Travis West and Daisy Wills-West, v. PPL Electric Utilities Corporation	Docket No.: C-2022-3032707
Further Call-In Telephonic Hearing	

Pages 31 - 99

Judge's Chambers

Commonwealth Keystone Building – Plaza Level

400 North Street

Harrisburg, PA

Tuesday, December 5, 2023

Commencing at 10:03 a.m.

INDEX TO EXHIBITS

Docket No. C-2022-3032707

Hearing Date: December 5, 2023

NUMBER	FOR IDENTIFICATION	IN EVIDENCE
PPL Electric Exhibit 1 PPL Electric Statement Number One	37	78
PPL Electric Exhibit 2	37	88

PPL Electric Statement

Number Two

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Travis West and Daisy Wills-West,	:	
	:	
Complainants,	:	
	:	
v.	:	Docket No. C-2022-3032707
	:	
PPL Electric Utilities Corporation,	:	
	:	
Respondent.	:	

REBUTTAL TESTIMONY OF RICHARD WHITE

PPL Electric Statement No. 1

August 7, 2023

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I. INTRODUCTION

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Richard White, and my business address is 827 Hausman Road, Allentown, PA 18104.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am employed by PPL Electric Utilities Corporation ("PPL Electric" or the "Company") as a Transmission Line Design Engineer.

Q. WHAT ARE YOUR DUTIES AS A TRANSMISSION LINE DESIGN ENGINEER?

A. In my current position I focus on transmission lines with voltages ranging from 69 kilovolts ("kV") to 500 kV. My primary responsibility is to design transmission lines and supporting structures to meet the requisite electrical clearances to the ground and objects on the ground. I follow and coordinate transmission line related projects from conception to completion. Additionally, I oversee PPL Electric's contractors' designs as they relate to transmission line projects. Lastly, I am responsible for conducting electromagnetic field ("EMF") testing and measurement within and beyond PPL Electric's various transmission line right(s)-of-way ("ROW") to ensure EMF levels are within applicable standards and guidelines.

Q. WHAT IS YOUR EDUCATIONAL BACKGROUND?

A. I hold a Bachelor of Science in Physics and a Bachelor of Science in Energy Engineering from The Pennsylvania State University.

Q. PLEASE DESCRIBE YOUR PROFESSIONAL EXPERIENCE.

A. I have been employed by PPL Electric in my current position as a Transmission Line Design Engineer for approximately 3 years.

Q. HAVE YOU PREVIOUSLY TESTIFIED AS A WITNESS BEFORE THE PENNSYLVANIA PUBLIC UTILITY COMMISSION ("COMMISSION")?

A. No.

Q. WOULD YOU PLEASE DESCRIBE THE SUBJECT MATTER OF YOUR REBUTTAL TESTIMONY?

A. My testimony will provide information and details on the following: (1) background information about EMF and transmission systems, generally; (2) the levels of EMF emitted by Line #696 Juniata-Alburtis 500 kV (hereinafter, "Line" or "Transmission Line") traversing Travis West and Daisy Wills-West's ("Complainants") property at 1008 Piketown Road, Harrisburg, PA 17112 ("Service Address" or "Property"); and (3) remedial options that the Company has considered to reduce the level of EMF at the Service Address.

Q. ARE YOU SPONSORING ANY EXHIBITS WITH YOUR TESTIMONY?

A. Yes, I am sponsoring the following exhibits:

- PPL Electric Exhibit No. RW-1 – A Record of the EMF Measurements Taken at the Service Address on January 19, 2022;

- PPL Electric Exhibit No. RW-2 – A Record of the EMF Measurements Taken at the Service Address on August 2, 2022;

- PPL Electric Exhibit No. RW-3 – PPL Electric's EMF Criteria and Standards – Transmission Engineering Instruction 8-000-003;

- PPL Electric Exhibit No. RW-4 – PPL Electric's Estimated Costs of Performing a Horizontal Configuration Rebuild of the Line; and

- PPL Electric Exhibit No. RW-5 – PPL Electric's Estimated Costs of Performing a Delta Configuration Rebuild of the Line.

II. BACKGROUND ON ELECTROMAGNETIC FIELDS AND TRANSMISSION SYSTEMS

Q. PLEASE GENERALLY EXPLAIN WHAT EMF IS.

A. As I noted earlier, "EMF" is short for electromagnetic field. EMFs are created from moving charged particles. A transmission line will create and emit EMF from the flow of electrons. The EMF emitted from transmission lines falls under a specific category of EMF called Extremely Low Frequency or "ELF." There are two types of fields generated from transmission lines: electric fields and magnetic fields. In concert, these fields make up EMF. EMF can – depending on its level and a particular person's sensitivity – result in a staticky feeling or shocking sensation when near the EMF source.

Q. DO PPL ELECTRIC'S TRANSMISSION LINES EMIT EMF?

A. Yes. All operational electric transmission and distribution lines emit EMF. This is not specific to PPL Electric or its facilities but applies generally for all electric utilities with transmission and distribution lines. As I noted, EMF consists of electric fields and magnetic fields. The magnetic field changes based on how much current flows through a line; the

more current, the stronger the magnetic field. The electric field changes based on the voltage of a line; the higher the voltage, the stronger the electric field. PPL Electric's system consists of 69 kV, 115 kV, 138 kV, 230 kV, and 500 kV transmission lines. The Line traversing the Service Address is a 500 kV line, thus, likely has relatively high EMF emissions compared to PPL Electric's 230 kV or 69 kV transmission lines. Importantly, EMF levels drop off quickly as one gets further away from the line.

Q. IS EMF HARMFUL?

A. Not in and of itself. The levels and effects of EMF can vary depending on a variety of factors, including voltage, current, weather, and a person's proximity to the EMF source. Further, EMF affects people differently. For instance, while one might feel the effects of EMF under a 500 kV transmission line like the Complainants allege, others may not feel anything. Moreover, I am unaware of any peer-reviewed study that has scientifically proven that ELF or EMF are detrimental to a person's health.

Q. IS THERE ANY WAY TO REDUCE EMF EMITTED FROM A TRANSMISSION LINE?

A. As I noted, electric and magnetic fields decrease as one gets further away from the EMF source. Additionally, electric fields are easily shielded by intervening objects or structures, such as trees or buildings.

III. EMF FROM THE LINE ON THE COMPLAINANTS' PROPERTY

Q. ARE YOU AWARE OF THE ALLEGED EMF EMITTED BY THE LINE ON THE COMPLAINANTS' PROPERTY?

A. Yes. In fact, I have been to the Property three times in response to their concerns regarding EMF.

Q. ARE THERE STANDARDS FOR THE LEVEL OF EMF THAT IS ACCEPTABLE FOR A TRANSMISSION LINE TO EMIT?

A. Yes, PPL Electric follows the Institute of Electrical and Electronics Engineers ("IEEE") standard C95.6 – Maximum Permissible Exposure ("MPE") limits. I've attached an internal PPL Electric document incorporating those limits hereto as PPL Electric Exhibit No. RW-3.

Q. PLEASE DESCRIBE THE MPE LIMITS DETAILED IN PPL ELECTRIC EXHIBIT NO. RW-3.

A. As you can see on page 5 of PPL Electric Exhibit No. RW-3, under Rule **5.1.3 – Criteria**, the MPE limit for electric fields outside of a ROW is 5 kV/m. Within a ROW, the MPE limit for electric fields is 10 kV/m. Relatedly, magnetic fields' MPE limit is 9,040 milligauss ("mG"). As I noted previously, EMF affects different people in different ways. For instance, EMF that can be felt and/or detected by one person may not be felt and/or detected by another. As EMF levels get lower, a lower percentage of the population can perceive the EMF.

Q. PLEASE DESCRIBE YOUR VISITS TO THE PROPERTY.

A. My first visit to the Service Address on September 30, 2021, was to discuss the Complainants' concerns surrounding the EMF emitted by the Line and to survey the Property, generally. On January 19, 2022, at approximately 11:00 a.m., I returned to the Service Address to conduct testing of the EMF levels. On August 2, 2022, I again returned to the Service Address at approximately 4:00 p.m. to conduct additional EMF testing under different weather conditions.

Q. WHY DID YOU CONDUCT TWO TESTS ON TWO SEPARATE DATES?

A. I conducted tests on both January 19, 2022, and August 2, 2022, to account for different testing conditions. As I noted previously, EMF levels can vary from day-to-day based on a number of factors, including the weather. By testing the EMF levels at the Service Address on both a cold winter day and a hot summer day, I gained a fuller understanding of the EMF levels present at the Service Address that might occur throughout any given year. EMF levels on a cool day are often lower than they would be on a warm day.

Q. WHAT WERE THE CONDITIONS WHEN YOU MEASURED THE EMF FROM THE LINE TRAVERSING THE COMPLAINANTS' PROPERTY?

A. On my January 19, 2022 visit to the Service Address, it was approximately 40 degrees Fahrenheit and sunny. Conversely, during my August 2, 2022 visit to the Service Address, it was approximately 90 degrees Fahrenheit and sunny. This information is reflected in PPL Electric Exhibit Nos. RW-1 and RW-2, respectively.

Q. WHAT DID YOU USE TO MEASURE THE EMF AT THE COMPLAINANTS' PROPERTY?

A. I used a Wave Control SMP2 meter with a wp400 probe. I selected this meter as it is the standard EMF reader that PPL Electric uses to measure EMF emissions from transmission lines. The SMP2 meter allows the user to detect both electric and magnetic fields at a higher value than what is described in the IEEE's standards.

Q. HAVE YOU USED THIS DEVICE BEFORE?

A. Yes. This is the standard device that I use when measuring EMF within or near PPL Electric's transmission lines ROWs in response to customers' concerns. During my time at PPL Electric, I've used this device at several different properties on several different occasions.

Q. WHAT LOCATIONS AT THE SERVICE ADDRESS DID YOU CONDUCT TESTING AT DURING THE VISIT ON JANUARY 19, 2022?

A. I tested the EMF levels at the Service address at six discrete locations at varying distances away from the Line and the Company's ROW. For clarity, I've included an aerial photograph of the Service Address with the testing locations delineated below:

Q. WHAT WERE THE RESULTS OF THE JANUARY 19, 2022 EMF TEST?

A. The results of the test are shown in PPL Electric Exhibit Table No. 1, shown below:

PPL ELECTRIC TABLE 1

Location	Location Description	Electric Field (kV/m)	Magnetic Field (mG)
1	Middle Conductor	3.74	157.1
2	Outside Conductor (towards home)	5.47	129.5
3	Edge of ROW (100ft from centerline)	1.42	38.4
4	By Horse Gate	0.69	24.0
5	By Shed Gate	0.81	35.5
6	Midway Between Outside Conductor and Shed	4.34	88.1

As you can see in PPL Electric Table 1, and in more detail in PPL Electric Exhibit No. RW-1, the levels of EMF at each discrete testing location were well below the maximum

allowable levels dictated by IEEE standards. The highest level of electric field was measured at testing location 2, which registered a high value of 5.47 kV/m. The lowest level of electric field was measured at testing location 5, near the Complainants' shed gate, at a value of 0.69 kV/m. The maximum allowable standard of electric fields within the Company's ROW is 10 kV/m according to IEEE standards; the highest electric field value measured at the Service Address was approximately 55% of the MPE limit within the ROW. Similarly, the highest electric field value measured outside of the Company's ROW at the Service Address was 0.81 kV/m, or approximately 16% percent of the MPE limit. The magnetic field values were, at their highest point, not even 2% of the MPE limit.

Q. CAN YOU DRAW ANY CONCLUSIONS AS A RESULT OF THE MEASUREMENTS TAKEN ON JANUARY 19, 2022?

A. Yes. My primary conclusion is that the EMF emitted by the Line during the winter months is well below the MPE limits for both electric fields and magnetic fields. Indeed, those values would likely be lower if the weather was colder.

Q. PLEASE DESCRIBE YOUR VISIT TO THE SERVICE ADDRESS ON AUGUST 2, 2022, AND THE TESTING CONDUCTED ON THAT DATE.

A. I returned to the Property on August 2, 2022, to take additional EMF measurements. As you can see in PPL Electric Exhibit No. RW-2, it was approximately 90 degrees that day. I tested the EMF levels at the Service address in ten discrete locations at varying distances

away from the Line and the Company's ROW during this visit. For clarity, I've included an aerial photograph of the Service Address with the testing locations delineated below:

Q. WHAT WERE THE RESULTS OF THE TEST CONDUCTED ON AUGUST 2, 2022?

A. The results of the test are shown in PPL Electric Table 2 below:

PPL ELECTRIC TABLE 2

Location	Location Description	Electric Field (kV)	Magnetic Field (mG)
A	under middle Phase	4.420	
B	Under outer phase closest to house	6.266	142.7
C	100' approximately from middle phase closet to house	1.314	
D	Close to barn door	0.716	
E	At corner of barn near line	1.821	
F	Near metal gate perpendicular to line	5.184	
G	Outer phase away from house	6.628	
H	High mound in field away from house	3.926	
I	100' approximately from line away from house	1.763	
J	Fence opposite from house phase away from house	6.5	

As you can see in PPL Electric Table 2, and in more detail in PPL Electric Exhibit No. RW-2, the levels of EMF at each of the ten testing locations were well below the MPE limits dictated by IEEE standards. The highest level of electric field was measured at testing location G (the outer phase of the Line), which registered an electric field value of 6.628 kV/m. The lowest level of electric field was measured at testing location D (near the Complainants' barn door), at a value of 0.716 kV/m. As the MPE limit for electric fields is 10 kV/m within the Company's ROW, the highest electric field value measured at the Service Address was approximately 66% of the MPE limit. Testing locations C and D were the only measurement locations taken from outside of the Company's ROW. These locations registered electric field levels of 1.314 kV/m and 0.716 kV/m, respectively, or approximately 26% and 14% of the MPE limit. As you can see in PPL Electric Table 2 and PPL Electric Exhibit No. RW-2, the magnetic field value registered during that visit was not even 2% of the MPE limit.

Q. CAN YOU DRAW ANY CONCLUSIONS AS A RESULT OF THE MEASUREMENTS TAKEN ON AUGUST 2, 2022 TEST?

A. Yes. My primary conclusion is that the EMF emitted by the Line during a warm, summer day like August 2, 2022, will generally be reflective of the higher end of EMF emissions from the Line. Thus, I believe that the measurements taken on August 2, 2022, when it was 90 degrees Fahrenheit, reflect near the highest EMF values that could realistically be expected at the Property. As I explained, the EMF readings taken at the Property that day were well below applicable MPE limits.

Q. FOR EACH OF THE TESTS YOU CONDUCTED, WHY DID YOU MEASURE THE EMF LEVELS AT DIFFERENT PLACES ON THE COMPLAINANTS' PROPERTY?

A. I selected several locations to measure EMF at the Service Address during each visit to gain a clear understanding of the varying levels of EMF throughout the Property. My first testing sites on each date were conducted directly under or near the middle phase of the Line to get a base level of EMF in the Company's ROW. I then tested directly under the outer phases of the Line. The outer phases of the Line can be expected to emit the highest levels of EMF due to the phase shift in the electricity, which can cause interference in the electric fields resulting in anticipated peak levels near the outer phases for the horizontally framed lines. I also surveyed the Property for particularly high spots under the Line (*i.e.*, locations closest to the Line itself) and conducted testing on those high spots. Additionally, I conducted testing at various points near the edge of the ROW, and in turn, tested outside

of the ROW. Further, I asked the Complainants if there were any particular areas of concern. In response to potential areas of concern, I conducted testing at those sites. Both the January 19, 2022, and August 2, 2022 tests rendered values well-within applicable MPE limits. *See* PPL Electric Exhibit Nos. RW-1, RW-2, and RW-3.

Q. DOES EVERYONE HAVE THE SAME SENSITIVITY TO EMF?

A. No. As I explained earlier in my testimony, EMF affects people differently. While the Complainants may feel a static or shocking sensation under or near the Line, others may not feel anything.

IV. ALTERNATIVES EVALUATED TO REMEDIATE THE EMF ON THE COMPLAINANTS' PROPERTY

Q. HAS THE COMPANY EVALUATED HOW TO REMEDIATE OR ADDRESS THE COMPLAINANTS' CONCERNS REGARDING EMF FROM THE LINE?

A. Yes.

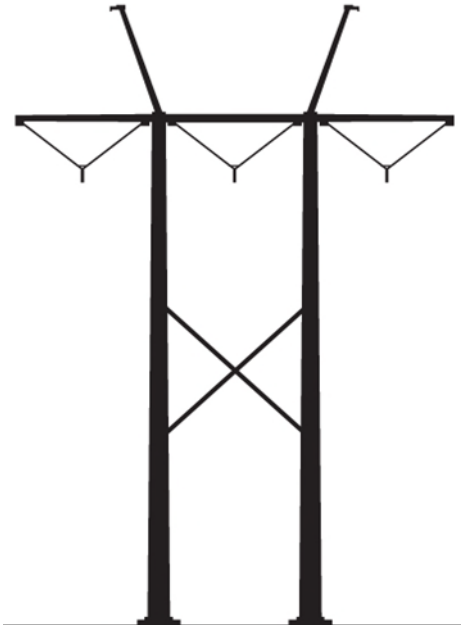
Q. PLEASE EXPLAIN.

A. PPL Electric evaluated two alternatives to remediate the EMF effects at the Service Address. The options we evaluated were two different reconfigurations to raise the Line – thereby increasing ground clearance for the lines traversing the Service Address – to put additional distance between the EMF source (*i.e.*, the Line) and people below. Both alternatives we evaluated were entirely cost-prohibitive. Moreover, both options evaluated

– even if not cost-prohibitive – were not guaranteed to any make meaningful difference in the Complainants' alleged EMF sensitivity under or near the Line. This says nothing of the fact that the Line, in its present location and configuration, is wholly in compliance with the Company's ROW agreement, as explained further by Mr. Huber in PPL Electric Statement No. 2.

Q. PLEASE EXPLAIN THE FIRST OPTION PPL ELECTRIC EVALUATED.

A. The first option we evaluated was to retain the horizontal configuration of the structures at the Service Address, but replace the two existing approximately 115 ft. tall poles on either side of the Company's ROW with 150 ft. tall poles, thereby raising the height of the conductors and, ultimately, the height of the Line. An illustration of the horizontal configuration can be found below:



Q. WHY DID THE COMPANY NOT PURSUE THIS OPTION?

A. For a couple of reasons. First, PPL Electric has a validly held ROW for the current configuration of the Line traversing the Property. Second, as reflected in PPL Electric Exhibit No. RW-4, this option was estimated to cost approximately $5,672,295.81. This cost is wholly unreasonable given the circumstances and the fact that PPL Electric has a right to the presence of the existing Line in its current form across the Property.

Q. WOULD PURSUING THIS OPTION ADDRESS THE COMPLAINANTS' CONCERNS?

A. There is no guarantee that it would. The potential EMF effects of replacing the existing support structures on either side of the Company's ROW with higher, similarly configured structures was modelled using PPL Electric software. That modelling indicated that pursuing this option could have decreased the maximum electric field levels within the Company's ROW to approximately 2 kV/m. For some people, this level could still be detectable, and the Complainants still may feel a static or shocking sensation under or near the Line, even though they would be further away from the Line given its increased height. Thus, beyond the exorbitant cost of pursuing this option, there is no guarantee that it would actually address or remediate the EMF effects that the Complainants allege they are experiencing.

Q. PLEASE EXPLAIN THE SECOND OPTION PPL ELECTRIC EVALUATED.

A. The second option we evaluated was to switch the existing poles to a delta frame configuration, which would require fewer poles than the current horizontal configuration. A delta configuration would consist of a monopole structure with two conductors on one side and one conductor on the other side, meaning that the conductors (*i.e.*, the Line) would be at three different heights. The delta configuration is a more compact structure than a structure that has all of the conductors on the same side; however, it would require a higher pole than a horizontal configuration. Thus, under this option, the two approximately 115 ft. poles on either side of the Property would be replaced with 200 ft. high poles, with the two poles beyond the structures on the Property being replaced with 150 ft. high poles to accommodate the increased height of the other structures. This option would also involve replacing the existing conductors and shield wires below the lines. An illustration of a delta configuration can be found below:

Q. WHY DID THE COMPANY NOT PURSUE THIS OPTION?

A. Much like the first option we evaluated, for several reasons. First, PPL Electric has a validly held ROW right for the current configuration of the Line to traverse the Property. Second, as reflected in PPL Electric Exhibit No. RW-5, this option was estimated to cost approximately $5,832,469.25. This cost is wholly unreasonable given the circumstances and the fact that PPL Electric has a right to the presence of the existing Line in its current form across the Property.

Q. WOULD PURSUING THIS OPTION ADDRESS THE COMPLAINANTS' CONCERNS?

A. Not necessarily, much like the first option we evaluated. The potential EMF effects of replacing the existing support structures with higher delta configured structures to raise the Line was modelled using PPL Electric software. That model indicated that pursuing this option could decrease the electric field levels within the Company's ROW to approximately 2 kV/m. This estimated electric field level could still be potentially perceivable by the Complainants. Again, because EMF affects peoples differently, the Complainants may be able to perceive EMF at any level above 0.00 kV/m, which would be impossible to achieve given the nature and presence of the Line.

Q. IN YOUR OPINION, ARE EITHER OF THESE OPTIONS FEASIBLE OR REASONABLE?

A. No. As I've explained, PPL Electric has a validly held ROW over the Property which houses the Line. Indeed, the Line has been present and operational across the Service Address since 1968. As explained in further detail by Mr. Huber in PPL Electric Statement No. 2, the Line is compliant with the ROW agreement. Moreover, the EMF emitted by the Line is well within the governing EMF MPE limits. Additionally, as I detail above, the costs associated with both evaluated options are extreme and unreasonable. Further, I'm advised by Counsel that costs associated with pursuing either of these options would ultimately be passed along to all of PPL Electric's customers. Lastly, pursuing either of the options delineated above are not guaranteed to eliminate the EMF effects the Complainants are allegedly experiencing. To pursue remedial options in an attempt to address the Complainants' alleged concerns, each of which would cost well over $5,000,000.00, without the guarantee of it improving the subjective EMF impact to the Complainants, would be misguided, unreasonable, and poor utility practice.

Q. DOES THIS CONCLUDE YOUR REBUTTAL TESTIMONY AT THIS TIME?

A. Yes, although I reserve the right to supplement my rebuttal testimony.

PPL Electric Exhibit No. RW-1

PPL Electric Utilities

EMF DATA SHEET

Transmission Line(s):	696 JUNI-ALBU	**# of Circuits**	1
Closest Grid #	27567s37920	**Line Configuration**	Horizontal
Customer Name	Travis & Daisy West	**Transmission Voltage:**	500kV
Address	1008 Piketown Rd, Harrisburg, Pennsylvania 17112	**Date:**	1/19/2022
PPL Engineer(s)	George Khoury, Richard White	**Time:**	11:10 AM – 12:00 PM

EMF Meter Information	
Meter Information	SMP2, WP400
Calibration Date	9/11/21, 10/11/21
Filter	10Hz

Weather Information	
Ambient Temp (°F)	**40**
% Humidity	**49**
Wind (mph)	**5**
General Comments:	**Sunny**

Print out a google map image of the location and mark the locations on the map that are being measured.

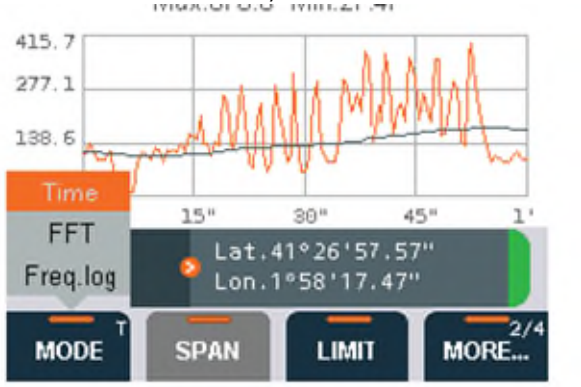
Location	Location Description	Electric Field (kV/m)	Magnetic Field (mG)	Comments
1	Middle Conductor	3.74	157.1	
2	Outside Conductor (towards home)	5.47	129.5	
3	Edge of ROW (100ft from centerline)	1.42	38.4	
4	By Horse Gate	0.69	24.0	
5	By Shed Gate	0.81	35.5	At least 4 ft from building
6	Midway Between Outside Conductor and Shed	4.34	88.1	At least 4 ft from building

PPL Electric Utilities

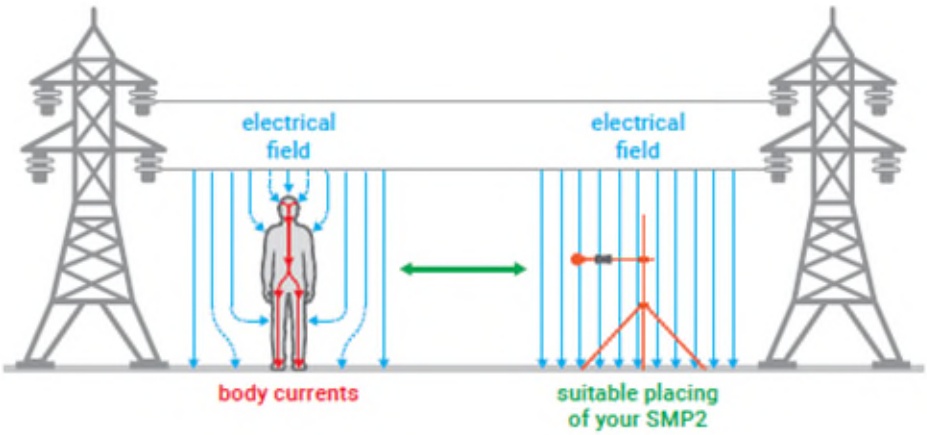
Business Use

Procedure for measuring electric field strength (E) produced by transmission lines:

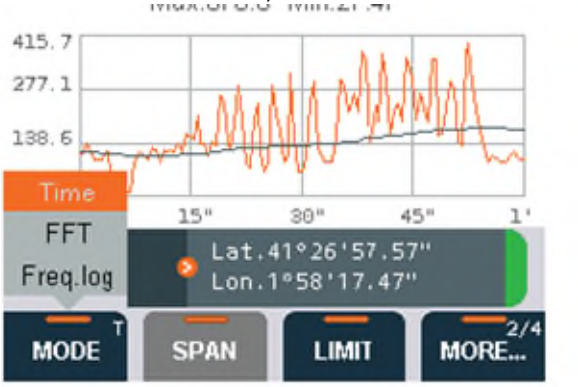
1) Check the meter to ensure E field measurement. Select appropriate unit of measurement (kV/m).
2) Set the meter stand so the probe is 1m above ground.
3) Select “MODE”:Time; “FILTER”: 10Hz on the SMP2 meter.



4) Ensure at least 8ft distance between the operator and the meter, 3.5ft away from permanent objects and a distance of at least 3 times the height of a nonpermanent object to measure unperturbed field. This will increase the accuracy of the readings.
5) At a minimum, measurements should be taken from the edge of the ROW to the other end close to the midspan or at minimum conductor height of the transmission line.
6) Several measurements should also be taken outside of the ROW
7) Select “LOG” to enable delayed recording every 1s (can be changed in the menu options) – stores the values and gps coordinates. Alternatively, perform a screen capture to save the display.
8) A lateral profile view can be plotted if needed.



Procedure for measuring magnetic field strength (H) produced by transmission lines:

1) Check the meter to ensure H field measurement. Select appropriate unit of measurement (mG).
2) Set the meter to approximately 1m above ground.
3) Select “MODE”:Time; “FILTER”: 10Hz on the SMP2 meter.
4) 

5) Magnetic field is not distorted by the operator and thus can be relatively close to the meter. The meter should be at least 3.5ft away from permanent objects and a distance of at least 3 times the height of a nonpermanent object to measure unperturbed field. This will increase the accuracy of the readings.
6) At a minimum, measurements should be taken from the edge of the ROW to the other end close to the midspan or at minimum conductor height of the transmission line.
7) Measurement locations should be per EMF Investigation Procedure
8) A lateral profile view can be plotted if needed.

Note: The RMS value are what the PPL limits are based on.

PPL Electric Exhibit No. RW-2

PPL Electric Utilities

EMF DATA SHEET

Transmission Line(s):	Juniata-Alburtis	**# of Circuits**	1
Closest Grid #	27567S37920	**Line Configuration**	Horizontal
Customer Name	Travis and Daisy West	**Transmission Voltage:**	500 kV
Address	1008 Pike Town Road, Harrisburg, Pa 17112	**Date:**	8/02/2022
PPL Engineer(s)	Richard White, Christopher Szmodis	**Time:**	4:00 PM – 4:30 PM

EMF Meter Information	
Meter Information	SMP2, WP400
Calibration Date	9/11/21, 10/11/21
Filter	10Hz

Weather Information	
Ambient Temp (°F)	90
% Humidity	39
Wind (mph)	10
General Comments:	Sunny and Clear

Print out a google map image of the location and mark the locations on the map that are being measured.

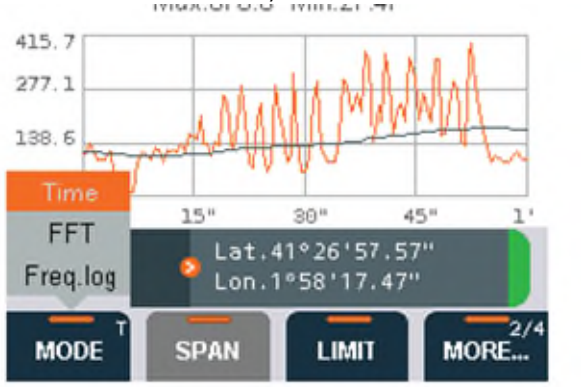
Location	Location Description	Electric Field (kV)	Magnetic Field (mG)
A	under middle Phase	4.420	
B	Under outer phase closest to house	6.266	142.7
C	100' approximately from middle phase closet to house	1.314	
D	Close to barn door	0.716	
E	At corner of barn near line	1.821	
F	Near metal gate perpendicular to line	5.184	
G	Outer phase away from house	6.628	
H	High mound in field away from house	3.926	
I	100' approximately from line away from house	1.763	
J	Fence opposite from house phase away from house	6.5	

PPL Electric Utilities

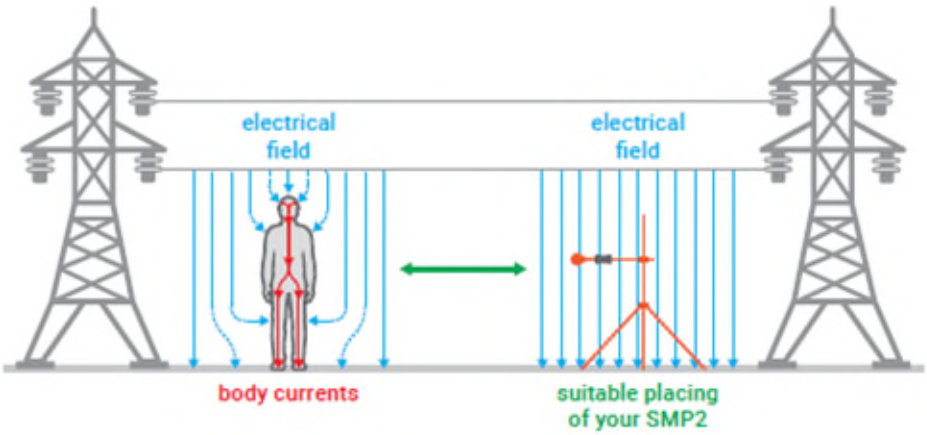
Business Use

Procedure for measuring electric field strength (E) produced by transmission lines:

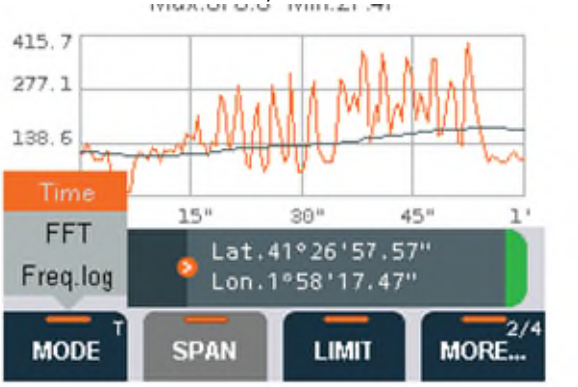
1) Check the meter to ensure E field measurement. Select appropriate unit of measurement (kV/m).
2) Set the meter stand so the probe is 1m above ground.
3) Select “MODE”:Time; “FILTER”: 10Hz on the SMP2 meter.



4) Ensure at least 8ft distance between the operator and the meter, 3.5ft away from permanent objects and a distance of at least 3 times the height of a nonpermanent object to measure unperturbed field. This will increase the accuracy of the readings.
5) At a minimum, measurements should be taken from the edge of the ROW to the other end close to the midspan or at minimum conductor height of the transmission line.
6) Several measurements should also be taken outside of the ROW
7) Select “LOG” to enable delayed recording every 1s (can be changed in the menu options) – stores the values and gps coordinates. Alternatively, perform a screen capture to save the display.
8) A lateral profile view can be plotted if needed.



Procedure for measuring magnetic field strength (H) produced by transmission lines:

1) Check the meter to ensure H field measurement. Select appropriate unit of measurement (mG).
2) Set the meter to approximately 1m above ground.
3) Select “MODE”:Time; “FILTER”: 10Hz on the SMP2 meter.
4) 

5) Magnetic field is not distorted by the operator and thus can be relatively close to the meter. The meter should be at least 3.5ft away from permanent objects and a distance of at least 3 times the height of a nonpermanent object to measure unperturbed field. This will increase the accuracy of the readings.
6) At a minimum, measurements should be taken from the edge of the ROW to the other end close to the midspan or at minimum conductor height of the transmission line.
7) Measurement locations should be per EMF Investigation Procedure
8) A lateral profile view can be plotted if needed.

Note: The RMS value are what the PPL limits are based on.

PPL Electric Exhibit No. RW-3

Overhead Transmission Line Electrical Studies

Contributing Parties:

	Signature	Department	Date
	Primary Group		
Preparer:	Matthew Donaldson	T&S Standards	4/15/2018
Reviewer:	Joe Renowden	T&S Standards	4/15/2108
Approver:	Yves Nembo	T&S Standards	4/15/2018
	Interfacing Groups		
Group 1:	Horst Lehmann	Transmission Engineering	4/15/2018
Group 2:	George Khoury	Transmission Engineering	4/15/2018
Group 3:			
Group 4:			

Document Information:

Location Code:	N/A
Sorts:	N/A
Supersedes:	N/A
Project ER:	N/A

Record of All Issued Revisions

Revision	Pages	Section	Description	Issue Date
00	All	All	Initial Issue	4/15/2018

Primary Distribution

RC 0880	RC 0881		

1.0 Scope

This document provides the technical requirements for performing electrical studies on overhead transmission lines rated 69kV and above.

2.0 References

EPRI AC Transmission Line Reference Book, 200 kV and Above, Third Edition, 2005

National Electrical Safety Code (NESC), 2017

IEEE Std C95.6 "Standard for Saftey Levels with Respect to Human Exposure to Electromagnetic Fields, 0-3kHz"

IEEE Standard 1260-1996 "Guide on the Prediction, Measurement, and Analysis of AM Broadcast Reradiation by Power Lines"

Code of Federal Regulations Title 47 Part 73-Broadcast Services

3.0 Definitions

EPRI – Electric Power Research Organization

NESC – National Electric Safety Code

EMF – Electromagnetic Field

4.0 Materials

N/A

5.0 Application and Design

5.1 Electric and Magnetic Fields (EMF)

Calculations for electric and magnetic fields shall be completed using the methods and criteria prescribed in this section.

5.1.1 Applicability

All new and rebuilt transmission lines with a nominal operating voltage 69kV and above shall meet the requirements contained herein.

When adding an additional circuit, reconductoring, or making other modification to a line EMF shall not be increased from the present condition or shall conform to the criteria limits listed below.

All new and rebuilt lines at or greater than 345kV shall have an EMF study performed to verify compliance. . No studies are required for lines rated below 345kV that utilize PPL standard conductors, insulator assemblies and clearance criteria.

5.1.2 Calculation Method

EMF shall be calculated using suitable software such as BPA's Corona and Field Effects Program, EPRI's TLW, or applets associated with the "EPRI AC Transmission Line Reference Book, 200 kV and Above, Third Edition".

Conductor height above ground shall be at maximum final sag.

Calculations shall be made using the maximum rms operating voltage.

Calculations shall be made 1m (meter) above ground.

5.1.3 Criteria

Electric fields shall be limited to 5 kV/m outside the ROW and 10 kV/m within the ROW per IEEE Std C95.6 Maximum Permissible Exposure (MPE) limits.

Magnetic fields shall be limited to 9,040mG per IEEE Std C95.6 Maximum Permissible Exposure (MPE) limits.

5.2 Corona, Audible Noise (AN) and Radio Interference (RIV)

Corona effects shall be calculated using the methods prescribed in this section and the line design shall comply with the limits defined in this section.

5.2.1 Applicability

All new and rebuilt transmission lines with a nominal operating voltage 69kV and above shall meet the requirements contained herein.

All lines at equaling or exceeding 345kV nominal operating voltage shall have a corona effects study performed to verify compliance. No studies are required for lines rated below 345kV that utilize PPL standard conductors, insulator assemblies and clearance criteria.

5.2.2 Calculation Method

Corona and its effects shall be calculated using suitable software such as BPA's Corona and Field Effects Program, EPRI's TLW, or applets associated with the "EPRI AC Transmission Line Reference Book, 200 kV and Above, Third Edition".

Conductors shall be approximated as a straight line, with a height above ground calculated using two thirds (2/3) the maximum final sag.

Calculations shall be made using the maximum rms operating voltage.

If there are multiple transmission lines in one ROW all circuits shall be considered for the analysis.

All audible noise calculations shall utilize an L50 exclusion limit.

Audible noise shall be calculated for heavy rain conditions.

5.2.3 Criteria

Audible noise shall be limited to 50 dBA at the edge of PPL ROW for all newly constructed or rebuilt transmission lines. The audible noise limit shall be reduced to 47dBA in areas where the transmission line ROW is located in a residential location.

When adding an addition circuit to an existing line, reconductoring or making other modifications to a line the audible noise shall not be increased by greater than 3dBA if it exceeds the 50dBA or 47dBA limits.

Radio interference shall be limited to 49.5 dBuV/m (300 uV/m) at the edge of ROW.

If local regulations impose more stringent requirements for either audible noise or RIV those limits shall govern.

5.3 NESC Rule 232C.1.c (5mA Rule)

5.3.1 Applicability

All new or rebuilt transmission lines shall conform to the requirements of the NESC (2017) Rule 232C.1.c.

> "For voltages exceeding 98 kV ac to ground, either the clearances shall be increased or the electric field, or the effects thereof, shall be reduced by other means as required to limit the steady-state current due to electrostatic effects to 5 mA rms if the largest anticipated truck, vehicle, or equipment under the line were short-circuited to ground. The size of the anticipated truck, vehicle, or equipment used to determine these clearances may be less than but need not be greater than that limited by federal, state, or local regulations governing the area under the line. For this determination, the conductors shall be at a final sag at 50 °C (120 °F)."

This includes the addition of new line(s) to an existing ROW. In this case all the lines in the ROW shall be considered in the analysis; not just the new line(s).

All new and rebuilt lines at or greater than 345kV shall have an EMF study performed to verify compliance. . No studies are required for lines rated below 345kV that utilize PPL standard conductors, insulator assemblies and clearance criteria.

5.3.2 Calculation Method

Calculations shall be made using the approach presented in the "EPRI AC Transmission Line Reference Book, 200 kV and Above, Third Edition". The equivalent area for vehicles shall be approximated as box shaped using the appropriate shape factor as defined by Figure 7.8-3.

Determination of locations for analysis shall be made given the types of lands and roads present at the time the line is being designed unless planned alterations are known. If undeveloped land is currently zoned for industrial use it should be considered an area accessible by trucks.

Vehicles shall be oriented in the worst case expected configuration (perpendicular or parallel to the line). Vehicles need not be considered in unexpected orientations such as a truck perpendicular within a roadway.

For all roads area on or immediately adjacent to the PA Turnpike an 85 foot tractor trailer shall be considered as a box 8.5 feet wide, 13.5 feet tall and 85 feet long.

For all other areas on or adjacent to PENNDOT roads, unless specifically restricted to a smaller size, a 65 foot tractor trailer shall be considered as a box 8.5 feet wide, 13.5 feet tall, and 65 feet long.

For all agricultural areas, due to the possibility of trucks in the field for removal of the harvested crop, a 65 foot tractor trailer shall be considered as a box 8.5 feet wide, 13.5 feet tall, and 65 feet long.

The electric field gradient calculation for the induced current shall be made at final sag with the conductor at a temperature of 120° F (50° C) per NESC Rule 232C.1.c.

5.3.3 Criteria

Calculated steady state current due to electrostatic effects shall not exceed 5 mA per NESC Rule 232C.1.c.

5.4 AC Interference

5.4.1 Background

Electrical supply lines can cause electrical effects on metallic objects near the lines. These effects are collectively referred to as AC interference. In the case of metal pipelines or railroad tracks, due to their length, the induced voltage can cause both system integrity and personnel safety issues. Other metallic objects such as fences and communications cables may be subject to the same effects but are not specifically addressed in this document. There are three main methods of coupling to metallic objects.

5.4.1.1 Inductive Coupling

Inductive coupling affects objects that are parallel or close to parallel (generally less than 45°) to the transmission line. The magnetic field produced in both steady state and faulted conditions causes a voltage to be induced on the metallic object. The magnitude of the voltage is proportional to the length in which the line and object are parallel and the current on the transmission line. Even objects well removed from the transmission right of way can be impacted by this phenomenon if the length is great or there are large currents on the line.

5.4.1.2 Conductive Coupling

Conductive coupling affects objects that are close to grounded transmission structures. During a single line-to-ground fault, current flows through the ground causing voltages to develop around on the structures. This ground current can cause voltages to develop on nearby metallic objects even if they are perpendicular to the transmission line.

5.4.1.3 Capacitive Coupling

Capacitive coupling causes voltages to be induced on ungrounded objects due to the electric field produced by the transmission line. This is the mechanism responsible for 5 mA calculations. Typically this does not affect railroads or pipelines as they are at or below ground level, but can be a concern for communication systems. One specific concern for capacitive coupling is during the construction of a pipeline when pipeline segments are welded on site using non-conductive supports.

5.4.2 Applicability

For all new or rebuilt transmission facilities if any foreign facilities (most commonly railroads or pipelines) are located within or in close proximity to transmission line ROW a study shall be performed to determine if there will be any interactions between PPL's and the foreign utilities facilities. A study shall also be performed if the construction of an applicable foreign facility is being proposed.

5.4.3 Coordinating with Foreign Entities

Establishing contact with railroad or pipeline owners early in the transmission line design can make the process of performing analysis and paying for possible mitigation systems run more smoothly. The coordination with foreign entities can be broken down in three steps.

5.4.3.1 Initiating Contact

Initial contact with foreign facility owner should describe the basic co-location of the objects in the corridor and basic electrical properties of the transmission line. There are many methods to accomplish this, with some listed below.

- Provide formal drawings showing the co-location of the transmission line and the foreign facility
- Provide geospatial files, such as Google Earth files, showing the location of the transmission line
- Request a crossing permit for the project

5.4.3.2 Determining Analysis Requirements

In some instances the foreign facility owner may not require analysis to be performed. This may be due to existing mitigation or systems that are not likely to be negatively impacted by induced AC voltage. Should analysis be waived confirm that the contact person at the foreign entity has the authority to do so. It is recommended to draft a legal agreement outlining the details of such an agreement.

5.4.3.3 Establishing Co-Location Agreement

The co-location agreement may be one or more documents that identify how the interaction between PPL and the foreign entity owner will progress. If it is determined that interaction between the PPL's and foreign utilities is likely a co-location agreement should be established.

5.4.4 Calculation Method

5.4.4.1 Inputs

All foreign conductor systems, such as communication lines, pipelines (water and fuel), railroads, and irrigation systems that are in close proximity to the corridor with the following characteristicsshall be considered in the analysis. Close proximity shall be defined as being routed along the corridor within a distance of ½ mile of the transmission centerline and having a common corridor length of the facilities of a minimum of 500 feet in length.

For each foreign conductor system that meets the guidelines above, the following is required:

- The characteristics of the foreign conductor system (size, type of material, voltage rating, type of coating or type of insulation material)
- Route map that shows the distance of the foreign conductor system with respect to the transmission line which includes a distance of at least one mile each side of the corridor
- The average depth below ground or height above ground of the foreign conductor system

Soil resistivity data for the area to be analyzed shall be gathered.

Both the typical and emergency line loads shall be obtained from PPL Transmission Planning.

The single line to ground fault magnitude will be required. PPL standard criteria limits for bus fault magnitudes shall be used as a basis for fault magnitudes.

5.4.4.1.1 Pipeline Specific Requirements

Guidelines for steady state and fault conditions for equipment and personnel safety, location of tests stations (including characteristics of the test stations), and details on compressor stations shall be obtained from the pipeline owner/operator.

5.4.4.1.2 Railroad Specific Requirements

The following information shall be obtained from the railroad owner/operator.

- Weight per unit length of the rails
- Separation between rails
- Location of all rail insulated joints inside the corridor
- Location of all highway crossings, including the control equipment manufacturer and their operating frequencies
- Tolerance limits of equipment due to AC Interference

- Signal equipment for train control and longitudinal control of track equipment including manufacturer and tolerance to AC Interference
- Other equipment is located across the track system including manufacturer, frequencies that operate, tolerance of equipment to AC Interference
- Railroad requirements for electromagnetic compatibility

5.4.4.2 Outputs

AC interference studies shall provide the following output data.

5.4.4.2.1 Pipelines

Steady state AC corrosion mitigation requirements and any interaction with the overhead line structures.

Steady state voltages induced on pipeline

Pipeline coating stress voltage rating

Touch and step voltages under fault conditions

5.4.4.2.2 Railroads

Rail-rail voltages

Voltage across insulating joints

Rail-ground voltages under fault conditions

Touch and step voltages under fault conditions at test stations and other exposed components, such as valve stations.

5.4.5 Criteria

Compliance limits for railroad and pipeline AC interference analysis generally followindustry guidelines. There can be exceptions based on individual companies. Typical values and the applicable standards for railroads and pipelines are identified below.

5.4.5.1 Railroads

Railroad AC interference analysis is concerned with signaling system integrity and personnel safety. Under steady state electrical transmission operation, the rail signaling system should not mis-operate and railroad employees should not be exposed to hazardous voltages. During fault scenarios, the voltagesshall be limited to values that do not cause permanent equipment failure or non-compliant touch voltages for personnel.

Compliance values used for railroad AC interference analysis are shown in the table below. The specific railroad shall be contacted for their allowable limits. The most stringent criteria shall apply.

TYPICAL RAILROAD COMPLIANCE LIMITS		
CASE	**TYPE**	**LIMIT**
Steady State	Touch Voltage	50 volts (to ground) at exposed parts
Steady State	Signaling	5 volts rail-to-rail
Fault	Touch/Step Voltage	IEEE Std 80-2013
Fault	Equipment Limits	1,000 – 2,000 volts

5.4.5.2 Pipelines

Pipeline AC interference analysis is typically concerned with pipeline integrity and personnel safety. Under steady state electrical transmission operation, the pipeline shall not be exposed to long term corrosion issues or voltages which exceed "let-go" voltages for the workers or general public. During fault scenarios, the voltages shall be limited to values that do not cause coating failure or non-compliant touch voltages for personnel.

Compliance values used for pipeline AC interference are shown in the table below. The specific pipeline shall be contacted for their allowable limits. The most stringent requirement shall apply.

TYPICAL PIPELINE COMPLIANCE LIMITS		
CASE	**TYPE**	**LIMIT**
Steady State	Touch Voltage	15 volts at above ground appurtenances
Steady State	AC Corrosion	20-100 amps per meter squared
Fault	Touch/Step Voltage	IEEE Std 80-2013
Fault	Coating Stress Voltage	1,000 – 5,000 volts

5.5 AM Reradiation

AM broadcast antennas radiate electromagnetic waves that are measured and reported as electric field strength patterns. These patterns are licensed, regulated, and protected under Federal Communication Commission (FCC) guidelines. The underlying cause of AM reradiation is the rebroadcast of the AM signal from the interaction with transmission line structures, conductors or OHGW, as a function of length in comparison to the broadcast signal wavelength. Either an increase or decrease in signal strength can result in a vidation of the license granted by the FCC. Therefore, if detailed analysis determines this condition is significant (which is a function of the incident field strength and the minimum pattern tolerance), then it must be mitigated.

5.5.1 Applicability

The addition of transmission lines at a distance less than 10 kilometers (approximately 6.2 miles) from the AM broadcast antenna can result in a condition where these broadcast patterns can be distorted by either constructive or destructive interference. Installation of any transmission facilities within the above listed distance shall be analyzed to determine if they have any detrimental effects on the signals.

5.5.2 Calculation Method

Federal Communications Commission (FCC) states an AM broadcast antenna must comply with Code of Federal Regulations Title 47 Part 73-Broadcast Services. Sections 37 and 44 dictate signal strength requirements for new and augmented licensing. To ensure the proposed line will not cause adverse variations to the signal strength, "IEEE Standard 1260-1996 Guide on the Prediction, Measurement, and Analysis of AM Broadcast Reradiation by Power Lines", shall be consulted.

An initial survey prediction technique based upon Section 6.2 of IEEE 1260 shall be used to evaluate the reradiation ratio against specific line parameters detailed in the table below. The reradiation ratio is calculated by Equation 1 (below), where, λ is the wavelength of the transmitted signal in meters, Tol_{min} is the minimum pattern tolerance in V/m, $Field_{1km}$ is the 1km un-attenuated field strength in the direction of the re-radiator in V/m, and D is the distance from the antenna to the point of intersection in meters.

$$r = \frac{Tolmin \ *D}{Field_{1km}*\lambda} \qquad \text{Eq. 1}$$

5.5.3 Criteria

The following compliance criteria, per IEEE Standard 1260, where λ is the wavelength (m) of the broadcast signal under investigation shall be maintained.

IEEE STD 1260 RERADIATION RATIO COMPLIANCE LIMITS		
Reradiation Ratio	**Maximum Structure Height (m)**	**Maximum Power Line Loop Length (m)**
r > 0.2	Structure is acceptable	Power Line is acceptable
0.1 < r ≤ 0.2	rλ	(0.94+0.3r)λ
0.02 ≤ r ≤ 0.1	(0.025+0.75r)λ	(0.76+2r)λ
r < 0.02	0.04λ	0.8λ

5.5.4 Design Considerations

Design considerations shall focus on avoiding placement of structures within 5 km of directional antennas as they have the most restrictive licensing requirements. In addition, if an AM station is identified prior to final design, structure height can be manipulated to ensure the structure height is not a multiple of a quarter wavelength of the antenna broadcast frequency, lessening the impacts of reradiation. AM reradiation is dependent upon the physical dimensions of the structures, the line conductors and OHGW. Alternatively, a detuning apparatus, passive or active, can be installed on the structure to mitigate the reradiation effects. Decision between a passive or active system shall depend on the project specific requirements. Basis for deciding between the two shall be to optimize initial capital cost with future maintenance cost.

5.6 Microwave Line of Sight

Microwave transmissions (links) rely on line-of-site communication. Line-of-sight (LOS) communication is limited to elliptical patterns radiated by the transmitting tower called Fresnel zones. This pattern varies over the distance of the link and is typically classified as near-field and far-field regions which are dependent upon a number of physical and environmental factors. The first Fresnel zone, which contains the bulk of the signal's energy, must have a majority of the path free to allow for transmission. If an obstruction is in this zone it is permitted to only block a certain percentage of the path, otherwise the transmission is lost.

In the near-field region of low power antennas (typical of short and long haul point-to-point microwave links), the generated waves are not yet planar and resemble a somewhat spherical pattern that may have phase shifts that do not vary linearly. Therefore, traditional LOS analysis with the use of first Fresnel zone blockage and reflection is difficult to predict and it is recommended that no obstructions are placed within this area.

The FCC regulates the frequencies at which microwave links are utilized and allows for licensing of certain microwave links for protection of the signal. Therefore, if detailed analysis determines a protected link is blocked beyond this acceptable limit, mitigation must be employed.

5.6.1 Applicability

Paths that cross the transmission line or run parallel to the transmission line at a distance greater than the first Fresnel zone radius are not expected to experience interference when the new transmission line is constructed. Conversely, paths that are separated from the transmission line by a distance less than the radius of the first Fresnel zone could experience interference. In such cases, the intersections of the microwave path and the transmission line and/or structures shall be evaluated to determine the percentage of signal blockage.

Any lines located within 250 feet of a microwave antenna path shall be evaluated.

5.6.2 Calculation Method

The distance (in meters) from the transmission antenna to the radiating near-field boundary, that should be kept free of obstructions, is calculated by Equation 2:

$$d = \frac{2D^2}{\lambda} \qquad \text{Eq. 2}$$

Where d is the distance in meters from the sending microwave antenna required to be free from any obstructions, D is the largest dimension of the radiating antenna, and λ is the wavelength of the transmitted signal in meters.

Far-field regions of the microwave transmission signal are planar and can be analyzed using LOS techniques based upon the first Fresnel zone calculations associated with the identified microwave links. The radius of the first Fresnel zone (in meters) is calculated by Equation 3.

$$F_{z1} = \sqrt{\frac{\lambda \times d_1 \times d_2}{d_1 + d_2}} \qquad \text{Eq. 3}$$

Where, λ is the wavelength of the transmitted signal in meters, d1 is the distance from the sending microwave antenna to the point of intersection in meters, and d2 is the distance from the receiving antenna to the point of intersection in meters.

5.6.3 Criteria

5.6.3.1 Far Field

Considering the relationship between first Fresnel zone blockage and signal loss, from industry experience any microwave link experiencing 40% or more blockage of its first Fresnel zone would be recommended for further analysis and possibly mitigation.

5.6.3.2 Near Field

In the near-field and reactive near-field regions of low power antennas (typical of short and long haul point-to-point microwave links), the generated waves are not yet planar and resemble a somewhat spherical pattern that may have phase shifts that do not vary linearly. Therefore, traditional LOS analysis with the use of first Fresnel zone blockage and reflection is difficult to predict and it is recommended that no obstructions are placed within this area.

6.0 Attachments

N/A

PPL Electric Exhibit No. RW-4

Project Information

ER:	EMF / H-FRAME
Estimate Type:	Development Estimate
Status of Current Est:	Complete
Mileage:	TBD

Estimate / Gate IFC

Row Labels	Unloaded Cost	Loaded Cost
EMF complaint / Delta	**$4,997,165.01**	**$5,672,295.81**
Procured Material	**$2,069,273.14**	**$2,387,610.12**
Construction	$2,069,273.14	$2,387,610.12
Structure	**$1,402,244.56**	**$1,617,965.86**
Overhead Cabling	**$482,116.04**	**$556,284.77**
Below Grade Support	**$172,125.00**	**$198,604.71**
Earthing	**$12,787.54**	**$14,754.77**
Indirect Labor	**$601,503.13**	**$692,835.36**
Engineering, Transmission	$270,668.49	$311,766.79
Project Management	$193,334.64	$222,690.57
Right-of-Way	$12,500.00	$14,398.00
Permitting	$75,000.00	$86,388.00
Siting	$50,000.00	$57,592.00
Construction Contractor	**$2,326,388.75**	**$2,591,850.34**
Construction	$2,001,388.75	$2,223,352.34
Structure	**$219,541.11**	**$248,924.49**
Overhead Cabling	**$304,053.20**	**$344,747.68**
Environmental B.M.P.	**$427,840.50**	**$442,318.62**
Below Grade Support	**$964,149.42**	**$1,090,310.55**
Earthing	**$85,804.52**	**$97,051.00**
Mob/De-Mob	$325,000.00	$368,498.00
Grand Totals	**$4,997,165.01**	**$5,672,295.81**

[redacted]

PPL Electric Exhibit No. RW-5

Project Information

ER:	EMF / DELTA CASE
Estimate Type:	Development Estimate
Status of Current Est:	Complete
Mileage:	TBD

Estimate / Gate IFC

Row Labels	Unloaded Cost	Loaded Cost
EMF complaint / H-Frame	**$5,133,611.05**	**$5,832,469.25**
Procured Material	**$2,443,993.13**	**$2,819,977.03**
Construction	$2,443,993.13	$2,819,977.03
Structure	**$1,666,874.82**	**$1,923,306.85**
Overhead Cabling	**$482,116.04**	**$556,284.77**
Below Grade Support	**$286,875.00**	**$331,007.85**
Earthing	**$8,127.27**	**$9,377.57**
Indirect Labor	**$591,359.88**	**$681,151.96**
Engineering, Transmission	$264,751.59	$304,951.47
Project Management	$189,108.29	$217,822.49
Right-of-Way	$12,500.00	$14,398.00
Permitting	$75,000.00	$86,388.00
Siting	$50,000.00	$57,592.00
Construction Contractor	**$2,098,258.04**	**$2,331,340.26**
Construction	$1,773,258.04	$1,962,842.26
Structure	**$190,997.65**	**$216,560.78**
Overhead Cabling	**$304,053.20**	**$344,747.68**
Environmental B.M.P.	**$427,840.50**	**$442,318.62**
Below Grade Support	**$796,185.65**	**$897,931.04**
Earthing	**$54,181.05**	**$61,284.14**
Mob/De-Mob	$325,000.00	$368,498.00
Grand Totals	**$5,133,611.05**	**$5,832,469.25**

[redacted]

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Travis West and Daisy Wills-West,	:	
	:	
Complainants,	:	
	:	
v.	:	Docket No. C-2022-3032707
	:	
PPL Electric Utilities Corporation,	:	
	:	
Respondent.	:	

REBUTTAL TESTIMONY OF
Chad M. Huber

PPL Electric Statement No. 2

August 7, 2023

TABLE OF CONTENTS

Page

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Chad M. Huber, and my business address is 827 Hausman Road, Allentown, PA 18104.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am employed by PPL Electric Utilities Corporation ("PPL Electric" or the "Company") as a Senior Right of Way ("ROW") Specialist.

Q. WHAT ARE YOUR DUTIES AS A SENIOR RIGHT OF WAY SPECIALIST?

A. I am accountable for participating in the vision and strategy for the transmission line siting, ROW and land acquisition, and real estate organization. This includes assisting with processes, workflow, as well as risk assessment and mitigation. I also provide support for ROW process improvement initiatives. In addition, I am responsible for identifying transmission line ROW encroachments and assist in addressing violations. I also facilitate the acquisition of license/lease agreements with other companies, landowners, and state and federal agencies. My duties also include support and guidance for the Company's overall capital expense plan, the implementation of best practices, and the maintenance of corporate reputation in the community.

Q. WHAT IS YOUR EDUCATIONAL BACKGROUND?

A. I hold a Bachelor of Science Degree in Environmental Systems Engineering from the Pennsylvania State University. I also earned the designation of "Right of Way

Professional – Electric and Utilities" from the International Right of Way Association ("IRWA") and previously held the Envision Sustainability Professional designation from the Institute for Sustainable Infrastructure.

Q. PLEASE DESCRIBE YOUR PROFESSIONAL EXPERIENCE.

A. I have been employed by PPL Electric in my current position as Senior Right of Way Specialist for approximately five and a half years. Prior to my employment at PPL Electric, I was employed by the former Louis Berger Group, Inc. ("LBG") for approximately eight years. During my employment at LBG, I was responsible for project and construction management for contracts held with the United States Postal Service, United states Army Corps of Engineering, and the Department of Homeland Security – Federal Emergency Management Agency.

Q. HAVE YOU PREVIOUSLY TESTIFIED AS A WITNESS BEFORE THE PENNSYLVANIA PUBLIC UTILITY COMMISSION ("COMMISSION")?

A. No. However, I have testified on behalf of PPL Electric in multiple civil matters in Pennsylvania Courts of Common Pleas.

Q. WOULD YOU PLEASE DESCRIBE THE SUBJECT MATTER OF YOUR REBUTTAL TESTIMONY?

A. My testimony will provide details on the Company's transmission line ROW traversing Travis West and Daisy Wills-West's ("Complainants") property at 1008 Piketown Road,

Harrisburg, PA 17112 that houses Line #696 Juniata-Alburtis 500 kV (hereinafter, "Line" or "Transmission Line").

Q. ARE YOU SPONSORING ANY EXHIBITS WITH YOUR TESTIMONY?

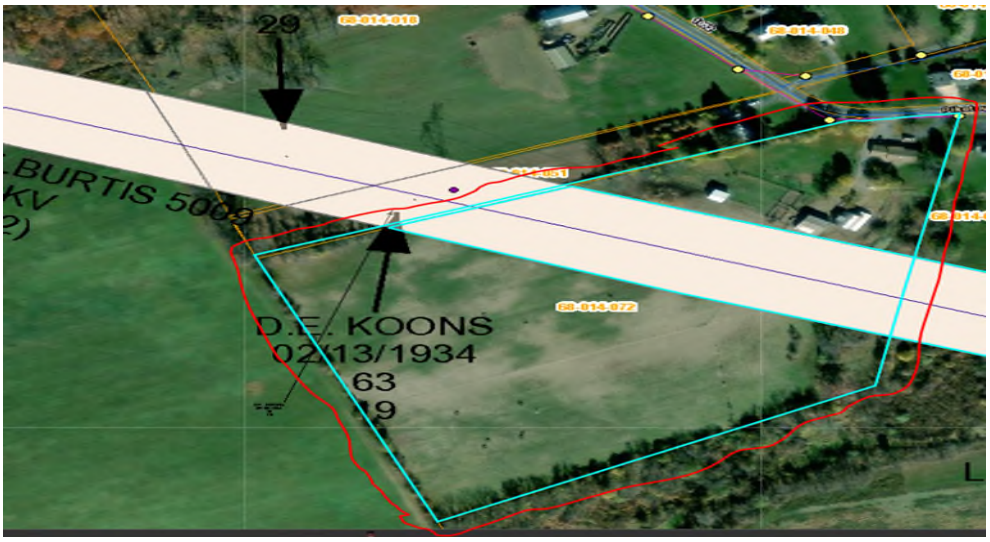
A. Yes, I am sponsoring the following Exhibit:

- PPL Electric Exhibit No. CH-1 – PPL Electric's ROW Agreement Over the Complainants' Property.

II. <u>TRANSMISSION LINE RIGHT-OF-WAY TRAVERSING THE PROPERTY</u>

Q. COULD YOU PLEASE PROVIDE AN OVERVIEW OF THE COMPANY'S TRANSMISSION LINE RIGHT-OF-WAY FOR LINE #696 JUNIATA-ALBURTIS 500 KILOVOLT ("kV") ON THE COMPLAINANTS' PROPERTY?

A. PPL Electric has fixed width easements for this transmission line. The easements are 200-feet in width. The transmission line ROW traversing the Complainants' property is also 200-feet in width and runs through the approximate middle of the property in a Northwest to Southeast direction. Below, I've included an aerial view that details the ROW traversing the Complainants' property. The white polygon presented laterally across the aerial view is representative of the ROW. The light blue polygon encompasses the Complainant's property.



Q. DO YOU HAVE A COPY OF THE RIGHT-OF-WAY AGREEMENT MEMORIALIZING THE COMPANY'S TRANSMISSION LINE RIGHT-OF-WAY ON THE COMPLAINANTS' PROPERTY?

A. Yes. Attached to my rebuttal testimony as PPL Electric Exhibit No. CH-1 is a copy of that ROW agreement.

Q. WHEN WAS THAT RIGHT-OF-WAY AGREEMENT EXECUTED?

A. The ROW agreement was executed on January 17, 1964, and was recorded in the Office of Recording of Deeds in and for Dauphin County, Pennsylvania in Miscellaneous Book R Volume 11, Page 334 on April 2, 1965.

Q. HAS IT BEEN IN EFFECT SINCE THE DATE OF EXECUTION?

A. Yes.

Q. COULD YOU GENERALLY DESCRIBE THE #696 JUNIATA-ALBURTIS 500 KV LINE?

A. The #696 Juniata-Alburtis 500kV line was constructed and placed in service in 1968. The transmission lines (*i.e.,* conductors) are supported by "lattice" type steel structures ranging in height from 100-feet to 135-feet and have an approximate width at the base of 35-feet. The width of the structures at the top end, where the conductors are connected to the structures, is approximately 70-feet. PPL Electric does not currently have plans to rebuild or replace the #696 Juniata-Alburtis 500 kV Transmission Line or its associated structures.

Q. HOW MUCH DISTANCE IS THERE BETWEEN THE COMPLAINANTS' HOUSE AND THE EDGE OF THE COMPANY'S RIGHT-OF-WAY ON THEIR PROPERTY?

A. The Complainants' house is approximately 210-feet from the north/northeast edge of the PPL Electric ROW corridor. However, other structures have been constructed in closer proximity to the ROW corridor, with some being immediately adjacent to and/or potentially encroaching upon the corridor, as you can see in the photo included on page 4 of my Rebuttal Testimony.

Q. DO THE COMPLAINANTS OWN ANY STRUCTURES ON THEIR PROPERTY WITHIN THE COMPANY'S RIGHT-OF-WAY CORRIDOR?

A. Not to my knowledge. However, structures appear to have been constructed immediately adjacent to and/or potentially encroaching upon the Company's ROW corridor.

Q. CAN PPL ELECTRIC RELOCATE THE LINE OFF-OF THE COMPLAINANTS' PROPERTY?

A. Not easily. In order to relocate the Company's structures off of the right-of-way traversing the Complainants' property, PPL Electric would have to obtain a new ROW agreement from different landowners depending on where the relocation would occur. Moreover, relocation of the lines would require significant and costly construction activities on the Complainants' property, as well as whatever property or properties the Line would be relocated to. PPL Electric witness Richard White will speak to this in more detail in PPL Electric Statement No. 1.

Q. DOES THIS CONCLUDE YOUR REBUTTAL TESTIMONY AT THIS TIME?

A. Yes, although I reserve the right to supplement my rebuttal testimony.

PPL Electric Exhibit No. CH-1

PP&L FORM 100-1E M & C (7-63)

JUNIATA-BRANCHBURG LINE

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2380

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Know all Men by these Presents, That We, Irvin M. Zimmerman & Mabel V. Zimmerman, his wife

of R. #1, Linglestown, Pa.

in consideration of the sum of One Dollar ($1.00) to us paid at the date hereof by PENNSYLVANIA POWER & LIGHT COMPANY, the receipt whereof is hereby acknowledged, and in consideration of the further sum of Ten Thousand Dollars and no/100 - - - - - - - - - - - - - - - ($10,000.00) Dollars to be paid to us when the rights hereby granted are exercised by the said Company, do hereby, for ourselves, our heirs, executors, administrators and assigns, irrevocably grant and convey unto the said PENNSYLVANIA POWER & LIGHT COMPANY, its successors and assigns, the right to construct, operate and maintain, and from time to time to reconstruct its electric lines, including such poles, towers, cables and wires above and under the surface of the ground, fixtures and apparatus as may be from time to time necessary for the convenient transaction of the business of the said Company, its successors and assigns, upon, across, over, under and along a strip of land 200 feet in width, said strip being a part of the property which we own, or in which we have any interest in the Township of West Hanover, County of Dauphin, Commonwealth of Pennsylvania, and upon, across, over, under and along the roads, streets and highways adjoining the said property, as shown on the plan hereto attached and made a part hereof, including the right of ingress and egress to and from the said lines at all times for any of the purposes aforesaid, together with the right to set and maintain the necessary guy and brace poles or towers and anchors, and to attach thereto the necessary guy wires; also the right to cut down, trim, remove, and to keep cut down and trimmed by mechanical means or otherwise, any and all trees, brush or other undergrowth on said strip of land or adjoining the same which in the judgment of the said Company, its successors and assigns, may at any time interfere with the construction, reconstruction, maintenance or operation of the said electric lines, poles, towers, wires, cables or other fixtures and apparatus, or menace the same, and in connection therewith, the right to remove, if necessary, the root systems of said trees, brush or other undergrowth, and to spray said brush and undergrowth with chemicals for their removal and control; and in consideration of the said payments do hereby release and quitclaim the said PENNSYLVANIA POWER & LIGHT COMPANY, its successors and assigns, of and from any and all damages, loss or injury that may be at any time caused by or result from the construction, reconstruction, operation and maintenance of the said electric lines, or the cutting down, trimming or removal of any and all trees, brush or other undergrowth on said premises.

And, further, in consideration of said payments, we do hereby covenant and agree for ourselves and our heirs, executors, administrators and assigns, to and with the said PENNSYLVANIA POWER & LIGHT COMPANY, its successors and assigns, that no house, barn or other structure, or inflammable or explosive materials of any kind, shall be built or stored on said strip of land, and that the said Company, its successors and assigns, shall not be limited in its or their enjoyment of the rights hereby granted to such electric lines, poles, towers, wires, cables, fixtures and apparatus as may be first constructed on said strip of land, but that the said Company, its successors and assigns, shall have, at all times in the future, the right to construct, operate and maintain, and from time to time to reconstruct additional electric lines, poles, towers, wires, cables, fixtures and apparatus upon, across, over, under or along the said strip of land.

Any and all damages caused to crops, grain and fences during the construction and maintenance of said electric line shall be paid for by said Company at a fair market value. Grantors reserve the right to construct roadways across easement area, the same to be constructed at approximate right angles to the easement area. Grantors agree that the existing ground elevation will not be changed over two feet (2') without Grantors first having obtained in writing Grantee's consent to said change in grade. That the edge of any of said roadways shall not be constructed within twenty-five (25') feet of any of Grantee's facilities. That Grantors shall not in the construction, maintenance or use of said roadways commit or permit to be committed any acts which will interfere with the rights herein granted to Grantee. It is further understood and agreed that Grantors shall have the right to use the easement area for the growing of agricultural crops or pasture purposes so long as the same does not interfere with the safe construction, operation and maintenance of said electric transmission lines.

I.M.Z. M.V.Z. J.C.H.

For Plan See Plan Book C. Vol. 2 - Page 93

GRID #27660 N 37884 S

PP&L CO. - CORPORATE FILES

On this ..... day of ..... 19 , before me, a Notary Public for the Commonwealth aforesaid, commissioned for and residing in the ..... of .....,

County of ....., came the above named .....

..... and acknowledged the foregoing instrument to be ..... act and deed, and desired the same to be recorded as such.

Witness my hand and notarial seal the day and year aforesaid.

.....
Notary Public

My commission expires

COMMONWEALTH OF PENNSYLVANIA }
COUNTY OF ..... } ss:

On this ..... day of ..... 19 ....., before me, a Notary Public for the Commonwealth aforesaid, commissioned for and residing in the ..... of .....,

County of ....., came the above named .....

..... and acknowledged the foregoing instrument to be ..... act and deed, and desired the same to be recorded as such.

Witness my hand and notarial seal the day and year aforesaid.

.....
Notary Public

My commission expires

Recorded in the Office for Recording of Deeds in and for Dauphin County, Pa. in Misc Book R. Vol. 11 Page 334, etc.

WITNESS my hand and seal of Office this 2nd day of April 1965

Mary K. Hanna

Recorder

Witness our hands and seals this 17th day of JAN. 1964,

Signed, sealed and delivered in the presence of:

Irvin M. Zimmerman (SEAL)

Irvin M. Zimmerman (SEAL)

Mabel V. Zimmerman (SEAL)

Mabel V. Zimmerman (SEAL)

(SEAL)

(SEAL)

Received Jan. 18, 1965, of PENNSYLVANIA POWER & LIGHT COMPANY the sum of One Thousand and no/100 Dollars,

in full payment of the further consideration above mentioned.

Irvin M. Zimmerman

Mabel V. Zimmerman

COMMONWEALTH OF PENNSYLVANIA
COUNTY OF Dauphin } ss: BOOK R VOL 11 PAGE 336

On this 18 day of January 1965, before me, a ~~Notary Public~~ Justice of Peace for the Commonwealth aforesaid, commissioned for and residing in the Township of West Hanover, County of Dauphin, came the above named Irvin M Zimmerman & Mabel V Zimmerman, Husband & Wife R D 1 Lenglestown Pa and acknowledged the foregoing instrument to be Their act and deed, and desired the same to be recorded as such.

Witness my hand and notarial seal the day and year aforesaid.

George W Wagner J P

~~Notary Public~~
Justice of Peace

My commission expires My Commission Expires Jan. 5, 1970

COMMONWEALTH OF PENNSYLVANIA
COUNTY OF ..... } ss:

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COMMONWEALTH OF PENNSYLVANIA)
: SS
COUNTY OF Dauphin)

On this 21st day of January, 19 64, before me, a Notary Public for the Commonwealth aforesaid, commissioned for and residing in the City of Harrisburg, County of Dauphin, came John C. Hoffacker, the subscribing witness to the foregoing instrument, who being duly sworn according to law, deposes and says that he saw Irvin M. Zimmerman & Mabel V. Zimmerman, his wife

the grantors above named, sign and seal and as their act and deed, deliver the said instrument for the use and purposes therein mentioned; and that Irvin M. Zimmerman & Mabel V. Zimmerman, his wife

acknowledged said instrument to be their act and deed, and desired the same to be recorded as such.

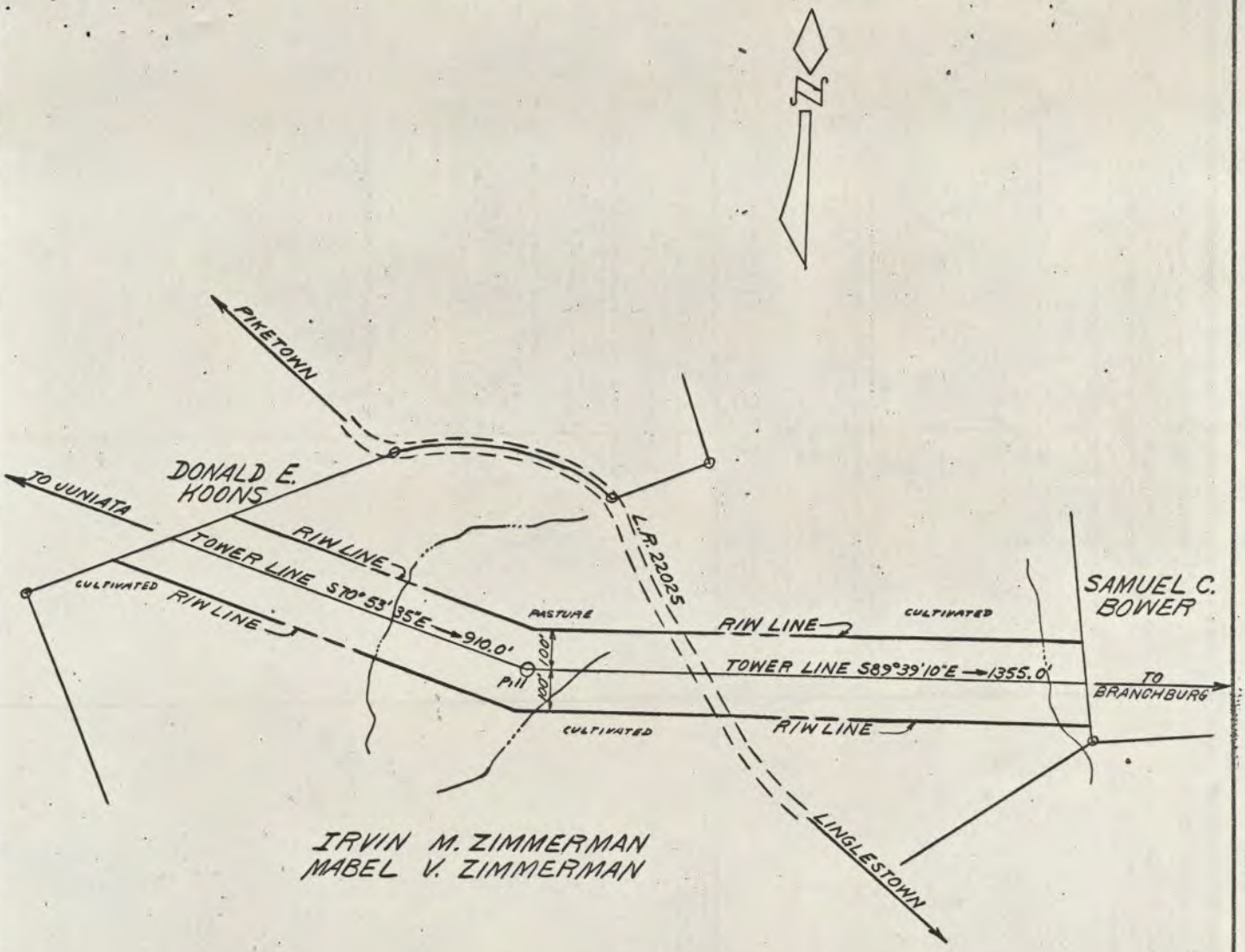
John C. Hoffacker

SWORN AND SUBSCRIBED before me, the day and year aforesaid.

E. Junior Ludwig
Notary Public
of
Harrisburg, Pa., Dauphin County

My Commission Expires: September 13, 1965

NO.	DATE	REVISION	E.R.	BY	CH.	SPONS'D.	APP'R.



JUNIATA-BRANCHBURG LINE

PLAN SHOWING ELECTRIC LINE RIGHT OF WAY OVER PROPERTY OF

IRVIN M. ZIMMERMAN AND MABEL V. ZIMMERMAN

WEST HANOVER TOWNSHIP, DAUPHIN COUNTY, PENNSYLVANIA

Scale: 1" = 400'

Date MAY 4, 1964

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PENNSYLVANIA

MICHAEL BAKER, JR., INC.
Consulting Engineers Rochester, Pennsylvania
Approved: William O. Baker

ER 120960

LA-67244-0