

COMMONWEALTH OF KENTUCY
BEFORE THE PUBLIC SERVICE COMMISSION
CASE NO. 2013-00291

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PUBLIC SERVICE
COMMISSION

HAROLD BARKER;)
ANN BARKER; and)
BROOKS BARKER,)
COMPLAINANTS)

DIRECT TESTIMONY OF
COMPLAINANTS' WITNESSES

V.)
EAST KENTUCKY POWER)
COOPERATIVE, INC.,)
DEFENDANT)

* * * * *

Complainants, **HAROLD BARKER, ANN BARKER and BROOKS BARKER**, by counsel, submit the following direct testimony in the above-styled matter:

1. Testimony of Ann Barker and Brooks Barker.
2. Testimony of John C. Pfeiffer, registered professional engineer. The original of Mr. Pfeiffer's testimony, in document form, is included with the original testimony of the other witnesses. Each copy includes his testimony in the form of a compact disc.
3. Testimony of David O. Carpenter, public health physician.

Respectfully submitted,



M. ALEX ROWADY, ESQ.
Blair & Rowady, P.S.C.
212 South Maple Street
Winchester, Kentucky 40391
(859) 744-3251
ATTORNEY FOR COMPLAINANTS

CERTIFICATE OF SERVICE

This is to certify that the original and eight true copies of the foregoing Direct Testimony of Complainants' Witnesses was hand-delivered to Kentucky Public Service Commission, P.O. Box 615, Frankfort, Kentucky 40602-0615 and a true copy was sent by first-class mail to David S. Samford, Esq., Gross Samford, PLLC, 2365 Harrodsburg Road, Suite B235, Lexington, Kentucky 40504, this 25th day of April, 2014.



M. ALEX ROWADY, ESQ.

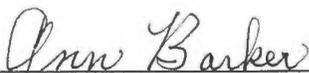
**COMMONWEALTH OF KENTUCY
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CASE NO. 2013-00291**

HAROLD BARKER;)	
ANN BARKER; and)	
BROOKS BARKER,)	
COMPLAINANTS)	
)	TESTIMONY OF ANN BARKER
V.)	and BROOKS BARKER
)	
EAST KENTUCKY POWER)	
COOPERATIVE, INC.,)	
DEFENDANT)	

* * * * *

ANN BARKER and **BROOKS BARKER**, after being duly sworn, testify as follows:

1. They are Complainants in the above-styled matter.
2. Complainant Ann Barker, along with her husband, Complainant Harold Barker, own real property located at 5450 Mt. Sterling Road, Winchester, Kentucky. Defendant East Kentucky Power Cooperative, Inc. owns and operates a 345 kV/138 kV transmission line which runs through said property.
3. They have attached hereto a joint statement which they adopt as their testimony herein.



ANN BARKER

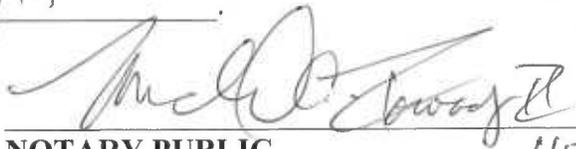


BROOKS BARKER

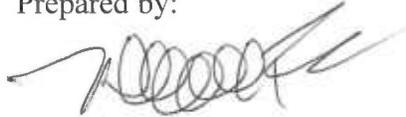
STATE OF KENTUCKY)
) s.s.
COUNTY OF CLARK)

24 Subscribed and sworn before me by **ANN BARKER** and **BROOKS BARKER**, on this day of April, 2014.

My commission expires: 10/7/15.


NOTARY PUBLIC 452763
STATE OF KENTUCKY AT LARGE

Prepared by:



M. ALEX ROWADY, ESQ.
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212 South Maple Street
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ATTORNEYS FOR COMPLAINANTS

Ladies and Gentlemen, "The Barkers" would like to thank the Public Service Commission, Mr. Derouen, Pam Ayer, Richard Raff, John Schupp, Jeff Moore, James Rice and Susan Dunn for their time in regards to our case # 2013-00291.

On October 7th, 2005, EKPC requested a staff opinion for the replacement and upgrading of their existing Smith-Hunt Sideview 69KV electric transmission line. EKPC indicated this would be a 345 KV/69KV and a separate and new centerline/easement would be less than 4,000 feet in 2 separate locations. They also stated there were approximately 6 separate locations where the lines would be too close to structures and the additional ROW of 50 feet would be moved away from these structures and then adjust the centerline/easement accordingly so as to provide adequate clearance from these structures. On October 26, 2005 the PSC ruled that based on this information EKPC furnished to them, no CPCN would be required under KRS 278.020(2).

KRS 278.020 (2) states that construction of any electric transmission line of 138KV or more and of more than 5,280 feet in length shall not be considered an ordinary extension of an existing system and shall require a CPCN. However, ordinary extensions of existing systems do not require a CPCN if replacing or upgrading any existing electric transmission line.

This was not an ordinary extension or upgrading. We went from:

1. All existing lines and poles were totally removed and replaced with all new construction of 345KV/138KV lines.
2. A ROW of 100 feet to 150 feet.
3. Wooden poles approximately 60 feet tall to steel poles 80-140 feet tall.
4. 5 wires to 11 wires.
5. A single circuit 69KV to a double circuit 345KV/138KV.

6. The home whose location was approved by EKPC was constructed in 1973, but now 40 years later with this massive expansion the ROW now goes through the middle of the front yard, part of the attached carport and garage/candy shop.
7. In three separate locations, a new centerline/easement was constructed for a total of 14,707ft.
 - 1) 3,755ft. section on the Northern end of the proposed route associated with the proposed North Clark County substation. EKPC did not own any of this land prior to the beginning of this project as indicated by:
 - a. Letter dated March 1st, 2006, to the U.S. Fish and Wildlife Service indicating EKPC had surveyed for the substation and the proposed route the latter part of September 2005. Page 77 Gilpin Group Report.
 - b. All of the following property was purchased by EKPC for the North Clark County Substation located on Donaldson Rd.
 1. October 29, 2005 EKPC paid \$1,000.00 as a Real Estate Option to Janet Belcher Smallwood and Timothy Smallwood and the Smallwood's executed a deed on June 6, 2006 to EKPC.
 2. November 24, 2005 EKPC paid \$2,000.00 as a Real Estate Option to Joey and Gulena Reffett and the Reffett's executed a deed on June 6, 2006 to EKPC.
 3. May 8, 2006 Roby Ballard II and Dawn Ballard executed a deed to EKPC.
 4. June 6, 2006 Joseph Ed Sterns and Therese Sterns executed a deed to EKPC.
 5. June 16, 2006 Joseph Ed Sterns and Therese Sterns executed a deed to EKPC.
 6. October 3, 2006 Earl S. Anderson and Sue F. Anderson executed a deed to EKPC.

This indicates EKPC knew the exact size these lines would be and the route months before we as landowners were notified.

- 2) 3,977ft. section on the Southern end of the route associated with the J.K. Smith property.
- 3) November 10, 2005 another new centerline/easement located on the Southern end of the route of 6,975ft. was added due to a request of a property owner. These 3 sections of the proposed route would not utilize the existing ROW and total 14,707ft.

Based on incorrect information that EKPC provided to the PSC per letter on October 7, 2005, the PSC ruled that no CPCN was required. Everything escalated immediately following this response.

-October 28, 2005 EKPC mailed notice of open house.

-October 29, 2005 EKPC paid \$1,000.00 as a real estate option for property located on Donaldson Rd. for the proposed North Clark Substation and related easement.

-October 31, 2005 The Barkers received notice of open house. First time we saw any information about this expansion.

-November 3rd, 2005 Notice of Open House in Winchester Newspaper.

-November 5th, 2005 Notice of Open House in Winchester Newspaper.

-November 7th, 2005 Notice of Open House in Winchester Newspaper.

-November 10, 2005 Open House, Met with Bruce Murray of EKPC. We were informed that a definite route and placement of poles had not been determined. The Barkers requested that everything be moved away from the house and had concerns about the possible increase of EMF levels since this was going to be a 345KV/138KV line. This was also noted in EKPC's Open House sign-in sheets.

-February 8, 2006 Mike Wells, ROW Agent, left his card on our door because we were not at home.

-February 16, 2006 Mike Wells came back to discuss the offer of \$4,400.00 for Parcel 200 and \$9,000.00 for Parcel 201. No official form and did not know where the easement would be. We requested ROW be staked.

-March 20, 2006 The survey company staked the proposed new ROW on the Barker property. The same day the Barkers called EKPC about the easement in the middle of the front yard and through the carport and garage/candy shop and told them we had asked Bruce Murray at the Open House to move everything away from the house and now it was in the front yard and residence. No one in the past 30 plus years from EKPC ever stated that the location of the residence was in the original easement until this new 150 foot easement was staked.

-March 23, 2006 A meeting with EKPC's Dominic Ballard, Mary Jane Warner, Mike Wells, Dan McNichol, Paul Dolloff, and Rick Drury as well as non-EKPC personnel Steve Adams and Don Pasley requesting that something had to be done with the positioning of the lines and poles.

-April 27, 2006 The Barkers asked for another meeting with EKPC's Dominic Ballard, Paul Dolloff, Dan McNichol and Rick Drury. EKPC indicated that maybe the poles could be moved if Fred Farris had not signed his easement on the property across the road. They would have to check with him and get back with us.

-May 8, 2006 Mike Wells came with a formal offer of \$14,000.00 for Parcel 201 and \$8,600.00 for Parcel 200. We refused the offers and told him we were in a worse situation than we were before.

-May 16, 2006 Mike Wells met Ann Barker in Applebee's parking lot and the offer was \$17,000.00 for Parcel 201 and \$8,600.00 for Parcel 200.

-May 29, 2006 The Barkers called for another meeting to confront EKPC with the fact that after our April 27, 2006 meeting EKPC went directly to Mr. Farris and he signed his easement that same evening on his property across the road from the Barkers. Securing Mr. Farris' easement on April 27, 2006 appeared to be a deliberate attempt by EKPC to block any adjustments to the easement and poles on our property. EKPC also said Mr. Farris had a plat for a subdivision on this property which further prevented any adjustment to the pole/easement. We informed EKPC, that Larry Disney of the State Real Estate Planning and Zoning Dept. said this was not possible on this small tract of land. EKPC indicated that maybe they could move the poles if we would pay \$10,000 each for 2 poles that would be taller. We agreed on this price. Two weeks later, EKPC called and indicated that we would not have to pay for the poles.

-May 2006 The Gilpin Group report was published stating that 3 houses are from 0 to 100 feet to the proposed route (page 40). Our house was one of those three residences mentioned. This report also stated, " No occupied structure would be located close enough to the proposed transmission line to experience increased EMF levels." (page 54). EKPC should have made it a priority to adjust the proposed easements on these 3 locations to ensure there would not be an increase in EMF levels. This report also states that this is a double circuit 345 KV/138 KV operation-18.68 miles long with 15.9 miles of construction on the existing easement. This is 2.78 miles of new ROW out of the old easement. (page 2 and 3). Per the Gilpin Group Report.

-June 9, 2006 EKPC condemned the property under eminent domain and filed a lawsuit against the Barkers along with 4 other landowners.

-June 29, 2006 William Sharp brought a letter of final offer of 4,113 feet for \$37,800.00. This was for 1.43 acres on Parcel 200 and 3.31 acres for Parcel 201 for a total of 4.74 acres for the additional easement.

-July 5th, 2006 The Barkers were served with a condemnation suit.

-December 7th, 2006 Trees removed from half of the front yard.

-May 2007 Work was completed through our property but no restoration of damages to the land, driveway or yard.

-September 2007 The lines were energized. We noticed the noise and shock we received when touching bare metal on the vehicles in our driveway. This confirmed our fears from the beginning concerning the EMF levels generated from such massive lines. From 1973 to 2007 we had no problems with the 69 KV power lines or easement nor did we have any issues with high EMF levels or getting shocked.

-December 2008 Paul Dolloff from Research and Development Dept. of EKPC came to our residence to provide the measurements of the electric field data taken on Dec. 5, 2008. Attached is the audio from this meeting in transcript and CD form. – Exhibit 2

Ladies and Gentlemen, from the beginning this project to the present we have continually been trying to get EKPC to move these lines. I requested to meet with EKPC's Board of Directors which was denied and also wrote a letter to CEO, Anthony Campbell on July 6, 2010 with no reply. Exhibit 3. On September 14, 2011 the Barkers, their Attorney, Alex Rowady, and EKPC's Attorney, Sherman Goodpaster met in Lexington at the Law office of Pierce Hamblin for mediation with no resolution. It was at this meeting, Sherman Goodpaster, Attorney for EKPC, indicated that EKPC was in a hurry to complete this project and no moves or adjustments were possible to this line/easement. On July 31, 2012 EKPC requested that only our Attorney, Alex Rowady, our Engineer, Mr. Pfeiffer, meet at their office with EKPC's Attorney, Sherman Goodpaster and their Engineers. We were not to be present. Everyone came to the meeting but EKPC Engineers never showed up. During this meeting, Mr. Goodpaster stated that the center

line/easement of the power lines could not have been moved as it would have required EKPC to file for another CPCN per our Engineer, John Pfeiffer. This was totally untrue since there was no CPCN to start with and a line can be moved if no greater than 500 feet in either direction of the approved route per Legislative Research Commission Report on Siting of Electric Transmission Lines Research Report No. 348, Chapter 2 and 3.

The health concerns associated with these enormous power lines is immense when this close to a dwelling. Dr. David O. Carpenter, Public Health Physician and Director of the Institute for Health and the Environment at the University at Albany, NY. has done extensive research in the health hazards caused by EMF. He testified in February 2010 on behalf of interveners, Robert and Patricia Johnson, before the state of Minnesota Legislature regarding the proposed CAP X2020 345KV power lines through Minnesota and Wisconsin. I have spoken with Dr. Carpenter and he said there is strong evidence that long exposures to magnetic fields above 2 Milligauss is associated with an increased risk and neurodegenerative diseases in adults, including Alzheimer's disease, cancer of the brain and Lou Gehrig's disease. He said high voltage power lines should be routed to prevent power line magnetic fields in homes from exceeding 4 Milligauss. Every effort should be made to avoid long term exposure to magnetic fields above 2 Milligauss. I have been recording the magnetic field in our home randomly since May 1, 2011. I have recorded 169 readings and only 6 times has the magnetic reading been 2 Milligauss or less. Exhibit 4. During the same period of time, we have experienced A/C voltage readings as high as 330 volts on vehicles on our driveway which results in a shock when touched. I have also spoken with Dr. Frank Barnes, Dean of Epidemiology, at the University of Colorado who could not believe a utility company would ever build a line this large so close to a home. Mr. Pfeiffer, our Engineer has other data from Health and Environmental Organizations on EMF dangers and risks associated with medically implanted devices.

The Barkers along with everyone else we have spoken with cannot understand why EKPC would go to such great lengths to run an easement with transmission lines this massive through a house and jeopardize the health of its occupants when they knew the problems this would create with lines this large. EKPC had more than enough time to make these changes and did so for others. The move on the "Foley Property" was much greater and was granted with the speculation of future subdividing of the property by the owner which as of today has not occurred. Whereas, the Barkers request was made for health and safety concerns for our family and the public. These changes could have been implemented at the time of construction with very minimal costs.

EKPC would first have to file a "Notice of Intent" to file an application with the PSC at least 30 days prior to filing a CPCN application. Prior to filing a CPCN application, EKPC would have been required to make known their intentions to the general public and each landowner. This notice would have a map showing the proposed route, the PSC docket number and the landowner's right to request a public hearing or to intervene per the Legislative Research Commission Report chapter 2 page 23. We believe EKPC did not want to devote any time to obtain a CPCN for this project, since in this same time frame they already had cases for Spencer, Rowan, Garrard, Butler and Warren county projects all requiring CPCN's and proper procedures.

On February 27, 2004 Senate Bill 246 was passed. This bill proposed to create 2 new subsections (2) and (3) to KRS278.020. The enactment of this bill enlarged the issues and concerns considered by the PSC in reviewing the construction of new or relocated transmission lines above a certain capacity, length and also justifying the actual need of the construction. It also reflects a clear legislative interest to elevate the rights of landowners and other interested parties regarding the route and construction of the transmission lines and also that the landowners be allowed to play an active role in the request for a CPCN.

We also believe that this 345KV/138KV, Smith-Hunt-Sideview Transmission Line falls under the category of regulations set forth in the Administrative Regulations of 807KAR5:001 Section 9 (3) as follows:

1. Was a 345KV/138KV actually needed after Warren County Coop declined to join EKPC as the 17th Coop. We believe this 138KV circuit of this transmission falls in the category of unnecessary because it has been operated as a 69KV line since its construction.
2. Did the construction of this line create a substantial burden to EKPC that was later passed onto the rate payers since EKPC was already in financial difficulties.

In the PSC ORDER, dated April 7, 2014 concerning EKPC's request for dismissal, reference is made to issues under KRS278.020 (2) , whether a CPCN is required for an entire project or for the segments of a transmission line project which equals or exceeds 1 mile in length that are not replacements or upgrades of an existing transmission line, we believe the PSC STAFF OPINION 2012-004 dated January 31, 2013 applies to this issue and states that Construction Work Plan (CWP) have always been treated as one construction project, because the cooperatives historically have financed (CWP's) as one project.

We believe the entire Smith-Hunt-Sideview Transmission Line Project applies to this same opinion referred in 2012-004 for CWP's since the transmission line in question was financed as one project and therefore shall require a CPCN for the entire transmission line project.

We believe KRS278.020 (2) is majorly flawed in that a utility company is allowed to build any size transmission line as long as it is constructed on some form of an existing easement and would not require a CPCN.

We are a prime example of the possible problems created by this statute. However, we realize ultimately that the deliberate misinformation and misstated facts to the PSC provided by a utility company for a construction project cannot be controlled by a statute.

The current transmission line ROW easement on the Barker property, "The Company shall be liable for any injury to persons, animals or property occasioned on owners' farm, including ROW, caused by an electric current coming from Companies line occasioned by the negligence of the cooperative in the construction, operation or maintenance of its said line."

The Barkers maintain that the building of the Smith-Hunt-Sideview-North Clark County transmission line was a project planned from the very beginning to mislead the PSC as to its size of the transmission line, the length the center line/easement would be moved, and the amount of new 345KV/138KV easement, therefore denying all 98 property owners the right of public hearings. At the same time, EKPC refused to move these high voltage lines a safe distance away from our residence. For over 8 years, The Barkers have strived to get this problem resolved which could have and should have been corrected in the very beginning. We have been trying to get EKPC to correct a major injustice to our family not only devaluating our property immensely, but creating a major health problem, to ourselves and others who come to our residence and candy shop.



The Barkers wanted to correct certain facts that we felt were not accurate in EKPC response to the Commissioners Staff's Initial Request dated Nov. 7th, 2013. Ref. case No. 2013-00291. There are several replies we feel needs to be clarified. They are as follows:

Response 1a: EKPC indicated they had erroneously calculated the centerline deviation of an inaccurate coordinate system that was referred in their GIS mapping system instead of the correct Kentucky State Plane, South Zone Coordinate System.

The Barkers property is directly across the road from Fred and Mary Farris at 7180 Mt. Sterling Road and in the Amended and Restated Transmission Line Easement dated April 27, 2006 for the (Farris) property the Kentucky State Plane, South Zone coordinate system is being used as the coordinate system.

The map accompanying the Janet and Timothy Smallwood (Janet Belcher Division) deed, dated June 6, 2006 also used the Kentucky South Zone State Plane coordinate system. Exhibit 1.

The Barkers do not understand how one coordinate system can be used in some places and a different system used in another location within the same 18.68 miles. If the wrong coordinate was used perhaps all 98 properties in these 18.68 miles are wrong also. Our Engineer, Mr. Pfeiffer can explain how the coordinate system is used to calculate the distance of this line.

Response 1b: EKPC indicated the ROW to construct the final route across the Violet Foley Estate property was provided to EKPC by the property owner at no cost. This was not true. Per phone conversation with David Foley in 2013, he indicated that they did receive compensation in the building of the lines.

Response 1d: EKPC indicated that 1,880ft. of the diversion in North Clark Line is located on EKPC's Substation property. This substation did not preexist nor did they own the land prior to the construction of the new 345 KV/138KV line/easement. Therefore, the entire length of 3,755ft. was all new ROW and easement.

Response 2: EKPC indicated in their response to the PSC that the final location of the North Clark Substation had not been finalized when the letter for a Staff Opinion was written on October 7, 2005.

On June 6, 2006, a deed between EKPC and Janet and Timothy Smallwood for the purchase of their property on the Donaldson Rd. which adjoins the substation made reference on October 29, 2005 EKPC paid the Smallwood's' \$1,000.00 as a Real Estate Option on the property. This was 3 days after the PSC letter of October 26, 2005, indicating no CPCN would be required for this project. This date indicates EKPC had to know it needed to purchase this property at the time of the letter to the PSC.

Response 5: EKPC indicated the additional easement ROW on the front portion of our property which is the 50 acre tract was 1.40 acres. This is not true. The acres are actually 1.43.

Response 6a: EKPC indicated on February 8, 2006, Dan McNickol and Mike Wells met with the Barkers' to discuss the easement acquisition. This is not true. We were not at home and Mike Wells left his business card in our door.

EKPC's exhibit 6b2 indicates the savings by removing pole UT79. EKPC indicated each set of UT78 and UT80 are 140 ft. tall. This is not true. Set UT78 is 130 ft. tall. This certainly would change the reported \$14,802 difference.

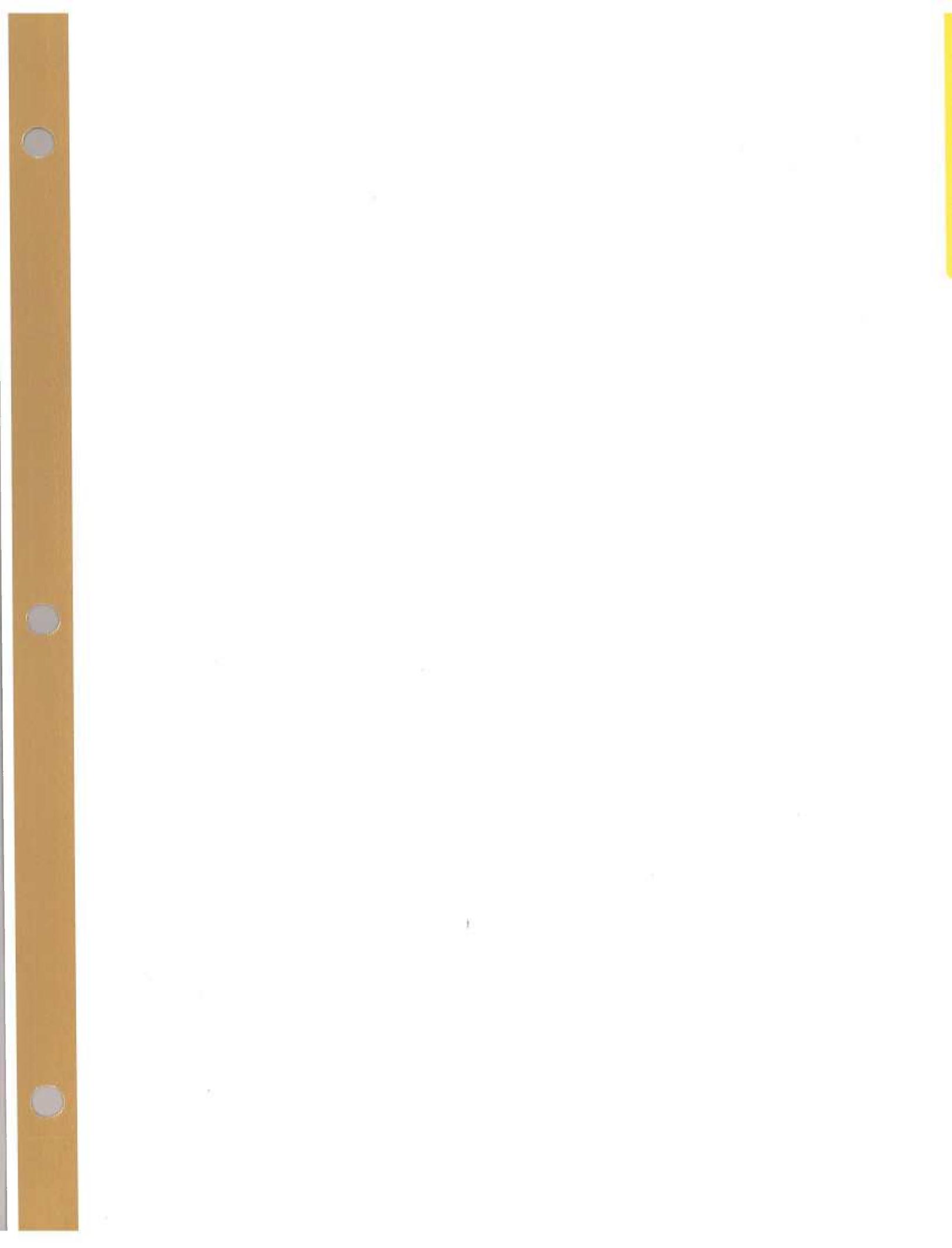
Response 6c: EKPC indicated they could not locate any documentation regarding the placement of the transmission lines or poles prior to the upgrade. This is not true. From the open house in 2005 through all the meetings we have continually asked that the poles/easement be moved away from the house.

Response 7: On EKPC's Open House Attendee List it showed these people also had issues concerning the lines. We have not contacted all of these people yet to know the specifics of their concerns. They are: Jerry Jessie, Robert Osborne, Paul Heil, Matthew Johnson, John Flynn and Danny Shimfessel.

The Barkers' would also like clarification when the actual letter for request of the staff opinion from Sherman Goodpaster to the PSC was actually written. The first page is dated October 7, 2005 and the second page is dated October 10, 2005.

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Included in our documentation is a DVD copy of our Engineer, John Pfeiffer's Investigation Report of the Smith-Hunt-Sideview Transmission Project dated April 24, 2014.



Prepared by:



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ATTORNEYS FOR COMPLAINANTS

COMMONWEALTH OF KENTUCKY
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Case NO. 2013-00291

In the Matter of:
HAROLD BARKER
ANN BARKER AND
BROOKS BARKER

VERSUS

EAST KENTUCKY POWER COOPERATIVE, INC.

AFFIDAVIT

My name is David O. Carpenter. I am a public health physician and professor, with a medical degree from Harvard Medical School. My current title is Director of the Institute for Health and the Environment at the University at Albany and Professor of Environmental Health Sciences within the School of Public Health. In addition I am an Honorary Professor, Queensland Children's Medical Research Unit, University of Queensland, Brisbane, Australia. Formerly, I was the Director of the Wadsworth Center for Laboratories and Research of the New York State Department of Health (1980-1985) and the Dean of the School of Public Health at the University of Albany (1985-1998), while remaining employed by the New York State Department of Health. I assumed my current position in 1998.

In the 1980s I served as the Executive Secretary of the New York State Powerlines Project, a state-funded study designed to determine whether there were adverse health effects from living near to power lines. The program of research showed that children living in homes with elevated magnetic fields coming from power lines suffered from an elevated risk of developing leukemia, and that electromagnetic field (EMF) exposure altered a variety of responses studied in animals and in cellular systems. After the Powerlines Project was finished I became the spokesperson for New York State on the issue of health effects of electromagnetic fields.

I have published several reviews and have edited two books on the Biologic Effects of Electric and Magnetic Fields. I am also a Co-Editor and a Contributing Author of the *BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF and RF)* (www.bioinitiative.org). This report was first published in 2007, and has been updated in 2012 and 2014. The *BioInitiative Report* documents bioeffects, adverse health effects and public health conclusions about impacts of electromagnetic radiation (electromagnetic fields including extremely-low frequency ELF-EMF and radiofrequency /microwave or RF-EMF fields). I will refer to specific sections of the report where appropriate but I also reference the entire report as a comprehensive and up-to-date review of the scientific information on this subject. .

In 2009, I was invited to present to the President's Cancer Panel on the subject of power line and radiofrequency fields and cancer, and have also testified on this issue before the United States House of Representatives.

Attached as Exhibit A is my *curriculum vitae*. I am an active researcher and educator. My research activities at present are focused on the general subject of environmental causes of human disease. I have authored over 370 major publications in peer-reviewed scientific journals, have edited five books and have numerous other publications as listed in my *curriculum vitae*. I participate in many international, national, state and local organizations and committees as listed in my *curriculum vitae* along with the Honors, Awards, and Fellowships I have received. While my personal research has not been directed at study of electromagnetic fields, I have had sufficient administrative and evaluation responsibilities related to human health effects of power line magnetic fields so as to consider myself an expert in this area.

In 2007 the International Agency for Research on Cancer (IARC), a part of the World Health Organization, declared extremely low frequency electromagnetic fields, including those coming from power lines to be Group 2B, possible human carcinogens. This designation was based primarily on studies of rates of childhood leukemia in children living in homes where the neighborhood power lines were close and carried high currents, resulting in elevation in the magnetic fields.

The first indication of concern from power lines came from the study of Wertheimer and Leeper (1979), who reported that children in Denver, Colorado whose home showed a "high wire code configuration", reflecting elevated magnetic fields, were at significantly greater risk of developing childhood cancer. While this report was greeted with skepticism, the results were confirmed by subsequent studies, including one that was a part of the New York State Power Lines Project (Savitz et al., 1998). Later three separate meta-analyses were performed (Wartenberg, 1998; Ahlbom et al., 2000; Greenland et al., 2000), all of which demonstrated that exposure to elevated magnetic fields results in increased rates of childhood leukemia. A meta-analysis is an analysis that considers all of the various individual studies and evaluates the aggregate conclusions. Thus a meta-analysis is more powerful and important than any individual research report if done carefully.

In a 1997 review by the US National Research Council (US National Research Council, 1997), there was a statement that "The link between wire-code rating and childhood leukemia is statistically significant (unlikely to have arisen from chance) and is robust in the sense that eliminating any single study from the groups does not alter the conclusion that the associations exist". In 2002, the International Agency for Research on Cancer identified ELF fields as being "possible human carcinogens". Later, the World Health Organization (WHO) (2007) stated that "epidemiological data ... show an association between ELF magnetic field exposure and an increased risk of childhood leukemia".

Reports since 2000 have generally confirmed an association between exposure to magnetic fields from power lines and childhood cancer. Draper et al. (2005), for example, found that UK children living near high voltage power lines had a significantly elevated risk for leukemia but not other cancers, and that the risk decreased with distance from the power line. In a study from Japan, Kabuto et al. (2006) found significant elevation in the risk of acute lymphoblastic leukemia [odds ratio (OR) = 4.7; 95% confidence interval (CI) = 1.15 – 19.0] among children whose bedrooms had magnetic fields $> 0.4 \mu\text{T}$ (4 mG), compared with those whose bedrooms had $< 0.1 \mu\text{T}$. (An odds ratio

is the ratio of disease found in the exposed population compared with those who are not exposed. Thus, an OR of 4.7 means that the risk of developing leukemia is almost five-fold greater in those with elevated bedroom magnetic fields. CI stands for confidence interval, and if the lower number is > 1.0 , epidemiologists consider that the relationship is statistically significant). In a study of 42 children with both leukemia and Down ' s Syndrome, compared with 117 Down ' s children who did not have leukemia, Mejia-Arangure et al. (2007) reported an OR of 3.7 (1.05 – 13.1) for development of leukemia in children with Down ' s Syndrome exposed to magnetic fields ≥ 6 mG. Folliart et al. (2006) and Svendsen et al. (2007) found that survival after diagnosis of childhood leukemia was reduced among children with elevated magnetic field exposures. Kheifets et al. (2010) performed a pooled analysis and concluded that “ recent studies on magnetic fields and childhood leukemia do not alter the previous assessment that magnetic fields are possibly carcinogenic ” . Infante-Rivard and Deadman (2003) reported that occupational exposure of a pregnant woman significantly increased the risk of her child developing leukemia.

Studies of adult leukemia in relation to residential exposure to magnetic fields have not shown strong associations, although Feychting et al. (1997) studied adult leukemia in relation to both residential and occupational exposures. While neither showed significant results, when both sources of exposure were considered there was a significant elevated in risk of adult leukemia (OR = 3.7; 1.5 – 9.4). In a meta-analysis of data published in 1997, Kheifets et al. (1997) concluded that most studies showed a small overall increase in risk [risk ratio (RR) = 1.18; 1.12 – 1.24]. Lowenthal et al. (2007) reported that children living within 300 m of a power line had an elevated (but not statistically significant) risk of developing leukemia (OR = 4.74; 0.98 – 22.9), while adults living within the same distance showed a smaller but significantly elevated risk (OR = 3.23; 1.26 – 8.29).

Evidence for elevated risks of other diseases is less strong, although there is a building body of evidence for increased risk of Alzheimer's Disease. A meta-analysis by Garcia et al. (2008) concluded

that there was a small but significant elevated risk in both case-control and cohort studies. Of interest was the observation by Feychting et al. (2003) that amyotrophic lateral sclerosis (ALS) was also elevated in electrical occupations, but the risk appeared to be due to electric shocks rather than magnetic field exposures. Huss et al. (2006), meanwhile, examined the risk of Alzheimer's disease in relation to residences near high voltage power lines and observed a dose-dependent increase in risk as a function of distance and duration of residence. However, they also found no association with ALS or Parkinson's Disease. There is one interesting report which showed significant elevations in rates of asthma in relation to magnetic field exposure during pregnancy (Li et al., 2011), but this observation has yet to be confirmed in other studies. A variety of other adverse health effects have been reported but are less well documented (www.bioinitiative.org; Carpenter, 2012).

However, in spite of the evidence cited above, many have questioned whether these associations are really reflective of a cause and effect, based primarily on two considerations. A single definitive mechanism, whereby these low energy EMFs can induce sufficient cellular changes resulting in cancer, has not been identified. There are many effects of EMFs that might explain the development of cancer, and many known human carcinogens, arsenic and dioxin for example, do not directly damage DNA. Several mechanisms have been suggested and demonstrated in some studies but not in others. DNA strand breaks have been demonstrated in neurons (Lai et al., 2004), but not in fibroblasts (Burdak-Rothkamm et al., 2009). Altered gene induction, especially of heatshock proteins, has been reported (Lin et al., 2001), while other studies demonstrated alteration in cytokine production (Salehi et al., 2012). Yang et al. (2008) reported that children with a particular genetic variation in DNA repair genes are at greater risk of developing acute leukemia upon exposure to ELF. While any of these mechanisms can explain cancer development, none have been definitively proven to be the basis of the clear association between exposure to magnetic fields and a variety of human diseases.

Another reason some are skeptical is that most animal studies failed to demonstrate cancer as a result of magnetic field exposure (Sommer & Lerchi, 2004). However, there is reason to question whether rodents are adequate models of human exposure to EMFs (Carpenter, 2012), since induced currents in small animals are very much smaller than those in a two-legged human. However, these considerations remain major sources of controversy in spite of the strong evidence in humans, which is the primary animal of interest.

The situation at the Barker home is such that there is clearly an elevated risk of a variety of diseases among those who live there. This is especially important in relation to risk of cancer, but there is also an elevated risk of development of Alzheimer's Disease as a consequence of the elevated magnetic fields and of amyotrophic lateral sclerosis as a consequence of the electrical shocks. The magnetic field within their home varies over time, as would be expected because current flow varies, but the average is about 10 mG and the peaks as high as 24 mG. These are an order of magnitude higher than the levels associated with elevation in the risk of cancer (2 mG). It is particularly onerous in that the utility did not have to run the line so close to their house, since there are open fields both to the east and the west.

It is my opinion to a reasonable degree of medical certainty that operation of the 345 kV power line this close to the Barker's home constitutes a real and significant health risk to the residents. While all of us depend on electricity for everyday life, the evidence that human (especially childhood) exposure to magnetic fields from powerline poses a hazard to health is sufficiently strong that it is imperative that every reasonable effort be taken to reduce exposure to the greatest number of persons possible. This must be a critical consideration when routes for a new high voltage powerlines are being considered, and this clearly did not occur when the present line was built. To fail to do so, given the strong evidence of harm to humans, is both irresponsible and invites later litigation. The 345kV line by the Barker home should be moved so as to no longer result in excessive magnetic field exposure to the residents.

David Starpeck

25 April 2014

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Wertheimer N, Leeper E Electrical wiring configurations and childhood cancer. *Am J Epidemiol* 1979;109:273-284.

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Yang Y, Jin X, Yan C, Tian Y, Tang J, et al. Case-only study of interactions between DNA repair genes (hMLH1, APEX1, MGMT, XRCC1 and XPD) and low-frequency electromagnetic fields in childhood acute leukemia. *Leuk Lymph* 2008;49:2344 – 50.

Applicant (Last, First, Middle): Carpenter, David O.

BIOGRAPHICAL SKETCH

Provide the following information for **ALL** key personnel in the order listed
in the "Key Personnel" section of the application.

Follow this format for each person. Duplicate biosketch form as needed. **DO NOT EXCEED 2 PAGES per person.**

NAME		POSITION TITLE	
Carpenter, David O.		Professor and Director	
EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)			
INSTITUTION AND LOCATION	DEGREE	YEAR(s)	FIELD OF STUDY
Harvard College, Cambridge, MA	BA	1958	Biomedical Sciences
Harvard Medical School, Boston, MA	MD	1964	Medicine

A. Positions and Honors.

- 9/61-6/62 Research Fellow, Department of Physiology, University of Goteborg, Sweden
- 7/64-6/65 Research Associate, Department of Physiology, Harvard Medical School, Boston, MA
- 7/65-1/73 Neurophysiologist, Lab of Neurophysiology, National Institutes of Mental Health, Bethesda MD
- 2/73-3/80 Chairman, Neurobiology Department Armed Forces Radiobiology Research Institute, Defense Nuclear Agency, Bethesda, MD
- 3/80-9/85 Director, Wadsworth Center, New York State Department of Health, Albany, NY
- 9/85-1/98 Dean, School of Public Health, University at Albany, SUNY, Albany, NY
- 9/85-Pres. Professor, Department of Environmental Health Sciences and the Department of Biomedical Sciences, School of Public Health, University at Albany, SUNY
- 1998-Pres. Member, U.S. Section of the Great Lakes Science Advisory Board of the International Joint Commission
- 2000-Pres. Member, Board of Directors, (Chair, 2006-2008, Treasurer, 2008-present) Pacific Basin Consortium for Health and Environmental Sciences
- 2001-Pres. Director, Institute for Health and the Environment, University at Albany, Albany, NY
- 2008-Pres. International Scholar, Open Society Institute

Honors

- 1989 Awarded Jacob Javits Neuroscience Investigator Award from the National Institute of Neurological and Communicative Diseases and Stroke
- 1999 Homer N. Calver Award, American Public Health Association for Studies in Environmental Health
- 2001 Academic Laureate Award from the University at Albany Foundation

B. Selected peer-reviewed publications (in chronological order). (375 peer reviewed articles, 5 books, 42 reviews and book chapters).

DeCaprio, A.P., Johnson, G.W., Tarbell, A.M., Carpenter, D.O. Chlarenzelli, J.R., Morse, G.S., Santiago-Rivera, A.L., Schymura, M.J., and the Akwesasne Task Force on the Environment. (2005) PCB exposure assessment by multivariate statistical analysis of serum congener profiles in an adult Native American population. Environ. Res., 98: 284-302.

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- Ruzzin J, Lee D-H, Carpenter DO and Jacobs D Jr. (2012) Reconsidering metabolic disease: The impact of persistent organic pollutants. *Atherosclerosis.* In press

CURRICULUM VITAE

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Positions Held:
Director, Institute for Health and the Environment
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Professor, Environmental Health Sciences
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Honorary Professor
Queensland Children's Medical Research Institute
University of Queensland
Brisbane, Australia

Education: 1959 B.A., Harvard College, Cambridge, MA
1964 M.D., Harvard Medical School, Boston, MA

Positions Held:

- 9/61-6/62 Research Fellow, Department of Physiology, University of Göteborg, Sweden with Professor Anders Lundberg
- 7/64-6/65 Research Associate, Department of Physiology, Harvard Medical School, Boston, MA under the direction of Dr. Elwood Henneman
- 7/65-2/73 Neurophysiologist, Laboratory of Neurophysiology, National Institutes of Mental Health, Dr. Edward V. Evarts, Chief, Assistant Surgeon, USPHS, currently a Reserve Officer in the USPHS.
- 2/73-3/80 Chairman, Neurobiology Department Armed Forces Radiobiology Research Institute, Defense Nuclear Agency, Bethesda, MD
- 3/80-9/85 Director, Wadsworth Center for Laboratories and Research, New York State Department of Health, Albany, NY
- 9/85-1/98 Dean, School of Public Health, University at Albany
- 9/85-Pres. Professor, Departments of Environmental Health Sciences and Biomedical Sciences, School of Public Health, University at Albany.
- 9/85-7/98 Research Physician, Wadsworth Center for Laboratories and Research, New York State Department of Health, Albany, NY
- 1/98-1/05 Adjunct Professor in the Center for Neuropharmacology & Neuroscience, Albany Medical College, Albany, NY
- 2001-Pres. Director, Institute for Health and the Environment, University at Albany, SUNY, Rensselaer, NY. The Institute was named a Collaborating Center of the World Health Organization in 2011.
- 2005-Pres. Senior Fellow, Alden March Bioethics Institute, Albany Medical College/Center, Albany, New York
- 2011-Pres. Honorary Professor, Queensland Children's Medical Research Institute, University of Queensland, Brisbane, Australia

Editor-in-Chief: Cellular and Molecular Neurobiology, 1981 – 1987
Editor-in Chief: Reviews on Environmental Health 2012-present
Editor-in-Chief: Journal of Local and Global Health Sciences 2012-present
Editorial Advisor: Cellular and Molecular Neurobiology, 1987 - Present
Editorial Boards: Journal of Public Health Management and Practice, 1995 - 2002
International Journal of Occupational Medicine & Environmental Health
 1996 – Present
Journal of Alzheimer's Disease – Associate Editor,2007-2009
Reviews in Environmental Health; 2008-2012
International Archives of Occupational and Environmental Health; 2009-present.
Journal of Environmental and Public Health, 2009-present.
Environmental Health Perspectives, 2010-present
Global Health Perspective, 2012-present
PLoS One, 2014-present

National and International Committees:

1978, 1981 Physiology Study Section (Ad hoc member)
 1979-1985 NIH International Fellowship Study Section
 1974-1981 Member, Steering Committee of the Section on the Nervous System, American Physiological Society (Chairman of the Committee, 9/76-4/80)
 1981-1989 Member, USA National Committee for the International Brain Research Organization
 1985-1986 Committee on Electric Energy Systems of the Energy Engineering Board, National Research Council
 1986-1987 Member, Neurophysiology Peer Panel for the National Aeronautics and Space Administration
 1987-1989 Member, Science Advisory Council of the American Paralysis Association
 1987-1990 Advisory Panel for the Electric Energy System Division, U.S. Department of Energy
 1985-1993 Committee #79, National Council on Radiation Protection and Measurements
 1986-1997 Member, Legislative and Education Committees, Association of Schools of Public Health
 1989-1994 Member, Neuroscience Discipline Working Group, Life Sciences Division of the NASA
 1994, 1995 Federation of American Societies for Experimental Biology Consensus Conference on FY 1995 Federal Research Funding
 1994-1997 Member, Legislative Committee of the Association of Schools of Public Health
 1997 Member, Executive Committee of the Association of Schools of Public Health
 1997-2000 National Advisory Environmental Health Sciences Council of the National Institutes of Health
 1998-Pres. Member, U.S. Section of the Great Lakes Science Advisory Board of the International Joint Commission
 2000-Pres. Member, Board of Directors, Pacific Basin Consortium for Hazardous Waste Health and Environment; Treasurer, 2001-2004, 2008-pres; Chair, 2004-2008
 2001-2008 United States Co-Chair, Workgroup on Ecosystem Health of the Science Advisory Board of the International Joint Commission
 2002-2003 Member, Committee on the Implications of Dioxin in the Food Supply, The National Academies, Institute of Medicine
 2003-2008 Member, United States Environmental Protection Agency, Children's Health Protection Advisory Committee
 2003-Pres. Chair, Advisory Committee to the World Health Organization and National Institute of Environmental Health Sciences on collaborative activities.
 2004-Pres. Member, Blue Ocean Institute Curriculum Advisory Board.
 2007-2011 Chair, Workgroup on Risks vs. Benefits of Fish Consumption, Science Advisory Board, International Joint Commission.
 2013 Invited Expert, International Agency for Research on Cancer, Panel for Monograph 107, Carcinogenicity of Polychlorinated Biphenyls.
 2013-present Member, Global Burden of Disease Panel

State and Local Committees:

- 1980-1987 Executive Secretary, New York State Power Lines Project
1985-1989 Board of Scientific Advisors, Institute of Basic Research, OMRDD, N.Y.
1986-1989 Member, Steering Committee, Health Policy and Administrative Consortium of the Capital District
1991-1992 Member, Connecticut Academy of Sciences and Engineering Committee on Electromagnetic Field Health Effects
1991-1992 Member, Board of Directors of the Capital District Chapter of the Alzheimer's Disease and Related Disorders Association, Inc.
1991-1992 Member, State Task Force for the Reform of Middle Level Education in NY State
1992-1993 Member, State Needs Task Force on Health Care and Education
1987-1998 Delegate-at-Large, New York State Public Health Association
1991-1995 Member, Board of Directors of the Capital District Amyotrophic Lateral Sclerosis Association
1994 Chair, Council of Deans, University at Albany, SUNY
1997-2008. Member, Board of Directors, (Chair 1998-2004) Albany-Tula Inc.: A Capital Region Alliance
2000-Pres. Member, Board of Directors, Healthy Schools Network, Inc.
2000-2003 Member, Medical Advisory Board, Hepatitis C Coalition, New York
2000-2004 Member, Environmental Protection Agency /National Association of State Universities and Land Grant Colleges Task Force
2001-2008 Member, Board of Directors, Environmental Advocates of New York
2004-2007 Member, Ad Hoc Advisory Group on Brownfield Cleanup Standards
2005-Pres. Member, Schooling Chefs Curriculum Advisory Board
2005-Pres. Member, Advisory Board, Healthy Child Healthy World
2005-2008 Member, Board of Directors, Citizens Environmental Coalition
2006-2009 Member, Board of Directors, Marine Environmental Research Institute
2007-2009 Member, New York State Renewable Energy Task Force
2013-present Member, Medical Society of the State of New York (MSSNY)
2013-present Member, Preventive Medicine and Family Health Committee, MSSNY

Honors, Awards and Fellowships:

- 1959 B.A. awarded magna cum laude. Thesis entitled "Metamorphosis of visual pigments: A study of visual system of the salamander, Ambystoma tigrinum" (Thesis advisor, Professor George Wald)
Elected to Phi Beta Kappa and to Sigma Xi
1964 M.D. awarded cum laude for a thesis in a special field. Thesis entitled "Electrophysiological observations on the importance on neuron size in determining responses to excitation and inhibition in motor and sensory systems" (Thesis advisor, Dr. Elwood Henneman)
1964 Awarded the Leon Resnick Prize given to a Harvard Medical School graduate showing promise in research
1970 Awarded the Moseley Traveling Fellowship for study in England (Fellowship declined)
1971 Invited as Visiting Professor of Physiology, Centro de Investigacion y de Estudios Avanzados, del Institute Politecnico Nacional, Mexico 14, D.F., Mexico, for 3 months
1982, 1986 Visiting Professor of Physiology, Department of Physiology, Kyushu University, Fukuoka, Japan, for a period of three months each
1987
1989 Awarded Jacob Javits Neuroscience Investigator Award from the National Institute of Neurological and Communicative Diseases and Stroke
1999 Awarded Homer N. Calver Award from the American Public Health Association for studies

in environmental health.

- 2001 Awarded 2001 Academic Laureate from the University at Albany Foundation.
- 2010 Awarded the Albion O. Bernstein, M.D. Award in recognition of an outstanding contribution to public health and the prevention of disease through lifelong research of environmental health hazards and for limitless devotion to medical education by the Medical Society of the State of New York.
- 2011 Awarded the Rodney Wylie Eminent Visiting Fellowship 2011 at the University of Queensland, Brisbane, Australia for a period of four weeks.
- 2013 Awarded the Annual Kenneth V. Dodgson, M.D., Lectureship at the University of Rochester Department of Occupational and Environmental Medicine Grand Rounds.

Federal Grants Held: (Principal Investigator Only)

- 1980-1983 United States Air Force, "Mechanisms of Radiation-Induced Emesis in Dogs", \$76,847 total direct costs.
- 1982-1988 National Institute of Health, "Mechanisms of Desensitization at Central Synapses", \$464,786 total direct costs.
- 1984-1986 Defense Nuclear Agency, "Mechanisms of Radiation-Induced Emesis in Dogs", \$330,504 total direct costs.
- 1986-1996 National Institute of Health, "Mechanisms of Excitatory Amino Acids Actions and Toxicity", 1986-1989 \$231,848 total direct costs; 1990-1996 \$562,926 total direct costs.
- 1989-1993 National Institute of Health, "Mechanisms of Lead Neurotoxicity" \$373,576 total direct costs
- 1990-1995 National Institute of Environmental Health Sciences, Superfund Basic Research Program, "Multidisciplinary Study of PCBs and PCDFs at a Waste Site", D.O. Carpenter, P.I. \$5,783,419 total direct costs.
- 1995-2001 Fogarty International Center, National Institutes of Health, International Training Program in Environmental and Occupational Health. A Central/Eastern European Environ/Occup Training Program, D.O. Carpenter, P.I. \$657,520 total costs.
- 1995-2001 National Institute of Environmental Health Sciences, Superfund Basic Research Program, "Multidisciplinary Study of PCBs," D.O. Carpenter, P.I. \$12,653,709 total direct costs.
- 1998-1999 Environmental Protection Agency, A Indoor Air Risk at Akwesasne - Pilot Project, D.O. Carpenter, P.I. \$9,996 total costs.
- 2000-2002 Association Liaison Office for University Cooperation in Development, A Cooperative Program in Environmental Health between the Institute of Public Health at Makerere University, Kampala, Uganda and the School of Public Health, University at Albany, USA, D.O. Carpenter, P.I. \$96,432 total costs.
- 2001-2007 Fogarty International Center, National Institutes of Health, International Training Program in Environmental and Occupational Health. A Multidisciplinary Environmental Health Training, D.O. Carpenter, P.I. \$850,000 total costs.
- 2006-2011 Pakistan-US Science and Technology Cooperative Program (US National Academy of Sciences). "Association of particulate matter with daily morbidity in an urban population," D.O. Carpenter, P.I., \$391,104 total costs.
- 2009-2013 Exploratory Center on Minority Health and Health Disparities in Smaller Cities. Project 2: Environmental contaminants and reproductive health of Akwesasne Mohawk women. \$387,825 for year 1. D.O. Carpenter, Co-PI.

- 2010-2013 Department of the Army, "Gulf War Illness: Evaluation of an Innovative Detoxification Program: D.O. Carpenter, P.I., \$636,958 total costs.
- 2010-2013 Higher Education for Development of the United States Agency for International Development, "Drinking Water Supply, Sanitation, and Hygiene Promotion : Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda". D. O. Carpenter, P.I., \$299,736 total costs.
- 2011-2016 National Institute of Environmental Health Sciences (1R01ES019620), "Protecting the health of future generations: Assessing and preventing exposures." PK Miller, FA von Hippel, CL Buck and DO Carpenter, Co-P.I.s, \$471,521 for the period 8/08/11-4/30/12, \$2,354,871 for the period 2011-2016.

Research Interests:

- Exposure to persistent organic pollutants and risk of diabetes, cardiovascular disease, and hypertension.
- Cognitive and behavioral effects of environmental contaminants on children (IQ, ADHD) and older adults (dementias, Parkinson's Disease and ALS).
- Ionizing and non-ionizing radiation biology.
- Effects of air pollution on respiratory and cardiovascular function.

Other Professional Activities:

Host, The Public Radio Health Show (a 30 min public health information show carried on 170+ stations nationwide), plus the Armed Forces Radio Network and Voice of America, 1985-2001.

Authored a biweekly health column in The Troy Record, a local newspaper, 1997-1999.

Member of the Ethics Board, Town of Guilderland, 2013 – present.

Major Peer-Reviewed Publications:

1. Carpenter, D.O., Lundberg, A. and Norrsell, U. Effects from the pyramidal tract on primary afferents and on spinal reflex actions to primary afferents. Experientia, 18:337, 1962.
2. Carpenter, D.O., Engberg, I. and Lundberg, A. Presynaptic inhibition in the lumbar cord evoked from the brain stem. Experientia, 18:450, 1962.
3. Carpenter, D.O., Lundberg, A. and Norrsell, U. Primary afferent depolarization evoked from the sensorimotor cortex. Acta Physiol. Scand., 59:126-142.
4. Carpenter, D.O., Engberg, I., Funkenstein, H. and Lundberg, A. Decerebrate control of reflexes to primary afferents. Acta Physiol. Scand., 59:424-437, 1963.
5. Carpenter, D.O., Engberg, I. and Lundberg, A. Differential supraspinal control of inhibitory and excitatory actions from the FRA to ascending spinal pathways. Acta Physiol. Scand., 63:103-110, 1965.
6. Henneman, E., Somjen, G.G. and Carpenter, D.O. Excitability and inhibibility of motoneurons of different sizes. J. Neurophysiol., 28:599-620, 1965.
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11. Carpenter, D.O. and Henneman, E. A relation between the threshold of stretch receptors in skeletal muscle and the diameter of axons. J. Neurophysiol., 29:353-368, 1966.
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13. Chase, T.N., Breese, G., Carpenter, D., Schanberg, S. and Kopin, I. Stimulation-induced release of serotonin from nerve tissue. Adv. Pharmacol., 6A:351-364, 1968.
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15. Olson, C.B., Carpenter, D.O. and Henneman, E. Orderly recruitment of muscle action potentials. Arch. Neurol., 19:591-597, 1968.
16. Carpenter, D.O. Membrane potential produced directly by the Na⁺ pump in Aplysia neurons. Comp. Biochem. Physiol., 35:371-385, 1970.
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18. Kraus, K.R., Carpenter, D.O. and Kopin, I. R. Acetylcholine-induced release of norepinephrine in the presence of tetrodotoxin. J. Pharmacol. Exp. Therap., 73:416-421, 1970.
19. Barker, J.L. and Carpenter, D.O. Thermosensitivity of neurons in the sensorimotor cortex of the cat. Science, 169:597-598, 1970.
20. Carpenter, D.O., Hovey, M.M. and Bak, A. Intracellular conductance of Aplysia neurons and squid axon as determined by a new technique. Intl. J. Neurosci., 2:35-48, 1971.
21. Carpenter, D.O., Breese, G., Schanberg, S. and Kopin, I. Serotonin and dopamine: Distribution and accumulation in Aplysia nervous and non-nervous tissues. Int. J. Neurosci., 2:49-56, 1971.
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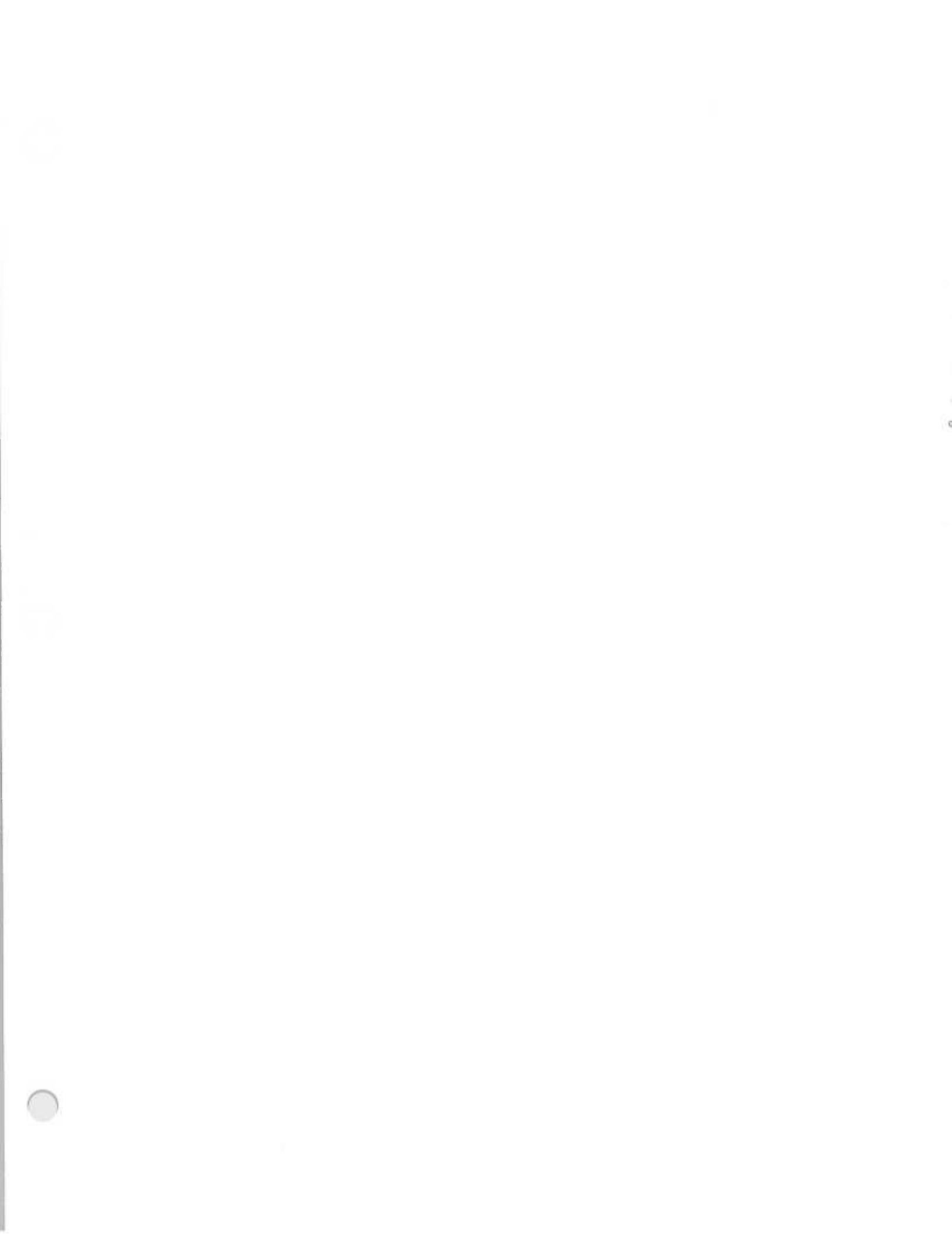
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DEED

This **DEED**, made and entered into this 6 day of June, 2006, by and between **Janet Belcher Smallwood and Timothy Smallwood**, her husband, 1624 Donaldson Road, Winchester, Kentucky 40391, Party of the First Part; and **EAST KENTUCKY POWER COOPERATIVE, INC.**, P.O. Box 707, Winchester, Clark County, Kentucky 40392-0707, Party of the Second Part,

WITNESSETH:

That for and in consideration of the sum of Forty-Two Thousand Dollars (\$42,000.00), One Thousand Dollars, (\$1,000.00), of which having heretofore been paid upon execution of the Real Estate Option dated October 29, 2005, and the balance of Fourty-One Thousand Dollars (\$41,000.00) being paid this date, the receipt of all of which is hereby acknowledged, the party of the first part has bargained and sold and by these presents does bargain, sell and convey unto the party of the second part, its successors and assigns forever, in fee simple, the following described property located on the north side of the Donaldson Road in Clark County, Kentucky, and more particularly described as follows:

Beginning at an existing rebar iron pin (Baldwin 1366) (found) in the line of Roby Ballard III and Dawn Ballard (DB 375, PG 667) and a corner to Joseph E. Stearns and Therese Stearns (DB 422, PG 307 & Slide 1507B); thence leaving the line of Ballard with the line of Stearns S77°33'17"W, 387.47 feet to an existing rebar iron pin (Baldwin 1366) (found); thence with a line dividing the lands of Belcher two (2) calls N37°01'51"W, 189.39 feet to a Mag Nail (set this survey); thence N09°27'50"W, 434.79 feet to an existing rebar iron pin (Justice 2360) (found), a corner to East Kentucky Power Cooperative, Inc. (DB 430, PG 580 & Slide 1266) and Roger McIntosh and Regina McIntosh (DB 377, PG 402); thence with the line of East Kentucky Power Cooperative, Inc. N74°13'40"E, 396.05 feet to an existing rebar iron pin (Justice 2360) (found), a corner to Roby Ballard III and Dawn Ballard (DB 375, PG 667); thence leaving the line of East Kentucky Power Cooperative, Inc. with the line of Ballard S16°49'47"E, 631.26 feet to the point of beginning. Containing 6.01 acres and shown on attached drawing labeled as "Exhibit A".

Being the same property conveyed to Janet Belcher, a single person, from John Turley, et al, as executors of the Will and of the estate of Carrie Frances Turley, deceased, by deed dated September 15, 2001 and of record in Deed Book 384, Page 261, in the Clark County Clerk's office, Clark County, Kentucky.

TO HAVE AND TO HOLD the above described real estate, together with all the appurtenances thereunto belonging, unto the party of the second part, its successors and assigns forever, in fee simple forever, with Covenant of General Warranty.

CONSIDERATION CERTIFICATE

The party of the second part joins in this deed for the purpose of certifying the consideration. All parties hereto state under oath that the consideration reflected in this deed is the full consideration paid for the property as required by KRS 382.135.

IN WITNESS WHEREOF, the parties hereto has placed their hand the day and year first above written.

FIRST PARTY



JANET BELCHER SMALLWOOD

FIRST PARTY



TIMOTHY SMALLWOOD

**SECOND PARTY, EAST KENTUCKY
POWER COOPERATIVE, INC.**

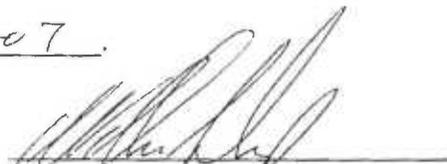


**SHERMAN GOODPASTER III
SENIOR CORPORATE COUNSEL**

STATE OF KENTUCKY)
) SCT.
COUNTY OF CLARK)

This Deed and Consideration Statement was subscribed, sworn to and acknowledged before me this 6 day of June, 2006, by Janet Belcher Smallwood, First Party.

My commission expires: 11-17-07.


NOTARY PUBLIC, KY.
STATE-AT-LARGE.

STATE OF KENTUCKY)
) SCT.
COUNTY OF CLARK)

This Deed and Consideration Statement was subscribed, sworn to and acknowledged before me this 6 day of June, 2006, by Timothy Smallwood, First Party.

My commission expires: 11-17-07.


NOTARY PUBLIC, KY.
STATE-AT-LARGE.

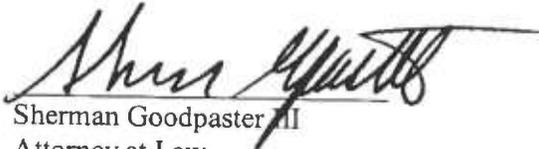
STATE OF KENTUCKY)
) SCT.
COUNTY OF CLARK)

This Deed and Consideration Statement was subscribed, sworn to and acknowledged before me this 7th day of June, 2006, by Sherman Goodpaster, III, in his capacity as Senior Corporate Counsel of East Kentucky Power Cooperative, Inc.

My Commission expires: 12/20/06.


NOTARY PUBLIC, KY.
STATE-AT-LARGE.

Prepared by:



Sherman Goodpaster III
Attorney at Law
P.O. Box 707
Winchester, KY 40392-0707
(606) 744-4812

COUNTY CLERK'S CERTIFICATE

(h:\legal\deeds\Smallwood, Janet Belcher & Timothy)

STATE OF KENTUCKY }
COUNTY OF CLARK } SS

I, Anita S. Jones, Clerk of Clark County, KY, do certify that the foregoing is a true and correct copy of Deed
AS SAME appears of record in my said office in D Book
434 Page 435-439

Given under my hand this, the day of April 17 2014
ANITA S. JONES, COUNTY CLERK
CLARK COUNTY, KENTUCKY
BY Donna Black D.C.

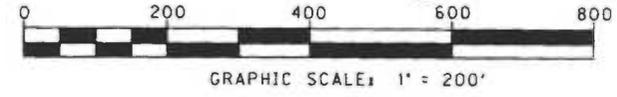
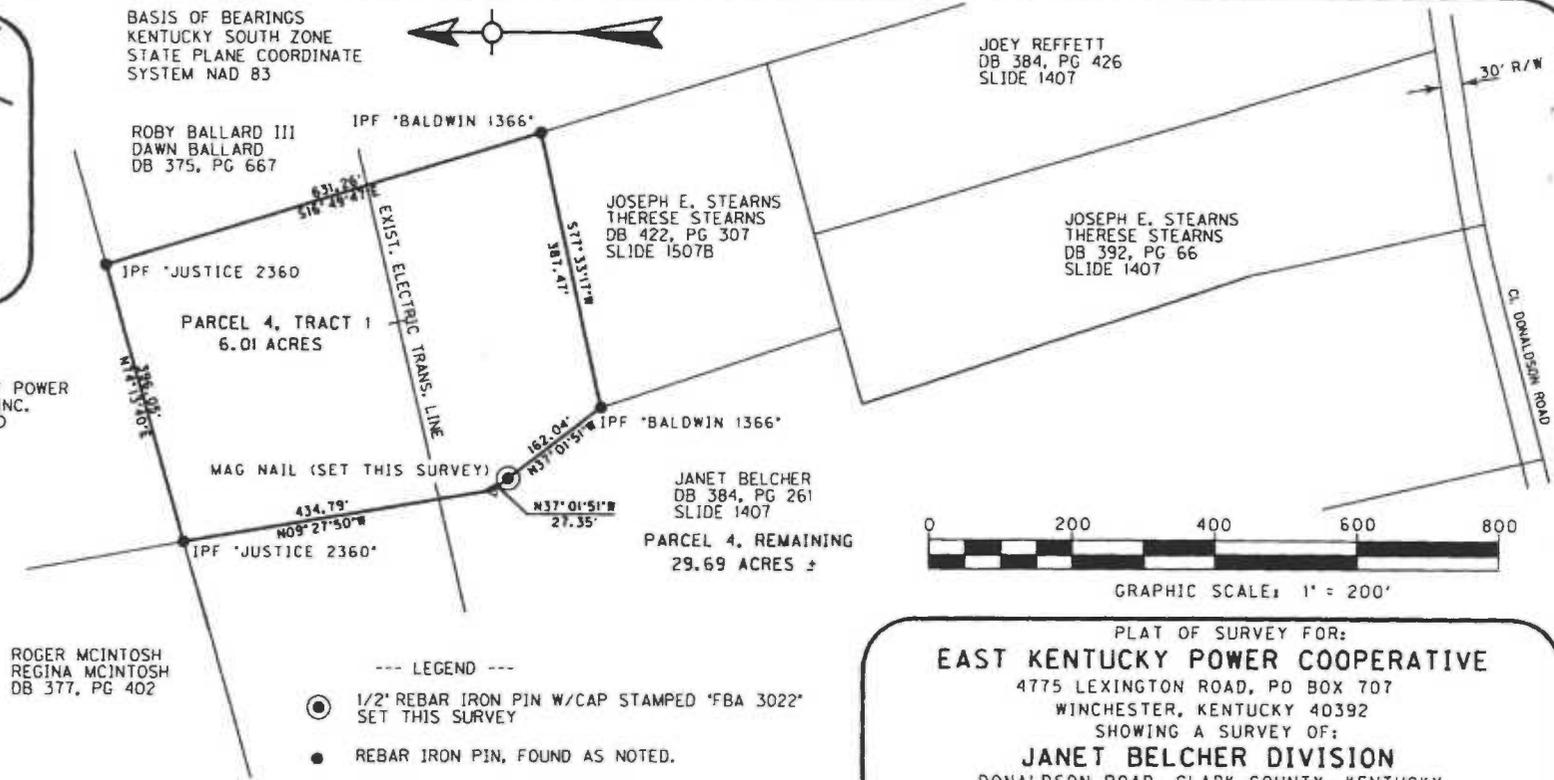
DOCUMENT NO: 134682
RECORDED ON: JUNE 23, 2006 12:39:49PM
TOTAL FEES: \$16.00
TRANSFER TAX: \$42.00
COUNTY CLERK: ANITA JONES
COUNTY: CLARK COUNTY
DEPUTY CLERK: LADONNA
BOOK 0434 PAGES 435 - 439



VICINITY MAP

EAST KENTUCKY POWER COOPERATIVE, INC.
DB 430, PG 580
TRACT 3
SLIDE 1266

BASIS OF BEARINGS
KENTUCKY SOUTH ZONE
STATE PLANE COORDINATE
SYSTEM NAD 83



- LEGEND ---
- 1/2" REBAR IRON PIN W/CAP STAMPED 'FBA 3022' SET THIS SURVEY
 - REBAR IRON PIN, FOUND AS NOTED.
 - ◁ EXIST. PK NAIL FOUND

LAND SURVEYOR'S CERTIFICATION

I hereby certify that the survey depicted by this plat was performed under my direction by the method of random traverse with sideshots. The unadjusted precision ratio of the traverse was 1:108,792 and was not adjusted. The survey as shown hereon is a class A survey and the accuracy and precision of said survey meets all the specifications of this class.

Blake Adams
BLAKE ADAMS, LS # 3088
6-20-06
DATE

PLAT OF SURVEY FOR:
EAST KENTUCKY POWER COOPERATIVE
4775 LEXINGTON ROAD, PO BOX 707
WINCHESTER, KENTUCKY 40392
SHOWING A SURVEY OF:
JANET BELCHER DIVISION
DONALDSON ROAD, CLARK COUNTY, KENTUCKY
DEED BOOK 384, PAGE 261

DATE: JUNE 6, 2006	SCALE: 1" = 200'	FILE: BLECHER.DGN
-----------------------	---------------------	----------------------

STATE OF KENTUCKY
F. B. ADAMS
3088
LICENSED PROFESSIONAL LAND SURVEYOR

BLAKE ADAMS ENGINEERING, INC.
438 WASHINGTON STREET
STANTON, KENTUCKY 40380
(606)663-2722

END OF DOCUMENT

EXHIBIT A

CLARK COUNTY
D434
PG 439

REAL ESTATE OPTION

In consideration of the sum of Two Thousand Dollars (\$2,000.00) or n/a% of the total paid by EAST KENTUCKY POWER COOPERATIVE, INC., of Clark County, Kentucky, hereinafter referred to as "OPTIONEE," to

Joey and Gulena Reffett
9302 Villa Fair Court
Louisville, KY 40291-1493

hereinafter referred to as "OPTIONORS," the receipt of which is hereby acknowledged, OPTIONORS do hereby grant and convey to OPTIONEE the right and option, exercisable at any time within a period of one-hundred eighty (180) days from the date hereof, to purchase the following described property situated, lying and being near Donaldson Road, in Clark County, Kentucky, and is more particularly described as follows:

Approximately 6 acres being Parcel # 6
On Slide 1407 in Clark County Clerk's Office
Winchester, KY.

BEING that property conveyed from John Turley + Brenda Turley ET. AL. to Joey Reffett by deed dated 9/21, 192001, and recorded in Deed Book No. 384, on Page 426, in the Clark County Court Clerk's Office.

Return to: Linda Pittman
1503 Schollsville Rd.
Winchester KY 40391

(Document 1)

Notice of OPTIONEE'S exercise of this option shall be deemed delivered to OPTIONOR if and when it is delivered personally to any one of the OPTIONORS or sent by registered or certified mail to any one of the OPTIONORS at his address. The date of delivery of such notice served by mail shall be the date on which said notice is deposited in the United States mail.

It is understood and agreed between the parties that the OPTIONEE shall have the right, during the period of this Option, and up until the settlement date, to survey the herein before described property, to conduct core drilling on said property, to place on said property and operate thereon pollution control monitoring equipment, and to conduct on said property such other engineering studies as the OPTIONEE may deem necessary in determining the site feasibility of the aforesaid property. The OPTIONEE shall pay for all damages that may be caused to fences, gates, crops, animals and other property located on the herein before described property as a result of its exercising its rights herein granted.

It is understood by and between the parties that should OPTIONEE exercise this option, the conveyance of the subject property shall be consummated in accordance with, and subject to, the following terms and conditions:

1. **Purchase Price** - Eighty Thousand Dollars and no cents (\$80,000.00) payable on the settlement date, less the sum paid for this option and any extension or renewal thereof.

2. **Deed** - OPTIONORS shall deliver to OPTIONEE on the settlement date a properly executed and acknowledged General Warranty Deed, in fee simple title and free of all liens and encumbrances, conveying the subject property to OPTIONEE.

3. **Possession** - Possession of the subject property shall be delivered to OPTIONEE on the date of final settlement and upon delivery of the aforesaid purchase price to OPTIONORS and upon delivery of said deed to OPTIONEE.

(Document1)

Taxes - Taxes shall be pro-rated as of the settlement date.

5. **Settlement Date** - Final settlement hereunder shall take place on the fifteenth (15th) day from the date of the exercise of this option or on such date prior hereto as shall be agreed upon between the parties hereto.

6. **Place of Settlement** - Final settlement hereunder shall be held in the Headquarters Building of the OPTIONEE located at 4758 Lexington Road in Clark County, Kentucky, or at such other place as shall be mutually agreed upon between the parties hereto.

7. **Title** - In the event title to the above described property is found to be not marketable, OPTIONEE will notify OPTIONOR immediately thereof and OPTIONOR shall have a reasonable time at its option to clear the defects in the title in order to make the same marketable, and in such case the time for settlement shall be extended for a period reasonably sufficient for said purpose. In the event title to said premises is found to be not marketable and OPTIONOR either cannot or does not desire to cure the defects in said title, OPTIONEE, as its sole recourse, shall have the option either to:

- (a) Declare this option and any exercise thereof to be null and void, whereupon OPTIONOR shall return forthwith to OPTIONEE all monies paid for this option and any extensions or renewals thereof and all obligations hereunder of each party hereto shall cease without any liability whatever to the other party.
- (b) Complete the purchase of the above described property in accordance with the terms hereof with a mutually agreed reduction in the purchase price on account of the defective title.

8. **Default** - Time shall be of the essence and should OPTIONEE fail to complete the settlement according to the terms and conditions hereof and within the time herein stipulated then, and in that event, OPTIONORS shall have the right to retain the consideration for this option and to declare this option agreement null and void.

(Document 1)

STATE OF KENTUCKY)
) Sct.
COUNTY OF _____)

The foregoing Real Estate Option was acknowledged before me this _____ day of
_____, 19____, by _____

My Commission expires _____.

NOTARY PUBLIC

Seal

STATE OF KENTUCKY)
) Sct.
COUNTY OF _____)

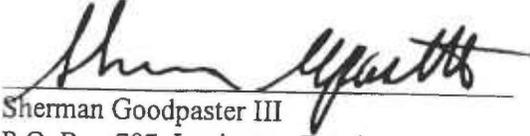
The foregoing Real Estate Option was acknowledged before me this _____ day of
_____, 19____, by _____

My Commission expires _____.

NOTARY PUBLIC

Seal

This Instrument was prepared by:



Sherman Goodpaster III
P.O. Box 707, Lexington Road
Winchester, Kentucky 40391
(606) 744-4812

COUNTY COURT CLERK'S CERTIFICATE

STATE OF KENTUCKY }
COUNTY OF CLARK } SS

I, Anita S. Jones, Clerk of Clark County, KY, do certify that the foregoing is a true and correct copy of Real Estate Option AS SAME appears of record in my said office in D Book 428 Page 841

Given under my hand this, the day of April 17 2014

ANITA S. JONES, COUNTY CLERK
CLARK COUNTY, KENTUCKY

BY Donna R B R D.C.

DOCUMENT NO: 129273
RECORDED ON: DECEMBER 02, 2005 10:50:53AM
TOTAL FEES: \$15.00
COUNTY CLERK: ANITA JONES
COUNTY: CLARK COUNTY
DEPUTY CLERK: LADONNA 

BOOK D428 PAGES 841 - 846

(Document 1)

END OF DOCUMENT

DEED

This **DEED**, made and entered into this 6 day of June, 2006, by and between **JOEY REFFETT and GULENA REFFETT**, his wife, 9302 Villa Fair Court, Louisville, Kentucky 40291-1493, Party of the First Part; and **EAST KENTUCKY POWER COOPERATIVE, INC.**, P.O. Box 707, Winchester, Clark County, Kentucky 40392-0707, Party of the Second Part,

WITNESSETH:

That for and in consideration of the sum of Eighty Thousand Dollars (\$80,000.00), Two Thousand Dollars, (\$2,000.00), of which having heretofore been paid upon execution of the Real Estate Option dated November 24, 2005, and the balance of Seventy-Eight Thousand Dollars (\$78,000.00) being paid this date, the receipt of all of which is hereby acknowledged, the party of the first part has bargained and sold and by these presents does bargain, sell and convey unto the party of the second part, its successors and assigns forever, in fee simple, the following described property situated, lying and being near Donaldson Road in Clark County, Kentucky, and more particularly described as follows:

That certain tract or parcel of land located on the north side of the Donaldson Road in Clark County, Kentucky and being identified as Parcel 6 containing 5.41 acres on the record plat for "Turley Property" of record on Plat Slide 1407, Clark County Clerk's office, reference to which plat is hereby made for a more particular description and which property has an address of 1734 Donaldson Road.

Being the same property conveyed to Joey Reffett, a single person, from John Turley and Brenda H. Turley, et al, as heirs of George W. Turley and Lula F. Turley, by deed dated September 21, 2001 and of record in Deed Book 384, Page 426, in the Clark County Clerk's office, Clark County, Kentucky.

TO HAVE AND TO HOLD the above described real estate, together with all the appurtenances thereunto belonging, unto the party of the second part, its successors and assigns forever, in fee simple forever, with Covenant of General Warranty.

CONSIDERATION CERTIFICATE

The party of the second part joins in this deed for the purpose of certifying the consideration. All parties hereto state under oath that the consideration reflected in this deed is the full consideration paid for the property as required by KRS 382.135.

IN WITNESS WHEREOF, the parties hereto has placed their hand the day and year first above written.

FIRST PARTY

Joey L. Reffett
JOEY REFFETT

FIRST PARTY

Gulena Reffett
GULENA REFFETT

**SECOND PARTY, EAST KENTUCKY
POWER COOPERATIVE, INC.**

Sherman Goodpaster III
SHERMAN GOODPASTER III
SENIOR CORPORATE COUNSEL

STATE OF KENTUCKY)
 Jefferson) SCT.
COUNTY OF ~~CLARK~~)

This Deed and Consideration Statement was subscribed, sworn to and acknowledged before me this 12 day of June, 2006, by Joey Reffett, First Party.

My commission expires: 11-17-07.

[Signature]
NOTARY PUBLIC, KY.
STATE-AT-LARGE.

DEED

This **DEED**, made and entered into this 8th day of May, 2006, by and between **ROBY BALLARD II and DAWN BALLARD**, his wife, 1744 Donaldson Road, Winchester, Kentucky 40391, Party of the First Part; and **EAST KENTUCKY POWER COOPERATIVE, INC., P.O.** Box 707, Winchester, Clark County, Kentucky 40392-0707, Party of the Second Part,

WITNESSETH:

That for and in consideration of the sum of Four Hundred Thirty-Five Thousand Dollars (\$435,000.00), Five Thousand Dollars, (\$5,000.00), of which having heretofore been paid upon execution of the Real Estate Option dated March 20, 2006, and the balance of Four Hundred Thirty Thousand Dollars (\$430,000.00) being paid this date, the receipt of all of which is hereby acknowledged, the party of the first part has bargained and sold and by these presents does bargain, sell and convey unto the party of the second part, its successors and assigns forever, in fee simple, the following described property situated on the Donaldson Pike in Clark County, Kentucky, and more particularly described as follows:

Beginning in the Donaldson Pike, corner to Turley and Ellis Wade; thence along Ellis Wade's line N 16° 05' W 2000.4 feet, passing Mrs. Maggie Wade's property to a post corner to Mrs. Wade and Mrs. Josie Boardman; thence along Mrs. Boardman's line S 75° 00' W 506.6 feet to a stake, corner to same and George Turley; thence along George Turley's line S 16° 05' E 1928 feet to center of Donaldson Pike; thence along center of said pike N 83° 00' E 520 feet to the place of beginning, containing 23 acres of land.

Being the same property conveyed to Roby Ballard II and Dawn Ballard, husband and wife, from John Carl Snowden and Lewis Ray Snowden, as executors of the Will and of the estate of Carrie Frances Turley, deceased, by deed dated October 12, 2000 and of record in Deed Book 375, Page 667, in the Clark County Clerk's office, Clark County, Kentucky.

TO HAVE AND TO HOLD the above described real estate, together with all the appurtenances thereunto belonging, unto the party of the second part, its successors and assigns forever, in fee simple forever, with Covenant of General Warranty.

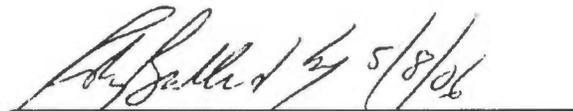
MAIL TO PURCHASER

CONSIDERATION CERTIFICATE

The party of the second part joins in this deed for the purpose of certifying the consideration. All parties hereto state under oath that the consideration reflected in this deed is the full consideration paid for the property as required by KRS 382.135.

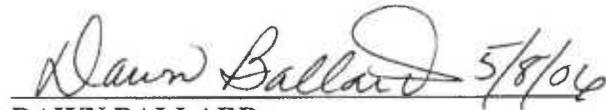
IN WITNESS WHEREOF, the parties hereto has placed their hand the day and year first above written.

FIRST PARTY



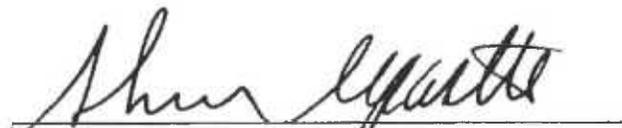
ROBY BALLARD II

FIRST PARTY



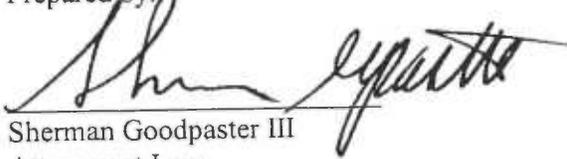
DAWN BALLARD

**SECOND PARTY, EAST KENTUCKY
POWER COOPERATIVE, INC.**



**SHERMAN GOODPASTER III
SENIOR CORPORATE COUNSEL**

Prepared by:



Sherman Goodpaster III
Attorney at Law
P.O. Box 707
Winchester, KY 40392-0707
(606) 744-4812

COUNTY CLERK'S CERTIFICATE

(h:\legal\deeds\Ballard, Roby & Dawn)

STATE OF KENTUCKY }
COUNTY OF CLARK } SS

I, Anita S. Jones, Clerk of Clark County, KY, do certify that the foregoing is a true and correct copy of Deed
AS SAME appears of record in my said office in D Book
433 Page 42

Given under my hand this, the day of April 17 2014
ANITA S. JONES, COUNTY CLERK
CLARK COUNTY, KENTUCKY

BY Denise R. Bloe D.C.

DOCUMENT NO: 133196
RECORDED ON: MAY 08, 2006 04:17:41PM
TOTAL FEES: \$14.00
TRANSFER TAX: \$435.00
COUNTY CLERK: ANITA JONES
COUNTY: CLARK COUNTY
DEPUTY CLERK: LADONNA
BOOK D433 PAGES 42 - 45

END OF DOCUMENT

DEED

This **DEED**, made and entered into this 6 day of June, 2006, by and between **JOSEPH ED STEARNS and THERESE STEARNS**, husband and wife, 1686 Donaldson Road, Winchester, Kentucky 40391, Party of the First Part; and **EAST KENTUCKY POWER COOPERATIVE, INC.**, P.O. Box 707, Winchester, Clark County, Kentucky 40392-0707, Party of the Second Part,

WITNESSETH:

That for and in consideration of the sum of the exchange of property as set forth in a separate deed of even date herewith, and other good and valuable consideration, the receipt of all of which is hereby acknowledged, the party of the first part has bargained and sold and by these presents does bargain, sell and convey unto the party of the second part, its successors and assigns forever, in fee simple, the following described property located on the north side of the Donaldson Road in Clark County, Kentucky, and more particularly described as follows:

Beginning at an iron pin "Justice 2360", in the southeast property corner, thence N 16°51'53" for 329.53 feet; thence N 77°33'17"E for 200.52 feet; thence S 16°49'41"E for 342.46 feet; thence N 73°51'28" E for 200.16 feet to the point of beginning containing approximately 1.54 acres.

Being the same property conveyed to Joseph E. Stearns and Therese Stearns, husband and wife, by deed recorded on April 18, 2005 in Deed Book 422, Page 307, in the Clark County Clerk's office, Clark County, Kentucky.

TO HAVE AND TO HOLD the above described real estate, together with all the appurtenances thereunto belonging, unto the party of the second part, its successors and assigns forever, in fee simple forever, with Covenant of General Warranty.

CONSIDERATION CERTIFICATE

The party of the second part joins in this deed for the purpose of certifying the consideration, as required by KRS 382.135. All parties hereto state under oath that the consideration reflected in this deed is the full consideration paid for the property and the fair

Attn: Bill Sharp
EKPC
P.O. Box 707
Win KY

STATE OF KENTUCKY)
) SCT.
COUNTY OF CLARK)

This Deed and Consideration Statement was subscribed, sworn to and acknowledged before me this 6 day of June, 2006, by Therese M. Stearns, First Party.

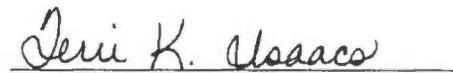
My commission expires: 11-17-07.


NOTARY PUBLIC, KY.
STATE-AT-LARGE.

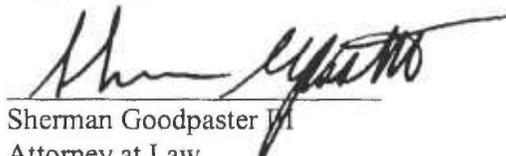
STATE OF KENTUCKY)
) SCT.
COUNTY OF CLARK)

This Deed and Consideration Statement was subscribed, sworn to and acknowledged before me this 6th day of June, 2006, by Sherman Goodpaster, III, in his capacity as Senior Corporate Counsel of East Kentucky Power Cooperative, Inc.

My Commission expires: 12/20/08.


NOTARY PUBLIC, KY.
STATE-AT-LARGE.

Prepared by:


Sherman Goodpaster III
Attorney at Law
P.O. Box 707
Winchester, KY 40392-0707
(606) 744-4812

COUNTY CLERK'S CERTIFICATE

DOCUMENT NO: 134680
RECORDED ON: JUNE 23, 2006 12:36:22PM
TOTAL FEES: \$14.00
TRANSFER TAX: \$12.00
COUNTY CLERK: ANITA JONES
COUNTY: CLARK COUNTY
DEPUTY CLERK: LADONNA
BOOK D434 PAGES 428 - 431

STATE OF KENTUCKY }
COUNTY OF CLARK } SS

I, Anita S. Jones, Clerk of Clark County, KY, do certify that the foregoing is a true and correct copy of Deed

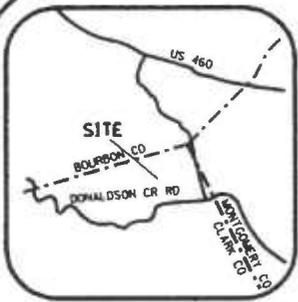
same appears of record in my said office in D Book 434 Page 428-431

Given under my hand this, the day of April 17 2014

ANITA S. JONES, COUNTY CLERK

CLARK COUNTY, KENTUCKY

BY Donna B. B. D.C.



VICINITY MAP

BASIS OF BEARINGS
KENTUCKY SOUTH ZONE
STATE PLANE COORDINATE
SYSTEM NAD 83

ROBY BALLARD III
DAWN BALLARD
DB 375, PG 667

EAST KENTUCKY POWER
COOPERATIVE, INC.
DB....., PG.....

EAST KENTUCKY POWER
COOPERATIVE, INC.
DB 430, PG 580
TRACT 3
SLIDE 1266

EAST KENTUCKY POWER
COOPERATIVE, INC.
DB....., PG.....

JOSEPH E. STEARNS
THERESE STEARNS
DB....., PG.....

JOSEPH E. STEARNS
THERESE STEARNS
DB 392, PG 66
SLIDE 1407

JOSEPH E. STEARNS
THERESE STEARNS
DB....., PG.....

JANET BELCHER
DB 384, PG 261
SLIDE 1407

ROGER MCINTOSH
REGINA MCINTOSH
DB 377, PG 402

--- LEGEND ---

- 1/2" REBAR IRON PIN W/CAP STAMPED 'FBA 3022'
SET THIS SURVEY
- REBAR IRON PIN, FOUND AS NOTED.
- ◁ EXIST. PK NAIL FOUND

LAND SURVEYOR'S CERTIFICATION

I hereby certify that the survey depicted by this plat was performed under my direction by the method of random traverse with slideshots. The unadjusted precision ratio of the traverse was 1:108,792 and was not adjusted. The survey as shown hereon is a class A survey and the accuracy and precision of said survey meets all the specifications of this class.

Blake Adams
BLAKE ADAMS, LS # 3088
6-20-06
DATE



GRAPHIC SCALE: 1" = 200'

PLAT OF SURVEY FOR:
EAST KENTUCKY POWER COOPERATIVE

4775 LEXINGTON ROAD, PO BOX 707
WINCHESTER, KENTUCKY 40392

SHOWING A SURVEY OF:
JOSEPH & THERESE STEARNS DIVISION

DONALDSON ROAD, CLARK COUNTY, KENTUCKY
DEED BOOK 422, PAGE 307

DATE:
JUNE 6, 2006

SCALE:
1" = 200'

FILE:
STEARNS.DGN



BLAKE ADAMS
ENGINEERING, INC.
438 WASHINGTON STREET
STANTON, KENTUCKY 40380
(606)663-2722



END OF DOCUMENT

DEED

This **DEED**, made and entered into this 16 day of June, 2006, by and between **EAST KENTUCKY POWER COOPERATIVE, INC.**, P. O. Box 707, Winchester, Clark County, Kentucky 40392-0707, Party of the First Part and **JOSEPH ED STEARNS AND THERESE M. STEARNS**, husband and wife, 1686 Donaldson Road, Winchester, Clark County, Kentucky 40391, Party of the Second Part,

WITNESSETH:

That for and in consideration of the sum of the exchange of property as set forth in a separate deed of even date herewith, and other good and valuable consideration, the receipt of all of which is hereby acknowledged, the party of the first part has bargained and sold and by these presents does bargain, sell and convey unto the party of the second part, its successors and assigns forever, in fee simple, the following described property located on the north side of the Donaldson Road in Clark County, Kentucky, and more particularly described as follows:

Tract #1

Beginning at a point in the southwest property corner and Donaldson Road, thence S 80° 49'33" W for 50.94 feet; thence N 16°50'21" W for 911.76 feet; thence N 74°24'36" E for 44.67 feet; thence N 16°28'15" W for 905.95 feet to the point of beginning containing 0.99 acres.

Being the same property conveyed to East Kentucky Power Cooperative, Inc., by deed dated 6/23/06 and of record in Deed Book 434, Page 432, in the Clark County Clerk's office, Clark County, Kentucky.

Tract #2

Beginning at an existing rebar iron pin (Baldwin 1366)(found) in the line of Janet Belcher (DB 384, PG 261), a corner to Joseph E. Stearns and Therese Stearns (DB 422, PG 307 & Slide 1507B); thence with the line of Belcher N37°01'51"W, 162.04 feet to an ½" rebar iron pin with cap stamped "FBA 3088" (set this survey); thence with a line dividing the lands of East Kentucky Power Cooperative, Inc. two (2) N76°52'59"E, 242.85 feet to an ½" rebar iron pin with cap stamped "FBA 3088" (set this survey); thence S 16°50'10"E, 150.64 feet to an ½" rebar iron pin with cap stamped "FBA 3088" (set this survey) in the line of Joseph E. Stearns and Therese Stearns (DB 422, PG 307 & Slide 1507B); thence with the line of Stearns S77°33'17"W, 186.95 feet to the point of beginning. Containing 0.74 acres.

Being the same property conveyed to East Kentucky Power Cooperative, Inc., by deed dated 6/23/06 and of record in Deed Book 434, Page 435, in the Clark County Clerk's office, Clark County, Kentucky.

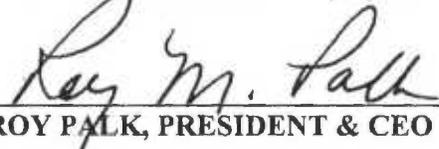
TO HAVE AND TO HOLD the above described real estate, together with all the appurtenances thereunto belonging, unto the party of the second part, its successors and assigns forever, in fee simple forever, with Covenant of General Warranty.

CONSIDERATION CERTIFICATE

The party of the second part joins in this deed for the purpose of certifying the consideration, as required by KRS 382.135. All parties hereto state under oath that the consideration reflected in this deed is the full consideration paid for the property and the fair market value of the property conveyed hereby is Twelve Thousand Nine Hundred Seventy Five Dollars and no cents (\$12,975.00).

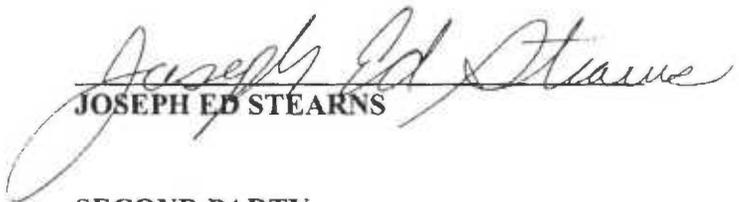
IN WITNESS WHEREOF, the parties hereto has placed their hand the day and year first above written.

**FIRST PARTY, EAST KENTUCKY
POWER COOPERATIVE, INC.**



ROY PALK, PRESIDENT & CEO

SECOND PARTY



JOSEPH ED STEARNS

SECOND PARTY



THERESA M. STEARNS

STATE OF KENTUCKY)
) SCT.
COUNTY OF CLARK)

This Deed and Consideration Statement was subscribed, sworn to and acknowledged before me this 6th day of June, 2006, by Roy Palk, in his capacity as President and CEO of East Kentucky Power Cooperative, Inc.

My Commission expires: March 23, 2007.


NOTARY PUBLIC, KY.
STATE-AT-LARGE.

STATE OF KENTUCKY)
) SCT.
COUNTY OF CLARK)

This Deed and Consideration Statement was subscribed, sworn to and acknowledged before me this 16 day of June, 2006, by Joseph Ed Stearns, Second Party.

My commission expires: 11-17-07.


NOTARY PUBLIC, KY.
STATE-AT-LARGE.

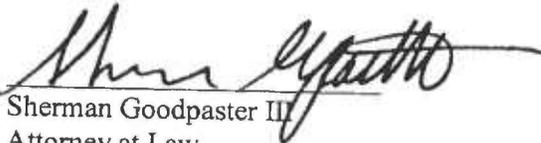
STATE OF KENTUCKY)
) SCT.
COUNTY OF CLARK)

This Deed and Consideration Statement was subscribed, sworn to and acknowledged before me this 16 day of June, 2006, by Therese M. Stearns, Second Party.

My commission expires: 11-17-07.


NOTARY PUBLIC, KY.
STATE-AT-LARGE.

Prepared by:



Sherman Goodpaster III
Attorney at Law
P.O. Box 707
Winchester, KY 40392-0707
(606) 744-4812

COUNTY CLERK'S CERTIFICATE

STATE OF KENTUCKY }
COUNTY OF CLARK } SS

I, Anita S. Jones, Clerk of Clark County, KY, do certify that the foregoing is a true and correct copy of Deed
AS SAME appears of record in my said office in D Book
434 Page 440-445 db

Given under my hand this, the day of April 17 2014

ANITA S. JONES, COUNTY CLERK
CLARK COUNTY, KENTUCKY

BY Donna R. Bal D.C.

DOCUMENT NO: 134683
RECORDED ON: JUNE 23, 2006 12:41:54PM
TOTAL FEES: \$18.00
TRANSFER TAX: \$13.00
COUNTY CLERK: ANITA JONES
COUNTY: CLARK COUNTY
DEPUTY CLERK: LADONNA
BOOK D434 PAGES 440 - 445



VICINITY MAP

BASIS OF BEARINGS
KENTUCKY SOUTH ZONE
STATE PLANE COORDINATE
SYSTEM NAD 83



EAST KENTUCKY POWER
COOPERATIVE, INC.
DB 430, PG 580
TRACT 3
SLIDE 1266

EAST KENTUCKY POWER
COOPERATIVE, INC.
5.27 ACRES REMAINING

ROGER MCINTOSH
REGINA MCINTOSH
DB 377, PG 402

ROBY BALLARD III
DAWN BALLARD
DB 375, PG 667

JOSEPH E. STEARNS
THERESE STEARNS
DB 422, PG 307
SLIDE 1507B

JOEY REFFETT
DB 384, PG 426
SLIDE 1407

JOSEPH E. STEARNS
THERESE STEARNS
DB 392, PG 66
SLIDE 1407

EXIST. ELECTRIC TRANS. LINE

MAG NAIL (SET THIS SURVEY)

IPF "BALDWIN 1366"

JANET BELCHER
DB 384, PG 261
SLIDE 1407



0.74 AC.



GRAPHIC SCALE: 1" = 200'

--- LEGEND ---

- 1/2" REBAR IRON PIN W/CAP STAMPED "FBA 3022" SET THIS SURVEY
- REBAR IRON PIN, FOUND AS NOTED.
- ◁ EXIST. PK NAIL FOUND

LAND SURVEYOR'S CERTIFICATION

I hereby certify that the survey depicted by this plat was performed under my direction by the method of random traverse with sideshots. The unadjusted precision ratio of the traverse was 1:108,792 and was not adjusted. The survey as shown hereon is a class A survey and the accuracy and precision of said survey meets all the specifications of this class.

Blake Adams
BLAKE ADAMS, LS # 3088

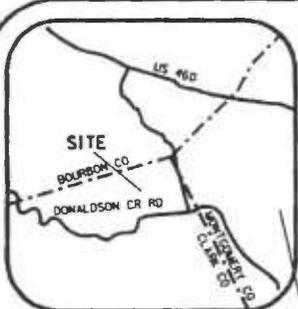
6-20-06
DATE

EXHIBIT A

PLAT OF SURVEY FOR:
EAST KENTUCKY POWER COOPERATIVE
4775 LEXINGTON ROAD, PO BOX 707
WINCHESTER, KENTUCKY 40392
SHOWING A SURVEY OF:
DIVISION OF PARCEL FROM JANET BELCHER
DONALDSON ROAD, CLARK COUNTY, KENTUCKY
DEED BOOK _____, PAGE _____

DATE: JUNE 6, 2006	SCALE: 1" = 200'	FILE: BLECHER-STERN.S.DGN
-----------------------	---------------------	------------------------------

STATE OF KENTUCKY F B ADAMS 3088 LICENSED PROFESSIONAL LAND SURVEYOR	BLAKE ADAMS ENGINEERING, INC. 438 WASHINGTON STREET STANTON, KENTUCKY 40380 (606)663-2722	
--	---	--



BASIS OF BEARINGS
KENTUCKY SOUTH ZONE
STATE PLANE COORDINATE
SYSTEM NAD 83



ROBY BALLARD III
DAWN BALLARD
DB 375, PG 667

EAST KENTUCKY POWER
COOPERATIVE, INC.
4.24 ACRES REMAINING

580° 49' 33" W
50.94'
30' R/W

S16° 50' 21" E 911.76'
0.99 AC.
N16° 28' 15" W 905.95'

JOSEPH E. STEARNS
THERESE STEARNS
DB 422, PG 307
SLIDE 1507B

IPF "JUSTICE 2360"

N74° 24' 36" E
44.67'

JOSEPH E. STEARNS
THERESE STEARNS
DB 392, PG 66
SLIDE 1407

EAST KENTUCKY POWER
COOPERATIVE, INC.

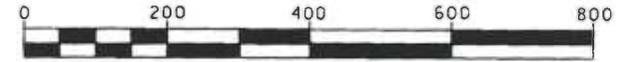
EXIST. ELECTRIC TRANS. LINE

MAG NAIL (SET THIS SURVEY)

JANET BELCHER
DB 384, PG 261
SLIDE 1407

--- LEGEND ---

- 1/2" REBAR IRON PIN W/CAP STAMPED "FBA 3022" SET THIS SURVEY
- REBAR IRON PIN, FOUND AS NOTED.
- ◁ EXIST. PK NAIL FOUND



GRAPHIC SCALE: 1" = 200'

PLAT OF SURVEY FOR:
EAST KENTUCKY POWER COOPERATIVE
4775 LEXINGTON ROAD, PO BOX 707
WINCHESTER, KENTUCKY 40392
SHOWING A SURVEY OF:
DIVISION OF PARCEL FROM JOEY REFFETT
DONALDSON ROAD, CLARK COUNTY, KENTUCKY
DEED BOOK _____, PAGE _____

DATE:
JUNE 6, 2006

SCALE:
1" = 200'

FILE:
REFFETT-STEARN.S.DGN



**BLAKE ADAMS
ENGINEERING, INC.**
438 WASHINGTON STREET
STANTON, KENTUCKY 40380
(606)663-2722



LAND SURVEYOR'S CERTIFICATION

I hereby certify that the survey depicted by this plat was performed under my direction by the method of random traverse with sideshots. The unadjusted precision ratio of the traverse was 1:108,792 and was not adjusted. The survey as shown hereon is a class A survey and the accuracy and precision of said survey meets all the specifications of this class.

Blake Adams
BLAKE ADAMS, LS # 3088

6-20-06
DATE

EXHIBIT A

END OF DOCUMENT

DEED

This **DEED**, made and entered into this 3rd day of October, 2006, by and between, **EAST KENTUCKY POWER COOPERATIVE, INC.**, P.O. Box 707, Winchester, Clark County, Kentucky 40392-07071744, Party of the First Part; and **EARL S. ANDERSON** and **SUE F. ANDERSON**, his wife, 1744 Donaldson Road, Winchester, Kentucky 40391, Party of the Second Part,

WITNESSETH:

That for and in consideration of the sum of Three Hundred Sixty Thousand Dollars (\$360,000.00), cash in hand, the receipt of all of which is hereby acknowledged, the party of the first part has bargained and sold and by these presents does bargain, sell and convey unto the party of the second part, its successors and assigns forever, in fee simple, as joint tenants with rights of survivorship, the following described property situated on the Donaldson Road in Clark County, Kentucky, and more particularly described as follows:

Being that certain tract or parcel of land on the north side of Donaldson Road, containing 15.32 acre, more or less, and being Parcel 1-A on the plat of East Kentucky Power Cooperative, of record on Slide 1661 in the Clark County Clerk's Office, to which reference is made for a more particular description thereof.

Being a portion of the same property conveyed to East Kentucky Power Cooperative, Inc. from Roby Ballard II and Dawn Ballard, husband and wife, by deed dated May 8, 2006 and of record in Deed Book 433, Page 42, in the Clark County Clerk's office, Clark County, Kentucky.

TO HAVE AND TO HOLD the above described real estate, together with all the appurtenances thereunto belonging, unto the party of the second part, its successors and assigns forever, in fee simple, as joint tenants with rights of survivorship, with Covenant of General Warranty.

RETURN TO MTCY

CONSIDERATION CERTIFICATE

The party of the second part joins in this deed for the purpose of certifying the consideration. All parties hereto state under oath that the consideration reflected in this deed is the full consideration paid for the property as required by KRS 382.135.

IN WITNESS WHEREOF, the parties hereto has placed their hand the day and year first above written.

**FIRST PARTY, EAST KENTUCKY
POWER COOPERATIVE, INC.**



ROY M. PALK, PRESIDENT & CEO

SECOND PARTY



EARL S. ANDERSON

SECOND PARTY

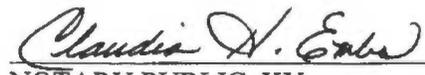


SUE F. ANDERSON

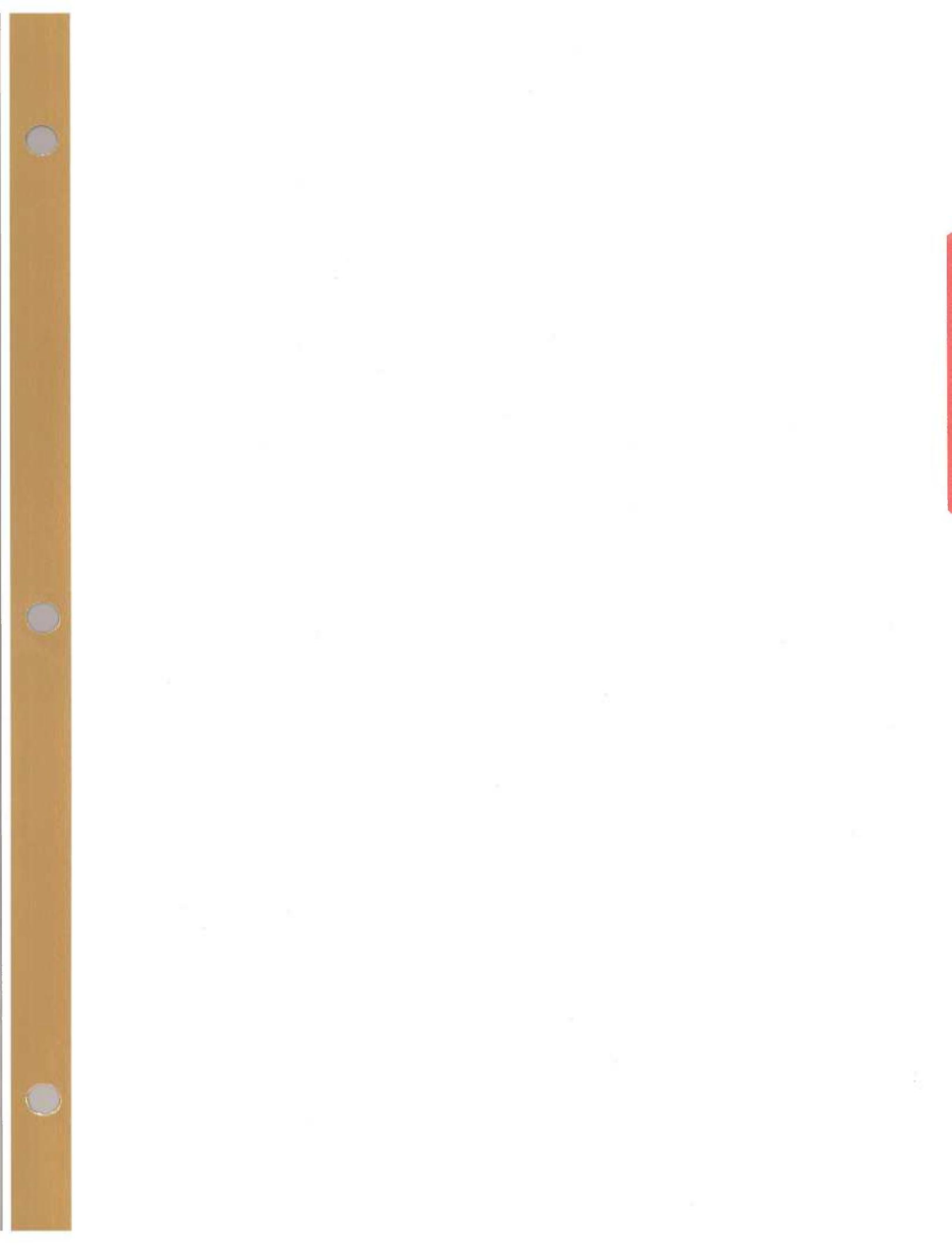
STATE OF KENTUCKY)
) SCT.
COUNTY OF CLARK)

This Deed and Consideration Statement was subscribed, sworn to and acknowledged before me this 3rd day of October, 2006, by Roy M. Palk, in his capacity as President and CEO of East Kentucky Power Cooperative, Inc., First Party.

My Commission expires: March 23, 2007



NOTARY PUBLIC, KY.
STATE-AT-LARGE.



Audio Clips From Meeting With Paul Dolloff Of EKPC Dated Dec. 2008 Concerning Electric/Magnetic Fields & Levels Experienced At The Barker Residence Including Ann, Harold And Brooks Barker.

1. Time-(23:05 to 23:32)

(Harold Barker)----- Getting Shocked, that's what it comes down to.

(Brooks Barker)----- But if they, if they would have you know routed it down that hill, and you know nobody-nobody said anything about a field like this generating this much going to be a product of you know it going by the house & then you know I'm sure they wouldn't- coming through their not going to divulge that, now after the fact that it is up.....

(Paul Dolloff)----- Yea, so that's why they call me—, go figure it out you know & help these people.

2. Time-(41:00 to 41:48)

(Paul Dolloff)----- I mean we are not going to deny that electric power lines- they have fields associated with them, they just do- I mean this, were not going to lie about that and the higher the voltage the greater the electric field is going to be.

(Harold Barker)----- And because the others were such low voltage, we did not get a shock...

(Paul Dolloff)----- Because it was much lower voltage, the electric field was that much less-exactly.

3. Time-(43:29 to 43:41)

(Ann Barker)----- No, what we want remedied is a healthful—healthful—we don't want to all be fried here, or all die of cancer one day.

(Paul Dolloff)----- Well I understand that.

4. Time-(44:20 to 45:42)

(Paul Dolloff)-----But If you want me to get you some satisfaction on getting an answer for this I can go try to make that happen.

(Ann Barker)----- Well I think we've got bigger problems here and then we'll get this straightened out.

(Paul Dolloff)----- OK

(Harold Barker)----- And if she has somebody come to the candy shop in this driveway with a pacemaker or.....

(Ann Barker)----- Yea I've got one woman I have to meet, she can't mmm she had a pacemaker put in and actually the instructions she has with the pacemaker,-

(Paul Dolloff)----- Ok.

(Ann Barker)----- Tells her two things, not to be near the high voltage lines- the second thing is not to be like standing over a car with the hood raised when it's running. Because of I think she said the alternator..

(Paul Dolloff)----- Now that's- that's exactly right. And that's – we've known that for a long time, I think I've shared that with you before cause that sometimes those umm pacemakers can be susceptible to to voltage- It will make them either skip or make it run erratically, and we always are mindful of that and you've seen it before when you go into the hospital, in the little cafeteria and the microwave has a sign- right

Audio Clips From Meeting With Paul Dolloff Of EKPC Dated Dec. 2008 Concerning Electric/Magnetic Fields & Levels Experienced At The Barker Residence Including Ann, Harold And Brooks Barker.

(Ann Barker)----- uhm

(Paul Dolloff) ----- if you have a pacemaker you might not want to be in this room, so we've, we've learned that a long time ago. So we're sensitive to that as a utility.

5. Time-(53:50 to 54:03)

(Paul Dolloff)-----But you know we're willing to help you as much as you want to, we're not going to hide anything, but that's all based on magnetic field, health related issues have always been based on magnetic field issues---apart from a pacemaker.

6. Time-(107:48 to 108:21)

(Harold Barker)-----Surely somebody else has..

(Ann Barker)-----It's hard to believe that the whole United States though..

(Harold Barker)-----yea in the whole United States??

(Paul Dolloff)-----Well the thing is again,, I think it actually has been looked at and they deemed it not a problem if you stay 100 ft. away from 69kv and you stay 150 ft. away from 345...

(Brooks Barker)-----From the edge of the easement??

(Paul Dolloff)-----Exactly.

(Paul Dolloff)-----But if you build right on the edge we'll

(Brooks Barker)-----You would have to be at the other end of the house or just a little bit further...

(Paul Dolloff)-----Well you know if you build a metal structure right on the edge like a barn, we'll go ground the roof or building or the siding—it's not a problem.

7. Time-(111:04 to 112:35)

(Brooks Barker)-----When you touch the metal out there- you're the ground rod basically to discharge that from the truck and you're - it's going through you the current and the voltage you know - it's small -it's small current, but it's you're still grounding it all to ground- through you.

(Paul Dolloff)-----Ok, so now on what your issue is—is that we have an electric field and anything in that electric field that's metal or conductive-- that electric field is gonna put a charge on it, and it's gonna want to raise the voltage of that piece of metal to a voltage ---and it will be not 0, and the earth is 0, so if you grab the earth and you grab that metal object you're going to have a difference in voltage- and when that happens you're going to get a shock because you're at 0 and the truck if you will is not at 0 and you touch it you're going to get a shock. It's just like when you rub your feet on a carpet- now you get a charge right? But you're door handle is at 0. When you grab the door handle and it discharges that electricity off of you back to 0 and it goes into the door handle. But as soon as that charge is gone-guess what -you're not going to get shocked the second time right—cause you're at 0.

(Brooks Barker)-----But it just stays on that though....

Audio Clips From Meeting With Paul Dolloff Of EKPC Dated Dec. 2008 Concerning Electric/Magnetic Fields & Levels Experienced At The Barker Residence Including Ann, Harold And Brooks Barker.

(Paul Dolloff)-----But it does stay on that- you're exactly right, you would have to re-rub your feet on a carper to build another charge--- if you're in the presence of a very strong electric field it will automatically charge back up.

(Brooks Barker)-----yea.

(Paul Dolloff)----- That's exactly right.

5450 Mt. Sterling Road
Winchester, Ky. 40391

July 6, 2010

Mr. Anthony Campbell
President and CEO of
East Kentucky Power Cooperative
4758 Lexington Rd.
Winchester, Ky. 40391

Reference: Requesting a meeting for a settlement of condemned property located at 5450 and 5624
Mt. Sterling Rd.

Dear Sir:

We realize you have been President and CEO of EKPC for approximately one year and that you have inherited a volume of problems. We know somewhere in that volume lies the above referenced property. We have resorted to requesting a meeting with you because this has been dragging on since November 10, 2005 when we had our first meeting with EKPC.

We have tolerated dilatoriness of responsibility, unnecessary delays and aggravation from EKPC, which easily could have been avoided. If more consideration had been given to high impact sites in the initial planning stages of the expansion, then we would not be experiencing the problems we have now. We question why the "zigzag" of the lines on the Shimfessel farm, which is northeast of our property, were not straightened. This would allow the easement to go east of our residence over an open field.

EKPC did not at anytime inform us that the electric and magnetic field would be so great that you would receive a shock if you touched the bare metal on a vehicle parked in our driveway. EKPC did not ever inform us that we would have a reading as high as 28 on the gauss meter in our living quarters. No one has been able to tell us what these readings will be or how great the shock when the electric lines are fully energized.

EKPC did not ever inform us that we would have to pick up 3 inch long metal staples discarded in the fields or recover 1 inch by 5 foot steel anchors, which are washing up in the field where they were buried. EKPC did not every inform us that we have to mow around tree stumps that range from 4 inches to two feet above the ground in the fields or to rebuild back a rock road bed on the farm in order to haul livestock and machinery in and out.

EKPC did not ever inform us that the concrete driveway to our house and Candy Shop would be used by heavy trucks to set temporary poles across the front yard, to remove trees from the front yard

and bore out the roots. Now 2 years later the broken concrete is a major hole which candy customers and family travel over every day.

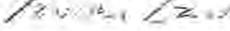
We still have to rock the farm road, replace a boundary fence, level out ditches, replace trees in our yard, repair the concrete driveway to our home and try to secure an answer from EKPC as to what the electric magnetic readings will be when the lines are to full voltage capacity. All of these are obvious problems, but it is the unknown that is the greatest concern. That is – the health concern of being exposed 15-20 hours each day to the electric magnetic field in our home. This is very different from a few minutes in front of a microwave. There again, EKPC never informed us.

Yes, EKPC has made offers and unusual proposals. The first was an offer by Mike Wells on May 8th, 2006. Then the proposal that we would have to pay for 2-140 ft. metal utility poles at a cost of \$10,000 each. This was later retracted by EKPC. Then the written offer which was delivered by your right of way agent and retracted because both figures were wrong in the letter. The last was Mr. Sherman Goodpaster suggested that maybe he could get some paid on our mortgage.

Our attorney submitted on December 21st, 2009 to your attorney, Mr. Goodpaster, what is a fair request for damages. We hired a certified real property appraiser, Steve Adams, who established a "before and after" fair market value of both condemned properties. He did not appraise damages to the land. Approximately 40% of land damages were out of easement. When your appraiser, R.J. Robinson, came to appraise the property, he did not enter either house nor check out completely the damages to the land.

We have been patient, honest and straight forward with EKPC, but it is apparent that this is not resolving anything. We had requested to appear before your board of directors or to speak with its chairman, Wayne Stratton, but Mr. Roger Cowden informed us that this was not allowed. This is the reason we are requesting assistance from you as President and CEO of EKPC. We can meet at anytime that is convenient with you and can be contacted at 859-983-0725.

Sincerely yours,

Harold Barker
Ann Barker
Brooks Barker

cc: Alex Rowady, Attorney at Law

Susan L. Dunn (PSC) - Ref: Complaint file #2008-02335

Magnetic Readings Inside Home

Page 1

W. P. No.	
ACCOUNTANT	
DATE	

Year	Date	Time	Kitchen Sink	12 feet from Sink @ Desk	30 feet from Sink in Pen & sofa
2011	5/1/2011	12:00 NOON	8.3	6.4	5.0
2011	5/2/2011	7:00 P.M.	9.0	8.0	6.0
2011	5/23/2011	5:15 P.M. 256 AC VOLTS .135 MA			
2011	6/3/2011	9:52 P.M.	14.9	9.1	7.4
2011	6/5/2011	11:00 P.M.	12.8	9.1	7.4
2011	6/6/2011	3:45 P.M.	12.9	9.5	7.3
2011	6/15/2011	5:20 A.M.	10.0	7.8	6.0
2011	6/16/2011	1:00 P.M.	20.9	15.8	12.4
2011	6/16/2011	9:45 P.M.			11.3
	6/16/2011	1:00 P.M. OFF TRUCK 288 AC VOLTS 7.5 DC VOLTS .143 MA			
2011	8/7/2011	12:00 NOON	14.3	10.9	8.6
2012	2/6/2012	3:50 P.M.	10.5	8.3	6.4
		11:30 P.M.	15.2	11.6	9.3
2012	2/7/2012	5:30 A.M.	13.2	10.1	8.1
		7:00 A.M.	10.6	8.0	6.3
2012	2/8/2012	5:00 A.M.	12.2	9.5	7.6
2012	2/9/2012	6:30 A.M.	10.2	7.7	6.2

Magnetic Readings
 Article Home

Page 2

W. P. No.	
ACCOUNTANT	
DATE	

Year	Date	Time	Kitchen Sink	12 feet from sink @ deck	30 feet from sink in Den @ sofa
2012	2/11/2012	7:00 P.M.	12.1	10.8	8.6
2012	2/12/2012	4:00 A.M.	20.7	16.2	13.0
		10:30 A.M.	18.2	14.4	11.5
		12:00 P.M.	20.6	14.9	12.2
2012	2/13/2012	4:45 A.M.	21.9	17.0	12.8
		10:30 A.M.	14.9	13.4	10.9
2012	2/14/2012	5:50 A.M.	13.0	9.6	7.8
		12:00 NOON	12.5	9.4	7.4
2012	2/22/2012	6:00 A.M.	10.4	7.5	5.9
2012	3/3/2012	9:30 A.M.	14.1	11.2	8.7
		5:00 P.M.	11.1	8.6	6.6
2012	3/5/2012	9:00 A.M.	17.1		
		3:00 P.M.	13.4	10.5	8.0
2012	3/6/2012	4:45 A.M.	18.9	13.8	10.9
		6:45 P.M.	14.7	11.3	8.9
2012	3/7/2012	6:30 A.M.	16.9	11.7	9.3
		10:00 P.M.	10.0	7.2	5.8
2012	3/26/2012	4:45 A.M.	5.9	4.4	3.4
12	3/28/2012	5:30 A.M.	7.9	5.6	4.4
2012	4/11/2012	6:30 A.M.	2.3	1.6	1.1
2012	4/17/2012	11:15 A.M.	4.3	3.2	2.5

Magnetic Readings
Ancient Home

W. P. No.

ACCOUNTANT

DATE

Page 3

Year	Date	Times	Kitchen Sink	13 feet from Sink & Desk	30 feet from Sink & Desk	
2012	4/21/2012	7:00 A.M. 8:00 P.M.	10.9 8.0	7.9 5.8	5.7 4.6	
2012	4/24/2012	5:30 A.M. 1:45 P.M.	11.9 6.3	8.8 4.5	6.8 3.5	
2012	4/25/2012	5:00 A.M. 6:15 P.M.	7.8 8.0	5.9 6.9	4.8 5.2	
2012	4/26/2012	5:30 A.M. 5:45 P.M.	6.9 8.3	4.9 6.1	4.0 4.9	
2012	4/27/2012	11:15 A.M.	5.5	3.8	2.8	
2012	4/28/2012	10:00 A.M. 7:45 P.M.	2.9 4.2	1.9 2.9	1.1 2.2	
2012	4/30/2012	5:00 A.M.	4.0	3.0	2.3	
2012	5/1/2012	4:30 P.M.	5.9	4.0	3.0	
2012	5/2/2012	5:00 A.M.	4.4	3.1	2.6	
2012	5/3/2012	6:00 A.M.	8.3	6.2	4.8	
2012	5/4/2012	12:15 P.M.	4.8	3.5	2.7	
2012	5/6/2012	2:00 P.M. 4:30 P.M.	9.5 10.9	6.9 7.6	5.4 5.8	
2012	5/7/2012	LINES WENT DOWN TO 0.2 @ 5:00 A.M. & 0.1 @ 9:00 A.M.				
2012	5/8/2012	5:00 A.M.	2.8	1.8	1.3	
2012	5/9/2012	4:45 P.M.	1.1	1.1	1.1	

MAGNETIC READINGS
INSIDE HOME

W. P. No.

ACCOUNTANT

DATE

Page 4

YEAR	DATE	TIME	KITCHEN SINK	12 FEET FROM SINK @ DESK	30 FEET FROM SINK IN DEN
2012	5/10/2012	10:30 A.M.	7.3	5.3	4.0
		2:30 P.M.	7.0	5.1	3.9
		5:15 P.M.	8.4	6.1	4.7
	5/11/2012	10:00 A.M.	7.4	5.5	4.2
	5/12/2012	9:00 A.M.	8.3	4.3	3.4
	5/14/2012	6:00 A.M.	5.8	3.9	3.0
	6/30/2012	12:30 P.M.	15.5	12.5	9.7
		4:45 P.M.	16.7	12.9	10.2
	7/1/2012	1:40 P.M.	13.8	11.6	9.3
	7/31/2012	11:01 A.M.	4.4	3.3	2.5
	8/1/2012	10:30 A.M.	7.9	5.4	4.3
	8/5/2012	11:00 A.M.	8.0	6.0	4.9
	8/13/2012	1:30 P.M.	8.4	6.4	5.3
	9/22/2012	5:20 P.M.	12.9	9.2	7.3
	2013	2/19/2013	4:45 A.M.	11.9	8.4
2/20/2013		4:45 A.M.	13.9	10.0	7.9
2/20/2013		3:00 P.M.	7.9	5.7	4.5
2/21/2013		4:45 A.M.	12.9	9.3	7.4
2/21/2013		4:30 P.M.	5.4	3.8	2.9
2/22/2013		4:45 A.M.	10.3	7.4	5.8
2/22/2013		6:15 P.M.	4.1	2.9	2.3

Magnetic Readings
Arnold Home

W. P. No.

ACCOUNTANT

DATE

Page 5

YEAR	DATE	TIME	KITCHEN SINK	12 FT. FROM SINK @ DESK	30 FT. FROM SINK IN DEN @ SOFA
2013	2/23/2013	3:00 P.M.	6.9	4.6	3.9
	2/25/2013	4:15 A.M.	15.2	11.0	8.8
	2/26/2013	4:45 A.M.	13.6	9.7	7.5
	2/27/2013	4:45 A.M.	16.9	12.1	9.1
	2/28/2013	4:45 A.M.	14.9	10.9	8.2
	3/1/2013	10:30 A.M.	10.3	7.5	5.8
	4/24/2013	4:55 A.M.	4.9	3.0	2.3
	4/25/2013	4:45 A.M.	5.3	3.5	2.7
	4/28/2013	11:15 A.M.	5.4	3.3	2.5
	4/29/2013	4:54 A.M.	2.9	1.9	1.0
	4/30/2013	4:45 A.M.	1.9	1.0	.7
	5/6/2013	4:55 A.M.	3.8	2.4	1.8
	5/7/2013	4:48 A.M.	2.4	1.4	1.1
	5/8/2013	4:45 A.M.	2.4	1.3	.9
	5/8/2013	11:45 A.M.	1.4	.9	.6
	5/9/2013	4:45 A.M.	4.0	2.6	2.0
	5/9/2013	4:50 A.M.	4.5	2.8	2.4
	5/13/2013	4:52 A.M.	6.9	5.1	4.0
	5/13/2013	4:40 P.M.	4.3	3.1	2.5
	5/14/2013	4:50 A.M.	6.0	4.3	3.1
	5/14/2013	4:40 P.M.	6.9	4.9	4.0
	5/15/2013	4:50 A.M.	4.4	2.9	2.1
	5/15/2013	5:15 P.M.	4.7	3.4	2.7
	5/16/2013	4:50 A.M.	5.9	3.9	3.1
	5/27/2013	2:08 P.M.	15.9	9.2	7.4
	6/8/2013	5:49 P.M.	20.0	13.7	10.7
	6/11/2013	5:40 P.M.	14.9	10.9	8.1
	7/1/2013	4:25 P.M.	17.0	12.2	9.4
	7/2/2013	11:30 A.M.	13.0	9.1	7.3
	7/7/2013	4:10 P.M.	12.9	8.8	7.0
	7/8/2013	1:45 P.M.	13.9	9.5	7.3
	7/9/2013	8:00 A.M.	6.9	4.1	3.3
	7/9/2013	12:00 P.M.	8.7	6.3	4.8

Magnetic Readings
Inside Home

Page 4

W. P. No.	
ACCOUNTANT	
DATE	

YEAR	DATE	TIME	KITCHEN SINK	12 FT. FRONT SINK @ DESK	30 FT. FRONT SINK IN DEN @ SOFA
2013	7/10/2013	12:00 NOON	8.0	5.8	4.5
	8/28/2013	6:05 P.M.	14.9	10.4	8.5
	9/10/2013	6:45 P.M.	1.1	0.6	.2
	10/13/2013	2:30 P.M.	12.7	9.2	7.1
	10/24/2013	4:45 A.M.	13.4	10.0	8.0
	11/9/2013	6:10 A.M.	20.0	14.8	11.7
	11/12/2013	7:15 A.M.	12.2	9.1	7.3
	11/13/2013	4:45 A.M.	17.9	13.3	10.5
	11/14/2013	6:30 A.M.	20.0	14.9	11.8
	11/23/2013	11:11 A.M.	15.9	11.9	9.1
	12/31/2013	6:00 A.M.	19.2	13.4	10.9
2014	1/4/2014	4:00 A.M.	24.4	20.4	
	1/5/2014	8:10 A.M.	12.9	8.9	6.8
	1/15/2014	4:45 A.M.	13.9	10.3	8.0
	1/15/2014	6:30 A.M.	16.4	12.9	9.7
	1/18/2014	9:19 A.M.	19.0	14.2	11.3
	1/19/2014	8:30 A.M.	16.9	11.3	8.4
	1/21/2014	4:40 A.M.	7.9	6.0	4.4
	1/21/2014	3:30 P.M.	16.9	9.5	7.4
	1/22/2014	4:40 A.M.	10.4	8.4	6.3
	1/22/2014	5:45 P.M.	4.8	3.7	3.1
	1/23/2014	4:40 A.M.	6.9	4.9	4.0
	1/24/2014	6:20 A.M.	9.1	8.1	6.1
	1/24/2014	7:30 P.M.	5.6	3.9	2.9
	1/25/2014	9:00 P.M.	16.3	12.1	9.5
	1/26/2014	7:45 A.M.	20.1	15.6	12.4
	1/27/2014	6:20 P.M.	15.3	12.1	9.5
	1/28/2014	4:10 A.M.	19.1	14.3	11.4
	1/29/2014	4:40 A.M.	16.9	13.2	10.8
	1/30/2014	1:20 P.M.	16.9	13.4	10.9
	1/31/2014	4:25 A.M.	18.9	13.9	11.0
	2/2/2014	8:37 A.M.	10.9	7.5	5.9
	2/2/2014	3:34 P.M.	10.4	7.4	5.8
	2/3/2014	6:00 A.M.	13.9	9.6	7.6
	2/3/2014	12:00 P.M.	8.2	6.0	4.9

Magnetic Readings
 Inside Home Page 7

W. P. No.

ACCOUNTANT

DATE

YEAR	DATE	TIME	KITCHEN SINK	12 FT. FROM SINK @ DESK	30 FT. FROM SINK IN DEN @ SOFA
2014	2/4/2014	12:10 A.M.	11.6	8.9	6.7
	2/4/2014	4:45 A.M.	15.9	10.0	7.8
	2/5/2014	6:00 A.M.	14.1	10.2	8.0
	2/5/2014	5:00 P.M.	7.9	5.7	4.9
	2/7/2014	4:45 A.M.	13.4	9.8	7.9
	2/8/2014	9:35 A.M.	7.1	0.9	0.4
	2/9/2014	12:45 P.M.	12.3	8.3	6.6
	2/14/2014	5:00 A.M.	19.7	13.7	10.9
	2/19/2014	4:30 A.M.	7.7	6.0	4.2
	2/20/2014	4:34 A.M.	11.0	6.9	5.4
	2/20/2014	4:07 P.M.	5.4	3.7	2.6
	2/21/2014	10:00 A.M.	8.4	5.9	4.7
	2/25/2014	4:37 A.M.	17.0	11.7	9.3
	2/26/2014	4:45 A.M.	17.4	13.0	10.3
	3/1/2014	9:35 A.M.	0.9	0.4	0.2
	3/11/2014	4:47 A.M.	10.1	7.9	6.7
	3/12/2014	4:12 A.M.	6.1	4.1	3.2
	3/13/2014	4:34 A.M.	5.1	3.5	2.6
	3/15/2014	7:37 A.M.	3.2	2.0	1.1
	4/19/2014	4:39 P.M.	8.3	5.5	4.3



Prepared by:

A handwritten signature in blue ink, appearing to read 'M. Alex Rowady', written over a horizontal line.

M. ALEX ROWADY, ESQ.

Blair & Rowady, P.S.C.

212 South Maple Street

Winchester, Kentucky 40391

859-744-3251

ATTORNEYS FOR COMPLAINANTS



Pfeiffer Engineering Co., Inc.

...the art of engineering

JOHN C. PFEIFFER

- EDUCATION:** B.S. Degree in Electrical Engineering, 1967 Christian Brothers University, Memphis, Tennessee
- TRAINING:** Project Methodology - Safety - Quality
Lessons in Professional Liability, Contract Review Workshop
System Safety-Fault Tree Analysis
Process Plant Startup
National Electrical Code (Several)
CEO Strategic Planning Program
Plus many others
- LICENSES:** Registered Professional Engineer, Electrical, Kentucky, Indiana, Tennessee and Ohio
- PATENTS:** Title - "Device for Testing Semiconductors and other Electrical Components" No. 3,825,828

Title – "A Golf Simulator", Patent Pending - Co-authored
- PUBLICATIONS:** "Arc Flash" – 2008, District Cooling Best Practice Guide, International District Energy Association

"Arc Flash Calculations – An Important Tool in Fire & Electrical Accidents" July 2005, Fire & Arson magazine

"Understanding Project Execution Methods" Sept. & Oct. 2004, Intech magazine

"What is Arc flash?" 2004, The Kentucky Manufacturer & Contractor, The Ohio Manufacturer & Contractor & Mike Holt Newsletter & Website

"Principles of Electrical Grounding" March, 1999, Conference Proceedings, 1999 Cincinnati Automation Expo

"How To Manage Automation Projects", Sept., 1995, A-B Journal

"Process Control through Computer/Programmable Controller Integration", 1981, U.S. ManTech Journal

"Process Safety & Reliability through Process Control Computer/Programmable Controller Interconnection," 1976, Conference Proceedings, Instrument Society of America, presented at ISA-76 International Conference & Exhibit, Houston, Texas

SEMINARS Presented: Changes to the 2002 Edition of the National Electrical Code
Principles of Electrical Grounding– ISA Automation Expo 2000
Arc Flash/Arc Blast
Project Management – ISA Automation Expo 2000
Forensic Engineering

TRAINING CLASSES: Technical classes developed and presented:
Arc Flash/Arc Blast& Electric Shock – Management class
Arc Flash/Arc Blast& Electric Shock – Maintenance class
Arc Flash/Arc Blast& Electric Shock – Contractor class
Electrical Grounding

ORGANIZATIONS: Institute of Electrical & Electronic Engineers - Life Member
Instrument Society of America - Senior Member
National Society of Professional Engineers
National Fire Protection Association
International Association of Arson Investigators

EXPERIENCE: Over forty years of engineering experience covering the following areas; computer system development, programming, installation and startup; motor process equipment control system design; chemical plant design, construction, and startup; power system design, analysis, and testing; and electronic equipment design.

1/81 to Present PFEIFFER ENGINEERING CO., INC., Louisville, Kentucky.
Founded and began operation of company to provide professional service to industry

Title: President & Chairman of the Board
Duties: Chief Executive Officer and Financial Manager of company. Project Manager on major projects, develops company's technical standards and provide forensic engineering services

The Company: Pfeiffer Engineering has been involved in the design of facilities, processes and systems for industrial, municipal, and institutional customers in this region of the country

Automation: Engineering, software development and system

integration of machines, process and overall plant automation systems for manufacturing equipment, material handling, batch and continuous process control, facility utility systems, and power monitoring

Communications: Develop plant wide communications systems for production monitoring and control

Electrical: Perform basic electrical system designs, lighting, emergency systems, as well as, complex industrial control systems, motor control, large motor control, dc and variable frequency motor speed control

Power Distribution: Perform load studies, energy management studies, harmonic distortion analysis, design of electrical distribution system from 120v to 13,800v systems, perform short circuit studies, develop protection device coordination, power factor correction, grounding and lightning protection systems

Facility: Assist in facility planning, boiler control, waste treatment facility design and control, fire detection and suppression systems, energy management and evaluation of hazardous areas

Instrumentation: Complete instrumentation design services for commercial, institutional, and industrial monitoring and control.

Process: Process layout, P&ID development, capital project estimating

Energy Management: Load studies, load shedding, power factor correction, evaluation of applying variable frequency drives, power monitoring.

10/73 to 1/81

ICI AMERICAS, INC., Charlestown, Indiana (Subsidiary of Imperial Chemical Industries, Ltd., London, England).

Title: Senior Process and Development Engineer

Duties: Overall project responsibility for all electrical systems for a new \$30 million explosive production facility, construction completed February, 1979. Primary responsibility was the development and coordination of the process control system and instrumentation for the totally automated and remotely controlled production facility. Responsibilities included the selection and implementation of the process control system, development of process sequences, control strategy, and the development of specifications and scopes of work for the electrical, instrumentation, and utility portions of the plant construction contract. Developed the plant startup project including

schedules, budget, personnel requirements, and organized the startup team. Managed the project during the commissioning phase while continuing to manage the process control system. Commissioning phase completed July 1, 1979, on schedule. Concentrated on the process control system once the plant startup progressed to the point where inert materials were entered to begin the initial production runs and portions of the plant were ready for full computer control.

Entered the project during the initial design phase, continued through the construction and commissioning phases and on into the initial startup phase. The control system consisted of a Foxboro 2/30 process controller, Foxboro Interspec/Spec 200 analog control system and Modicon programmable controllers.

7/72 to 10/73

RAY PFEIFFER ASSOCIATES, INC., Louisville, Kentucky.

Title: Engineer

Duties: The design and development of low cost electronic test equipment. Coordinated the equipment assembly with component vendors and assembly companies. Also the development, coordination and sale of special purpose industrial products.

6/71 to 6/72

C & I GIRDLER, INC., Louisville, Kentucky (Subsidiary of the Bechtel Corporation).

Title: Engineer

Duties: The design of electrical control systems for industrial process plants. Designs included relay and solid-state controls, use of programmable controllers, and interface systems to digital control systems. Duties included performing initial studies of production facilities, field investigation, layout of motor control centers, power distribution systems and assisted in cost estimating.

8/67 to 4/71

SPERRY RAND CORPORATION, Sperry Systems Management Division, Great Neck, N.Y.

Title: Field Engineer II

Duties: The installation, checkout, maintenance and programming of Polaris/Poseidon submarine navigation systems which included digital computers, computer interface equipment, special purpose digital equipment and other associated navigation equipment. Lead engineer on installation projects. Supervised engineers, technicians and electricians.



Pfeiffer Engineering Co., Inc.

...the art of engineering

Accident Investigation/Forensic Engineering

Pfeiffer Engineering Co., Inc. has a long history in accident investigation and forensic engineering service going back to before the company was founded. John C. Pfeiffer, P.E., principal engineer, has practiced in the field of forensic engineering since the early 70's with over 191 investigations completed or still in process.

Investigations cover a wide variety of causes from product failure, material properties, and software inadequacies to human errors. Besides assisting in investigations we can help in determining corrective action to prevent the reoccurrence of similar accidents and rebuilding systems after the fact.

Registered Professional Engineer:

Kentucky
Indiana
Ohio
Tennessee

Qualified as an Expert Witness:

- Kentucky OSHA
- Indiana – Clark Superior Court
- Federal Court - Eastern District of KY
- Kentucky – Jefferson Circuit Court

Field of Expertise:

- Arc Flash Hazards
- Electrical Power
- Electrocutions
- Electric shock
- Industrial Control Systems
- Equipment & Machinery Control
- Control Software
- Process Instrumentation and Control
- Electrical system involved in fires
- Arson Investigations – elimination of electrical causes
- Static Electricity
- Explosions – Electrical/Static electric causes
- Fraud involving electrical systems

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2701 Lindsay Avenue • Louisville, KY 40206-2222 • phone: 502.897.1630 • fax: 502.895.3894

Investigation Experience:

- Fires 130
- Electric shock 9
- Electrocution 11
- Equipment Damage 16
- Injuries 10
- Theft 2
- Explosions 2
- Lightning 2
- Property Infringement 1
- Static Electric 1

Plaintiff vs. Defendant Cases:

- For the Plaintiff 56%
- For the Defendant 44%

Examples:

- Electrical disconnect failure – arc flash
- Child Electrocution – multiple cases
- Chemical Plant Explosion
- CNC machine failure resulting in death of operator
- Software defect resulting in burns
- Maintenance supervisor fraudulent activities in subcontracting work
- Fire investigation – assisting in arson investigation

Experience Related to ECPC:

- 47 Years experience as an electrical engineer
- Performed design or design/construction for:
 - Louisville Gas & Electric
 - Kentucky Utilities
 - Duke Energy
- Investigated accidents involving
 - Louisville Gas & Electric
 - Kentucky Utilities
 - Duke Energy
 - NSTAR
 - National Grid
 - Union Electric
- Additional Experience
 - Aerial cable design including Sag calculations
 - Distribution line design and analysis
 - Power system analysis for major facilities



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INVESTIGATION REPORT

FOR

Mr. & Mrs. Barker
5450 Mount Sterling Road
Winchester, Kentucky

PREPARED BY:

PFEIFFER ENGINEERING CO., INC.

BY: JOHN C. PFEIFFER, P.E.

PRESIDENT

PROJECT NO. 212001

DATE: April 24, 2014



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SECTION 1

I. INTRODUCTION:

At the request of Ann Barker, John C. Pfeiffer, P.E., investigated the installation of new overhead electrical transmission lines belonging to the East Kentucky Power Cooperative (EKPC). The purpose of the investigation was to determine if hazards are now present on her property as a result of the new transmission line.

II. QUALIFICATIONS:

John C. Pfeiffer, P.E. is a registered electrical engineer in the states of Kentucky, Ohio, Tennessee and Indiana and is employed by Pfeiffer Engineering Co., Inc. as principal engineer/owner. He has worked in the practice of electrical engineering for more than forty years. Primary experience is in the design of electrical systems for industry.

III. COMPLIANCE:

All work is performed in compliance with the National Fire Protection Association No. 921 "Guide for Fire and Explosion Investigation".

IV. SUMMARY OF ISSUES:

This report is a review of the issues concerning the location of the new 345,000 Volt (345kV) Smith-Hunt-Sideview transmission line that EKPC installed across the farm belonging to Mr. & Mrs. Barker. The issues concern the safety or perceived safety of the transmission lines that were installed very close to their house. Due to the procedures followed by EKPC the Barkers' were denied the time to explore the health and safety issues associated with such a high voltage transmission line afforded by the Certificate of Public Convenience and Necessity process required by the Public Service Commission.

The EKPC report¹ states that there are only three (3) houses that are within 0 to 100 feet of the new transmission line. One of these houses is the Barker house/garage, which is within 48 feet of the nearest 345 kV conductor. This report will layout two options for relocation of the transmission line to a safer distance from the Barker house and the estimated total cost of this relocation (at the time of initial construction) is only \$2000.00 or 0.01% of the cost of the overall transmission line project. Thus, if EKPC had followed the design guidelines of the Rural Utility Service branch of the U.S. Department of Agriculture, the cost to EKPC would have been absolutely minimal particularly considering that there were only three houses so close to the transmission lines. If EKPC would have considered the Barkers' safety and the general public's safety this additional cost would have been well worth reducing the potential health risk that the Barkers' now face.

The cost to move the line now that they are installed will be many times the cost if the line was installed correctly from the beginning.

This report may appear to express a legal opinion which the author is not qualified to opine but rather the intent is to define many facts that which are primarily scientific in nature.

¹ EKPC Environmental Report for the Proposed Smith to Sideview electric Transmission Project, May 2006, page 40 (Gilpin Report)



Figure 2 - New Transmission Lines at the Barker House

V. Overall Concerns:

There are a number of key issues with respect to this transmission line, which will be addressed here and then detailed later on in this report.

- A. East Kentucky Power Cooperative Inc. (EKPC) was required by KRS 278 to obtain a Certificate of Public Convenience and Necessity (CPCN). EKPC misrepresented critical distances where new right-of-way for the transmission line is required in addition to the existing right-of-way being used for the majority of the project. This mis-statement of facts occurred on October 7, 2005 in EKPC's letter to the Public Service Commission requesting a waiver for the need to apply for a CPCN. As a result of this mis-statement of facts the Barkers' were denied the right to express their concerns for any health risk associated with such a high voltage transmission line in close proximity to their house. The house and garage is partly in the existing right-of-way.
- B. The Barkers' have concerns associated with health risks to themselves as well as visitors to their house, particularly for children, pregnant women and older people with implanted medical devices that visit their candy shop.
- C. EKPC recognized the Barkers' health concerns as well as the close proximity of their house to the right-of-way at EKPC's open house as documented by Mr. Thad A. Mumm, P.E. This request by the Barkers' was made well before the design of the transmission line was complete. Design was performed between 8/05 and 4/06, and the Open House

on 11/10/05. Mr. Mumm noted³ that the Barkers' concerns for EMF and requested that the transmission line be moved away from their house. Mr. Mumm is an electrical engineer and was employed by EKPC between January 2005 and October 2007 as an engineer responsible for the design, routing and construction of 69kV to 345kV transmission lines⁴.

- D. EKPC met with the Barkers' on 4/27/06 concerning the placement of H-frame utility poles near their front yard as was planned. On 5/8/06, EKPC met again with Barkers' to inform them that the pole could be moved about 40 feet back from its planned location. The pole was in fact moved about 500 feet back to where the pole is today.
- E. At this point in the design of the transmission line, while they were relocating the poles and line, they could have easily designed the changes in line location so that the right-of-way did not encroach on the Barkers' house and garage. Thad Mumm, one of EKPC's electrical engineers, recorded the Barkers' concerns about EMF and line location on November 10, 2005.
- F. EKPC mis-represented the health concerns associated with Electro Magnetic Fields (EMF) when Dr. Paul A. Dolloff, met with the Barkers' on 12/05/08. He stated that he knew of no regulations in the United States concerning power line EMF. Dr. Dolloff is a Senior Engineer, Research & Development Group of EKPC and a member of the Electric Power Research Institute (EPRI) which is one of the premier engineering organizations dealing with electrical energy transmission. The EPRI has performed and/or collected a large amount of technical reports concerning the health effects of power line EMF. See Section 9 which lists 370 of the many EMF health reports available on the EPRI website.
- G. The health and safety issues of EMF have existed for many years and after thousands of tests and research projects, there is no consensus as to the existence or severity of these effects. One of the biggest problems with the EMF health issue is the lack of consensus on how research is performed. Some of the following questions still have to be agreed to.
 - What is Proof? Is an unreasonably high and overly-restrictive definition of proof keeping organizations from accepting the issues?
 - What is sufficient proof? How much proof is needed?
 - Are we researching all EMF frequencies during a research project or do we limit the research to just power line frequencies?
 - Do we have to determine the exact mechanisms that cause a disease to take precautions? We still don't know how a lot of cancers work yet we believe that cancer is a serious issue.

³ EKPC Transmission Line Siting Data List, from 11/10/05

⁴ LinkedIn - <http://www.linkedin.com/pub/thad-a-mumm-p-e/3a/7b2/a26>

- Do we have to be able to reproduce in the laboratory using mice before we accept that there is a serious concern?
- Some of these issues have existed for many years. As research continues with 1800 such projects over the last few years some of the last issues have started to be proven, such as a potential mechanism as to how EMF cause disease has been found and as well as some EMF effects have been replicated in laboratory mice.
- As of today, no one has proven that EMF does not affect health.

H. Perceived Health Risk:

Transmission lines that are of a voltage level of 138kV and 345kV are perceived by many in the general public and also by many learned professionals, to pose a significant health risk. These health risks are associated with the electromagnetic fields (EMF) that are produced by these transmission lines.

These perceived health risk are also affecting the candy business that Mrs. Ann Barker runs out of her garage, as people are afraid to come to her business because of the close proximity to these lines.

SECTION 2 – OPINION

The purpose of this investigation was to determine if there is a potential of danger to people being in the vicinity of the Barkers' house due to the close proximity of the new electric transmission lines as well as the Barkers themselves.

The analysis and conclusions are based upon the information reviewed to date plus general engineering knowledge and experience. Information reviewed at a later date may warrant modifying or clarifying the conclusions.

It is my opinion, based on a reasonable degree of engineering certainty, that the electric utility should have known of these potential health risks and could have easily reduced these hazards.

- A. That EKPC set the new right of way too close to the Barkers' house, garage/office and driveway.

Evidence:

EKPC photograph presented at a public meeting on November 10, 2005, which shows the existing right of way crossing the garage and driveway.

At EKPC's Open House on November 5, 2005, Mr. Mumm is an electrical engineer and was employed by EKPC between January 2005 and October 2007 as an engineer responsible for the design, routing and construction of 69kV to 345kV transmission lines⁵, noted the close proximity of the Barker house to the power lines and the potential for EMF problems⁶.

- B. That EKPC did review the Barkers' close proximity to the transmission lines at a time when corrective action could have been taken at minimal cost.

Evidence:

This section of the transmission line was redesigned as it encroached upon the Barkers' house. The H-frame pole system was relocated approximately 500 feet to the north.

- C. The cost of relocating the power lines before construction started would have been in the range of \$2,000.00 to \$4,000.00.

Evidence:

A calculation of the additional cost is provided below.

- D. That there is a real danger for people with implanted medical heart devices when they are in the close proximity of the Barker house, such as on the driveway. The danger comes from the electric fields at the house, which can rise to a level that will interfere with implanted medical devices.

Evidence:

5 LinkedIn - <http://www.linkedin.com/pub/thad-a-mumm-p-e/3a/7b2/a26>

6 EKPC Transmission Line Siting Data List, from 11/10/05

EKPC had concerns about electric fields that could product micro-shocks at the time of construction of the power line. They sent workers to the farm to install grounding connections to the fences around the house.

Even after fence grounding was installed, the potential of micro-shocks still exists and vehicles become charged as they sit in the driveway. The truck belonging to Brooks Barker had measured charges that were recorded at 265.7 volts. Other measurements have read as high as 330.0 volts.

Electric Power Research Institute (EPRI) is in the process of developing a small hand held electric field meter, which is intended to be used by electrical lineman and electricians to use to check for dangerous electric fields.

Medical Institute Opinions:

Yale Medical Group, Yale School of Medicine “Living With a Pacemaker or Implantable Cardioverter Defibrillator (ICD).

“Avoid certain high-voltage or radar machinery, such as radio or television transmitters, arc welders, high-tension wires, radar installations, or smelting furnaces.”

Rochester Medical Center, Permanent Pacemakers, “Avoid being near areas with high voltage, magnetic force fields, or radiation because these can cause pacemaker malfunction. These areas may include high-tension wires, power plants, large industrial magnets and arc welding machines. Symptoms of pacemaker malfunction are dizziness, lightheadness or changes in heart rhythm. If symptoms occur, back up 10 feet and check your pulse.”

Mercy Health Organizations, “You should avoid all strong magnetic fields, such as welding, large transformers, or large motors.”

Electric Power Research Institute (EPRI), They are in the process of developing a device which will be a simple method to test for potential problems.

E. That there is a potential health risks due to the magnetic and electric fields.

There are an overwhelming number of research projects and papers that have been written on the effects of electric and magnetic fields caused by low frequency power sources on the health of people, animals, etc. Organizations, such as Electric Power Research Institute (EPRI) has documented 398 or more such reports over 30 years. From 2007 to 2012 an additional 1800 research projects were performed. The following is a list of just a few of the world wide organizations who are studying the effects of EMF:

- World Health Organization (WHO)
- Electric Power Research Institute (EPRI)
- Institute of Electrical and electronic Engineers (IEEE)
- Department of energy (DOE)\
- National Institute of environmental Health (NIEHS)
- International Agency for Research on Cancer (IARC)
- Biolnitiative Working Group
- European Health Risk Assessment Network (EFHRAN)

Evidence:

The World Health Organization has reviewed over 1800 new studies between 2007 and 2012 on EMF health effects.

EPRI has performed research on EMF effects for over 30 years.

“The World Health Organization (WHO) has weighed the full body of evidence from all these studies and classified EMF as **“possible carcinogenic,”** primarily because of observations made in human populations that show an association between magnetic field exposures and childhood leukemia.” (EPRI publication: EMF and Your Health, January 2012).

EPRI EMF Research News: American Journal of Epidemiology on November 5, 2008, reported an increased risk in mortality from Alzheimer’s disease and senile dementia among people who live less than 50 meters (164 feet) from power lines, compared with those who lived at least 600 meters (1968 feet) from power lines.

Xiaoming Shen and his colleagues of Jiao Tong University School of Medicine in Shanghai announced the results of research that may finally explain just how EMF radiation causes childhood leukemia. They finally determined that the distribution of leukemia among children living near high voltage power lines or transformers is not random; rather, it affects children carrying a certain genetic variant that is, the ability to repair DNA breaks vastly more often.^{7,8,9}

Acute exposure to a 60 Hz increases DNA strand breaks in rat brain cells.¹⁰ And these are repeatable tests.

High frequency EMF has been known for many years that it will KILL human cells. This high frequency EMF known as X-Rays have been used for years to kill cancer cells in the human body.

Seven states have standards dealing with exposure to electric and magnetic fields. Other states have taken steps to limit exposure to EMF. In addition, a number of countries have established standards and limits to EMF exposure.¹¹

- Six states have limits on magnetic fields^{12 13}
 - Florida
 - New York
- Two states have limits on electric fields^{14 15}
 - Florida

7 Faulty DNA Repair May Explain EMF Role in Childhood Leukemia, Microwave News, December 15, 2008

8 Power-line radiation and childhood leukemia, IEEE spectrum, December 16, 2008

9 Leukemia & Lymphoma, Dec. 2008

10 Bioelectromagnetics vol 18, Issue 2, pages 156-165, H. Lai & N.P. Singh

11 Environmental Law Centre, Regulating Power Line EMF Exposure: International Precedents, 4/15/05

12 International Commission Non-Ionizing Radiation Protection (ICNIRP)

13 NEIHS 2002

14 International Commission Non-Ionizing Radiation Protection (ICNIRP)

15 NEIHS 2002

- Minnesota
- Montana
- New Jersey
- New York
- Oregon
- States with state and local power line restrictions
 - Connecticut
 - California
 - Washington
 - Rhode Island
 - Colorado
 - Kentucky – Sitings of Electrical Transmissions Lines, research Report No. 348, 11/2/07, Health concerns related to electromagnetic Fields.
- Countries
 - European Union – European Council issued Council recommendation 1999/519/EC setting a limit on the exposure of EMF to the public
 - United Kingdom – adopted ICNIRP standards
 - Austria
 - Finland
 - France
 - Italy
 - Latvia
 - Republic of Lithuania
 - Romania
 - Switzerland

With all of this existing research, research continues and a definitive cause-effect connection has only been basically defined and a cause-effect connection has NOT been eliminated. This is partly due to the lack of consensus as to the research protocols.

F. The full effects of EMF on the Barker house has yet be felt.

The power lines are being operated at far less than full capacity today. As the loading increases, the power lines will sag causing them to come closer to the house. This

sagging of the power lines is due to the heat buildup because of resistive losses in the power line conductors.

As the power lines come closer to the Barker house, the EMF levels will increase.

Evidence:

Calculations of conductor sag and their effect on EMF have been developed for this location and is defined below.

I have estimated that the magnetic fields will be varying from 10 mG and to a high of 191 mG over time. Also the electric fields will vary from 0.997 kV/m to a high of 1.438kV/m over time.

“The background levels of power line magnetic fields in the typical U.S. home are between 0.5 mG and 4 mG with an average of 0.9 mG.”¹⁶ The Barkers’ house has measurements at the kitchen window as shown below.

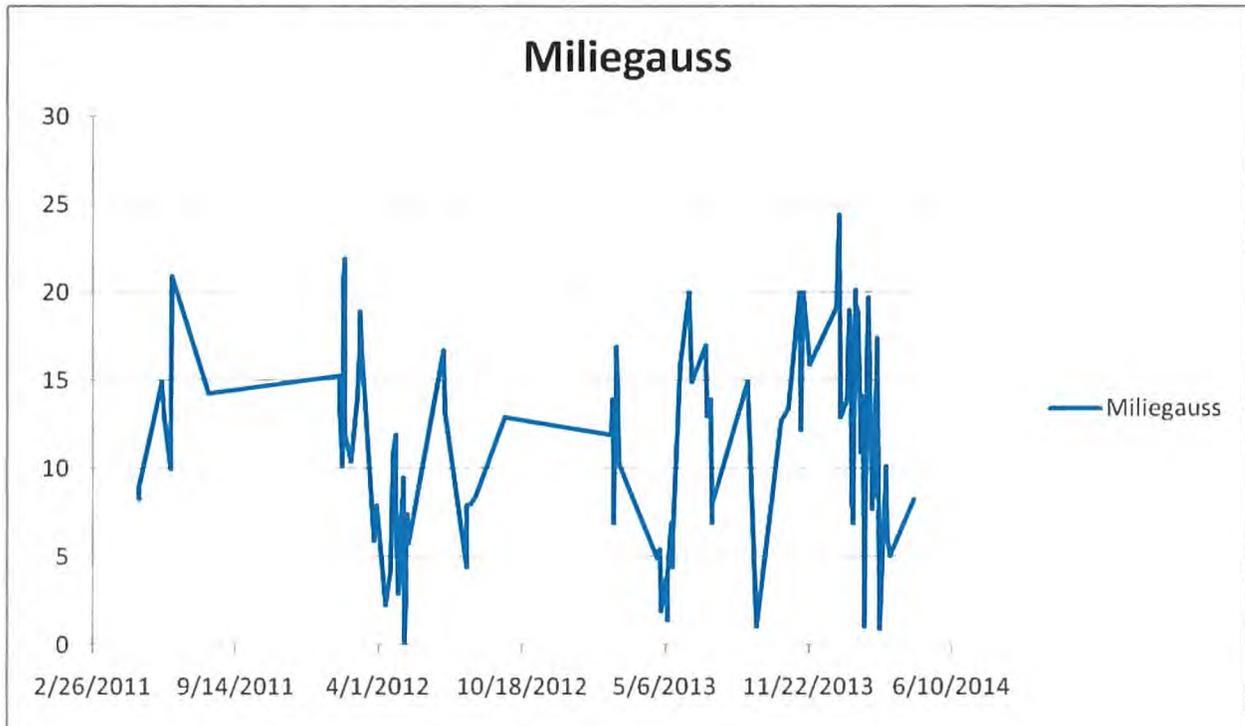


Figure 3 - Barker Magnetic Field Measurements

G. EKPC personnel knowingly mislead the Barkers with respect to the known health risks associated with EMF.

Evidence:

Recording of the conversation between Dr. Paul A. Dolloff, EKPC Senior Engineer, Research & Development Group of EKPC where he stated that he does not know of any standards dealing with EMF in the US. Dr. Dolloff being in a senior position of EKPC and a member of EPRI where he has access to all of their literature on EMF he surely knew or should have known of what other utilities are doing with respect to EMF. Dr. Dolloff had access to the needed test equipment at EKPC.

¹⁶ CapX2020 “Electric and Magnetic Fields (EMF): the Basics, www.capx2020.com

H. EKPC Environmental Report produced by the Gilpin Group, May 2006, stated that "no structures would be located close enough to the proposed transmission line to experience increased EMF levels."¹⁷ This is clearly an inaccurate statement as will be shown at trial.

Further, it is my opinion that the electric utility should have known of these potential health risks and could have easily reduced these hazards.

¹⁷ EKPC Environmental Report, May 2006, Page 54

SECTION 3 – BASIC INFORMATION

VI. BASIC FACTS

- Barker property – 5450 Mt. Sterling Road, Winchester, Kentucky 40391
- Original transmission line was 69 kV.
- EKPC checked the location of the Barker house before the house was built (according to Ann Barker) and did not object to its location.
- The Right Of Way was increased from 100 feet to 150 feet for this new line.
- Initial design placed one H-frame pole system next to the house. This design was shown to the Barkers at a public meeting on November 10, 2005.
- The Right of Way for the new line was shown to be Barkers as being right next to their house.
- EKPC reviewed the location of the Barker house when the new transmission line was designed.
- This section of the transmission line was redesigned as it encroached upon the Barkers' house. The H-frame pole system was relocated approximately 400 feet to the north.
- Micro-shocks are being felt by persons on the Barker property since the new lines were energized.
- Electrostatic charge buildup has been measured on cars/trucks in the driveway as high as 330 volts.
- The cost for moving the line 221 feet to the east at the time of construction would have only added approximately between \$2,000.00 and \$4,000.00 to the overall cost of the project.
- Only three (3) houses on the proposed transmission line were within 100' of the right-of way.
- RUS requires that every reasonable effort should be made by the engineer to accommodate the landowner.
- RUS requires that it may be necessary to consider routing small segments of the line due to the inability of the right-of-way agent to satisfy the demands of property owners.
- Dr. Paul A. Dolloff, EKPC Research & Development, stated that **he knew of no standards anywhere¹⁸ within the United States.**

¹⁸ Meeting at the Barker house on 12/2008, meeting was video recorded.

- EKPC stated that there are "no structures would be located close enough to the proposed transmission line to experience increased EMF levels."¹⁹

VII. TIMELINE OF EVENTS

11/9/51	Original easement issued, 50 acres where the house is located
6/13/52	Easement issued for the 150 acres for the remaining part of the farm
1974	House built
8/05 – 4/06	Survey
8/05 – 4/06	Design
8/05 – 8/06	Negotiate ROW
10/7/05	EKPC requested a waiver of the CPCN
10/26/05	PSC granted the waiver of the CPCN
10/28/05	EKPC mailed notices to 250 property owners
10/29/05	Janet Smallwood & Timothy Smallwood accepted an option on their ROW
10/31/05	The Barkers' received letter inviting her to meeting
10/31/05	The Barkers' received booklet on EMF
11/3/05	Notices of meeting published in the Winchester newspaper
11/5/05	Notices of meeting published in the Winchester newspaper
11/7/05	Notices of meeting published in the Winchester newspaper
11/10/05	Public meeting @ Clark County Cooperative Office The Barkers' first meeting with EKPC EKPC stated that they did not know the exact route of the line
12/20/05	Letter to U.S. fish and Wildlife Service provided the proposed route
1/1/06	Established the centerline of the transmission line
4/06 – 7/06	Structure staking
4/06 – 4/07	Line construction
4/27/06	EKPC met with the Barkers' to discuss the H-frame pole near their front yard.
5/8/06	EKPC decided to relocate the H-Frame pole
5/06	Gilpin Group Environmental Report
5/27/06	Legal Notice on rebuilding the transmission line
6/25/07	Final Report
7/16/07	Public Service Commission – applicant's response
12/5/08	EKU electric field measurements
2010	Voltage reading – car lug nut to earth 253.5 v
2010	Voltage reading – car lug nut to earth 265.9 v
1/8/12	6.5 mG @9:45 pm inside house
1/9/12	6.9 mG @6.45 am inside house
1/19/12	PECI mG measurements

SECTION 4 – CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY

VIII. BASIC REQUIREMENTS:

The requirements that govern how the public can comment on the acceptability of new transmission line projects is partly contained within KRS 278, which requires a Certificate of Public Convenience and Necessity. The requirement that defines when a CPCN is required is stated in paragraph 278.020 (1) and (2). Following this definition is an exception, which will allow the PSC to waive the CPCN requirement. The use of this exception by EKPC is one of the reasons for this report. This exception requires the determination of the length on the transmission line from engineering maps and the determination as to where the transmission line deviates from existing Right-of-Ways.

"278.020 Certificate of Convenience and Necessity required for construction provision of utility service or of utility -- Exceptions -- Approval required for acquisition or transfer of ownership -- Public hearing on proposed transmission line -- Severability of provisions.".....

"(2) For the purposes of this section, construction of any electric transmission line of one hundred thirty-eight (138) kilovolts or more and of more than five thousand two hundred eighty (5,280) feet in length shall not be considered an ordinary extension of an existing system in the usual course of business and shall require a certificate of public convenience and necessity. However, ordinary extensions of existing systems in the usual course of business not requiring such a certificate shall include:

- (a) The replacement or upgrading of any existing electric transmission line; or
- (b) The relocation of any existing electric transmission line to accommodate construction or expansion of a roadway or other transportation infrastructure; or
- (c) An electric transmission line that is constructed solely to serve a single customer and that will pass over no property other than that owned by the customer to be served."

The above statute requires that all new transmission lines of a voltage of 138kV or greater be considered for the certificate process. The new Smith-Hunt-Sideview transmission line is a 345kV transmission line that is replacing an existing 69kV transmission line. The 69kV transmission line was completely removed.

What is contested here is the length of new right-of-way that is required where no previous right-of way existed. EKPC has made various claims as to the lengths of additional right-of-way required in this project. The following is an engineering evaluation of the lengths of each section of this new transmission line and defines where each deviation takes place. There are three areas where deviations take place.

1. North Clark New Substation/Switchyard
2. Clark (Hunt) Substation
3. J.K. Smith Generating Station Substation/Switchyard

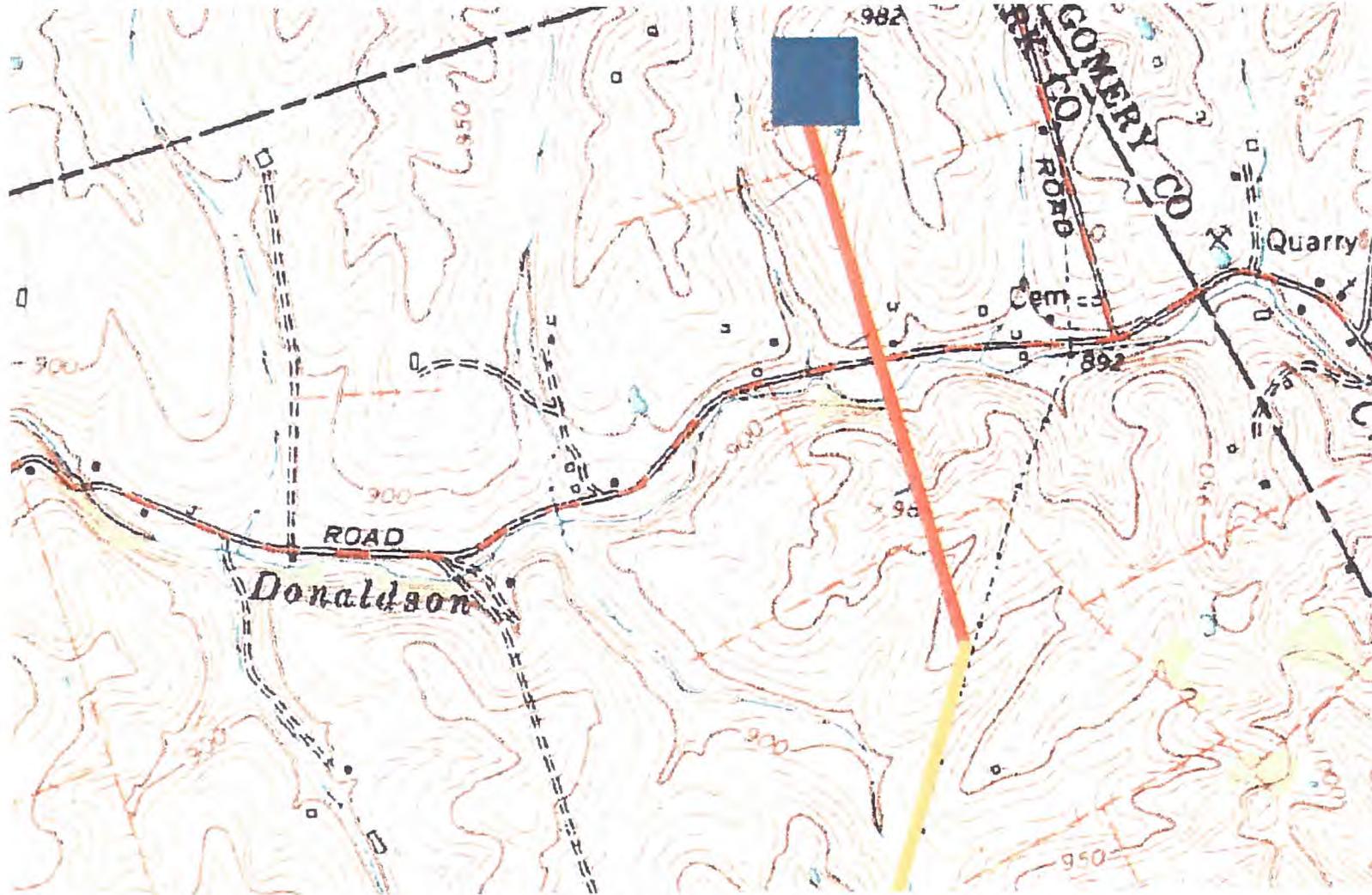
Based upon EKPC documentation²⁰ the transmission line is approximately 18.68 miles long and consists of a 345 kV circuit and a 138 kV circuit. This transmission line's estimated cost was reported to be \$20,000,000.00.

IX. ENGINEERING EVALUATION of KRS 278:

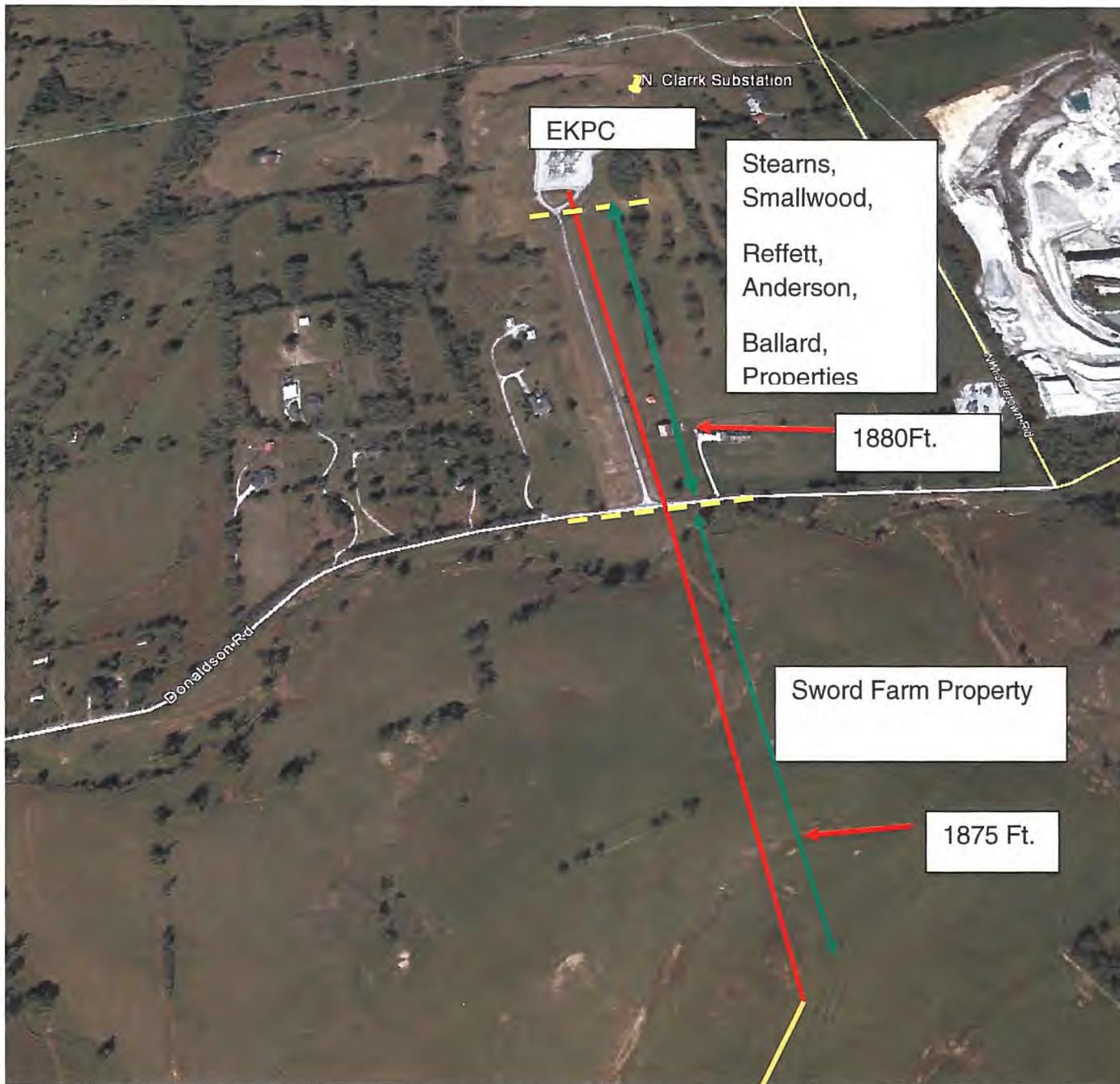
In Kentucky as well as all states there are various standards that have to be interpreted on a daily basis by engineers in their performance of engineering work as defined by the State of Kentucky. Standards such as the National Electrical Code – NFPA 70 are adopted by the State Legislature every three years in order to make these standards a requirement. Engineering interpretation of portions of KSR 278 fall into the class where Engineering interpretation is a valid duty of an engineer and does not require the interpretation of a legal staff.

²⁰ EKPC Environmental Report for the Proposed Smith to Sideview electric Transmission Project, May 2006

X. NORTH CLARK GENERATING STATION – NEW SUBSTATION



The above map from the Gilpin report defined the new right-of-way requirements in orange the existing right-of-way which is to be reused in yellow.



EKPC answer to PSC Request 1, Response 1d. page 3 of 3, states "that 1880 feet of this derivation ...is located on EKPC's substation property."

This property did not belong to EKPC until:

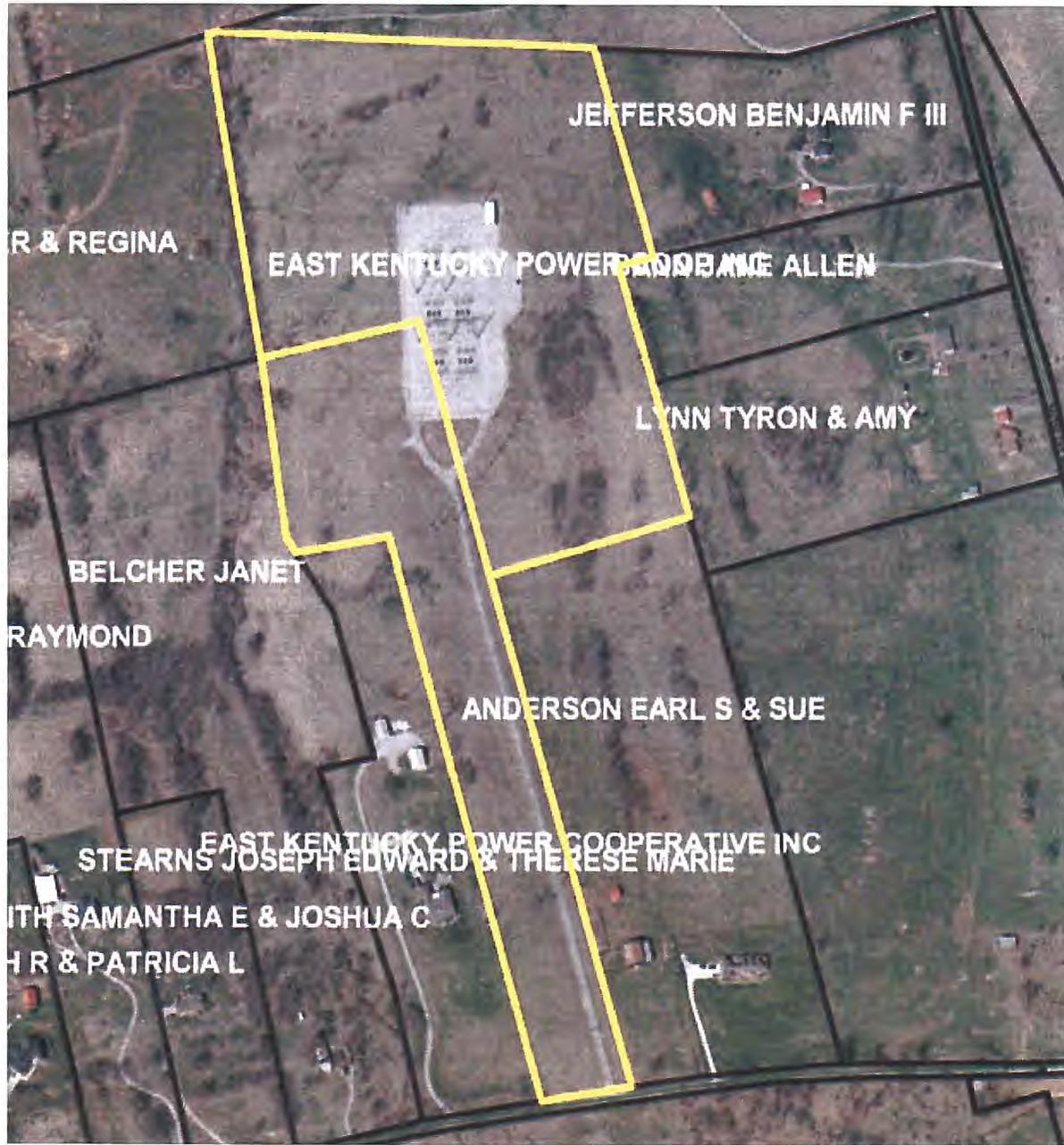
- a. Joseph & Therese Stearns – June 6, 2006 & June 16, 2006
- b. Roby & Dawn Ballard – May 8, 2006
- c. Janet & Timothy Smallwood June 6, 2006
- d. Joey & Gulena Reffett June 6, 2005
- e. Earl & Sue Anderson – October 3, 2006

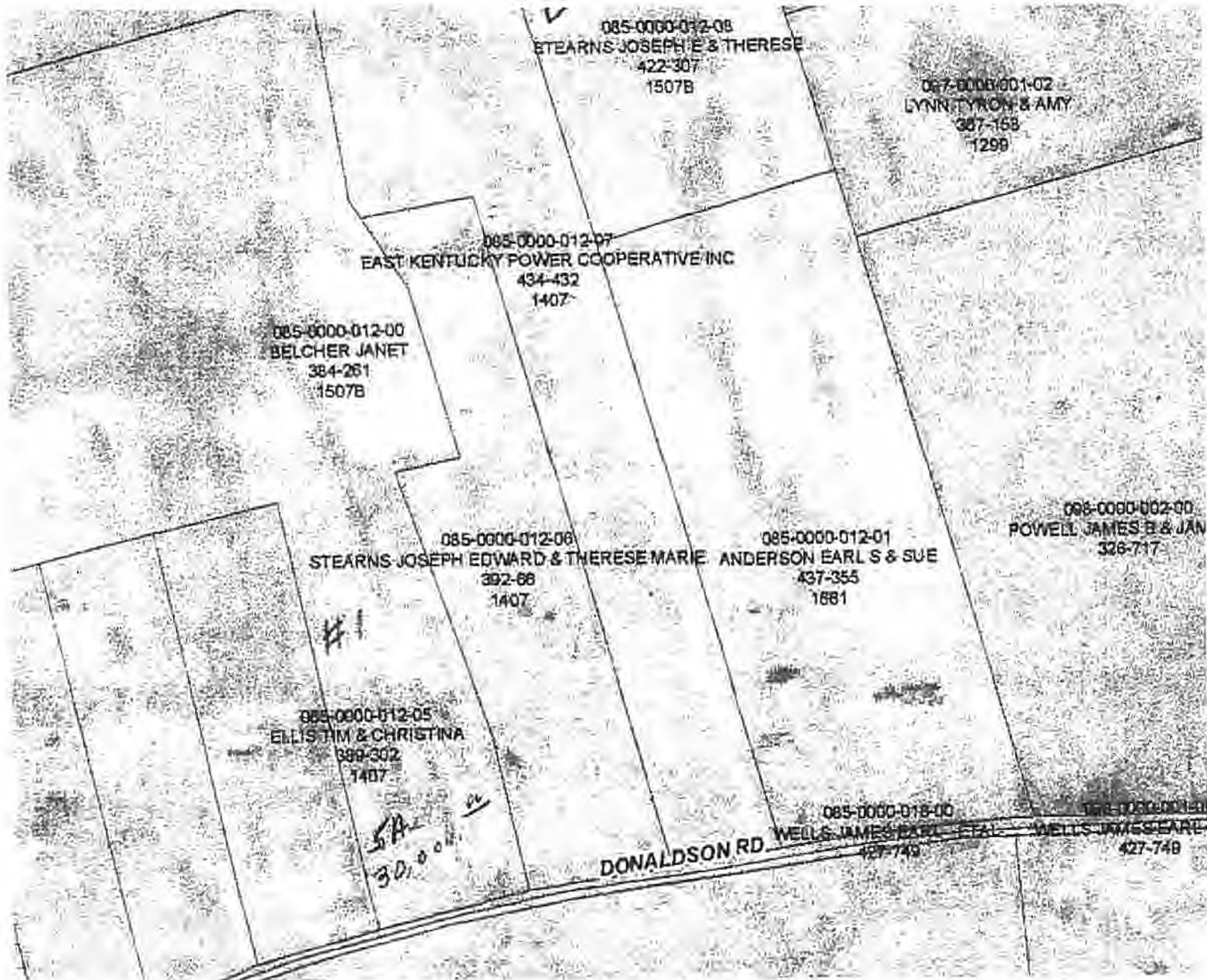
EKPC signed option to purchase the Reffett property on 11/24/2005

The above aerial view from Google Earth shows the existing and new transmission lines as they existed in 2013. The colors differentiate the new transmission line right-of-way from what was existed before this project. Also listed is the measured length of the new right-of-way. These measurements are not of the accuracy that could be provided by a Registered Land Surveyor but have the accuracy obtained using manual methods with topographical maps.

One of EKPC's claims is that the 1880 feet section of this deviation from existing right-of-way is on existing EKPC property. That is incorrect since the property leading up to the substation/switching site was purchased for this project. The chart on the right of the diagram shows the dates the property segments were purchased.

Also, nowhere in KSR 278.020 states that utility owned property is exempted for the CPCN requirements.





Kentucky property map



COMMUNITY MAP

EAST KENTUCKY POWER COOPERATIVE, INC.
DB 430, PG 380
TRACT 3
SLIDE 1266

BASIS OF BEARINGS
KENTUCKY SOUTH ZONE
STATE PLANE COORDINATE
SYSTEM NAD 83

ROBY BALLARD III
DANN BALLARD
DB 375, PG 667

IPF 'BALDWIN 1366'

JOSEPH E. STEARNS
THERESE STEARNS
DB 422, PG 307
SLIDE 1507B

JOEY REFFETT
DB 384, PG 426
SLIDE 1407

JOSEPH E. STEARNS
THERESE STEARNS
DB 392, PG 66
SLIDE 1407

IPF 'JUSTICE 2390'
PARCEL 4, TRACT 1
6.01 ACRES

STREET

LESLIE ELECTRIC TRANS. LINE

IPF 'LAW 1366'

MAG NAIL (SET THIS SURVEY)

JANET BELCHER
DB 384, PG 261
SLIDE 1407

PARCEL 4, REMAINING
29.69 ACRES

ROGER MCINTOSH
REGINA MCINTOSH
DB 377, PG 402

--- LEGEND ---

- ⊙ 1/2" REBAR (IRON PIN W/CAP STAMPED "BA 3022" SET THIS SURVEY
- REBAR IRON PIN, FOUND AS NOTED.
- ◻ EXIST. PK NAIL FOUND



GRAPHIC SCALE, 1" = 200'

SURVEYOR'S CERTIFICATION

I hereby certify that the survey depicted by this plat was performed under my direction by method of random traverse with sideshots, unadjusted precision ratio of the traverse 1:108,792 and was not adjusted. The survey shown hereon is a class A survey and the accuracy and precision of said survey meets all specifications of this class.

Blake Adams
BLAKE ADAMS, LS # 3088 DATE 6-29-06

EXHIBIT A

PLAT OF SURVEY FOR
EAST KENTUCKY POWER COOPERATIVE

4775 LEXINGTON ROAD, PO BOX 707
WINCHESTER, KENTUCKY 40392

SHOWING A SURVEY OF:
JANET BELCHER DIVISION
DONALDSON ROAD, CLARK COUNTY, KENTUCKY
DEED BOOK 384, PAGE 261

DATE: JUNE 6, 2006	SCALE: 1" = 200'	FILE: BLECHER.1119
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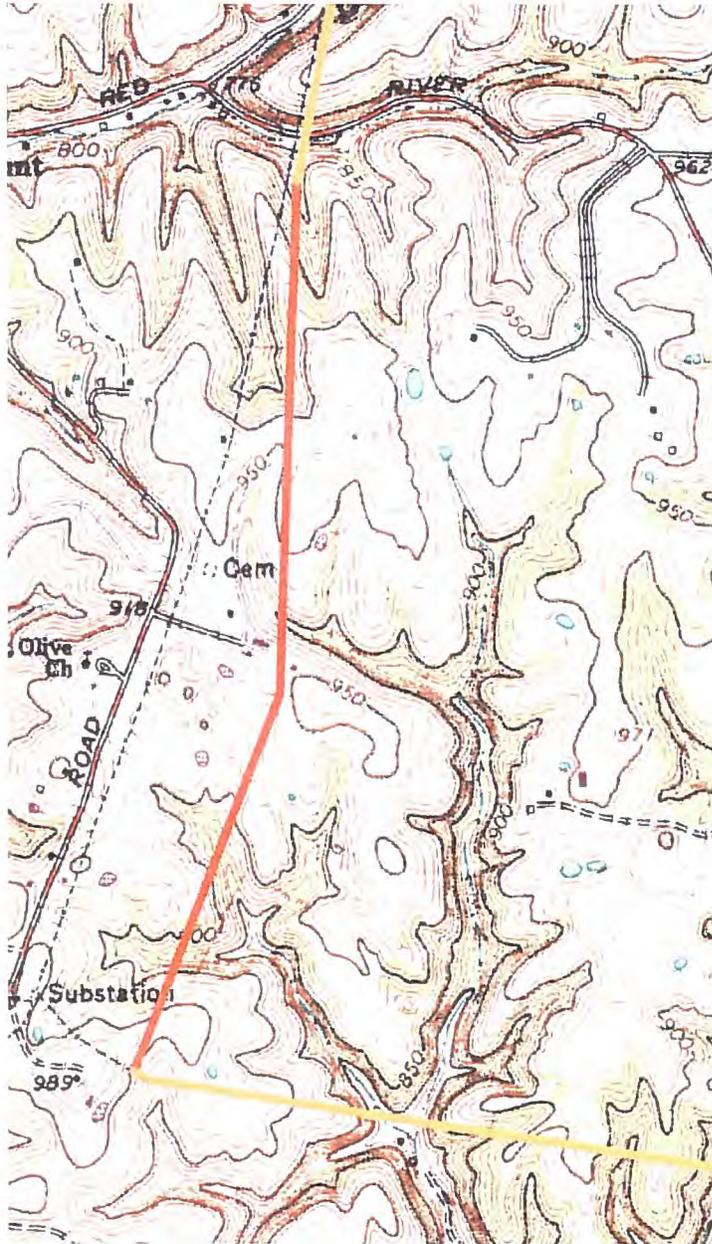


BLAKE ADAMS
ENGINEERING, INC.
438 WASHINGTON STREET
STANTON, KENTUCKY 40380
(606)563-2722

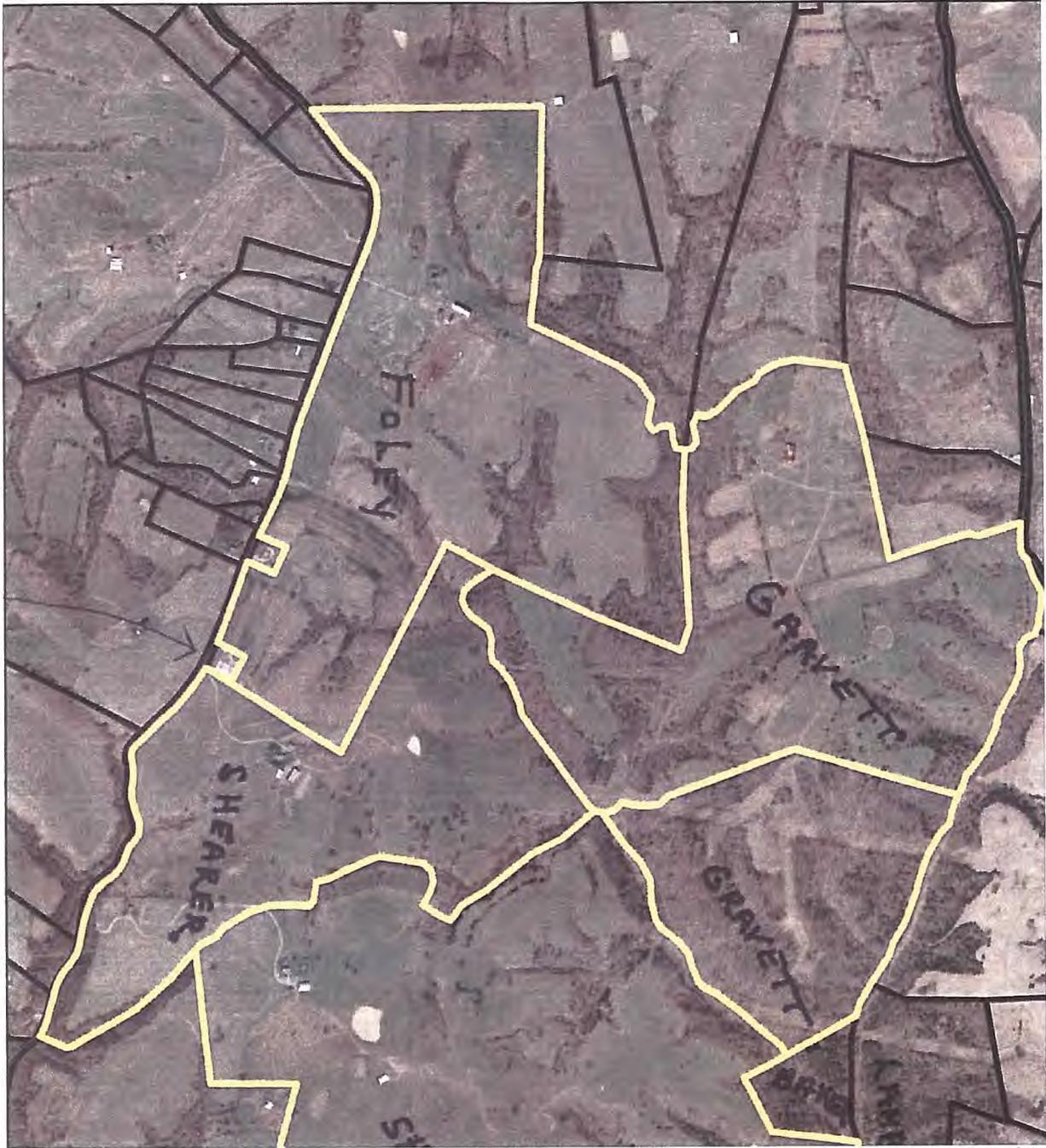


Survey map of EKPC purchase of the Smallwood property. Property was optioned by EKPC on October 29, 2005. Sherman Goodpaster's letter to the PSC for waiver of CPCN was on October 7, 2005.

XI. CLARK SUBSTATION



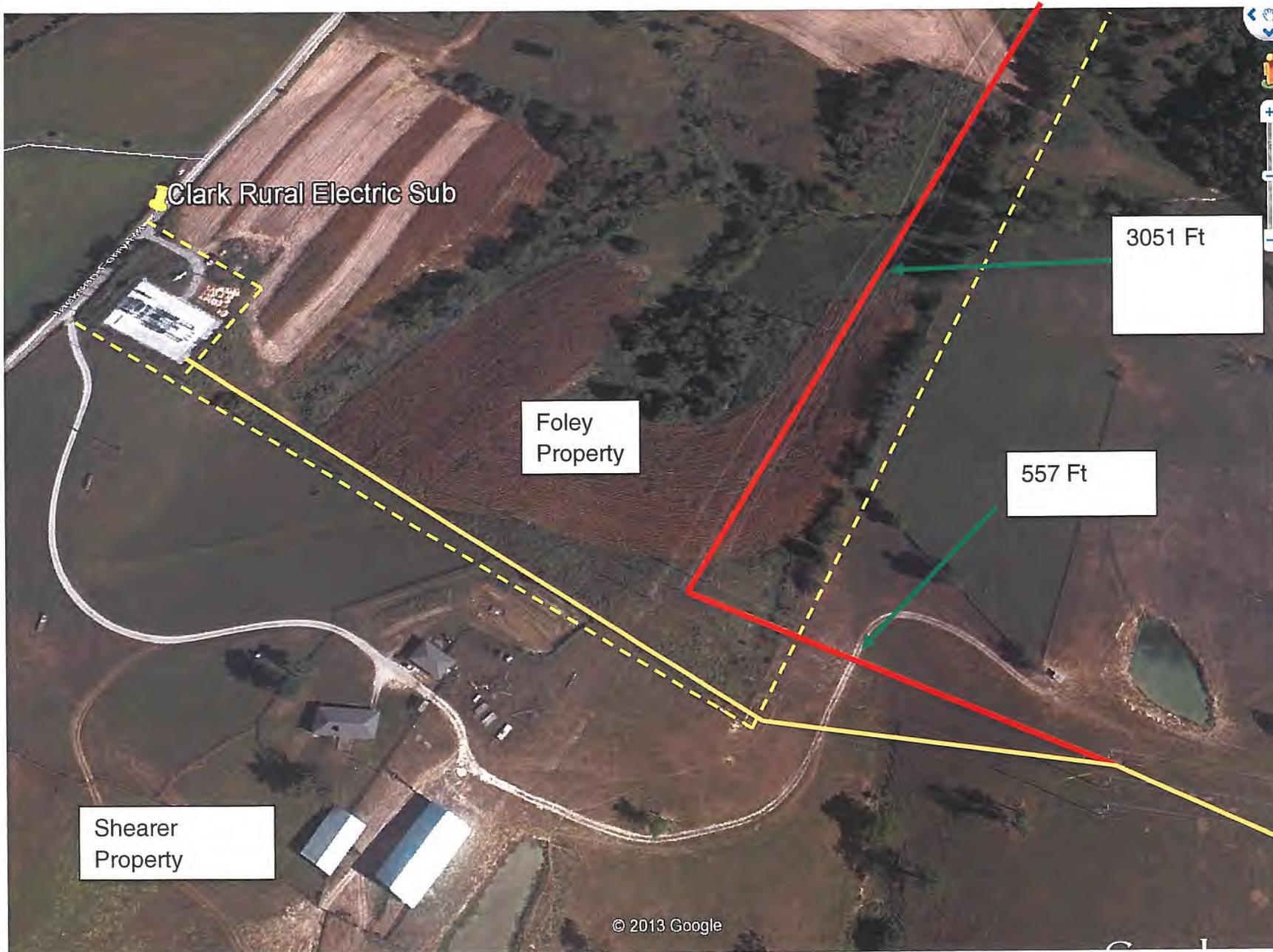
The above map from the Gilpin report defined the new right-of-way requirements in orange the existing right-of-way which is to be reused in yellow



Map from the state of Kentucky defines the property owners around the Clark Substation

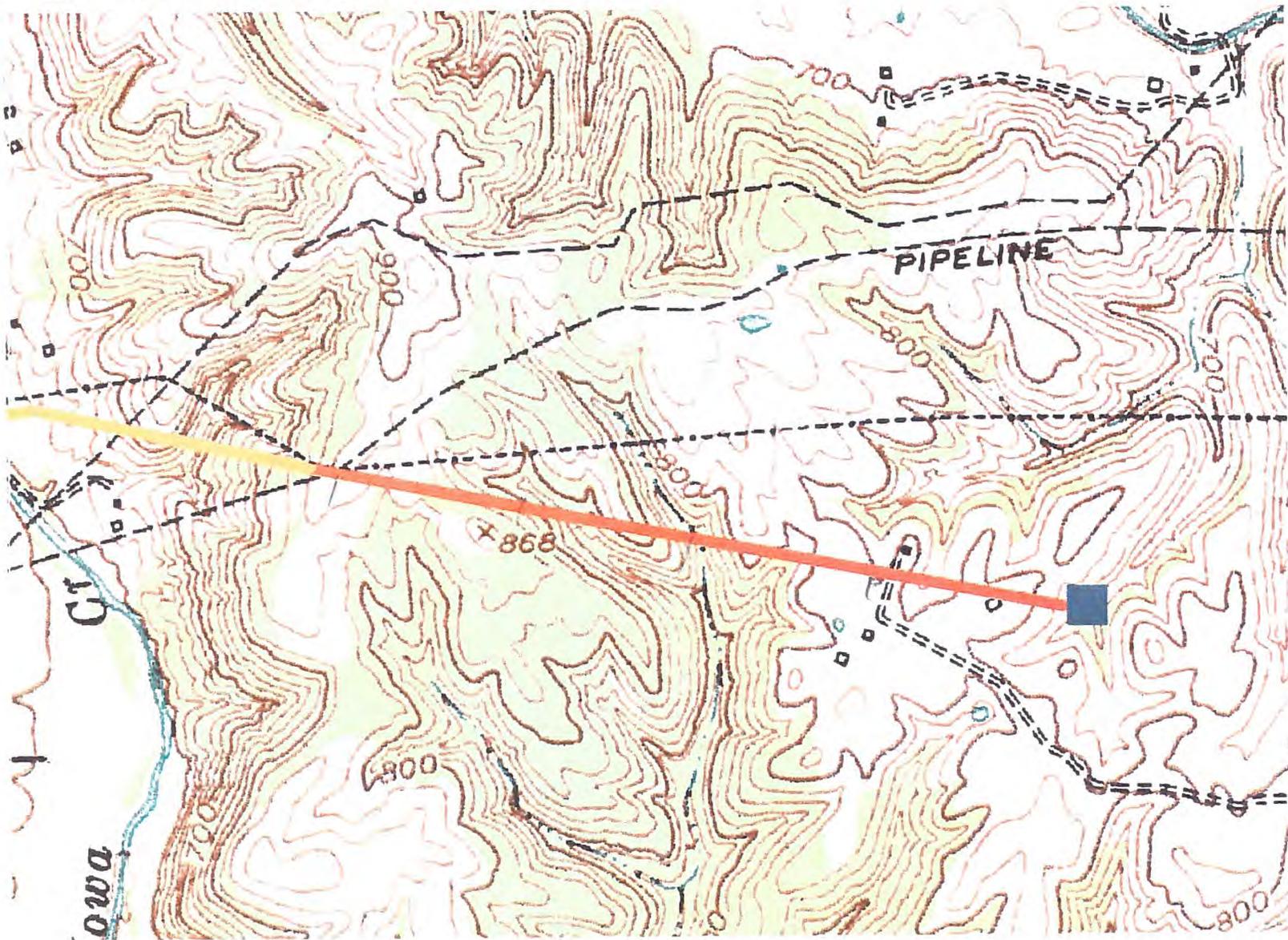


Map from the state of Kentucky defines the existing transmission lines before this project was installed along with the new transmission lines

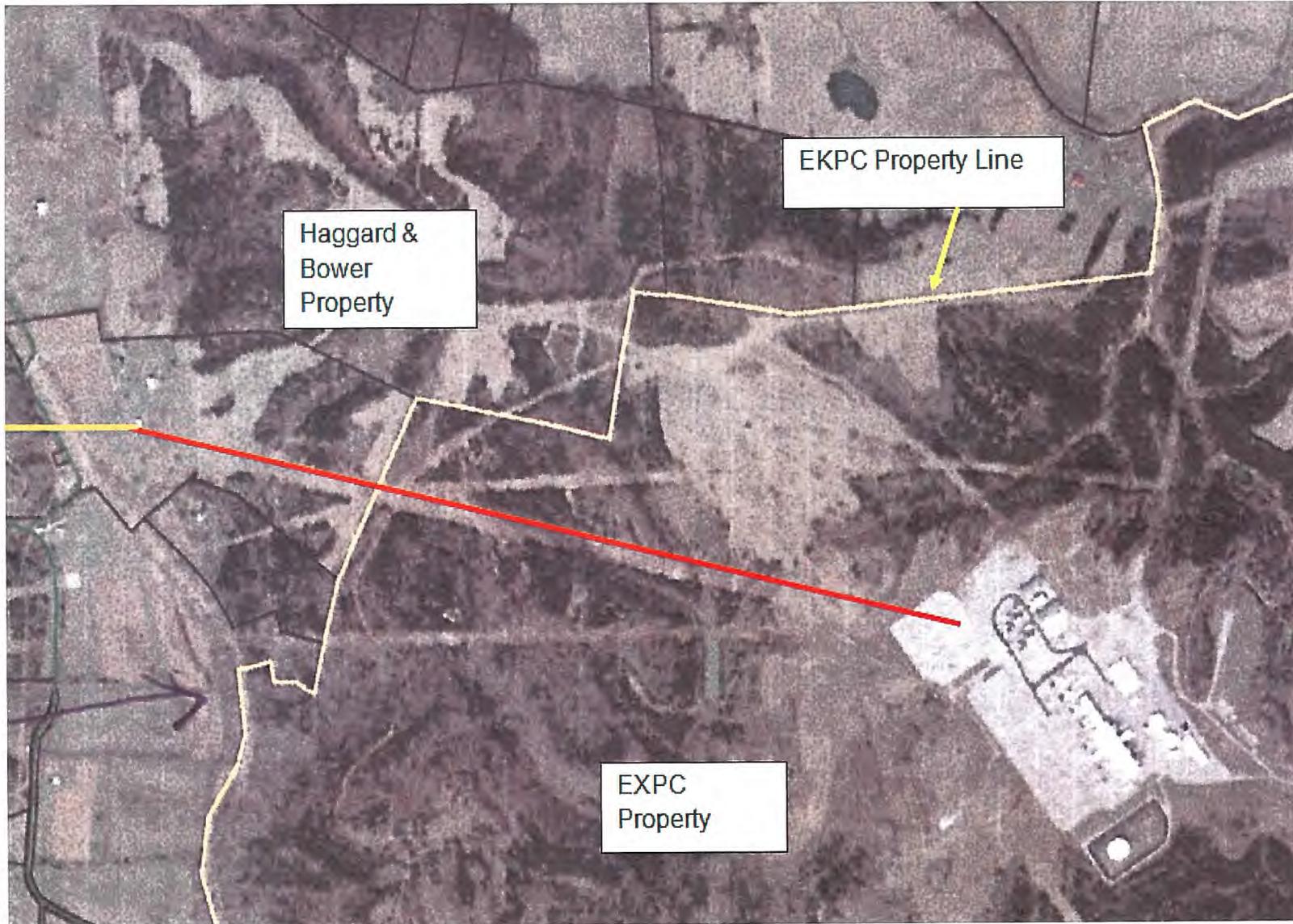


The above aerial view from Google Earth shows the existing and new transmission lines as they existed in 2013. The colors differentiate the new transmission line right-of-way from what existed before this project. Also listed is the measured length of the new right-of-way. These measurements are not of the accuracy that could be provided by a Registered Land Surveyor but have the accuracy obtained using manual methods with topographical maps.

XII. J.K. SMITH GENERATING STATION:

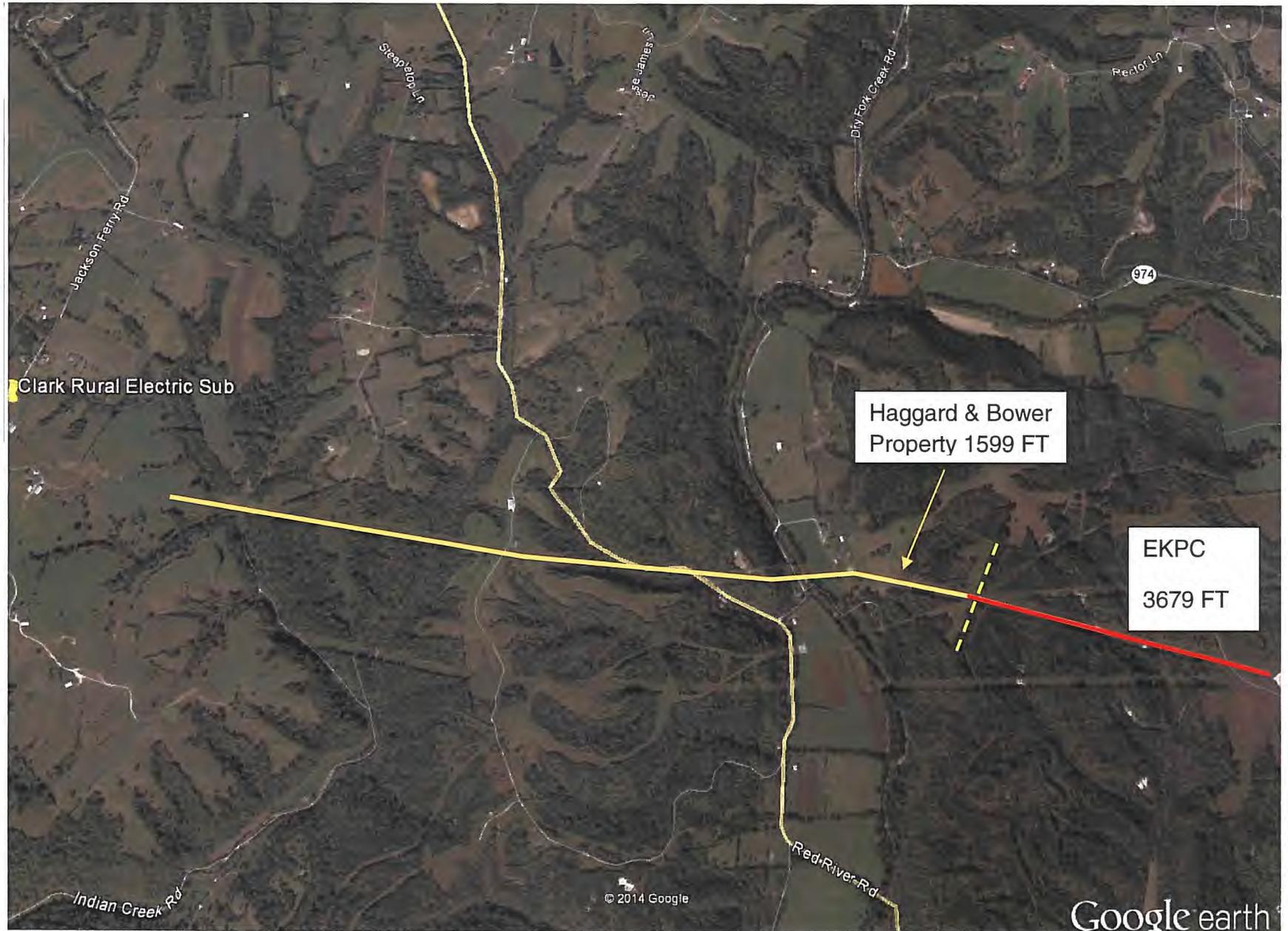


The above map from the Gilpin report defined the new right-of-way requirements in orange the existing right-of-way which is to be reused in yellow.



Map from the state of Kentucky defines the property owners around the J.K. Smith Generating Station.





The above aerial view from Google Earth shows the existing and new transmission lines as they existed in 2013. The colors differentiate the new transmission line right-of-way from what existed before this project. Also listed is the measured length of the new right-of-way. These measurements are not of the accuracy that could be provided by a Registered Land Surveyor but have the accuracy obtained using manual methods with topographical maps.

XIII. SUMMERIZATION of LINE DEVIATION SEGMENTS:

	Line Segment Distance in Feet	Total Line Segment Distance in Feet	Property Owners	Total Line Segment Distance in Feet	Total Line Segment Distance in Feet	Data Source
North Clark	1880		Stearns, Reffett, etc.	1693		Gilpin pg 18
	1875		Sword			
Segment Total Clark Substation		3755			3755	PSC Request 1
	557		Foley & Shearer			
	3051		Foley Property 1			
	3435		Foley Property 2			
Segment Total JK Smith Gen Station		7043		6969		Gilpin pg 18 PSC Request 1
	0		Haggard & Bower		6975	
	3679		EKPC			
Segment Total		3679		3977	3977	Gilpin pg 18
Total Deviation from Existing ROW		14477		10946	14707	

On May 27, 2006 in a legal public notice in the local newspaper listed that the rebuilt portion of the line is 15.9 miles and the total line length is 19 miles. Other documents show the total line length more accurately as 18.68. Using the 15.9 miles and 18.86 miles the calculated deviation from the established ROW is 2.78 miles or **14678.4 feet** not 5280 feet as EKPC claims.

SECTION 5 – Right-of-Way

XIV. Right Of Way

A. Requirements²¹

3. TRANSMISSION LINE LOCATION, ENGINEERING SURVEY AND RIGHT-OF WAY ACTIVITIES

Final route selection, whether for a large or small project, is a matter of judgment and requires sound evaluation of divergent requirements, including costs of easements, cost of clearing, and ease of maintenance as well as the effect a line may have on the environment. Public relations and public input are necessary in the corridor selection and preliminary survey stages.

3.3 Right-of-Way: A right-of-way agent (or borrower's representative) should precede the preliminary survey party in order to acquaint property owners with the purpose of the project, the survey, and to secure permission to run the survey line. The agent or surveyor should also be responsible for determining property boundaries crossed and for maintaining good public relations. The agent should avoid making any commitments for individual pole locations before structures are spotted on the plan and profile sheets. However, if the landowner feels particularly sensitive about placing a pole in a particular location along the alignment, then the agent should deliver that information to the engineer, and every reasonable effort should be made by the engineer to accommodate the landowner.

3.6 Rerouting: During the final survey, it may be necessary to consider routing small segments of the line due to the inability of the right-of-way agent to satisfy the demands of property owners. In such instances, the engineer should ascertain the costs and public attitudes towards all reasonable alternatives. The engineer should then decide to either satisfy the property owner's demands, relocate the line, initiate condemnation proceedings, or take other action as appropriate. Additional environmental review may also be required.

B. RIGHT-OF-WAY WIDTH²²

5.1 General: The preliminary comments and assumptions in Chapter 4 of this bulletin also apply to this chapter.

5.2 Minimum Horizontal Clearance of Conductor to Objects: Recommended design horizontal clearances of conductors to various objects are provided in Table 5-1 and minimum radial operating clearances of conductors to vegetation in Table 5-2. The clearances apply only for lines that are capable of automatically clearing line-to-ground faults.

21 Bulletin 1724e-200 Design Manual For High Voltage Transmission Lines, U.S. Department Of Agriculture, Rural Utilities Service Electric Staff Division

22 Bulletin 1724e-200 Design Manual For High Voltage Transmission Lines, U.S. Department Of Agriculture, Rural Utilities Service Electric Staff Division

Clearance values provided in Table 5-1 are recommended design values. In order to provide an additional margin of safety, the recommended design values exceed the minimum clearances in the 2007 NESC. Clearance values provided in Table 5-2 are minimum operating clearances to be used by the designer to determine appropriate design clearances for vegetation maintenance management.

5.2.1 Conditions Under Which Horizontal Clearances to Other Supporting Structures, Buildings and Other Installations Apply:

Conductors at Rest (No Wind Displacement): When conductors are at rest the clearances apply for the following conditions: (a) 167°F but not less than 120°F, final sag, (b) the maximum operating temperature the line is designed to operate, final sag, (c) 32°F, final sag with radial thickness of ice for the loading district (0 in., ¼ in., or ½ in.).

Conductors Displaced by 6 psf Wind: The clearances apply when the conductor is displaced by 6 lbs. per sq. ft. at final sag at 60°F. See Figure 5-1.

TABLE 5-1
 RECOMMENDED DESIGN HORIZONTAL CLEARANCES (in feet) FROM CONDUCTORS
 AT REST AND DISPLACED BY 6 PSF WIND TO OTHER SUPPORTING STRUCTURES,
 BUILDINGS AND OTHER INSTALLATIONS
 (NESC Rules 234B, 234C, 234D, 234E, 234F, 234I, Tables 234-1, 234-2, 234-3)

Conditions under which clearances apply:								
No wind: When the conductor is at rest the clearances apply at the following conditions: (a) 120°F, final sag, (b) the maximum operating temperature the line is designed to operate, final sag, (c) 32°F, final sag with radial thickness of ice for the loading district (1/4 in. for Medium or 1/2 in. Heavy).								
Displaced by Wind: Horizontal clearances are to be applied with the conductor displaced from rest by a 6 psf wind at final sag at 60°F. The displacement of the conductor is to include deflection of suspension insulators and deflection of flexible structures.								
The clearances shown are for the displaced conductors and do not provide for the horizontal distance required to account for blowout of the conductor and the insulator string. This distance is to be added to the required clearance. See Equation 5-1.								
Clearances are based on the Maximum Operating Voltage								
Nominal voltage, Phase to Phase, kV _{L-L}	34.5 & 46	69	115	138	161	230		
Max. Operating Voltage, Phase to Phase, kV _{L-L}	----	72.5	120.8	144.9	169.1	241.5		
Max. Operating Voltage, Phase to Ground, kV _{L-G}	----	41.8	69.7	83.7	97.6	139.4		
Horizontal Clearances - (Notes 1,2,3)	NESC Basic Clear							
	Clearances in feet							
1.0 From a lighting support, traffic signal support or supporting structure of another line								
At rest (NESC Rule 234B1a)	5.0	6.5	6.5	7.2	7.6	8.1	9.5	
Displaced by wind (NESC Rule 234B1b)	4.5	6.2	6.7	7.6	8.1	8.5	9.9	
2.0 From buildings, walls, projections, guarded windows, windows not designed to open, balconies, and areas accessible to pedestrians								
At rest (NESC Rule 234C1a)	7.5	9.2	9.7	10.6	11.1	11.5	12.9	
Displaced by wind (NESC Rule 234C1b)	4.5	6.2	6.7	7.6	8.1	8.5	9.9	
3.0 From signs, chimneys, billboards, radio, & TV antennas, tanks & other installations not classified as buildings								
At rest (NESC Rule 234C1a)	7.5	9.2	9.7	10.6	11.1	11.5	12.9	
Displaced by wind (NESC Rule 234C1b)	4.5	6.2	6.7	7.6	8.1	8.5	9.9	
4.0 From portions of bridges which are readily accessible and supporting structures are not attached								
At rest (NESC Rule 234D1a)	7.5	9.2	9.7	10.6	11.1	11.5	12.9	
Displaced by wind (NESC Rule 234D1b)	4.5	6.2	6.7	7.6	8.1	8.5	9.9	
5.0 From portions of bridges which are ordinarily inaccessible and supporting structures are not attached								
At rest (NESC Rule 234D1a)	6.5	8.2	8.7	9.6	10.1	10.5	11.9	
Displaced by wind (NESC Rule 234D1b)	4.5	6.2	6.7	7.6	8.1	8.5	9.9	

TABLE 5-1 (continued)
 RECOMMENDED DESIGN HORIZONTAL CLEARANCES (in feet) FROM CONDUCTORS
 AT REST AND DISPLACED BY 6 PSF WIND TO OTHER SUPPORTING STRUCTURES,
 BUILDINGS AND OTHER INSTALLATIONS
 (NESC Rules 234B, 234C, 234D, 234E, 234F, 234I, Tables 234-1, 234-2, 234-3)

Conditions under which clearances apply:							
No wind: When the conductor is at rest the clearances apply at the following conditions: (a) 120°F, final sag, (b) the maximum operating temperature the line is designed to operate, final sag, (c) 32°F, final sag with radial thickness of ice for the loading district (1/4 in. for Medium or 1/2 in. Heavy).							
Displaced by Wind: Horizontal clearances are to be applied with the conductor displaced from rest by a 6 psf wind at final sag at 60°F under extreme wind conditions (such as the 50 or 100-year mean wind) at final sag at 60°F. The displacement of the conductor is to include deflection of suspension insulators and deflection of flexible structures.							
The clearances shown are for the displaced conductors and do not provide for the horizontal distance required to account for blowout of the conductor and the insulator string. This distance is to be added to the required clearance. See Equation 5-1.							
Clearances are based on the Maximum Operating Voltage							
Nominal voltage, Phase to Phase, kV_{L-L}	34.5 & 46	69	115	138	161	230	
Max. Operating Voltage, Phase to Phase, kV _{L-L}	----	72.5	120.8	144.9	169.1	241.5	
Max. Operating Voltage, Phase to Ground, kV _{L-G}	----	41.8	69.7	83.7	97.6	139.4	
Horizontal Clearances - (Notes 1,2,3)	NESC Basic Clear	Clearances in feet					
<hr style="border-top: 1px dashed red;"/>							
6.0 Swimming pools – see section 4.4.3 of Chapter 4 and item 9 of Table 4-2. (NESC Rule 234E)							
Clearance in any direction from swimming pool edge (Clearance A, Figure 4-2 of this bulletin)	25.0	27.2	27.7	28.6	29.1	29.5	30.9
Clearance in any direction from diving structures (Clearance B, Figure 4-2 of this bulletin)	17.0	19.2	19.7	20.6	21.1	21.5	22.9
<hr style="border-top: 1px dashed red;"/>							
7.0 From grain bins loaded with permanently attached conveyor							
At rest (NESC Rule 234F1b)	15.0	17.2	17.7	18.6	19.1	19.5	20.9
Displaced by wind (NESC Rule 234C1b)	4.5	6.7	7.2	8.1	8.6	9.0	10.4
8.0 From grain bins loaded with a portable conveyor. Height 'V' of highest filling or probing port on bin must be added to clearance shown. Clearances for 'at rest' and not displaced by the wind. See NESC Figure 234-4 for other requirements. Horizontal clearance envelope (includes area of sloped clearance per NESC Figure 234-4b)							(24+V) + 1.5V (Note 3)
9.0 From rail cars (Applies only to lines parallel to tracks) See Figure 234-5 and section 234I (Eye) of the NESC							
Clearance measured to the nearest rail	14.1	14.1	15.1	15.6	16.0	17.5	
ALTITUDE CORRECTION TO BE ADDED TO VALUES ABOVE							
Additional feet of clearance per 1000 feet of altitude above 3300 feet		.02	.02	.05	.07	.08	.12
Notes:							
1. Clearances for categories 1-5 in the table are approximately 1.5 feet greater than NESC clearances.							
2. Clearances for categories 6 to 9 in the table are approximately 2.0 feet greater than NESC clearances.							
3. "V" is the height of the highest filling or probing port on a grain bin. Clearance is for the highest voltage of 230 kV.							

4.4.4 Lines Over Swimming Pools: Clearances over swimming pools are for reference purposes only. Lines should not pass over or within clearance 'A' of the edge of a swimming pool or the base of the diving platform. Clearance 'B' should be maintained in any direction to the diving platform or tower.

FIGURE 4-4: SWIMMING POOL CLEARANCES (See TABLE 4-2)
 From IEEE/ANSI C2-2007, National Electrical Safety Code, Copyright 2006. All rights reserved.

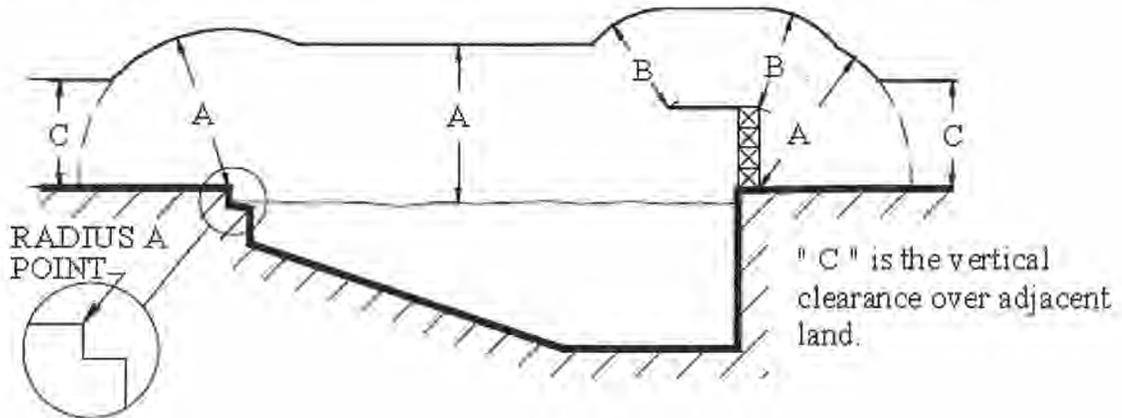


TABLE 5-3

TYPICAL RIGHT-OF-WAY WIDTHS

	Nominal Line-to-Line Voltage in kV				
	69	115	138	161	230
ROW Width, ft	75-100	100	100-150	100-150	125-200

Right-of-way widths can be calculated using the method described below. The calculated values for right-of-way widths are directly related to the particular parameters of the line design. This method provides sufficient width to meet clearance requirements to buildings of undetermined height or vegetation located directly on the edge of the right-of-way. See Figures 5-8 and 5-9

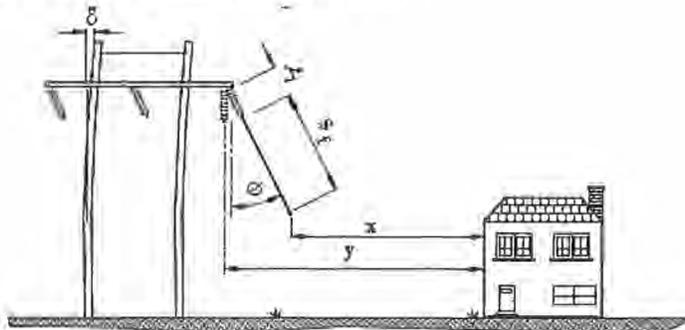


FIGURE 5-1: HORIZONTAL CLEARANCE REQUIREMENT TO BUILDINGS

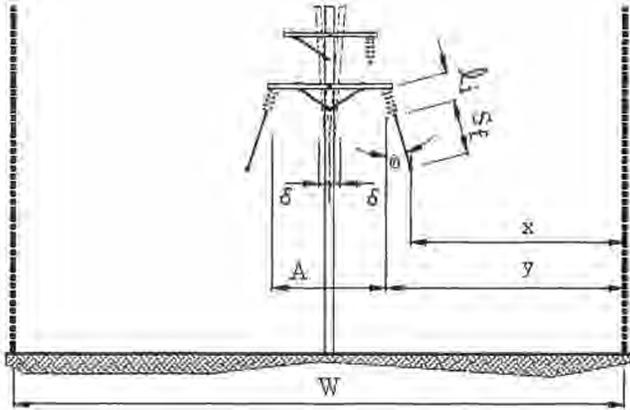


FIGURE 5-9: ROW WIDTH FOR SINGLE LINE OF STRUCTURES

$$W = A + 2(l_i + S_f) \sin \phi + 2\delta + 2x \quad \text{Eq. 5-3}$$

where:

W = total right-of-way width required

A = separation between points of suspension of insulator strings for outer two phases

X = clearance required per Table 5-1 and appropriate clearance derived from Table 5-2 of this bulletin (include altitude correction if necessary)

Y = clearance required per Section 5.2.1 and Table 5-1 and appropriate clearance derived from Section 5.2.2. and Table 5-2 of this bulletin (include altitude correction if necessary)

ϕ = conductor swing out angle in degrees under all rated operating conditions

S_f = conductor final sag at all rated operating conditions

l_i = insulator string length ($l_i = 0$ for post insulators or restrained suspension insulators).

δ = structure deflection at all rated operating conditions

For those spans that exceed this base span, additional width is added as appropriate.

$A = 54$ FT. (Pole diagram)

$X = 12.9$ ft. for 230kV (More for 345 kV)

$\delta =$ unknown

$\Phi = 20$ Degrees (estimated)

$$S_f = 32.3$$

$$l_i = 10 \text{ Ft.}$$

$$W = A + 2(l_i + S_f) \sin \phi + 2\delta + 2x$$

$$X = 7.5 + .4(V_{L-G} - 22)/12 = 13.4$$

$$\text{WOR} = W = 54 + 2(10 + 32.3) \cdot 9129 + 2 \times 13.4$$

$$\text{WOR} = W = 166 \text{ feet}$$

EKPC set the WOR at 150 feet but it should have been 166 feet or more.



Figure 4 - Preliminary EKPC Right Of Way Document²³

The above photograph was presented to the Barkers by EKPC at a public meeting on November 10, 2005. The photograph shows the original 100 foot right of way and the additional 50 feet of right of way that EKPC was requesting as well as the location of the utility pole.

The above photograph clearly shows that the transmission line ROW crosses the Barkers garage/business and the carport attached to the house.

²³ EKPC presented this photograph at the public meeting on Meeting of 11/10/2005

The location of the utility pole was later relocated to the north due to the objections of the Barkers. From this photograph and the sketches that follow, the right of way still encroaches upon the Barker house and should have been shifted to the east according to the Rural Utility Service design standards.²⁴

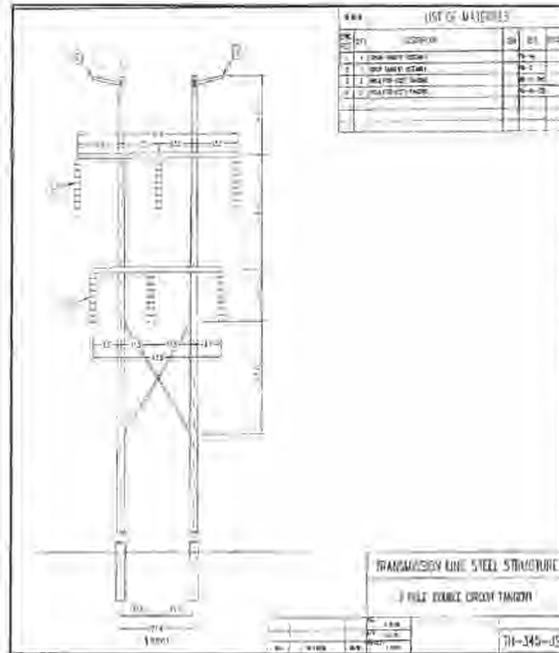


Figure 5 - EKPC Pole Design Drawing

The above figure shows the design drawing of the pole structure that was installed. This drawing was provided to the Barkers as part of the informational handout at the public meeting.

The Google Earth website was used to measure how close the installed transmission lines come to the Barker house. From this website measurements can be made and have been found in the past to be very accurate.

²⁴ U.S. Department of Agriculture, Rural Utility Service, Bulletin 1724E-200 Design Manual for High Voltage Transmission Lines



Figure 6 - Google Earth Measurement of House to Transmission Line – 33.77 Ft.



Figure 7 – Google Earth Measurement of House to Transmission Line – 30.69 Ft.



Figure 8 - Google Earth Measurement of House to Transmission Line – 47.36 Ft.

Based on Google Earth measurements of the distance of the house to the transmission line the transmission line comes within 30 feet of the garage or well inside the Right of Way. The right of way is 75 feet on either side of the center conductor or 48 feet from the outer conductor.

When you consider that the right of way should have been 166 ft or more rather than 150 ft, this places the right of way over the more of the house and garage.

As a means of verifying the accuracy of Google Earth we measured the distance between the two outer conductors. Google Earth measured 54 feet, the same as the design drawing.

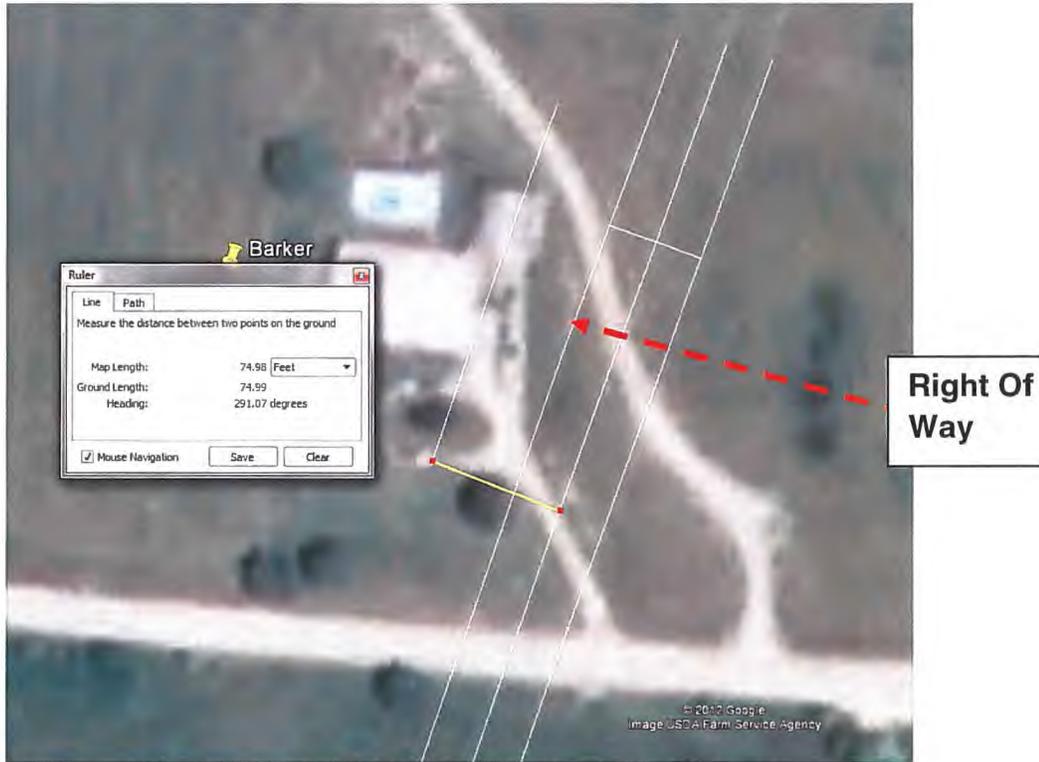


Figure 9 - ROW Line Measurement – 75 Feet



Figure 10 – ROW Line Measurement – 75 Feet



Figure 11 - Google Earth Measurement of Width of Transmission Line – 54 Ft.

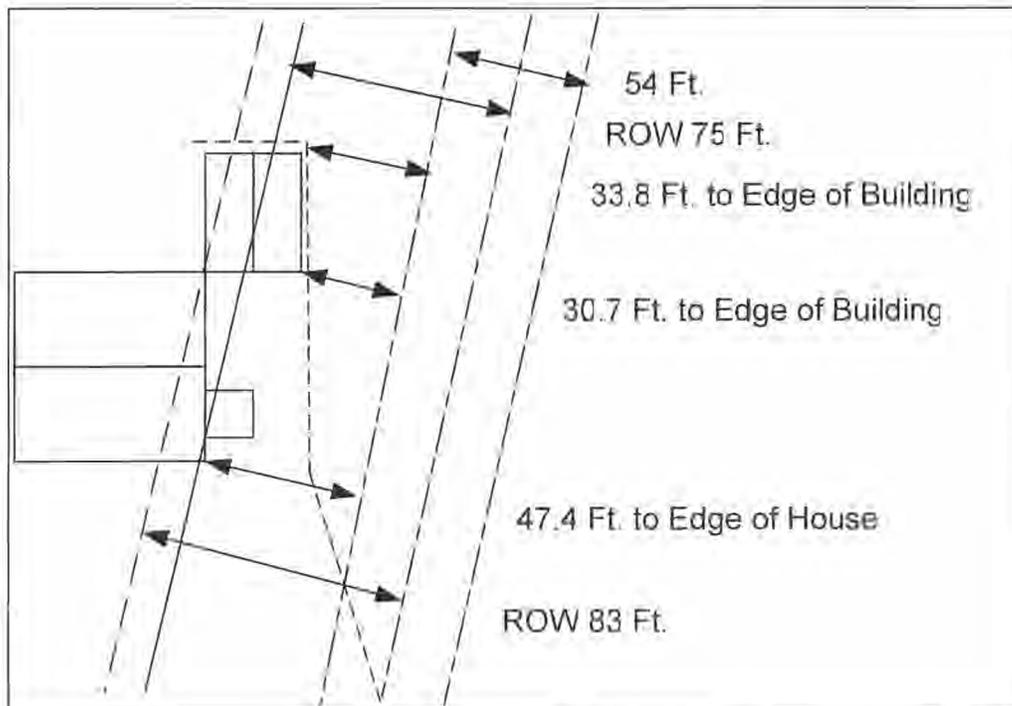


Figure 12 - Sketch of the Close Proximity of the Barkers' House to the Transmission Lines ROW

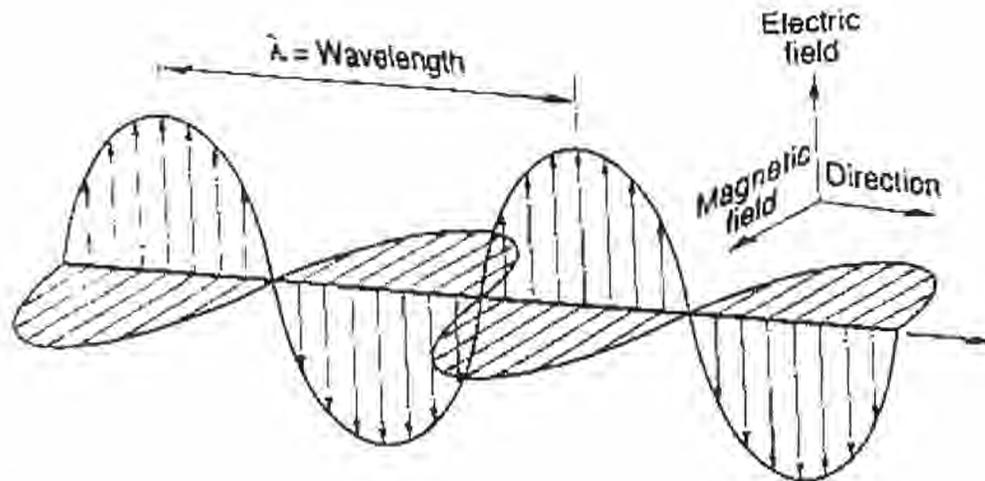
The above sketches confirm that the right of way does go through the Barkers' house and violates the intent of the RUS standards since this transmission was completely rebuilt. The existing transmission line and poles were removed before the new transmission line was constructed. Thus, the new line was required to comply with the right of way requirements.

SECTION 6 - Medical Concerns

The purpose of this section is first to explain what EMF is about, then providing information on the health issues. Next, how the health issues effect the Barkers'

XV. EMF

Electromagnetic fields consist of electric (E) and magnetic (H) waves travelling together, as shown in the diagram below. They travel at the speed of light and are characterized by a frequency and a wavelength.



Electric fields arise from electric charges. They govern the motion of other charges situated in them. Their strength is measured in units of volt per meter, (V/m), or kilovolt per meter (kV/m). When charges accumulate on an object they create a tendency for like or opposite charges to be repelled or attracted, respectively. The strength of that tendency is characterized by the **voltage** and is measured in units of volt, (V). Any device connected to an electrical outlet, even if the device is not switched on, will have an associated electric field that is proportional to the voltage of the source to which it is connected. Electric fields are strongest close the device and diminish with distance. Common materials, such as wood and metal, shield against them.

- Electric field strength is proportional to the voltage.
- The strength of electric fields decrease with distance.
- Electric fields may tend to add together or cancel each other out when there are two sets of cables involved.
- Electric fields will induce a charge on ungrounded metallic objects within the field.
- An electric field is stopped by grounded objects and can be shielded.
- People are able to detect the presence of some electric fields

Magnetic fields arise from the motion of electric charges, i.e. a current. They govern the motion of moving charges. Their strength is measured in units of ampere per meter, (A/m) but is usually expressed in terms of the corresponding magnetic induction measured in units of Tesla, (T), millitesla (mT) or microtesla (μT). In some countries another unit called the gauss, (G), is commonly used for measuring magnetic induction ($10,000 \text{ G} = 1 \text{ T}$, $1 \text{ G} = 100 \mu\text{T}$, $1 \text{ mT} = 10 \text{ G}$, $1 \mu\text{T} = 10 \text{ mG}$). Any device connected to an electrical outlet, when the device is switched on and a current is flowing, will have an associated magnetic field that is proportional to the current drawn from the source to which it is connected. Magnetic fields are strongest close to the device and diminish with distance. They are not shielded by most common materials, and pass easily through them.

- Magnetic field strength is proportional to the current.
- The strength of magnetic fields decrease with distance.
- Magnetic fields may tend to add together or cancel each other out when there are two sets of cables involved.
- Magnetic fields will induce a current in a conducting metal loop.
- A magnetic field cannot be stopped by grounded objects and other objects
- People are not able to detect the presence of magnetic fields.

A. EMF Scientific Units

- Electric field Strength (E) – units in V/m or kV/m
- Magnetic Field Strength (H) – units in A/m
- Magnetic Flux Density (B) – units in Gauss (G) or Tesla (T)
- $1\text{mG} = 0.1\mu\text{T} = 0.001 \text{ mT}$
- $1\text{A/m} = 1.25 \mu\text{T}$

B. EMF Standards and Concerns

The electrical utility and health organizations have had concerns about the effects of EMF on the human body for many years and there have been many studies to try to quantify these effects. To date, no conclusions have been reached as additional scientific data needs to be obtained. However, the data collected does show a causal relationship. As a result the international community continues to develop a large amount of data and has established standards and guidelines to reduce the potential health effects.

C. Induced currents²⁵

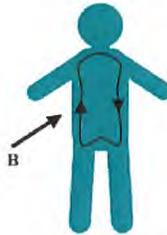
The quantum energy of 50 Hz electromagnetic fields is too small to break chemical bonds. It is clear that power-frequency EMFs or radiation does not cause ionization in

²⁵ <http://www.emfs.info/The+Science/highfields/Inducedcurrents/>

the same way that x-rays or alpha particles do. Instead, the main known way 50 Hz fields interact with people is by inducing currents.

What currents do magnetic fields produce?

Any alternating magnetic field will induce an electric field, which in turn produces a current in a conducting medium. The human body is conducting and will therefore have a current induced in it – albeit, usually, a very small one. As shown on the figure below the current circulates round the body.



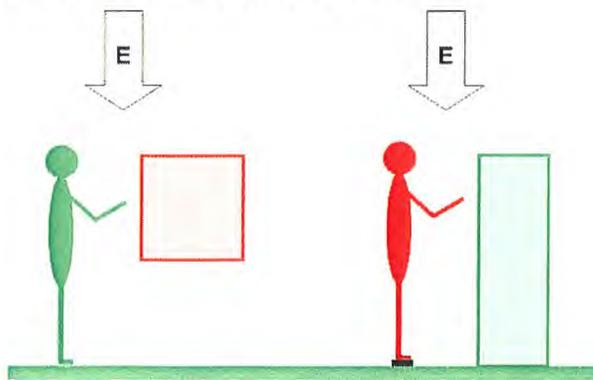
What currents do electric fields produce?

Alternating electric fields also induce currents in the body. As shown below, for a vertical field, they run up and down the body. The calculation has to take account of the perturbation to the field caused by the body itself. For a typical person standing in a vertical field, a current of 1 mA through the body is induced by 70 kV/m.



Effects of induced currents on the body

Within the body, currents induced by fields have the same range of effects as currents injected via electrodes, e.g. in an electric shock. However, these effects depend entirely on the size of the current. Thus current densities of about 0.1 A/m^2 can stimulate excitable tissue and current densities above about 1 A/m^2 can cause ventricular fibrillation, as well as producing heating. However these current densities correspond to fields far larger than are ever encountered at 50 Hz.



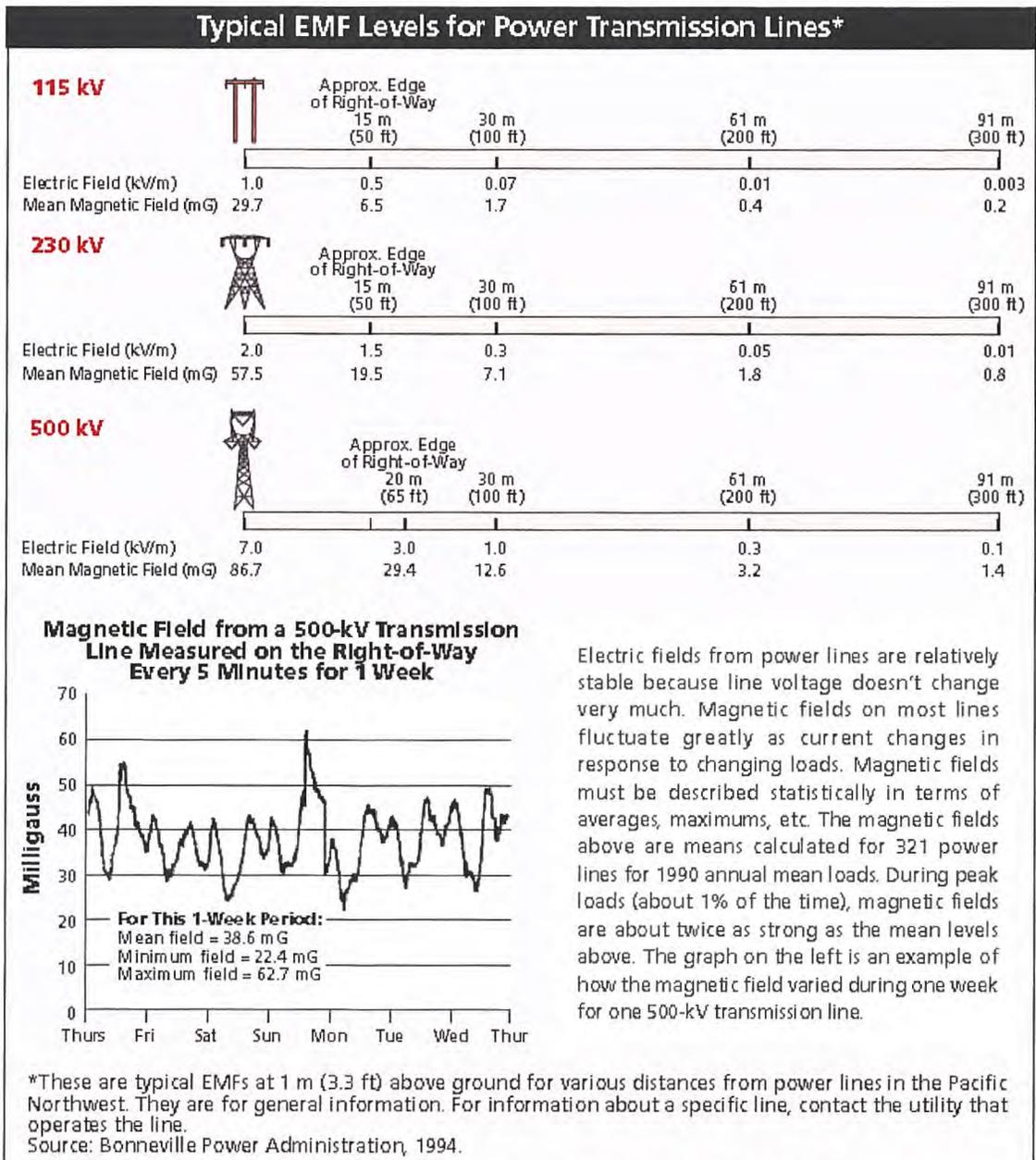
At lower fields a range of possible effects have been reported. The established effect observed in humans at the lowest magnetic field is the magnetophosphene effect, where a flickering sensation is produced in peripheral vision by 50 Hz magnetic fields above about 10 mT (i.e. 10,000 μ T). Magnetophosphenes are probably caused by induced current densities in the retina; the threshold at 20 Hz (the most sensitive frequency) is about 20 mA/m².

Micro-shocks are a related but separate phenomenon, caused not by a continuous current but by a one-off discharge.

D. Sources of EMF

Electromagnetic fields come from many sources as will be defined below. However, what we are concerned with are the fields produced by electrical transmission lines.

Magnetic Fields



Electric fields from power lines are relatively stable because line voltage doesn't change very much. Magnetic fields on most lines fluctuate greatly as current changes in response to changing loads. Magnetic fields must be described statistically in terms of averages, maximums, etc. The magnetic fields above are means calculated for 321 power lines for 1990 annual mean loads. During peak loads (about 1% of the time), magnetic fields are about twice as strong as the mean levels above. The graph on the left is an example of how the magnetic field varied during one week for one 500-kV transmission line.

Figure 13 –Typical EMF Levels for Transmission Lines²⁶

The following are typical magnetic field strengths measured with a gauss meter.

26 EMF Electric and Magnetic Fields Associated with the Use of Electric Power, June 2002, National Institute of Health

Sources of Magnetic Fields (mG)*									
	Distance from source					Distance from source			
	6"	1'	2'	4'		6"	1'	2'	4'
Office Sources					Workshop Sources				
AIR CLEANERS					BATTERY CHARGERS				
Lowest	110	20	3	–	Lowest	3	2	–	
Median	180	35	5	1	Median	30	3	–	
Highest	250	50	8	2	Highest	50	4	–	
COPY MACHINES					DRILLS				
Lowest	4	2	1	–	Lowest	100	20	3	
Median	90	20	7	1	Median	150	30	4	
Highest	200	40	13	4	Highest	200	40	6	
FAX MACHINES					POWER SAWS				
Lowest	4	–	–	–	Lowest	50	9	1	
Median	6	–	–	–	Median	200	40	5	
Highest	9	2	–	–	Highest	1000	300	40	
FLUORESCENT LIGHTS					ELECTRIC SCREWDRIVERS (while charging)				
Lowest	20	–	–	–	Lowest	–	–	–	
Median	40	6	2	–	Median	–	–	–	
Highest	100	30	8	4	Highest	–	–	–	
ELECTRIC PENCIL SHARPENERS					Distance from source				
Lowest	20	8	5	–	1' 2' 4'				
Median	200	70	20	2					
Highest	300	90	30	30					
VIDEO DISPLAY TERMINALS (see page 48) (PCs with color monitors)**					Living/Family Room Sources				
Lowest	7	2	1	–	CEILING FANS				
Median	14	5	2	–	Lowest	–	–	–	
Highest	20	6	3	–	Median	3	–	–	
Bathroom Sources					Highest				
HAIR DRYERS					50 6 1				
Lowest	1	–	–	–	WINDOW AIR CONDITIONERS				
Median	300	1	–	–	Lowest	–	–	–	
Highest	700	70	10	1	Median	3	1	–	
ELECTRIC SHAVERS					Highest				
Lowest	4	–	–	–	20 6 4				
Median	100	20	–	–	COLOR TELEVISIONS**				
Highest	600	100	10	1	Lowest	–	–	–	
					Median				
					7 2 –				
					Highest				
					20 8 4				

Figure 14 - Sources of Magnetic Fields²⁷

27 EMF Electric and Magnetic Fields Associated with the Use of Electric Power, June 2002, National Institute of Health

Sources of Magnetic Fields (mG)*									
	Distance from source					Distance from source			
	6"	1'	2'	4'		6"	1'	2'	4'
Kitchen Sources					Kitchen Sources				
BLENDERS					ELECTRIC OVENS				
Lowest	30	5	–	–	Lowest	4	1	–	–
Median	70	10	2	–	Median	9	4	–	–
Highest	100	20	3	–	Highest	20	5	1	–
CAN OPENERS					ELECTRIC RANGES				
Lowest	500	40	3	–	Lowest	20	–	–	–
Median	600	150	20	2	Median	30	8	2	–
Highest	1500	300	30	4	Highest	200	30	9	6
COFFEE MAKERS					REFRIGERATORS				
Lowest	4	–	–	–	Lowest	–	–	–	–
Median	7	–	–	–	Median	2	2	1	–
Highest	10	1	–	–	Highest	40	20	10	10
DISHWASHERS					TOASTERS				
Lowest	10	6	2	–	Lowest	5	–	–	–
Median	20	10	4	–	Median	10	3	–	–
Highest	100	30	7	1	Highest	20	7	–	–
FOOD PROCESSORS					Bedroom Sources				
Lowest	20	5	–	–	DIGITAL CLOCK****				
Median	30	6	2	–	Lowest	–	–	–	–
Highest	130	20	3	–	Median	1	–	–	–
GARBAGE DISPOSALS					High	8	2	1	–
Lowest	60	8	1	–	ANALOG CLOCKS				
Median	80	10	2	–	(conventional clockface)****				
Highest	100	20	3	–	Lowest	1	–	–	–
MICROWAVE OVENS***					Median	15	2	–	–
Lowest	100	1	1	–	Highest	30	5	3	–
Median	200	4	10	2	BABY MONITOR (unit nearest child)				
Highest	300	200	30	20	Lowest	4	–	–	–
MIXERS					Median	6	1	–	–
Lowest	30	5	–	–	Highest	15	2	–	–
Median	100	10	1	–					
Highest	600	100	10	–					

Sources of Magnetic Fields (mG)*									
	Distance from source					Distance from source			
	6"	1'	2'	4'		6"	1'	2'	4'
Laundry/Utility Sources					Laundry/Utility Sources				
ELECTRIC CLOTHES DRYERS					PORTABLE HEATERS				
Lowest	2	–	–	–	Lowest	5	1	–	–
Median	3	2	–	–	Median	100	20	4	–
Highest	10	3	–	–	Highest	150	40	8	1
WASHING MACHINES					VACUUM CLEANERS				
Lowest	4	1	–	–	Lowest	100	20	4	–
Median	20	7	1	–	Median	300	60	10	1
Highest	100	30	6	–	Highest	700	200	50	10
IRONS					SEWING MACHINES				
Lowest	6	1	–	–	Home sewing machines can produce magnetic fields of 12 mG at chest level and 5 mG at head level.				
Median	8	1	–	–	Magnetic fields as high as 35 mG at chest level and 215 mG at knee level have been measured from industrial sewing machine models (Sobel, 1994).				
Highest	20	3	–	–					
<p>Source: EMF In Your Environment, U.S. Environmental Protection Agency, 1992.</p> <p>* Dash (–) means that the magnetic field at this distance from the operating appliance could not be distinguished from background measurements taken before the appliance had been turned on.</p> <p>** Some appliances produce both 60-Hz and higher frequency fields. For example, televisions and computer screens produce fields at 10,000-30,000 Hz (10-30 kHz) as well as 60-Hz fields.</p> <p>*** Microwave ovens produce 60-Hz fields of several hundred milligauss, but they also create microwave energy inside the appliance that is at a much higher frequency (about 2.45 billion hertz). We are shielded from the higher frequency fields but not from the 60-Hz fields.</p> <p>**** Most digital clocks have low magnetic fields. In some analog clocks, however, higher magnetic fields are produced by the motor that drives the hands. In the above table, the clocks are electrically powered using alternating current, as are all the appliances described in these tables.</p>									

E. Electric Fields

In the United States, there are no federal standards limiting occupational or residential exposure to 60-Hz EMF. However, at least seven states have set standards for transmission line electric fields; two of these also have standards for magnetic fields (see table below). In most cases, the maximum fields permitted by each state are the maximum fields that existing lines produce at maximum load-carrying conditions. Some states further limit electric field strength at road crossings to ensure that electric current induced into large metal objects such as trucks and buses does not represent an electric shock hazard.

State Transmission Line Standards and Guidelines				
State	Electric Field		Magnetic Field	
	On R.O.W.*	Edge R.O.W.	On R.O.W.	Edge R.O.W.
Florida	8 kV/m ^a 10 kV/m ^b	2 kV/m	—	150 mG ^a (max. load) 200 mG ^b (max. load) 250 mG ^c (max. load)
Minnesota	8 kV/m	—	—	—
Montana	7 kV/m ^d	1 kV/m ^e	—	—
New Jersey	—	3 kV/m	—	—
New York	11.8 kV/m 11.0 kV/m ^f 7.0 kV/m ^d	1.6 kV/m	—	200 mG (max. load)
Oregon	9 kV/m	—	—	—

*R.O.W. = right-of-way (or in the Florida standard, certain additional areas adjoining the right-of-way). kV/m = kilovolt per meter. One kilovolt = 1,000 volts. ^aFor lines of 69-230 kV. ^bFor 500 kV lines. ^cFor 500 kV lines on certain existing R.O.W. ^dMaximum for highway crossings. ^eMay be waived by the landowner. ^fMaximum for private road crossings.

Figure 15 - State Transmission Line Standards and Guidelines²⁸

Add North Dakota to the above list.

Two organizations have developed voluntary occupational exposure guidelines for EMF exposure. These guidelines are intended to prevent effects, such as induced currents in cells or nerve stimulation, which are known to occur at high magnitudes, much higher (more than 1,000 times higher) than EMF levels found typically in occupational and residential environments. These guidelines are summarized in the tables below.

The International Commission Non-Ionizing Radiation Protection (ICNIRP) concluded that available data regarding potential long-term effects, such as increased risk of cancer, are insufficient to provide a basis for setting exposure restrictions.

The American Conference of Governmental Industrial Hygienists (ACGIH) publishes "Threshold Limit Values" (TLVs) for various physical agents. The TLVs for 60-Hz EMF shown in the table are identified as guides to control exposure; they are not intended to demarcate safe and dangerous levels.

The following are several other standards found:

- California Safety Limits for Public Schools 1.2 mG²⁹
- Swiss Standard 2.5 mG ELF³⁰
- Swedish standard 1.0 mG³¹

28 EMF Electric and Magnetic Fields Associated with the Use of Electric Power, June 2002, National Institute of Health

29 EMF Levels & Safety, ScanTech Consultants, www.scantech7.com

30 EMF Levels & Safety, ScanTech Consultants, www.scantech7.com

31 EMF Levels & Safety, ScanTech Consultants, www.scantech7.com

ICNIRP Guidelines for EMF Exposure		
Exposure (60 Hz)	Electric field	Magnetic field
Occupational	8.3 kV/m	4.2 G (4,200 mG)
General Public	4.2 kV/m	0.833 G (833 mG)

International Commission on Non-Ionizing Radiation Protection (ICNIRP) is an organization of 15,000 scientists from 40 nations who specialize in radiation protection.
Source: ICNIRP, 1998.

ACGIH Occupational Threshold Limit Values for 60-Hz EMF		
	Electric field	Magnetic field
Occupational exposure should not exceed	25 kV/m	10 G (10,000 mG)
Prudence dictates the use of protective clothing above	15 kV/m	–
Exposure of workers with cardiac pacemakers should not exceed	1 kV/m	1 G (1,000 mG)

American Conference of Governmental Industrial Hygienists (ACGIH) is a professional organization that facilitates the exchange of technical information about worker health protection. It is not a government regulatory agency.
Source: ACGIH, 2001.

Figure 16 - Guidelines³²

F. Does EMF affect people with pacemakers or other medical devices?

According to the U.S. Food and Drug Administration (FDA), interference from EMF can affect various medical devices including cardiac pacemakers and implantable defibrillators. Most current research in this area focuses on higher frequency sources such as cellular phones, citizens band radios, wireless computer links, microwave signals, radio and television transmitters, and paging transmitters.

Sources such as welding equipment, power lines at electric generating plants, and rail transportation equipment can produce lower frequency EMF strong enough to interfere with some models of pacemakers and defibrillators. The occupational exposure guidelines developed by ACGIH state that workers with cardiac pacemakers should not be exposed to a 60-Hz magnetic field greater than 1 gauss (1,000 mG) or a 60-Hz electric field greater than 1 kilovolt per meter (1,000 V/m) (see ACGIH guidelines above). Workers who are concerned about EMF exposure effects on pacemakers, implantable defibrillators, or other implanted electronic medical devices should consult their doctors or industrial hygienists.

³² EMF Electric and Magnetic Fields Associated with the Use of Electric Power, June 2002, National Institute of Health

Non-electronic metallic medical implants (such as artificial joints, pins, nails, screws, and plates) can be affected by high magnetic fields such as those from magnetic resonance imaging (MRI) devices and aluminum refining equipment, but are generally unaffected by the lower fields from most other sources.

The FDA MedWatch program is collecting information about medical device problems thought to be associated with exposure to or interference from EMF.

What is a safe level of induced current?

Exposure guidelines are usually designed to prevent all effects of induced currents, on the basis that any effect in the brain or nervous system is potentially harmful. For example, the ICNIRP exposure guidelines currently recommend that people at work should not be exposed to current densities in the head, neck and trunk of greater than 10 mA/m^2 (the "basic restriction") with a lower limit of 2 mA/m^2 for the general population, which may include people who are more sensitive because of medical conditions.

G. Effects on equipment

There are several types of equipment that can be affected by fields. However, the fields required are usually rather higher than those commonly encountered in the environment.

- Credit cards, railway tickets etc. have information encoded on a magnetic strip. This can be corrupted by magnetic fields above about $10,000 \mu\text{T}$. Such fields almost never occur at 50 Hz, but a problem can arise with static fields such as those from magnetic catches on handbags.
- Some cars with electronic control systems have been found to be susceptible to interference from power-frequency magnetic fields above about $2,000 \mu\text{T}$. Again, such fields are rare at 50 Hz. This tends to be more of a problem at higher frequencies.
- There is no direct effect of EMFs on bicycles but riding a bicycle under a high-voltage power line can produce a micro-shock.
- Quartz watches with analogue dials use a small stepper motor to drive the hands. This stepper motor can be driven by a suitably oriented external power-frequency magnetic field of about $1000 \mu\text{T}$ or greater, causing the hands to rotate 100 or more times faster than normal. The effect is spectacular but has not been found to cause any damage to the watch.
- Power-frequency electric and magnetic fields constitute a possible source of interference with the operation of some types of implanted cardiac pacemakers or other active implants. Interference has been reported in certain models of implanted cardiac pacemaker with electric fields above about 1.5 kV/m and with magnetic fields above about $100 \mu\text{T}$ at 50 Hz, though interference would not usually occur at fields as low as these. Most pacemakers are designed to 'fail safe' by reverting to fixed-rate operation when they sense the presence of interference above a certain level. The field strengths necessary to induce such behavior vary from one pacemaker model to another but are generally higher than the fields encountered in the environment. There has been no recorded case in Britain of a patient coming to any harm as a result of fields produced

by the power system. The UK Department of Health, Medicines and Healthcare products Regulatory Agency (MHRA), does not consider that transmission-line electric or magnetic fields constitute a significant hazard. More detail on EMFs and implanted medical devices.

- Magnetic fields may, in some circumstances, affect the steadiness of the image on visual display units (VDUs) which use cathode-ray tubes. This can occur if the frame frequency of the VDU is close to but different from the power frequency (50 Hz). The effect is to cause the image to wobble at a frequency, which depends on the difference between the frame frequency and the power frequency. Some VDU models may typically be sensitive to fields of 0.5 microtesla, although liquid-crystal, plasma and other modern display technologies are virtually immune from such problems. Limited amelioration can be achieved by careful orientation of the VDU and by screening. Screening magnetic fields is, however, difficult; even using high-permeability alloys such as "mumetal", worthwhile screening factors still require large amounts of the screening material.
- A fluorescent tube works by an electric field inside the tube causing a discharge, and this electric field can come either, as normally, from applying a mains voltage across the tube, or from the electric field produced by a power line. So fluorescent tubes will produce a visible glow under a power line, though usually it is only visible after dark as it is much weaker than the light they normally produce. The current through a fluorescent tube under a power line would probably be 20 – 200 micro-amps (μA) depending on the field. This is much less than a person can normally perceive, so you can hold the tube yourself under the power line without it hurting. (For comparison, a 10 W tube at 230 V draws 40 mA – 200 times greater). You can sometimes also make a fluorescent tube produce visible flickers by holding one end and rubbing your foot on a carpet to generate static electricity, though again, this needs to be done in a dark room.

H. Micro-shocks³³

In certain circumstances, a person exposed to a high electric field could experience small spark discharges on touching other objects.

This can happen two different ways. In both cases the common feature is the person touching an object, where one is at earth potential and the other, which is not earthed, has been raised to a higher potential by the electric field. When the person touches the object, charge flows so as to equalize the potentials, and this charge, concentrated on the small area of skin where contact is first made, creates the micro-shock.

The size of micro-shocks

The size of a micro-shock depends on the size of the objects concerned and how well grounded or insulated they are, as well as the field, so it is not possible to set a simple field limit to prevent them. Generally speaking, below 5 kV/m they are not a problem. Above 5 kV/m they may start being painful, depending on the individual situation.

How sensitive people are to micro-shocks

³³ <http://www.emfs.info/The+Science/highfields/Microshocks/Microshocks.htm>

There is data from America showing that in a field of 5 kV/m, for example, around 80% of people will perceive a micro-shock when touching a grounded object, but only about a quarter will describe it as annoying.

Micro-shocks and bicycles

One particular way a micro-shock can be experienced is by riding a bicycle under a high-voltage power line.

Micro-shocks are the phenomenon when a person gets charged in an electric field. When they touch a conducting object they discharge, and although the amount of charge involved is small, because that is concentrated on the small area of the skin where the contact is first made, it produces a sensation very much like the discharge you can sometimes get after walking across a carpet. See more on micro-shocks in general.

One specific way this can happen is by riding a bicycle underneath a high-voltage power line. If you are in electrical contact with a metal part of the bicycle all the times, then no charge can build up between you and the bicycle, and you should not experience any micro-shocks. However, if you are electrically isolated from the bicycle - e.g. you are holding rubber handlebar grips, or are wearing insulating gloves - then a charge can build up. This can then discharge as a micro-shock. The most common place for this to happen is either on the fingers if they brush against the brake lever, or in the inside of the upper thigh, as it comes close to the top of the seat pillar just below the saddle or to the saddle rails once each pedal revolution.

These micro-shocks do not cause any harm to the body or have any lasting effects that we know of. However, in the highest fields - that is, under spans of 400 kV power lines with the lowest clearance - they can be mildly painful, and they are certainly disconcerting because they are usually unexpected. (more on electric field levels under high-voltage power lines and on the sizes of the voltages and charges involved in micro-shocks)

How exposure limits change from 50 to 60 Hz

Exposure limits can vary a lot over the full range of frequencies from extremely low to radio frequencies. But even within the extremely low frequency range - where power systems operate - there can be differences between 50 Hz and 60 Hz. 50 Hz is used in parts of the world more influenced by British and European practice, 60 Hz is used in parts of the world more influenced by American practice.

In this page we summarize how the values of the exposure limits change from 50 to 60 Hz.

I. The 1998 ICNIRP Guidelines

These are the values used in the 1998 ICNIRP guidelines themselves and also the EU Recommendation for public exposure and Directive for occupational exposure which are based on them

	50 Hz	60 Hz	Units
Occupational			
basic restriction	10	10	mA/m^2
magnetic field reference levels	500	417	μT
electric field reference level	10	8.333	kV/m
General public			
basic restriction	2	2	mA/m^2
magnetic field reference levels	100	83	μT
electric field reference level	5	4.167	kV/m

J. The 2010 ICNIRP Guidelines

	50 Hz	60 Hz	Units
Occupational			
basic restriction: Head	100	120	mA/m^2
basic restriction: Whole Body	800	800	mA/m^2
magnetic field reference levels	1000	1000	μT
electric field reference level	10	8.333	kV/m
General public			
basic restriction: Head	20	24	mA/m^2
basic restriction: Whole Body	400	400	mA/m^2
magnetic field reference levels	200	200	μT (2000mG)
electric field reference level	5	4.167	kV/m

K. CONSIDERATIONS REGARDING POSSIBLE LONG-TERM EFFECTS³⁴

As noted above, epidemiological studies have consistently found that everyday chronic low-intensity (above 0.3– 0.4 μT) (3 – 4mG) power frequency magnetic field exposure is associated with an increased risk of childhood leukemia. IARC³⁵ has classified such fields as possibly carcinogenic. However, a causal relationship between magnetic fields

³⁴ ICNIP Guidelines, 2010

³⁵ International Agency for Research on Cancer

and childhood leukemia has not been established nor have any other long term effects been established. The absence of established causality means that this effect cannot be addressed in the basic restrictions. However, risk management advice, including considerations on precautionary measures, has been given by WHO (2007a and b) and other entities.

L. Cardiac Pacemakers and Similar Devices

American Conference of Governmental Industrial Hygienist (ACGIH) issued standards for workers in 2001.³⁶

The American Conference of Governmental Industrial Hygienists (ACGIH) issued guidelines for EMF exposure for workers with pacemakers or implantable defibrillators. Maximum safe exposure for workers with these medical devices at 60 Hz (the frequency of most transmission lines) is **1 G (1,000 mG)** for magnetic fields and **1 kV/m** for electric fields.

Workers with Cardiac Pacemakers 1kV/m 1000mG

M. Controversy Over EMF

The health and safety issues of EMF have existed for many years and after thousands of tests and research projects, there is no consensus as to the existence or severity of these effects. One of the biggest problems with the EMF health issue is the lack of consensus on how research is performed. Some of the following questions still have to be agreed to.

- What is Proof? Is an unreasonably high and overly-restrictive definition of proof keeping organizations from accepting the issues?
- What is sufficient proof? How much proof is needed?
- Are we researching all EMF frequencies during a research project or do we limit the research to just power line frequencies?
- Do we have to determine the exact mechanisms that cause a disease to take precautions? We still don't know how a lot of cancers work yet we believe that cancer is a serious issue.
- Do we have to be able to reproduce in the laboratory using mice before we accept that there is a serious concern?
- Some of these issues have existed for many years. As research continues with 1800 such projects over the last few year some of the last to issues have started to be proven, such as a potential mechanism as to how EMF cause disease has been found and as well as some EMF effects have been replicated in laboratory mice.
- As of today, no one has proven that EMF does not affect health.

³⁶ www.capx2020.com/Images/EMF_factsheet.pdf

The World Health Organization has reviewed over 1800 new studies between 2007 and 2012 on EMF health effects.

EPRI has performed research on EMF effects for over 30 years.

"The World Health Organization (WHO) has weighed the full body of evidence from all these studies and classified EMF as "**possible carcinogenic**," primarily because of observations made in human populations that show an association between magnetic field exposures and childhood leukemia." (EPRI publication: EMF and Your Health, January 2012).

EPRI EMF Research News: American Journal of Epidemiology on November 5, 2008, reported an increased risk in mortality from Alzheimer's disease and senile dementia among people who live less than 50 meters (164 feet) from power lines, compared with those who lived at least 600 meters (1968 feet) from power lines.

Xiaoming Shen and his colleagues of Jiao Tong University School of Medicine in Shanghai announced the results of research that may **finally explain just how EMF radiation causes childhood leukemia**. They finally determined that the distribution of leukemia among children living near high voltage power lines or transformers is not random; rather, it affects children carrying a certain genetic variant that is, the ability to repair DNA breaks vastly more often.^{37 38 39}

Acute exposure to a 60 Hz increases DNA strand breaks in rat brain cells.⁴⁰ And these are repeatable tests.

XVI. TRANSMISSION LINE SAG:

All cables that are stretched between two poles will have some amount of sag in the center of the span. The amount of sag is a function of:

- Cable Weight
- Cable Tension
- Cable Temperature
- External Temperature
- Wind
- Ice

Electrical cables also are affected by the electrical current passing through the cable. Due to the internal resistance of the cable heat builds up in the cable and this heat causes cable elongation and additional sag. From the time when the cable is first installed the cable will also

37 Faulty DNA Repair May Explain EMF Role in Childhood Leukemia, Microwave News, December 15, 2008

38 Power-line radiation and childhood leukemia, IEEE spectrum, December 16, 2008

39 Leukemia & Lymphoma, Dec. 2008

40 Bioelectromagnetics vol 18, issue 2, pages 156-165, H. Lai & N.P. Singh

stretch which will cause additional sag. The following two diagrams show the affects of cable sag.

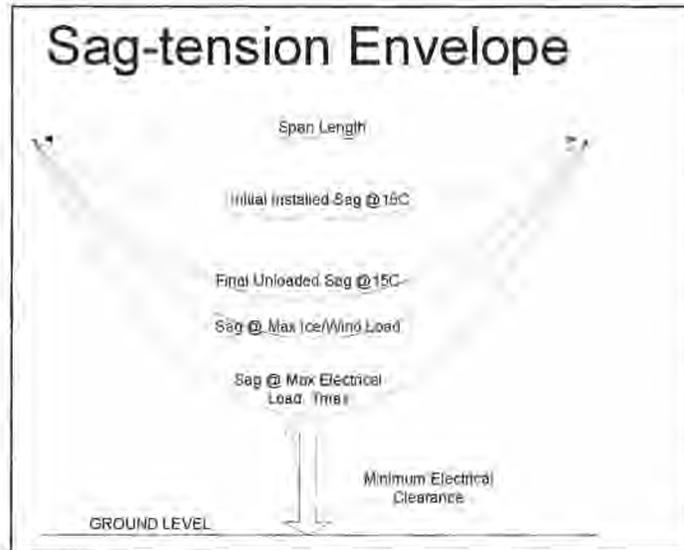


Figure 17 – Transmission Line Sag-Tension⁴¹

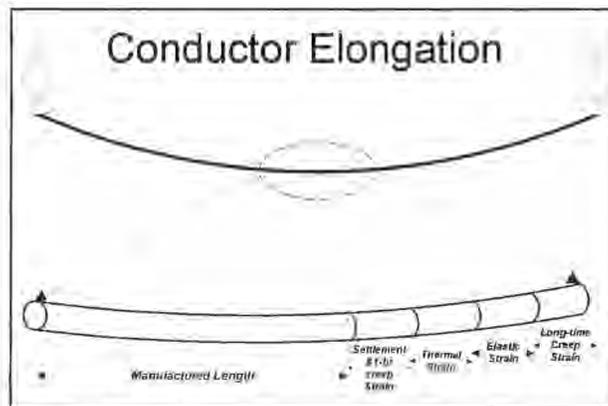


Figure 18 - Transmission Line Elongation⁴²

A. Cables:⁴³

The following data is based upon the cables used in the transmission line crossing the Barker property.

Upper cable (Dual Cables):

- Measured diameter: 1.182 inches
- Measured strand diameter: 0.132 inches

41 IEEE TP&C Tutorial June 2005

42 IEEE TP&C Tutorial June 2005

43 Data estimated from samples left behind on Barker property

Estimated cable type: Alcan
 ACSR 954kcmil 1.196 in dia 54/7 Al/St 0.1329 AL cond. Dia.
 Code Name Cardinal Alcan base cost \$3.0725 per foot⁴⁴

Lower cable:

Measured diameter: 1.1120 inches
 Measured strand diameter: 0.18 inches
 Estimated cable type: Alcan
 ACSR 795kcmil 1.108 in dia 26/7 Al/St 0.1749 AL cond. Dia.
 Code Name Drake Alcan base cost \$2.3849 per foot

B. Cable Sag Calculations.⁴⁵

The two cables being considered are separated by 1070 feet and the pole height is approximately 118 FT(top of upper cross arm).

	Upper Cable	Lower Cable	Tension
Estimated Initial Sag:	20.79	19.87	25%
Estimated Final Sag:	26.85	26.61	19.4%/18.7%
Estimated Sag @ 167 Degrees F	29.5	28.8	17.6%/17.2%
Estimated Sag @ 212 Degrees F	32.3	31.58	16.1%/15.7%

Definitions:

Thermal Rating - The maximum electrical current, which can be safely carried in overhead transmission line (same meaning as ampacity).

RBS - Rated Breaking Strength of conductor. A calculated value of composite tensile strength, which indicates the minimum test value for stranded bare conductor. Similar terms include Ultimate Tensile Strength (UTS) and Calculated Breaking Load (CBL).

⁴⁴ Alcan 1/3/12 base price from the internet

⁴⁵ Sag and Tension of Conductors by D.A. Douglas & Ridley Thrash, 2006

SECTION 7- MEASUREMENTS

XVII. FIELD MEASUREMENTS:

Various EMF measurements were made at the Barker home since the new line was energized.

A. Magnetic Field Measurements in the House:

The following is a partial list of magnetic field measurements taken at the Barker house.

	Kitchen sink	12 Ft. from sink	30 Ft. from Sink	
5/1/11	8.3 mG	6.4 mG	5.0 mG	12:00 Noon
6/3/11	14.9 mG	9.1 mG	7.4 mG	9:52 PM
6/16/11	20.9 mG	15.8 mG	12.4 mG	1:00 PM
2/6/12	10.5 mG	8.3 mG	6.4 mG	3:50 PM
2/13/12	21.9 mG	17.0 mG	13.8 mG	4:45 AM
4/11/12	2.3 mG	1.6 mG	1.1 mG	6:30 AM

B. Voltage Measurements by the Barker Family

5/23/11	256 VAC	5:15PM	Truck
6/16/11	288 VAC	1:00 PM	Truck
2010	265.7		
2010	253.5		
?	330.0		



Figure 19 – Measurement by Brooks Barker

265.7 V was measured by Brooks Barker in 2010. The measurement was from the wheel lug nut to the earth. A similar measurement was also made in 2010 and the reading was 253.5 V. Readings have been made as high as 330v.

C. Measurements by EKPC⁴⁶

On December 5, 2008, 12:20 to 1:10 P.M. EKPC made measurements of the electric field strength on the property of the Barkers. They began at the corner of the house under the carport. The made a measurement every 5 feet from the house to a point 100 feet from the house. The temperature that day was 27 degrees F and both the 345kV and the 69kV lines were energized.

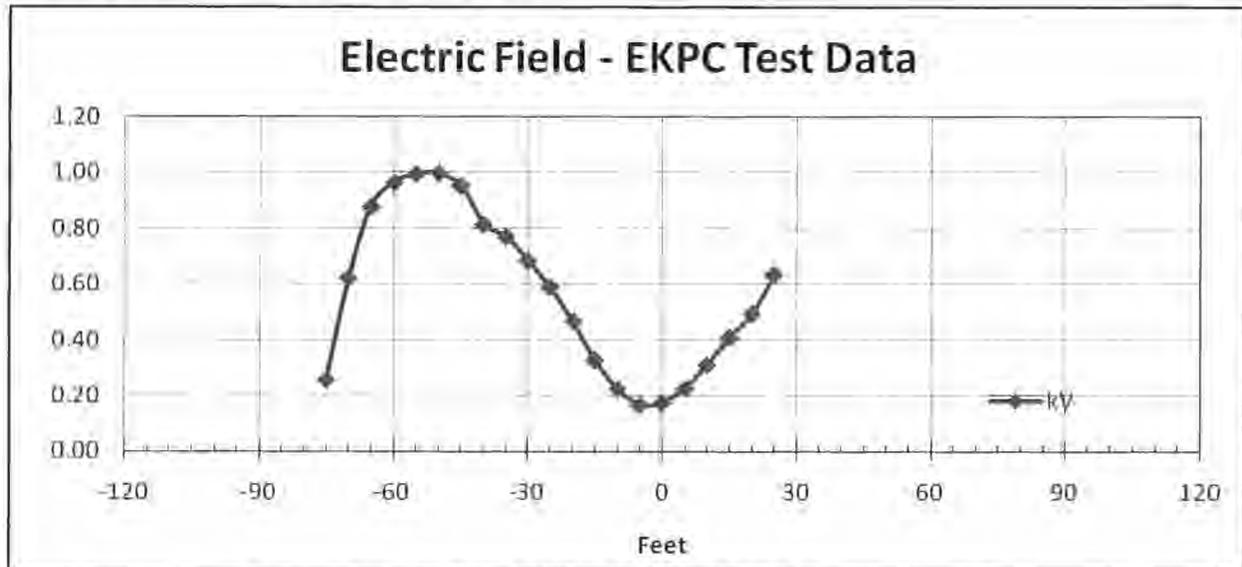


Figure 20 - Plot of EKPC Electric Field Measurements

⁴⁶ Report to Sherman Goodpaster from Paul Dolloff on December 8, 2008

D. Measurements By PECl

Measurements made by Pfeiffer Engineering Co., Inc. (PECl) were made on January 19, 2012 with the temperature at approximately 35 Degrees F. Pfeiffer Engineering used an Alpha Lab Model UHS ac milligauss meter.

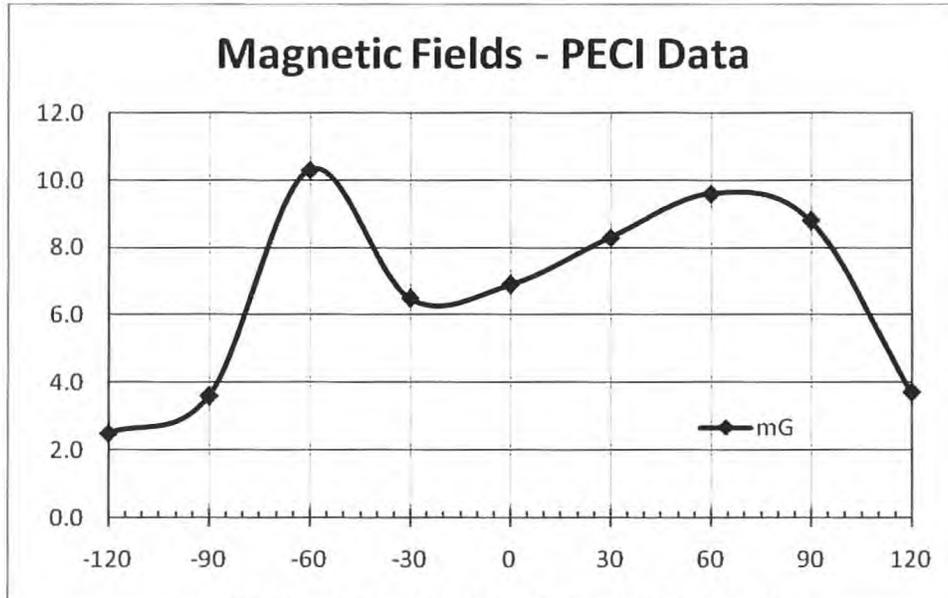


Figure 21 - Plot of PECl Magnetic Field Data



Figure 22 – Magnetic Fields Measurement Methods – Shows the line, measuring wheel and Flags

The method we used was to attach a line to the rear corner of the garage (North West) and run the line out into the field to a point past the transmission line. The line was moved until it was approximately parallel with the back side of the garage. It was also approximately perpendicular to the transmission line. Next, the center transmission line cable was located and marked with a flag. From that point measurement points were marked at 30 foot intervals and measurements were taken.

E. Effects of the Land

Both sets of field measurements resulted in unusual looking plots. This is because, as we move from the house toward the center of the transmission line, the land falls off to the east. This causes the distance from the measuring point to the transmission line to be inconsistent. Also as we go past the first cable of the transmission line the measurements are distorted by the fields from all the cables interacting. Thus, the data becomes complex and some of it has to be discarded.



Figure 23 – Magnetic Field Measurements – Note the Drop Off of the Land



Figure 24 – Magnetic Fields Measurements – Showing Where Measuring Line was Run

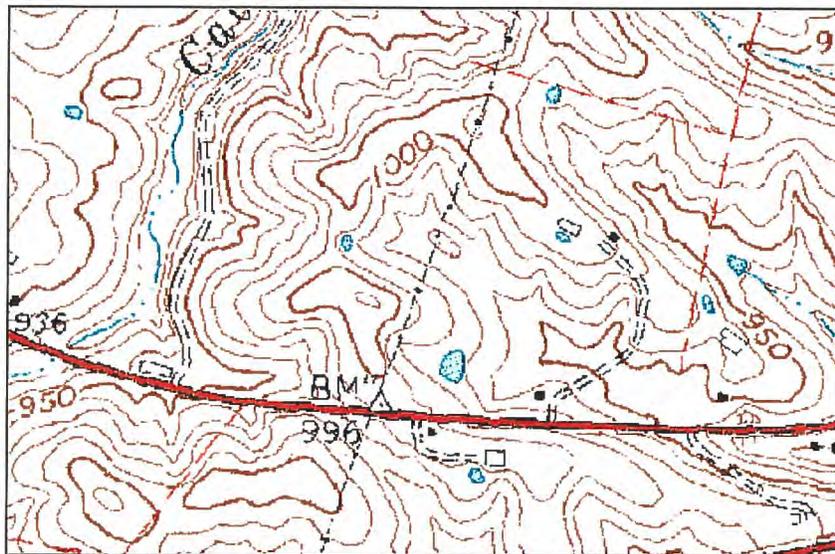


Figure 25 – Topographical Map of the Barkers' Farm

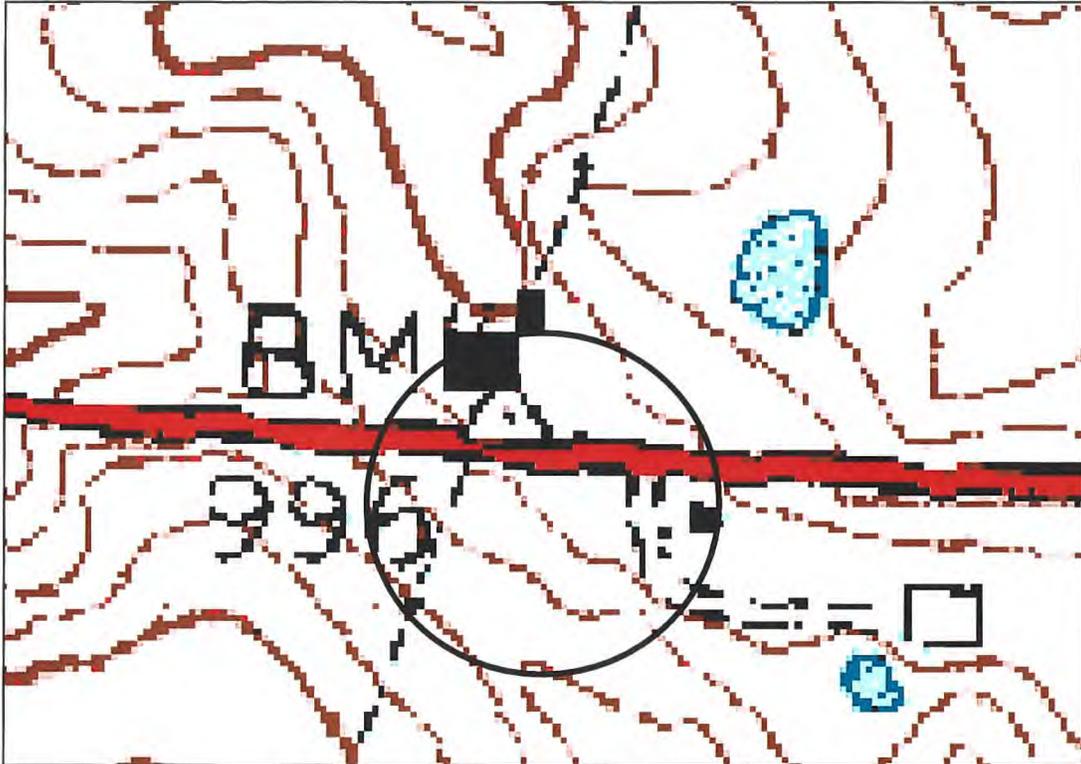


Figure 26 - Circle is ~200 Ft. in Diameter

The above figure shows roughly how much the land drops off under the transmission lines.



Figure 27 - Establishing a Reference

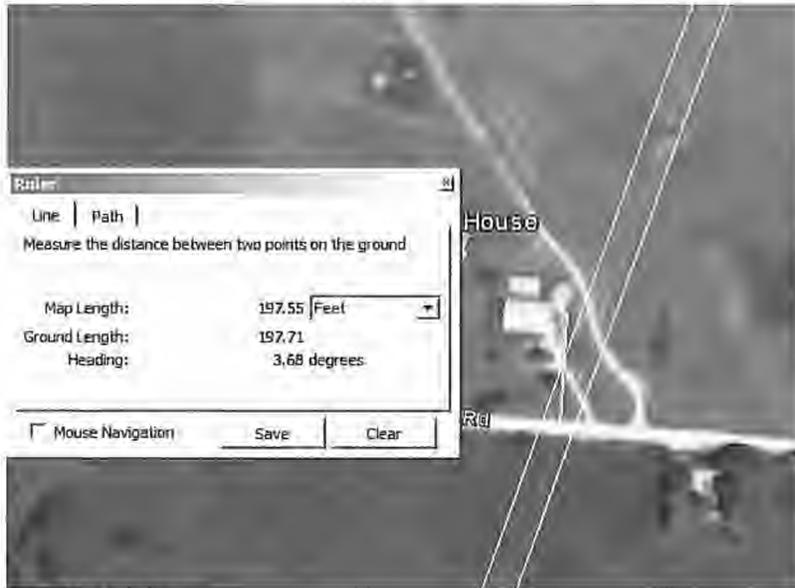


Figure 28 - Establishing a Reference

The above aerial photographs allow us to establish a scale on the topographical map and thus show the approximate location of the Barkers' house. From this we can estimate how much the ground drops off during the measurements of the electric and magnetic fields.

The following charts have been lined up so we can compare the values with respect to the house.

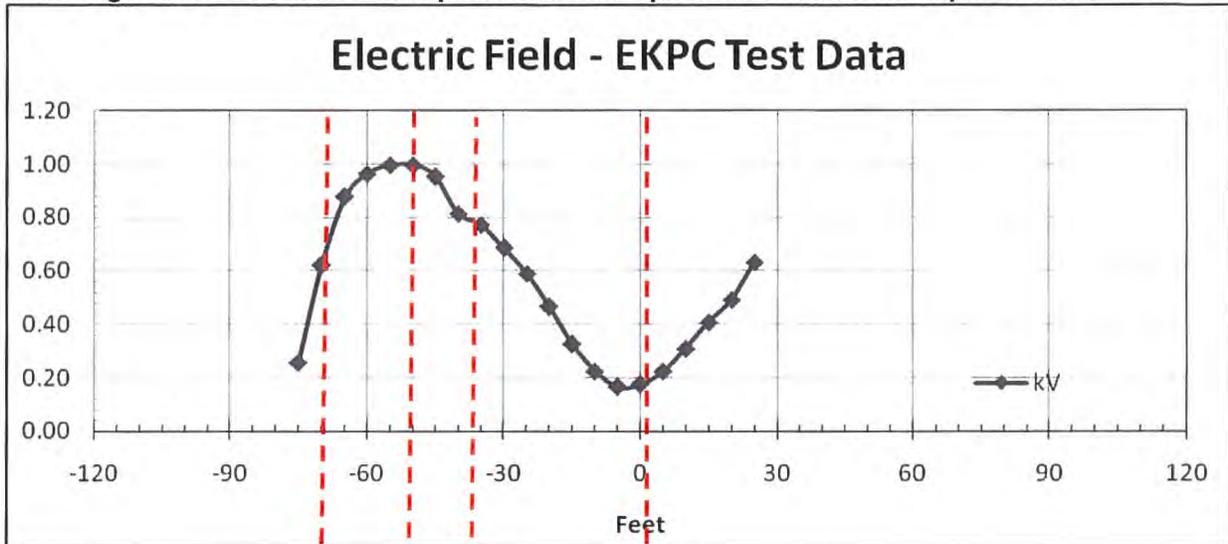


Figure 29 –Electric Field Measurements

Center of Power Line

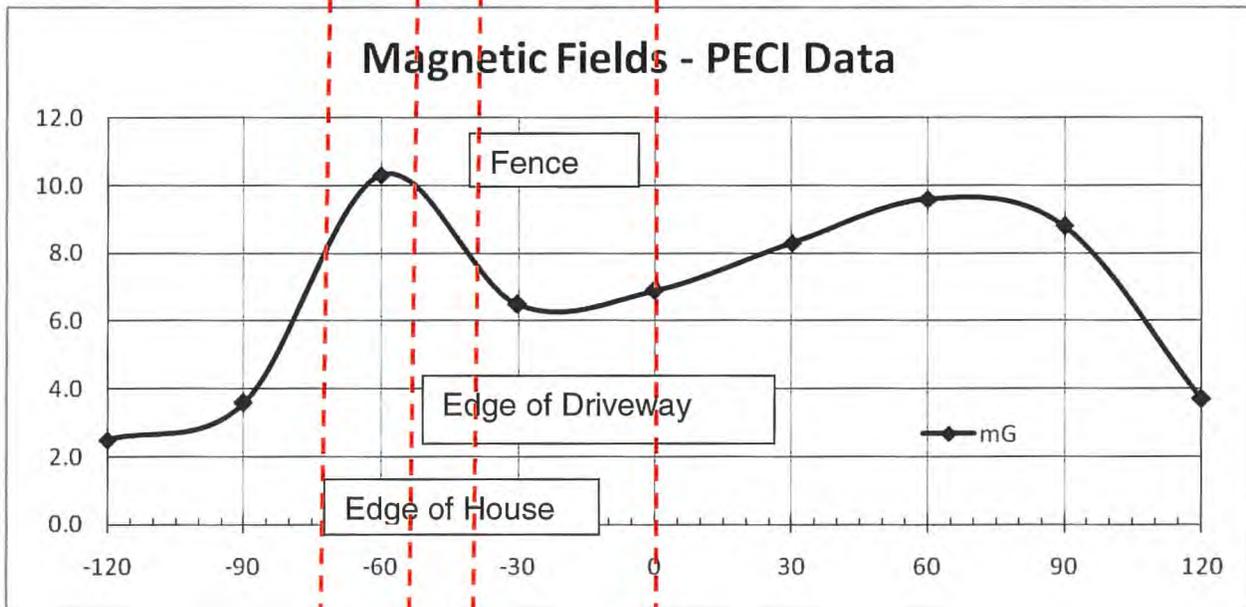


Figure 30 – Magnetic Field Measurements

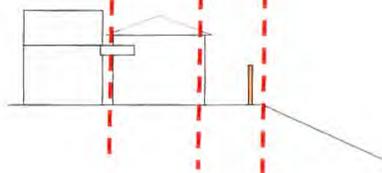


Figure 31 - Rough Sketch Showing Approximately Where the Measurements Were Made

Note that the ground drops off past the fence. This drop off causes the above data to be distorted as we approach the center of the power line.

The above show the following measurements as displayed in the above chart.

	Electric	Magnetic Fields
At the edge of the house	0.257 kV/m	8.0 mG
Just off the outer edge of the driveway	0.996 kV/m	10.0 mG
At the fence	0.793 kV/m	8.0 mG
Center of the power line	0.176 kV/m	7.0 mG

The primary area of concern is the area between the house and the fence where people are likely to walk. Below is an aerial view of the Barker property with the above measurements.

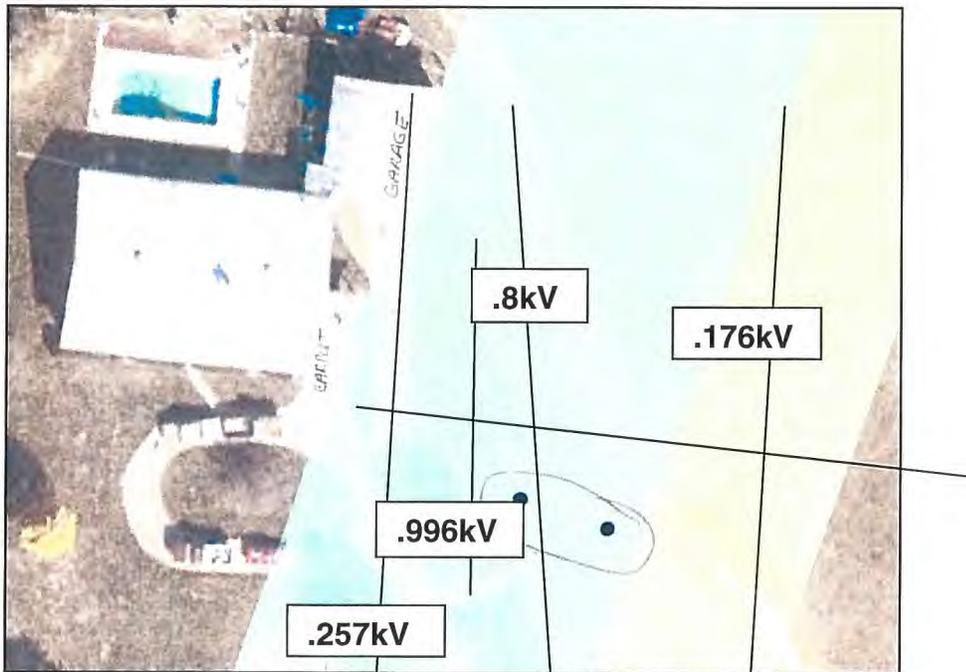


Figure 32 - EKPC Electric Field Measurements

F. Reality of Measurements:

The measurements shown above, while accurate do not represent the worse-case conditions. There are a number of variables that affect the intensity of the electric and magnetic fields.

4. 138 kV Line

This line, at the time of the measurements, was operated at 69kV. Thus, the resultant EMF is lower that what can be expected in the future.

5. Electrical Energy

The EKPC electric field measurements were made with the power line operating under the following conditions:

Actual Conditions			Maximum ⁴⁷ Winter/Summer	Load vs. Capacity (W)
345kV Line	351.9kV	255.2 MVA	1948/1554	13.1%
69kV Line	71.0kV	17.1 MVA	351/280	4.9%

Temperature: ²⁷ Degrees F with a constant breeze

Pfeiffer Engineering magnetic field measurements were made with the power line operating under the following conditions:

Actual Conditions			Maximum Winter/Summer	Load vs. Capacity (W)
345kV Line	67.8 MVA avg	(28 to 110MVA)	1948/1554	3.5%
69kV Line	28.4 MVA avg	(27 to 29 MVA)	351/280	8.1%

6. Maximum Line Conditions:

Thermal Capacity (MVA)

Normal/Contingency Conditions⁴⁸

176/212 Degree F Operation

<u>Winter</u>	<u>Summer</u>
---------------	---------------

2-345kV Line	1746 MVA	1947 MVA	1257 MVA	1554 MVA
69kV Line	315 MVA	351 MVA	227 MVA	280 MVA

7. Full Load Effects:

From the above data it is easy to see that the measurements were made in the winter where the temperature was low and the transmission lines were being operated at well below their capacity. Also the lower line was operated at 69kV where it is planned for the line to be operated at twice that voltage or at 138kV.

As the lower line's voltage is raised it will cause the electric fields to rise. As the energy is increased the magnetic fields will also increase. Also, as the energy levels (MVA) increase the transmission lines will begin to sag.

⁴⁷ Table 2 EKPC typical Line Ratings - Commonwealth of KY Before the Public Service Commission, Case 2006-00463, 7/16/07

⁴⁸ Table 2 EKPC typical Line Ratings - Commonwealth of KY Before the Public Service Commission, Case 2006-00463, 7/16/07

The measurements made by EKPC and PECEI were made when the energy transmission was low and the temperature was low so the sag would be near the design final sag values of 26.85 & 26.61 feet. As the weather heats up and the electricity demand increases due to the use of air conditioning. The lines will sag more.

For the first few years after the transmission lines are installed the electric load on the lines is expected to be low as is shown in the data. However, all such lines are designed for future load increases and thus, it is reasonable to expect the loading on these lines will increase and will approach their design capacity sometime in the future. Thus, we need to look at the affects of further line sag.

Transmission lines are designed for normal operation at line capacity, which is the point where the cables will heat up to a point where their temperature will reach between 167 and 176 degrees F and under emergency conditions for the temperature to reach up to 212 degrees F for extended periods of time. Transmission lines can also be expected to exceed 212 degrees F for short periods of time.

As the sag in the transmission lines increase the electric fields and magnetic fields at the edge of the house will increase because the sag will lower the lines and thus bring them closer to the house.

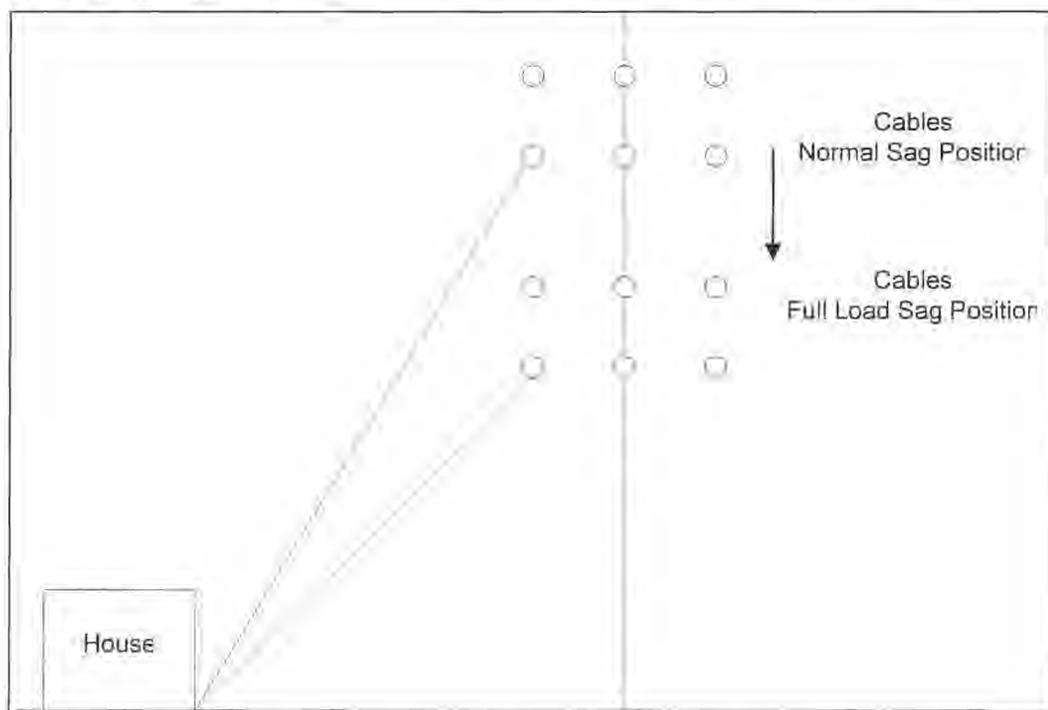


Figure 33 - Transmission Line Sag Effects

The above sketch shows the affects of increasing the sag on the power lines. The lines become closer to the house and the drive way.

From the above the electric and magnetic field measurements, under winter conditions, with minimal levels of energy flow are as follows:

	Electric Fields	Magnetic Fields
At edge of driveway	0.996 kV/m	8mG
Standards	1.0 kV/m	1000mG

From the above it can be seen that the electric fields are the main concern. At the time of the tests the electric fields were at the limit of the recognized standards. Further, it is known that:

- Increasing the voltage of the 69kV line to 138kV will increase the electric fields.
- Increasing the energy transmission levels will increase the sag, which will increase the electric fields.
- Increasing the energy transmission levels will increase the magnetic fields.

G. Electric Fields Data

We next need to compare the measured data against typical data for transmission lines. The following chart shows the typical electric field under a 345kV line. This chart is for a transmission line with only one circuit where as the new transmission line has two circuits.

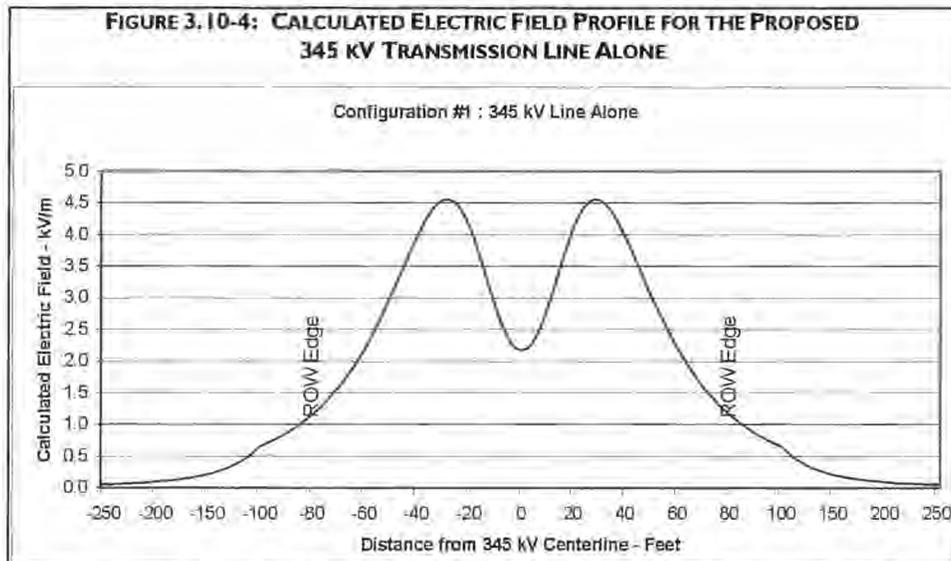


Figure 34 – Typical Electrical Fields for a 345kV Transmission Line – Single Circuit

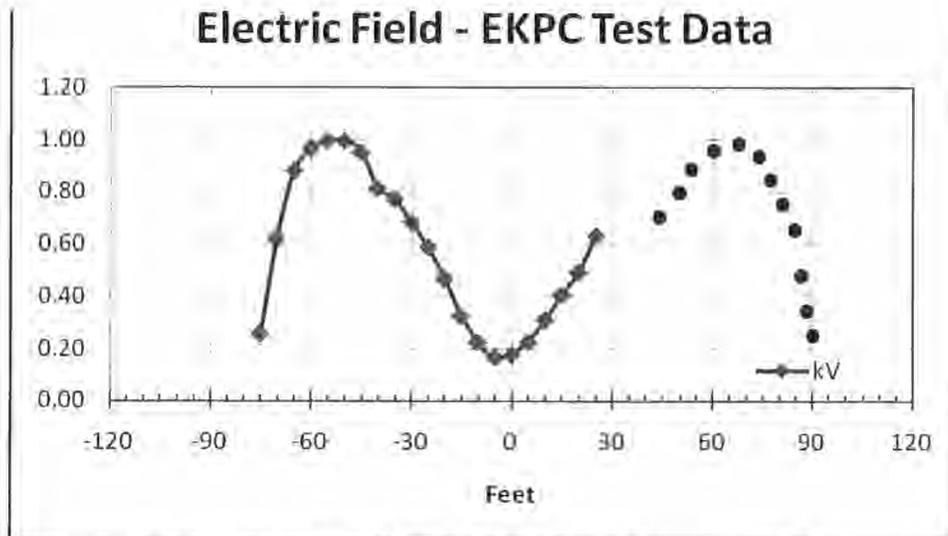


Figure 35 – EKPC Electric Fields Measured Data

In comparing the two charts, they look nothing alike. By adding a few dots as shown above the curve starts to compare to the above. The distorted data is partly due to the land dropping off rather than being flat. The fact that the transmission line has two circuits, one at 345kV and the other at 69kV complicates this issue and further distorts the data. Also the last point measured (toward the house) was measured under the carport. The carport blocked a part of the electric fields.

In order to analyze the data only a small part of the data could be used. The analysis process began with the development of standardized models for electric and magnetic fields. Next, the models were adjusted for actual site conditions and then compared against field data.

Electromagnetic fields decrease (decay) as you move away from the transmission lines. The following chart shows the typical decay of electric and magnetic fields. In general the decay is in the order of $1/R$ where the R is the distance from the transmission line.

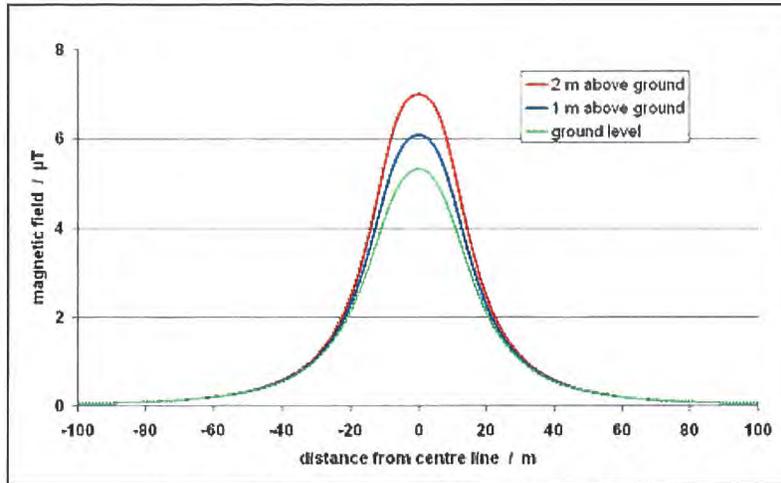


Figure 36 - Typical Magnetic Fields

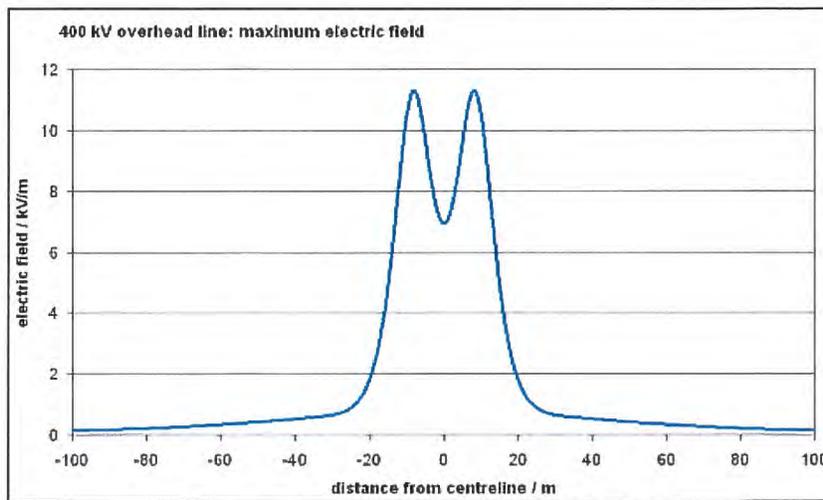


Figure 37 - Typical Electric Fields

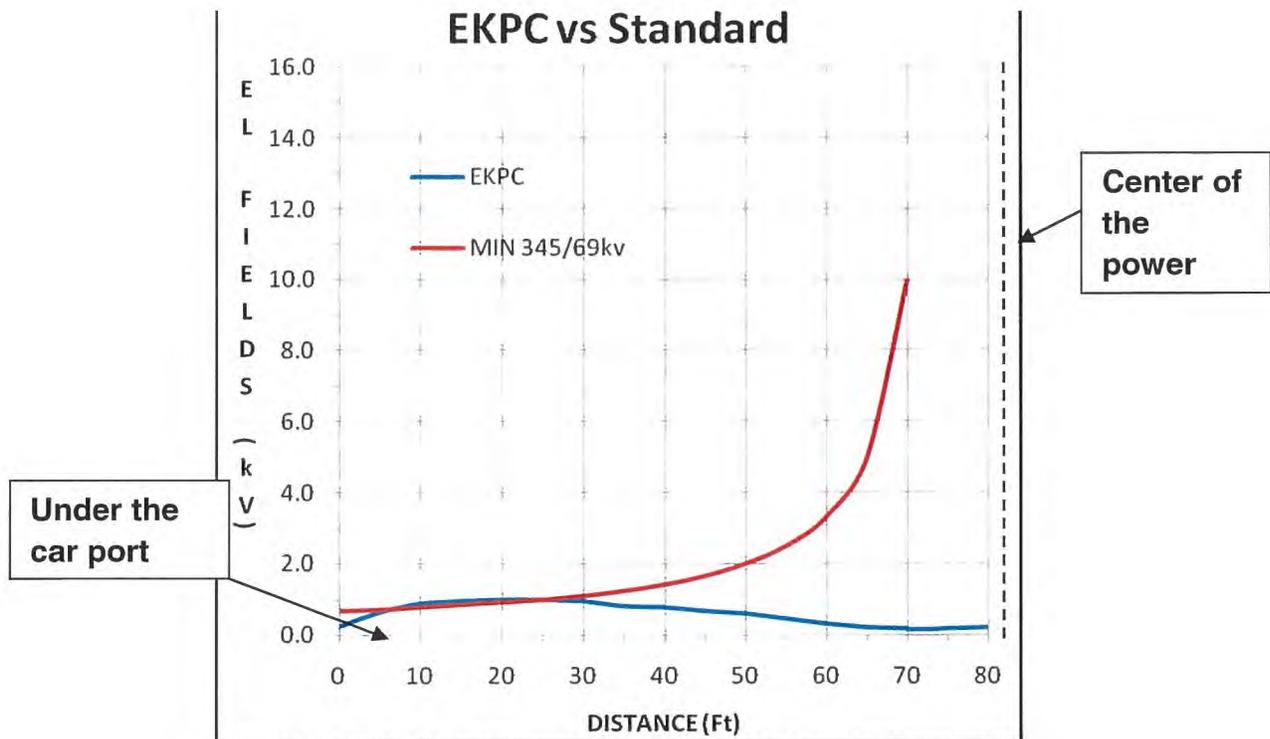


Figure 38 – EKPC Data as Compared With Calculated Data

The above figure shows the electric field model data (MIN 345/69Kv) and compares it to the measured values (EKPC). From 0 feet to 10 feet (x axis) the data goes in different directions. This is the area where field measurements were made under the carport, which partly blocked some of the field strength. As we go from 30 to 70 feet the ground is dropping off as we are approaching the transmission line, which has its centerline at 75 ft. Thus the only acceptable data is from 10 to 30 feet, which closely matches the calculated curve (MIN 345/69kV).

In developing our model we calculated the amount of sag in the lines and estimated the overall height of the poles. We were not able to determine the difference in elevation between the base of the pole and where the measurements were made. This height value is a constant and thus can be factored in our model based upon known measurement points.

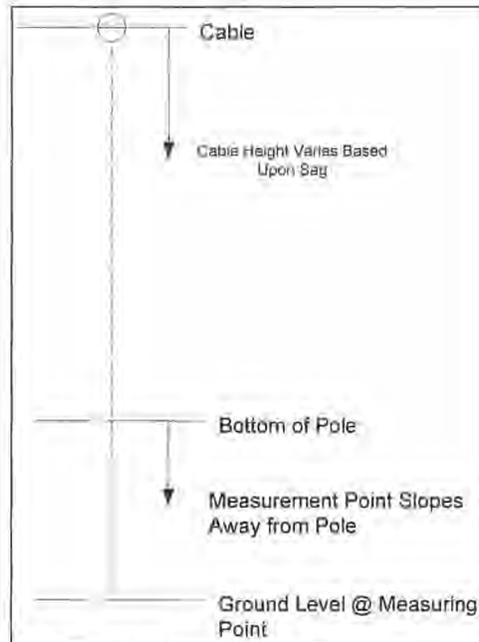


Figure 39 - Pole Height vs. Measuring Points

The model was expanded and we assumed that the 345 kv and 69 kv line fields were additive. That is, they can be added together.

In order to build this model we manually calculated the fields produced at one point. That point was at distance 25 ft. or 50 ft from the centerline of the transmission line. At this point electric fields were measured at 0.997 kV/m. From this starting point we extrapolated a standard curves which represented the 345 kv and 69 kv lines. When the two curves are added together they provide 0.997 kv/m at distance 25 ft..

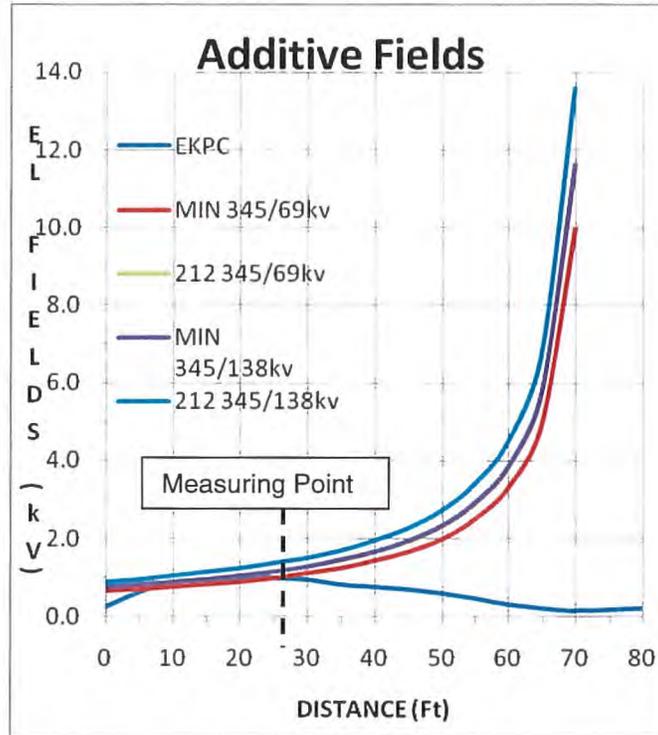


Figure 40 - Fields Assumed to be Additive

In the above figure the initial curve is labeled as MIN 354/69kV.

We next doubled the effect of the voltage on the lower line to approximate the effect of raising the voltage to 138kV, the lines design voltage. Both of these curves assume a current flow for the day the measurements were made.

Next, we assumed worse case conditions. That is, assume a maximum sag in the lines. This occurs when the current flowing will cause the lines to reach a temperature approaching 212 degrees F. Again two curves were produced for each voltage combination.

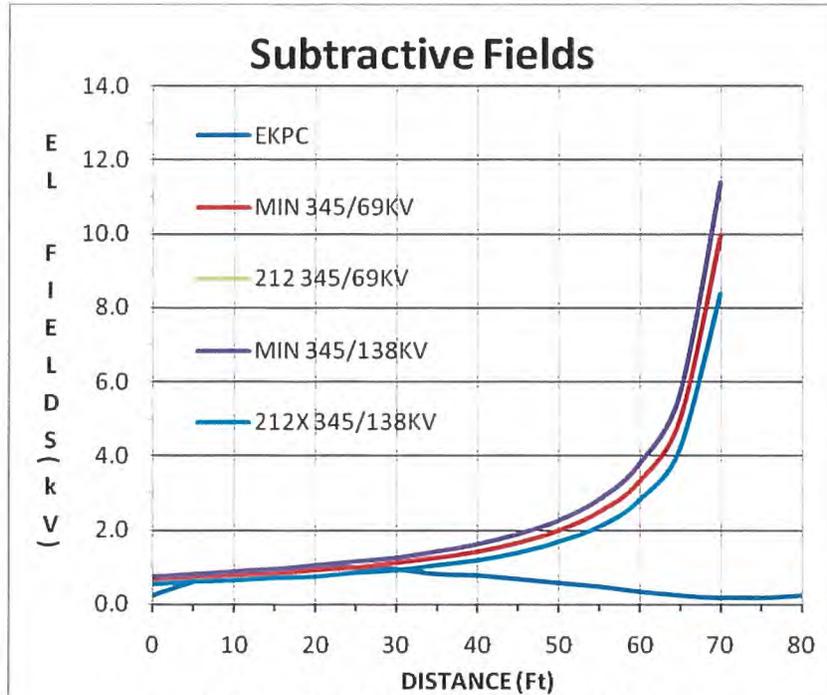


Figure 41 - Fields Assumed to be Subtractive

The next step was to adjust the model to have the two lines subtracting. Then regenerate the curves. The above figure shows the effects as if the fields were actually subtracting on the day of the test.

When we consider the lines as additive or subtractive it becomes apparent that if the lines were assumed to be additive and one line is turned off, the overall fields will be reduced. The opposite is true if the lines were subtractive when the measurements were made. In this case, if the 69kv line is turned off, the overall fields will increase.

In the next figure we illustrate the effect of the 69kv line being off at some time in the future if our base assumption at the time of measurement was that the fields were subtractive.

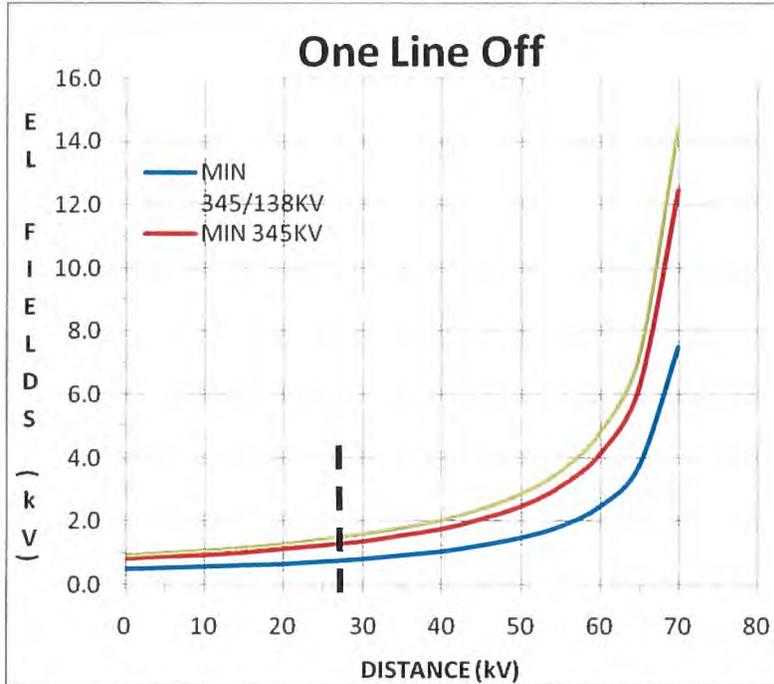


Figure 42 - Fields Subtractive with 138kV Line Turned Off

Results:

Edge of Driveway = Distance = 20 Ft.

345kV/69kV	Minimum Sag – Additive	0.997 kV/m
345kV/69kV	Maximum Sag – Additive	1.159 kV/m
345kV/138kV	Minimum Sag – Additive	1.163 kV/m
345kV/138kV	Maximum Sag – Additive	1.359 kV/m
345kV/69kV	Minimum Sag – Subtractive	0.997 kV/m
345kV/69kV	Minimum Sag – Subtractive	1.138 kV/m
345kV/138kV	Minimum Sag – Subtractive	0.748 kV/m
345kV/138kV	Maximum Sag – Subtractive	0.838 kV/m
345kV	Minimum Sag – Subtractive	1.246 kV/m
345kV	Maximum Sag – Subtractive	1.438 kV/m

From the above it is easy to see that the electric fields, in most cases, will be very close to 1kV/m or greater.

Magnetic Field Data

A similar approach was taken in analysis of the magnet fields. The figures below show the results of varying the current in the line and the resulting additional sag that was produced.

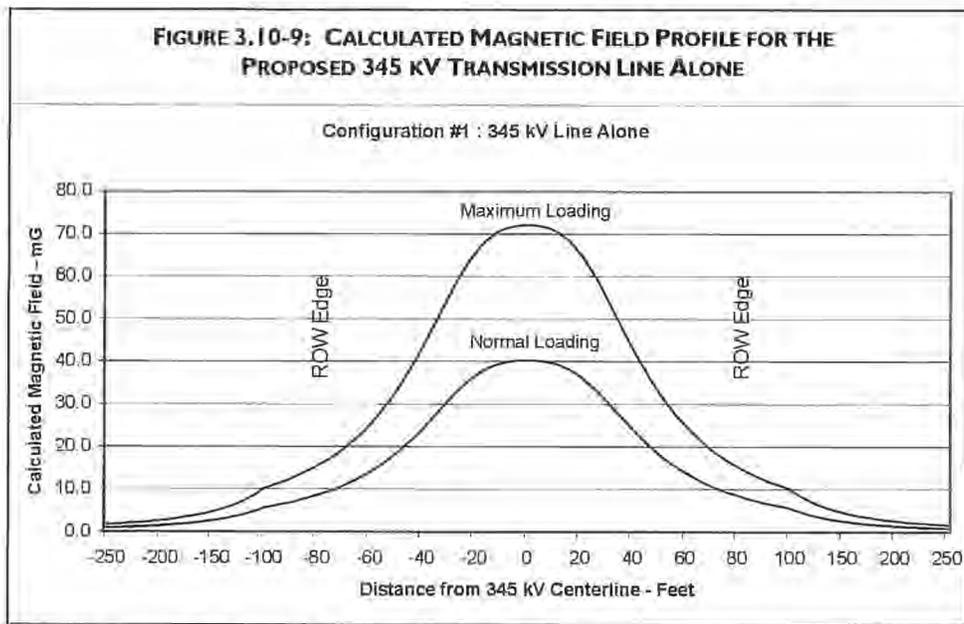


Figure 43 - Typical Electrical Fields for a 345kV Transmission Line – Single Circuit

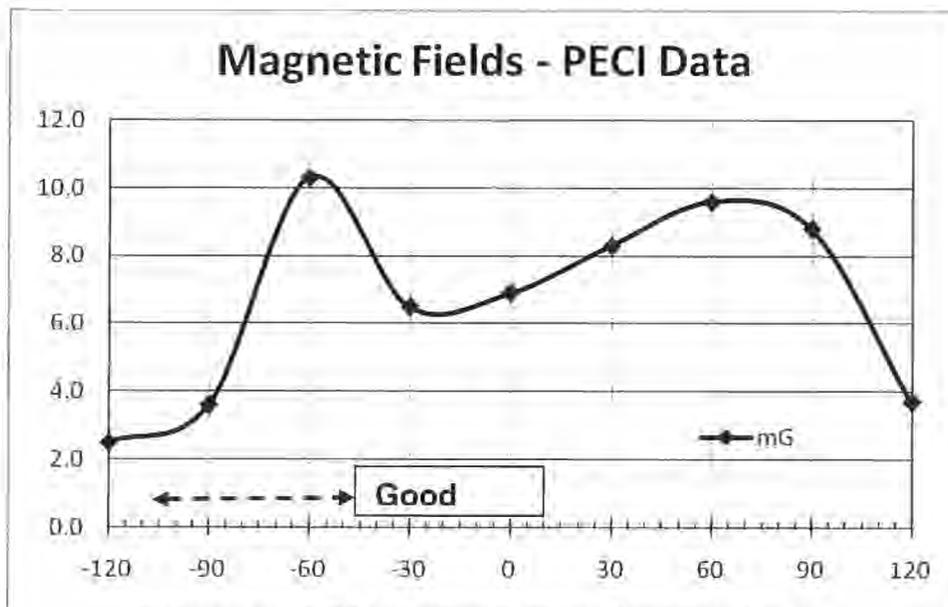


Figure 44 - PECEI Magnetic Fields Measurements

As with the electric fields only a few data points could be used. The data points from -120ft to -60 ft. is the only good data as the remaining data is under the transmission lines.

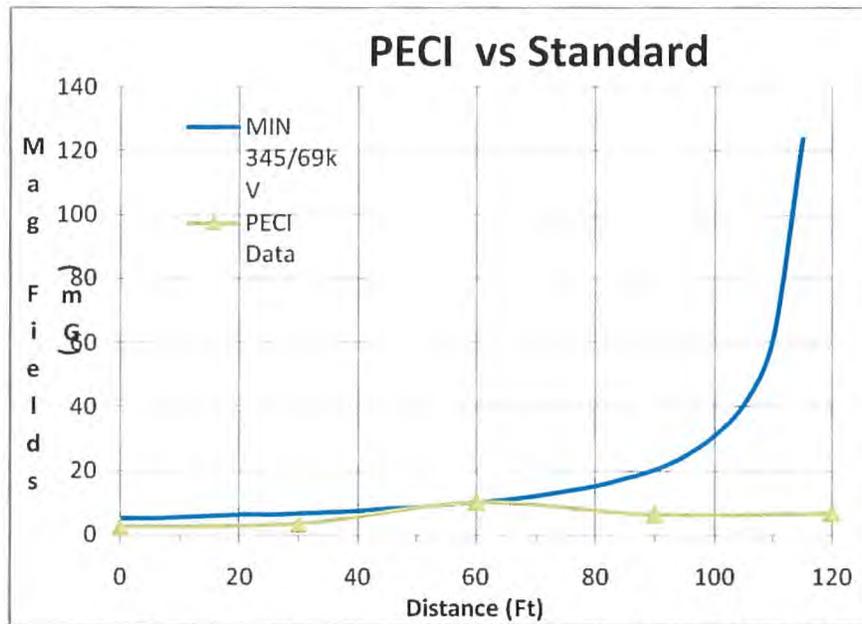


Figure 45 – PEGI Data as Compared With Calculated Data

The above figure shows the measured data (PEGI Data) and the calculated data (MIN 345/69kV). The base point for the calculations was the point at 60 ft from the centerline, which was measured at 10.3 mG. From this point and using the current flow data in each line the minimum field curves were generated. As seen in the figure above the first three data points match up fairly well with the calculated data.

With the currents measured in the power lines the day of our testing we established this a minimum loads on the line the same as we did for the electric fields. We also calculated curves for both additive fields and subtractive fields. Next, we determined what current would be flowing in each line at worse case conditions. For this we used EKPC's maximum conductor operating temperature values and their corresponding currents 3258 amps and 1468 amps for 345kv and 69kv lines in the winter.

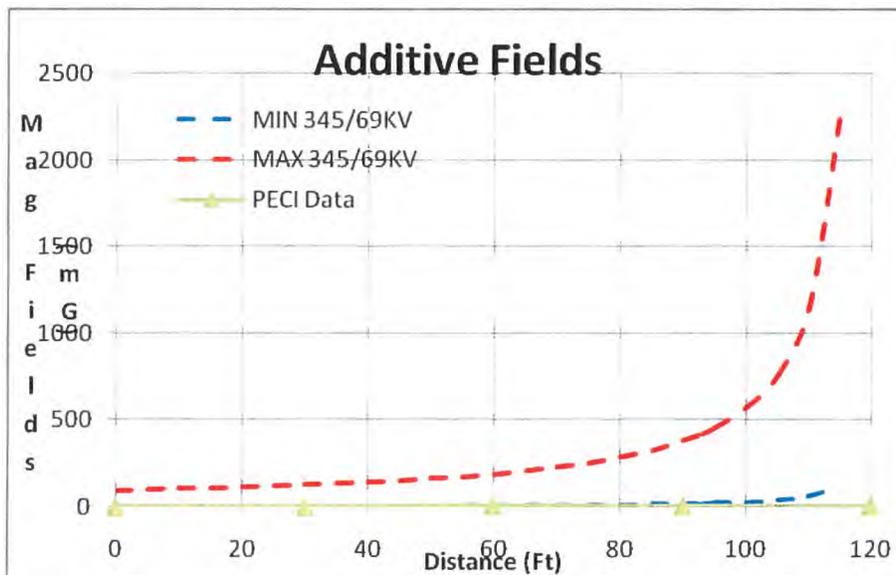


Figure 46 - Fields Assumed to be Additive

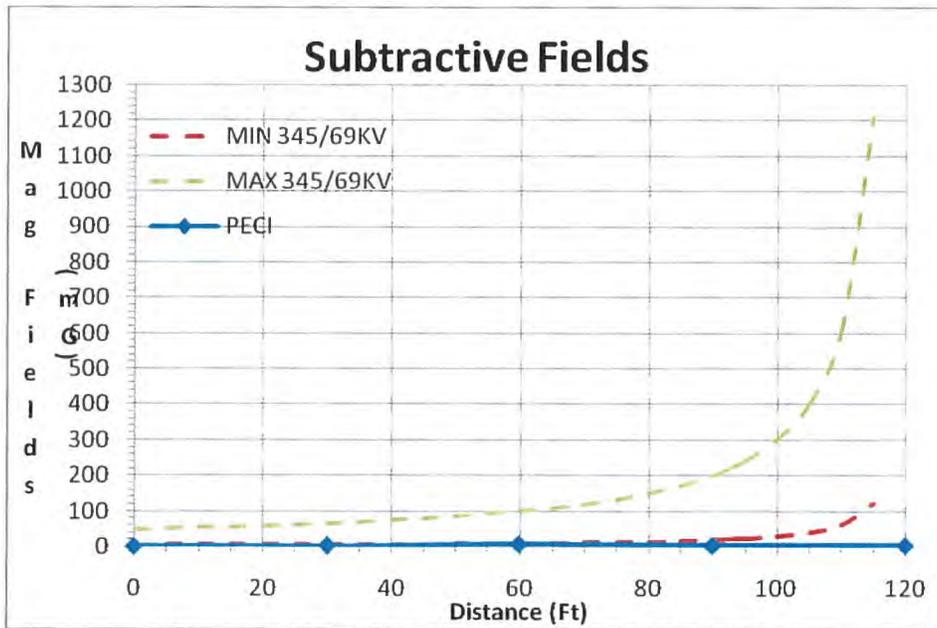


Figure 47 - Fields Assumed to be Subtractive

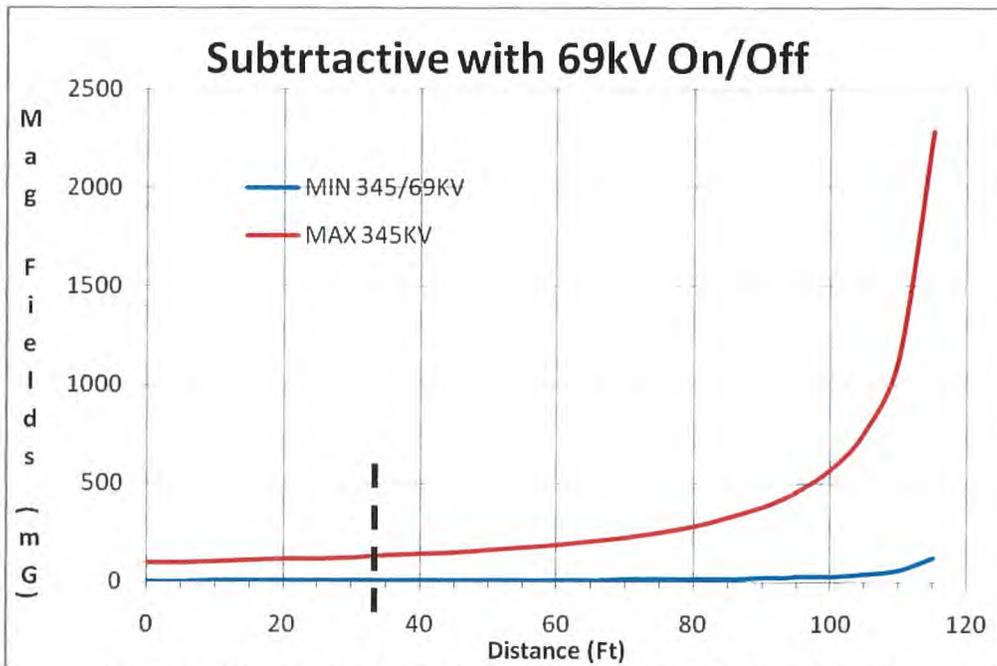


Figure 48 - Fields Subtractive with 69kV Line Turned Off

Results:

Edge of Driveway = Distance = 25 Ft.

345kV/69kV	Minimum Sag – Additive	10.3 mG
345kV/69kV	Maximum Sag – Additive	191 mG
345kV/69kV	Minimum Sag – Subtractive	10.3 mG
345kV/69kV	Minimum Sag – Subtractive	101.0 mG
345kV	Minimum Sag – Subtractive	190.7 mG

From the above it is easy to see that the magnetic fields will be varying between 10 mG and 191 mG.

XVIII. ANALYSIS of the MEASUREMENTS:

When we compare the EKPC electric field measurements with existing standards we can see that the electric field strength is right at the edge of the acceptable limits; 0.998 kV vs. 1.000 kV.

When we compare the magnetic field measurements with existing standards the measurements are below the existing standards but we expect that these fields will also go much higher. Our projected magnetic fields exceed one state’s limit and approach another state’s limit. In addition we believe that these standards will be lowered in the future.

According to David O. Carpenter, MD, Director, Institute for Health and the Environment University at Albany, East Campus, Rensselaer, New York, “new regulatory limits for Extremely Low Frequency (ELF) based on biologically relevant levels of ELF are warranted. ELF limits should be set below those exposure levels that have been linked in childhood leukemia studies to increased risk of disease, plus an additional safety factor. It is no longer acceptable to build new power lines and electrical facilities that place people in ELF environments that have been determined to be risky (at levels generally at 2 mG (0.2 µT) and above).

While new ELF limits are being developed and implemented, a reasonable approach would be a 1 mG (0.1 µT) planning limit for habitable space adjacent to all new or upgraded power lines and a 2 mG (0.2 µT) limit for all other new construction, It is also recommended for that a 1 mG (0.1 µT) limit be established for existing habitable space for children and/or women who are pregnant. This recommendation is based on the assumption that a higher burden of protection is required for children who cannot protect themselves, and who are at risk for childhood leukemia at rates that are traditionally high enough to trigger regulatory action. This situation in particular warrants extending the 1 mG (0.1 µT) limit to existing occupied space. “Establish” in this case probably means formal public advisories from relevant health agencies.”⁴⁹

49 Section 17 - Key Scientific Evidence And Public Health Policy Recommendations, BioInitiative Working Group, July 2007

EMF and Childhood Leukemia, by Robert Syfers, Spring 2006 – a EPRI publication

"Decades of research have studied possible effects of exposure to electric and magnetic fields. While the great majority of studies have shown no link between EMF and a variety of maladies, several key epidemiologic studies have caused expert scientific panels to conclude that there is indeed a statistically significant association between power-frequency magnetic fields and the development of childhood leukemia. Nevertheless, laboratory confirmation and a convincing explanation of the link eluded researchers and health theorist for some years. EPRI is now addressing two theories that may finally clarify the issue."

National Institute of Environmental Health Sciences (NIEHS) report shows the following state standards for transmission lines.

NIEHS June 2002	On ROW		Edge of ROW
Florida	8 kV/m	2 kV/m	150 mG 69 - 230kv
	10 kV/m	2 kV/m	200 mG 500kv
			250 mG 500kv
Minnesota	8 kV/m		
Montana	7 kV/m	1 kV/m	
New Jersey		3 kV/m	
New York	11.8 kV/m	1.6 kV/m	200 mG max. loads
	11 kV/m		
	7 kV/m		
North Dakota	9 kV/m		
Oregon	9 kV/m		

Figure 49 - Table of State EMF Regulations

Electric Fields

State requirement range:	1 to 3 kV/m ⁵⁰
ACGIH	25 kV/m
ACGIH – workers with pacemakers	1 kV/m ⁵¹
Measured fields	0.997 kV/m EKPC
Expected Fields	1.371 kV/m Potential Danger

Magnetic Fields:

State requirement range:	150 mG to 250 mG
ACGIH– workers with pacemakers	1000 mG
AIHA	833 mG

⁵⁰ EMF Electric and Magnetic Field Association with the use of Electric Power – 6/2002 sponsored by NIEHS/DOE Rapid Program

⁵¹ ACGIH exposure for workers with cardiac pacemakers

British NRPB	833 mG	
California Safety Limits for Public Schools	1.2 mG ⁵²	
Swiss Standard	2.5 mG ELF ⁵³	
Swedish standard	1.0 mG ⁵⁴	
Dr. David Carpenter	2.0 mG	
Measured Fields	10.3 mG	PECI
Expected Fields	191 mG	Potential Danger

Definitions:

U.S. National Institute of Environmental Health Sciences (NIEHS)

American Conference of Governmental Industrial Hygienists (ACGIH)

XIX. OPINIONS of EKPC

A. EKPC's Opinion:

EKPC's opinion as expressed by Dr. Paul A. Dolloff:

Dr. Paul A. Dolloff, EKPC Senior Engineer, Research & Development Group

A member of the following organizations:

- Electric Power Research Institute (EPRI) Working Groups and Task Forces
- International Council on Large Electric Systems (CIGRE)
- National Rural Electric Cooperative Association (NRECA) Engineering Planning Subcommittee

EPRI is one of the key technical organizations studying the effects of EMF produced by transmission lines on public health. This organization has produced many articles on EMF and has reviewed hundreds of other articles. Please see the lists at the end of this report.

Per the meeting with Dr. Paul A. Dolloff, Ph. D of East Kentucky Power Cooperative, December, 2008:

- EMF consists of electrical fields and magnetic fields.
- The electric fields cause problems of electric shock as has been experienced on the Barker farm.
- Electric fields are a function of voltage, i.e. the power line voltage (345kV)
- Magnetic fields are a function of current, i.e. the power line current flow.
- There are no standards with respect to EMF health concerns applicable to EKPC or the State of Kentucky.

52 EMF Levels & Safety, ScanTech Consultants, www.scantech7.com

53 EMF Levels & Safety, ScanTech Consultants, www.scantech7.com

54 EMF Levels & Safety, ScanTech Consultants, www.scantech7.com

- Dr. Paul A. Dolloff stated that he knew of no standards anywhere.

EKPC stated that there are "no structures would be located close enough to the proposed transmission line to experience increased EMF levels."⁵⁵

Dr. Dolloff has been exposed to the issues concerning EMF and thus should have been aware of the state of standards development in the U.S. utility industry.

He stated that he knew of no standards anywhere concerning EMF and transmission lines. This is clearly an inaccurate statement on his part. As stated above there are definitely international standards and state standards regarding EMF levels at or near transmission lines. Since Dr. Dolloff is part of EKPC's research and development department it should have been part of his group's responsibility to keep up on such standards.

B. EKPC Environmental Report:

EKPC Environmental Report produced by the Gilpin Group, May 2006, stated that "no structures would be located close enough to the proposed transmission line to experience increased EMF levels."⁵⁶ This is clearly an inaccurate statement.

XX. CORRECTIVE ACTION By EKPC

EKPC personnel have taken some steps to reduce the effects of the EMF produced by the new transmission lines. Shown below are photographs of grounding installed at two locations along the fence that runs parallel to the Barkers' driveway. This grounding was installed at the time of the installation of the new transmission lines.

This grounding was installed as a precautionary measure as EKPC knew that the fence will charge due to the electric fields producing micro-shocks to persons touching the fence. This grounding will only help reduce the effects of the electric fields and will have no effect on the magnetic fields.

55 EKPC Environmental Report..... May 2006

56 EKPC Environmental Report..... May 2006, Page 54



Figure 50 - Fence Grounding at House



Figure 51 - Additional Fence Grounding on the Farm

Even with the grounding of the fence along the driveway people are still getting shocked when they touch vehicles in the driveway and high voltage can still be measured from a vehicle to the earth.

XXI. REDUCTION of EFFECTS:

There are a number of ways to reduce the effects of EMF generated by transmission lines. Below are a few of the common methods.

Rotate the phase sequence of one of the circuits as shown below

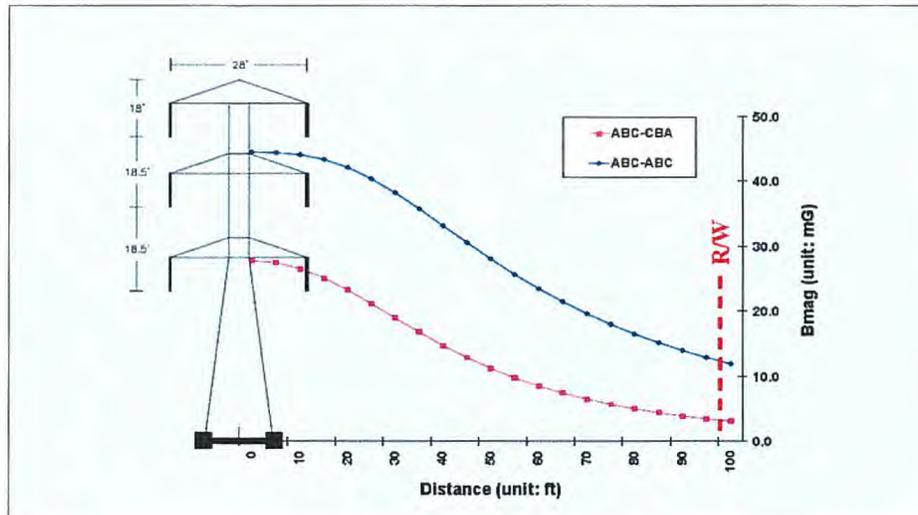


Figure 52 - Effects of Phasing⁵⁷

Increase the height of the poles.

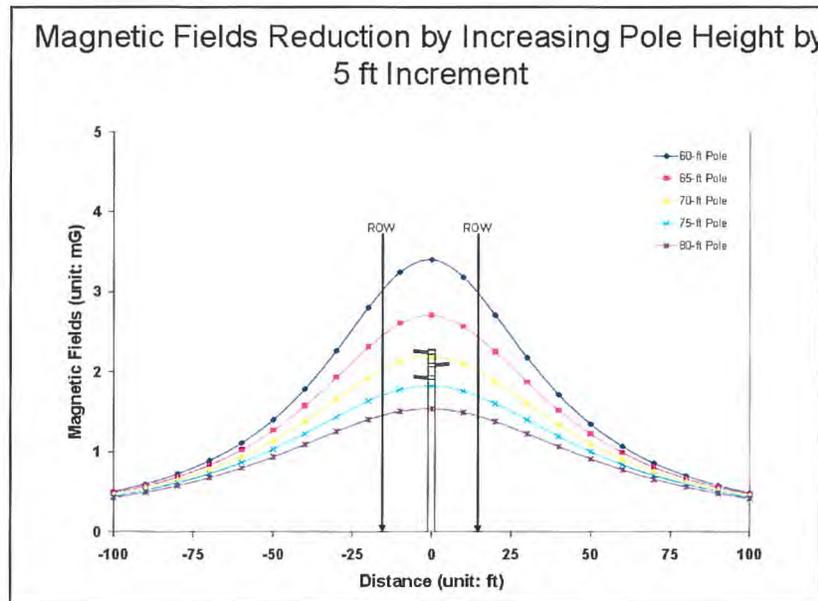


Figure 53 - Effects of Pole Height⁵⁸

⁵⁷ California's EMF Policy, California Public Utilities Commission, Jack Sahl, Southern California Edison

⁵⁸ California's EMF Policy, California Public Utilities Commission, Jack Sahl, Southern California Edison

Move the line further away from the house.

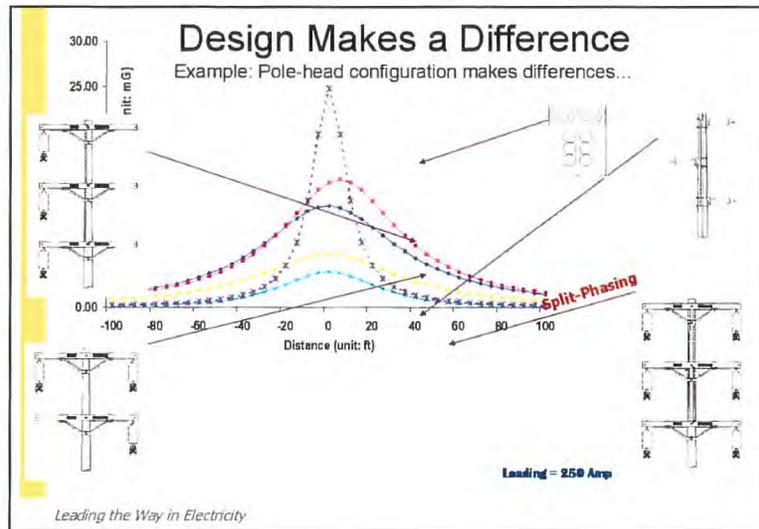


Figure 54 – Effects of distance from Power Line⁵⁹

XXII. REROUTING OPTIONS:

Two slightly different routing options are shown below for the transmission line. First the transmission line is shown as it was run. This is followed by a picture of the actual transmission lines as they run very close to the Barker house.

⁵⁹ California's EMF Policy, California Public Utilities Commission, Jack Sahl, Southern California Edison

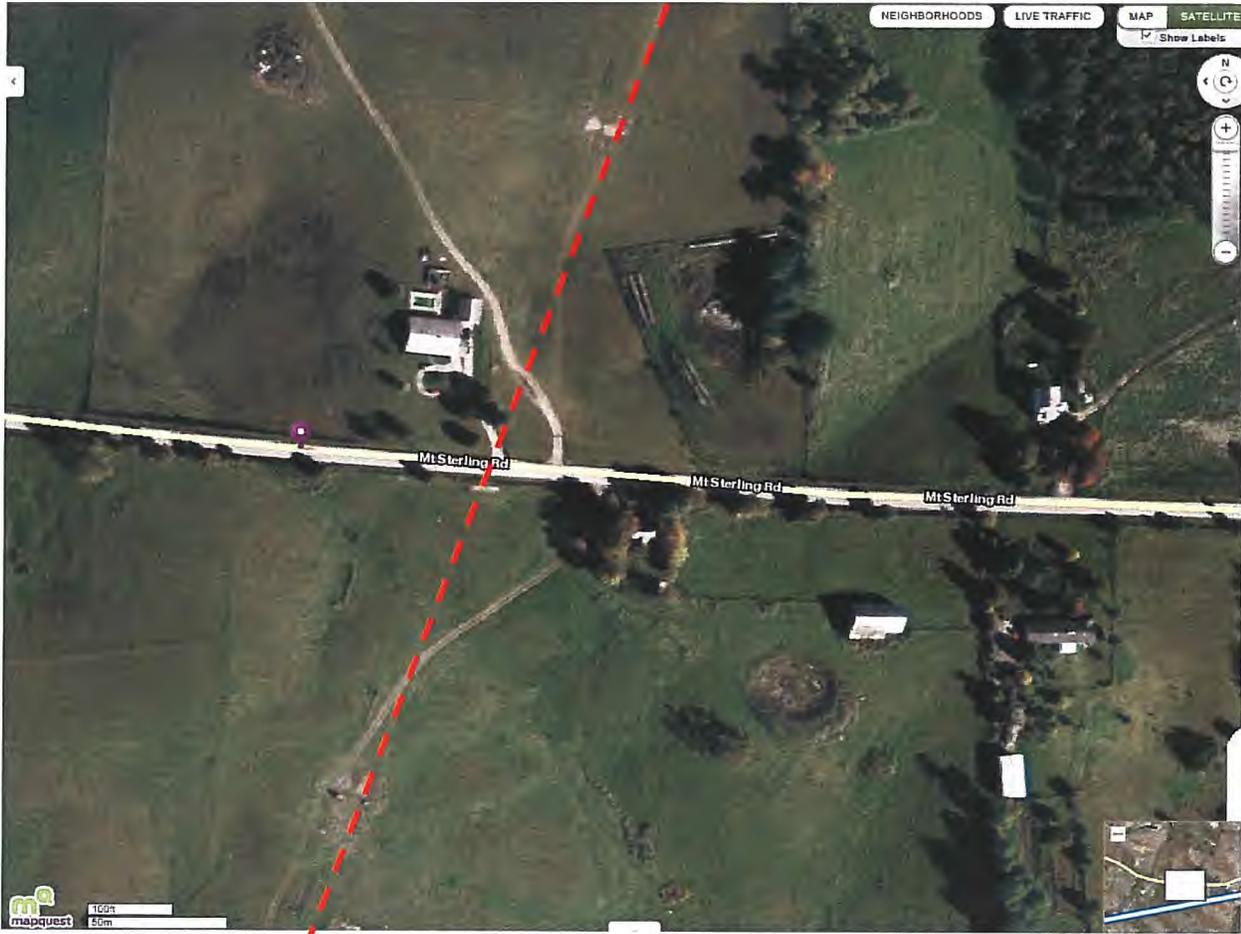


Figure 55 - Route of the new transmission line



Figure 56 - Transmission Line Location

In the above picture it is hard to discern the line as they were very light in the Google Earth image. This picture shows approximately the location of the lines as they are today. What follows are two diagrams that show optional routes the lines could have taken in order to provide additional space between the transmission lines and the house. As we move the lines further to the east we reduce the amount of EMF and thus reduce the potential health hazards and reduce the concern of visitors to the Barker store.

We chose the two options to be to the east, however, the lines could be moved to the west.



Figure 57 - Transmission Line Relocation - Option 1 – Move 221 Ft. to East



Figure 58 - Option 2 – Move 309 Ft. to East

The options reposition the lines resulting in moving the centerline of the transmission line 222 feet, option 1 or 309 feet, option 2 further away from the house. In doing this the length of the conductors will be increased. See the table below.

The cost of a section of the transmission line can be broken into the following:

- Design
- Right of Way expense
- Surveying
- Cable
- Poles
- Construction

Of all of these cost items the only item that would have been affected would be the cost of the cable if the change had been implemented when EKPC moved the poles from next to the Barker house to a point 400 ft. to the north. The design and surveying cost would be the same. The right of way had to be expanded under all options thus no additional cost. There is no increase in the number of poles and the cost of construction would not go up. Only the cost of the cable would increase. The following table shows the additional cable that would have had to be purchased and these costs are based upon Alcan's current base cost for this type of cable. Thus the cost of having the transmission line being further to the east from the beginning is minimal.

	Centerline of line to the house	Increase in line length	Additional 345kV line	Additional 138kV line	345kV line Base cost of wire	138kV line Base cost of wire	Total Cost
Existing	55.6 ft	0					
Option 1	221.5 ft	54 Ft	324 ft.	162 ft	\$1,389.38	\$458.29	\$1,848.35
Option 2	309 ft.	118 Ft	708 ft	354 ft.	\$3,040.31	\$1,004.33	\$4,044.64

XXIII. Effects of doing nothing:

1. Increased magnetic fields
2. Increased electric fields
3. Increased risk to people with pace makers and similar implanted devices
4. Increased risk of cancer and leukemia
5. Increased noise (hum) as the cable load increases
6. Worse problems with micro-shocks
7. Reduced property value

SECTION 8 – REFERENCES

XXIV. References:

The following references are in addition to documents sited above"

- National Electrical Code
- National Electrical Safety Code
- National Fire Protection Association, NFPA 921
- O.S.H.A.
- RUS Bulletin 1724E-200, Design Manual for High Voltage Transmission Lines, May 2009
- RUS BULLETIN 1724E-203
- Chapter 14, Sag and Tension of Conductors, D. A. Douglass Power Delivery Consultants Inc. and Ridley Thrash, Southwire Corporation
- PJM Design and Application of Overhead Transmission Lines 69kV and Above, Section V.A of PJM TSDS Technical Requirements 5/20/2002
- CHAPTER 3: AFFECTED ENVIRONMENT & ENVIRONMENTAL CONSEQUENCES, FINAL EIS AND PROPOSED RMP AMENDMENTS
- Amended Declaration of Dr. David O. Carpenter, M.D. Civil Action No. 3:11-cv-00739-MO, United States District Court, District of Oregon, Portland Division
- TESTIMONY OF DAVID O. CARPENTER, PUC DOCKET NO. ET2/TL-08-1474, OAH DOCKET NO. 7-2500-20283-2
- BioInitiative Working Group, August 2007
- Calculation and measurement of the magnetic field of power transmission lines, CIGRE ŠK C3 – 1
- Current Status of Scientific Research, Consensus, and Regulation Regarding Potential Health Effects of Power-Line Electric and Magnetic Fields (EMF) January 2006
- Assessment of Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields - Working Group Report, NIEHS with support of the EMF Research and Public Information Dissemination (EMFRAPID) Program through the United States

Department of Energy and the National Institute of Environmental Health Sciences/National Institutes of Health.

- International Commission On Non-Ionizing Radiation Protection - Icnirp Publication –

2010 Icnirp Guidelines For Limiting Exposure To Time-Varying Electric And Magnetic

Fields (1 Hz – 100 KHz) Published In: Health Physics 99(6):818-836; 2010

- EMF Electric and Magnetic Fields Associated with the Use of Electric Power, June 2002, National Institute of Health
- ELF Electromagnetic Fields and Cancer, Report of an Advisory Group on Non-ionizing Radiation, 2001
- Final Report Focused Review of Documentation Filed by East Kentucky Power Cooperative, Inc. For a Proposed 345 kV Transmission Line Within Kentucky Case No. 2006-00463
- APPLICANT'S RESPONSE TO COMMISSION STAFF'S FIRST DATA REQUEST DATED JULY 6,2007
- Electrical Field around the overhead Transmission Lines, S.S. Razavipour, M. Jahangiri, H. Sadeghipoor
- EMF Health Risk Evaluations, EPRI
- EMF and Childhood Leukemia, Robert Syfers
- EMF Research News, EPRI, December 2011
- Pacemaker Interference by 60-Hz Contact Currents, IEEE

- Interference in Implanted Cardiac Devices, Part I, SERGIO L. PINSKI and RICHARD G. TROHMAN
- Interference in Implanted Cardiac Devices, Part II, SERGIO L. PINSKI and RICHARD G. TROHMAN
- Living and Working Safely AROUND HIGH-VOLTAGE POWER LINES. Bonneyville Power Administration
- MANUAL FOR MEASURING OCCUPATIONAL
- ELECTRIC AND MAGNETIC FIELD EXPOSURES, OSHA
- Power-line radiation and childhood leukemia: this cold case may finally be solved: Tekla Perry, December 16, 2008
- EMF – Electric & Magnetic Fields, Public service commission of Wisconsin, January 2008
- EMF Levels & Safety, Scantech
- ICNIRP GUIDELINES, FOR LIMITING EXPOSURE TO TIME-VARYING ELECTRIC

AND MAGNETIC FIELDS (1 HZ – 100 kHz), HEALTH PHYSICS 99(6):818-836; 2010

- EPRI Comments on the IEEE Standard for Safety Levels With Respect to Human Exposure to Electromagnetic Fields, 0 to 3 kHz (2002)
- IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0–3 kHz, IEEE C95.6-2002

SECTION 9 – EPCI

XXV. EPRI EMF Research Literature

Abstracts for Recent Studies

1. An integrated job exposure matrix for electrical exposures of utility workers. Bracken TD, Kavet R, Patterson RM, Fordyce TA. *Journal of Occupational and Environmental Hygiene* 2009;6(8):499–509. Job-exposure matrices are arrays of rows and columns that match various job titles, tasks, and work environments with exposures workers are likely to encounter on the job. At electric power companies, workers may be exposed to magnetic fields, electric fields, perceptible nuisance shocks, and imperceptible contact currents. Workers may also experience electrical injuries. This paper describes a job-exposure matrix that improves upon previous matrices, which focused on magnetic fields, by addressing all of these factors for 22 job categories. The integrated job-exposure matrix indicates that the highest exposures for all factors combined occur in 4 job categories that involve work near electrical equipment: cable splicers, electricians, line workers, and substation operators.
2. **Future Needs of Occupational Epidemiology of Extremely Low Frequency (ELF) Electric and Magnetic Fields (EMF): Review and Recommendations.** Kheifets L, Bowman JD, Checkoway H, Feychting M, Harrington M, Kavet R, Marsh G, Mezei G, Renew DC, van Wijngaarden E. *Occupational and Environmental Medicine* advance online publication, 19 Sep 2008; doi:10.1136/oem.2007.037994. This paper summarizes the proceedings of a 2006 occupational EMF epidemiology workshop sponsored by the UK's Energy Networks Association. The paper reviews the epidemiologic literature on occupational EMF and health, identifies the highest priority research needs, and proposes steps to address remaining uncertainties. The authors conclude that although the existing epidemiologic evidence does not indicate strong or consistent associations between occupational exposure to EMF and adverse health effects, further research is needed. Identifying exposure assessment improvements and research on the neurodegenerative disease amyotrophic lateral sclerosis (ALS, or Lou Gehrig's disease) as the top research priorities, they recommend development of a holistic job-exposure matrix and an international collaborative study of ALS and electrical occupations.
3. **Occupational Electromagnetic Fields and Leukemia and Brain Cancer: An Update to Two Meta-Analyses.** Kheifets L, Monroe J, Vergara X, Mezei G, Afifi A. *Journal of Occupational and Environmental Medicine* 2008;50:677–88. The aim of this work was to use meta-analysis, a statistical method that combines published data from individual epidemiologic studies, to clarify inconsistent and inconclusive study results on occupational EMF exposure and adult brain cancer and leukemia. As the World Health Organization recommended in its 2007 EMF health risk evaluation, the authors incorporated results from new studies into meta-analyses they published in 1995 and 1997. In addition to the previously included studies, the updated meta-analyses include 20 new brain cancer studies and 21 new leukemia studies. Although combining data from the new studies yielded small risk increases

(10–13%) for brain cancer and leukemia, combining data from new and previous studies yielded lower risk estimates for both diseases than those reported in the original meta-analyses. In addition, risk for leukemia subtypes was inconsistent in a comparison of the updated meta-analyses with the previous ones, and there was no clear pattern for workplace EMF exposure and risk of either leukemia or brain cancer. The authors concluded that these results do not support the hypothesis that occupational EMF exposure is responsible for the risk increases.

4. Exposure to 50 Hz Magnetic Field in Apartment Buildings with Built-In Transformer Stations in Hungary. Thuróczy G, Jánossy G, Nagy N, Bakos J, Szabó J, Mezei G. Radiation Protection Dosimetry advance online publication, 30 Jul 2008; doi: 10.1093/rpd/ncn199. Multilevel apartment buildings with built-in electricity transformer rooms are common in many countries. In this study in Hungary, Thuróczy et al. measured magnetic field levels in apartments in 31 buildings with basement or ground-floor transformer rooms. They found that apartments located immediately above transformer rooms had considerably higher power-frequency (50 hertz [Hz] in Europe) magnetic field levels than those farther away. The authors concluded that the location of apartments relative to transformer rooms reliably predicts magnetic field exposures. These results support the idea that in an epidemiologic study, magnetic field exposures in apartments in buildings with transformer rooms could be assessed without access to apartments or contact with residents. Such a study would avoid selection bias, a form of inadvertent error in epidemiologic studies that arises during the process of study participant selection. This measurement study is part of a feasibility assessment for an international study with minimal selection bias to further investigate the reported epidemiologic association between magnetic fields and childhood leukemia.
5. Assessment of Selection Bias in the Canadian Case-Control Study of Residential Magnetic Field Exposure and Childhood Leukemia. Mezei G, Spinelli JJ, Wong P, Borugian M, McBride ML. American Journal of Epidemiology 2008;167(12):1504–10. Selection bias is a common methodological error that occurs in epidemiologic studies when those selected for study participation who agree to participate differ in ways that affect study results from those who are not selected or do not agree to participate. This assessment evaluates selection bias in a 1999 case-control study of magnetic field exposure and childhood leukemia in Canada (McBride et al.) that found a weak association. In the original study, the investigators assessed exposure using personal and residential magnetic field measurements and wire coding, a less accurate method based on the characteristics of power lines near residences. In the selection bias evaluation, Mezei et al. used wire coding alone because it is the only method available for assessing exposure for nonparticipants. When they included only actual, participating controls in the analyses, they found a moderate increase in the risk of childhood leukemia for children residing near power lines with the highest wire codes; when they included nonparticipating controls as well, the risk was lower. The authors conclude that although these results suggest that some selection bias may be present in the Canadian study, it may not entirely account for the observed risk increase. They also caution that the use of wire coding rather than field measurements to assess exposure limits interpretation of the results.

6. Recent Advances in Research Relevant to Electric and Magnetic Field Exposure Guidelines. Kavet R, Bailey WH, Bracken TD, Patterson RM. *Bioelectromagnetics* 2008;29(7):499–526. This review paper summarizes recent scientific advances relevant to the development and implementation of new or revised EMF exposure guidelines. National and international guidelines limit occupational and public exposure to electric fields, magnetic fields, and contact current (current that flows through the body when it is in simultaneous contact with two conductive surfaces carrying different voltages). Exposure limits are set to prevent known nerve stimulation effects, such as annoyance, startle, and pain. Magnetic field exposure limits are based on prevention of the magnetophosphenes effect (perception of a flickering light when exposure exceeds a nerve stimulation threshold, that is, the minimum level for an effect). This paper examines nerve stimulation thresholds and the relevance of magnetophosphenes to guideline limit setting. It also covers dose to body tissues from exposure to contact current and dose to tissues and cells from exposure to spark discharges, or microshocks. In addition, the paper discusses assessment of exposure to high electric fields in real-life situations (such as line work on transmission towers), exposure to nonuniform magnetic fields, and exposures in the workplace.
7. Calculated SAR distributions in a human voxel phantom due to the reflection of electromagnetic fields from a ground plane between 65 MHz and 2 GHz. Findlay RP, Dimbylow PJ. *Physics in Medicine and Biology* 2008;53:2277–89. National and international guideline-setting organizations specify limits for exposure to radio-frequency (RF) electromagnetic fields from sources such as radio and television broadcast towers and mobile telecommunications antennas. RF fields deposit thermal energy in the bodies of exposed persons; to protect against excessive heating, guidelines specify basic restrictions limiting the rate at which body tissues may absorb RF energy (the specific absorption rate, or SAR). Because the SAR is difficult to measure, guidelines include limits for corresponding maximum permissible exposures (MPEs) for external field levels, which are easier to measure. This paper describes research to more accurately estimate tissue absorption rates and corresponding field levels. Researchers used accurate computer models of the human body called voxel phantoms to investigate RF energy absorption under various exposure conditions. Results show that guideline basic restrictions and MPE limits provide adequate protection.
8. Residential Magnetic Field Exposure and Childhood Brain Cancer: A Meta-Analysis. Mezei G, Gadallah M, Kheifets L. *Epidemiology* 2008;19:424–30. Epidemiologic studies investigating the possibility that residential magnetic field exposure might be associated with childhood brain cancer have yielded inconsistent results. To elucidate the reasons for differences in the results and to provide a statistically robust risk estimate, the authors conducted a meta-analysis of 13 studies. (Meta-analysis is a statistical method that combines published data from individual epidemiologic studies. It is often used when individual studies are too small to permit definite conclusions.) The meta-analysis showed no association of childhood brain cancer with residential distances less than 50 meters from power lines or with wire codes (a surrogate for magnetic field exposure based on power line characteristics) or lower levels of calculated or measured magnetic fields. Although there was a

suggestion of an association with measured or calculated fields above 0.3 0.4 microtesla (3 4 milligauss), the association was not statistically significant. The authors conclude that a moderate risk increase cannot be excluded with certainty at higher exposure levels.

9. Indoor Transformer Stations as Predictors of Residential ELF Magnetic Field Exposure. Ilonen K, Markkanen A, Mezei G, Juutilainen J. *Bioelectromagnetics* 2008;29:213–8. Epidemiologic studies have reported an association between exposure to magnetic fields and childhood leukemia. However, a causal relationship is not the only explanation: major EMF health risk evaluations note that the association could result from another exposure that is present along with magnetic fields or from inadvertent error in the selection of study participants. To further investigate this possibility, EPRI is planning an international study that will evaluate leukemia incidence among children living in apartment buildings with electricity transformer rooms. The study design avoids errors in participant selection through both selection from cancer and population registries and magnetic field exposure assessment that does not require subject participation. In addition, the study will include larger numbers of children with higher exposures (those whose apartments are adjacent to transformer rooms) than previous studies. This paper reports the results of a preliminary magnetic field measurement study in Finland indicating that exposure in apartments can reliably be predicted according to their location with respect to transformers.
10. Nighttime Exposure to Electromagnetic Fields and Childhood Leukemia: An Extended Pooled Analysis. Schüz J, Svendsen AL, Linet MS, McBride ML, Roman E, Feychting M, et al. *American Journal of Epidemiology* 2007;166:263–9. This analysis extended a 2000 pooled analysis of nine childhood leukemia studies (Ahlbom et al.) to determine whether nighttime magnetic field measurements more accurately represent actual exposure than 24- or 48-hour measurements. (Pooled analyses combine original data from individual epidemiologic studies to better discern exposure-disease relationships for a larger number of study participants.) The authors reasoned that nighttime bedroom measurements might be more accurate because children would tend to be in their rooms during the entire measurement period. In addition, nighttime exposure could be more biologically relevant owing to the possibility that magnetic fields might suppress normal nocturnal levels of melatonin, a pineal gland hormone that may protect against cancer development. Results showing similar risk estimates for 24- or 48-hour and nighttime magnetic field exposures do not support these hypotheses.
11. Survey of Residential Extremely-Low-Frequency Magnetic Field Exposure among Children in Taiwan. Li CY, Mezei G, Sung FC, Silva M, Chen PC, Lee PC, et al. *Environment International* 2007;33:233–8. Several factors complicate interpretation of epidemiologic results indicating an association between magnetic fields above 0.3 0.4 microtesla and childhood leukemia risk. Among these factors are inadvertent error in study participant selection and the possibility that another exposure occurring along with magnetic fields actually increases risk. Another factor is the unreliability of risk estimates in many studies, owing mainly to small numbers of study participants with higher magnetic field exposures. Future studies to clarify the

magnetic field childhood leukemia association will be useful only if they include sufficient numbers of children with higher exposures. A study in Taiwan, a densely populated, industrialized country with reportedly higher residential magnetic field levels, is a possibility. In an EPRI-funded survey, about 57 percent of 2214 homes in Taiwan with children under age 7 had measured magnetic field levels above 0.3–0.4 microtesla. These results indicate that a greater percentage of children in Taiwan have higher magnetic field exposures than in North America and Europe, where most epidemiologic studies of EMF and childhood leukemia were conducted.

12. Assessment of Non-Response Bias in a Survey of Residential Magnetic Field Exposure in Taiwan. Li CY, Mezei G, Sung FC, Silva M, Lee PC, Chen PC, et al. *Bioelectromagnetics* 2007;28:340–8. In this paper, researchers report the results of an assessment of nonresponse bias in the Taiwan residential magnetic field exposure survey described above. Nonresponse bias is a common form of inadvertent error in the selection of epidemiologic study participants that can occur when people identified as potential study subjects cannot or will not respond to requests to participate. Bias occurs if nonrespondents differ from respondents with respect to exposure or disease status. To assess nonresponse bias in the Taiwan survey, the authors conducted a second magnetic field measurement survey among households that had declined participation and compared the results with those of the original survey. The finding that results are similar indicates little nonresponse bias.
13. Extremely-Low-Frequency Magnetic Field Exposure of Children at Schools near High Voltage Transmission Lines. Li CY, Sung FC, Chen FL, Lee PC, Silva M, Mezei G. *The Science of the Total Environment* 2007;376:151–9. This magnetic field measurement study in Taiwan compared children attending schools near high-voltage transmission lines (HVTL) with children whose schools were at least 100 meters from HVTL. The study included both 24-hour personal magnetic field exposure monitoring and measurements at selected classrooms and playgrounds located within 30 meters of HVTL. The results indicate that the two groups of children had a similar mean exposure and a similar proportion of 24-hour exposure above 0.4 microtesla. However, a higher percentage of children at schools close to HVTL had mean exposures greater than 0.4 microtesla during school hours. Mean exposures were particularly high (0.7 microtesla) on playgrounds near HVTL.
14. Magnetic Field Exposure and Prognostic Factors in Childhood Leukemia. Foliart DE, Mezei G, Iriye R, Silva JM, Ebi KL, Kheifets L, et al. *Bioelectromagnetics* 2007;28:69–71. This analysis of data from a 2006 study of magnetic field exposure and long-term survival among children with leukemia (Foliart et al.) examined the possibility that magnetic field exposure might be associated with unfavorable prognostic factors. White blood cell count, genetic abnormalities, and other prognostic factors for leukemia are used to estimate the chance that a child will recover from the disease and the chance that the disease might recur after treatment. This analysis found no association between exposure to magnetic fields and the presence of unfavorable prognostic factors.
15. Magnetic Field Exposure and Long-Term Survival among Children with Leukaemia. Foliart DE, Pollock BH, Mezei G, Iriye R, Silva JM, Ebi KL, et al. *British Journal of*

Cancer 2006;94:161–4. In contrast to previous studies investigating the relation between magnetic field exposure and childhood leukemia incidence (the occurrence of new cases), this study examined whether magnetic field exposure influences relapse and survival rates in children who already have leukemia. The authors report that children whose homes had higher measured magnetic fields (above 0.3 microtesla) experienced more complications during the follow-up period after diagnosis, but this finding was not statistically significant. These children also experienced poorer survival; this finding was statistically significant. However, because these results are based on very small numbers of leukemia cases, they are imprecise. The authors note that independent confirmation of the results is needed since the study is the first of its kind.

16. Socioeconomic Status and Childhood Solid Tumor and Lymphoma Incidence in Canada. Mezei G, Borugian MJ, Spinelli JJ, Wilkins R, Abanto Z, McBride ML. American Journal of Epidemiology 2006 advance online publication, 8 March 2006; doi:10.1093/aje/kwj118. This study follows up a 2005 study (Borugian et al.) in which the same team of researchers used neighborhood income to measure socioeconomic status (SES) among childhood leukemia cases identified from Canadian cancer registries. In the 2005 study, children from the poorest neighborhoods had a modestly decreased risk of acute lymphoid leukemia, the most common form of childhood leukemia, compared to children from the richest neighborhoods. In the new study, the relationship between SES and other types of childhood cancer was examined. A moderately lower risk of carcinomas and renal tumors was observed among the poorest children. Although these results could indicate a relation between SES and these types of cancer, the authors note that they could be due to chance. No consistent relation was observed between SES and various other childhood cancers; this may argue against a causal role for environmental exposures that are strongly linked to SES.
17. Physical Activity and Magnetic Field Exposure in Pregnancy. Savitz DA, Herring AH, Mezei G, Evenson KR, Terry JW, Jr., Kavet R. Epidemiology 2006;17:222–5. Two 2002 studies by Lee et al. and Li et al. reported that high peak magnetic field exposure (the highest exposure encountered during a day) was associated with increased miscarriage risk. However, previous evidence provides little support for a magnetic field?miscarriage association. In a commentary published along with the 2002 studies, epidemiologist David Savitz suggested that the association might be explained by differences in physical activity between women who had normal pregnancies and women who miscarried: owing to less nausea and vomiting in early pregnancy and more mobility and energy in later pregnancy, women who miscarried would move around more, encountering more sources of high magnetic fields (for example, household appliances, office equipment, and electric power lines). To test this hypothesis, Savitz and his team investigated the relation between physical activity level, measured with an activity meter, and magnetic field exposure among pregnant women. They found that women with higher activity levels were more likely to encounter high peak magnetic fields. These results support Savitz's hypothesis, but more research is needed to address the relation between physical activity and symptoms associated with pregnancy outcomes.

18. Physical Activity and Magnetic Field Exposure in Pregnancy. Savitz DA, Herring AH, Mezei G, Evenson KR, Terry JW, Jr., Kavet R. *Epidemiology* 2006;17:222–5. Two 2002 studies by Lee et al. and Li et al. reported that high peak magnetic field exposure (the highest exposure encountered during a day) was associated with increased miscarriage risk. However, previous evidence provides little support for a magnetic field?miscarriage association. In a commentary published along with the 2002 studies, epidemiologist David Savitz suggested that the association might be explained by differences in physical activity between women who had normal pregnancies and women who miscarried: owing to less nausea and vomiting in early pregnancy and more mobility and energy in later pregnancy, women who miscarried would move around more, encountering more sources of high magnetic fields (for example, household appliances, office equipment, and electric power lines). To test this hypothesis, Savitz and his team investigated the relation between physical activity level, measured with an activity meter, and magnetic field exposure among pregnant women. They found that women with higher activity levels were more likely to encounter high peak magnetic fields. These results support Savitz's hypothesis, but more research is needed to address the relation between physical activity and symptoms associated with pregnancy outcomes.
19. Analyses of Magnetic-Field Peak-Exposure Summary Measures. Mezei G, Bracken TD, Senior R, Kavet R. *Journal of Exposure Analysis and Environmental Epidemiology* advance online publication, 12 October 2005; doi:10.1038/sj.jea.7500457. To shed light on the magnetic field?miscarriage association reported by Lee et al. and Li et al. in their 2002 studies, this analysis investigated the characteristics of peak magnetic field exposure measures. The analysis examined activity level information and magnetic field exposure data from the Li et al. study and three previous studies that measured personal exposure to residential magnetic fields. The results showed that the magnitude of measured peak magnetic fields depended on the sampling interval set for the exposure meter and that maximum measurement values varied when measurements were repeated. Also, study subjects (both men and women) with higher activity levels had higher peak magnetic field exposures. This analysis lends support to the hypothesis that the association between magnetic fields and miscarriage in the 2002 studies may be due to higher activity levels among women who miscarry.
20. Selection Bias and its Implications for Case-Control Studies: A Case Study of Magnetic Field Exposure and Childhood Leukemia. Mezei G, Kheifets L. *International Journal of Epidemiology* advance online publication, 22 November 2005; doi:10.1093/ije/dyi245. EMF health risk evaluation panels have noted that the association between magnetic fields and childhood leukemia observed in epidemiologic case-control studies could at least partly result from selection bias, a form of inadvertent error that may arise during the process of study participant selection. The authors of this case study examined epidemiologic studies of magnetic fields and childhood leukemia to evaluate the potential for selection bias in these studies. They found evidence both for and against selection bias; in many studies, however, reporting of selection processes was inaccurate and incomplete, making evaluation difficult. The authors conclude that better reporting and evaluation are needed, along with new methods for selecting and recruiting controls.

21. Childhood Leukemia and Socioeconomic Status in Canada. Borugian MJ, Spinelli JJ, Mezei G, Wilkins R, Abanto Z, McBride ML. *Epidemiology* 2005;16:526–31. Early childhood leukemia studies reported a higher leukemia incidence in children from families with higher socioeconomic status (SES). However, more recent case-control studies of magnetic field exposure and childhood leukemia have reported a higher incidence among children with lower SES. To investigate whether the shift in incidence is real or a result of unintentional error (bias) due to case selection or study participation, researchers used neighborhood income as a measure of SES in a study of childhood leukemia cases identified from population-based Canadian cancer registries. They found that children in the poorest neighborhoods had a moderately lower risk of acute lymphoid leukemia, the most common form of childhood leukemia, than children in the richest neighborhoods. These results suggest that high SES may be a risk factor for childhood leukemia and that inconsistent results in previous studies may stem from differences in case selection or study participation.
22. The Interaction between ELF Electric Fields and RF Survey Meters: Theory and Experiment. Olsen RG, Yamazaki K. *IEEE Transactions on Electromagnetic Compatibility* 2005;47:86–96. Radio-frequency (RF) survey meters, used to measure workers' personal exposure to RF electromagnetic fields, may give erroneous readings in the presence of strong extremely low frequency (ELF) fields. This paper presents theoretical and experimental information that contributes to accurate assessment of electric power company worker exposure near high-voltage transmission towers and distribution facilities hosting RF communications antennas.
23. Animal Models for the Study of Childhood Leukemia: Considerations for Model Identification and Optimization to Identify Potential Risk Factors. McCormick DL, Kavet R. *International Journal of Toxicology* 2004;23:149–61. In this paper, authors David McCormick of IIT Research Institute and Rob Kavet of EPRI discuss the technical challenges involved in identifying and optimizing a mouse model suitable for studying the potential role of environmental agents in childhood leukemia development. The paper won the American College of Toxicology President's Award for the best paper published in 2004 in the *International Journal of Toxicology*.
24. Association of Residential Magnetic Fields with Contact Voltage. Kavet R, Zaffanella LE, Pearson RL, Dallapiazza J. *Bioelectromagnetics* 2004;25:530–6. Grounding of the electrical service in a U.S. home to the home's water line, as required by the National Electrical Code, results in a voltage between the water line and the earth. This voltage, in turn, drives a voltage between water fixtures and conductive drain pipes that can be a source of contact current exposure to a bathing child touching the water fixtures or water stream. In this study of 191 single-family Denver homes, both voltages were positively associated with spot-measured average residential magnetic fields. These results support the hypothesis that exposure to contact current may be responsible for the association found in epidemiologic studies between magnetic fields and childhood leukemia.

XXVI. EPRI EMF Health Assessment Bibliography of Peer-Reviewed Papers

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