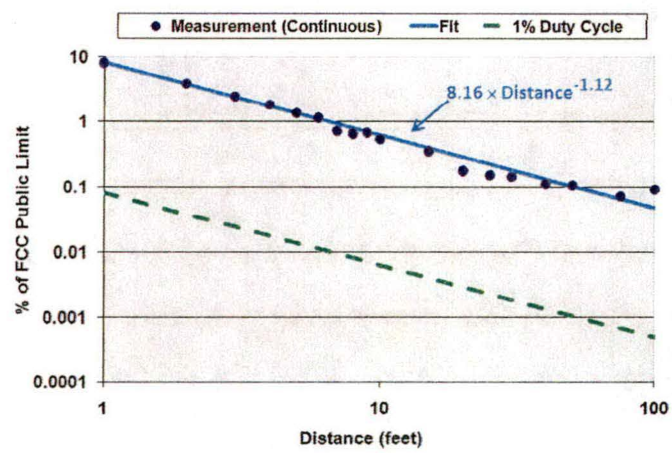


Figure 6 – Profile of emissions from the rack of ten Smart Meters as a function of distance, expressed as a percentage of the FCC exposure limits. The blue line is a mathematical fit to the measured data. The green dashed line indicates exposure relative to FCC limits when units transmit 1% of the time.

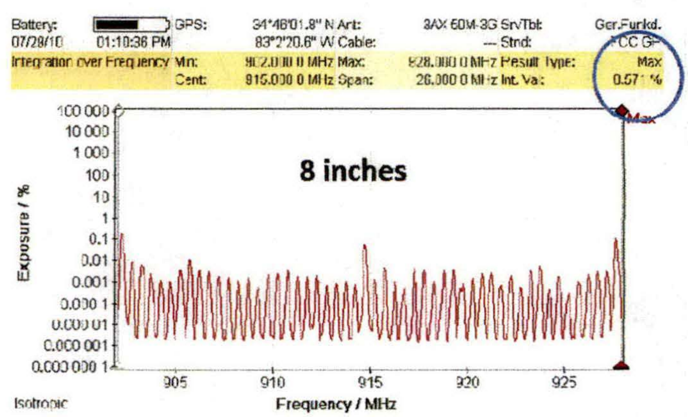


Figure 7 – Readouts of exposure levels at 8 inches behind the rack. Note that the exposure levels are expressed as a percentage of the FCC limit (circled in blue).

of the FCC limit or 0.03% for a 5% duty cycle. Exposure was measured at less than half this value at 10 feet behind the rack.

Smart Meters in Context of Other Typical Radio-Frequency Exposures

Most environments have numerous sources of RF emissions to which most people are exposed to some extent. The total exposure depends on such factors as one's proximity to the source and the intensity of the emission, the time over which exposure lasts, and the emission's distribution in space and its time course. With regard to spatial characteristics, the exposure levels for virtually all sources found near homes, including smart meters, diminish very rapidly with distance. Furthermore, for many sources, the exposure is localized with respect to the part of the body exposed. For example, a cell phone's emission, when it is in use, is confined to the ear and nearby bone, and the adjacent part of the brain. For a smart meter, the exposure varies significantly over a vertical pathway from the floor through the length of a person's body. A sample measurement of a meter conducted in the EPRI study indicated that exposure would occur primarily from 3 to 6 feet above the floor, with the average across the body less than a quarter of the peak measurement. (This was just a single sample, and though the general principle of variability with height applies, this observation should not be generalized.)

For other sources usually at a distance from the home, including radio and TV broadcast antennas and cellular telephone base stations, the exposures are relatively more uniform across the body. This arises because the body's dimensions are negligible compared to the distances from such sources.

As one considers RF levels from various sources, it is important to keep in mind that the FCC exposure limits for the general public aim to limit exposure such that first, the absorption of RF energy averaged across the whole body is limited to 0.08 watts per kilogram (W/kg); this metric is referred to as the *specific absorption rate* or *SAR*, which serves as the basis for specifying the exposure limit (the SAR not to be exceeded is referred to as the *basic restriction*). Second, the FCC stipulates that "[f]or most consumer-type devices, such as hand-held cellular telephones, the appropriate SAR limit is 1.6 watt/kg as averaged over any one gram of tissue." As indicated in the discussion earlier on spatial and temporal averaging, 30-minute averaging of SAR applies to the general public's exposure to fields from "source-based" devices, which include smart meters. However, for consumer devices, classified as "portable" (such as cellular telephones), the FCC states (OET Bulletin 65, page 10) "...it is often not possible to control exposures to the extent that averaging times can be applied. In those situations, it is often necessary to assume continuous exposure." A further distinction is that, while the RF field levels associated with various common sources can be viewed as snapshots of potential exposure levels, they do not necessarily translate to an exceedance insofar as concerns the FCC rule. For example, although a cell phone's RF emission within inches of the headset may exceed the FCC level that applies to whole body exposure, the local SAR for phones marketed today is to not exceed the 1.6 W/kg stipulated by the FCC.

With this perspective in mind, comparative levels of RF emissions are shown in Table 1. In the bottom row, the table shows estimates for exposure levels from a single meter for the direction in which the field is maximum (assuming an antenna gain of about 4, meaning the field at the maximum point is four times the field for the same antenna power radiated evenly in all directions, or isotropically). The table indicates levels for distances of 3 and 10 feet, with meters operating at 1 watt (W) and at a quarter watt (or 250 milliwatts, mW) with duty cycles of 1%, 5% for each power level (footnote 6 describes how to calculate instantaneous power density levels, which are the same as for 100% duty cycle or continuous operation). The entries in the table indicate that these estimated smart meter emissions, even at the maximum point, are at the same order of magnitude as emissions from such sources as radio/TV transmission and WiFi routers and far lower than the localized exposure fields from cell phones or microwave ovens. At 3 feet, the level in the table for the condition with the greatest exposure (1 W, 5% duty cycle) is about 0.3% of the FCC limit, and for the lowest, but not atypical condition (250 mW, 1% duty cycle), the level is 0.016% of the FCC limit; at 10 feet these values are 0.03% and 0.0014%, respectively. Using values published by Dimbylow and Bolch (Phys. Med. Biol. 52:6639-6649, 2007), one would estimate that for the 1 W, 5% duty cycle case, a uniform exposure of 0.002 mW/cm^2 as shown in the table, would produce a SAR of between 0.00012 W/kg for an adult-sized person to 0.00023 W/kg for a small child, which respectively are 0.15% and 0.28% of the whole body SAR limit of 0.08 W/kg. Further consider that, because of the non-uniformity of the field along the vertical, the exposure averaged across the body (and thus the SAR) is lower than the peak value (perhaps by a factor of 3 or 4). Further technical information and references for the table are provided in its footnotes.

Table 1 – Radio-Frequency Levels from Various Sources

Source	Frequency	Exposure Level (mW/cm²)	Distance	Time	Spatial Characteristic
Cell phone[1]	900 MHz, 1800 MHz	1–5	At ear	During call	Highly localized
Cell phone base station[2]	900 MHz, 1800 MHz	0.000005–0.002	10s to a few thousand feet	Constant	Relatively uniform
Microwave oven[3]	2450 MHz	~5 0.05-0.2	2 inches 2 feet	During use	Localized, non-uniform
Local area networks[4]	2.4–5 GHz	0.0002–0.001[a] 0.000005–0.0002[b]	3 feet	Constant when nearby	Localized, non-uniform
Radio/TV broadcast[5]	Wide spectrum	0.001 (highest 1% of population) 0.000005 (50% of population)	Far from source (in most cases)	Constant	Relatively uniform
Smart meter[6]	900 MHz, 2400 MHz	0.0001 (250 mW, 1% duty cycle) 0.002 (1 W, 5% duty cycle)	3 feet	When in proximity during transmission	Localized, non-uniform
		0.000009 (250 mW, 1% duty cycle) 0.0002 (1 W, 5% duty cycle)	10 feet		

[a] wireless router

[b] client card

FCC rule: From 300 MHz to 1,500 MHz, $MPE = 0.2 \times f/300$ mW/cm² (f is frequency in MHz); for 1,500 MHz and greater, $MPE = 1$ mW/cm². For example, at 900 MHz $MPE = 0.2 \times (900/300)$ mW/cm² = 0.6 mW/cm². Note: Compliance for cell phones is provided by manufacturers, and expressed in terms of SAR, which cannot exceed 1.6 W/kg for any single gram of tissue.

(1) Based on a 3-inch, 250 mW antenna emitting in a cylindrical wavefront.

(2) Elliott P, Toledano MB, Bennett J, Beale L, de Hoogh K, Best N, Briggs DJ. 2010. Mobile phone base stations and early childhood cancers: case-control study. BMJ 340:c3077.

ICNIRP. 2009. "Exposure to high frequency electromagnetic fields, biological effects and health consequences (100 kHz-300 GHz)." International Commission on Non-Ionizing Radiation Protection, Oberschleißheim, Germany, page 14.

Ramsdale PA, Wiener A. 1999. Cellular Phone Base Stations: Technology and Exposures. Radiat Prot Dos 83:125-130.

(3) ICNIRP. 2009. "Exposure to high frequency electromagnetic fields, biological effects and health consequences (100 kHz-300 GHz)." International Commission on Non-Ionizing Radiation Protection, Oberschleißheim, Germany, page 21.

Tell RA. 1978. Field-strength measurements of microwave-oven leakage at 915 MHz. IEEE Trans Electromagnetic Compatibility 20:341-346.

R.A. Tell, personal communication.

(4) Wireless router based on 30-100 mW isotropic emitter.

Client card based on: Foster KR. 2007. Radiofrequency exposure from wireless LANs utilizing Wi-Fi technology. Health Phys 92:280-9.

(5) Tell RA, Mantiply ED. 1980. Population Exposure to VHF and UHF Broadcast Radiation in the United States. Proc IEEE 68:6-12.

(6) Based on spatial peak power density with 6 dB (x4) antenna gain. For instantaneous power density during transmission, multiply the value for 1% duty cycle by 100, and the value for 5% duty cycle by 20.

Conclusion

The measurement study described in this paper is a valuable first step in characterizing the RF environment associated with wireless smart meter technology. For the type of smart meter and relatively small sample of meters characterized, the results indicate that in front of the meters, even with 10 meters nominally rated at ¼ watt operating continuously (100% duty cycle) on the same rack, the exposure level a foot from the center of the rack was a small fraction of the FCC exposure limit for the general public and, as expected, diminished with increasing distance from the rack. The power density levels were comparably lower behind the meters. An extensive analysis of smart meter transmissions for almost 47,000 meters in southern California was included in the EPRI study. The report estimated that 99.5% of the sample was operating at a duty cycle of about 0.22% or less, a value that translates to 3 minutes and 10 seconds of transmitting over a day; the maximum duty cycle associated with any meter did not exceed 5%. The duty cycle for cell relays

within the same sample did not exceed 1%. In a smaller study of over 6,800 meters, also in the EPRI study, end-point and cell relay meters were monitored for the number of bytes of data transmitted over an observation period of one day. This method provided a direct (exact) measure of time, and reported duty cycles even lower than those in the larger sample, with no one-day average duty cycle exceeding 1%.

The average exposure levels from smart meters, as measured in the current study, are at levels similar to those that are present from other common RF sources, both indoor and outdoor. As there may be differences in power levels, duty cycles, and other configurations between smart meters and AMI systems, EPRI plans to evaluate other types of smart meters and systems, as well, and also reevaluate exposure patterns as the currently existing systems evolve. The current study was conducted as part of a wider objective at EPRI to address questions about exposures from emerging smart grid technologies and to better understand issues about potential health effects in association with such exposures. EPRI wishes to thank the peer reviewers of this paper for their insightful comments.

The full EPRI technical report detailing the study titled, *An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter* (1021126) is available to the public at the EPRI website, www.epri.com. EPRI wishes to thank the peer reviewers of this paper for their insightful comments.

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EMF Health Assessment and Radio-Frequency Safety (Program 60)

The Electric Power Research Institute, Inc. (EPRI, www.epri.com) conducts research and development relating to the generation, delivery and use of electricity for the benefit of the public. An independent, nonprofit organization, EPRI brings together its scientists and engineers as well as experts from academia and industry to help address challenges in electricity, including reliability, efficiency, health, safety and the environment. EPRI also provides technology, policy and economic analyses to drive long-range research and development planning, and supports research in emerging technologies. EPRI's members represent more than 90 percent of the electricity generated and delivered in the United States, and international participation extends to 40 countries. EPRI's principal offices and laboratories are located in Palo Alto, Calif.; Charlotte, N.C.; Knoxville, Tenn.; and Lenox, Mass.

Together . . . Shaping the Future of Electricity

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ADVANCED METER/AMI FAQ

What are "Advanced Meters"?

"Advanced Meters" are solid state electrical meters that utilities install to collect and transmit metering information back to its office. These replace the analog type meters which were limited to just displaying the total usage and required the utility to visit each meter monthly to manually read the meter.

Advanced Metering Infrastructure (AMI) ... What is it?

The name sounds complicated, but Owen Electric's AMI system produces a variety of benefits, including better customer service, improved reliability and greater operational efficiency.

How does my automated meter work?

With AMI meters, Owen can read the meter remotely from our central office. Information from the meter is transmitted back to the co-op. Transmitting this information electronically means that a meter reader no longer visits your home to manually read the meter monthly.

What data is collected by the meter?

The meter records the following information:

- Total kWh usage. This may also be divided into different groups if the member is on one of OEC's Time of Day rates.
- KW values for each hour.
- Minimum and maximum voltage levels.
- Blink counts.
- Last six outage events including start time and duration.

How often does my meter "transmit" information?

On average, the meter will transmit meter data five times a month. Each transmission will last an average of two to three seconds.

How secure is the meter data?

Owen considers member information security a top priority. The data transmitted through the AMI system to and from the meter is encrypted using a special proprietary technique. We continue to monitor and test for security threats. None of your account information is included.

Are "advanced meters" accurate?

These meters follow multiple accuracy standards testing both by the manufacturers and the utilities. In addition, the Kentucky Public Service Commission requires sample testing each year on a defined amount of the installed meters. Billing exception reports and validation routines on the readings are also performed daily to ensure accuracy.

How does the AMI system work?

To perform a meter read an Owen employee sends a command to AMI equipment in the substation via the Wide Area Network (WAN). The AMI equipment generates a Power Line Carrier (PLC) signal which is induced onto the distribution power lines. This signal "rides" along the sine waves of the lines through the system, transformer, and to the meter. The meter contains a transmitter which hears the information requested then sends that information back to the substation AMI equipment. Again, this signal is sent via PLC signal across the power lines. The substation equipment then sends the information back to the employee via the WAN. This entire process takes an average of 4-6 seconds.

What are the specific benefits of AMI?

Here are just a few of the benefits made available through AMI technology:

- Improves electric service reliability and power quality – fewer outages, blinks and surges.
- Allows more respect for member privacy and property access – With this new system, the only time Owen will need to physically be at your meter is if there is an electric service problem or when we perform the annual inspection of your electric service.
- Improves outage notification and management process by more quickly pinpointing the exact location of outages, meaning a faster response time.
- Provides additional metering data to better assist members with billing and service questions.
- Gives capability to provide members with valuable usage information such as consumption patterns, outage and blink count history and voltage information.
- Improves meter reading accuracy and consistent billing periods – With an AMI system, meters can be automatically set to read the meters on the same day of each month. This, for example, eliminates a 27-day billing period one month and then a 35-day billing period the following month.
- Reduces losses by identifying power theft.
- Gain efficiencies by eliminating the labor and transportation costs of in-person meter reading .
- Ensures better overall safety for Owen employees.
- Promotes energy efficiency by enabling innovative pricing, appliance control and real-time customer feedback.

Will cooperative employees need to come to read the meter manually again once the new meter is in place?

Owen employees will no longer regularly need to spend valuable time traveling to every meter for a monthly read. All meter reads will be digitally transmitted back to the co-op headquarters.

Once co-op employees no longer need to read the meter, can obstacles be constructed that may make the meter inaccessible?

No. Reasonable access to equipment still must be maintained. This allows for Cooperative personnel to either read or maintain the meter if necessary at reasonable times. Routine inspections of all meters and services will continue in order to look for safety hazards, theft or other problems.

Will the new meter notify the co-op when the power goes out?

No, however, the AMI system will enhance the Cooperative's ability to pinpoint outage locations and verify service restoration.

Can you monitor the activity within my home with my meter?

No, Owen's meter has no surveillance capability. The meter simply measures electric energy usage as the previous electro-mechanical meter did. Individual devices within the home cannot be monitored with the meter.

Are there any potential health impacts from a meter that can receive and send data?

The Federal Communications Commission (FCC) has adopted and used recognized safety guidelines for evaluating RF environmental exposure since 1985. Federal health and safety agencies such as the Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), the National Institute for Occupational Safety and Health (NIOSH), and the Occupational Safety and Health Administration (OSHA) have also been actively involved in monitoring and investigating issues for RF exposure. In 1996, the FCC adopted the National Council on Radiation Protection (NCRP's) recommended Maximum Permissible Exposure limits for RF exposure. The FCC also adopted the specific absorption rate (SAR) limits for devices operating within close proximity to the body as specified within the American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE) guidelines.

There has been considerable research* conducted on the health impacts of RF exposure levels from advanced (or 'smart') meters. This research has demonstrated that there is no health threat from RF exposure levels below those designated by the FCC.

***California Council on Science and Technology:** "Wireless smart meters, when installed and maintained properly, result in much smaller radio frequency (RF) exposure than many existing common household electronic devices"

"The current FCC standard provides an adequate factor of safety against known thermally induced health impacts of existing common household electronic devices and smart meters"

***Maine Center for Disease Control:** concluded there is "no consistent or convincing evidence to support a concern for health effects related to the use of radio frequency in the range frequencies and power used by smart meters"

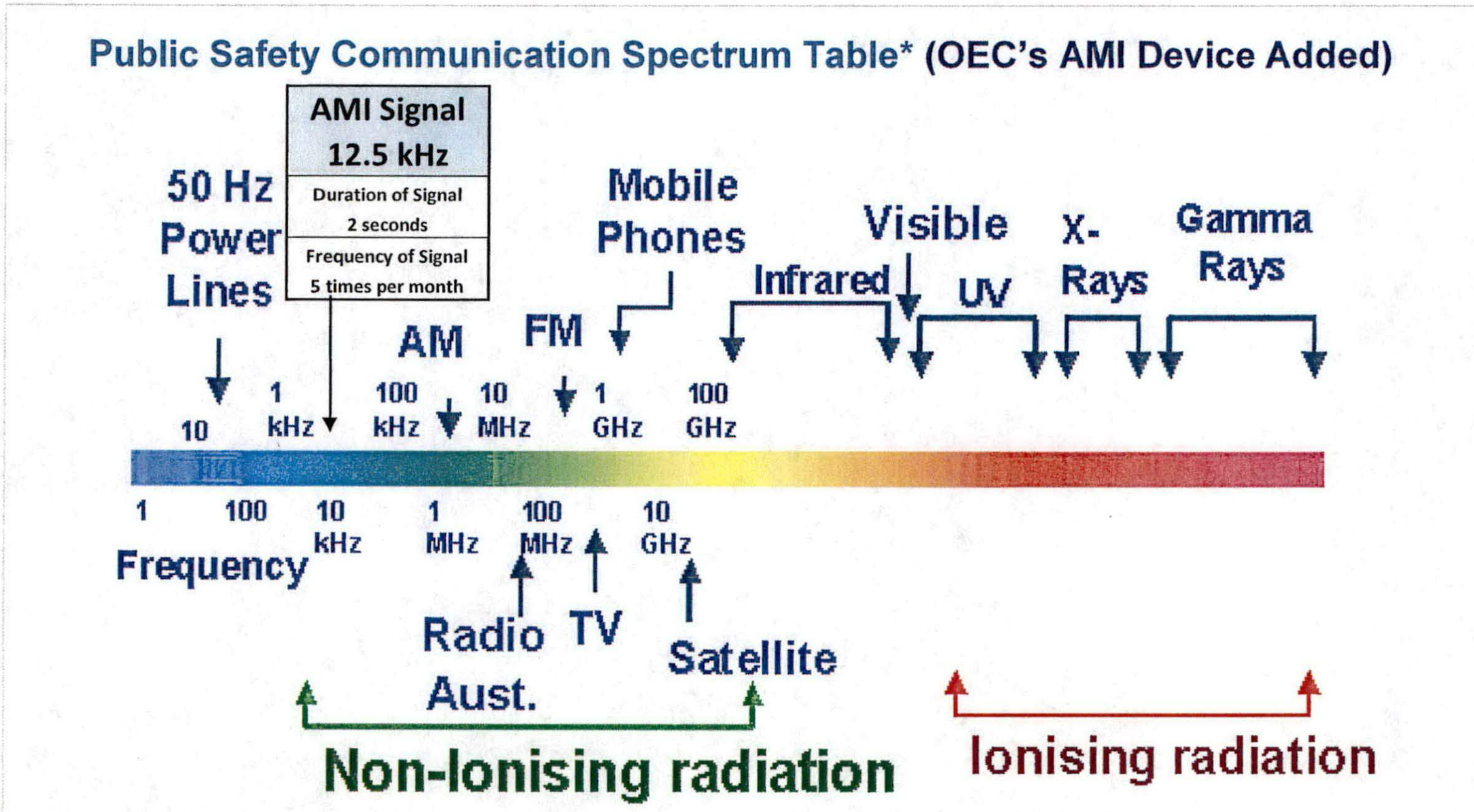
Additionally, Owen's AMI/Advanced Meter system has some unique characteristics that further mitigate health concerns:

Owen's system is not radio frequency or wireless-based like many other systems. Owen's communication signal travels over the electric power line and is not transmitted through the open air.

A common misconception about smart meters is that they are always "on" or transmitting 100% of the time. This is far from the case. In fact, **Owen's typically meter transmits only five (5) times per month for approximately two (2) seconds per transmission.** This equates to only ten (10) seconds per month or 0.0004% of the time.

In summary, **Owen's meter system meets and exceeds all Federal Communications Commission (FCC) regulations regarding acceptable ranges of RF exposure limits.**

<u>Owen's AMI system operates at an extremely low frequency of 12.5 kHz</u>. A kHz (kilohertz) is a relatively low unit of frequency. Most radio frequency based smart meters operate in the 900+ mHz (megahertz) frequency range which is approximately 72,000 times greater than Owen's system. Additionally, many commonly used household devices operate at much higher frequency levels (see following chart).



*Source: ACD Telecom, LLC & Public Safety Communications

ACD Telecom, LLC specializes in public safety communications and consulting services to public safety agencies.

If you have additional questions, feel free to contact Owen Electric at 1-800-372-7612.

EAST KENTUCKY POWER COOPERATIVE

STATE OF KENTUCKY
PAUL ANDREW DOLLOFF, PhD
30610
LICENSED PROFESSIONAL ENGINEER

Owen Electric
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March 24, 2018

Dear

This letter contains the electromagnetic field (EMF) measurements taken Tuesday, March 6, 2018 around 2:00 p.m. at the home of located at Figure One is a picture of the home. As requested by East Kentucky Power Cooperative (EKPC) is providing this report with EMF readings taken on this property.

Figure One

The home is located near structure DX 080 on the EKPC Boone to Munk, 69kV transmission line. Figure two is a satellite photograph of the property showing the home and the location of the transmission power line. The shortest distance between the home and the power line is approximately 250ft, as given by the yellow arrow. The red circle shows the location of structure DX 080.

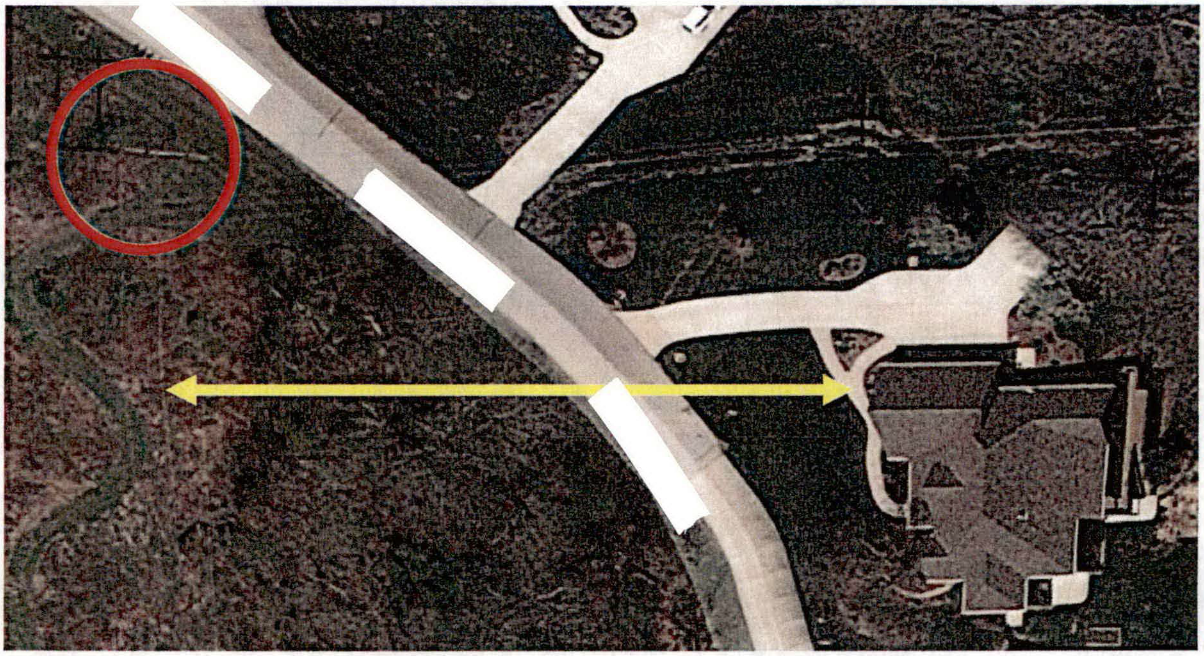

Figure Two   Power Line and Property

At 4:00 p.m., the EKPC 24-hour dispatch center was contacted to obtain the loading conditions of this transmission power line. This data is given in Table One.

Table One   Loading Data During Inspection

	Voltage (kV)[1]	MW	MVAr	Current (A)
Transmission Power Line	69.6	2.8	1.3	25.6

Electromagnetic fields (EMF) are invisible energy (radiation) produced by electricity. EMF is composed of two different fields: An electric field and a magnetic field. The strength of the electric field is dependent upon the voltage of the power lines. The higher the voltage, the higher the electric field will be. The strength of the magnetic field does not depend on the voltage but will vary with the amount of current that is flowing on the power line. Therefore, as the amount of current increases, so will the strength of the magnetic field.

Though high electric fields may present an electrical shock hazard, magnetic fields are of interest when considering the effects of EMF on human health. For this reason, only magnetic field readings were taken during this visit to the home.

Magnetic field readings were taken between 2:30 p.m. and 3:30 p.m. on Tuesday, March 6, 2018. During this time period the weather was clear and the ambient temperature was 48 °F.

Figure Three is another satellite photograph showing the locations at which magnetic field measurements were taken.

Figure Three Magnetic Field Measurement Locations

Table Two provides the magnetic field readings for the measurement locations indicated in Figure Three. Note that magnetic fields are measured in units of milliGauss (mG).

Table Two Measurement Locations and Associated Magnetic Field Reading

Measurement	Reading (mG)	Location Details
1	0.9	Phone/cable TV pedestals
2	0.6	Middle of driveway at road
3	0.4	Middle of property at road
4	0.5	Property corner at road
5	0.2	Corner of house
6	0.5	Front porch
7	0.5	Middle of front yard
8	0.4	Driveway/sidewalk intersection
9	1.4	Directly under distribution power line
10	5.6	Distribution power pole
11	0.3	Directly under distribution power line
12	0.2	Directly under distribution power line
13	0.4	Front of garage door #1
14	0.5	Front of garage door #2
15	5.3	Electric revenue meter
16	0.2	Corner of fence
17	0.3	Middle of fence
18	0.1	Corner of fence
19	0.1	Corner of fence
20	0.1	Corner of fence
21	0.1	Corner of fence
22	0.1	Corner of fence
23	0.1	Corner of fence
24	0.1	Back patio
25	0.1	Hot tub
26	0.1	Corner of deck
27	0.1	Corner of deck
28	0.2	Sitting bench

Because the distance between the EKPC power line and the property is over 100 ft, magnet field influences due to this power line are negligible. The magnetic field readings are highest closest to the distribution power line feeding the house and at the electric revenue meter. At these locations, the amount of current flow is greatest. Note that the strength of the magnetic field drops off as the distance from the line increases.

During the site visit, supplemental reading material was provided to In June 2002, the U.S. Department of Energy (DOE) published a booklet entitled, *EMF, Electric and Magnetic Fields Associated with the Use of Electric Power*. The "Electric and Magnetic Fields & You" pamplet was produced by East Kentucky Power Cooperative. These publications are intended to further education regarding EMF.

Any device that uses electricity will produce EMF. Starting on page 33 in the U.S. DOE booklet, a table gives typical magnetic field readings for various household appliances. Comparing these stated magnetic field values to the readings taken during this survey may help put the measurements in perspective. Magnetic field readings from typical household appliances are also given in the EKPC pamplet.

Currently, there are no federal standards limiting occupational or residential exposure to 60 Hz electric or magnetic fields (EMF). However, some states do have exposure limits. On page 46 of the U.S. DOE booklet, a table gives the limits for those states with EMF exposure limits. Though EMF standards exist in other states, Kentucky has no 60 Hz EMF exposure limits.

The reader may be interested in discussing this report with their health care provider. If you have any further questions or would like to request additional measurements, please do not hesitate to contact me.

Best regards,

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Owen Electric Cooperative, Inc.

Case No. 2018-00354

December 3, 2018 Response to Commission Staff's
First Request for Information
Dated November 19, 2018

Question No. 3

Responding Witness: Jack Scott Lawless

Q-3. Provide an explanation as to why Owen Electric believes using information from the year ending December 31, 2007, is reasonable.

A-3. The December 31, 2007 information was accepted and relied upon by the KPSC in Case No. 2008-00154[2] when considering the reasonableness of a $30 Non-recurring Charge Owen Electric proposed to assess to any Member who had electric service disconnected or reconnected or who made payment on a past due account directly to a Field Service Representative ("FRS") upon the FSR's arrival at the Member's meter location to disconnect service for non-payment.

As explained in Owen Electric's Application, Exhibit 2, Page 1 of 2, the resources necessary for Owen Electric to establish and maintain a Member's Opt-Out account will not be materially different from the resources Owen Electric currently expends to disconnect or reconnect a Member's service or for an FSR to collect Member payment in the field. Each of these activities requires an FSR to visit the Member's meter location and a Member Service Representative to access and update the Member's account information.

Because the cost of the resources necessary to provide Opt-Out service and the aforementioned non-recurring services are similar, it is reasonable for Members to expect Owen Electric to charge an amount for each service that is similar, if not the same.

To meet Member expectations, Owen Electric requests that the KPSC approve an opt-out charge in the amount of $30, the same amount of the Non-Recurring Charges approved by KPSC in Case No. 2008-00154. Because the rate amounts are the same, it is reasonable and appropriate to use the same financial information to justify each rate. Owen Electric respectfully requests that the KPSC accept the information for the period ending December 31, 2007, as adequate support for the charges included in the proposed Opt-Out Tariff.

[2] Application of Owen Electric Cooperative, Inc. for Adjustment of Rates (Ky. PSC June 25, 2009).

Owen Electric Cooperative, Inc.

Case No. 2018-00354

December 3, 2018 Response to Commission Staff's
First Request for Information
Dated November 19, 2018

Question No. 4

Responding Witness: Jack Scott Lawless

Q-4. Confirm that the AMS is fully deployed in Owen Electric's service territory. If this cannot be confirmed, provide the estimated date when Owen anticipates full deployment.

A-4. Yes, Owen Electric's AMS is fully deployed. Refer to Owen Electric's Response to PSC-1, Question No. 1, for more detailed information on the date deployment was complete.

Owen Electric Cooperative, Inc.

Case No. 2018-00354

December 3, 2018 Response to Commission Staff's
First Request for Information
Dated November 19, 2018

Question No. 5

Responding Witness: Jack Scott Lawless

Q-5. Explain why Owen Electric is proposing an opt-out fee and how the proposed opt-out fee addresses this need.

A-5. Owen Electric proposes to assess the opt-out fees to recover a portion of the cost to administer the Opt-Out Tariff from Members participating in the tariff. Although the proposed fees will not provide full recovery, the level of partial recovery is consistent with the KPSC's ruling in Case No. 2008-00154 and is acceptable to Owen Electric at this time.

Owen Electric Cooperative, Inc.

Case No. 2018-00354

December 3, 2018 Response to Commission Staff's
First Request for Information
Dated November 19, 2018

Question No. 6

Responding Witness: Jack Scott Lawless

Q-6. Explain if Owen Electric has estimated the number of opt-outs and how these opt outs will impact the robustness of the system. Provide supporting work papers which quantify any effect.

A-6. Owen Electric has not estimated the number of Members that will elect to participate in the Opt-Out Tariff, but it does not expect the Opt-Out Tariff to impact the efficiency or effectiveness of its AMS. As detailed in Owen Electric's Response to PSC-1, Question 1, Member concerns regarding Owen Electric's AMS have not been pervasive. Owen Electric will continue diligent efforts to educate Members on AMS technology. As a result, the number of Members electing to receive service through the Opt-Out Tariff is expected to be low and have no impact on the efficiency or effectiveness of Owen Electric's AMS.

Owen Electric Cooperative, Inc.

Case No. 2018-00354

December 3, 2018 Response to Commission Staff's
First Request for Information
Dated November 19, 2018

Question No. 7

Responding Witness: Jack Scott Lawless

Q-7. Provide the non-recurring cost incurred for information technology required for the opt-out program.

A-7. Owen Electric does not anticipate incurring information technology costs for the opt-out program. Owen Electric expects to adequately and properly serve all Members participating in the Opt-Out Tariff using existing electronic billing and accounting software with no upgrades or updates.