Respondent Exhibits

A PUC Initial Decision

B Environmental Quality Report

C Smart Meter Opt. out Survey

D Amer. Academy Med.

E Health Trust Research

F Planetary Pollution

G Toxicology Program

H Microwave Frequency Fields

I Journal Entry

J PECO

KD1 Account Contact History

KD2 AMI Program Plan

KD3 AMI Customer Privacy Policy

KD4 Requirements for Service

KD5 Rules for Electric Service

KD6 Supply of Service

CD1 The Electromagnetic Spectrum

CD2 Comparison of Average RF Field Level

CD3 Comparison of Peak RF Field Level

CD4 RF From Common Sources Compared to Exposure

CD5 Comparison of RF From UHF TV

MI1 Public Health Reviews

Respondent Exhibits

MI2 State Health Agency & PUC Reviews of Smart Meters

MI3 Public Health Reviews RF Fields and Claimed Electromagnetic Hypersensitivity

MI4 Lack of Scientific Objectivity and Reliability

DV1 Smart Meter Tech. Procurement and Installation Plan

PPL1 Electronic CD Statement 1

PPL2 Electronic MI Non. Proprietary Statement 2

PPL3 Electronic KD Statement 3

PPL4 Electronic DF Statement 4

EXHIBIT A

PUC's record of the 'Initial Decision' of McKnight v. PECO, C-2017-2621057

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Alexia and Lawrence McKnight	:	
	:	
v.	:	C-2017-2621057
	:	
PECO Energy Company	:	

INITIAL DECISION

Before
Darlene Davis Heep
Administrative Law Judge

INTRODUCTION

Alexia and Lawrence McKnight (Complainants) contend that the reinstallation of an AMI[1] meter at their home would be unsafe or unreasonable in violation of 66 Pa. C.S. § 1501. Specifically, they allege that installation of an AMI meter in 2015 exacerbated the medical condition of Mrs. McKnight and her Electromagnetic Hypersensitivity (EHS) condition improved after the meter was removed. They are particularly concerned about electromagnetic fields.[2]

A preponderance of the evidence supports a finding that Mrs. McKnight became ill after the installation of the Landis + Gyr AMI meter when the McKnights were concurrently experiencing a voltage problem at their residence. The preponderance of the evidence does not support a finding that installation of any AMI meter will negatively affect the health of Mrs. McKnight. This Initial Decision will prohibit the reinstallation of the

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1 AMI is an acronym for "advanced metering infrastructure." AMI meters are also known as "smart meters."

2 "Electromagnetic Fields" and "Radio Frequency Fields" were used interchangeably in these proceedings and will be referred to as EFs herein.

C-2018-3000490
6/25/20
A

Landis + Gyr meter at the McKnight residence, require PECO Energy Company (PECO) to investigate voltage issues at the service address and allow PECO to install another brand of AMI meter at the Complainants' home.

HISTORY OF THE PROCEEDING

On August 27, 2017, Dr. Alexia McKnight filed a Complaint against PECO seeking to prevent PECO from reinstalling an AMI meter at her home. She stated that, when PECO initially installed an AMI meter at her home (since removed), it violated Section 1501 of the Public Utility Code "by creating many harmful illnesses in myself as soon and as long as the PECO AMI meter was deployed on my residence." She also requested that PECO be ordered to never deploy an AMI meter at her residence. Dr. Lawrence McKnight was added as a Complainant later in the proceedings. (April 10, Tr. 6).

On September 13, 2017, PECO filed its Answer, denying the material allegations in the Complaint and stating that the AMI meter was installed in accordance with its tariff and Act 129 of 2008.

On October 4, 2017, a Hearing Notice was issued, setting the hearing for April 10, 2018.

On October 23, 2017, a Prehearing Order was issued. The Prehearing Order established discovery deadlines.

On March 23, 2018, a Corrected Hearing Notice was issued, setting hearing dates of April 10, 11, and 12, 2018.

On March 23, 2018, an Order was issued setting new discovery deadlines.

On April 10-13, 2018, evidentiary hearings were held. Complainants appeared *pro se* and presented testimony and exhibits of Mrs. McKnight, Mr. McKnight, Peter Prociuk, M.D., Mr. William Bathgate, and William Rea, M.D.

PECO was represented by Ward Smith, Esq., Shawane Lee, Esq., and Tom Watson, Esq., and presented testimony and exhibits of Mr. Bryan Uber, Mr. Glenn Pritchard, Christopher Davis, Ph.D., and Mark Israel, M.D.

The transcript of the hearing is more than 1,000 pages. The record closed on July 26, 2018, the date the Complainants filed a Reply Brief. [3]

FINDINGS OF FACT

1. Complainants are Dr. Alexia McKnight and Dr. Lawrence McKnight, who are married to each other.

2. Complainants reside at 258 Heyburn Road, Chadds Ford, Pennsylvania (service address). (April 10, Tr. 8).

3. The McKnights have lived at the service address since 2003. (April 10, Tr. 72).

4. Dr. Alexia McKnight is a Doctor of Veterinary Medicine and works as a Veterinary Radiologist in her home. (April 10, Tr. 15:19-20).

5. Dr. Lawrence McKnight is a medical doctor, with board certification in Internal Medicine, who works as a Hospitalist and in the field of Medical Informatics. (April 10, Tr. 80-82).

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[3] The Complainants here and in *Bachman v PECO,* C-2017-2623504, asked to have overlapping hearing dates so that they could share expert witnesses. That request was granted. Following the completion of the hearings, the Bachmans settled with PECO and a Certificate of Satisfaction was filed on June 25, 2018.

6. Mr. McKnight was recognized as an expert as a physician, including how to make diagnoses, how to interpret medical records, and how to interpret scientific research publications. (April 10, Tr. 96-97).

7. Prior to the AMI meter installation, the service address had an AMR[4] meter since approximately 2001. (April 10, Tr. 21).

8. Bryan Uber is a Senior Supervisor, Customer Field Operations, for PECO. (April 12, Tr. 112).

9. On November 30, 2015, PECO installed an AMI meter at the service address, a Landis + Gyr AMI meter #127832547. (April 10, Tr. 8; April 12, Tr. 117-18; PECO Exhibit BU-1 at 2; McKnight Exhibit 5).

10. Only one AMI Meter, Landis + Gyr (serial #127832547), was used at the service address. (PECO BU-1 at page 2, entry 11/30/2015; PECO BU-1 at page 4, entry 9/7/2016).

11. Mrs. McKnight was at home when the Landis + Gyr AMI meter was installed in November 2015. (April 10, Tr. 9-11).

12. Following installation of the Landis-Gyr meter, Mrs. McKnight developed various physical ailments. (April 10, Tr. 9-11).

13. Mrs. McKnight later developed cardiac ailments associated with lightheadedness, and, after taking her own pulse, found it irregular. (April 10, Tr. 12:7; April 10, Tr. 71:12-16).

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[4] AMR is an acronym for "automatic meter reading."

14. Mr. McKnight witnessed the change in his wife when the AMI meter was installed. (April 10, Tr. 83:9).

15. When Mrs. McKnight complained of lightheadedness and palpitations, Mr. McKnight took her pulse and found it irregular and bradycardic. (April 10, Tr. 126:20-22). He then advised her to see a Cardiologist. (April 10, Tr. 67:4-5).

16. Mrs. McKnight saw a cardiologist, who conducted tests for cardiovascular symptoms on May 23, May 27, June 16 and June 20, 2016. (April 10, Tr. 39; April 10, Tr. 25:5-8).

17. At some point following installation of the Landis-Gyr meter, Mrs. McKnight was unable to sleep in her home. (April 10, Tr. 9-11).

18. Mrs. McKnight's ailments significantly improved on March 20, 2016 when the McKnights turned off power to the upstairs circuits while the AMI meter was installed. (April 10, Tr. 20:5-7).

19. In March of 2016, the Complainants contacted PECO to report stray voltage, or voltage to ground, issues. (PECO Exhibit BU-1).

20. Russel Brocato, a now retired PECO Power Quality technician, was sent to investigate and repair the stray voltage issue at the service address. (April 10, Tr. 209:1-3).

21. Stray voltage occurs when there are loose connections and an imbalance of the electrical phases. (April 10, Tr. 222).

22. A stray voltage problem is not directly related to the type of meter installed. (April 10, Tr. 222).

23. Mr. Brocato removed the meter and used jumpers to connect the power to the residence. (April 10, Tr. 209).

24. At some point in April or May of 2016, the AMI meter was reinstalled at the service address. (April 12 Tr 133-134).

25. The stray voltage issue continued through April and May of 2016. (PECO Exhibit BU-1).

26. On May 24, 2016, PECO removed the AMI meter at Complainants' request and replaced it with a jumper plate. (April 10, Tr. 8; April 10, Tr. 8:15-17).

27. When the AMI meter was removed in May 2016, Mrs. McKnight's ailments lessened, and her physical condition improved. (April 10, Tr. 12-13, 47-48, 84:8, 85).

28. Unknown to Mrs. McKnight, an AMI meter was reinstalled at the service address on or about September 9, 2016. (April 10, Tr. 53, 58).

29. In September of 2016, Mrs. McKnight began to fall ill once again. (April 10, Tr. 36-38).

30. Mr. McKnight observed his wife become ill again after reinstallation of the AMI meter. (April 10, Tr. 84:21; April 10, Tr. 84).

31. On September 27, 2016, Mrs. McKnight sent a letter to Craig Adams, who was then President of PECO, stating her concerns about installation of an AMI meter. (April 10, Tr. 15-17; Complainants' Exh. 1).

32. On October 18, 2016, the McKnights filed an executive complaint about the meter. (April 12, Tr. 119).

33. On October 19, 2016, PECO employee Brenda Eison sent Mrs. McKnight a letter responding to her letter to Mr. Adams. (April 10, Tr. 22-23; Complainants' Exh. 4).

34. On October 26, 2018, Mrs. McKnight called PECO regarding her executive complaint; PECO's AMI Department called her back the same day. (April 12, Tr. 123-24).

35. PECO called Mrs. McKnight that day to confirm receipt of the executive complaint and responded to it in writing the next day. (April 12, Tr. 120-22).

36. On November 1, 2016, the PECO Landis + Gyr AMI meter was again removed and replaced with a jumper plate. (April 10, Tr. 13-15).

37. After the AMI meter removal on November 1, 2016, Mrs.. McKnight's symptoms resolved. (April 10, Tr. 15:8-9).

38. On March 8, 2017, Mrs. McKnight's treating physician, Dr. Peter Prociuk, sent a letter to Exelon attorney Tracy Hannan, stating that installation of an AMI meter was medically contraindicated for Mrs. McKnight and requesting an accommodation under the Americans with Disabilities Act ("ADA"). (April 10, Tr. 16-17; Complainants' Exh. 2).

39. Mrs. McKnight first contacted Dr. William Rea M.D., a specialist in Electrical Hypersensitivity Syndrome (EHS), in August 2017. (April 10, Tr. 27:1-3).

40. Dr. Rea is a medical doctor who has an Environmental Medicine facility in Dallas, Texas. (April 12, Tr. 56).

41. Dr. Rea was recognized as a medical expert, with a specialty in EHS. (Apr 12 Tr. 58).

42. Dr. Rea conducted a series of tests, including exposing Mrs. McKnight to real and sham exposures of electric and/or magnetic fields (EMF), including a "blinded provocation study" and testified that she reacted to the 60 hertz, the 3 kilohertz, and 5 megahertz exposures. (April 12, Tr. 66-79; April 10, Tr. 27-29).

43. To receive the treatments of Dr. Rea, Mrs. McKnight was required to sign disclosures stating that his treatments were "not endorsed, sanctioned, or supported by the Texas Medical Board." (April 10, Tr. 40-42; Late-file Exhibit B).

44. Dr. Prociuk is a medical doctor who practices homeopathic medicine. (April 11, Tr. 241-42).

45. Dr. Prociuk has been Mrs. McKnight's personal physician since 2010. (April 11, Tr. 243).

46. Dr. Prociuk was recognized as an expert in medicine. (April 11, Tr. 246-47).

47. Dr. Prociuk reviewed medical records from Mrs. McKnight's cardiologist. (April 11, Tr. 247).

48. William Bathgate is an electrical engineer who lives in Michigan. (April 11, Tr. 322-23).

49. Mr. Bathgate was recognized as an expert in electrical engineering and in the design and measurement of power systems and radio design. (April 11, Tr. 327-28).

50. Mr. Bathgate is not able to make a determination that AMI meters are unsafe. (April 11, Tr. 367-68).

51. Mr. Bathgate took readings of PECO's AMI meters with the HF35C measuring device. (April 11, Tr. 448).

52. PECO's AMI system operates in a licensed spectrum at about 901 MHz, not in the unlicensed Industrial, Scientific, and Medical Band at 902-928 MHz; Mr. Bathgate was not aware of that fact when he prepared his expert report on EF transmissions from the PECO AMI system. (April 11, Tr. 439-44).

53. Mr. Bathgate's expert testimony on EFs and emissions was based on his general understanding of AMI meter systems; it does not apply to systems that operate on a licensed spectrum such as PECO's AMI system.

54. The conducted emission standards of the Federal Communication Commission (FCC) apply to unlicensed transmitters, not licensed transmitters as used on the PECO AMI system. (April 11, Tr. 456-57; Complainant's Joint Exh. 7).

55. PECO's AMI system is not a mesh system, i.e., it is not a system designed with many information collector devices. (April 11, Tr. 451; April 12, Tr. 200).

56. Glenn Pritchard is PECO's Manager of Advanced Grid Operations. (April 12, Tr. 141).

57. Mr. Pritchard was recognized as an expert in the design, operation, and technology of Advanced Meter Installations. (April 12, Tr. 142-46).

58. From approximately 2000 until April 2017, PECO used an AMR meter system that was comprised of transmit-only meters that transmitted using radio frequencies. (April 12, Tr. 147-149).

59. The AMR system was shut down in April of 2017. (*Id.*).

60. Approximately 1.7 million electric AMI meters and 500,000 gas AMI meters have been deployed by PECO. (April 12, Tr. 113, 149, 154).

61. The McKnights are on their own transformer (April 12, Tr. 205:25).

62. PECO used a Rush Track 7000 Power Quality Meter to measure transients (voltage spikes outside the norm) and waveforms at the service address. PECO Exhibit GP-13 (April 12, Tr. 184).

63. PECO now has available for customers the Landis + Gyr, Aclara and Sensus Stratus AMI meters. (April 12, Tr. 168-169).

64. PECO's Landis + Gyr meter has a FlexNet radio module, a Zigbee radio, and switch mode power supply. (April 12, Tr. 168).

65. PECO AMI meters are Underwriter Laboratories (UL) certified, a safety certification. (April 12, Tr. 170).

66. PECO's Aclara meter has a FlexNet module and switch mode power supply, but no Zigbee radio and is UL listed. (April 12, Tr. 168-69, 170, 198-199).

67. PECO's Sensus Stratus meter became available in April 2018; it has FlexNet modules and Zigbee radios, but the Zigbee radio can be turned off remotely. The Sensus Stratus has a capacitor pump, not a switch mode power supply, and is UL listed. (April 12, Tr. 169).

68. For each of the meters used by PECO, the manufacturer and an approved testing agency obtained written equipment authorization certifications from the FCC allowing use of the meters. (April 12, Tr. 171-72; PECO Exh. GP-11).

69. PECO's AMI meters comply with FCC regulations. (April 12, Tr. 172).

70. Mr. Pritchard demonstrated that the only functional differences between AMR meters and AMI meters is the periodicity of radio transmissions, the remote connect/disconnect switch on an AMI meter, and the fact that some AMI meters have a capacitor pump rather than a switch mode power supply. (April 12, Tr. 174-78).

71. Transients exist regardless of the type of meter used – AMI, AMR, or analog – or if no meter at all is installed. (April 12, Tr. 179-81).

72. Service at the service address remains provided through a jumper plate.

73. The service address, with no meter, has various transients occurring in the household. (April 12, Tr. 183-87).

74. Because PECO uses a licensed, non-mesh system, PECO's AMI system has fewer radio transmissions than any other utility system, including the ability to "tune down" the number of transmissions from each AMI meter. (April 12, Tr. 199-202).

75. Dr. Christopher Davis is a Ph.D. physicist who is the Minta Martin Professor of Engineering and Professor of Electrical and Computer Engineering at the University of Maryland. (April 13, Tr. 9-12).

76. Dr. Davis was recognized as an expert in the fields of physics, biophysics, chemistry, electrical engineering, electromagnetics, bioelectromagnetics, and dosimetry. (April 13, Tr. 16, 18).

77. The FCC has safety standards that explain the maximum permissible exposure ("MPE") that people can be exposed to if they are near a radiofrequency transmitter. (April 13, Tr. 23-24; PECO Exh. CD-3).

78. The FCC's MPEs are designed to avoid human health effects from exposure to high levels of radiofrequency fields; conversely, exposures below the MPE levels do not cause health effects. (Id.).

79. The radiofrequency transmissions from PECO's AMI meters are approximately 5.8 million times lower than the FCC's MPE. (April 13, Tr. 26-29; PECO Exh. CD 5).

80. The FCC's MPE's are calculated on a 30-minute average exposure; The instantaneous peak transmissions from a PECO AMI meter are approximately 40 times smaller than the amount they are allowed to transmit on an averaged basis. (April 13, Tr. 29-30; PECO Exh. CD-6).

81. The radiofrequency transmissions from PECO's AMI meters are approximately 4.4 million times lower than the guidelines of the International Commission on Non-Ionizing Radiation Protection. (April 13, Tr. 31-34; PECO Exh. CD-7).

82. People are exposed to radiofrequency fields from a variety of sources, including cell towers, UHF (TV) transmitters, cell phones, and microwave ovens. (April 13, Tr. 34-35; PECO Exh. CD-8).

83. The service address is continuously exposed to radiofrequency transmissions from UHF TV transmitters. At the service address, the background exposure to radio frequency fields from UHF stations is 168 times larger than the exposure of continuously sitting one meter in front of an AMI meter 24 hours a day, seven days a week. (April 13, Tr. 36-37; PECO Exh. CD-9).

84. Radiofrequency exposure from PECO AMI meters is 79% less than exposure from PECO's previously used AMR meters. (April 13, Tr. 37-38; PECO Exh. CD-10).

85. PECO's AMI meters are not subject to the conducted emission standards of the FCC because those standards apply to unlicensed transmitters, and PECO's AMI meters use a licensed spectrum transmission. (April 13, Tr. 49-51).

86. Harmonics and transients are normal in the delivery of electric service to residences and exist whether an AMI meter is in use or not. (April 13, Tr. 70-71).

87. PECO's AMI meters do not produce 5 Hz, 3 kilohertz, or 5 megahertz fields. (April 13, Tr. 75-76).

88. Mark Israel is a medical doctor who is the Professor of Systems Biology and Pediatrics and Medicine at Dartmouth Medical School, and Executive Director of the Israel Cancer Research Fund. (April 13, Tr. 176-177).

89. Dr. Israel was recognized as an expert in medicine, medical research, and radiofrequency and electromagnetic fields and health. (April 13, Tr. 182-190).

90. Dr. Israel reviewed the medical records provided by Mrs. McKnight's cardiologist. His cardiovascular examination of these records showed that all cardiovascular outcomes were normal. (April 13, Tr. 206-213).

91. The Lamech Australian survey referenced by Dr. Procuik in support of EHS is based on self-reporting of symptoms from a population that self-identified as having EHS. (April 13, Tr. 227-28).

92. Dr. Israel's expert opinion is that there is no reliable medical basis to conclude that radiofrequency fields from PECO's AMI meters did or will cause, contribute to, or exacerbate any health condition or any symptoms or medical concerns reported by Mrs. McKnight. (April 13 Tr. 194-202; PECO Exh. MI-3).

APPLICABLE LAW

The Pennsylvania Public Utility Code ("Code") requires each public utility to provide the following:

> Every public utility shall furnish and maintain adequate, efficient, safe, and reasonable service and facilities, . . . Such service and facilities shall be in conformity with the regulations and orders of the commission.

66 Pa.C.S. § 1501.

The statutory definition of "service" is to be broadly construed. *Country Place Waste Treatment Co., Inc. v. Pa. Pub. Util. Comm'n*, 654 A.2d 72 (Pa.Cmwlth. 1995).

> Service, used in its broadest and most inclusive sense, includes any and all acts done, rendered, or performed, and any and all things furnished or supplied, and any and all facilities used, furnished, or supplied by public utilities, or contract carriers by motor vehicle, in the performance of their duties under this part to their patrons, employees, other public utilities, and the public, as well as the interchange of facilities between two or more of them.

66 Pa.C.S. § 102.

Section 332(a) of the Code, 66 Pa.C.S. § 332(a), provides that the party seeking relief from the Commission has the burden of proof. The Complainants seek relief from the Commission, and, therefore, have the burden of proof here.

"Burden of proof" means a duty to establish a fact by a preponderance of the evidence, or evidence more convincing, by even the smallest degree, than the evidence presented by the other party. *Se-Ling Hosiery v. Margulies*, 364 Pa. 54, 70 A.2d 854 (1950).

If a complainant establishes a *prima facie* case, the burden of going forward with the evidence shifts to the utility. If a utility does not rebut that evidence, a complainant will prevail. If the utility rebuts a complainant's evidence, the burden of going forward with the

evidence shifts back to a complainant, who must rebut the utility's evidence by a preponderance of the evidence. The burden of going forward with the evidence may shift from one party to another, but the burden of proof never shifts; it always remains on a complainant. *Replogle v. Pennsylvania Electric Company,* 54 Pa. PUC 528 (1980), and *Waldron v. Philadelphia Electric Company*, 54 Pa. PUC 98 (1980).

If a respondent submits evidence of "co-equal" weight to counter a complainant's evidence, the complainant has not satisfied the burden of proof unless additional evidence opposing the respondent's evidence is presented. *Morrissey v. Pa. Dept. of Highways,* 424 Pa. 87, 225 A.2d 895 (1967), and *Burleson v. Pa. Pub. Util. Comm'n*, 66 Pa. Cmwlth. 282, 443 A.2d 1373 (1982), *aff'd.* 501 Pa. 443, 461 A.2d 1234 (1983).

Decisions by the Commission must be supported by substantial evidence in the record. 2 Pa.C.S. § 704. "Substantial evidence" is an appellate standard of review and not a standard of evidence. *Samuel J. Lansberry, Inc. v. Pa. Pub. Util. Comm'n*, 578 A.2d 600, 602 (Pa. Cmwlth. 1990) *(Lansberry)*. Substantial evidence is such relevant evidence that a reasonable mind might accept as adequate to support a conclusion. *Consolidated Edison Company of New York v. National Labor Relations Board,* 305 U.S. 197, 229, 59 S.Ct. 206, 217 (1938). More is required than a mere trace of evidence or a suspicion of the existence of a fact sought to be established. *Norfolk & Western Ry. Co. v. Pa. Pub. Util. Comm'n,* 489 Pa. 109, 413 A.2d 1037 (1980) *(Norfolk); Erie Resistor Corp. v. Unemployment Comp. Bd. of Review,* 166 A.2d 96 (Pa. Super. 1961)*; Murphy v. Pa. Dept. of Public Welfare, White Haven Center*, 480 A.2d 382 (Pa. Cmwlth. 1984).

Smart Meter Deployment

PECO installed Smart Meters in response to Act 129 of 2008 ("the Act" or "Act 129") and associated Commission Orders and directives. Act 129 directed electric distribution companies ("EDCs") to file Smart Meter technology, procurement and installation plans with the Commission for approval. The Act provided:

(f) *Smart Meter technology and time of use rates.*

(1) Within nine months after the effective date of this paragraph, electric distribution companies shall file a Smart Meter technology procurement and installation plan with the commission for approval. The plan shall describe the Smart Meter technologies the electric distribution company proposes to install in accordance with paragraph (2).

(2) Electric distribution companies shall furnish Smart Meter technology as follows:

(i) Upon request from a customer that agrees to pay the cost of the Smart Meter at the time of the request.
(ii) In new building construction.
(iii) In accordance with a depreciation schedule not to exceed 15 years.

66 Pa.C.S. § 2807(f). The Act requires that any smart meter technology utilized have bidirectional or two-way communication technology. 66 Pa.C.S. § 2807(g).

The Commission ordered EDCs with greater than 100,000 customers to adhere to the guidelines established for smart meter technology, procurement and installation on June 18, 2009. EDCs were required to file a Smart Meter technology, procurement and installation plan.[5] The Commission approved the smart meter installation plan developed by PECO.[6] Under that plan, PECO is replacing AMR meters with AMI or "smart meters."

From approximately 2000 until April 2017, PECO used an AMR meter system that was comprised of transmit-only meters that transmitted using radio frequencies. That system was shut down in April 2017. Approximately 1.7 million electric AMI meters and 500,000 gas AMI meters were deployed by PECO. Apr 12 Tr. 147-149.

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[5] *See Smart Meter Procurement and Installation*, Docket No. M-2009-2092655 (Implementation Order entered June 24, 2009) (*Smart Meter Procurement and Installation Order*).

[6] *See Petition of PECO Energy Company for Approval of its Smart Meter Technology Procurement and Installation Plan*, Docket No. M-2009-2123944 (Order entered August 15, 2013) (*Smart Meter Plan*).

In 2013, the Commission concluded that there is no provision in the Code or the Commission's Regulations or Orders that allows a PECO customer to "opt out" of smart meter installation. *See Povacz v. PECO Energy Company*, Docket No. C-2012-2317176 (Opinion and Order entered January 24, 2013).

The Commission has stated, however, that a customer should be heard on an allegation that equipment installed by PECO may be unsafe or its installation unreasonable. Recently, in *Paul v. PECO Energy Co.*, Docket No. C-2015-2475355 (Opinion and Order entered June 14, 2018) (*Paul v. PECO*) the Commission reiterated that pursuant to Section 1501 of the Code, a public utility has a duty to maintain safe, adequate and reasonable service and facilities and to make repairs, changes, and improvements that are necessary or proper for the accommodation, convenience, and safety of its patrons, employees, and the public, referencing 66 Pa.C.S. § 1501, cited above. Again, "service" is to be broadly construed. *Country Place Waste Treatment Co., Inc. v. Pa. Pub. Util. Comm'n*, 654 A.2d 72 (Pa.Cmwlth. 1995).

In *Paul v. PECO* and *Frompovich v. PECO Energy Co.*, Docket No. C-2015-2474602 (Opinion and Order entered May 3, 2018), the Commission noted that pursuant to Section 1501 of the Code, the Commission developed regulations governing electric safety standards. Under these regulations, an EDC must use reasonable efforts to properly warn and protect the public from danger. The EDC must also exercise reasonable care to reduce the hazards to which customers may be subjected to by reason of the EDC's provision of electric utility service and its associated equipment and facilities. *See* 52 Pa. Code § 57.28(a)(1).

The Commission has also stated, "[t]he ALJ's role . . . will be to determine based on the record in this particular case, whether there is sufficient evidence to support a finding that Complainant was adversely affected by the smart meter or whether [the utility's] use of a smart meter will constitute unsafe or unreasonable service in violation of Section 1501 under the circumstances in this case." *Kreider v. PECO Energy Co.*, Docket No. P-2015-2495064 at 23 (Order entered January 28, 2016) (citing *Woodbourne-Heaton*, 1992 Pa. PUC Lexis 160, at *12-13). *Frompovich v. PECO Energy Co.*, Docket No. C-2015-2474602 (Opinion and Order entered May 3, 2018 at 10).

DISCUSSION

The McKnights contend that installation of a smart meter at their home would be unsafe and unreasonable in violation of Section 1501and are seeking to prohibit reinstallation of a smart meter at their home. The McKnights would like the jumper plate to remain in place at their home or installation of an analog meter. (April 10, Tr. 21; McKnight Main Brief at 14). This decision grants the relief requested, in part, and denies the relief requested, in part.

The evidence presented by the McKnights established that Mrs. McKnight began to experience negative health effects after the November 30, 2015, installation of the Landis + Gyr AMI meter at her home replacing an AMR meter. (April 10, Tr. at 9-11). She soon was unable to sleep in her home and began to sleep in a boat in her yard. (April 10, Tr. 9-11). In response, she consulted a cardiologist and Dr. Prociuk, who has been Mrs. McKnight's personal physician since 2010. (April 11, Tr. 243; Tr. April 10, Tr. 25:5-8). Mr. McKnight, a physician, took his wife's pulse and found that it was irregular and bradycardic after installation of the meter. (April 10, Tr. 126:20-22). He then advised her to see a cardiologist (April 10, Tr. 67:4-5).

During the period of March and April of 2016, the McKnights also reported stray voltage problems at their home. PECO sent out a technician to investigate and, on at least one occasion, the meter was removed and replaced with a jumper to provide electricity to the household. PECO records show that Mrs. McKnight contacted PECO on May 17, 2016 and reported that she experienced electric shock while in her home. (PECO Exhibit BU-1). When the AMI meter was removed on May 24, 2016, Mrs. McKnight's health improved. (April 10, Tr. 47-48).

A Landis + Gyr meter was reinstalled at the McKnight residence in early September 2016. Mrs. McKnight again began to experience ill health. (April 10, Tr. 13- 15). On November 1, 2016, at Mrs. McKnight's request, a PECO employee again removed the AMI meter and replaced it with a jumper plate (no meter). Her health and physical symptoms again improved. (April 10, Tr. 13-15).

PECO suggests that Mrs. McKnight began to show ill health affects after the installation of the meter because she was at home at the time and was aware that the smart meter was being installed. However, Mrs. McKnight credibly testified that she was on a business trip when the meter was reinstalled in September of 2016, thus she was not aware of the reinstallation when she again began to suffer ill health effects. (April 10, Tr. 53, 58).

PECO correctly notes that Mrs. McKnight suffered some health issues prior to installation of the meter. (April 10, Tr. 9-11). PECO expert witness Dr. Mark Israel also noted that a review of Mrs. McKnight's medical records provided by Mrs. McKnight's cardiologist showed that all cardiovascular outcomes were normal and did not report that Mrs. McKnight has the cardiovascular symptom that she claims. (April 13, Tr. 206-213).

However, the cardiologist tests were not conducted until after the meter was removed. The meter was removed sometime in May 2016. It was still installed and operating on May 9, 2016. (April 12, Tr. 117-18). Mrs. McKnight saw a cardiologist for her cardiovascular symptom and tests were conducted on May 23, May 27, June 16 and June 20, 2016. (April 10, Tr. 39).

The evidence shows that Mrs. McKnight began to suffer ill health effects after installation of the Landis + Gyr meter on both occasions, concurrently with the stray voltage issues experienced by the McKnights. However, "the record in this particular case" (*Kreider)* supports a finding that Mrs. McKnight became ill when a particular meter, Landis + Gyr (serial #127832547) was installed at this particular service address under these particular circumstances. Therefore, re-installation of the Landis + Gyr smart meter at the service address would be unreasonable under Section 1501.

However, the evidence does not support a finding that all AMI meters or that AMI meters in and of themselves will have a negative health effect upon Mrs. McKnight or that Mrs. McKnight suffers from EHS and that smart meters in general would have a negative effect on her health.

In support of their position, the McKnights called Dr. Peter Prociuk, M.D., to testify. He is a medical doctor who practices homeopathic medicine. (April 11, Tr. 241-42). Dr. Prociuk has been Mrs. McKnight's personal physician since 2010. (April 11, Tr. 243). Dr. Prociuk was recognized as an expert in medicine, but not as an expert in EHS. (April 11, Tr. 246-47). Dr. Prociuk testified that the smart meter was injurious to Mrs. McKnight's health and the cause of her palpitations. (April 11, Tr. 258:21-25.). He believed that harmonics created by smart meters were at the core of the problem. (April 11, Tr. 312:8-11). His opinion is based on reports that her symptoms worsened after the installation of the smart meter, the Lamech Australian survey on EHS and a 1991 study of persons believed to suffer from EHS by Dr. Rea. (April 11, Tr. 258, 260, 268).

As a physician, Dr. Lawrence McKnight was qualified as an expert in making medical diagnoses and in interpreting medical records and research. (April 10, Tr. 95). He testified that based on his review of the literature, there were three possible mechanisms of EF transmission which need to be mitigated. These 3 mechanisms include 'dirty electricity' (conducted transients), radio frequency from the AMI's primary antenna, and a secondary antenna effect where the EF is coupled onto household wiring (April 10, Tr. 90:7-22; 200:1-6). In reaching his conclusion that EHS is a real condition, and not a nocebo effect, Mr. McKnight relied upon: (1) a 1991 study by Dr. Rea; (2) a study of a single patient by Dr. Andrew Marino; and (3) his observations of his wife. He felt that there were other studies that are "suggestive studies that in and of themselves are not sufficient evidence but can be combined together, and there's a lot of things pointing in this direction." (April 10, Tr. 165-68).

Mr. McKnight considered that his wife was experiencing a "nocebo" effect, which occurs when a person believes that exposure to an agent will make them ill and, consequently, when they perceive they have been exposed to that agent, they become ill, even if they have not been exposed and even if the agent in fact does not cause illness. At some point, when the AMI meter was installed, Mr. McKnight began to turn the power off before going to bed and Mrs. McKnight was able to sleep even though the AMI meter was still installed. (April 10, Tr. 186). He ultimately rejected the nocebo effect and concluded that Mrs. McKnight has EHS. (April 10, Tr. 102-110). Mr. McKnight does not agree with the studies of EHS that did

not report a relationship between EMF exposure and symptoms, noting that the authors discussed and dismissed the argument that their results were "false negatives," or "Type II" errors. (April 10, Tr. 168-175). Mr. McKnight also does not agree with the World Health Organization conclusion that EHS is not caused by exposure to EMF. He believes that in reaching that conclusion, the World Health Organization committed a Type II error. (April 10, Tr. 174-75).

William Bathgate also testified on behalf of the McKnights. He was recognized as an expert in electrical engineering and in the design and measurement of power systems and radio design. (April 11, Tr. 327-28).

PECO now has available three AMI meters - the Landis + Gyr, the Aclara and the Sensus Stratus. Mr. Bathgate performed conducted emission tests of 2 versions of the Aclara meter proposed by PECO to be installed at the service address. (April 11, Tr. 342:25; Complainant Joint Exhibit 5 at page 10). He reported that both meters produced transients, known in layman's terms as "dirty electricity," of over 300 millivolts. (Complainant Joint Exhibit 5 at page 3-4) which is more than 1,200 times the FCC class B specification for unintended conducted emissions of other devices like this in households. (April 11, Tr. 348:14-16; 354:20). He also tested other meters, including the Landis + Gyr, and testified that they have the same problem with extremely high conducted transients. (April 11. Tr/ 366:2-4).

Mr. Bathgate also testified that the AMI meters result in what he described as a secondary antenna effect, which he described as the antenna of the AMI meter in close proximity to other wires within the meter box, creating a secondary antenna effect on other household wires and ground. (April 11, Tr. 389:17-390:4). He also testified that he has conducted similar conducted electromagnetic field emission tests on numerous AMI meters made by at least five different manufacturers and found that effectively all of them violate the FCC's conducted emission standards. (April 11, Tr. 365-66).

However, countervailing evidence was more persuasive with respect to AMI meters in general. The cross examination of Complainants' witnesses elicited information

weighing against a finding that all AMI meters will harm Mrs. McKnight or that Mrs. McKnight suffers from EHS.

Dr. Prociuk's concerns with the AMI meter are "entirely related to EMF." (April 11, Tr. 312). The Australian study that Dr. Prociuk reviewed and referenced in support of his theory was by Lamech. As Dr. Prociuk stated, in that study, people who self-identified as having EHS and who perceived that they had changes in health after a mandatory smart meter rollout in Australia were invited to report their perceived health changes to an internet site. Dr. Prociuk stated "This type of study can be used to formulate a new hypothesis but can only make limited statements on causality." (April 11, Tr. 269-70). Although he believes that EHS is a "real thing," Dr. Prociuk stated that EHS has not reached the level of being a formal diagnosis. (April 11, Tr. 271). There is no diagnostic test for EHS, (April 11, Tr. 277-78). Also, Dr. Prociuk is "not sufficiently versed in the literature on EMF" to know whether studies have been published since 1991 that use the same methodology as Dr. Rea's 1991 study upon which he relied. Before the conclusions of the Rea study could be considered "established scientifically," larger independent studies would have to be performed. (April 11, Tr. 281-82). When speaking of a connection between exposure to AMI meters and EHS, Dr. Prociuk acknowledges that the clinical science demonstrating such a connection is not well-established. (April 11, Tr. 289).

Also, Mr. Bathgate acknowledged that it is possible to make an AMI meter that meets the FCC's conducted emission standards (April 11, Tr. 366). Mr. Bathgate is not able to make a determination that AMI meters are unsafe. (April 11, Tr. 367-68). Mr. Bathgate also acknowledged that his concerns about AMI meters were not directly applicable to PECO AMI meters because PECO's AMI system operates on a private, licensed spectrum. (April 11, Tr. 439-44; April 12, Tr. 10-11; April 12, Tr. 172).

PECO also presented its own rebuttal testimony and evidence. Glenn Pritchard is PECO's Manager of Advanced Grid Operations. (April 12, Tr. 141). He testified that for each of the meters used by PECO, the manufacturer and an approved testing agency obtained written equipment authorization certifications from the FCC allowing use of the meters. (April 12, Tr. 171-72). Copies of the certifications were introduced into the record. (PECO Exh. GP-11).

Evidence also showed that PECO's AMI meters comply with FCC regulations. (April 12, Tr. 172).

Mr. Pritchard also disputed the testimony of Mr. Bathgate suggesting that transients created by the AMI meter were a problem. He testified that transients exist regardless of the type of meter used – AMI, AMR, or analog – or if no meter at all is installed. (April 12, Tr. 179-81). He also testified that he used a higher quality transient measuring meter than that used by Mr. Bathgate and found that, even in the absence of an electric meter, readings of transients at the service address were "very noisy, representing different transients . . . that are occurring in the household." (April 12, Tr. 183-87). Mr. Pritchard also rebutted any theory that there was a secondary antenna effect causing a problem at the service address, specifically questioning the measuring device used by Mr. Bathgate. Mr. Pritchard obtained an HF35C meter, which Mr. Bathgate had used for his measurements and found the readings unreliable. (April 12, Tr. 187-190; April 12, Tr. 190-91; April 12, Tr. 191-92). The device picked up a broad range of signals and yet did not pick up a signal when he attempted to measure a spot where he knew a cable was buried. *Id.*

Mr. Pritchard also testified that because PECO uses a licensed, non-mesh system, PECO's AMI system has fewer radio transmissions than other utility systems. He also stated that the company can "tune down" the number of transmissions from each AMI meter. (April 12, Tr. 199-202). Therefore, Mr. Bathgate's general concerns about AMI systems were not applicable to the PECO system. Mr. Pritchard was of the opinion that if the millions of deployed meters had a problem with FCC Class B certification for conducted emissions, it would have been discovered by now. (April 12, Tr. 231).

PECO also presented Dr. Christopher Davis. He is a Ph.D. physicist who is the Minta Martin Professor of Engineering and Professor of Electrical and Computer Engineering at the University of Maryland. (April 13, Tr. 9-12). He was recognized as an expert in the fields of physics, biophysics, chemistry, electrical engineering, electromagnetics, bioelectromagnetics, and dosimetry. (April 13, Tr. 16, 18).

The McKnights note that Dr. Davis does not have formal training in biology, (Tr. April 13 at 17:5-11). However, for the past 50 years, he has worked closely with biologists, M.D.s, engineers and physicists examining bioelectromagnetics (April 13, Tr. at 17).

Dr. Davis also testified that while he believes that people who are said to have idiopathic environmental intolerance (IEI, also called electromagnetic hypersensitivity (EHS)) have symptoms, "nobody has been able to show that the symptoms are caused by exposure to electromagnetic fields." (April 13, Tr. 154). Dr. Davis was particularly certain that PECO's AMI meters are not harmful. In his opinion, there is no reliable scientific basis to conclude that radiofrequency fields from PECO's AMI meters are capable of producing any adverse biological effects. (April 13, Tr. 42-44; PECO Exh. CD-13).

Dr. Davis explained that the FCC has safety standards and a maximum permissible exposure ("MPE") that people can be exposed to if they are near a radiofrequency transmitter. They are designed to avoid human health effects from exposure to high levels. (April 13, Tr. 23-24; PECO Exh. CD-3).

He testified that PECO's AMI meters do not create ionizing radiation and the transmissions from them are not capable of breaking chemical bonds. (April 13, Tr. 24-26; PECO Exh. CD-4). He also noted that the radiofrequency transmissions from PECO's AMI meters are approximately 5.8 million times lower than the FCC's MPE. (April 13, Tr. 26-29; PECO Exh. CD 5). He also stated that even the peak transmissions, when the meter is sending, from a PECO AMI meter are approximately 40 times smaller than the amount they are allowed to transmit on an averaged basis. (April 13, Tr. 29-30; PECO Exh. CD-6). Additionally, he noted, the radiofrequency transmissions from PECO's AMI meters are approximately 4.4 million times lower than the guidelines of the International Commission on Non-Ionizing Radiation Protection. (April 13, Tr. 31-34; PECO Exh. CD-7).

According to Dr. Davis, people generally are exposed to radiofrequency fields from a variety of sources, including microwave ovens, cell towers, UHF(TV) transmitters and cell phones. (April 13, Tr. 34-35; PECO Exh. CD-8). He determined that the service address is

continuously exposed to radiofrequency transmissions. He also calculated that radio frequency fields from UHF stations at the service address are 168 times larger than the exposure of continuously sitting one meter in front of an AMI meter 24 hours a day, seven days a week. (April 13, Tr. 36-37; PECO Exh. CD-9).

Dr. Davis also stated that compared to the AMR meter previously installed at the service address, the AMI meters would reduce the McKnights' radiofrequency exposure by 79%. (April 13, Tr. 37-38; PECO Exh. CD-10). He also addressed the tests performed by Dr. Rea and the report that Mrs. McKnight responded to exposure to 60 hertz, 3 kilohertz and 5 megahertz. Dr. Davis testified that electric power to your home and power lines is 60 hertz and that AMI meters do not produce 5 megahertz or 3 kilohertz fields. (April 13, Tr. 75-76).

Dr. Davis also rebutted the testimony of Mr. Bathgate that PECO's AMI meters produced transients, or dirty electricity, of more than 1,200 times the FCC class B specification. (infra. At 53). Dr. Davis stated that PECO's AMI meters and conducted emissions standards are not subject to the conducted emission standards of the FCC because those standards apply to unlicensed transmitters, and PECO's AMI meters use a licensed spectrum transmission. (April 13, Tr. 49-51). He further noted that PECO's AMI meters do not transmit transients every six to seven minutes as Mr. Bathgate testified regarding PECO's AMI meters. Dr. Davis used "expensive and extensive high-quality measurement equipment," to make his calculations because the AMI meters "emit so infrequently, that you need extremely sophisticated equipment to capture these brief on/off periods of the RF transmissions from the meters." He was not able to say with certainty what Mr. Bathgate was measuring, other than they were sources other than a single AMI meter, and that AMI meters "don't transmit with that regularity." (April 13, Tr. 51-53).

Dr. Davis measured transients both with and without an AMI meter present, for all three models of PECO AMI meters currently in use. His measurement showed that there were transients coming into a residence when only an analog meter was used. For all of the AMI meters, the addition of the AMI meter reduced the transients, so according to Dr. Davis the smart meters were not generating additional transients. (April 13, Tr. 58-61).

He testified that PECO's AMI meters have radiofrequency transmission levels that are extremely low compared to the many other sources of radiofrequency fields in the environment. (April 13, Tr. 68). As for harmonics and transients, he stated that they are normal in the delivery of electric service to residences, and that they exist whether an AMI meter is in use or not. (April 13, Tr. 70-71).

Dr. Davis reviewed Dr. Rea's 1991 study and concluded, for numerous reasons related to its design and methods, that the 1991 paper is not scientifically reliable. (April 13, Tr. 61-67).

Also persuasive was the testimony of Dr. Mark Israel, M.D. on behalf of PECO. He is a medical doctor and the Professor of Systems Biology and Pediatrics and Medicine at Dartmouth Medical School. He is also Executive Director of the Israel Cancer Research Fund. (April 13, Tr. 176-177). Dr. Israel was recognized as an expert in medicine, medical research, and radiofrequency and electromagnetic fields and health. (April 13, Tr. 182-190).

For more than 30 years, Dr. Israel has evaluated scientific studies on power frequency, radiofrequency, related research and health. (April 13, Tr. 178-179). He has taught pediatrics, anatomy, endocrinology, immunology, hematology, neurology, neurosurgery, cardiology, biochemistry, cell biology, genetics, molecular genetics, medical oncology and radiation oncology. (April 13, Tr. 181). In his testimony, rather than the term EHS, Dr. Israel used the term IEI (idiopathic environmental intolerance) as it is the term used by the World Health Organization, stating " it's medically a more neutral term. And it also calls attention to the fact that it's idiopathic," i.e, cause is unknown." (April 13, Tr. 195-196). Dr. Israel has extensively reviewed the literature, studies and reports regarding health and electromagnetic fields and radiofrequency. Those studies show that IEI, EHS, and the variety of symptoms attributed to it are not caused by radiofrequency fields. (April 13, Tr. 194-202; PECO Exh. MI-3).

Like Dr. Davis, Dr. Israel does believe that people who purportedly have IEI or EHS have real symptoms (April 13, Tr. 285:24-25). Also, like Dr. Davis, he is certain that electromagnetic and radiofrequency fields are not the cause of those symptoms.

As for any suggestion that Mrs. McKnight has a heart condition that would be negatively affected by an AMI meter, Dr. Israel reviewed the medical records provided by Mrs. McKnight's cardiologist. He showed that all cardiovascular outcomes were normal. (April 13, Tr. 206-213). Also, he did not find that there was any indication that Mrs. McKnight had an elevated risk of developing the cardiovascular symptom suggested. (April 13, Tr. 214).

Dr. Israel also questioned Dr. Rea's diagnosis and medical treatment of Mrs. McKnight. He testified that the EHS studies relied upon and conducted by Dr. Rea were not well founded and not scientifically sound. (April 13, Tr. 225-28). He also questioned that Dr. Rea did not send Mrs. McKnight to see a specialist or prescribe treatment for her alleged ailments. (April 13, Tr. 217, 219). PECO also introduced evidence that two state medical boards questioned the EHS treatments of Dr. Rea. (April 12, Tr. 85; PECO Rea Cross Exh. 3; April 12, Tr. 108; April 12, Tr. 82; PECO Rea Cross Exh. 1). Based on his extensive knowledge regarding the research, Dr. Israel's expert opinion is that there is no reliable medical basis to conclude that radiofrequency fields from PECO's AMI meters did or will cause, contribute to, or exacerbate IEI, EHS, or any symptoms or medical conditions reported by Mrs. McKnight. (April 13, Tr. 194-202; PECO Exh. MI-3).

There was evidence presented by the Complainants that Mrs. McKnight became ill after the Landis + Gyr AMI meter #127832547 was installed at the service address. This was not rebutted by PECO. However, concurrently the McKnights were having a voltage problem at their residence, which PECO made every attempt to repair. This suggests some interaction with that meter and the environment of the service address.

Substantial evidence does not support a finding that Mrs. McKnight suffers from EHS that would be negatively affected or worsen if any AMI meter is installed. The evidence does not support a finding that EHS is a condition accepted by the medical community or that

Mrs. McKnight suffers from the EFs present as background in her home. (April 13, Tr. 36-37; PECO Exh. CD-9). Also, Mrs. McKnight had a greater exposure to EFs when her home had an AMR meter and the record does not support a finding that she suffered the same ailments as she now presents as due to the AMI meter, which reduces EF exposure by 79%. (April 13, Tr. 37-38; PECO Exh. CD-10).

Further, it was shown that Mr. Bathgate's concerns about smart meters in general did not apply to the PECO AMI system. Also, Mr. Bathgate could not definitively say that AMI meters are unsafe. Also, Dr. Davis and Dr. Israel persuasively discounted any studies purportedly showing that AMI meters or EFs at the level emitted by AMI meters cause health problems. PECO AMI meters operate well under the safety standards set by the FCC and meet UL certification safety standards. (FOFs 65, 79-81).

There are no actions by PECO that would constitute a violation requiring imposition of a penalty against PECO. By installing the AMI meter at the service address, PECO attempted to comply with Act 129 and its Commission approved deployment plan. PECO also responded to the inquiries and concerns of the McKnights (FOFs 19-36). However, the fact remains that after Landis + Gyr AMI meter #127832547 was installed, Mrs. McKnight began to experience health problems.

Therefore, this Initial Decision will grant the relief requested with respect to Landis + Gyr AMI meter #127832547 and deny the request to prevent installation of any AMI meter at the McKnight residence and allow PECO to install its Stratus or Aclara AMI meter at the service address. There was no showing that these meters, or their specifications, would be harmful to Mrs. McKnight. PECO will also be required to investigate any remaining voltage issues present at the service address.

CONCLUSIONS OF LAW

1. The Commission has jurisdiction over the parties and the subject matter in this proceeding. 66 Pa. C.S. §701.

2. Utility companies are required to furnish and maintain adequate, efficient, safe, and reasonable service and facilities. *Mary Paul v. PECO Energy Company*, Docket No. C 2015-2475355 (Order and Opinion entered June 14, 2018); 52 Pa. Code § 57.194.

3. Under Section 332(a) of the Pennsylvania Public Utility Code, the proponent of a rule or order has the burden of proof. 66 Pa. C.S. § 332(a). It is well established that "[a] litigant's burden of proof before administrative tribunals as well as before most civil proceedings is satisfied by establishing a preponderance of evidence which is substantial and legally credible." *Samuel J. Lansberry, Inc. v. Pa. Pub. Util. Comm'n*, 578 A.2d 600, 602 (Pa. Cmwlth. 1990).

4. The preponderance of evidence standard requires proof by a greater weight of the evidence. *Commonwealth v. Williams*, 557 Pa. 207, 732 A.2d 1167 (1999). This standard is satisfied by presenting evidence that makes the existence of a contested fact more likely than its nonexistence. *Brown v. Commonwealth*, 940 A.2d 610, 614 n.14 (Pa. Cmwlth. 2008) (citation omitted).

5. A person does not sustain his or her burden of proof in an electric and magnetic field exposure case when the record evidence, "taken as a whole, leads to the ultimate finding and conclusion that the scientific studies at present are inconclusive," rather, the person must demonstrate by a preponderance of the evidence that such exposure actually causes adverse health effects. *Letter of Notification of Phila. Elec. Co. Relative to the Reconstructing and Rebuilding of the Existing 138 kV Line to Operate as the Woodbourne-Heaton 230 kV Line in Montgomery and Bucks Counties*, 1992 Pa. PUC Lexis 160, at *210-11 (June 29, 1992) (Initial Decision) ("*Woodbourne-Heaton*").

6. "[T]he Complainant will have the burden of proof during the proceeding to demonstrate, by a preponderance of the evidence, that [the utility] is responsible or accountable for the problem described in the Complaint." *Kreider v. PECO Energy Co.*, Docket No. P-2015-2495064, p. 18 (Order entered Sept. 3, 2015).

7. Whether there is sufficient evidence to support a finding that the Complainant was adversely affected by the smart meter or whether [the utility's] use of a smart meter will constitute unsafe or unreasonable service in violation of Section 1501 will be determined based on the record in this particular case and under the circumstances in this case." *Kreider v. PECO Energy Co.*, Docket No. P-2015-2495064, p. 23 (Order entered Jan. 28, 2016) (citing *Woodbourne-Heaton*, 1992 Pa. PUC Lexis 160, at *12-13).

8. There is sufficient evidence to support a finding that Mrs. McKnight will be adversely affected by reinstallation of the Landis + Gyr AMI meter #127832547 and that reinstallation of the Landis + Gyr AMI meter #127832547 would constitute unsafe or unreasonable service in violation of 66 Pa.C.S. § 1501. *Kreider v. PECO Energy Co.*, Docket No. P-2015-2495064 at 23 (Order entered Jan. 28, 2016) (citing *Woodbourne-Heaton*, 1992 Pa. PUC Lexis 160, at *12-13).

9. There is insufficient evidence to support a finding that Mrs. McKnight will be adversely affected by any smart meter or that PECO's use of any smart meter will constitute unsafe or unreasonable service in violation of 66 Pa.C.S. § 1501. *Kreider v. PECO Energy Co.*, Docket No. P-2015-2495064 at 23 (Order entered Jan. 28, 2016) (citing *Woodbourne-Heaton*, 1992 Pa. PUC Lexis 160, at *12-13).

ORDER

THEREFORE,

IT IS ORDERED:

1. That the claims and relief requested in the Complaint at Docket No. C-2017-2621057, are granted in part and denied in part.

2. That PECO Energy Company shall not reinstall Landis + Gyr AMI meter #127832547 at the service address at 258 Heyburn Road, Chadds Ford, Pennsylvania.

3. That PECO Energy Company shall investigate 258 Heyburn Road, Chadds Ford, Pennsylvania for any stray voltage or voltage to ground voltage issues within 30 days of the final order in this matter and that PECO Energy Company will correct any stray voltage or voltage to ground issues pertaining to PECO Energy Company equipment and facilities, if any exist, as soon as practicable.

4. That upon completion of Paragraph 3, PECO Energy Company may install an Aclara or Sensus Straus AMI meter at the service address.

5. That the Docket at C-2017-2621057 be marked closed.

Date: October 19, 2018

/s/
Darlene D. Heep
Administrative Law Judge

EXHIBIT B

IEQ Indoor Environmental Quality Project Report, Access Board, (2006)

Entered into the Record by ALJ Heep in Lucey v. Metropolitan Edison Company C-2018-3003679 not for the truth of the matter but as a document reviewed and referenced by the complainant. It is an exception to the Hearsay rule.

IEQ Indoor Environmental Quality

A project of the National Institute of Building Sciences (NIBS) with funding support from The Architectural and Transportation Barriers Compliance Board (Access Board)

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Introduction

The Architectural and Transportation Barriers Compliance Board (Access Board) is an independent federal agency devoted to accessibility for people with disabilities. The Access Board is responsible for developing and maintaining accessibility guidelines to ensure that newly constructed and altered buildings and facilities covered by the Americans with Disabilities Act and the Architectural Barriers Act are accessible to and usable by people with disabilities. In November 1999, the Access Board issued a proposed rule to revise and update its accessibility guidelines. During the public comment period on the proposed rule, the Access Board received approximately 600 comments from individuals with multiple chemical sensitivities (MCS) and electromagnetic sensitivities (EMS). They reported that chemicals released from products and materials used in construction, renovation, and maintenance of buildings, electromagnetic fields, and inadequate ventilation are barriers that deny them access to most buildings.

Americans spend about 90 percent of their time indoors, where concentrations of air pollutants are often much higher than those outside. According to the U.S. EPA Healthy Buildings, Healthy People: A Vision for the 21st Century, www.epa.gov/iaq/hbhp/hbhptoc.html "Known health effects of indoor pollutants include asthma; cancer; developmental defects and delays, including effects on vision, hearing, growth, intelligence, and learning; and effects on the cardiovascular system (heart and lungs). Pollutants found in the indoor environment may also contribute to other health effects, including those of the reproductive and immune systems." (p. 4). The report further notes that "Most chemicals in commercial use have not been tested for possible health effects. (p. 8).

There are a significant number of people who are sensitive to chemicals and electromagnetic fields. Surveys conducted by the California and New Mexico Departments of Health and by medical researchers in North Carolina found 16 to 33 percent of the people interviewed reported that they are unusually sensitive to chemicals, and in the California and New Mexico health departments' surveys 2 percent to 6 percent reported that they have been diagnosed as having multiple chemical sensitivities. C. Miller and N. Ashford, "Multiple Chemical Intolerance and Indoor Air Quality," in Indoor Air Quality Handbook Chapter 27.8 (McGraw-Hill 2001). Another California Department of Health Services survey has found that 3 percent of the people interviewed reported that they are unusually sensitive to electric appliances or power lines. P. LeVallois, et al., "Prevalence and Risk Factors of Self-Reported Hypersensitivity to Electromagnetic Fields in California," in California EMF Program, "An Evaluation of the Possible Risks From Electric and Magnetic Fields (EMFs From Power Lines, Internal Wiring, Electrical Occupations and Appliances, Draft 3 for Public Comment, April 2001" Appendix 3 (http://www.dhs.ca.gov/ehib/emf/RiskEvaluation/riskeval.html).

Individuals with multiple chemical sensitivities and electromagnetic sensitivities, who submitted written comments and/or attended the public information meetings on the draft final rule, requested that the Access Board include provisions in the final rule to make buildings and facilities accessible for them.

The Board has not included such provisions in their rules, but they have taken the commentary very seriously and acted upon it. As stated in the Background for its Final Rule Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Recreation Facilities: http://www.access-board.gov/recreation/final.htm

> "The Board recognizes that multiple chemical sensitivities and electromagnetic sensitivities may be considered disabilities under the ADA if they so severely impair the neurological, respiratory or other functions of an individual that it substantially limits one or more of the

individual's major life activities. The Board plans to closely examine the needs of this population, and undertake activities that address accessibility issues for these individuals.

The Board plans to develop technical assistance materials on best practices for accommodating individuals with multiple chemical sensitivities and electromagnetic sensitivities. The Board also plans to sponsor a project on indoor environmental quality. In this project, the Board will bring together building owners, architects, building product manufacturers, model code and standard-setting organizations, individuals with multiple chemical sensitivities and electromagnetic sensitivities, and other individuals. This group will examine building design and construction issues that affect the indoor environment, and develop an action plan that can be used to reduce the level of chemicals and electromagnetic fields in the built environment."

This report and the recommendations included within are a direct outgrowth from that public comment process. The Access Board contracted with the National Institute of Building Sciences (NIBS) to establish this Indoor Environmental Quality Project as a first step in implementing that action plan.

A broad and distinguished Steering Committee was established and met in January 2004 in Bethesda, Maryland, to review the project objectives. Subsequently four task teams (committees) were established to address specific issues in buildings related to Operations & Maintenance, Cleaner Air Rooms, Design and Construction, and Products and Materials. The following reports from these four committees offer recommendations for improving IEQ in buildings. They also list valuable resources and references to allow readers to investigate the pertinent issues in greater depth. The focus of the project was on commercial and public buildings, but many of the issues addressed and recommendations offered are applicable in residential settings.

Many volunteers worked diligently to create the recommendations in this report. These individuals are listed in the separate committee sections of the report, but special thanks go to the committee chairs: respectively Hal Levin, Building Ecology Research Group; Michael Mankin, California Division of the State Architect; Roger Morse, Morse-Zentner Associates; and Brent Kynoch, Kynoch Environmental Management, Inc. Lastly, an enormous debt of gratitude is owed to four amazing individuals who made significant contributions to the work of all four committees: Mary Lamielle, National Center for Environmental Health Strategies; Ann McCampbell, MD, Multiple Chemical Sensitivities Task Force of New Mexico; Susan Molloy, National Coalition for the Chemically Injured; and Toni Temple, Ohio Network for the Chemically Injured.

The overall objectives of this project were to establish a collaborative process among a range of stakeholders to recommend practical, implementable actions to both improve access to buildings for people with MCS and EMS while at the same time raising the bar and improving indoor environmental quality to create healthier buildings for the entire population.

This IEQ project supports and helps achieve the goals of the Healthy Buildings, Healthy People project, which acknowledges that "We will create indoor environments that are healthier for everyone by making indoor environments safer for the most vulnerable among us, especially children." (p.17)

Summary Recommendations

The recommendations in this report are only a first step toward the action plan envisioned by the Access Board.

The NIBS IEQ committee offers several recommendations for further action. It is recommended that a follow-on project organize and convene one, or more, workshops to deliberate the issues and recommendations in this report. It is also recommended that a project be organized to develop a single guidelines document. Such guidelines would be built on refinement and coordination of the recommendations of the Design & Construction and Products & Materials committees in this report. This same, or a separate project, should develop new building code provisions to accelerate the implementation of improved IEQ. Lastly, it is recommended that a project be organized to develop guidelines for the design of an "ideal space" for people with MCS and EMS. The recommended follow-up projects should involve collaborative effort and funding from a range of organizations across the building community; e.g., American Institute of Architects (AIA), Associated General Contractors of America (AGC), Building Owners & Managers Association International (BOMA), American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Environmental Protection Agency (EPA), and, of course, the Access Board.

Steering Committee

Nicolas Ashford, Massachusetts Institute of Technology
Kathy Barcus, Clarke Construction Company, Inc.
Marilyn Golden, Disability Rights Education and Defense Fund (DREDF)
Harry Gordon, Burt Hill Kosar and Rittelmann Associates
Mark Jackson, Lennox Industries, Inc.
Brent Kynoch, Kynoch Environmental Management, Inc.
Mary Lamielle, National Center for Environmental Health Strategies
Ann McCampbell, Multiple Chemical Sensitivities Task Force of New Mexico
Claudia Miller, University of Texas Health Sciences Center - San Antonio
Susan Molloy, National Coalition for the Chemically Injured
Roger Morse, Morse Zentner Associates
Larry Perry, Building Owners and Managers Association
Bruce Small, Building Inspections
Toni Temple, Ohio Network for the Chemically Injured
James Wasley, University of Wisconsin-Milwaukee

James Raggio, Access Board
Alexander Shaw, National Institute of Building Sciences

Some cleaning products also contain disinfectants. The U.S. EPA notes that one major concern from a health standpoint is the increased incorporation of antimicrobial agents and fragrances in cleaners and air fresheners marketed to reduce indoor air contamination (1).

Many commonly used disinfectant or sanitizer products contain chlorine, phenol, quaternary ammonium compounds, and isopropyl and other alcohols. These produce hazardous fumes and present access barriers for people with chemical sensitivities.

Electromagnetic Fields

For people who are electromagnetically sensitive, the presence of cell phones and towers, portable telephones, computers, fluorescent lighting, unshielded transformers and wiring, battery re-chargers, wireless devices, security and scanning equipment, microwave ovens, electric ranges and numerous other electrical appliances can make a building inaccessible.

The National Institute for Occupational Safety and Health (NIOSH) notes that scientific studies have raised questions about the possible health effects of EMF's. NIOSH recommends the following measures for those wanting to reduce EMF exposure – informing workers and employers about possible hazards of magnetic fields, increasing workers' distance from EMF sources, using low-EMF designs wherever possible (e.g., for layout of office power supplies), and reducing EMF exposure times (11).

Renovation/Remodeling/Furniture

Many new building materials, such as paints, adhesives, wallboard, carpet, and insulation, as well as upholstered furniture, particleboard cabinets, and other furnishings emit hazardous volatile organic compounds (VOC's), contribute to poor indoor air quality (IAQ) and create significant access barriers for people with asthma and/or chemical sensitivities. These materials often outgas and are problematic for prolonged periods of time.

Smoke & Combustion

Many people with asthma and most people with chemical sensitivities are made sick by exposure to: 1) smoke, such as that from tobacco, fireplaces, candles, incense, and barbeques, and other outdoor fires, 2) vehicle and other engine exhaust, especially exhaust from vehicles using diesel or oxygenated fuel, and 3) combustion appliances burning kerosene, propane, or natural gas (natural gas usually being better tolerated than kerosene or propane). If combustion appliances are used, they should be directly vented to the outdoors. Electrical appliances are preferred by people with chemical sensitivities.

Noise & Vibration

Noise and vibration from HVAC systems, vacuums, pumps, helicopters and other sources can trigger severe symptoms, including seizures, in susceptible individuals.

Synergistic Effects of Indoor Air Pollutants

Indoor air is a "chemical soup" made up of a variety of chemicals emitted by building materials, cleaning products, pesticides, personal care and consumer products, emissions from building equipment and activities, etc. While individual chemicals may be hazardous, combinations of chemicals can be even more hazardous through additive or synergistic effects. Synergistic effects

RECOMMENDED ACTIONS FOR FACILITY MANAGERS AND OPERATIONS & MAINTENANCE STAFF

The O & M Committee identified pesticides (indoors & outdoors), fragrances (especially fragrance-emitting devices/FEDS, air fresheners, and deodorizers), and volatile cleaners (including citrus & pine) as the biggest access barriers for people with chemical sensitivities related to operations and maintenance of a building. Cell phone use was identified as a significant barrier for people with electromagnetic sensitivities.

The Committee developed recommendations for making buildings more accessible for people with chemical and/or electromagnetic sensitivities in the areas of pest control, cleaning & disinfecting, mechanical / HVAC, landscape maintenance, and enclosure maintenance. They are listed in bullet form in the Appendix and summarized in the body of the report below.

In addition, recommendations are given for renovation, remodeling, and furnishings and for adoption of polices on smoking, fragrances, cell phone use, notification of building activities, and vehicle idling.

The Committee recognizes that the list of recommendations is long and that few buildings will be able to implement all of them. The recommendations are the ideal goal towards which to strive. Any steps taken to reduce the levels of the problematic substances or conditions listed above will improve access for people with chemical and/or electromagnetic sensitivities and create a healthier building.

Some of the recommendations will not apply to certain types of buildings or geographic areas. The recommendations are given in sufficient detail to help those who need to address a specific issue. Resources from which to obtain more information or guidance are also provided in the Appendix and at the end of the document in Additional Resources.

Recommendations for Pest Control

Adopt an Integrated Pest Management (IPM) program for building interiors and grounds as described in "Healthy Hospitals, Controlling Pests Without Harmful Pesticides" (17). The Los Angeles Unified School District also has an exemplary plan for an IPM program (18).

IPM is a program of prevention, monitoring, record-keeping, and control that eliminates or drastically reduces the use of pesticides. The focus of IPM is to prevent pest problems by reducing or eliminating sources of pest food, water, and shelter and by maintaining healthy lawns (19) and landscapes.

The first approach in controlling a pest outbreak is to improve sanitation, make structural repairs (such as fixing leaky pipes and caulking cracks), and using physical or mechanical controls such as screens, traps, vacuums, and mechanical weed cutters. Increased sanitation measures include more frequent trash removal, restricting eating to designated areas, securing trash container lids, and steam cleaning trash containers. The IPM approach uses knowledge of a pest's biology, habitat, and needs to time specific interventions to prevent and control pests. A least hazardous chemical is used only when other strategies have failed.

Pesticide use is discouraged in a true IPM program. If pesticides are used indoors or outdoors, however, the following precautions should be taken -- notification of applications (even for "spot" or crack & crevice treatments) should be given through posting of signs (before, during, and after applications) and by other means to building occupants, especially those on a pesticide notification

GENERAL RECOMMENDATIONS

Indoor Air & Environmental Quality Program

The O & M Committee recommends that facilities adopt an Indoor Air & Environmental Quality Program (IAQ/IEQ) to promote practices that prevent or reduce the contamination of indoor air, thereby contributing to a safe, healthy, productive and comfortable environment for building occupants. Benefits of good IAQ/IEQ may include improved health of occupants, decrease in the spread of infectious disease, protection of susceptible populations, increased productivity of occupants, improved relationships/fewer complaints, reduction in potential building closures (due to unhealthful conditions), less deterioration of buildings and equipment, reduced maintenance costs, and decreased liability and risk (22).

An IAQ/IEQ Program should include the maintenance of a log that records building problems and health complaints reported by building occupants.

Policies

The O & M committee recommends the following policies be adopted in commercial and public buildings:

No Smoking Policy

It is recommended that smoking be prohibited inside buildings. Smoking should be restricted to designated outdoor smoking areas that are 100 feet from paths of travel, entryways, operable windows, and air intakes.

Fragrance-Free Policy

It is recommended that a fragrance-free policy include prohibition of fragrance-emitting devices (FEDS) and sprays; use of fragrance-free maintenance, laundry, paper and other products; restrictions on perfume, cologne, and other scented personal care products used by employees, visitors, and other occupants; and prohibitions on use of potpourri and burning incense and scented candles.

An important first step is educating staff and others about the need for and benefits of reducing or eliminating the use of fragranced products.

Resources

No Scents Makes Sense brochure, Lung Association of New Brunswick:
http://www.nb.lung.ca/pdf/NoScentsMakeSense.pdf

Guidelines on Wearing Scented Products and We Share the Air posters, University of Waterloo, Ontario, Canada, www.safetyoffice.uwaterloo.ca/hspm/hspmm_intro/safety_manual_index.htm, (under 12. Hygiene).

See "Steps for Implementing a Scent-free Policy in the Workplace" in Additional Resources.

Cell Phone Use Policy

It is recommended that cell phone use be prohibited in areas of a building when requested by an electromagnetically sensitive individual who needs to work or visit that area. Also, see information on use of a Cleaner Air Symbol in the Designated Cleaner Air Room report.

Notification Policy

It is recommended that facilities adopt a posting and notification policy to notify staff, visitors, and other building occupants of pesticide applications, cleaning and maintenance activities, renovation and construction, and other activities that may produce hazardous fumes or dust.

Vehicle Idling Policy

It is recommended that facilities limit or prohibit idling of vehicles, especially diesel vehicles, near entryways, loading docks, operable windows, and air intakes (23).

Recommendations for Future Actions

1. The O & M Committee recommends that the U.S. Access Board sponsor a meeting with stakeholders, including architects, building owners and managers, government officials, scientists, advocates, sensitive and vulnerable individuals, and others to evaluate the recommendations of this report (Operations & Maintenance). This meeting should provide a forum for increasing awareness of the report, facilitating dialogue among stakeholders, assessing the feasibility of the recommendations, and identifying ways to advance the recommendations.

2. The recommendations on cleaning products and practices in this report are based on information that is currently available. The O & M committee found that much more information and research is needed to better define cleaning products and practices that are effective and that will best protect occupant health. Some of the data gaps or problems the Committee identified are lack of information on labels and Material Safety Data Sheets, lack of information on fragrance ingredients combined with incomplete information on their health effects, and safety questions about citrus- and pine-based cleaning products because, among other things, they react with ozone to produce hazardous byproducts.

We, therefore, recommend that the U.S. Access Board and/or NIBS, in conjunction with U.S. EPA and other stakeholders, sponsor a workshop to examine existing information on cleaning products and practices, identify those products and practices that have the least adverse impact on indoor environmental quality and occupant health (including impacts on sensitive and vulnerable individuals), develop best practices, and determine research needs.

National Institute of Building Sciences (NIBS)
Indoor Environmental Quality (IEQ) Project
Designated Cleaner Air Rooms Committee

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INTRODUCTION AND OVERVIEW

Individuals with multiple chemical and/or electromagnetic sensitivities have identified the availability of designated cleaner air rooms and paths of travel in public and commercial buildings as highly important for improving access. The Designated Cleaner Air Rooms Committee examined the rationale for having Designated Cleaner Air Rooms, the types of

buildings or occupancies that may be appropriate for having such rooms, the minimum criteria for such a designation, and who would benefit from having these rooms.

Promising Practices

In November 2001 the State of California adopted a Cleaner Air Symbol and Conditions of Use in its building code to identify areas in publicly funded or leased facilities owned by the State of California that are accessible to and useable by people who are adversely impacted by airborne chemicals or particulate(s) and/or the use of certain electrical fixtures or devices.(1) The symbol can be used when minimum conditions established in the code are met. Use of the designation is voluntary.

A fact sheet on the California Cleaner Air Symbol and Criteria can be found at:
http://www.documents.dgs.ca.gov/dsa/pubs/cleanerair_factsheet.pdf

See 1117B.5.11 Cleaner air symbol (page 109) of the California Code of Regulations for the code language: (see Appendix A)
www.documents.dgs.ca.gov/dsa/pubs/regulations_02-16-05.pdf

Recommended Actions

The Committee was charged with

1) reviewing the California symbol and criteria and investigating where it has been implemented, how it has worked, and what modifications and improvements, if any, are necessary to recommend broader usage;

2) developing and promoting a national Cleaner Air Symbol and Conditions of Use as appropriate; and

3) defining the scope of guidelines for creating an ideal zone (room and path of travel) hereafter referred to as a Clean Air Room in buildings for people with chemical and/or electromagnetic sensitivities.

During the project, the scope of work was expanded to include a brief discussion of accommodations for people with multiple chemical and/or electromagnetic sensitivities to address the needs of those individuals for whom a Cleaner Air Room would not provide adequate access or for those situations when such a designation would not be possible or feasible. Resources that address access and accommodations for people with multiple chemical and/or electromagnetic sensitivities at work, at school, at public meetings, and in hospitals are included at the end of this report.

Committee Recommendations

- The Committee highly recommends that the Access Board and/or the National Institute of Building Sciences (NIBS) fund or seek funding for FY2006 to develop specifications for designing and constructing a Clean Air Room and Path of Travel, the ideal or model room. This project is a natural outgrowth of the work of the other three committees.

- The Committee proposes a Pilot Project for FY2006 to implement a national Cleaner Air Symbol, as promulgated by the State of California, and Conditions of Use, as modified in the National Cleaner Air Signage, Conditions of Use section below, in

select public and commercial buildings such as independent living centers, disability organizations, schools and other educational institutions, public meeting places, or other business or government entities. The Committee recommends that one or more committee members in conjunction with the Access Board and/or the National Institute of Building Sciences assist in its implementation, track its use, analyze how well it has worked, and determine whether modifications or improvements are necessary prior to recommending promotion nationally. This same group would also examine implementation of the California Signage which is expected to take place during the same time frame.

- The Committee recommends that the Access Board, or a committee created by the Board, identify, review, summarize, and publish best practices for accommodations for people with multiple chemical and/or electromagnetic sensitivities on the website. Such a project was previously proposed by Access Board officials and discussed with members of this Committee but was not part of the charge of the current project.

NATIONAL CLEANER AIR SIGNAGE

Background:
In November 2001 the State of California adopted the California Cleaner Air Symbol, California Building Code, Title 24, Parts 2 and 12, 1117B.5.11ff., which established a symbol and criteria for conditions of use to identify a room, facility, and paths of travel that are accessible to and useable by people who are adversely impacted by airborne chemicals or particulate(s) and/or the use of electrical fixtures and/or devices. Installation and use of the Cleaner Air Symbol is on a voluntary basis in state buildings. The Committee learned that the Cleaner Air Symbol has yet to be implemented in California although members of our group are aware of individuals in California and in other states who are using the symbol as a means of advocating for or obtaining individual access needs.

The California Cleaner Air Symbol and Conditions of Use were also proposed for adoption at the meeting of the Accredited Standards Committee A117 on Architectural Features and Site Design of Public Buildings and Residential Structures for Persons with Disabilities in December 2001.(2) The Cleaner Air Symbol received a favorable vote. It was later dropped prior to the issuance of the final standard in 2003: International Code Council, American National Standard-Accessible and Useable Buildings and Facilities, ICC/ANSI A117.1-2003. The Cleaner Air Symbol is expected to be reintroduced for consideration during a new standard cycle that will begin shortly. The Standard must be adopted by a state or locality to be enforceable.

The Committee also discussed the identification of state buildings in California that might qualify for the Cleaner Air Symbol either due to a building's unique ability to meet the implementation criteria, or the need to make public meeting rooms accessible for those with chemical and/or electromagnetic sensitivities. Committee members are also aware of the need to encourage residents of California who may need to access state buildings to seek to implement the Cleaner Air Symbol.

Purpose:
To provide voluntary guidelines for a Cleaner Air Symbol that can be used nationally or adapted for state and local use.

Proposed Language:

National Cleaner Air Symbol: The national symbol shall be the standard used to identify a room, facility, and paths of travel that are more accessible to and useable by people who are adversely impacted by airborne pollutants, such as those with chemical sensitivities, asthma, and other respiratory conditions, and/or people who are adversely impacted by electromagnetic fields from electrical fixtures and equipment such as those with electromagnetic sensitivities.

The Symbol will comply with the specifications as described in the California code.
When the Cleaner Air designation symbol is used, the following requirements must be met:

- The symbol and text, "Cleaner Air" is displayed within a minimum 6-inch square;
- The "Cleaner Air" text is located under the symbol, as shown
- The Cleaner Air Symbol is shown as either a negative or positive image.
- The symbol and text are posted in either black and white, or in Federal Blue and white. When blue is used, Federal Blue Color No. 15090, Federal Standard 595B, is used.
- There is at least a 70% color contrast between the backgrounds of the sign and the surface that it is mounted on.

Conditions of Use
The Cleaner Air Symbol may be posted to identify the room and path of travel if there is verification that the room, facility, and path of travel to the room meet all of the Cleaner Air Requirements as indicated below:

- No Smoking
- Fragrance-Free
- Pesticide-Free (Indoors and Outdoors)
- Least Toxic/Risk Cleaning Products
- No Recent Construction or Remodeling Including Carpet Installation
- Cell phones turned off
- Ability to turn off or unplug computers and other electrical equipment by occupant or staff
- Ability to turn off fluorescent lighting by occupant or staff
- Ability to adjust temperature and air flow by occupant or staff, or the availability of operable window(s)

Paths of Travel

Every effort should be made to make the Paths of Travel as accessible as possible for those with multiple chemical and/or electromagnetic sensitivities even though the paths of travel might not meet all of the criteria of the Cleaner Air Room. It is important that the Path of Travel from the building entrance to the Cleaner Air Room be as short as possible. The building entrance should also be fully accessible to those with mobility and other impairments.

Restrooms

If possible, restrooms that are already fully accessible to those with mobility and other impairments should be designated for use by those individuals using the Cleaner Air Room. These restrooms should be located along the path of travel or as close as possible to the Cleaner Air Room. The restrooms should meet as many of the criteria as possible. The restrooms should prohibit smoking and be free of perfumes, fragranced products, air fresheners, deodorizers, and pesticides. Cleaning should be done with the same least toxic products used in the Cleaner Air Room. Cell phones should be turned off along the path of travel and in the restrooms.

In the event of a chemical pesticide application made to the building or grounds, other than a least hazardous pesticide such as those listed above, remove the sign and consult with those who use the space and others regarding the length of time that the room would need to be closed to protect affected populations based on the product(s) used. (See Operations and Maintenance for least hazardous pest management materials and cautions in the event that a chemical pesticide application is considered for use in the Cleaner Air Room, Path of Travel, Restrooms, or the building or grounds.)

Least Toxic/Risk Cleaning Products:
Avoid or limit the use of products containing chlorine, ammonia, quaternary ammonium, phenol, isopropyl and other alcohols, formaldehyde, and other petroleum distillates. Do not use fragranced, citrus-and/or pine-based cleaning products as mentioned above. Consult those who plan to use the Cleaner Air Room and Path of Travel for cleaning product recommendations. Follow the recommendations of Operations and Maintenance Report for best practices.

No Recent Construction or Remodeling Including Carpet Installation:
Every effort should be made to avoid remodeling activities in the Cleaner Air Room, path of travel, and restrooms. Any remodeling activity would require removal of the signage. The length of time for removal should be determined by the type of activity, extent of the remodeling, and the products and materials selected for use. It is important to choose the least toxic, least problematic products and practices. Except for minimal touch up painting, for example, it would not be unusual to have the signage removal in effect for a period of 3- 6 months to a year or more depending on the nature and extent of the remodeling activity. Be sure to consult building occupants with existing health problems and those who are using the Cleaner Air Room for their input and to help determine when the Cleaner Air Room may again be safe for use. (See Products and Materials Report and Design and Construction Report for more information)

Cell Phones Turned Off:
Protect those with electromagnetic sensitivities and others who may be adversely affected by electrical equipment.

Ability to turn off or unplug computers and other electrical equipment by occupant or staff:
Protect those with electromagnetic sensitivities and others who may be adversely affected by computers and electrical equipment.

Ability to turn off fluorescent lighting by occupant or staff:
LEED (Leadership in Energy and Environmental Design) recommendations for new construction call for individual control of lighting.(3) Newer fluorescents that contain electronic rather than magnetic ballasts may be less problematic for some people with electromagnetic sensitivities because they do not produce a visible flicker or audible hum. They are also less prone to trigger seizures.

Ability to adjust temperature and air flow by occupant or staff, or the availability of operable window(s):
LEED recommendations for new construction include individual control of temperature and ventilation.(3) Opening an operable window may improve the air quality or air flow in a Cleaner Air Room and compensate for situations when individual control of temperature and air flow is not possible.
The text below is duplicated on the website

*****

RECOMMENDATIONS FOR ACCOMMODATIONS

People with chemical and/or electromagnetic sensitivities can experience debilitating reactions from exposure to extremely low levels of common chemicals such as pesticides, cleaning products, fragrances, and remodeling activities, and from electromagnetic fields emitted by computers, cell phones, and other electrical equipment.

The severity of sensitivities varies among people with chemical and/or electromagnetic sensitivities. Some people can enter certain buildings with minor accommodations while others may be so severely impacted that they are unable to enter these same spaces without debilitating reactions. Furthermore tolerances to specific exposures can vary greatly from one individual to the next. Meanwhile some exposures, such as the application of certain pesticides or extensive remodeling, for example, may be devastating to all chemically sensitive people and make a building or facility inaccessible for a substantial period of time.

According to the Americans with Disabilities Act (ADA) and other disability laws, public and commercial buildings are required to provide reasonable accommodations for those disabled by chemical and/or electromagnetic sensitivities. These accommodations are best achieved on a case-by-case basis.

Reasonable accommodations for a chemically sensitive and/or electromagnetically sensitive individual can include providing a space or meeting area that addresses one or more of the Cleaner Air criteria, upon request, such as

- Remove fragrance-emitting devices (FEDS)
- Delay or postpone indoor or outdoor pesticide applications, carpet cleaning, or other cleaning or remodeling until after the meeting
- Provide room or meeting area near exterior door or with window(s) that can be opened
- Require cell phones and computers be turned off
- Provide incandescent lighting in lieu of fluorescent lighting
- Provide at least one nonsmoking, fragrance-free person per shift to provide services (e.g. nurse, police officer, security guard, clerk)

For individuals who are unable to use or meet in a building or facility, or who are too severely impacted by chemical and/or electromagnetic exposures to use a designated Cleaner Air Room, accommodations may include:

- Meet an individual at the door or outside to conduct business
- Allow a person to wait outside or in car until appointment
- Provide a means, such as a phone, intercom, bell, or buzzer to summon staff to an outside door for assistance
- Permit business to be conducted by phone, fax, mail, or e-mail rather than in person
- Allow participation in a meeting by speakerphone

End duplicated text

SPECIAL ACKNOWLEDGEMENT: The Committee extends a generous thank you to Sharon Toji, Access Communications, for designing the Cleaner Air Symbol and making it available for public use.

INTRODUCTION

The Building Design & Construction Committee was charged with making recommendations for designing commercial and public buildings that would be more accessible for people with multiple chemical and/or electromagnetic sensitivities and provide healthier environments for all occupants.

The Committee found that major access barriers for chemically sensitive individuals are factors that contribute to poor air quality, such as pesticides, new carpets, tobacco smoke, inadequate ventilation, mold, certain building materials, and building activities that generate air pollutants. For electromagnetically sensitive individuals, access barriers include fluorescent lighting, unshielded transformers and wiring, security and scanning equipment and numerous other electrical appliances.

The recommendations that follow, therefore, focus on minimizing or eliminating these barriers through designing

- for pest prevention to reduce the need for or the use of pesticides,
- for preventing moisture and mold growth,
- for optimum ventilation via HVAC systems and operable windows,
- for exhausting air contaminants,
- for minimizing use of carpet and other flooring that emit volatiles, and
- for shielding occupants from electromagnetic fields.

Although many building materials can be problematic for chemically sensitive people, the Committee made minimal suggestions regarding product choices as this was the charge of the Building Products and Materials Committee.

Recommendations for Future Actions

The Committee recommends that the Access Board, NIBS, or other entity create a Design Manual using the outline in this report. This Manual would provide more detailed guidance than is provided here.

The Committee acknowledges that while the scientific evidence may be inconclusive about whether ambient electromagnetic fields pose a substantial health risk to the general population, the presence of EMF is an access barrier for people who are electromagnetically sensitive. Therefore, the Committee recommends that measures be taken to reduce EMF whenever possible in order to increase access for these individuals as well as taking a precautionary approach to protecting the health of all.

- Operable windows are preferred. Being able to open windows is an important access issue for chemically sensitive individuals and can be beneficial for other occupants in certain situations. Operable windows should be detailed to minimize air infiltration.

Design to prevent pest problems. (Appendix 3)

- Use inert pest resistant materials. When treatment of wood is required, treating with disodium octaborate tetrahydrate may be among the safer options.
- Incorporate pest barriers such as termite shields, window screens, and bird screens in construction details. Bird and bat droppings pose great IAQ risks.
- Some pesticides such as boric acid are considered environmentally safe. If used, granular or gel forms are preferred. Care should be taken to ensure that particles do not infiltrate interior habitable space.

Shield occupants from external sources of EMF. Windows with low e glazing, metal roof, and siding components may reduce certain interior EMF. (Reference 2)

Roof Design

- Pitched roofs are preferred, because they shed water quickly, clean the roof of pollutants and potential toxins, and are less prone to leakage.
- Inert roofing materials, such as coated metal or clay tile, are ideal. Note that galvanized metal presents a rust hazard and should be avoided.
- Flat roofs are not preferred. If used, membrane and high albedo (highly reflective to heat) type are recommended. Asphalt or modified bitumen built-up roofs are less preferable. (Reference 3)

Wall Design

- Use best design practices to prevent moisture and condensation within walls. Calculate dew points for each exterior wall (and roof) type to verify performance at each condition. Provide detail for all flashing and counter-flashing locations.

Foundation Design

- Provide under-slab vapor barriers, insulation, and damp-proofing to prevent moisture infiltration and condensation.

Protect stored building materials from water damage and mold growth.

Avoid use of water-damaged or mold-affected materials.

Plumbing, Mechanical and Electrical Equipment

Properly insulate pipes to prevent condensation, especially within walls.

Use modeling software to determine airflow and to ensure isolation of pollutant sources and adequate ventilation.

Ventilate areas occupied by people with chemical sensitivities with goal of eliminating odors (ideally entire building). These ventilation rates meet or exceed all worldwide standards. (Reference 4)

Provide local control of temperature and airflow (ideally for every occupant). (Reference 5)

Utilize Displacement Air Distribution method to move pollutants away from occupants.

Dedicate building as Smoke-Free. (Reference 6)

Isolate mechanical equipment from occupied areas.

Provide direct exhaust from rooms and areas that have pollutant-generating sources or activities. These include but are not limited to: (see Appendix 5)

- Bathrooms (code requirement).
- Kitchens or office kitchenettes (this is in addition to code-required hoods or stove exhausts).
- Copy and print rooms.
- Computer rooms.

Ductwork

- Avoid insulation inside ductwork. Use external insulation wrap of non-friable (airborne particle creating) material.
- Oil coatings used in fabrication of sheet metal stock can affect air quality. Prior to installation, thoroughly clean ductwork with a low VOC product. Use methods that do not leave residue or cause oxidation. (Reference 7)

Prohibit the use of fragrances and disinfectants in air distribution systems.

Maintain relative humidity between 30%-50%.

Locate outside air louvers away from pollutant sources.

Filtration (Reference 8)

- Carbon and HEPA filters are preferred.
- Avoid ozone generating air-purification systems.
- Avoid electrostatic air cleaning due to ozone.

In renovation work, re-evaluate HVAC system performance to ensure that original design standards are met.

Shield occupants from internal EMF. Design electrical systems to minimize EMF. Maximum recommended magnetic field levels of 2.5 milligauss (preferably 1 milligauss in occupied areas) and as low as technically achievable in areas to be occupied by people with sensitivities.

Finishes and Furnishings

Refer to Products and Materials Group report for specific recommendations on materials.

Floor Coverings

- Use inert materials wherever possible, such as, but not limited to:
  - Stone, tile, terra-cotta, brick, ceramic tiles,
  - Terrazzo,

APPENDICES

Appendix 1 - Site Selection: Potential Sources of Pollutants and EMF.

The Committee recognizes that few, if any, building sites are likely to be free of all the pollutant sources listed below. The recommendation is to minimize proximity to as many of these sources as possible in order to maximize outdoor environmental quality and hence indoor environmental quality.

Table A-1 Potential Sources of Pollutants and EMF

General (Air, Soil)	Engine Exhaust	Pesticides	Industrial/ Commercial	EMF
Recognized area of poor air quality Smog Smoke (chimney, industrial, etc.) Superfund Sites Brownfields Landfills Hazardous waste sites Compost sites Underground storage tanks Floodplains Wetlands Filled-in wetlands Military bases	Heavy traffic Highways Interstates Diesel exhaust Airports	Agriculture (unless organic) Golf courses Mosquito spraying Parks & Forests Roadside spraying Dairies Chicken & hog farms Other intensive livestock operations	Refineries Mines Chemical plants Cement plants Power plants Manufacturing Logging/Pulp mills Incinerators Sewage treatment plants Gas stations Dry cleaners Other commercial sources that emit air pollutants (See Appendix 5 on Use and Occupancy)	Substations Cell phone towers Radio towers Transponders Transformers High tension lines Electrical distribution lines Radar installations Military bases Airports Electrical Transportation Power-generating dams

Appendix 2 - Roof Gardens

Roof gardens involve a range of potential issues related to moisture penetration and mold growth. Flat roofs are prone to pooling water and leaking. Foot traffic can cause or accelerate deterioration leading to leaking. Roof repair is more difficult under gardens. Plants may attract pests that subsequently encourage pesticide use. Planting soils can create dust. Plants can emit volatile fumes and pollen. Plants can drop leaves and fruit that rot and become moldy. Selected plants should be low allergen plants without strong fragrance (See Exterior Landscaping above). If used, roof gardens should be located away from air intakes, operable windows, and doors. Design should ensure that moisture will not penetrate the roof membrane or cause conditions of standing water.

REFERENCES

Reference 1

ASHRAE Fundamentals Handbook, 2001, 25.19:

http://www.infiltec.com/inf-larg.htm

http://www.argonair.com/pdf/Myth%20About%20Bldg%20Env.pdf

Reference 2

P.Levallois, et al., "Prevalence and Risk Factors of Self-Reported Hypersensitivity to Electromagnetic Fields in California" and "An Evalutaion of the Possible Risks from Electric and Magnetic Fields (EMF) From Power Lines, Internal Wiring, Electrical Occupations and Appliances."
http://www.dhs.ca.gov/ps/deodc/ehib/emf/RiskEvaluation/Appendix3.pdf.

Case study for EMF control (Research Triangle)

http://www.ncgreenbuilding.org/site/ncg/public/show_project.cfm?project_id=120

"EMF reduction: The team reviewed available literature on EMF and their threat to health and determined that while EMF radiation could be measured, its threat to humans had not yet been proven or disproved. Nevertheless, the team recommended adopting a philosophy of prudent avoidance toward EMF risks and undertook modifications of the building design to reduce occupant exposure. EMF radiation can be mitigated by distance and by shielding. Distance offers maximum protection and is "low-tech," while the costs associated with shielding are high and the results are difficult to measure. Consequently, the design team chose to create "buffer zones" to reduce prolonged exposures in portions of the building that are occupied for long periods of time, such as the laboratories and offices. The largest sources of EMF were identified as the building's transformers, the electrical rooms with their many cables, and the electrical conduit that was routed under the building atria. As a first step circulation and utility spaces were used to maximize the separation between a source and any potential receptors."

Reference 3

Fumes from activities involving the installation and repair of modified bitumen roofs.

http://environmentalchemistry.com/yogi/chemicals/cn/Asphalt%A0fumes.html

Reference 4

Chapter 59, Indoor Air Quality Handbook CFD (Computational Fluid Dynamics) Method for indoor Air Quality Studies. Qingyan Chen, Leon Glicksman, MIT

EXHIBIT C

SMART METER OPT OUT SURVEY (Compiled by Dr. Laura Murphy)

This exhibit can be checked online to verify its contents. All the docket numbers are there. All the information is there.

United States 2018 State Smart Meter Opt-Out Survey with Authorities

This state smart meter opt-out survey is up to date as of August 1, 2018, using information that is publicly available on the internet.

Background:

1. Smart meter opt outs take three general forms:

    a. State legislation mandating smart meter opt outs.

    b. State public utility commission regulations mandating smart meter opt outs.

    c. State public utility commission orders approving opt outs and opt out tariffs for different utilities in their smart meter filings.

2. For several states that are new to smart meter deployment, we were unable to find state mandates, public utility regulations or tariffs regarding opt out filings, so we left those states blank, because we could find no references to smart meter opt out or to mandatory smart meter deployment for residential households.

3. If we were able to find at least one utility in the state which permits smart meter opt outs, we listed that state as a "YES", because obviously, there is at least the possibility of opting out of smart meter deployment in that state.

4. All cited authorities in this survey are compiled and available in full format following this link: https://www.ehs.group/

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States which have considered smart meter harm	Opt Out?	DATE	Authority
Alabama			
Alaska			
Arizona	YES	12/18/2014	Arizona Corporation Commission Decision No 74871 Docket No E-01345A-13-0069
Arkansas	YES	10/30/2017	Arkansas PSC ORDER 8: DOCKET 16-060-U (Entergy AMI metering application)
California	YES	2/1/2012	CA PSC smart meter opt out order 12-02-014.
Colorado			
Connecticut			
Delaware			
Florida	YES	1/7/2015	Florida PSC order PSC-15-0026-FOF-EI, Docket 130223-EI
Georgia	YES	12/17/2013	"Smart Meter Q & A - Georgia Public Service Commission On December 17, 2013 the Commission approved a Smart Meter Opt-Out tariff as part of Georgia Power's 2013 rate case. Customers who opt out of having a smart meter installed and prefer to maintain a mechanical meter at their residence or facility can now do so with a basic service charge of $19 per month." Georgia Public Service Commission Docket # 36989

Hawaii	YES	2013	Kauai Island Utility Cooperatives opt out; August 2017 smart meter opt in only: Hawaiian Electric
		8/29/2017	Maui Hawaiian Electric proposes opt in only
		2/7/2018	Hawaii PUC Order No 35268 Docket 2017-0226
Idaho	YES	2015	Idaho Falls response to CRC opt out recommendations #6.4
Illinois	YES	2/5/2014	Illinois Commerce Comm. Com Ed Opt Out Order 13-0552
Indiana	YES	6/13/2018	Indiana Utility Reg Comm Order Cause 44963
Iowa	YES	pre 2018	Alliant Energy filings with Iowa Utilities Bd allow opt outs from AMI Meters.
Kansas			
Kentucky	YES	4/13/2016	Kentucky PSC Order case 2012-00428
Louisiana	YES	October 2012	Lafayette Utility System smart meter opt out tariff approved by City-Parish Council
Maine	YES	5/19/2011 6/22/2011	Maine PUC Part I Opt Out Order, Opt Out Order.
Maryland	YES	1/7/2013	Maryland Public Service Commission Order No. 85294 Cases no 9207, 9208, 9294
Massachusetts	YES	2014	Massachusetts Dept of Public Utilities tariff 13-83-A
Michigan	YES	6/28/2013	Michigan PSC Decision Case No. U-17087
Minnesota	YES	as of August 2018	Connexus Energy Opt out form

Mississippi	YES	5/17/2017	PSC Order docket 2016-UA-261
Missouri	YES	2018	Missouri City Utilities AMI Opting Out information, City Utilities website 2018
Montana			
Nebraska			
Nevada	YES	2/4/2013	Nevada PUC Docket No. 12-05003
New Hampshire	YES	6/7/2012	NH Cons Stat. Title 34 Ch. 374 section 374-62
New Jersey			
New Mexico	YES	4/11/2018	NM Public Reg Comm. Final Order, Case No. 15-00312-UT
New York	YES	10/19/2017	NY PSC Order Case no 14-M-0196
North Carolina	YES	6/22/2018	North Carolina Utilities Commission Order in Docket No. E-7, SUB 1115; Docket No. E-100, SUB 147; DOCKET No. E-100, SUB 153
North Dakota			
Ohio	YES	4/27/2016	OHIO PUC Order re Duke Energy Opt Out case numbers 14-1160-EL-UNC
Oklahoma	YES	7/1/2018 5/1/2017	Okla. Corp Comm. Order No. 679358, Docket No. PUD 201700496 Okla. Corp Comm. Order No 662059, Docket No. PUD 201500273

Oregon	YES	3/21/2017	PUC PACIFICORP, d/b/a PACIFIC POWER Order No. 17-113
Pennsylvania	NO	5/3/2018 6/14/2018	PUC final decision C-2015-2474602 PUC final decision C-2015-2475355
Rhode Island	YES	2/1/2013	RI PUC Case No. 2130
South Carolina	YES	11/17/2016	SC PSC DOCKET NO. 2016-354-E - ORDER NO. 2016-791
South Dakota			
Tennessee	YES	August 2012	Cleveland Utilities offers opt outs
Texas	YES	8/9/2013	TEXAS PUC non standard meter service Project 41111 Rule PUC Regulations Section 25.133
Utah	YES	3/7/2017	Provo Municipal Council 17-043 AMI Opt Out Policy and fee request
Vermont	YES	5/18/2012	30 V. Stat. Ann. § 2811
Virginia	YES	5/14/2013	Dominion Energy smart meter opt outs: Dominion Energy website under "Location: Virginia"
Washington	YES	4/10/2018	Wash UTC docket U-180117 Policy Statement
West Virginia	YES	5/14/2013	Dominion Energy smart meter opt outs: Dominion Energy website under "Location: West Virginia"
Wisconsin	YES	11/1/2012	Order docket 5-WI-101 Wisconsin Public Service Commission
Wyoming	YES	12/23/2013	Wyoming PSC Docket No. 10012-59-CT-13 (Record No. 13658)

EXHIBIT D

American Academy of Environmental Medicine: Recommendations regarding Electromagnetic and Radiofrequency Exposures (July 12, 2012)

Entered into the Record by ALJ Heep in Lucey v. Metropolitan Edison Company C-2018-3003679 not for the truth of the matter but as a document reviewed and referenced by the complainant. It is an exception to the Hearsay rule.

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American Academy of Environmental Medicine Recommendations Regarding Electromagnetic and Radiofrequency Exposure

Physicians of the American Academy of Environmental Medicine recognize that patients are being adversely impacted by electromagnetic frequency (EMF) and radiofrequency (RF) fields and are becoming more electromagnetically sensitive.

The AAEM recommends that physicians consider patients' total electromagnetic exposure in their diagnosis and treatment, as well as recognition that electromagnetic and radiofrequency field exposure may be an underlying cause of a patient's disease process.

Based on double-blinded, placebo controlled research in humans,[1] medical conditions and disabilities that would more than likely benefit from avoiding electromagnetic and radiofrequency exposure include, but are not limited to:

- Neurological conditions such as paresthesias, somnolence, cephalgia, dizziness, unconsciousness, depression
- Musculoskeletal effects including pain, muscle tightness, spasm, fibrillation
- Heart disease and vascular effects including arrhythmia, tachycardia, flushing, edema
- Pulmonary conditions including chest tightness, dyspnea, decreased pulmonary function
- Gastrointestinal conditions including nausea, belching
- Ocular (burning)
- Oral (pressure in ears, tooth pain)
- Dermal (itching, burning, pain)
- Autonomic nervous system dysfunction (dysautonomia).

Based on numerous studies showing harmful biological effects from EMF and RF exposure, medical conditions and disabilities that would more than likely benefit from avoiding exposure include, but are not limited to:

- Neurodegenerative diseases (Parkinson's Disease, Alzheimer's Disease, and Amyotrophic Lateral Sclerosis).[2-6]
- Neurological conditions (Headaches, depression, sleep disruption, fatigue, dizziness, tremors, autonomic nervous system dysfunction, decreased memory, attention deficit disorder, anxiety, visual disruption).[7-10]
- Fetal abnormalities and pregnancy.[11,12]
- Genetic defects and cancer.[2,3,13-19]
- Liver disease and genitourinary disease.[12,20]

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Because Smart Meters produce Radiofrequency emissions, it is recommended that patients with the above conditions and disabilities be accommodated to protect their health. The AAEM recommends: that no Smart Meters be on these patients' homes, that Smart Meters be removed within a reasonable distance of patients' homes depending on the patients' perception and/or symptoms, and that no collection meters be placed near patients' homes depending on patients' perception and/or symptoms.

Submitted by: Amy L. Dean, DO and William J. Rea, MD

Approved July 12, 2012 by the Executive Committee of the American Academy of Environmental Medicine

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EXHIBIT E

Davis, Devra: Environmental Health Trust Research Letter to Staff at Teton National Park Re: Telecommunications Infrastructure Plan EA (April 10, 2019).

Entered into the Record by ALJ Heep in Lucey v. Metropolitan Edison Company C-2018-3003679 not for the truth of the matter but as a document reviewed and referenced by the complainant. It is an exception to the Hearsay rule.

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David Vela, Superintendent
Grand Teton National Park
John D. Rockefeller, Jr. Memorial Parkway

Re: Telecommunications Infrastructure Plan EA

Dear Mr. Vela & National Park Staff,

Environmental Health Trust (EHT) is a nonprofit Think Tank and policy organization dedicated to identifying and reducing environmental health hazards. EHT provides independent scientific research and advice on controllable environmental hazards to local, state and national governments. Today, we write to advise you of scientific grounds for major health and environmental concerns about the proposal for the installation of wireless telecommunications facilities and associated infrastructure at nine developed areas in the park and to express our grave concerns about this planned expansion of mobile communications in Grand Teton National Park. You may recall your discussions last year with me about the need to limit exposures to wildlife and fauna from wireless radiation that took place when we met as part of the City Kids final ascent of the Grand.

We fully recognize there is a need for communication for emergency purposes. We further recognize that the Park plays a unique role in our country and in our lives by providing a wilderness that is apart from the normal hectic life that many Americans lead today. We are deeply concerned that by expanding wireless communications this proposal will irrevocably impair the wilderness experience and that there are wired solutions that would be far less damaging.

The transmissions to and from these proposed microwave wireless installations will be emissions that are an environmental pollutant known to cause cancer (in both experimental animals and humans) and other adverse health and environmental effects (e.g., on birds, bees, trees) according to internationally recognized authoritative research, including studies conducted by the U.S. National Toxicology Program, which is the nation's premiere testing program.

In light of the scientific documentation showing harmful effects, EHT writes today to advise regarding technical scientific information on impacts to human health, wildlife and the environment, explaining why more than 240 expert scientists are calling for immediate reductions in exposures to microwave wireless radiation.

Documented Impacts to Wildlife and the Environment

We would like to make you aware that there is growing literature showing the adverse impacts of microwave radiation on animal and bird behavior and physiology, as well as plants and trees. As the Natural Resources Defense Council and the Public Employees for Environmental Responsibility have argued, an environmental impact

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assessment should be performed before building these networks. Peer-reviewed research links EMF emissions to myriad adverse environmental and health effects. Environmental effects include disruptions to reproduction, development, orientation, and migration of animals,[1], and damage to plants and crops.[2]

Albert Manville, former U.S. Fish and Wildlife Service agency lead on avian-structural impacts, wrote "A BRIEFING MEMORANDUM: What We Know, Can Infer, and Don't Yet Know about Impacts from Thermal and Non-thermal Non-ionizing Radiation to Birds and Other Wildlife"[3] documenting the body of research and concluding:

> "There is an increasing body of published laboratory research that finds DNA damage at low intensity exposures — well below levels of thermal heating — which may be comparable to far field exposures from cell antennas. This body of work would apply to all species, including migratory birds, since DNA is DNA, whether single-strand or double helix. The first study to find such effects was conducted by H. Lai and N.P. Singh in 1995 (Lai and Singh 1995). Their work has since been replicated (e.g., Lai and Singh 1996, as well as in hundreds of other more recent published studies), performed in at least 14 laboratories worldwide. The take-home message: low level transmission of EMF from cell towers and other sources probably causes DNA damage. The laboratory research findings strongly infer this relationship. Since DNA is the primary building block and genetic "map" for the very growth, production, replication and survival of all living organisms, deleterious effects can be critical."

Please note the following published research studies.

- "A review of the ecological effects of RF-EMF" 2013 review of 113 published studies found in 65% of the studies (50% of the animal studies and about 75% of the plant studies) RF-EMF had a significant effect on birds, insects, other vertebrates, other organisms and plants (Cucurachi 2013). The review paper cites development and reproduction in birds and insects as the most strongly affected endpoints.[4]

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[1] See, e.g., Kimmel, Stefan, et al. "Electromagnetic radiation: influences on honeybees (Apis mellifera)." *IIAS-InterSymp Conference*, 2007 (finding that 39.7% of the non-irradiated bees had returned to their hives compared to only 7.3% of the irradiated bees); Cucurachi, C., et al. "A review of the ecological effects of radiofrequency electromagnetic fields (RF-EMF)." *Environment International*, vol. 51, 2013, pp. 116–40; "Briefing Paper on the Need for Research into the Cumulative Impacts of Communication Towers on Migratory Birds and Other Wildlife in the United States." *Division of Migratory Bird Management (DMBM)*, U.S. Fish & Wildlife Service, 2009; Balmori, A. "Mobile phone mast effects on common frog (Rana temporaria) tadpoles." *Electromagnetic Biology and Medicine*, vol. 29, no. 1-2, 2010, pp. 31-5; Harkless, Ryan, Muntather Al-Quraishi and Mary C. Vagula. "Radiation hazards of radio frequency waves on the early embryonic development of Zebrafish." *SPIE Proceedings*, vol. 9112, 2014.

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- A 2012 Review "Impacts of radio-frequency electromagnetic field (RF-EMF) from cell phone towers and wireless devices on biosystem and ecosystem – A Review" on 919 research papers found 593 showed impacts, 180 showed no impacts, and 196 were inconclusive studies."[5]
- Studies on bees have found behavioral effects (Kumar 2011[6], Favre 2011[7]), disrupted navigation Goldsworthy 2009[8], Sainudeen 2011[9], Kimmel et al. 2007[10]), decreasing egg-laying rate (Sharma and Kumar, 2010[11]) and reduced colony strength after RF exposures (Sharma and Kumar, 2010, Harst et al. 2006[12]).
- A study focusing on RF from cellular antennas found increased sperm abnormalities in mice exposed to RF from GSM antennas (Otitoloju 2010).[13]
- "Exposure of Insects to Radio-Frequency Electromagnetic Fields from 2 to 120 GHz" published in Scientific Reports is the first study to investigate how insects (including the Western honeybee) absorb the higher frequencies (2 GHz to 120 GHz) to be used in the 4G/5G rollout. The scientific simulations showed increases in absorbed power between 3% to 370% when the insects were exposed to the frequencies. Researchers concluded, "This could lead to changes in insect behavior, physiology, and morphology over time…."[14]
- Researchers published a study on frogs in Electromagnetic Biology and Medicine exposing eggs and tadpoles to electromagnetic radiation from cell phone antennas for two months, from the egg phase until an advanced phase of tadpole and found low coordination of movements, an asynchronous growth, resulting in both big and small tadpoles, and a high mortality rate. The authors conclude, "these results indicate that radiation emitted by phone masts in a real situation may affect the development and may cause an increase in mortality of exposed tadpoles."[15]

We also want to bring your attention to the growing body of literature showing the impacts on trees and plants. Here again, experimental literature has found that rhizomes, nitrification and other critical processes to plant growth and health are affected by cell phone like radiation under controlled conditions. There have been over one hundred studies that have shown this and most recently a field study[16] that showed under controlled conditions, trees that are

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[5] S Sivani*, D Sudarsanam, Impacts of radio-frequency electromagnetic field (RF-EMF) from cell phone towers and wireless devices on biosystem and ecosystem – a review, Biology and Medicine, 4 (4): 202–216, 2012.

[6] Kumar, N. R., Sangwan, S., & Badotra, P. (2011). Exposure to cell phone radiations produces biochemical changes in worker honey bees. *Toxicology international, 18*(1), 70–72. doi:10.4103/0971-6580.75869.

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[8] Dr. Andrew Goldsworthy, The Birds, the Bees and Electromagnetic Pollution, May 2009.

[9] Sainudeen Sahib.S, Electromagnetic Radiation (EMR) Clashes with Honey Bees, *International Journal of Environmental Sciences*, Volume 1, No 5, 2011.

[10] Kimmel, Stefan, et. al, Electromagnetic Radiation: Influences on Honeybees (Apis mellifera), 2007.

[11] Ved Parkash Sharma, Neelima R. Kumar, Changes in honeybee behaviour and biology under the influence of cellphone radiations, *Current Science*, Vol. 98, No. 10, 25 May 2010.

[12] Wolfgang Harst, Jochen Kuhn, & Hermann Stever, Can Electromagnetic Exposure Cause a Change in Behaviour? Studying Possible Non-Thermal Influences on Honey Bees – An Approach within the Framework of Educational Informatics, 2006.

[13] Otitoloju, A.A., Obe, I.A., Adewale, O.A. et al., Preliminary study on the induction of sperm head abnormalities in mice, Mus musculus, exposed to radiofrequency radiations from global system for mobile communication base stations. Bull Environ Contam Toxicol (2010) 84: 51. doi.org/10.1007/s00128-009-9894-2.

[14] Thielens, A., Bell, D., Mortimore, D. B., Greco, M. K., Martens, L., & Joseph, W. (2018). Exposure of Insects to Radio-Frequency Electromagnetic Fields from 2 to 120 GHz. *Scientific Reports, 8*(1), 3924. https://doi.org/10.1038/s41598-018-22271-3.

[15] Balmori A. Mobile phone mast effects on common frog (Rana temporaria) tadpoles: the city turned into a laboratory. Electromagn Biol Med. 2010 Jun;29(1-2) 31-35. doi:10.3109/15368371003685363. PMID: 20560769.

[16] Cornelia Waldmann-Selsam, Alfonso Balmori-de la Puente, Helmut Breunig, Alfonso Balmori,

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closer to cell phone towers start to die more readily; and this can be seen if one looks at the branches of the trees closest to the antennae of the cell phone tower with the fake tree at the Stilson parking lot off Hwy 390.

Please note these published studies:

- A field monitoring study spanning 9 years involving over 100 trees (Waldmann-Selsam 2016)[17] found trees sustained significantly more damage on the side of the tree facing the antenna, leaving the entire tree system prone to degradation over time. Documentation of tree damage from base stations is made visible in the Report "Tree Damage Caused by Mobile phone base stations" (Breunig, 2017).[18]
- A study on Aspen trees near Lyons, Colorado entitled "Adverse Influence of Radio Frequency Background on Trembling Aspen Seedlings" published in the *International Journal of Forestry* found adverse effects on growth rate and fall anthocyanin production concluding that, "results of this preliminary experiment indicate that the RF background may be adversely affecting leaf and shoot growth and inhibiting fall production of anthocyanins associated with leaf senescence in trembling aspen seedlings. These effects suggest that exposure to the RF background may be an underlying factor in the recent rapid decline of aspen populations. Further studies are underway to test this hypothesis in a more rigorous way."[19]
- An analysis of 45 peer-reviewed scientific publications (1996-2016) on changes in plants due to the non-thermal RF-EMF effects from mobile phone radiation entitled "Weak radiofrequency radiation exposure from mobile phone radiation on plants concludes, "Our analysis demonstrates that the data from a substantial amount of the studies on RF-EMFs from mobile phones show physiological and/or morphological effects (89.9%, $p < 0.001$). Additionally, our analysis of the results from these reported studies demonstrates that the maize, roselle, pea, fenugreek, duckweeds, tomato, onions and mungbean plants seem to be very sensitive to RF-EMFs. Our findings also suggest that plants seem to be more responsive to certain frequencies..."[20]

Electromagnetic Fields Alter Animal and Insect Orientation

Science of the Total Environment published environmental scientist Alforso Balmori's "Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation," which states, "Current evidence indicates that exposure at levels that are found in the environment (in urban areas and near base stations) may particularly alter the receptor organs to orient in the magnetic field of the earth. These results could have important implications for migratory birds and insects, especially in urban areas, but could also apply to birds and insects in

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Radiofrequency radiation injures trees around mobile phone base stations, Science of The Total Environment, Volume 572, 2016, Pages 554-569, ISSN 0048-9697, doi.org/10.1016/j.scitotenv.2016.08.045.

[17] Cornelia Waldmann-Selsam, Alfonso Balmori-de la Puente, Helmut Breunig, Alfonso Balmori, Radiofrequency radiation injures trees around mobile phone base stations, *Science of The Total Environment*, Volume 572, 2016, Pages 554-569, ISSN 0048-9697, doi.org/10.1016/j.scitotenv.2016.08.045.

[18] Breunig, Helmut, Tree damage caused by mobile phone base stations An observation guide, 2017.

[19] Katie Haggerty, "Adverse Influence of Radio Frequency Background on Trembling Aspen Seedlings: Preliminary Observations," *International Journal of Forestry Research*, vol. 2010, Article ID 836278, 7 pages, 2010. doi.org/10.1155/2010/836278.

[20] Malka N. Halgamuge (2017) Review: Weak radiofrequency radiation exposure from mobile phone radiation on plants, *Electromagnetic Biology and Medicine*, 36:2, 213-235, DOI: 10.1080/15368378.2016.1220389.

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natural and protected areas where there are powerful base station emitters of radiofrequencies. Therefore, more research on the effects of electromagnetic radiation in nature is needed to investigate this emerging threat." [21]

Multiple research studies have documented how animals magnetoreception can be disrupted by external electromagnetic fields from mice[22] to cows to dogs to birds.[23] Electromagnetic exposure is especially disruptive to migratory birds.[24] Electromagnetic fields have been shown to disrupt the magnetic compass orientation used by birds to navigate.[25,26] Researchers have suggested this disruption of magnetoreception is due to cryptochrome photoreceptors that allow birds to use built-in receptors as a biological compass.

In 2012 the government of India's Ministry of the Environment and Forest issued a report on the potential impacts of communication towers on wildlife, citing hundreds of research studies that found adverse effects. Recommendations from the Ministry include, "Introduce a law for protection of urban flora and fauna from emerging threats like ERM/EMF as conservation issues in urban areas are different from forested or wildlife habitats."[27]

A 2017 report to UNESCO[28] by botanist Mark Broomhall details the association between increasing amounts of electromagnetic radiation from cellular antennas on the Mt. Nardi tower complex and species disappearance and exodus from the Mt. Nardi area of the Nightcap National Park World Heritage Area during a 15-year period (2000-2015). He estimates "in both volume and species that from 70 to 90 % of the wildlife has become rare or has disappeared from the Nightcap National Park within a radius of the Mt. Nardi tower complex. This statement can be summarised with concrete data: 3 bat species once common have become rare or gone, 11 threatened and endangered bird species are gone, 11 migratory bird species are gone, 86 bird species are demonstrating unnatural behaviours, 66 once common bird species are now rare or gone." The Report concludes, "With these short explanations of events we can appreciate that the effects of this technology and its application on Mt. Nardi over the last fifteen years, affect not only the top of the life chain species but they are devastating the fabric of the continuity of the World Heritage, causing genetic deterioration in an insidious, massive and ever escalating scale. To truly understand what these studies reveal is to stare into the abyss."

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[21] Alfonso Balmori, Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation, *Science of The Total Environment*, Volumes 518–519, 2015, Pages 58-60, ISSN 0048-9697, doi.org/10.1016/j.scitotenv.2015.02.077.

[22] Malkemper, E.P., et al. "Magnetoreception in the wood mouse (Apodemus sylvaticus): influence of weak frequency-modulated radio frequency fields." *Scientific Reports*, vol. 4, no. 9917, 2015.

[23] Wiltschko Roswitha, Thalau Peter, Gehring Dennis, Nießner Christine, Ritz Thorsten, Wiltschko Wolfgang. Magnetoreception in birds: the effect of radio-frequency fields.12. *Journal of The Royal Society Interface*.

[24] Engels, Svenja, et al. "Anthropogenic electromagnetic noise disrupts magnetic compass orientation in a migratory bird." *Nature* 509.7500 (2014): 353-356.

[25] Wiltschko, Roswitha, et al. "Magnetoreception in birds: the effect of radio-frequency fields." *Journal of The Royal Society Interface* 12.103 (2015): 20141103.

[26] Schwarze, S.,, et al. "Weak Broadband Electromagnetic Fields are More Disruptive to Magnetic Compass Orientation in a Night-Migratory Songbird (Erithacus rubecula) than Strong Narrow-Band Fields." *Front Behav Neurosci.* 10.55 (2016).

[27] Expert Committee, Ministry of Environment and Forest, Government of India, Report on Possible Impacts of Communication Towers on Wildlife Including Birds and Bees, Constituted on 30th August, 2010.

[28] Broomhall, Mark. "Report detailing the exodus of species from the Mt. Nardi area of the Nightcap National Park World Heritage Area during a 15-year period (2000-2015.)" United Nations Scientific and Cultural Organization (2017).

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It is very important that in considering antenna placement, there be a full environmental assessment on migratory animal patterns (from the smallest to the largest) and not simply on birds and mammals like the pronghorn but also on impacts to amphibians and insects.

Wireless Radiation is Known to Harm Humans and Wildlife

Human health effects include impaired reproduction, increased incidence of brain cancer, DNA breaks, oxidative stress and immune dysfunction, altered brain development, sleep changes, hyperactivity, and memory and cognitive problems.[29] Since the WHO/IARC classified EMF as a Group 2B Possible Carcinogen in 2011, the peer-reviewed research connecting wireless exposure to cancer has significantly strengthened and several scientists have published documentation that the weight of current peer-reviewed evidence supports the conclusion that radiofrequency radiation should be regarded as a human carcinogen.[30,31,32]

- The 10 year $30 million National Institute of Environmental Health Sciences National Toxicology Program's (NTP) Studies of the Toxicology and Carcinogenicity of Cell Phone Radiation[33,34] found that RFR was associated with "clear evidence" of cancer due to the increased malignant schwannomas found in RFR-exposed male rats. The brain (glioma) cancers and tumors in the adrenal glands were also considered evidence of an association with cancer. In addition, exposed animals had significantly more DNA damage, heart damage, and low birth weight.
- The Ramazzini Institute published its findings[35] that animals exposed to very low-level RFR developed the same types of cancers as reported by the NTP.
- Long-term research on humans who have used cell phones has found increased tumors—schwannomas and glioblastomas—the same cell type as found in the NTP and Ramazzini Institute studies. Persons who started using cell phones under age 20 had the highest risk.[36]
- A 2015 Jacobs University study (replicating a 2010 study) found that weak cell phone signals significantly promote the growth of tumors in mice and that combining a toxic chemical exposure with RF more than doubled the tumor response.[37,38]

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[29] For more information on acute health symptoms, see, e.g., Martin Pall, Microwave Frequency Electromagnetic Fields (EMFs) Produce Widespread Neuropsychiatric Effects Including Depression, 75 *J. Chemical Neuroanatomy* 43-51 (Sept. 2016); Response of residents living in the vicinity of a cellular phone base station in France ; Electromagnetic Fields: A Hazard to Your Health?, Healthy Children.

[30] Adams, Jessica A., et al. "Effect of mobile telephones on sperm quality: a systematic review and meta-analysis." *Environment International*, 70, 2014, pp. 106-112.

[31] Deshmukh, P.S., et al. "Cognitive impairment and neurogenotoxic effects in rats exposed to low-intensity microwave radiation." *International Journal of Toxicology*, vol. 34, no. 3, 2015, pp. 284-90.

[32] Aldad, T.S., et al. "Fetal Radiofrequency Radiation Exposure From 800-1900 MHz-Rated Cellular Telephones Affects Neurodevelopment and Behavior in Mice." *Scientific Reports*, vol. 2, no. 312, 2012.

[33] National Toxicology Program, Cell Phone Radio Frequency Radiation

[34] High exposure to radio frequency radiation associated with cancer in male rats

[35] L. Falcioni, L. Bua, E. Tibaldi, M. Lauriola, L. De Angelis, F. Gnudi, D. Mandrioli, M. Manservigi, F. Manservisi, I. Manzoli, I. Menghetti, R. Montella, S. Panzacchi, D. Sgargi, V. Strollo, A. Vornoli, F. Belpoggi, Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission, *Environmental Research*, Volume 165, 2018, Pages 496-503, ISSN 0013-9351, doi.org/10.1016/j.envres.2018.01.037.

[36] https://www.pathophysiologyjournal.com/article/S0928-4680(14)00064-9/fulltext

[37] Lerchl, Alexander, et al. "Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans." *Biochemical and Biophysical Research Communications*, vol. 459, no. 4, 2015, pp. 585-90.

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- "5G wireless telecommunications expansion: Public health and environmental implications," is a research review published in Environmental Research, which documents the range of adverse effects reported in the published literature from cancer to bacteria growth changes to DNA damage and concludes that "a moratorium on the deployment of 5G is warranted" and "the addition of this added high-frequency 5G radiation to an already complex mix of lower frequencies, will contribute to a negative public health outcome both from both physical and mental health perspectives."[39]
- A study published in Electromagnetic Biology and Medicine, "Impact of radiofrequency radiation on DNA damage and antioxidants in peripheral blood lymphocytes of humans residing in the vicinity of mobile phone base station," compared people living close and far from a cell antennas and found that people living closer to cellular antennas had higher radiation levels in the homes and several significant changes in their blood predictive of cancer development."[40]
- A 2019 study of students in schools near cell towers found their higher RF exposure was associated with impacts on motor skills, memory and attention (Meo 2019).[41] Examples of other effects linked to cell towers in research studies include neuropsychiatric problems[42], elevated diabetes[43], headaches[44], sleep problems[45] and genetic damage[46]. Such research continues to accumulate after the 2010 landmark review study on 56 studies that reported biological effects found at very low intensities, including impacts on reproduction, permeability of the blood-brain barrier, behavior, cellular and metabolic changes, and increases in cancer risk (Lai and Levitt 2010).[47]
- Published research has found impacts from wireless radiation exposure to reproduction and brain development in addition to a myriad of other adverse effects.[48,49,50,51] Although renowned institutions, such

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[38] Tillmann, Thomas, et al. "Indication of cocarcinogenic potential of chronic UMTS-modulated radiofrequency exposure in an ethylnitrosourea mouse model." *International Journal of Radiation Biology*, vol. 86, no. 7, 2010, pp. 529-41.

[39] https://doi.org/10.1016/j.envres.2018.01.016

[40] Zothansiama & Zosangzuali, Mary & Lalramdinpuii, Miriam & Jagetia, Ganesh & Siama, Zothan. (2017). Impact of radiofrequency radiation on DNA damage and antioxidants in peripheral blood lymphocytes of humans residing in the vicinity of mobile phone base stations. Electromagnetic Biology and Medicine. 36. 1-11. 10.1080/15368378.2017.1350584.

[41] Meo, S. A., Almahmoud, M., Alsultan, Q., Alotaibi, N., Alnajashi, I., & Hajjar, W. M. (2019). Mobile Phone Base Station Tower Settings Adjacent to School Buildings: Impact on Students' Cognitive Health. *American Journal of Men's Health*. doi.org/10.1177/1557988318816914.

[42] G. Abdel-Rassoul, O. Abou El-Fateh, M. Abou Salem, A. Michael, F. Farahat, M. El-Batanouny, E. Salem, Neurobehavioral effects among inhabitants around mobile phone base stations, NeuroToxicology, Volume 28, Issue 2, 2007, Pages 434-440, ISSN 0161-813X, doi.org/10.1016/j.neuro.2006.07.012.

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[44] Hutter, H. P., Moshammer, H., Wallner, P., & Kundi, M. (2006). Subjective symptoms, sleeping problems, and cognitive performance in subjects living near mobile phone base stations. *Occupational and environmental medicine*, *63*(5), 307–313. doi:10.1136/oem.2005.020784.

[45] R. Santini, P. Santini, J.M. Danze, P. Le Ruz, M. Seigne, Enquête sur la santé de riverains de stations relais de téléphonie mobile: I/Incidences de la distance et du sexe, Pathologie Biologie,
Volume 50, Issue 6, 2002, Pages 369-373, ISSN 0369-8114, doi.org/10.1016/S0369-8114(02)00311-5.

[46] Gursatej Gandhi, Gurpreet Kaur & Uzma Nisar (2015) A cross-sectional case control study on genetic damage in individuals residing in the vicinity of a mobile phone base station, Electromagnetic Biology and Medicine, 34:4,344-354, DOI: 10.3109/15368378.2014.933349.

[47] B. Blake Levitt and Henry Lai, Biological effects from exposure to electromagnetic radiation emitted by cell tower base stations and other antenna arrays, Environ. Rev. Downloaded from www.nrcresearchpress.com by 172.58.41.200 on 04/10/19

[48] Adams, Jessica A., et al. "Effect of mobile telephones on sperm quality: a systematic review and meta-analysis." *Environment International*, 70, 2014, pp. 106-112.

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as the Cleveland Clinic, advise men to keep phones and wireless devices away from their reproductive organs, the public remains largely unaware.

Once the towers are erected they will be upgraded over time with new antennas and soon 5G technology. 5G would use today's wireless frequencies while adding new, higher frequencies to transmit data at faster speeds. These higher frequency millimeter waves uniquely penetrate the eyes and skin,[52,20,21,22] and have been shown to accelerate bacterial and viral cell growth.[53] Millimeter waves were originally developed as a military weapon to create the sensation that the skin is burning.[54] Currently accepted standards are not sophisticated enough to measure effects on sweat glands or quantify the risks of cumulative exposure.[55,56]Any future applications of these technologies must consider the biological effect of cumulative exposures to these frequencies.

Radiofrequency radiation exposure is increasing at a rapid pace.

A 2018 article published in *The Lancet Planetary Health* points to unprecedented increasing RF exposures, and the abstract concludes, "due to the exponential increase in the use of wireless personal communication devices (eg, mobile or cordless phones and WiFi or Bluetooth-enabled devices) and the infrastructure facilitating them, levels of exposure to radiofrequency electromagnetic radiation around the 1 GHz frequency band, which is mostly used for modern wireless communications, have increased from extremely low natural levels by about 1018 times…"(Bandara and Carpenter 2018).[57]

Another key finding from Zothansiama 2017 was that homes closer to antennas had measurably higher radiation levels—adding to the documentation that antennas increase RF levels. An Australian study also found that children in kindergartens with nearby antenna installations had nearly three-and-a-half times higher RF exposures than children with installations further away (more than 300 meters (Bhatt 2016).[58]

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[49] Deshmukh, P.S., et al. "Cognitive impairment and neurogenotoxic effects in rats exposed to low-intensity microwave radiation." *International Journal of Toxicology*, vol. 34, no. 3, 2015, pp. 284-90.

[50] Aldad, T.S., et al. "Fetal Radiofrequency Radiation Exposure From 800-1900 MHz-Rated Cellular Telephones Affects Neurodevelopment and Behavior in Mice." *Scientific Reports*, vol. 2, no. 312, 2012.

[51] Sonmez, O.F., et al. "Purkinje cell number decreases in the adult female rat cerebellum following exposure to 900 MHz electromagnetic field." *Brain Research*, vol. 1356, 2010, pp. 95-101.

[52] A lecture by Paul Ben-Ishai, PhD at the Israel Institute for Advanced Studies on this finding can be found on the 2017 IIAS Conference website. Feldman, Yuri and Paul Ben-Ishai. "Potential Risks to Human Health Originating from Future Sub-MM Communication Systems." *Conference on Wireless and Health*, 2017.

[53] Cindy L. Russell, 5G Wireless Telecommunications Expansion: Public Health and Environmental Implications, 165 Envt'l Res. 484 (2018).

[54] For information on Active Denial Systems, see, e.g., Vehicle-Mounted Active Denial System (V-MADS) ; Active Denial System FAQs.

[55] A lecture by Paul Ben-Ishai, PhD at the Israel Institute for Advanced Studies on this finding can be found on the 2017 IIAS Conference website. Feldman, Yuri and Paul Ben-Ishai. "Potential Risks to Human Health Originating from Future Sub-MM Communication Systems." *Conference on Wireless and Health*, 2017.

[56] Hayut, Itai, Paul Ben Ishai, Aharon J. Agranat and Yuri Feldman. "Circular polarization induced by the three-dimensional chiral structure of human sweat ducts." *Physical Review E*, vol. 89, no. 042715, 2014.

[57] Priyanka Bandara, David O Carpenter, Planetary electromagnetic pollution: it is time to assess its impact, *The Lancet Planetary Health*, Volume 2, Issue 12, 2018, Pages e512-e514,ISSN 2542-5196, doi.org/10.1016/S2542-5196(18)30221-3.

[58] Bhatt, C. R., Redmayne, M., Billah, B., Abramson, M. J., & Benke, G. (2016). Radiofrequency-electromagnetic field exposures in kindergarten children. *Journal Of Exposure Science And Environmental Epidemiology*, *27*, 497. Retrieved from https://doi.org/10.1038/jes.2016.55.

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A 2018 multi-country study that measured RF in several countries found that cell phone tower radiation is the dominant contributor to RF exposure in most outdoor areas exposure in urban areas was higher and that exposure has drastically increased. As an example, the measurements the researchers took in Los Angeles, USA was 70 times higher than the US EPA estimate 40 years ago.[59]

FCC limits are non-protective

FCC limits are based only on thermal heating and do not account for biological impacts at levels far lower than FCC limits. The Department of Interior wrote a 2014 letter on the impact of cell towers on migratory birds documenting several studies that found adverse effects and concludes that "The electromagnetic radiation standards used by the Federal Communications Commission (FCC) continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable today."[60]

In the United States, RFR radiation regulatory limits were set by the FCC more than two decades ago in 1996. However, the FCC limits are not safety standards. Although the EPA was actively researching this issue and tasked to develop proper safety limits,[61,62] the EPA was abruptly defunded in 1996 and the FCC adopted guidelines developed by industry-connected non-independent groups (ANSI/IEEE C95.1-1992, NCRP's 1986 Report)[63] Experts from U.S. government agencies (including the EPA and NIOSH) have repeatedly documented issues concerning the inadequacy of these limits but their letters have gone unanswered.[64,65] The EPA has clarified that the FCC limits do not protect against effects from long-term low-level exposures.[66] In 2008, the National Academy of Sciences released a Report on research needs that included recommending research on the impacts to brain development and exposures to children and pregnant women.[67]

In 2012, the Government Accountability Office issued a Report calling for RFR standards to be updated with current research recommending that the FCC formally reassess the current RF energy exposure limit, including its effects on

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[59] Sanjay Sagar, Seid M. Adem, Benjamin S'ruchen, Sarah P. Loughran, Michael E. Brunjes, Lisa Arangua, Mohamed Aqiel Dalvie, Rodney J. Croft, Michael Jerrett, Joel M. Moskowitz, Tony Kuo, Martin Röösli, Comparison of radiofrequency electromagnetic field exposure levels in different everyday microenvironments in an international context, Environment International, Volume 114, 2018, Pages 297-306, ISSN 0160-4120, doi.org/10.1016/j.envint.2018.02.036.

[60] W.R.Taylor, February 7, 2014, United States Department of the Interior, Letter In Reply Refer To: (ER 14/0001) (ER 14/0004).

[61] A lecture by Paul Ben-Ishai, PhD at the Israel Institute for Advanced Studies on this finding can be found on the 2017 IIAS Conference website. Feldman, Yuri and Paul Ben-Ishai. "Potential Risks to Human Health Originating from Future Sub-MM Communication Systems." *Conference on Wireless and Health*, 2017.

[62] Hayut, Itai, Paul Ben Ishai, Aharon J. Agranat and Yuri Feldman. "Circular polarization induced by the three-dimensional chiral structure of human sweat ducts." *Physical Review E*, vol. 89, no. 042715, 2014.

[63] https://www.fcc.gov/general/fcc-policy-human-exposure#block-menu-block-4

[64] A lecture by Paul Ben-Ishai, PhD at the Israel Institute for Advanced Studies on this finding can be found on the 2017 IIAS Conference website. Feldman, Yuri and Paul Ben-Ishai. "Potential Risks to Human Health Originating from Future Sub-MM Communication Systems." *Conference on Wireless and Health*, 2017.

[65] Hayut, Itai, Paul Ben Ishai, Aharon J. Agranat and Yuri Feldman. "Circular polarization induced by the three-dimensional chiral structure of human sweat ducts." *Physical Review E*, vol. 89, no. 042715, 2014.

[66] https://ehtrust.org/wp-content/uploads/4c0f61dc30e3d6bb27d90f53a57c616e.pdf

[67] Consensus Study Report, Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communication Devices, 2008.

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human health, the costs, and benefits associated with keeping the current limit, and the opinions of relevant health and safety agencies, and change the limit if determined appropriate. In response to the 2012 GAO Report, the FCC opened proceedings (ET Docket No. 13-84 Reassessment of FCC Radiofrequency Exposure Limits and ET Docket No. 03-137 Proposed Changes in the Commission's Rules Regarding Human Exposure to Radiofrequency Electromagnetic Fields) to explore whether it should modify its radiofrequency exposure standards. The FCC also noted, "we specifically seek comment as to whether our current limits are appropriate as they relate to device use by children." To date, the FCC has failed to act. Over 900 comments have been filed since the FCC opened these dockets these dockets, but no US health agency has submitted any opinion or scientific documentation to either docket.

Due to the FCC's inaction, the GAO has updated the status[68] as "Closed - Not Implemented" with these comments: "despite many years of consideration, FCC still has no specific plans to take any actions that would satisfy our recommendations. Accordingly, we are closing the recommendations as not implemented."

Children are more vulnerable.

Children's skulls are thinner, their heads are smaller, and the radiation penetrates deeper into their brain. Research has found that a child's head's absorption can be over two times greater, and absorption of the skull's bone marrow can be ten times greater, than adults.[69,70] The American Academy of Pediatrics, which is the largest organization of U.S. pediatricians, has repeatedly written to the U.S. government documenting children's vulnerabilities and recommends reducing children's and pregnant women's exposure.[71]

The California Department of Health, the Connecticut Department of Health, many international health organizations and medical associations, and more than 20 governments are recommending wireless exposure reduction, especially for children.[72]

Several countries have allowable public exposure limits lower than ICNIRP levels with limits that are even more protective for kindergartens, schools and hospitals. In addition, some governments' regulatory actions include banning cell phones or removing Wi-Fi and cell towers in or near schools.[73] For example:

- Belgium and France have banned the sale of cell phones designed for young children and made it illegal to market cell phones to children less than 14 years of age.

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[68] Exposure and Testing Requirements for Mobile Phones Should Be Reassessed GAO-12-771: Published: Jul 24, 2012. Publicly Released: Aug 7, 2012.

[69] A lecture by Paul Ben-Ishai, PhD at the Israel Institute for Advanced Studies on this finding can be found on the 2017 IIAS Conference website. Feldman, Yuri and Paul Ben-Ishai. "Potential Risks to Human Health Originating from Future Sub-MM Communication Systems." *Conference on Wireless and Health*, 2017.

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- France has banned cell phones in elementary and middle schools, and playgrounds.[74]
- The Supreme Court of India upheld the High Court of the State of Rajasthan's decision to remove all cell towers from the vicinity of schools, hospitals and playgrounds because this radiation is "hazardous" and causes cancer, brain tumour, digestive disorder and tachycardia.[75]
- The Environment Minister of Italy has decreed to reduce as much as possible indoor exposure to both ELF-EMF and RF-EMF.
- Cyprus has banned Wi-Fi from kindergartens and elementary classrooms.
- In Chile, the 2012 "Antenna Law" prohibits cell antennas/towers in "sensitive areas" such as "educational institutions, nurseries, kindergartens, hospitals, clinics, nursing homes or other institutions of similar nature."[76]

Children will have a lifetime of exposure to wireless radiation; in order to protect their healthy future, public health authorities must limit this exposure as much as possible.

Moreover, recent cell phone radiation tests released by the French government found that nine out of ten cell phones exceed regulatory limits for radiofrequency radiation when tested in body contact positions (simulating a phone in pants pocket, bra or resting on chest). Despite this documentation, U.S. radiation limits have still not been revised. To this date, there has been no public record of an independent systematic review of the research by any U.S. health agency in order to set proper safety standards. The current outdated regulations are inadequate to protect public health.

Since 1997, insurance companies have refused to insure wireless companies and "electromagnetic field exclusions" in insurance policies are an industry standard. EMFs are deemed as "high-risk" in insurance white papers, and EMFs are defined as a "pollutant" by many insurance companies alongside smoke, chemicals, and asbestos. Some companies will only cover liability from EMFs under additional "Pollution Liability" policy enhancement coverage. Some policies not only exclude damages from EMFs but also exclude paying for the defense of "*any supervision, instruction, recommendation, warning or advice given or which should have been given in connection with bodily injury, property damage, abatement and/or mitigation etc.*"

Wireless companies warn their shareholders—in mandated annual 10k filings—that they may incur financial losses from lawsuits related to EMF radiation emissions of their products. For example:

- AT&T states, "*We may incur significant expenses defending such suits or government charges and may be required to pay amounts or otherwise change our operations in ways that could materially adversely affect our operations or financial results.*"
- Crown Castle's 2016 10-K ANNUAL REPORT states, "*If radio frequency emissions from wireless handsets or equipment on our wireless infrastructure are demonstrated to cause negative health effects, potential future claims could adversely affect our operations, costs or revenues. The potential connection between radio frequency emissions and certain negative health effects, including some forms of cancer, has*

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[74] « Plus de téléphones portables dans les écoles et collèges à la rentrée 2018 », annonce Jean-Michel Blanquer, Le Monde (Dec. 10, 2017).

[75] Abhinav Sharma, Rajasthan HC orders relocation of mobile towers from schools, hospitals, Economic Times (Nov. 28, 2012).

[76] New communications antenna law in Chile, 20 Communications Law: Newsletter of the International Bar Association Legal Practice Division 14-16 (2013).

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been the subject of substantial study by the scientific community in recent years. We cannot guarantee that claims relating to radio frequency emissions will not arise in the future or that the results of such studies will not be adverse to us...If a connection between radio frequency emissions and possible negative health effects were established, our operations, costs, or revenues may be materially and adversely affected. We currently do not maintain any significant insurance with respect to these matters."

Most wireless companies—from AT&T to Nokia to T Mobile to Verizon Wireless—have issued similar warnings to their shareholders.[77]

Will the visiting public to the National Parks also be warned of the risk?

Scientists Worldwide: Reduce Exposure

An increasing number of experts around the world are calling for reduced exposure—due to the unprecedented threat to public health and the environment—to stop the installation of radiation-emitting equipment placed within meters of homes, playgrounds, and schools.

- In 2015, the International EMF Scientist Appeal, now signed by over 225 scientists from 41 nations, urging the development of more protective guidelines for EMF (including RF-EMF), encouraging precautionary measures, and calling for education of the public about health risks, particularly risks to children and fetal development, was submitted to the Secretary-General of the United Nations, the Director-General of the World Health Organization, and U.N. Member Nations.[78]
- In June 2017, EMF Scientists submitted Comments to the U.S. FCC, asking the FCC to critically consider the potential impact of the 5th generation wireless infrastructure on the health and safety of the U.S. population before proceeding to deploy this infrastructure.
- In September 2017, I joined over 180 experts from 35 countries who sent a declaration to the European Union calling for a moratorium on 5G until hazards have been fully investigated by independent scientists, citing potential neurological impacts, infertility, and cancer.[79]

The tobacco and asbestos crises demonstrate that failing to act on public health hazards when they arise can lead to irreversible damage later. EHT thus strongly opposes building out 5G infrastructure—which would place thousands of new sources of microwave radiation emissions in close proximity to workers, families, and local wildlife—at least until more testing has been conducted.

Cell Towers Create Additional Safety Hazards

Another area of concern with the proposed expansion of the wireless infrastructure is fires. Cell towers are known to catch fire such as the 150-foot tower in Washington that experienced an electrical malfunction at a lighted beacon on top of the tower which caught an Osprey's nest on fire. Many birds, particularly raptors, choose to nest on or near cell towers because of the heat they provide, the clear view, and high vantage point that they favor for their nesting

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[77] Corporate Company Investor Warnings In Annual Reports 10k Filings Cell Phone Radiation Risks
[78] Blank, M., et al. "International Appeal: Scientists call for protection from non-ionizing electromagnetic field exposure." *European Journal of Oncology*, vol. 20, no. 3/4, 2015, pp. 180-2.
[79] "Appeal to the European Union: Scientists warn of potential serious health effects of 5G." 13 September 2017.

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sites. There are many more examples of these towers catching fire, such as a 125-foot tower in Maryland. A church in South Africa that housed antennas caught fire this month, and news reports state authorities are investigating if it was a short circuit from the equipment that started the fire.

Towers have also been known to attract lightning strikes. The higher the tower the higher the probability that lightning will strike the tower, presenting another type of fire hazard.[80]

We at the Environmental Health Trust urge you, as stewards of our national parks and along with your mission, "The **National Park Service** preserves unimpaired the **natural** and cultural resources and values of the **national park** system for the enjoyment, education, and inspiration of this and future generations," to seek out the research and information about the health effects on both humans and the flora and fauna of the parks in order to protect and preserve. Taking all information into consideration you are also following the National Park Service's own statement, "by caring for the parks and conveying the park ethic, we care for ourselves and act on behalf of the future. The larger purpose of this mission is to build a citizenry that is committed to conserving its heritage and its home on earth."[81]

Respectfully submitted,

Devra Davis

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President, Environmental Health Trust
Fellow, American College of Epidemiology
Visiting Prof. Hebrew Univ. Hadassah Medical Center & Ondokuz Mayis Univ. Medical School
Associate Editor, Frontiers in Radiation and Health

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EXHIBIT F

Priyanka Bandara, David O. Carpenter, "Planetary electromagnetic pollution: it is time to access its impact," *The Lancet Planetary Health,* Volume 2, issue 12, 2018, pages e512-e514, ISSN 2542-5196, doi.org/10.1016/S2542-5196(18)30221-3

Entered into the Record by ALJ Heep in Lucey v. Metropolitan Edison Company C-2018-3003679 not for the truth of the matter but as a document reviewed and referenced by the complainant. It is an exception to the Hearsay rule.

Planetary electromagnetic pollution: it is time to assess its impact

As the Planetary Health Alliance moves forward after a productive second annual meeting, a discussion on the rapid global proliferation of artificial electromagnetic fields would now be apt. The most notable is the blanket of radiofrequency electromagnetic radiation, largely microwave radiation generated for wireless communication and surveillance technologies, as mounting scientific evidence suggests that prolonged exposure to radiofrequency electromagnetic radiation has serious biological and health effects. However, public exposure regulations in most countries continue to be based on the guidelines of the International Commission on Non-Ionizing Radiation Protection[1] and Institute of Electrical and Electronics Engineers,[2] which were established in the 1990s on the belief that only acute thermal effects are hazardous. Prevention of tissue heating by radiofrequency electromagnetic radiation is now proven to be ineffective in preventing biochemical and physiological interference. For example, acute non-thermal exposure has been shown to alter human brain metabolism by NIH scientists,[3] electrical activity in the brain,[4] and systemic immune responses.[5] Chronic exposure has been associated with increased oxidative stress and DNA damage[6,7] and cancer risk.[8] Laboratory studies, including large rodent studies by the US National Toxicology Program[9] and Ramazzini Institute of Italy,[10] confirm these biological and health effects in vivo. As we address the threats to human health from the changing environmental conditions due to human activity,[11] the increasing exposure to artificial electromagnetic radiation needs to be included in this discussion.

Due to the exponential increase in the use of wireless personal communication devices (eg, mobile or cordless phones and WiFi or Bluetooth-enabled devices) and the infrastructure facilitating them, levels of exposure to radiofrequency electromagnetic radiation around the 1 GHz frequency band, which is mostly used for modern wireless communications, have increased from extremely low natural levels by about 10^{18} times (figure). Radiofrequency electromagnetic radiation is also used for radar, security scanners, smart meters, and medical equipment (MRI, diathermy, and radiofrequency ablation). It is plausibly the most rapidly increasing anthropogenic environmental exposure since the mid-20th century, and levels will surge considerably again, as technologies like the Internet of Things and 5G add millions more radiofrequency transmitters around us.

Unprecedented human exposure to radiofrequency electromagnetic radiation from conception until death has been occurring in the past two decades. Evidence of its effects on the CNS, including altered neurodevelopment[14] and increased risk of some neurodegenerative diseases,[15] is a major concern considering the steady increase in their incidence. Evidence exists for an association between neurodevelopmental or

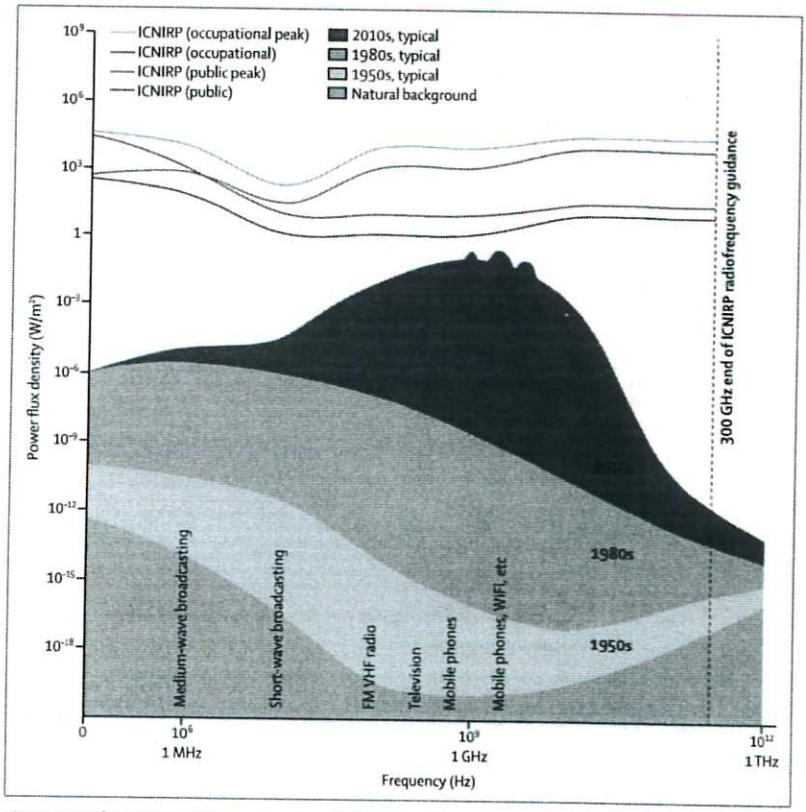

Figure: **Typical maximum daily exposure to radiofrequency electromagnetic radiation from man-made and natural power flux densities in comparison with International Commission on Non-Ionizing Radiation Protection safety guidelines[1]**

Anthropogenic radiofrequency electromagnetic radiation levels are illustrated for different periods in the evolution of wireless communication technologies. These exposure levels are frequently experienced daily by people using various wireless devices. The levels are instantaneous and not time-averaged over 6 minutes as specified by International Commission on Non-Ionizing Radiation Protection for thermal reasons. Figure modified from Philips and Lamburn[12] with permission. Natural levels of radiofrequency electromagnetic radiation were based on the NASA review report CR-166661.[13]

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behavioural disorders in children and exposure to wireless devices,[14] and experimental evidence, such as the Yale finding, shows that prenatal exposure could cause structural and functional changes in the brain associated with ADHD-like behaviour.[16] These findings deserve urgent attention.

For the **Oceania Radiofrequency Scientific Advisory Association** see www.orsaa.org

At the Oceania Radiofrequency Scientific Advisory Association, an independent scientific organisation, volunteering scientists have constructed the world's largest categorised online database of peer-reviewed studies on radiofrequency electromagnetic radiation and other man-made electromagnetic fields of lower frequencies. A recent evaluation of 2266 studies (including in-vitro and in-vivo studies in human, animal, and plant experimental systems and population studies) found that most studies (n=1546, 68·2%) have demonstrated significant biological or health effects associated with exposure to anthropogenic electromagnetic fields. We have published our preliminary data on radiofrequency electromagnetic radiation, which shows that 89% (216 of 242) of experimental studies that investigated oxidative stress endpoints showed significant effects.[7] This weight of scientific evidence refutes the prominent claim that the deployment of wireless technologies poses no health risks at the currently permitted non-thermal radiofrequency exposure levels. Instead, the evidence supports the International EMF Scientist Appeal by 244 scientists from 41 countries who have published on the subject in peer-reviewed literature and collectively petitioned the WHO and the UN for immediate measures to reduce public exposure to artificial electromagnetic fields and radiation.

For the **International EMF Scientist Appeal** see www.emfscientist.org

Evidence also exists of the effects of radiofrequency electromagnetic radiation on flora and fauna. For example, the reported global reduction in bees and other insects is plausibly linked to the increased radiofrequency electromagnetic radiation in the environment.[17] Honeybees are among the species that use magnetoreception, which is sensitive to anthropogenic electromagnetic fields, for navigation.

Man-made electromagnetic fields range from extremely low frequency (associated with electricity supplies and electrical appliances) to low, medium, high, and extremely high frequency (mostly associated with wireless communication). The potential effects of these anthropogenic electromagnetic fields on natural electromagnetic fields, such as the Schumann Resonance that controls the weather and climate, have not been properly studied. Similarly, we do not adequately understand the effects of anthropogenic radiofrequency electromagnetic radiation on other natural and man-made atmospheric components or the ionosphere. It has been widely claimed that radiofrequency electromagnetic radiation, being non-ionising radiation, does not possess enough photon energy to cause DNA damage. This has now been proven wrong experimentally.[18,19] Radiofrequency electromagnetic radiation causes DNA damage apparently through oxidative stress,[7] similar to near-UV radiation, which was also long thought to be harmless.

At a time when environmental health scientists tackle serious global issues such as climate change and chemical toxicants in public health, there is an urgent need to address so-called electrosmog. A genuine evidence-based approach to the risk assessment and regulation of anthropogenic electromagnetic fields will help the health of us all, as well as that of our planetary home. Some government health authorities have recently taken steps to reduce public exposure to radiofrequency electromagnetic radiation by regulating use of wireless devices by children and recommending preferential use of wired communication devices in general, but this ought to be a coordinated international effort.

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We declare no competing interests. We thank Alasdair Philips for assistance with the figure and Victor Leach and Steve Weller for assistance with the ORSAA Database, which has enabled our overview of the scientific evidence in this area of research.

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EXHIBIT G

National Toxicology Program, Fact Sheet on "Cellphone Radio Frequency Radiation Studies (January 2020) https://ntp.niehs.nih.gov

This exhibit is government advice not subject to cross examination or expert admissions.

National Toxicology Program

Headquartered at the
National Institute of Environmental
Health Sciences NIH·HHS

Cellphone Radio Frequency Radiation Studies

Cellphones are used by 95% of American adults.[1] Given the large number of users, any harmful effects associated with cellphone use could be a significant public health concern.

Cellphones use radio frequency radiation (RFR) to transmit signals. The U.S. Food and Drug Administration (FDA) nominated RFR for study by the National Toxicology Program (NTP), due to widespread human exposure and limited information about the potential health effects of long-term cellphone use.

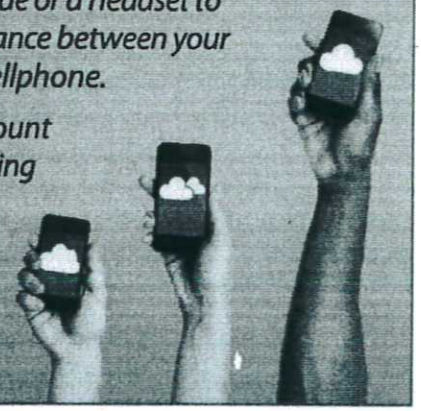
What did NTP study?

NTP conducted toxicology studies in rats and mice to help clarify potential health hazards, including cancer risk, from exposure to RFR used in 2G and 3G cellphones. 2G and 3G networks were standard when the studies were designed and are still used for phone calls and texting.

The $30 million NTP studies took more than 10 years to complete and are the most comprehensive assessment, to date, of health effects in animals exposed to RFR. The results will help guide other studies of newer technologies.

If you are concerned about potential health risks from RFR, the FDA suggests the following tips:[2]

- *Use speaker mode or a headset to place more distance between your head and the cellphone.*
- *Reduce the amount of time spent using your cellphone.*



What did the studies find?

NTP studies found that exposure to high levels of RFR, like that used in 2G and 3G cellphones, was associated with:

- **Clear evidence of tumors in the hearts of male rats.** The tumors were malignant schwannomas.
- **Some evidence of tumors in the brains of male rats.** The tumors were malignant gliomas.
- **Some evidence of tumors in the adrenal glands of male rats.** The tumors were pheochromocytomas.

For female rats, and male and female mice, it was unclear, also known as equivocal, whether cancers observed in the studies were associated with exposure to RFR.

The conclusions were based on NTP's four categories of evidence that a substance may cause cancer:

- Clear evidence (highest)
- Some evidence
- Equivocal evidence
- No evidence (lowest)

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Do the rat and mouse findings apply to humans?

The findings in animals cannot be directly applied to humans for two key reasons:

- *The exposure levels and durations were greater than what people may receive from cellphones.*
- *The rats and mice received RFR across their whole bodies, which is different from the more localized exposures humans may receive, like from a cellphone in their pocket or next to their head.*

However, the studies question the long-held assumption that radio frequency radiation is of no concern as long as the energy level is low and does not significantly heat the tissues.

Did NTP find health effects other than cancer?

NTP found lower body weights among newborn rats and their mothers, especially when exposed to high levels of RFR during pregnancy and lactation, yet these animals grew to normal size. They also found that RFR exposure was associated with an increase in DNA damage. DNA damage, if not repaired, can potentially lead to tumors. Specifically, they found RFR exposure was linked with significant increases in DNA damage in the frontal cortex of the brain in male mice, the blood cells of female mice, and the hippocampus of male rats.

What factors contributed to the NTP conclusions?

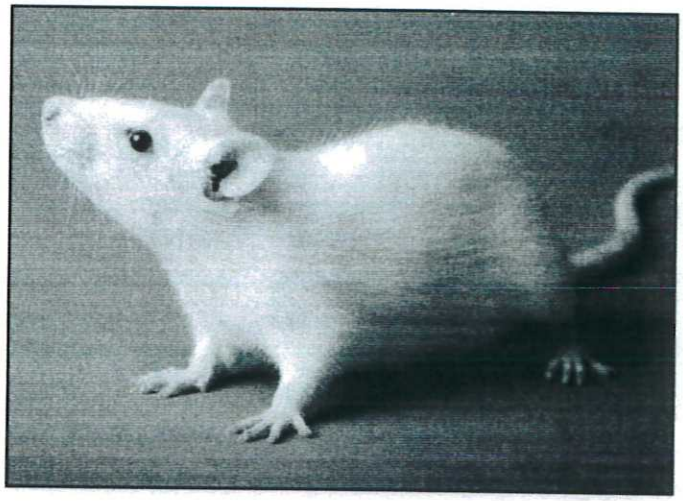
In addition to seeing tumors in the male rats with higher exposures to RFR, NTP scientists also observed other changes in the hearts of exposed male and female rats that supported their conclusions.

The evidence for tumors in the brain and adrenal glands was not as strong as what NTP scientists saw in the heart. However, the type of brain cancer observed is similar to a type of brain tumor linked to heavy cellphone use in some human studies.[3]

Still, the effects observed in the animals were relatively rare. NTP scientists are not sure why male rats appear to be at greater risk for developing tumors compared to female rats.

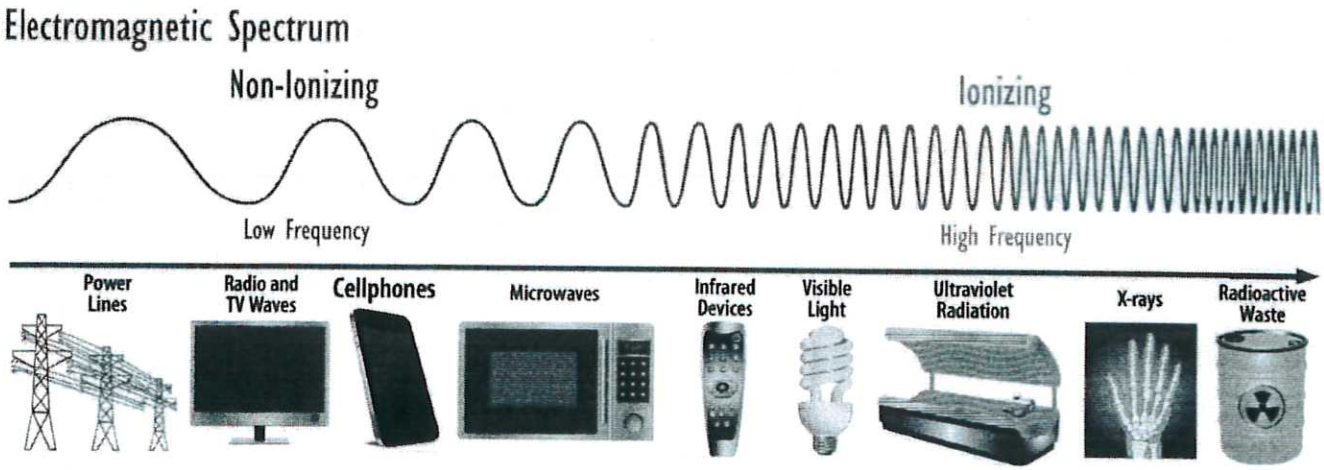
How do the RFR levels used in the studies compare to typical human exposures?

The lowest exposure level used in the studies was equal to the maximum local tissue exposure currently allowed for cellphone users. This power level rarely occurs with typical cellphone use. The highest exposure level in the studies was four times higher than the maximum power level permitted for local tissues.



Why did NTP expose the animals' whole bodies to RFR?

Although many previous studies focused on exposure to the brain, NTP scientists wanted to make sure that they were considering health effects to the whole body, especially since many people do not hold their phones next to their head much of time.



RFR used in cellphones is at the lower frequency and lower energy end of the electromagnetic spectrum.

What is the difference between electric and magnetic fields and RFR?

RFR is a subcategory of electric and magnetic fields (EMF), which are the invisible waves of force that surround any electrical device. The different types of EMF are distinguished by their frequencies. RFR is a form of low frequency, non-ionizing radiation that was thought to be relatively harmless.

How were the studies conducted?

Rats and mice were exposed to RFR in special chambers for up to two years, or most of their natural lives. NTP scientists looked for a range of cancers and noncancer health effects.

Exposure to RFR began in the womb for rats and at 5-6 weeks old for mice. The RFR exposure was intermittent, 10 minutes on and 10 minutes off, totaling about nine hours each day. The RFR levels ranged from 1.5 to 6 watts per kilogram of body weight in rats, and 2.5 to 10 watts per kilogram in mice.

The chambers were shielded rooms with a transmitting antenna that radiated RFR fields, plus rotating stirrers that generated a uniform field.[4,5] Pilot studies established field strengths that did not raise animal body temperatures excessively.[6]

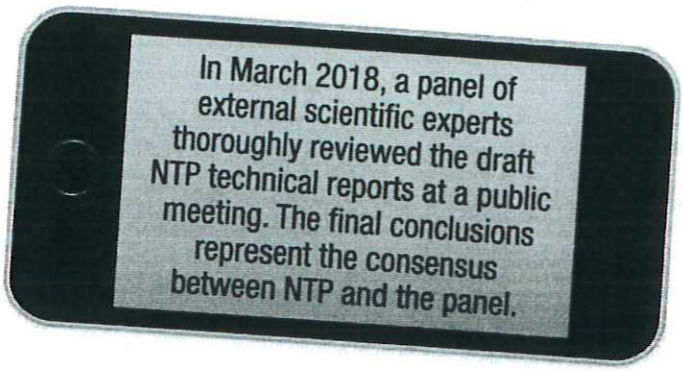
The rats and mice were exposed to whole body RFR at frequencies of 900 and 1900 megahertz, respectively, from two technologies – Code Division Multiple Access (CDMA) and Global System for Mobile Communications (GSM).

NTP and RFR experts from the National Institute of Standards and Technology (NIST) and the IT'IS Foundation designed and built the chambers specifically for these studies.

Chambers at the IIT Research Institute in Chicago where the studies took place

What is the difference between CDMA and GSM?

CDMA and GSM are two common ways of transmitting cellphone signals in the U.S. and Europe. There are substantial differences in signal structure that may result in different RFR exposures, so NTP wanted to expose the animals to both modulations.



How do the NTP studies relate to 4G, 5G, or Wi-Fi?

NTP studies of RFR used in 2G and 3G cellphones do not apply to 4G or 5G technologies. These newer technologies use different methods of signal modulation than NTP used in the studies. The NTP studies also did not investigate frequencies and modulations used for Wi-Fi.

What were the studies' strengths?

NTP was able to control exactly how much RFR the animals received — something that is not possible when studying human cellphone use.

Were there any surprise findings?

NTP found longer lifespans among the exposed male rats. This may be explained by an observed decrease in chronic kidney problems that are often the cause of death in older rats.

What will NTP do with the results of the studies?

NTP will provide these studies to the FDA and Federal Communications Commission. The agencies will review the information as they continue to monitor new research on the potential health effects of RFR.

Final reports and data tables are available on the NTP website at https://ntp.niehs.nih.gov/go/cellphone.

What are NTP's future plans for studying cellphone RFR and 5G wireless technology?

5G is the emergent technology that will eventually overtake the existing technology. In the meantime, people will continue to be exposed to RFR in the 700–2700 MHz range. As the 5G network is implemented, some of the signals used by the 5G network will use the same lower frequencies used by the older technology, but the 5G network will also use higher frequencies—up to 60,000 MHz—thereby exposing people to a much broader spectrum of frequencies. The higher frequencies, known as millimeter waves, can rapidly transmit enormous amounts of data with increased network capacity compared with current technologies. Millimeter waves do not travel as far and do not penetrate the body as deeply as do the wavelengths from the lower frequencies. Millimeter waves are likely to penetrate no deeper than the skin, whereas the lower frequencies have been shown to penetrate at least 3 to 4 inches into the human body.

NTP is currently evaluating the existing literature on the higher frequencies intended for use in the 5G network, and is working to better understand the biological basis for the cancer findings reported in earlier studies on RFR with 2G and 3G technologies. Additionally, work is ongoing to develop smaller RFR exposure chambers for additional short-term studies that will take weeks and months to complete rather than years. The exposure system is also being designed to have the capability to conduct studies with various RFR frequencies and modulations to keep up with the changing technologies in the telecommunications industry.

Where can I go for more information?

For more information on what federal agencies are doing to determine whether RFR used in cellphones may affect human health, visit the following websites:

National Toxicology Program
https://ntp.niehs.nih.gov/go/cellphone

National Cancer Institute
www.cancer.gov/about-cancer/causes-prevention/risk/radiation/cell-phones-fact-sheet

U.S. Food and Drug Administration
https://go.usa.gov/B5tx

Federal Communications Commission
www.fcc.gov/consumers/guides/wireless-devices-and-health-concerns

The National Toxicology Program
is an interagency program headquartered at the
National Institute of Environmental Health Sciences
that tests and evaluates chemicals in our environment.

For more information on NTP,
go to **https://ntp.niehs.nih.gov**.

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EXHIBIT H

Pall, Martin L 2016, 'Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression', *Elsevier: Journal of Chemical Neuroanatomy*, vol.75, Part B, pp 43-51

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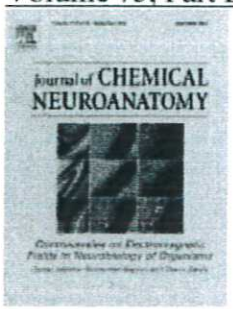

Review

Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression

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Highlights

- Microwave EMFs activate voltage-gated Ca2+ channels (VGCCs) concentrated in the brain.
-

- Animal studies show such low level MWV EMFs have diverse high impacts in the brain.
- VGCC activity causes widespread neuropsychiatric effects in humans (genetic studies).
- 26 studies have EMFs assoc. with neuropsychiatric effects; 5 criteria show causality.
- MWV EMFs cause at least 13 neuropsychiatric effects including depression in humans.

Abstract

Non-thermal microwave/lower frequency electromagnetic fields (EMFs) act via voltage-gated calcium channel (VGCC) activation. Calcium channel blockers block EMF effects and several types of additional evidence confirm this mechanism. Low intensity microwave EMFs have been proposed to produce neuropsychiatric effects, sometimes called microwave syndrome, and the focus of this review is whether these are indeed well documented and consistent with the known mechanism(s) of action of such EMFs. VGCCs occur in very high densities throughout the nervous system and have near universal roles in release of neurotransmitters and neuroendocrine hormones. Soviet and Western literature shows that much of the impact of non-thermal microwave exposures in experimental animals occurs in the brain and peripheral nervous system, such that nervous system histology and function show diverse and substantial changes. These may be generated through roles of VGCC activation, producing excessive neurotransmitter/neuroendocrine release as well as oxidative/nitrosative stress and other responses. Excessive VGCC activity has been shown from genetic polymorphism studies to have roles in producing neuropsychiatric changes in humans. Two U.S. government reports from the 1970s to 1980s provide evidence for many neuropsychiatric effects of non-thermal microwave EMFs, based on occupational exposure studies. 18 more recent epidemiological studies, provide substantial evidence that microwave EMFs from cell/mobile phone base stations, excessive cell/mobile phone usage and from wireless smart meters can each produce similar patterns of neuropsychiatric effects, with several of these studies showing clear dose–response relationships. Lesser evidence from 6 additional studies suggests that short wave, radio station, occupational and digital TV antenna exposures may produce similar neuropsychiatric effects. Among the more commonly reported changes are sleep disturbance/insomnia, headache, depression/depressive symptoms, fatigue/tiredness, dysesthesia, concentration/attention dysfunction, memory changes, dizziness, irritability, loss of appetite/body weight, restlessness/anxiety, nausea, skin burning/tingling/dermographism and EEG changes. In summary, then, the mechanism of action of microwave EMFs, the role of the VGCCs in the brain, the impact of non-thermal EMFs on the brain, extensive epidemiological studies performed over the past 50 years, and five criteria testing for causality, all collectively show that various non-thermal microwave EMF exposures produce diverse neuropsychiatric effects.

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Keywords

Excessive calcium effects
Oxidative/nitrosative stress
Low-intensity microwave electromagnetic fields

Chemicals having roles:

Calcium(2+)

Nitric oxide (NO)

Oxido nitrite (peroxynitrite)

1. Introduction

Microwave syndrome (Hocking, 2001, Johnson Liakouris, 1998), a combination of various neuropsychiatric symptoms originally described in persons with occupational exposures to microwave frequency EMFs, has been disputed largely because of the lack of an apparent mechanism for generating these symptoms. It is reported to often include such symptoms as fatigue, headache, insomnia, dysesthesia (impaired sensation), irritability, lack of concentration and other symptoms (Hocking, 2001, Johnson Liakouris, 1998). Similar but more extensive combinations of symptoms have been reported following occupational exposures in two U.S. government reports from the 1970s/1980s (Naval Medical Research Institute Research Report, 1971, Raines, 1981) and following environmental exposures as described in two more recent reviews (Khurana et al., 2010, Levitt and Lai, 2010).

The goal here is not just to review the epidemiology, however, but more importantly to consider the issue of possible physiological mechanism(s). Hennekens and Buring (1989), on p. 40 in their textbook Epidemiology in Medicine state "The belief in the existence of a cause and effect relationship is enhanced if there is a known or postulated biologic mechanism by which the exposure might reasonably alter risk of developing disease." It is of critical importance therefore to assess possible biological mechanism before considering the epidemiological evidence.

Accordingly, this paper considers the mechanism by which low intensity microwave EMFs impact the cells of our bodies, how that mechanism may be predicted to impact the nervous system, evidence for such impact from experimental animal studies, genetic polymorphism evidence for that mechanism acting in humans to produce neuropsychiatric effects and finally, the epidemiological evidence for such effects in human populations with repeated low level

microwave EMF exposure. Consideration of each of these types of evidence influences the overall interpretation presented in this paper.

2. Microwave/lower frequency EMFs act to activate voltage-gated calcium channels

In 24 different studies reviewed earlier (Pall, 2013) and two additional studies (Li et al., 2014, Lisi et al., 2006), microwave and lower frequency low intensity EMF effects were blocked or greatly lowered by calcium channel blockers, agents thought to be specific for blocking voltage-gated calcium channels (VGCCs). In these 26 studies, a total of 5 distinct types of channel blockers were used, with each type having a distinct structure and binding to a distinct site, such that it is essentially certain that these must be acting by blocking VGCCs, which is their only known common property. In each of these 26 studies, each of the responses studied, were blocked or greatly lowered by calcium channel blockers, showing that VGCC activation has roles in producing a wide variety of EMF effects. There is a large literature on changes in calcium fluxes and in calcium signaling following microwave EMF exposure (partially reviewed in Walleczek, 1992, Adey, 1993); each of these, including calcium efflux changes, can be explained as being due to VGCC activation, again suggesting a widespread role of VGCC activation in producing biological responses to EMFs. Pilla (2012) showed that pulsed microwave field exposure, produced an almost instantaneous increase in calcium/calmodulin-dependent nitric oxide (NO) signaling, providing strong evidence that these fields can produce an almost instantaneous VGCC activation. It is likely, that these EMFs act directly on the voltage sensor of the VGCCs to produce VGCC activation (Pall, 2015) with the voltage sensor being exquisitely sensitive to these EMFs because of its physical properties and location in the plasma membrane.

EMFs have been proposed to act to produce a wide variety of responses in the cell, via downstream effects of VGCC activation (Pall, 2013, Pall, 2014, Pall, 2015), including elevated intracellular calcium [Ca2+]i, excessive calcium and nitric oxide signaling and also excessive peroxynitrite, free radicals and oxidative stress.

VGCC activation has been shown to have a universal or near-universal role in the release of neurotransmitters in the brain and also in the release of hormones by neuroendocrine cells (Berridge, 1998, Dunlap et al., 1995, Wheeler et al., 1994), with such release being produced by calcium signaling. There are high densities of diverse VGCCs occurring in neurons throughout the nervous system. Both the high VGCC density and their function in neurotransmitter and neuroendocrine release throughout the nervous system suggests that the nervous system is likely to be highly sensitive to low intensity EMFs.

3. Genetic polymorphism studies

Genetic polymorphism studies are powerful tools for looking at the roles of specific proteins in human populations. In Table 1, a series of genetic polymorphism studies have been performed that show that an allele producing increased expression of the gene encoding the channel of the main L-type VGCC in the brain, produces diverse neuropsychiatric effects. These studies clearly

show that excess L-type VGCC activity can cause neuropsychiatric effects. They also predict, therefore, that increased VGCC activity produced by microwave EMFs may be able to also produce widespread neuropsychiatric effects.

Table 1. Influence of genetic polymorphism of the CACNA1C in producing diverse neuropsychiatric effects.

Citation	Genetic polymorphism	Changes produced by allele of gene
Bhat et al. (2012)	Polymorphism producing Increased expression of CACNA1C L-type VGCC subunit	Review: The polymorphism Is associated with increased susceptibility to bipolar disorder, "depression, schizophrenia, autism spectrum disorders, as well as changes in brain function and structure in control subjects who have no diagnosable psychiatric illness."
Bigos et al. (2010)	Polymorphism producing Increased expression of CACNA1C L-type VGCC subunit	Associated with increases in both bipolar disorder and schizophrenia
Krug et al. (2010)	Polymorphism producing increased expression of CACNA1C L-type VGCC subunit	Negatively influences language production on a semantic level
Krug et al. (2014)	Polymorphism producing increased expression of CACNA1C L-type VGCC subunit	Influences episodic memory and retrieval
Soeiro-de-Souza et al. (2012)	Polymorphism producing increased expression of CACNA1C L-type VGCC subunit	Produces impaired facial emotion recognition
Tesli et al. (2013)	Polymorphism producing increased expression of CACNA1C L-type VGCC subunit	Produces increased activation of the amygdala during emotional processing
Thimm et al. (2011)	Polymorphism producing increased expression of CACNA1C L-type VGCC subunit	Associated with attention deficits including alerting, orienting and executive control of attention

4. Histological and functional changes in central nervous system (CNS) and peripheral nervous system (PNS) in animals exposed to microwave EMFs

The most extensive literature on histological and functional changes in animals is from the Soviet literature from the 1950s/1960s with additional Western literature from the same time period. Both Soviet and non-Soviet literature were reviewed in an English language Publication by Tolgskaya and Gordon (1973). This publication is, therefore, the main focus of this section. That publication was divided into thermal and non-thermal exposure studies, with the non-thermal studies which occupy the majority of the text (pp. 53–137) being of sole interest here.

These were all derived from the Tolgskaya and Gordon (1973) review and page numbers listed are page numbers from that document. All refer to changes produced by non-thermal exposures in the nervous system of experimental animals, with most being in rats.

This discussion scrolls down through Table 2.

Table 2. Histological and functional changes in brain function in animals following exposure to non-thermal microwave EMFs.

Observations including page numbers	Comment from Author
The majority of the histological changes seen following non-thermal exposures, occurred in the nervous system, despite its being only about 2% of the tissue mass in rodents; this suggests that the nervous system is highly sensitive to such exposures. Elsewhere (pp. 129, 136), it is suggested that the nervous system is the most sensitive tissue, followed by the heart and the testis, among all of the tissues of the body. The most severe histological changes produced by these non-thermal EMF exposures occur in the nervous system (pp. 136).	High CNS sensitivity to EMFs is predicted by the high density of VGCCs that occur in neurons throughout the nervous system, plus the VGCC role in neurotransmitter and neuroendocrine release.
Pulsed fields were more active than non-pulsed fields in producing histological changes (pp. 71, 97).	Pulsed fields have often been found to be more biologically active than are non-pulsed fields in many different studies from many countries (Pall, 2015, Pangopoulos et al., 2013, Belyaev, 2015).
Nervous system regions impacted by non-thermal microwave and lower frequency fields include: cortex, diencephalon including the hypothalamus and thalamus, hippocampus, autonomic ganglia, sensory fibers, pituitary gland including neurohypophysis.	
Neuroendocrine changes seem to undergo change over increased time of exposure. Neurosecretion in the hypothalamus and in the pituitary each go through a complex sequence over time, where EMF exposure initially	Elevated [Ca2+]i stimulates hormone secretion. However when such elevated [Ca2+]i occurs over extended time periods it is highly damaging to the cell, leading in some cases to apoptosis; thus this time

Observations including page numbers	Comment from Author
produces increased hormone secretion but where over time, the neurosecretory cells become "exhausted", leading to lowered secretion and in some cases cell death (pp. 77–96).	course of action should not be surprising.
Histological changes include boutons/argyrophilia, smaller neurons, vacuole formation in neuroendocrine cells, bead-like thickening along dendrites (pp. 66, 70, 71, 73, 97, 98, 100, 111, 115–117, 121–125). Spines near the ends of dendrites become deformed and with still more sessions of irradiation, disappeared entirely (p. 70). Sensory neurons, following exposures, developed changes characteristic of irritation, with "marked tortuosity of the nerve fibers." Many histological changes are seen in the hypothalamic cells (pp. 87–92) as their neuroendocrine function becomes impacted. Histological changes were found even with exposures that produced no apparent functional changes.	
Many histological and functional changes are reported to initially be reversible, following cessation of exposure, but progressively become irreversible with longer exposure. (pp. 64, 72, 74). Paralleling the development of irreversibility, it is found that "Repeated exposure leads to gradual increase in severity of observed changes." … including "increasingly severe disturbance of conditioned reflex activity in the animals, changes in responses of animals particularly sensitive to acoustic stimulation…." (p. 104).	If this is also true in humans, then claims that there cannot be non-thermal effects, claims which act to prolong exposures, may be causing irreversible damage to many humans.
EEG changes (pp. 55, 60, 102), including seizure activity following sensory provocation.	Lai (1997) has an extensive review of EEG changes in animals following non-thermal microwave EMF exposures
Neurodegeneration is reported in a number of places in this review (pp. 72, 83, 117).	
Synaptic connections in regions of the brain are disrupted (pp. 65–74, 97, 113, 121, 136), and at the extreme, some neurons are completely asynaptic (p. 73).	Synaptic connections are known to be disrupted in autism; could this suggest that autism may be generated by EMF exposure? No doubt, we need much more evidence on this.

Observations including page numbers	Comment from Author
"after prolonged and repeated irradiation with low-intensity centimeter waves, with no elevation of the body temperature and when the animal's condition remained satisfactory, changes were nevertheless found in the sensory fibers of the skin and viscera in the form of irritation phenomena. These findings concur with the view in the literature that the receptor system as a whole and, in particular its preterminal portions are highly sensitive." p. 76. This description is similar to what is reported to occur in electromagnetic hypersensitivity (EHS). Other such studies are described and include cumulative changes over time, that may also explain changes reported in EHS (pp. 75, 99, 100, 104).	One wonders whether almost 60 years ago, the Soviet literature may have already described a possible animal model for EHS. None is known to exist today, and because of that, EHS studies are severely constrained. Clearly one needs to be skeptical about this interpretation, but it is of great importance that this be further studied.

The majority of the histological changes seen in these mostly rodent studies, are seen in the nervous system, despite its being less than 2% of the rodent cell mass. There are statements made that the nervous system, both central and peripheral, is the most highly sensitive tissue to these non-thermal microwave and lower frequency EMFs. Following the nervous system in sensitivity are the myocardium and the testis; myocardial cells are known to have very high densities of VGCCs with especially high densities in the pacemaker cells and the testis is known to have high densities specifically of the T-type VGCCs. Pulsed EMFs are more active in producing histological changes in the brain than are non-pulsed fields, in two studies reviewed; there is a much larger literature showing that in most cases pulsed fields are more biologically active (Pall, 2015, Pangopoulos et al., 2013, Belyaev, 2015).

A wide variety of brain and peripheral nervous system tissues show histological changes following non-thermal exposures. Among the important tissues impacted are the hypothalamus and pituitary gland, where both show similar patterns of changes in neuroendocrine activities. There Is an initial increase in neuroendocrine activity (this may be produced directly by VGCC stimulation of secretion), followed over time by "exhaustion" of neuroendocrine activity (this may be produced by tissue damage produced from long term intracellular calcium [Ca2+]i elevation).

There are widespread histological changes produced in neuronal and neuroendocrine tissues. These were repeatedly reported to be largely reversible on cessation of EMF exposure. They become, however, irreversible when exposure is extended in time. There are changes in EEG activity, which may be an easily measurable monitor of neurological damage.

In a summary statement, Tolgskaya and Gordon (1973) state, "This does not confirm the view, so widely held in the past among Soviet investigators and still maintained to a large extent even at the present time in the West, that the action of microwaves is entirely thermal."

While there were many studies of brain impact of non-thermal EMFs performed in the 1950s/60s that make the information content of Tolgskaya and Gordon (1973) quite high, there is also a substantial recent literature on brain effects of non-thermal microwave EMF exposures (see, for example: Ammari et al., 2008a, Ammari et al., 2008b, Bas et al., 2009, Brillaud et al., 2007, Carballo-Quintás et al., 2011, Eberhardt et al., 2008, Dasdag et al., 2009, Dasdag et al., 2012, Grafström et al., 2008, Kumlin et al., 2007, López-Martín et al., 2006, Mausset-Bonnefont et al., 2004, Odaci et al., 2008, Rağbetli et al., 2010, Salford et al., 2003, Sonmez et al., 2010).

5. Older epidemiological reviews and other related studies

Two U.S. Government reports each listed many apparent neuropsychiatric effects of microwave/radiofrequency EMFs and a third recognized the role of non-thermal effects on our bodies, but had only a little consideration of neuropsychiatric effects.

The earliest to these was a Naval Medical Research Institute (NMRI) Research Report (1971) which listed 40 apparent neuropsychiatric changes produced by non-thermal exposures including: 5 central/peripheral nervous system (NS) changes, 9 CNS effects, 4 autonomic system effects, 17 psychological disorders, 4 behavioral changes and 2 misc. effects. This NMRI report also provided a supplementary document listing over 2300 citations documenting these and other effects of microwave exposures in humans and in animals.

The Raines (1981) NASA report reviewed extensive literature based on occupational exposures to non-thermal microwave EMFs, with that literature coming from U.S., Western European and Eastern European studies. There are no obvious differences in the literature coming from these different regions. Based on multiple studies, Raines (1981) reports 19 neuropsychiatric effects to be associated with occupational microwave/radiofrequency EMFs.

The Bolen (1994) report put out by the Rome Laboratory of the U.S. Air Force, acknowledged the role of non-thermal effects of microwave EMFs on humans. This report states in the Conclusion section that "Experimental evidence has shown that exposure to low intensity radiation can have a profound effect on biological processes. The nonthermal effects of RF/MW radiation exposure are becoming important measures of biological interaction of EM fields." Clearly Bolen (1994) rejects the claim that only thermal effects occur. Bolen (1994) discusses a specific non-thermal neuropsychiatric effect, where anesthetized animals are awakened when the head is irradiated with microwave EMFs. This suggests a similar mechanism to that acting in humans where such EMFs produce insomnia (see below).

6. Specific epidemiological studies on neuropsychiatric effects of microwave EMFs

There are 26 different epidemiological studies described in Table 3. Although 4 of these only studied a single neuropsychiatric effect, 22 of these each provide substantial evidence for the pattern described in the earlier U.S. reports, that a wide range of neuropsychiatric effects are produced by exposure to various non-thermal microwave frequency EMFs. Perhaps the most

important of these 26 is the Santini et al. (2003) study of people living near cell phone base stations.

Table 3. Neuropsychiatric symptoms apparently produced by exposure to various electromagnetic fields.

Citation	EMF exposure	Apparent neuropsychiatric symptoms
Abdel-Rassoul et al. (2007)	Living near mobile phone base station	Significant increases in neuropsychiatric complaints included: headache, memory changes, dizziness, tremors, depressive symptoms, sleep disturbance; attributed to effects of EMFs on the human nervous system.
Al-Khlaiwi and Meo (2004)	Mobile phone use	Higher prevalence of fatigue, headache, dizziness, tension and sleep disturbance; the authors conclude that mobile phone use is a risk factor for developing these symptoms.
Altpeter et al. (2000)	Short-wave broadcasting tower, ranging from 6.1 to 21.8 MHz	Sleep disruption shown to occur, correlated with exposures and apparent increase over time; short term suppression of melatonin shown, based on melatonin increases during a 3 day period when the tower was turned off.
Bortkiewicz et al. (2004)	Living near cell phone base station EMFs	Sleep disturbance, irritability, depression, blurred vision, concentration difficulties, nausea, lack of appetite, headache, vertigo.
Bortkiewicz et al. (2012)	Living near mobile phone base stations	Dose response relationships for sleep disturbance, irritability, depression, blurred vision, concentration difficulties, nausea, lack of appetite.
Chu et al. (2011), also Chia et al. (2000), Oftedal et al. (2000)	Mobile phone use	Headache during prolonged mobile phone use or within an hour following such use, with pain occurring on the ipsilateral side of the head; similar observations obtained in each of the 3 studies in column 1; see also Frey (1998).
Conrad (2013)	Smart meter EMF exposure	14 common new symptoms (both severe and moderate) among those exposed and symptomatic, 13 apparent neuropsychiatric: Insomnia, tinnitus, pressure in the head, concentration difficulty, headaches, memory problems, agitation, dizziness, fatigue, skin tingling/burning, involuntary muscle contractions, eye/vision problems, numbness; These ranged in prevalence from 63% to 19% of those experiencing symptoms, such that most symptomatic people experienced multiple symptoms.
Dasdag et al.	People working in MW	These groups suffered from headache, fatigue,

Citation	EMF exposure	Apparent neuropsychiatric symptoms
(1992)	broadcasting or at a television transmitter station	irritability, stress, sleepiness, loss of appetite, loss of hearing.
Dwyer and Leeper (1978)	People working in radiofrequency EMFs	Headache, eyestrain, dizziness, disturbed sleep, daytime sleepiness, moodiness, mental depression, memory impairment, muscle and/or cardiac pain, breathing difficulties, increased perspiration, difficulty with sex life.
Eger and Jahn (2010)	Living near mobile phone base station	Neuropsychiatric symptoms, with most showing dose–response relationships: depression; headache; cerebral symptoms; dizziness; disorders of optical and acoustic sensory systems; sleep disturbance; skin changes; with the exception of dizziness, all of these had $p < 0.001$.
Johnson Liakouris (1998)	Study of personnel in U.S. embassy in Moscow exposed to microwave EMFs	Statistically significant increases in neurological (peripheral nerves and ganglia), dermographism (skin responses), irritability, depression, loss of appetite, concentration difficulties, peripheral ganglia and nerve dysfunction.
Khan (2008)	Excessive mobile phone use	Complaints of headache, fatigue, impaired concentration, memory disturbance, sleeplessness, hearing problems.
Kolodynskii and Kolodinska (1996)	Children living near a Radio Location Station, Latvia	Memory dysfunction, attention dysfunction, lowered motor function, slowed reaction time, lowered neuromuscular endurance.
Lamech (2014)	Exposure to wireless smart meter radiation in Victoria, Australia	The most frequent symptoms to develop after smart meter radiation exposure were insomnia, headache, tinnitus, fatigue, cognitive disturbances, dysesthesias (abnormal sensation), dizziness.
Navarro et al. (2003)	Living near cell phone base station	Statistically significant dose response relationships for fatigue, irritability, headache, nausea, loss of appetite, sleep disorder, depressive tendency, feeling of discomfort, difficulty of concentration, loss of memory, visual disorder & dizziness.
Oberfeld et al. (2004)	Living near cell phone base station	Statistically significant dose–response relationships for headache, fatigue, irritability, loss of appetite, visual disorder, nausea, sleeping disorders, dizziness, poor concentration, memory loss.
Oto et al. (1994)	Occupational exposure of 25 workers to either UHF television broadcasting	10 neuropsychiatric changes were assessed, all showing statistically significant changes compared with controls: Somatization*, obsessive

Citation	EMF exposure	Apparent neuropsychiatric symptoms
	(10) or to 1062 kHz medium wave broadcasting (15)	compulsivity*, interpersonal sensitivity, depression, anxiety*, hostility*, phobic anxiety*, paranoid ideation, psychoticism*, sleeping disturbance. *$p < 0.001$.
Sadcikova (1974)	Occupational exposure to microwave radiation, including at <.07 mW/cm^2	Heaviness in head*, fatigue*, irritability*, sleepiness, memory loss*, cardiac pain*, dermographism (skin sensitivity)*, hyperhidrosis* * significant increase with time of exposure.
Salama and Abou El Naga (2004)	High cell (mobile) phone use	Most common effects were headache, ear ache, sense of fatigue, sleep disturbance, concentration difficulty, face burning sensation. The first three of these had very high statistical significance for correlation with extent of cell phone use.
Santini et al. (2003)	Living near cell phone base stations	Each of the following neuropsychiatric symptoms showed statistical significant dose–response relationships: nausea, loss of appetite, visual disturbance, irritability, depressive tendencies, lowered libido, headache, sleep disturbance, feeling of discomfort, fatigue.
Schüz et al. (2009)	Mobile phone use	Found a small, statistically significant increase in migraine and vertigo. Also found an apparent lowered occurrence of Alzheimer's, other dementia, Parkinson's and epilepsy – these latter were interpreted as being due to perhaps early symptoms of the developing diseases lowering probability of acquiring a mobile phone.
Söderqvist et al. (2008)	Use of mobile phone among adolescents	Increased mobile phone use was associated with increases in tiredness, stress, headache, anxiety, concentration difficulties and sleep disturbances.
Thomée et al. (2011)	High mobile phone use	High mobile phone use was associated with statistically significant rises in stress and sleep disturbance, with somewhat weaker association with depression.
Waldmann-Selsam et al. (2009)	Digital TV signaling	Constant headaches, pressure in head, drowsiness, sleep problems, tightness in chest, shortness of breadth, depressive mood, total apathy, loss of empathy, burning skin, inner burning, leg weakness, pain in limbs, stabbing pain in various organs, weight increase.

There are three recent studies on the generation of headache during or shortly following long mobile phone calls (listed under Chu et al., 2011 in Table 3). The timing of development of these

headaches and the finding that they occur on the ipsilateral side of the head, the side receiving much higher EMF exposure during the call, both argue strongly that these headaches are caused by the long mobile phone calls. Such causality was concluded earlier by Frey (1998) based on earlier studies and is now still more strongly documented.

7. Criteria for assessing causality in epidemiological studies

It is important to consider the different criteria that allow one to judge whether a cause and effect relationship is justified by the studies listed in Table 3 and the individual studies cited in Raines (1981). There are five such criteria that should be considered in making that judgment (see pp. 39–43 in Hennekens and Buring, 1989):

Strength of Association: Is there a strong correlation between exposure and the neuropsychiatric symptoms? There clearly is for several studies cited in Raines (1981). One example is the Dwyer and Leeper (1978) study (see Table 3) where there is a large increase in symptoms and where that increase is greater with longer occupational exposure. Another example is the Lerner (1980) study of 1300 microwave workers, where workers with relatively low exposure levels had an approximate doubling of neurological complaints and where those with substantially higher exposure levels had an approximate tripling of neurological complaints over controls. Sadcikova (1974) found that 7 of 8 neuropsychiatric symptoms studied, showed a statistically significant rise in prevalence with longer occupational exposure (see Table 3). Sadcikova (1974), also found that microwave workers had increases of 3 to over 10-fold in: feeling of heaviness in the head; tiredness; irritability; sleepiness; partial loss of memory; and skin sensitivity. There is also a strong association where important new exposures occur – this is clearly the case with all of the studies of people living near cell/mobile phone base stations, listed in Table 3 and also with the two studies of people who become exposed to radiation from smart meters. The studies listed in Table 3 under Chu et al. (2011) (see also Chia et al., 2000, Oftedal et al., 2000) are of a special type. Here people making very long (over 1 h) cell/mobile phone calls develop headaches an hour or more following the initiation of the long call. So these occur within a specific time range following initiation of these long calls, such that headache would only occur very infrequently in that time frame by chance. So here again, there is a strong association. While there is no question that many of these studies show high strength of association, it is also clear that it is becoming progressively more difficult to do these studies. As exposures become almost universal in countries around the world, it is getting difficult if not impossible to find good negative controls. There may be a similar problem in doing animal studies, such that it may be necessary to raise animals in Faraday cages in order to avoid exposures that would otherwise occur as a consequence of our near ubiquitous EMFs.

Biological credibility is extremely strong here, with three aspects of the biology predicting that these low intensity fields cause widespread neuropsychiatric effects. This was discussed above and is reconsidered in the following section.

Consistency within the different epidemiological studies and with other types of studies. The epidemiological studies listed in Table 3 and also those showing neuropsychiatric effects that were cited in Raines (1981) have been performed in many different countries with different cultures. They have been performed in multiple countries in Western Europe, Eastern Europe,

the Middle East and in East Asia, as well as in the U.S. and Australia. They are, therefore, not limited to one or two cultural contexts. This is deemed, therefore, an important indicator of causality. We also have a surprising consistency of apparent neuropsychiatric effects of different fields, including various occupational exposures and exposures to cell/mobile phone base stations, exposure to the phones themselves, exposure to smart meter pulses, and other EMFs (see Table 3). Pulsation patterns, frequencies and exact intensities may produce various biological responses (Pall, 2015, Pangopoulos et al., 2013, Belyaev, 2015) so it is a bit surprising that we have as much consistency as we do have across different types of exposures. We also have consistency with the biology discussed in the previous section. Because elevated VGCC activity produced by genetic polymorphism (Table 1) produces diverse neuropsychiatric effects, it is not surprising that elevation of VGCC activity produced by microwave EMF exposure apparently also produces diverse neuropsychiatric effects. Similarly because non-thermal EMF exposures produce widespread changes in brain structure and function in animals (Tolgskaya and Gordon, 1973), it is not surprising that the neuropsychiatric symptoms, which are produced as a consequence of brain dysfunction are produced by such EMFs.

Time sequence: It is clear that the all of these effects follow exposure in the various studies that have been published. In some studies, it is also clear that longer occupational exposure times produce increased symptom prevalence. These include Dwyer and Leeper (1978) and Baranski and Edelwejn (1975). These observations all support a causal relationship between exposure to EMF and the development of neuropsychiatric symptoms.

Dose–response relationship: It is assumed, here, that biological effects have a positive correlation with the intensity of the apparent causal stressor. This is not necessarily true of EMF effects, because it has been shown that there are "window effects" where specific intensities have larger biological effects, than *do either lower or higher intensities* (Pall, 2015, Pangopoulos et al., 2013, Belyaev, 2015). Nevertheless, where different intensities were studied in these epidemiological studies, they do show the dose–response relationship assumed here including Altpeter et al. (2000), Dwyer and Leeper (1978), Eger and Jahn (2010), Lerner (1980), Navarro et al. (2003), Oberfeld et al. (2004), Salama and Abou El Naga (2004), Santini et al. (2003) and Thomée et al. (2011). Thus these data do fit well to the assumed dose–response relationship, found in most causal roles. The Altpeter et al. (2000) study showed a special type of evidence for causality: during a 3-day period when the broadcasting tower was turned off, the melatonin levels recovered to near-normal levels. The studies of headache occurrence on prolonged cell/mobile phone calls (typically well over one hour) listed under Chu et al. (2011) in Table 3 also suggest the assumed dose–response relationship (see also Chia et al., 2000, Oftedal et al., 2000 and earlier citations listed in Frey, 1998). Because such headaches only occur with prolonged cell/mobile phone calls, these studies also provide evidence for a dose–response relationship because low doses are ineffective. Furthermore these same studies provide evidence for such a dose–response relationship from another type of observation. Because the headaches occur predominantly on the ipsilateral side of the head which receives much higher EMF exposure intensity, rather than on the contralateral side of the head, which receives much lower intensities, this provides an additional type of evidence for the predicted dose–response relationship.

While the evidence is convincing that the various neuropsychiatric apparent consequences of microwave EMF exposure are in fact caused by such exposures, there may be somewhat more controversy about another EMF-neuropsychiatric linkage. Havas et al. (2010) have reported a similar list of neuropsychiatric symptoms in electromagnetic hypersensitivity (EHS) patients. They found that each of the following symptoms were common in EHS: poor short term memory; difficulty of concentration; eye problems; sleep disorder; feeling unwell; headache; dizziness; tinnitus; chronic fatigue; tremors; body pain; difficulty speaking; tingling sensation in feet or hands; difficulty writing; difficulty walking; migraine. The similarity of these symptoms to the most commonly found symptoms following non-thermal microwave EMF exposures (Table 3), suggests that EHS is a genuine sensitivity to EMFs. In the bottom row in Table 2, sensitivities were found in rodent studies following non-thermal exposure that suggest a possible animal model for the study of EHS. Each of these EHS-related issues needs to be followed up experimentally.

8. Discussion and conclusions

In the previous section, each of the five criteria for assessing whether an epidemiological association is causal, were considered. Those five are (Hennekens and Buring, 1989): (1) strength of association; (2) biological credibility; (3) consistency; (4) time sequence; (5) dose–response relationship. Each of these five provide strong support for causality such that the combination of all five provides compelling evidence for causality. Low-intensity microwave frequency EMFs do cause diverse neuropsychiatric symptoms. While each of these five is important here, the one that is most important is the criterion of biological credibility.

Three related sets of biological observations each predict that low-intensity microwave EMFs produce widespread neuropsychiatric effects:

1.

Such EMFs act via activation of VGCCs, acting through the VGCC voltage sensor which is predicted to be exquisitely sensitive to these EMFs (Pall, 2015). VGCCs occur in high densities throughout the nervous system and have essential roles throughout the nervous system in releasing neurotransmitters and neuroendocrine hormones. These properties predict, therefore, that these low intensity non-thermal microwave EMFs cause widespread changes in the nervous system, causing, in turn, diverse neuropsychiatric effects.

2.

Elevated VGCC activity, produced by an allele of the CACNA1C gene which encodes the channel of the main L-type VGCC in the brain, produces various neuropsychiatric effects (Table 1). This predicts, that low intensity non-thermal microwave frequency EMFs which also produce elevated L-type and other VGCC activity, therefore produce widespread neuropsychiatric effects.

3.

Studies reviewed in the Tolgskaya and Gordon, 1973 publication (Table 2) have shown that the cells of the mammalian nervous system show high sensitivity to various non-thermal microwave and lower frequency EMFs, being apparently more sensitive than any other organ in the body of rodents. These studies predict that the human nervous system is likely to be similarly sensitive to these EMFs, predicting, therefore, widespread neuropsychiatric effects in humans.

We not only have biological credibility but also more importantly, each of these distinct but interrelated biological considerations predicts that low-intensity, non-thermal microwave EMFs produce widespread neuropsychiatric effects. That common prediction is verified by extensive data summarized in citations provided by the Naval Medical Research Institute Research Report (June 1971), data provided by The Raines (1981) NASA report, and by 26 epidemiological studies summarized in Table 3.

The most commonly reported neuropsychiatric symptoms from these studies are summarized in Table 4.

Table 4. Commonly reported neuropsychiatric symptoms following microwave EMF exposure.

Symptom(s)	Numbers of studies reporting
Sleep disturbance/insomnia	17
Headache	14
Fatigue/tiredness	11
Depression/depressive symptoms	10
Dysesthesia (vision/hearing/olfactory dysfunction)	10
Concentration/attention/cognitive dysfunction	10
Dizziness/vertigo	9
Memory changes	8
Restlessness/tension/anxiety/stress/agitation/feeling of discomfort	8
Irritability	7
Loss of appetite/body weight	6
Skin tingling/burning/inflammation/dermographism	6
Nausea	5

A total of 22 different studies described in Table 3 were used for data for this table, but not 4 others that only assessed a single neuropsychiatric end point. The Altpeter study which only assessed sleep disturbance/melatonin depletion and the three studies listed under Chu et al. which only assessed headache occurrence following long cell phone calls, listed in Table 3 were not included. Because many of the studies only assessed from 3 to 7 specific symptoms, it is not surprising that the numbers of studies reporting a specific symptom fall far below 22. Where

several symptom descriptions were included under one heading, such as dysesthesia, if a study had more than one of these symptom descriptions, it was only counted once.

All the symptoms listed in Table 4 should be considered established parts of microwave syndrome (Hocking, 2001, Johnson Liakouris, 1998). Even if the statistical significance in each study was of the lowest statistical significance ($p < .05$) one would expect only 1 positive study to occur at random out of the 22 studies included here. Because many individual symptoms were not surveyed in many individual studies, the expectation is substantially lower than that. Each of these, having shown positive results in 5 or more studies are highly unlikely, therefore, to have occurred by chance. Stong statistical significance is also seen for individual neuropsychiatric effects reported to have $p < 0.001$ in the Eger and Jahn (2010) and Oto et al. (1994) studies (see Table 3).

EEG changes may well be part of microwave syndrome, as well. While none of the studies described in Table 3 measured EEGs, six studies of human occupational exposure cited in the Raines (1981) showed EEG changes (Baranski and Edelwejn, 1975, Bise, 1978, Dumanskij and Shandala, 1974, Lerner, 1980, Sheppard and Eisenbud, 1977). Murbach et al. (2014) cited 10 human studies in support of their statement that "the most consistently reported effects (of mobile phone use) in various studies conducted by different laboratories are changes in the electroencephalogram (EEG) power spectrum." Three recent studies (Lustenberger et al., 2013, Schmid et al., 2012a, Schmid et al., 2012b) and several earlier studies cited in Wagner et al. (1998) have each shown EEG changes in sleeping humans exposed to non-thermal pulsed microwave fields. Two recent studies showed EEG changes in persons exposed to Wi-Fi fields (Maganioti et al., 2010, Papageorgiou et al., 2011). Lai (1997) described 8 animal studies showing changes in EEG patterns in animals exposed to non-thermal EMFs and three additional animal studies were described in Tolgskaya and Gordon (1973). With the exception of the 6 studies cited in the second sentence in this paragraph, all of these are direct experimental studies which are not, therefore, susceptible to the questions of causality that can be raised about epidemiological studies. It is the author's view that future studies should consider studying EEG changes as an objectively measurable assessment of brain physiology and that before and after increased exposure studies should be considered when a new EMF source is to be introduced into human populations. While such studies must be done carefully, given the complexity of EEGs, even very small numbers of individuals may produce highly statistically significant results in well designed studies analyzed with paired *t*-tests.

One of the citations from the previous paragraph, Bise (1978) reviewed earlier studies of low level microwave frequency exposures in humans and concluded that such EMFs produced the following neuropsychiatric effects: headache, fatigue, irritability, dizziness, loss of appetite, sleepiness, sweating, difficulty of concentration, memory loss, depression, emotional instability, dermographism, tremor, hallucinations and insomnia. The strong similarity of this list from 37 years ago and the list in Table 4 should be noted. The Bise (1978) list is based on occupational exposure studies whereas the current list in Table 4 is based primarily on EMF exposures from cell/mobile phone base stations, from heavy cell phone usage and from smart meters, *three types of exposures that did not exist in 1978*. The strong similarity between the Bise (1978) list and the current one 37 years later alone produces a compelling argument that the 11 neuropsychiatric

effects found on both lists are caused by exposure to multiple types of low-intensity microwave EMFs.

The pattern of evidence is compelling in support of the earlier statement of Levitt and Lai (2010) that "the primary questions now involve specific exposure parameters, not the reality of complaints or attempts to attribute such complaints to psychosomatic causes, malingering or beliefs in paranormal phenomena."

We can barely imagine how the combinations of neuropsychiatric effects, including those in Table 4, will influence human behavior and social interactions, now that the majority of the human populations on earth are exposed to ever increasing intensities and diversity of microwave frequency EMFs. You may recall that three of the occupational exposure studies cited in (Raines, 1981 showed increasing prevalence of neuropsychiatric symptoms with years of exposure to consistent patterns of EMF exposure intensities (Dwyer and Leeper, 1978, Sadcikova, 1974, Baranski and Edelwejn, 1975). With ever increasing exposures in human populations, we have no idea what the consequences of these ever increasing exposures will be.

Conflict of interest

The author declares no conflict of interest.

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Controversies on Electromagnetic Fields in Neurobiology of Organisms
Edited by
Suleyman Kaplan, PhD, Devra Davis, PhD MPH

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  September 2016, pp.

- **Different methods for evaluating the effects of microwave radiation exposure on the nervous system**

  September 2016, pp.

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EXHIBIT I

My Journal Entry on my Doctor's visit with Doctor Kracht and my Appointment Confirmation from the Doctor's Office

Woodlands Healing Research Center
Family, Environmental & Preventive Medicine

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Kathy Anthony

Appointment Confirmation

This is to confirm your appointment on Mon. Jan. 27, at 8:00 am The following forms are required for your appointment:

- The appropriate Medical History Intake Form, example: Adult New Patient Medical History Intake Form (depending upon your printer this form will approximately be 15 pages)
- Demographic Information Form (3 pages)
- Signature on File Form (1 page)
- HIPAA Privacy Notice (4 pages)
- HIPAA Permission for Release of Information (3 pages)
- Medicare/Medigap Authorization Form (ONLY FOR MEDICARE PATIENTS)

*** If you have insurance our office participates with, and you would like our office to submit your claim to insurance for reimbursement, you must bring your insurance card with you to the visit, or you will be responsible for payment at the time of service. Without your insurance card, you will not be able to have laboratory testing done.**

To avoid delays or possible appointment rescheduling, please plan on arriving early with your paperwork completed. For those of you coming from a distance, please allow for traffic conditions. Should you have problems downloading the paperwork, please contact our office at the above number.

Fasting is not necessary
Allow 2 hrs

A Healthy Approach In An Unhealthy World

C.2018.3000490
6.25.20
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WOODLANDS HEALING RESEARCH CENTER

5724 Clymer Rd.

Quakertown, PA 18951

Phone (215) 536-1890

Doctor's appointment with Doctor William G. Kracht on Monday, January 27, 2020 @ 8am

Doctor Journal Entry : 1/27/2020

After waiting several months for a doctor's appointment, I finally met with Doctor Kracht. I had heard about Doctor Kracht through other people who believed that they were suffering from physical symptoms related to the placement of Smart Meters on their homes. This doctor, they believed was sensitive to their needs and was helping them.

My visit started out as any other normal doctor's visit: insurance forms, necessary paperwork, height, weight, blood pressure check (which confirmed my BP issues), and then it was time to see Doctor Kracht.

On meeting Doctor Kracht, we talked about my obvious physical problems: Blood Pressure issues, stomach problems (dyspepsia), episodes of depression (as also noted by my regular GP, Doctor Dorville [who wrote a doctor's note for me in October of 2019 that deferred the Hearing date in October of 2019]). We talked about getting some more testing done in regard to my stomach issues, and then I was given a test to implement when I got home (to ascertain the GI Microbial contents of the stomach).

After discussing these physical issues with Doctor Kracht, I then brought up the recent Smart Meter controversy and told him that several individuals had recommended him in regard to helping them with this matter. Doctor Kracht then told me that he had recently been involved in a PUC case involving Smart meters for one of his patients that he had been seeing for a number of years. He also said

that after that negative experience, he did not want to get involved with any more Smart Meter cases before the PA PUC.

Doctor Kracht then went on to say that he believes that some people might be more sensitive than others in regard to non-ionizing radiation, and that he thinks that Doctor Pall probably explains well the mechanism by which these sensitivities occur.

Doctor Kracht then went to his computer to find an article for me. Coincidentally, it was the same article (American Academy of Environmental Medicine: Recommendations regarding Electromagnetic and Radiofrequency Exposures (July 12, 2012) brought forth from Lucey v. Metropolitan Edison Company, C-2018-3003679.

Finally, Doctor Kracht said that he wishes more scientists/ researchers would be working/studying this problem because it was obviously affecting a certain segment of the population and perhaps all of us to some degree.

This concludes my visit with Doctor Kracht……

EXHIBIT J

Benlian v. PECO, 15-2128, U.S. District Court

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OpinionCase details
Benlian v. Peco Energy Corp.

Citing Cases

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More recently, the Honorable Nitza I. Quiñones Alejandro held that, although PECO could be a state actor…

Plouffe v. Bayview Loan Servicing, LLC

However, all of Plouffe's claims under EESA, HAMP, ARRA, and HARP fail as a matter of law because none of…

4 Citing Cases

Case Details

Full title:RAFI BENLIAN Plaintiff, pro se v. PECO ENERGY CORPORATION and EXELON…

Court:UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF PENNSYLVANIA

Date published: Jul 20, 2016

Citations

CIVIL ACTION NO. 15-2128 (E.D. Pa. Jul. 20, 2016)

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Benlian v. Peco Energy Corp.

Opinion

CIVIL ACTION NO. 15-2128

07-20-2016

RAFI BENLIAN Plaintiff, pro se v. PECO ENERGY CORPORATION and EXELON CORPORATION Defendants

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NITZA I. QUIÑONES ALEJANDRO, J.

MEMORANDUM OPINION

INTRODUCTION

On April 21, 2015, Plaintiff Rafi Benlian ("Benlian"), proceeding *pro se*, commenced a civil action against Defendants PECO Energy Company and Exelon Corporation (collectively "Defendants"), alleging that during the period of April to June 2013, the electric service to his home was shut off by Defendants' employees. Benlian asserts that Defendants' conduct (1) violated his equal protection and procedural due process rights guaranteed by the Fourteenth Amendment of the United States Constitution; (2) constituted an unlawful conspiracy to interfere with his civil rights under 42 U.S.C. § 1985(3); and (3) violated Section 504 of the Rehabilitation Act, 29 U.S.C. § 794 ("§ 504"). [ECF 3].

On August 31, 2015, Defendants filed the instant *motion to dismiss* pursuant to Federal Rules of Civil Procedure 12(b)(1) and 12(b)(6). Even though Benlian filed several letters, after the motion to dismiss was filed, addressing his issues and objections, Defendants contend that their motion is unopposed, because Benlian has not filed a formal response to the motion consistent with Local Rule of Civil Procedure 7.1(c). Following a careful review of these issues, and for the reasons herein articulated, Defendants' motion to dismiss is granted.

While Defendants seek dismissal of the amended complaint under Rules 12(b)(1) and 12(b)(6), their argument that the amended complaint should be dismissed for lack of subject matter jurisdiction under Rule 12(b)(1) is premised on the argument that Benlian fails to state a valid civil rights or conspiracy claim. [ECF 8 at 8]. Benlian, however, asserts federal claims based on an alleged violation of his equal protection and procedural due process rights, conspiracy under 42 U.S.C. § 1985(3), and a violation of § 504. All three of these purported claims are grounded on federal law, which confers this Court with jurisdiction. *See* 28 U.S.C. § 1331. Whether

Benlian's allegations are sufficient to state valid claims is properly considered under Rule 12(b)(6). Thus, this Court will consider Defendant's motion under Rule 12(b)(6).

BACKGROUND

The relevant factual allegations, as gleaned from Benlian's 40-page amended complaint, [ECF 3], and which this Court must accept as true and construe in the light most favorable to Benlian, are summarized as follows:

In re Schering Plough Corp. Intron/Temodar Consumer Class Action, 678 F.3d 235, 243 (3d Cir. 2012).

Rafi Benlian is a resident of Havertown, Pennsylvania, (Am. Compl. ¶ 3), and a 100% service disabled veteran. *Id.* at ¶¶ 5, 8. Benlian has been diagnosed as suffering from rheumatoid arthritis, immune system deficiency, hearing loss and hyperacusis, hernias, Restless Leg Syndrome, and difficulty of breathing. *Id.* at ¶¶ 1, 5, 7. In 1995, the Department of Veterans Affairs or Veterans Administration ("VA") provided Benlian with pulmonary breathing equipment, which he has used daily ever since for six to nine hours. *Id.* at ¶ 8. To accommodate his particular health needs, Benlian moved into a room in the rear of his home which had been converted from a car port. *Id.* at ¶ 9.

Defendant PECO Energy Company ("PECO") is a Pennsylvania electric and gas utility provider, and a subsidiary of Defendant Exelon Corporation ("Exelon"), which is headquartered in Illinois. *Id.* at 2, 26-27, ¶¶ 10, 14. Prior to the summer of 2012, Benlian had had no disputes with Defendants. *Id.* at ¶ 10.

In October 2008, the Pennsylvania General Assembly approved Act 129 of 2008 ("Act 129"), which required electric distribution companies with more than 100,000 customers to install digital smart meter technology. 66 Pa. C.S. § 2807(f); Am. Compl. ¶¶ 11-12. Act 129 does not permit customers to opt out of the installation of smart meters and mandates that "[e]lectric distribution companies shall furnish smart meter technology." 66 Pa. C.S. § 2807(f)(2). In October 2009, the U.S. Department of Energy awarded Defendants $200 million for the smart meter/smart grid technology. Am. Compl. ¶ 12.

Sometime in mid-August 2012, Benlian's analog meter located in the rear of his home was replaced with a smart meter. *Id.* at ¶ 17. Some days thereafter, Benlian began experiencing unusual physical symptoms, including headaches with neck pain, waking several times during the night to debilitating pain while hooked up to the pulmonary breathing equipment, and a worsened arthritic condition. *Id.* at ¶ 19-20. Benlian had not experienced these symptoms prior to the installation of the smart meter. In addition, Benlian noticed that his hearing aids made pulsating and hissing sounds within 30 feet from the smart meter, *id.* at ¶ 21, and that the family cat, which favored a habitat five to six feet from the exterior wall on which the smart meter was installed, became lethargic, started vomiting, and lost weight. *Id.* at ¶ 23.

Benlian attempted to reach a supervisor of Defendants to report the negative impact he had experienced and observed since the smart meter's installation. He spoke with Defendants'

customer service representatives, who advised him that the smart meter installation was mandatory and that customers could not opt out and, therefore, there was nothing that could be done. *Id.* at ¶¶ 24-25. One week later, Benlian noticed that the smart meter's cover appeared to have been replaced to make it look as if the meter had been there for a longer time, rather than just recently installed. *Id.* at ¶ 26.

After researching the purported dangers of electromagnetic emissions that emanated from smart meters, Benlian concluded that the onset of his unusual physical symptoms was due to the smart meter. On September 10, 2012, Benlian submitted an "Affidavit Notice" demanding that Defendants remove and replace the smart meter with a no-radiation emitting analog meter; otherwise, he would replace it himself with an analog meter. *Id.* at ¶¶ 27-34. That same day, an employee of PECO called Benlian to inform him that PECO received the Affidavit Notice and that the smart meter had been on his property for ten years. *Id.* at ¶ 34. Benlian surmised that PECO ignored his Affidavit Notice; he removed the smart meter and shipped it back to Defendants, along with photographs of the

meter reading prior to its replacement, and a copy of the Affidavit Notice with the following command: "DEFAULT - NO TIMELY OR VALID REBUTTAL OR COMPLIANCE." *Id.* at ¶¶ 35-36. Within days of replacing the smart meter with an analog meter, Benlian noticed that his headaches and neck pain had subsided and his sleep had improved. *Id.* at ¶ 37. He continued to pay his utility bills. *Id.* at ¶ 40.

On December 4, 2012, Benlian was notified by PECO that an electric power suspension/shut off ("shut off") was scheduled for December 17, 2012, because he had not provided access to the meter, and was directed to call Defendants to provide such access. *Id.* at ¶ 41. Benlian contacted Defendants and spoke with "Mr. Ware," who acknowledged that another customer, whose pre-existing medical condition was aggravated by a smart meter, had submitted an Affidavit Notice and Demand for removal of the smart meter, which resulted in Defendants' accommodation of that customer's specific needs by installing a smart meter on a pole in the backyard, away from the house. *Id.* at ¶¶ 44-45. Mr. Ware represented that such an option could be implemented for Benlian. The scheduled December 17, 2012 shut off did not occur. *Id.* at ¶¶ 46-47.

On December 22, 2012, Benlian received two letters from Defendants, one from PECO's Medical Certification Verification Department informing him that it had been contacted and requested medical documentation to prove that Benlian had serious medical issues. The second letter advised him of an electricity shut off that would occur on December 26, 2012. *Id.* at ¶ 49. In response, Benlian had his physicians, Dr. P. Taylor and Dr. Mark Monaco, submit documentation to PECO. Dr. Monaco also stated that Benlian would need to use the electrically-operated pulmonary equipment for the rest of his life. The documentation from Benlian's doctors purportedly prevented the December 26, 2012 shut off. *Id.* at ¶ 50.

On April 6, 2013, an employee of Defendants came to Benlian's residence to install a smart meter. Benlian refused entrance and the employee left a shut off notice which was scheduled for April 12, 2013. *Id.* at ¶ 57. Benlian contacted his doctors who, again, submitted medical documentation to Defendants. The documentation was returned, marked "VOID - We are returning the enclosed request for medical certification, which has been denied." *Id.* at ¶ 58. The shut off, however, did not occur on April 12, 2013. *Id.* at ¶ 60.

On April 24, 2013, 12 or more of Defendants' employees arrived at Benlian's residence, wearing hard hats, dark glasses, and no name tags, accompanied by three large specialty trucks and six or seven small trucks, which converged in front of Benlian's property in "a very intimidating manner." *Id.* at

¶ 62. One of the employees, allegedly a supervisor, indicated that they were there to replace Benlian's analog meter with a smart meter, or else the electric power to the house would be shut off. *Id.* at ¶ 63. When Benlian asked for identification, the employee stated that he was familiar with Benlian's case and that he was "a member of the 'committee' that decided to serve [Benlian] with this ultimatum." *Id.* at ¶ 64. Benlian protested that the installation of the smart meter would worsen his compromised health condition. *Id.* at ¶ 65. The electricity, nonetheless, was shut off. *Id.* at ¶ 66. Benlian, of Armenian descent, likened this incident to that of the Armenian Genocide of 1915, commemorated on April 24, in that PECO's shut-off "arbitrarily deprived R. Benlian of life" without due process, reminiscent of the loss of property, liberty, and lives during the aforesaid historic event. *See id.* at ¶¶ 61, 67.

Benlian expressed concerns to Defendants about the electrical shut off affecting, among other things, the ability to charge batteries for his hearing aids, cellular phone, and pulmonary apparatus; the lack of heat because the house's gas furnace required an electric motor to circulate air, and the temperatures in mid-April 2013 were as low as the mid-20s Fahrenheit at night and in the early morning hours. *Id.* at ¶ 76. Conversely, during the last week of May 2013, while Benlian's electricity was still turned off, temperatures reached above 90 degrees which prohibited the use of his pulmonary equipment because it could not be used at temperatures above 83 degrees. As a result, Benlian spent several nights in his car, engine running and windows cracked open, to use the pulmonary equipment. *Id.* at ¶ 80.

In April 2013, Benlian met with a social worker at the Coatesville, Pennsylvania VA, who wrote a letter to Defendants about the hardship caused by the shut off. *Id.* at ¶ 81. In May 2013, with the assistance of a fellow veteran friend, Benlian was able to establish contact with "Mr. Ludwick," a supervisor of Defendants. *Id.* at ¶ 79. In early June 2013, Haverford Township commissioner, Chris Connell, Sr., came to Benlian's residence and observed that the electricity had not been restored. *Id.* at ¶¶ 81, 85. On June 11, 2013, Mr. Ludwick contacted Benlian to inform him that PECO would restore electricity, which occurred that day. Five days later, a PECO crew installed the mandated smart meter on a pole far from Benlian's house. *Id.* at ¶ 86.

Hyperacusis is a disorder in loudness perception.

See also Exhibit "C(e)1." [ECF 3-1].

Id.

The Affidavit Notice provided that:

[I]f within 14 days of delivery of the notice, PECO fails to replace all radiation emitting devices or fails to rebut all points raised in the document with facts, evidence, truth and law, with a sworn statement . . . by a fully identified, responsible and qualified officer of PECO/EXELON.

[sic] Mr. Benlian will replace the offending meter with a safe, and lawful analog meter - calibrated and zeroed upon installation, within specifications for standard industry use. Exh. "G1." [ECF 3-1].

See also Request for Medical Certification, Exh. "K1"; 72 Hours Shut Off Notice, Exh. "L1."

The amended complaint indicates that no shut off took place on April 12, 2012 - this appears to be a typographical error.

Indicated in the amended complaint as "Mr. Ludwig."

Defendants argue that Benlian fails to state an equal protection or procedural due process claim, a conspiracy claim under 42 U.S.C. § 1985(3), or a claim under § 504. Subsequently, Benlian filed four letters addressed to this Court. In his first letter dated September 9, 2015, Benlian advised that page 15 had been omitted from the copy of the amended complaint attached to Defendants' motion. [ECF 10]. Benlian argued that the information contained on page 15 "is crucial to the timeline and the description of the constitutional depravation [sic] in the complaint," but otherwise did not address the arguments made in Defendants' motion to dismiss. The second letter dated October 13, 2015, advised that electric power to his storage property in Upper Darby was shut off and that his wife was experiencing health problems. [ECF 13].

Defendants also argue that, as a threshold matter, this Court does not have subject matter jurisdiction because Benlian cannot state a claim for a civil rights violation or present any other federal question. [ECF 8].

See also [ECF 8-1].

On October 1, 2015, Defendants requested that their motion be granted as uncontested pursuant to Local Rule 7.1(c) because the time period in which to formally respond to their motion had passed. [ECF 12]. On November 16, 2015, Defendants filed a reply in further support of their motion. [ECF 18].

In the absence of a timely response, a motion may be granted as uncontested. L.R. 7.1(c).

On November 17, 2015, Benlian submitted a third letter that highlighted Defendants' previously described actions and cursorily refuted Defendants' argument that Benlian's claims are not based in federal law. [ECF 19]. In a subsequent fourth letter dated December 7, 2015, Benlian requested that this Court accept his letter as a "Reply Memorandum" in opposition to Defendants' motion, [ECF 20], citing as grounds the "extrinsic and intrinsic" evidence presented with the previous letter submissions. While Benlian's November 17, 2015 letter addressing Defendants' lack of federal law argument was filed beyond the response deadline provided in Local Rule 7.1(c), this Court will liberally construe all of Benlian's *pro se* correspondences as a "response" and will decline to grant Defendants' request to consider the motion as uncontested.

LEGAL STANDARD

When considering a motion to dismiss for failure to state a claim pursuant to Rule 12(b)(6), the court "must accept all of the complaint's well-pleaded facts as true, but may disregard any legal conclusions." *Fowler v. UPMC Shadyside*, 578 F.3d 203, 210 (3d Cir. 2009). The court must determine "whether the facts alleged in the complaint are sufficient to show that the plaintiff has a 'plausible claim for relief.'" *Id.* at 211 (*quoting Ashcroft v. Iqbal*, 556 U.S. 662, 679 (2009)). The complaint must do more than merely allege the plaintiff's entitlement to relief; it must "show such an entitlement with its facts." *Id.* (citations omitted). "[W]here the well-pleaded facts do not permit the court to infer more than the mere possibility of misconduct the complaint has alleged - but it has not 'show[n]' - 'that the pleader is entitled to relief.'" *Iqbal*, 556 U.S. at 679 (quoting Fed. R. Civ. P. 8(a)) (alterations in original). "A claim has facial plausibility when the plaintiff pleads factual content that allows the court to draw the reasonable inference that the defendant is liable for the misconduct alleged." *Id.* at 678 (citing *Bell Atlantic Corp. v. Twombly*, 550 U.S. 544, 555 (2007)). "Threadbare recitals of the elements of a cause of action, supported by mere conclusory statements do not suffice." *Id.* To survive a motion to dismiss under Rule 12(b)(6), "a plaintiff must allege facts sufficient to 'nudge [his] claims across the line from conceivable to plausible.'" *Phillips v. Cnty. of Allegheny*, 515 F.3d 224, 234 (3d Cir. 2008) (quoting *Twombly*, 550 U.S. at 570)).

In addition, "a *pro se* complaint, however unartfully pleaded, must be held to less stringent standards than formal pleadings drafted by lawyers." *Erickson v. Pardus*, 551 U.S. 89, 94 (2007). When presented with a *pro se* litigant, the court has a special obligation to construe the complaint liberally. *Higgs v. Attorney Gen. of the United States*, 655 F.3d 333, 339 (3d Cir. 2011). Thus, even if a *pro se* plaintiff's claims are not set out in the clearest fashion, the court is obligated to discern all the possible claims that the plaintiff may be alleging. *Id.* at 339 (citing *Estelle v. Gamble*, 429 U.S. 97, 106 (1976)); *Thomas-Warner v. City of Phila.*, 2011 WL 6371898, at *4 (E.D. Pa. Dec. 20, 2011). However, in so doing the court still determines whether a *pro se* plaintiff has alleged sufficient facts to support the claims divined from the pleadings. This policy of liberally construing *pro se* submissions is "driven by the understanding that '[i]mplicit in the right of self-representation is an obligation on the part of the court to make reasonable allowances to protect *pro se* litigants from inadvertent forfeiture of important rights because of their lack of legal training.'" *Higgs*, 655 F.3d at 339 (quoting *Triestman v. Fed. Bureau of Prisons*, 470 F.3d 471, 475 (2d Cir. 2006)).

DISCUSSION

As stated, Defendants seek to dismiss the amended complaint because: Benlian (1) fails to state an actionable claim under 42 U.S.C. § 1983 ("§ 1983") for violations of civil rights/state-created danger, Fourteenth Amendment equal protection, or procedural due process; (2) has not sufficiently stated a conspiracy claim under 42 U.S.C. § 1985(3); and (3) has not sufficiently stated a claim pursuant to § 504 of the Rehabilitation Act. These contentions will be addressed *ad seriatim*.

42 U.S.C. § 1983 Claim

To assert a claim under 42 U.S.C. § 1983, a plaintiff must allege facts sufficient to establish that he was deprived of a federal constitutional or statutory right by a state actor. *Rhett v. Evans*, 576

F. App'x 85, 87 (3d Cir. 2014) (citing *Kach v. Hose*, 589 F.3d 626, 646 (3d Cir. 2009)). Thus, there can be no cause of action under § 1983 absent a violation of a right secured either by the Constitution and/or the laws of the United States, *Reichley v. Pennsylvania Dept. of Agric.*, 427 F.3d 236, 244 (3d Cir. 2005), by a defendant acting under color of official authority. *Id.* (citing *West v. Atkins*, 487 U.S. 42, 48 (1988)). That is, the defendant must be a state actor. Whether entities, such as Defendants, are "state actors" is not always obvious on its face, as there are instances where a private entity can act in such a way that it is construed as a state actor or is treated as having engaged in state action.

Although there is no "simple line" between state and private actors, *Brentwood Acad. v. Tenn. Secondary Sch. Athletic Ass'n*, 531 U.S. 288, 295 (2001), "[t]he principal question at stake is whether there is such a close nexus between the State and the challenged action that seemingly private behavior may be fairly treated as that of the State itself." *Kach*, 589 F.2d at 646 (quoting *Leshko v. Servis*, 423 F.3d 337, 339 (3d Cir. 2005)). To determine whether state action exists, a court must consider: (1) "whether the private entity has exercised powers that are traditionally the exclusive prerogative of the state"; (2) "whether the private party has acted with the help of or in concert with state officials"; and (3) whether "the [s]tate has so far insinuated itself into a position of interdependence with the acting party that it must be recognized as a joint participant in the challenged activity." *Mark v. Borough of Hatboro*, 51 F.3d 1137, 1142 (3d Cir. 1995). Under any consideration, "[t]he inquiry is fact-specific." *Groman v. Twp. of Manalapan*, 47 F.3d 628, 638 (3d Cir. 1995); *see also Crissman v. Dover Downs Entm't Inc.*, 289 F.3d 231, 234 (3d Cir. 2002) (*en banc*) (noting that "the facts are crucial.").

In his amended complaint, Benlian avers that Defendants were "State Actors Functioning under the Color of State Law" pursuant to § 1983. Am. Compl. ¶ 15; 2:12-13, 24, 25. This Court takes judicial notice of Defendant Exelon's filings before the Securities and Exchange Commission and notes that Defendant Exelon is a registered public utility holding company, subject to regulation by the Securities and Exchange Commission under the Public Utility Holding Company Act of 1935, 15 U.S.C. § 79 *et seq.*, and Defendant PECO is an operating company wholly owned by Exelon. As such, Defendants contend that neither one of them is a government entity or agency. (ECF 8 at 10). This Court agrees.

In *Jackson v. Metro. Edison Co.*, 419 U.S. 345, 350 (1974), the United States Supreme Court held that a privately owned and operated utility corporation, which held a certificate of public convenience issued by the Pennsylvania Utilities Commission, was not a state actor. Here, Defendants are also privately owned and operated utility companies and are not, on their face, state actors.

That is not to say that Defendants cannot ever be state actors for purposes of § 1983. Courts in this district noted that PECO may be a state actor in certain circumstances, but that merely acting in concert with the Pennsylvania Utilities Commission does not render it a state actor. *Dunlap v. Peco Energy Co.*, 1996 WL 617777, at *2 (E.D. Pa. Oct. 23, 1996) (citing *Goadby v. Phila. Elec. Co.*, 639 F.2d 117, 120 n.2 (3d Cir.1981)). In *Dunlap*, the Court noted that when a utility company exercises a traditionally governmental power, such as eminent domain, state action may be present, but mere business activities such as furnishing electrical power are not state functions. *Id.* The court, quoting *Jackson*, noted that the critical inquiry is "whether there is a

sufficiently close nexus between the State and the challenged action of the regulated entity so that the action of the latter may fairly be treated as that of the State itself." *Id.* (quoting *Jackson*, 419 U.S. at 351).

Though Benlian concedes that *Jackson*'s holding is valid and that no state action was implicated there, he refutes the lack of state action and argues that the "mandate of (Act 129) fully qualifies the Defendants . . . as private companies functioning under 'Color of State Law' in the process of implementation of PA, (Act 129)," *id.* at ¶ 14, and that his dispute with Defendant PECO would not have occurred but for Act 129. Benlian attempts to distinguish *Jackson* by noting that his issue is the shut off of his electricity due to the installation of smart meters, while the issue in *Jackson* was electricity shut off due to nonpayment of bills. Benlian's argument, however, lacks merit.

In *Crissman*, a case involving a private corporation that owned and operated a racing facility, the Third Circuit, in reiterating its holdings in other matters addressing whether government regulation and funding convert private action to state action, held that state licensing was not enough to make a private entity a state actor, and that "*regulation* - even detailed regulation, as we have here - does *not* equate to state action," *Crissman*, 289 F.3d at 243 (emphasis provided). Moreover, "the flow of funds does not implicate the state in private activity." *Id.*; *see also Rendell-Baker v. Kohn*, 457 U.S. 830, 842 (1982) ("That a private entity performs a function which serves the public does not make its acts state action."); *Thompson v. Eva's Vill. and Sheltering Program*, 243 F. App'x 697, 698 (3d Cir. 2007) (citing *Leshko v. Servis*, 423 F.3d 337, 341 (3d Cir. 2005) (regulation and receipt of government funds, without more, does not constitute state action)).

Guided by these decisions, this Court concludes that the regulation requiring utility companies to install smart meters without an opt-out provision, as required by Act 129, is the kind of detailed regulation which does not equate to a state action. The installation of smart meters, and the provision of electricity to customers such as Benlian, is a business activity, and not a state function or a state action. The installation of smart meters pursuant to Act 129 does not create a sufficiently close nexus between the Commonwealth of Pennsylvania and the Defendants for the Defendants' actions to be treated as state action. Furthermore, Defendants' $200 million grant from the U.S. Department of Energy does not implicate the State in private activity. Therefore, in light of the well-settled case law cited, Benlian's attempt to cast Defendants' implementation of Act 129 and/or their receipt of government funds as state action fails. Consequently, having failed to assert a state action, Benlian's § 1983 claim cannot proceed in this forum.

This Court notes that Pennsylvania law sets out formal and informal procedures for addressing the shut off of one's electricity, handled by the Public Utility Commission and Bureau of Consumer Services. *See* 52 Pa. Code §§ 56.163, 56.173.

42 U.S.C. § 1985(3) Claim

Defendants also assert that Benlian has failed to sufficiently state a conspiracy claim under 42 U.S.C. § 1985(3) ("§ 1985(3)"). To state a claim under § 1985(3), a plaintiff must show, among other things, "a conspiracy" that is "motivated by a racial or class based discriminatory animus."

Scheib v. Butcher, 602 F. App'x 67, 68 (3d Cir. 2015) (citing *Lake v. Arnold*, 112 F.3d 682, 685 (3d Cir. 1997)). In general, § 1985, like § 1983, does not create substantive rights but merely serves as a conduit for vindicating federal rights and privileges that have been defined elsewhere. *Spence v. Caputo*, 2015 WL 630294, at *30 (W.D. Pa. Feb. 12, 2015) (citing *Brown v. Philip Morris Inc.*, 250 F.3d 789, 805 (3d Cir. 2001)). Unlike § 1983, however, § 1985(3) reaches private actors. *See Mangan v. Brierre*, 257 F. App'x 525, 528 (3d Cir. 2007); *see also Okpor v. Rutgers, State Univ. of New Jersey*, 196 F. App'x 129, 130 (3d Cir. 2006) (finding that § 1985(3) protects individuals from deprivations of rights committed by either private or state actors as part of a conspiracy).

However, "[i]n the context of actions brought against private conspirators, the Supreme Court has thus far recognized only two rights protected under § 1985(3): the right to be free from involuntary servitude and the right to interstate travel." *Brown*, 250 F.3d at 805 (quoting *Bray v. Alexandria Women's Health Clinic*, 506 U.S. 263, 278 (1993)). In *United Bhd. of Carpenters and Joiners, Local 610 v. Scott*, 463 U.S. 825, 828-29 (1983) and *Griffin v. Breckenridge*, 403 U.S. 88, 102-103 (1971), the Supreme Court has distilled the required elements to plead a claim under § 1985(3); *to wit*: (1) a conspiracy between two or more actors; (2) motivated by a racial or class-based discriminatory animus designed to deprive, directly or indirectly, any person or class of persons to the equal protection of the laws; (3) an act in furtherance of the conspiracy; and (4) an injury to person or property or the deprivation of any right or privilege of a citizen of the United States.

Benlian purports to support a claim of civil conspiracy under § 1985(3), claiming that: he was a "targeted victim of conspiracy perpetuated by Defendants," who deprived him of equal protection, and retaliated against him for sending the Affidavit Notice, Am. Compl. 32:14-16; that Defendants' "inner corporate body" decided to make an example of Benlian by shutting off his electricity to discourage others from taking similar action, *id.* at 34:27-35:3; that PECO lied to him about the smart meter being on his property for ten years, *id.* at 32:20-24; that Defendants "sidelined" the efforts of Mr. Ware, who suggested to Benlian the option of placing a smart meter on a pole at a safe distance away from Benlian's house, *id.* at 34:4-14; that Defendants conspired with unknown actors to suppress potential class action suits about the dangers of smart meters, *id.* at 33:22-25; and that Defendants' "committee" had a "meeting of the minds" by approving and implementing the electricity shut off on April 24, 2013, a day intentionally chosen to intimidate Benlian. *Id.* at 35:9-25. For the reasons that follow, however, Benlian's conspiracy claim lacks merit.

In *Robison v. Canterbury Vill., Inc.*, 848 F.2d 424 (3d Cir. 2008) the Third Circuit "joined a plethora of other federal courts in holding that an alleged conspiracy between a corporation and its officers or agents cannot satisfy the first element of a § 1985(3) claim." *Rose v. Morning Call, Inc.*, 1997 WL 158397, at *7 (E.D. Pa. Mar. 28, 1997). Similarly, under the "intracorporate conspiracy doctrine," a conspiracy under Pennsylvania law cannot arise between a principal and its agent because of the nature of the relationship. *Scheib*, 602 F. App'x at 68 (citing *Duffy v. Lawyers Title Ins. Co.*, 972 F. Supp. 2d 683, 698 (E.D. Pa. Sept. 17, 2013)). That is, "[i]t is well-settled that a corporation cannot conspire with its subsidiaries, its agents, or its employees." *Duffy*, 972 F. Supp. 2d at 698 n.32 (quoting *Michael v. Shiley, Inc.*, Civ. 93-1729, 1994 WL 59349, at *15 (E.D. Pa. Feb. 25, 1994), *aff'd in part, rev'd in part on other grounds*, 46 F.3d

1316 (3d Cir. 1995)); *see also Plemmons v. PMA Ins. Co.*, Civ. 90-2495, 1991 WL 125982, at *13 (E.D. Pa. July 3, 1991) ("Since a corporation, as a legal creation, can only act through its agents, an alleged conspiracy between a corporation and its agents is a conspiracy between an entity and itself, which is no conspiracy at all."). As noted earlier, PECO is an operating company wholly owned by Exelon. As pled in the amended complaint, Benlian essentially alleges a conspiracy between Exelon and PECO, a corporation and its subsidiary, among whom no conspiracy can exist.

Notwithstanding, two exceptions to the intracorporate conspiracy doctrine have been recognized for purposes of satisfying the conspiracy element in a § 1985(3) claim; *to wit*: a conspiracy between a corporation and its agent may be maintained (1) where the agent is alleged to have acted in a personal rather than corporate capacity, or (2) where an independent third party is alleged to have joined the conspiracy. *Robison*, 848 F.2d at 431. Here, Benlian has satisfied neither of these exceptions. Although he singled out several individuals who purportedly were supervisors of Defendants, Mr. Ware, Mr. Ludwig, and the unidentified supervisor who ordered the shut off at Benlian's home on April 24, 2013, Benlian does not sufficiently allege that these individuals acted in their personal capacity. Instead, all allegations point to actions on behalf of Defendants. Mr. Ware is the alleged supervisor of Defendants who spoke to Benlian about the possibility of placing the smart meter on a pole away from the house; the unidentified supervisor of April 24, 2013, was allegedly a member of the "committee" that decided to serve Benlian with the ultimatum of replacing the smart meter or having his electricity shut off; and Mr. Ludwig was the person who notified Benlian on behalf of PECO that electricity would be restored. Nowhere in the amended complaint has Benlian identified any other third party who was part of Defendants' purported conspiracy.

As a result, not only has Benlian failed to sufficiently plead the existence of a conspiracy and a violation of the only two rights protected under § 1985(3) - *i.e.*, the right to be free from involuntary servitude and the right to interstate travel - but he he has also failed to satisfy the existence of either of the two exceptions for a conspiracy.

Section 504 / Rehabilitation Act Claim

Finally, Defendants contend that Benlian does not have a private cause of action under Section 504 of the Rehabilitation Act, 29 U.S.C. § 794 ("§ 504" or "Rehabilitation Act"). In the amended complaint, Benlian avers that he is a qualified individual with disabilities and invokes § 504 to argue that Defendants retaliated against him by refusing to accommodate his disabilities and instead choosing to shut off his electricity. Referencing the $200 million grant from the U.S. Department of Energy, Benlian asserts that "[§] 504 creates a private right of action for individuals subjected to disability discrimination by any program or activity receiving federal financial assistance." Am. Compl. 38:18-19.

Section 504 is commonly referred to as the "civil rights bill of the disabled." *Three Rivers Ctr. for Indep. Living, Inc. v. Housing Auth. of the City of Pittsburgh*, 382 F.3d 412, 416 (3d Cir. 2004) (quoting *ADAPT v. Skinner*, 881 F.2d 1184, 1187 (3d Cir. 1989) (*en banc*)). It prohibits discrimination on the basis of disability by programs that receive federal funds. *P.P. ex rel. Michael P. v. W. Chester Area Sch. Dist.*, 585 F.3d 727, 730 (3d Cir. 2009); *Bowers v. Nat'l*

Collegiate Athletic Ass'n, 346 F.3d 402, 432 (3d Cir. 2003). Specifically, the statute provides that:

No otherwise qualified individual with a disability in the United States, as defined in section 705(20) of this title, shall, solely by reason of her or his disability, be excluded from the participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance or under any program or activity conducted by any Executive agency or by the United States Postal Service.

29 U.S.C. § 794(a).

By its terms, § 504 applies only to "program[s] or activit[ies]" receiving federal financial assistance and does not apply to individuals. *Emerson v. Thiel Coll.*, 296 F.3d 184, 190 (3d Cir. 2002); *Fitzpatrick v. Pennsylvania, Dep't of Transp.*, 40 F. Supp. 2d 631, 637-38 (E.D. Pa. 1999). Though § 504 does not itself provide a private right of action for aggrieved individuals, it does provide that the "remedies, procedures, and rights set forth in Title VI of the Civil Rights Act of 1964 [42 U.S.C.A. § 2000d *et seq.*] shall be available to any person aggrieved by any act or failure to act by any recipient of federal financial assistance or federal provider of such assistance under section 794 of this title." *Bowers*, 346 F.3d at 419 (quoting 29 U.S.C. § 794(a)(2)). Title VI provides that no person shall be excluded from participation nor subjected to discrimination by any program or activity receiving federal funds. 42 U.S.C. § 2000d.

Although the statute provides no private right of action, one has been *implied* that allows for both compensatory damages and injunctive relief. *Datto v. Harrison*, 664 F. Supp. 2d 472, 490 (E.D. Pa. 2009) (citing *Barnes v. Gorman*, 536 U.S. 181, 185-87 (2002)). Congress has also specifically provided that the remedies and procedures of Title VI are available to those seeking to enforce § 504. *Id.* (citing 29 U.S.C. § 794a(a)(2)); *Bowers*, 346 F.3d at 426 ("[A]lthough the remedy available to persons aggrieved by violations of the Rehabilitation Act . . . is at root an implied one, [the statute], by cross-referencing Title VI, which already had been interpreted as creating a private right of action, arguably [contains an] explicit provision[ ] creating a private right of action.").

The Third Circuit in *Three Rivers* addressed the issue of whether a private right of action exists to enforce regulations that an agency promulgates to a federal statute. For an *implied* right of action to exist, a statute must manifest Congress' *intent* to create the personal right and private remedy. *Three Rivers*, 382 F.3d at 421 (citing *Sandoval*, 532 U.S. at 286) (emphasis provided). Thus, a determination must be made as to whether or not "Congress intended to confer individual rights upon a class of beneficiaries. Accordingly, where the text and structure of a statute provide no indication that Congress intends to create new individual rights, there is no basis for a private suit, whether under § 1983 or under an implied right of action." *Gonzaga Univ. v. Doe*, 536 U.S. 273, 285-86 (2002).

Congress' intent in enacting a statute is always the "focal point" in determining whether courts should infer a private right of action from the statute. *Three Rivers*, 382 F.3d at 421 (citing *Thompson v. Thompson*, 484 U.S. 174, 179 (1988)). The Supreme Court set forth in *Cort v. Ash*, 422 U.S. 66 (1975) four factors to guide a court's review in discerning such intent. *Three Rivers*,

382 F.3d at 421; *Thompson*, 484 U.S. at 179; *see also Hindes v. F.D.I.C.*, 137 F.3d 148, 169 (3d Cir. 1998). These factors are:

First, is the plaintiff "one of the class for whose *especial* benefit the statute was enacted,"-that is, does the statute create a federal right in favor of the plaintiff? Second, is there any indication of legislative intent, explicit or implicit, either to create such a remedy or to deny one? Third, is it consistent with the underlying purposes of the legislative scheme to imply such a remedy for the plaintiff? [Fourth,] is the cause of action one traditionally relegated to state law, in an area basically the concern of the States, so that it would be inappropriate to infer a cause of action based solely on federal law?

Three Rivers, 382 F.3d at 421 (quoting *Cort*, 422 U.S. at 78 (citations omitted)).

"The first two criteria are critical. If they do not point toward a private right, the remaining two 'cannot by themselves be a basis for implying a right of action.'" *Am. Tel. & Tel. Co. v. M/V Cape Fear*, 967 F.2d 864, 866 (3d Cir. 1992) (quoting *Touche Ross & Co. v. Redington*, 442 U.S. 560, 580 (1979)). That is, for an implied right of action to exist, a statute must manifest Congress' intent to create (1) a personal right and (2) a private remedy. *See Alexander*, 532 U.S. at 286. Accordingly, courts must look to the enabling statute to find the source of a right of action to enforce regulations, because "an agency's rulemaking power cannot exceed the authority granted to it by Congress." *Three Rivers*, 382 F.3d at 242 (citing *Angelastro v. Prudential-Bache Sec., Inc.*, 764 F.2d 939, 947 (3d Cir. 1985)).

In light of these factors, this Court opines that Benlian has failed to establish that Act 129 confers a personal right or private remedy. Benlian acknowledges the purpose of Act 129, statutorily embodied in 66 Pa. C.S. § 2807, is to "improve energy conservation in the state of PA, under the supervision, and legal framework set up by the PA PUC." Am. Compl. ¶ 11. In addition, a review of the enactment of Act 129 reveals that the Pennsylvania General Assembly declared the objectives served by the statute as:

(1) the health, safety and prosperity of all citizens of this commonwealth are inherently dependent upon the availability of adequate, reliable, affordable, efficient and environmentally sustainable electric service at the least cost, taking into account any benefits of price stability, over time and the impact on the environment.

(2) it is in the public interest to adopt energy efficiency and conservation measures and to implement energy procurement requirements designed to ensure that electricity obtained reduces the possibility of electric price instability, promotes economic growth and ensures affordable and available electric service to all residents.

(3) it is in the public interest to expand the use of alternative energy and to explore the feasibility of new sources of alternative energy to provide electric generation in this commonwealth.

2008 Pa. Legis. Serv. Act 2008-129 (H.B. 2200).

While systemic legislation may in fact benefit a group of individuals, it does not mean that the legislation confers a personal right onto those individuals. "[T]he question whether a statute is *intended* to *benefit* particular plaintiffs is quite different from the question whether the statute *in*

fact benefits those plaintiffs. . . ." *Three Rivers*, 382 F.3d at 419 (quoting *Pa. Pharmacists Ass'n v. Houstoun*, 283 F.3d 531, 535 (3d Cir. 2002) (emphasis in original)). Personal rights are those intentionally and "unambiguously conferred" through "rights-creating" language. *Id.* at 419-20 (quoting *Gonzaga*, 536 U.S. at 284; *see also Sabree ex rel. Sabree v. Richman*, 367 F.3d 180, 187-88 (3d Cir. 2004)). Personal rights inhere in the individual; they are "individually focused" and create "individual entitlements." *Three Rivers*, 382 F.3d at 419. Non-personal rights, by contrast: (1) often have a "systemwide" or "aggregate" focus; (2) are defined in terms of obligations of the person or entity regulated rather than in terms of entitlements of the individual protected; (3) are "not concerned with whether the needs of any particular person have been satisfied"; and (4) regard "institutional policy and practice, not individual instances" of conduct. *Id.* (citing *Gonzaga*, 536 U.S. at 282; *Sandoval*, 532 U.S. at 288-89; *Blessing v. Firestone*, 520 U.S. 329, 343-44 (1997)).

As alluded to, Act 129, through its enabling statute at 66 Pa. C.S. § 2807, sets forth the duties of electric distribution companies. In this Court's view, the non-personal aspects of Act 129 are evident. First, its focus is "systemwide" in that "each electric distribution company shall maintain the integrity of the distribution system . . . in conformity with the National Electric Safety Code and such other standards practiced by the industry in a manner sufficient to provide safe and reliable service to all customers connected to the system." § 2807(a). Second, Act 129 defines obligations of the entity regulated, *i.e.*, electric distribution companies, rather than in terms of entitlements of the individual protected, *i.e.*, electric customers, such as Benlian. Third, Act 129 establishes general consumer protections and regulations to be followed by electric distribution companies and is not necessarily concerned with whether the needs of any particular customer have been satisfied. Lastly, Act 129 sets forth institutional policy and practice with respect to the implementation of smart meter technology, not as to specific, individual instances of conduct.

PECO is one of more than 200 electric utility companies to receive a Smart Grid Investment Grant from the U.S. Department of Energy, as part of the American Recovery and Reinvestment Act of 2009 ("ARRA"), for the purpose of stimulating the economy by, *inter alia*, modernizing the electric grid. In light of the stated objectives of Act 129, this Court is constrained to conclude that Act 129 was intended not to confer an "especial personal benefit," but rather, to provide for overall improvements to the nationwide grid to benefit a wider group of individuals. As such, Act 129 reveals no federal implied right in favor of Benlian. Consequently, Benlian cannot support a private right of action against Defendants under the Rehabilitation Act.

Energy.Gov, *Recovery Act: Smart Grid Investment Grants*, http://energy.gov/oe/recovery-act-smart-grid-investment-grants; *see also* Exhibit "C(e)1." This Court notes also that there has been no suggestion that Congress, when it enacted the ARRA, intended to create a personal right or a private remedy that would sustain a private right of action. As noted above, the ARRA was enacted to stimulate the economy, and the Smart Grid Investment Grant from the U.S. Department of Energy was established to modernize the United States' electrical power grid. *E.g.*, *Naperville Smart Meter Awareness v. City of Naperville*, 114 F. Supp. 3d 606, 609 (N.D. Ill. 2015). The ARRA, and the grant of federal funds to electricity providers, was not intended to create a private right of action against electricity providers that used the funds for their intended purpose—modernizing the electrical grid. As with Act 129, this Court concludes that the ARRA and the Smart Grid Investment Grant did not confer a "personal benefit" but rather provided

funds to create systemic improvements to the electrical grid for the benefit of the populace as a whole. Benlian cannot, therefore, assert a private right of action based on the ARRA against Defendants under the Rehabilitation Act. *See Three Rivers*, 382 F.3d at 419-22. --------

CONCLUSION

For the reasons stated herein, Defendants' motion to dismiss is granted. An Order consistent with this Memorandum Opinion follows. NITZA I. QUIÑONES ALEJANDRO
Judge, United States District Court

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C-2018-3000490

PPL Electric Exhibit KD-1

6/25/20

Account Contact History
Account: 8836728528 Customer Name: HOWARD ANTHONY
From 6/29/2015 to 9/27/2019

Contact Date	Contact Type	Remarks	User
2019-09-06	SC - PUC Formal Complaint	extending PUC Formal Complaint suspend charge date.	E02623
2019-08-14	Correspondence - General	Template Name Make up Estimate Billing Created By Giumento Julie A Letter Edited Yes CS Letters ID 3256959	CSLET
2019-08-14	SC - GRACE EXTENSION	Suspend Charge automatically added by CSLET	CSLET
2019-08-14	Miscellaneous	WATT Billing - WFM follow-up Work Item 2442575 Completed	JULIE GIUMENTO
2019-08-12	Miscellaneous	WATT Generalist - Bill Account Maintenance Work Item 2436476 Completed	MEGAN L MCGRAW
2019-08-12	Billing	working billing request mailbox canceled last bill and rebilled on Adj 8 5 R 99251 based on proration of actuals 5 3 R 95093 and 8 10 R 99472 from check read sent makeup est bill letter.	JULIE GIUMENTO
2019-08-12	Miscellaneous	WATT Billing - WFM follow-up Work Item 2442575 Created	JULIE GIUMENTO
2019-08-12	Cancel/Only Service		JULIE GIUMENTO
2019-08-10	Check Read - Billing Request Completed	Action Taken Read Meter	MDT
2019-08-07	Miscellaneous	WATT ID 2436476 Issued check read - billing request for 8 8 19 as per request. Holding to for order to complete.	MEGAN L MCGRAW
2019-08-07	Check Read - Billing Request Issued	Please check reading as per Mike Gower.	MEGAN L MCGRAW
2019-08-02	Miscellaneous	please issue a billing requested check read order use this actual reading to adjust estimated billing	MICHAEL C GOWER
2019-08-02	Miscellaneous	WATT Generalist - Bill Account Maintenance Work Item 2436476 Created	MICHAEL C GOWER
2019-05-02	Batch Enrollment		
2019-01-18	SC - GRACE EXTENSION	Caller Back Office Ratepayer. Suspending customer charges due to paperless bill delay	E177845
2018-07-13	Data Repair	DR_INC10174679_MEMOED_1	CSSDR044
2018-07-05	Miscellaneous	WATT No Bill - No Bill Residential Work Item 2163323 Created	CSS
2018-03-15	SC - PUC Formal Complaint	The customer filed Formal Complaint WATT ID 2039175.	E02623
2018-03-15	Miscellaneous	WATT FieldFormalComplaint - Service Related-AMI Issues Work Item 2039175 Created	DONNA KINGCAID
2017-12-06	RF Meter Replacement	RF meter exchange follow up RTU - 2017-12-06 - 83938331 Customer Refused AMI Device customer did not want me on property	CSSDR044
2017-12-06	RF Meter Replacement	RF meter exchange follow up RTU - 2017-12-06 - 83938331 Customer Refused AMI Device customer did not want me on property	CSSDR044
2017-12-06	RF Meter Replacement	RF meter exchange follow up RTU - 2017-12-06 - 83938331 Customer Refused AMI Device customer did not want me on property	CSSDR044
2017-12-05	Batch Enrollment		
2017-11-29	Miscellaneous	Meter Vision 20 20 response letter was mailed using Sheila Ketterer s letterhead on 11 28 2017. Customer concern was due to meter refusal.	KAYLEIGH MOSS
2017-11-28	Meter	Caller Back Office Ratepayer. Dan McKee talked to customer on 11 28 at 1600. Customer very unhappy with new meters being installed. They are contacting their state reps and refuse to accept a new meter. A follow-up letter from Corp Comm will be drafted and sent to customer.	DANIEL J MCKEE
2017-11-16	Meter	Caller CATHY ANTHONY Spouse. DOESNT WANT METER CHANGED..INFORMED WE NEED TO HAVE THE METERS COMPLETED BY 2020 EMAILED METER VISION TO CONTACT SPOUSE...UNDERSTANDS WHAT I WENT OVER WITH HER..	CARMEN P URBAN
2017-10-30	RF Meter Replacement	3 week Letter Sent - 2017-10-30 - 3 Week Letter Sent Mailed to 505 NORWAY PL	CSSDR044
2017-10-27	RF Meter Replacement	Call Center Comment - 2017-11-27 - Bethlehem Operating Center Do Not Schedule Appointments Before 11 27 2017	CSSDR044
2017-10-10	RF Meter Replacement	6 week Letter Sent - 2017-10-09 - 6 Week Letter Sent Mailed to Address 505 NORWAY PL	CSSDR044
2017-02-25	Meter	Pre-sweep MEX TranGrid 65269S47012 LAT 40.599723584 LONG -75.39901502 BManf Anchor MtRepair No Remed None Required Hrd2Access No Bf-SrvSz 100 Af-SrvSz _0_0	CSSDR044
2016-12-05	Miscellaneous	A contractor will perform a meter inspection at this premise. Meter inspections are being performed as part of the meter replacement project. The goal of these inspections is to gather some general information on customers meters which will be used to update our customer service database in advance of meter deployment.	CSSDR044
2016-07-25	Electric Outage - Issuance	Cond 1 Cond 2 Cond 3 Cond 4 Note WEB Call Type 10 No Lights Comments none	WEB
2016-03-28	Cust Choice 1 Bill	Supplier added on 2016-03-31 - First Energy Solutions	
2016-03-28	Batch Enrollment		
2016-03-11	Cust Choice 1 Bill	Supplier added on 2016-03-16 - Talen Energy	
2016-03-11	Batch Enrollment		
2015-11-17	WEB Maintain EFT Bank Info	Web Update ABP Bank Info	SELF SERVICE USER

C-2018-3000490
PPL Electric Exhibit KD-2
6/25/20

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January 15, 2016

VIA HAND DELIVERY

Rosemary Chiavetta, Secretary
Pennsylvania Public Utility Commission
Commonwealth Keystone Building
400 North Street, 2nd Floor North
P.O. Box 3265
Harrisburg, PA 17105-3265

Re: Petition of PPL Electric Utilities Corporation for Approval of Its Smart Meter Technology Procurement and Installation Plan
Docket No. M-2014-2430781

Dear Secretary Chiavetta:

Enclosed for filing pursuant to the Pennsylvania Public Utility Commission's Order entered September, 3, 2015, in the above-referenced proceeding, please find PPL Electric Utilities Corporation's AMI Program Communications Plan. Copies will be provided as indicated on the Certificate of Service.

Respectfully submitted,

Anthony D. Kanagy

ADK/jl
Enclosures

cc: Honorable Susan D. Colwell
Certificate of Service

RECEIVED
2016 JAN 15 PM 3:19
PA PUC
SECRETARY'S BUREAU

PPL Electric Utilities Corporation

AMI Program
Communications Plan

January 15, 2016

PPL Electric Utilities - Communications Plan
January 15, 2016

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1. Executive Summary

1.1 Program Overview

The Pennsylvania Public Utility Commission (PA PUC) has approved PPL Electric Utilities Corporation's (PPL Electric) plan to fully replace its current Power Line Carrier (PLC) Advanced Metering Infrastructure (AMI) solution with an RF Mesh AMI solution. This includes the replacement of all meters (approximately 1.4 million) as well as the implementation of several supporting systems needed to enable advanced metering functionality, including an AMI Head End system, a Meter Data Management System (MDMS), a Meter Asset Management (MAM) system, a Customer Portal application and the associated IT architecture. The proposed solution also calls for the addition of a Meter Operating Center (MOC) to be implemented prior to deployment. This solution will allow PPL Electric to ensure a high level of operational performance, maintain network and infrastructure integrity, and effectively manage the deployment of the new metering system. These solution components are illustrated in Appendix A.

The RF Mesh AMI solution will be deployed from 2015 through 2021 starting with an IT system upgrade to be completed by the end of 2016. Deployment of meters will begin with a solution validation phase in late 2016 to validate full system functionality, deployment processes and field tools, followed by a full deployment phase from 2017 – 2019. Following the completion of deployment in 2019, the system will enter a two-year system stabilization period in 2020 and 2021. This phase will be used to optimize system performance and ensure all functionality is delivered.

A high-level view of the schedule and approximate numbers of meters to be installed is shown below in *Figure 1: High Level Program Schedule.*

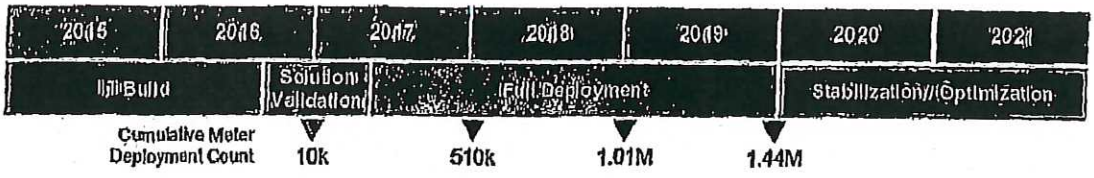

Figure 1: High Level Program Schedule

As part of the deployment of the RF Mesh AMI system, PPL Electric has developed a plan for communicating with stakeholders throughout the duration of the program. The Communications Plan is critical to the success of the overall program and will ensure that stakeholders are kept informed about program status, schedule, and features and benefits of the new RF Mesh AMI system and new meters. The plan will also ensure that the questions and concerns of stakeholders

are addressed. PPL Electric completed a comprehensive stakeholder communications effort back in 2002 – 2004 when PPL Electric installed its first AMI system. PPL Electric has leveraged lessons learned from the first implementation as well as industry best practices and insights gained from meetings with other electric utilities and stakeholders to develop the Communications Plan.

Communications will be delivered in three phases, which may overlap, based on program life cycle and how and when stakeholders are impacted by the program. Communications will continue to evolve over time as we evaluate stakeholder comments and incorporate stakeholder feedback.

The three phases of the communications implementation plan are illustrated below in *Figure 2: Communications Phases.*

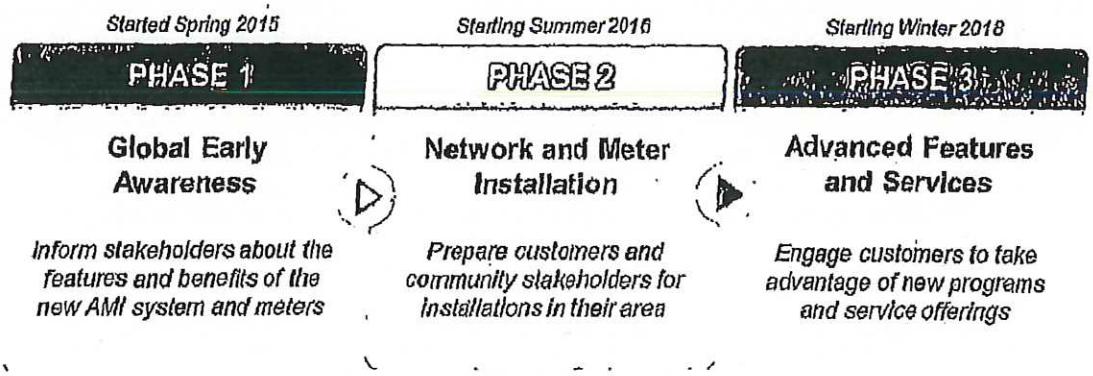

Figure 2: Communications Phases

- Phase 1: Global Early Awareness – Phase 1 occurs prior to the start of implementation of the RF Mesh network and meters. Communications during this phase are designed to inform stakeholders about PPL Electric's plan to replace its existing AMI system and meters.
- Phase 2: Network and Meter Installation – Phase 2 starts in the months preceding the installation of RF Mesh network devices in an area. Communications during this phase are designed to prepare stakeholders for the installation of RF Mesh network devices and meters in their geographic area.
- Phase 3: Advanced Features and Services – Phase 3 starts once the RF Mesh AMI system has been deployed and new functionality is enabled. Communications during this phase are designed to educate and engage customers to participate in new programs and services made available to them as a result of the new AMI system.

These three communications phases are described in detail in Section 2: Implementation Plan.

1.2 Communications Plan Objectives

The overall objectives of the communications effort are to:

- Inform stakeholders about PPL Electric's AMI program and provide reasons why PPL Electric is upgrading its current AMI system
- Educate customers about the features and benefits of the new AMI system and meters
- Train and prepare PPL Electric employees and contractors to address customer questions and concerns
- Respond to all stakeholder concerns and questions in a timely manner
- Inform stakeholders of program progress and address stakeholder concerns regarding the new AMI system and meters
- Prepare customers and community stakeholders for installations in their geographic region
- Educate customers about new programs and services made available to them
- Engage customers to participate in new programs and services that will help them better understand and manage their energy use
- Ensure stakeholders have a mechanism to provide feedback and solicit additional information about the program

1.3 Guiding Principles

PPL Electric has developed a set of guiding principles to ensure consistent and effective messaging throughout the program. Communications from PPL Electric regarding the program should be:

- **Consistent:** Messages delivered from PPL Electric employees and contractors are consistent
- **Diverse:** A mix of communications channels are utilized to effectively reach different stakeholder groups
- **Contextual and Simple:** Communications are clear and easy-to-understand
- **Realistic:** Stakeholder expectations are addressed through communications that accurately represent the value of the program and focus on what's changing now as opposed to future potential benefits
- **Two Way:** Stakeholders have a mechanism to provide feedback to the project and communications are monitored, evaluated and adjusted as necessary

- **Tailored:** Communications are customized based on audience, intent and project life cycle such that the right information is provided to the right people at the right time

1.4 Key Messages

Key messages to be communicated to stakeholders throughout the program include:

- The replacement of current meters will give customers **improved access to data** that will help them manage energy use and shop for their electricity supply.
- The new meters will **also improve service reliability** by helping us better detect outages; will help us ***more quickly connect or disconnect service,*** providing faster service to those moving into or out of homes; and will bring us into **full compliance** with state regulations on metering technology.
- Our current meters are **nearing the end of their useful lives** and this project will proactively replace them.
- The new meters will improve our ability to detect theft and tampering, saving money for all customers.
- As we have always done, we will **carefully protect** our customers' information, consistent with all regulatory requirements and, to support that commitment, we have developed a stand-alone customer privacy policy specifically related to the protection of meter information.
- We are **committed to proactive communications** with customers and other stakeholders in the period leading up to the rollout of the new meters, and to helping customers understand the benefits of the new meters once they are in place. We are also committed to listening to and addressing all stakeholders' questions and concerns.

1.5 Audiences

PPL Electric will communicate and engage with a variety of stakeholder groups throughout the program. Communication efforts will be tailored to meet each group's distinct informational needs. Stakeholder groups include:

- PPL Electric Customers
- PPL Electric Employees
- PA PUC
- PA PUC Stakeholder Groups (including consumer and business advocacy groups)
- Local and State Government Officials

- Emergency Service Providers (including local law enforcement)
- Public and Community Groups (including chambers of commerce, small business advocacy groups, consumer organizations and low income advocacy groups)
- Media
- Electric Generation Suppliers (EGSs)

1.6 Communication Tactics

PPL Electric will utilize a variety of delivery methods throughout the project to communicate with different external stakeholder groups. Key tactics that may be utilized to deliver program-related communications include:

- PPL Electric Website (www.pplelectric.com/newmeters) - PPL Electric has developed a dedicated section of its external website to house information about the meter replacement program and new meters.
- Direct Mail - Direct mailings include letters, postcards and brochures. These materials will be used to notify customers about deployment and provide information about the new meters and new programs and services.
- Email Notifications - Email notifications may be utilized to notify customers about deployment or to provide information about new programs and services.
- Connect Newsletter - The 'Connect' customer newsletter, which is delivered to customers as a bill insert, can be utilized to provide information about deployment, project milestones and launch of new features.
- Phone Calls - Phone calls, including automated voice messages, can be used to remind customers about their meter replacement or to schedule an appointment for a meter replacement.
- Handouts - Handouts include door hangers, brochures, fliers and fact sheets. Handouts can be downloaded off PPL Electric's website or available to be mailed to customers upon request.
- News Releases and Media Outreach - State and local news sources can be utilized to notify communities about deployment or other major project milestones.
- Stakeholder Meetings - Stakeholder meetings can be utilized to communicate project impacts and status to key stakeholder groups including consumer advocacy groups, government officials, regulators and other community leaders.

- Social Media (e.g., PPL Electric Facebook page, Twitter account, Google+) - Social media can be utilized to better understand customer sentiment, obtain feedback and communicate information about new programs and services.
- Video - Videos can be posted to PPL Electric's website or YouTube channel to demonstrate a meter replacement or to educate customers about how to make use of new programs and services.

2. Implementation Plan

2.1 Phase 1: Global Early Awareness

Phase 1 occurs prior to the start of implementation of the RF Mesh network and meters. During this phase, PPL Electric will be focused on building out the IT infrastructure to support the new AMI system and preparing its employees for upcoming process and technology changes. The objective of Phase 1 is to establish awareness of PPL Electric's plan to replace its existing AMI system and inform stakeholders about the features and eventual benefits of the new AMI system and meters. Phase 1 communications are targeted at all stakeholder groups.

PPL Electric has already started its awareness campaign by meeting with multiple external stakeholder groups to discuss its Smart Meter Plan filed with the PA PUC in June 2014 and by updating its website to include information and FAQs about the new AMI system and new electric meters.

Key Messages

Key information to be communicated during Phase 1 includes:

- An overview of PPL Electric's plan to upgrade its current meter reading system
- Why PPL Electric is upgrading its current system and installing new electric meters
- How customers will benefit from the new meters
- How the new AMI system and meters work
- Differences between the old AMI system and the new AMI system
- High level schedule for meter installations
- How much the upgrade will cost and how this cost will impact customers
- Measures PPL Electric is taking to ensure customer privacy and security

External Activities

Regulatory Updates - PPL Electric will provide updates on program status and milestones to the PA PUC and stakeholder groups. Project status updates will continue to be provided throughout the duration of program.

Supplier Updates - PPL Electric will provide updates to electric generation suppliers on program status and upcoming changes that impact them. These updates will be given during monthly

supplier meetings and at supplier conferences. Program updates will continue to be incorporated in supplier meetings throughout the duration of program.

New Meter FAQs - PPL Electric will develop a series of questions and answers regarding the new AMI system and meters. The FAQs will contain the key messages described above as well as additional information to address common stakeholder inquiries and concerns regarding program schedule, cost, deployment and health, safety, privacy and security concerns. These FAQs will be available on PPL Electric's website and provided to PPL Electric employees and contractors to assist them in addressing inquiries from customers.

New Meter Brochure – A brochure will be developed to provide information about the new advanced meters. This brochure includes frequently asked questions about the meters and addresses health, safety, privacy and security concerns. This brochure will be available on PPL Electric's website for customers to download and provided to Field Operations employees and Customer Service Representatives (CSRs) to give to customers upon request.

Website Updates – PPL Electric has developed a dedicated section of its website to serve as the central source of information for external stakeholders throughout the duration of the project. The address of the website is www.pplelectric.com/newmeters. PPL Electric has already added content and documentation to the website regarding the Smart Meter Plan filing and new meters. The website includes frequently asked questions that address all of the key messages listed above. The website will continue to be updated throughout the duration of the project.

Social Media Updates – Social media may be utilized to provide updates on program status and announce major program milestones.

Meter Inspection Notification Letter – In October 2015, PPL Electric started conducting site visits to collect information on customers' electric meters in advance of deployment. The purpose of the site visits is to update PPL Electric's customer service database with information regarding the type and location of customers' meters. These site visits will continue through the end of 2016 and will cover PPL Electric's entire service area. Prior to sending representatives out to customers' homes and businesses, PPL Electric will send a notification letter to impacted customers. This letter will contain information regarding the purpose of these site visits and how they tie to PPL Electric's meter replacement plan, future benefits of the new meters, information about how to identify PPL Electric contractors, contact information and where to find additional information about the meter replacement program. A sample of this letter is available in *Appendix C: Sample Meter Inspection Notification Letter.*

Internal Activities

PPL Electric has developed a comprehensive plan that includes a series of communications, outreach and training activities designed to prepare PPL Electric employees for upcoming

process, organizational and technology changes resulting from the implementation of the RF Mesh AMI system. The goal of the internal communications effort for Phase 1 is to establish a general understanding of the project scope and benefits and keep employees informed of program status. Some of the internal tactics that PPL Electric is currently executing and will start to execute in the future as part of Phase 1 of the Communications Plan are described below.

Change Champion Network – PPL Electric has implemented a Change Champion Network consisting of 30+ employees from departments across the organization. These employees have been selected to serve as liaisons for the project. The Change Champion Network meets monthly and each meeting includes a discussion of program status as well as a deep dive presentation on a topic related to the project (e.g., Meter Deployment, the Meter Data Management System (MDMS)). During each meeting, Change Champions are provided with key information to take back to coworkers in their department.

Program Updates – The PPL Electric project team will continue to meet with employee groups across the organization in an effort to keep employees informed of program status and any upcoming changes. These meetings have provided an overview of the program and subsequent meetings will discuss specific impacts and upcoming changes to each department.

Program Newsletter – The PPL Electric project team will distribute a bi-monthly program newsletter to employees. The newsletter will provide information about program status and upcoming milestones, and will be distributed throughout the duration of the program.

New Meter FAQs – PPL Electric will develop a list of FAQs to provide employees prior to deployment. This list of FAQs will include all the information provided in the FAQs on the PPL Electric's website plus additional information to address more specific questions regarding program schedule, cost, deployment and health, safety, privacy and security concerns. These FAQs will be provided to Customer Service Representatives along with instructions for handling calls from customers regarding the meter replacement program.

2.2 Phase 2: Network and Meter Installations

The objective of Phase 2 is to prepare customers, government officials and other community stakeholders for the installation of AMI RF Mesh network devices and meters in their geographic area. The AMI RF Mesh network devices will be installed four to six months ahead of the installation of meters in a given area. Phase 2 communications will start approximately one month prior to the installation of RF Mesh network devices in an area and are targeted at customers and community stakeholders. Phase 2 communications will start in approximately the summer of 2016 in the first installation area and will continue until installations are complete.

PPL Electric Utilities - Communications Plan
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Key Messages

In addition to the awareness messages communicated in Phase 1, Phase 2 communications will include the following key messages:

- How the AMI RF Mesh system works
- Timeline of installations
- Who is involved in the installations including how to identify PPL Electric contractors
- What to expect during the meter replacement
- Contact information
- Features of the new meters
- Immediate and future benefits of new meters
- How to access additional information on PPL Electric's website

External Activities

PPL Electric will follow a staged process to prepare customers and community stakeholders for installations in their area. Installation communications activities will occur at different times in geographical regions based on the installation schedule. PPL Electric will communicate with local law enforcement, government officials and community leaders prior to beginning any field work in their area.

A summary of the key notifications leading up to deployment in an area is illustrated below in *Figure 3: Deployment Notifications.*

PPL Electric Utilities - Communications Plan
January 15, 2016

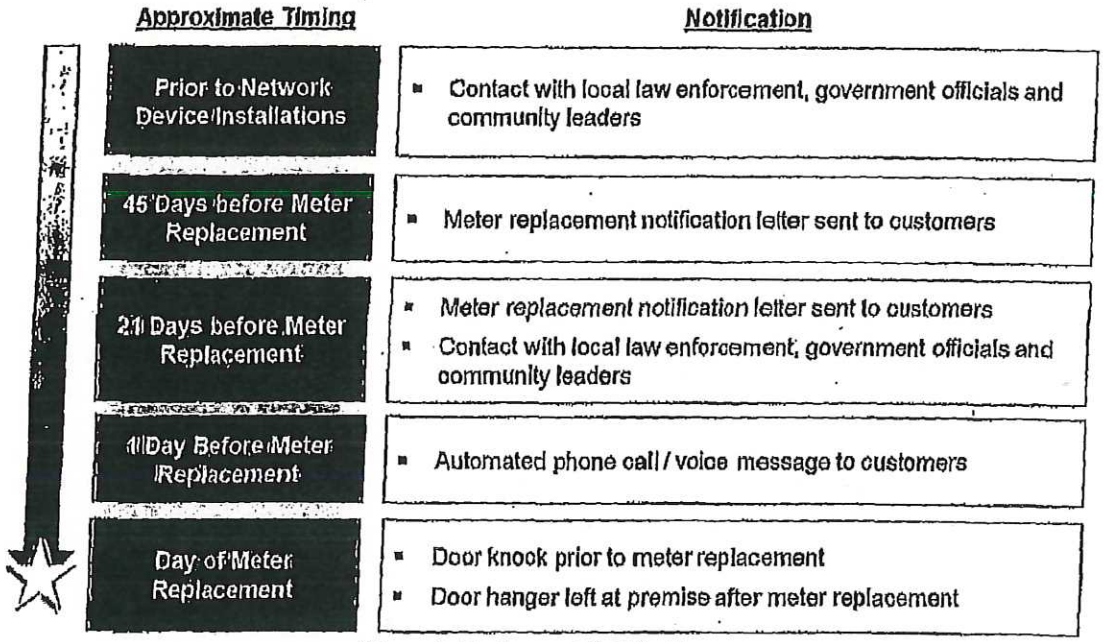


Figure 3: Deployment Notifications

Prior to Network Device Installations

Contact with Local Law Enforcement, Government Officials and Community Leaders – Prior to the installation of network devices in an area, PPL Electric will contact local law enforcement, local and state government officials (elected officials, civic leaders) and leaders of community groups to inform them that PPL Electric is preparing to start network deployment. This communication will occur prior to network deployment or approximately four to six months prior to meter deployment. This communication will include information about PPL Electric's meter replacement plan, the features of the new AMI system and meters, when network and meter deployments will occur, who will be performing the installations and how to access information on PPL Electric's website. PPL Electric will provide these stakeholders with a fact sheet containing FAQs regarding network and meter deployment and a copy of the new meter brochure.

Contact with the PA PUC - PPL Electric will provide information to the PA PUC including the Bureau of Consumer Services prior to the start of meter installations. The Commission will be provided with a copy of the new meter brochure, FAQs regarding meter installations and the meter replacement program and a copy of the installation schedule. This information will assist Commission employees in addressing any inquiries received from customers regarding PPL Electric's meter replacement program.

45 Days before Meter Replacement

Direct Mail Notification to Customers – Customers scheduled to receive a new meter will be sent a notification letter in the mail approximately forty-five days prior to their scheduled meter replacement. In addition to notifying the customer that they are scheduled to receive a new meter, this letter will provide information about PPL Electric's meter replacement program, the new AMI system and meters and how to access additional information on PPL Electric's website. A sample of this letter is available in *Appendix D: Sample 45 Day Meter Exchange Notification Letter.*

PPL Electric Website Update – In preparation for deployment, PPL Electric's website (www.pplelectric.com/newmeters) will be updated to include information about network and meter deployment. This information includes the deployment timeline, who will be performing the installations and how to identify them, what to expect during the meter installation, specific information for medical and commercial customers and how to schedule an appointment for a meter replacement.

21 Days before Meter Replacement

Direct Mail Notification to Customers – Customers scheduled to receive a new meter will be sent a second notification letter in the mail approximately twenty-one days prior to their scheduled meter replacement. This communication will focus on the meter and meter replacement event. Key messages include the features of the new meter, what to expect during the meter replacement, who will be performing the exchange, contact information and how to access additional information on PPL Electric's website.

Connect Newsletter – A news story may be included in the customer newsletter to announce the start of meter deployment in the first deployment area and provide the address of the website to visit for more information. Periodic updates regarding deployment may be included in the newsletter to announce major deployment milestones.

Contact with Local Law Enforcement, Government Officials and Community Leaders – Prior to the installation of meters in an area, PPL Electric will contact local law enforcement, local and state government officials (elected officials, civic leaders) and leaders of community groups to remind them of the upcoming deployment. PPL Electric will provide these stakeholders with an updated meter installation schedule and FAQs regarding meter deployment.

1 Day before Meter Replacement

Automated Phone Call – The day before a customer is scheduled to have their meter replaced, PPL Electric's deployment vendor will make an automated phone call to customers. Per regulations from the Federal Communications Commission, PPL Electric will not make automated phone calls to customers' cell phones unless the customer has provided their consent.

The phone call will inform the customer that their meter is scheduled to be exchanged within the next couple days and provide brief information about what to expect during the meter replacement and a number to call if the customer wishes to schedule an appointment. A sample of the call script is available in *Appendix E: Sample Auto Dial.*

Day of Meter Replacement

Courtesy Contact / Door Knock – Prior to beginning the meter replacement, the installer will attempt to make contact with the customer to inform them of the potential brief interruption of power. The installer will inform the customer that they are working on behalf of PPL Electric. Installers will carry PPL Electric contractor identification badges and have company logos on their vehicles. Installers will also be provided with copies of the new meter brochure to provide to customers that request additional information about the new meter.

Door Hanger - After the meter replacement is complete, the installer will leave a door hanger at the customer's premise that informs them of the meter replacement and provides a number to call if they have any questions or concerns regarding the meter replacement. The door hanger will direct the customer to visit the website to learn more about the new meter. If the meter replacement could not be completed, the door hanger will indicate that a return visit is required and provide a number for the customer to call to schedule an appointment.

Additional Contact Attempts - If a customer's meter is indoors or in another location that the installer cannot access (e.g., behind a locked gate) and the customer is not home to provide access to the meter, PPL Electric's deployment vendor will follow a nine step contact attempt process consisting of a combination of three phone calls, three field visits and three notification letters to attempt to contact the customer and schedule an appointment to complete the meter replacement. If the customer does not provide access after the nine contact attempts have been made, the meter replacement order will be returned by PPL Electric's deployment vendor to the PPL Electric deployment team to review and determine the next appropriate action. If a customer refuses to allow the meter replacement, they will move to the customer concerns process outlined in Section 3.

Deployment Call Handling

PPL Electric's deployment vendor will operate a contact center to handle customer calls throughout the deployment. The number of this contact center will be listed on the notification letters and door hanger provided to customers as well as on PPL Electric's website. The deployment vendor's contact center employees will address matters concerning installation inquiries, scheduling and concerns.

The deployment vendor will maintain a log of all customer calls and provide regular reports to PPL Electric's Customer Service department detailing all customer calls and feedback received

during the deployment. Customer concerns regarding the new technology or installation process will be addressed following the process outlined in *Section 3: Customer Concerns Process.*

Installer Verification

All PPL Electric installers will carry photo identification and have company logos on their vehicles. All letters sent to customers regarding meter installation activities will include information about how to identify PPL Electric contactors and will provide a number to call if the customer has any questions or wishes to verify whether a person represents PPL Electric. This information will also be included on PPL Electric's website.

Internal Activities

In addition to the internal communications activities described in Phase 1, PPL Electric will complete an extensive employee education program prior to the deployment of the RF Mesh AMI solution. This includes training for customer-facing roles (e.g., contact center employees, field operations employees) as well as training for roles that support customer operations (e.g., billing department, advanced metering department). Employees will be trained on procedures for handling customer inquiries and concerns related to the deployment of the new meters and RF Mesh AMI solution. Contact center employees will receive a copy of all materials sent to customers as well as a comprehensive messaging document containing information to address various types of inquiries and concerns. Field operations employees will be provided with copies of the new meter brochure and FAQs to provide to customers upon request.

2.3 Phase 3: Advanced Features and Services

PPL Electric's existing PLC AMI solution provides many advanced features for customers including the ability to view hourly usage data online and enhanced pricing programs. The new RF Mesh AMI solution will support all these existing features as well as new functionality which will be gradually introduced to customers over time. The scope of the functionality to be enabled during the last phases of the program is still being finalized. The scope will include enhancements to the customer web portal as well as integration with Home Area Network (HAN) devices, currently anticipated in winter 2018. This phase will continue throughout the lifetime of the new meters, evolving as new programs and energy saving technologies are introduced.

Key Messages

Key information communicated during Phase 3 includes:

- Information about enhanced features of the customer web portal

- Information about how customers can utilize the features and tools available on the customer web portal to better understand and manage their energy usage
- Information about Home Area Networks and how they work
- Information that can be sent via Home Area Networks
- Features and benefits of HAN devices including how customers can utilize usage and pricing information to modify their energy usage and save money on their bill
- Types of HAN-compatible devices
- Information to address privacy and security concerns associated with HAN communications

Proposed Activities

The Phase 3 communications activities will be further developed once the scope of new programs and HAN technologies becomes more clearly defined. PPL Electric currently plans to offer some combination of the following communications initiatives:

- Direct Mail Notification to Customers
- Email Notification to Customers
- Demonstration Videos
- Web Portal Online Tutorial
- HAN Brochure and FAQs
- Connect Newsletter Story

3. Customer Concerns Process

The implementation of the new RF Mesh AMI solution will enable new features and benefits for both PPL Electric and its customers. The RF Mesh AMI Solution is also expected to generate inquiries from customers regarding the new technology and concerns over health, safety, privacy and security. As part of the Communications Plan, PPL Electric has developed a Customer Concerns Process to address customer inquiries and alleviate any confusion regarding the impact of the new technology.

Customer Concerns Team

PPL Electric has established a Communications Team consisting of representatives from PPL Electric Communications, Customer Experience and the Meter Replacement Program. The Communications Team is responsible for developing and executing the Communications Plan including developing materials and guidelines for employees to address customer inquiries and concerns.

To effectively address the questions and concerns of stakeholders, the Communications Team will engage personnel from groups across the organization as well as PPL Electric contractors. Key groups that will be engaged in addressing customer concerns related to the implementation of the new AMI system and meters include the Customer Contact Center, Field Operations, Regional Affairs, Key Accounts, Regulatory, Public Affairs, Billing and PPL Electric's deployment vendor.

Concerns Process

Customer inquiries and concerns will be routed appropriately based on their origin and the nature of the concern. In most cases, customer concerns will be routed to the PPL Electric contact center, where CSRs will be equipped and trained to address and resolve them.

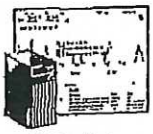
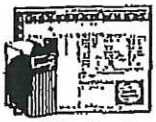
PPL Electric's contact center and / or the deployment vendor's contact center will address customer calls using information provided in the FAQs and integrated messaging document. If the customer still wants more information, the CSR will transfer the call to their supervisor. The contact center supervisors will then work with the customer to better understand their concern and attempt to address their concern using information provided in training and in the integrated messaging document. If the customer still wants more information than provided and/or wishes to speak to someone directly involved with the project, the contact center supervisor will inform the customer that a member of the project team will contact them within two business days.

A member of the project team or other subject matter expert will then call the customer back within two business days of the customer's initial call. The member of the project team or other

subject matter expert will make every attempt to address the concern – this may require them to engage other subject matter experts. All issues will be logged and reported and sent to the appropriate internal parties to review.

4. Appendix

4.1 Appendix A: Solution Components

Customer Presentment	Meters	Communications Network Infrastructure		Head End System	Data Management	Operations
Web Portal	*Electric meters that send and receive usage and other operational data to and from RF network devices*	**Local Area Network** RF Collectors and Routers *Devices used to send and receive data to and from customers' meters and the Head End system*	**Wide Area Network** Fiber Backhaul Cellular Backhaul *Communication infrastructure responsible for transmitting meter data to the Head End system*	*System that sends and receives data to and from the AMI network and relays the data to other downstream systems*	 Meter Data Management System (MDMS) Enterprise Data Warehouse (EDW)	Meter Operating Center (MOC)  Meter Asset Management System (MAM)
Home Area Network (HAN) Devices						

4.2 Appendix B: Sample FAQs

Below is a sample of the Frequently Asked Questions that will be made available to stakeholders and PPL Electric employees. These FAQs will continue to be revised and expanded upon throughout the project based on stakeholder comments and feedback.

Customer FAQs

Why is PPL Electric Utilities installing new electric meters?
There are several reasons, all of which involve better service for our customers:

- The new meters will enable new energy-saving technologies and will make our electric system more reliable.
- Our current electric meters are reaching the end of their useful life and we want to be proactive in replacing them.
- Technology has changed significantly since our current meters were installed.
- The new meters will bring us into full compliance with state-mandated regulations on electric meter technology.

How will the new system help customers save energy?
The new metering system will help customers make wise energy decisions. It will give customers access to pricing and electric use information to manage their energy usage more efficiently and help save money on their electric bills.

How will the new meters improve electric system reliability?
The new meters can report power outages automatically. This will mean that PPL Electric Utilities will be able to dispatch repair crews more quickly to restore power.

When will the new meters be installed?
The new meters are expected to be installed between late 2016 and 2019.

What is the cost of this project?
We estimate that the cost will be about $450 million to install about 1.4 million electric meters and to design and install all of the related support equipment and computer systems.

How will customers be charged for the upgraded meter system?
Customers would pay for the new meters over time, through a monthly charge on their electric bills. The charges will be phased in starting in 2015, increase during the installation period, then decline. The average residential customer will pay about $2.25 per month over the time the meters are in service.

Will the new meters improve the way PPL Electric Utilities starts and stops electric service, such as when customers move?
Yes. Currently, the company has to send a service person to visit a home or business to physically connect or disconnect the meter. Under the new system, we can complete service

requests remotely, meaning that these starts and stops will be faster and more convenient for customers.

What's the difference between the current meters and the new ones?
Our current meters use PPL Electric Utilities power lines to communicate meter reading information to our billing system. Most of the existing meters are dial meters with a spinning disk. We're installing electronic digital meters equipped with wireless communication technology. The new meters will communicate data to PPL Electric Utilities through this radio signal system.

Should I be concerned about the privacy of my information with these new meters?
No. As we always have done, we will carefully protect our customers' information, consistent with all regulatory requirements. All data transmitted by the meters will be encrypted and protected by PPL Electric Utilities. The new meter system will have multiple layers of safeguards designed to keep your electricity usage data private.

Additional Q&As for CSRs and others if they are asked

Are these meters safe?
Meter manufacturers follow stringent standards established by the American National Standards Institute. We require manufacturers to test the meters and conduct our own tests to ensure meters meet these standards.

Will customers be able to opt out if they don't want a new meter?
No. State law and regulations mandate this metering technology for all electric utility customers and do not provide for an opt-out option.

Some people have expressed health concerns with this type of meter. Is that an issue?
The new meters will use very low level radio-frequency signals to send a customer's electricity usage information to our billing system. The signals used by PPL Electric Utilities' new meters will be similar to those used in many everyday appliances, including cellular and cordless phones, baby monitors, garage door openers, wireless networks and security systems. In addition, these meters typically transmit for a total of only a few minutes a day. The meters will conform to all applicable safety standards. Many government agencies, regulatory agencies and health organizations have studied the issue and none has found any health risks caused by the use of this type of meter in homes and businesses.

Questions related to customer charges:

How will customers be charged for the upgraded meter system?
Customers will pay for the new meters over time, through a monthly charge on their electric bill. These charges will be phased in, and will vary based on the actual costs incurred by PPL Electric Utilities. Charges will be adjusted quarterly. Charges will increase for several years as the new

metering system is installed, then decline after the system is fully deployed.

Why do customers have to start paying for the new meter system even before new meters are installed?
Before the new meters can be installed, the system needs to be designed and we also need to install the communications and computer equipment the new meters need. This infrastructure needs to be purchased and in place so the meters will work when they are installed.

Are customers still paying for the current meters?
Yes, because the costs of the current meter system were spread out over many years, there will be an overlap period through 2019, during which PPL Electric will recover the remaining costs of the existing system while at the same time paying the initial costs of the new system.

Is it fair that customers should pay for both systems at once?
As with any asset we purchase and install to benefit customers, PPL Electric recovers the full costs through monthly charges on customer bills, as approved by the PUC.

When will customers see the charges for new meters on their bills?
Initial charges for the new meters are already included on customers' monthly bills. For residential customers, they are included in the Customer Charge listed in the Billing Details section of your bill.

How long will the charges continue?
The charges will continue through the expected 15-year lifespan of the meters.

Why do the charges vary from year to year?
We are proposing that customers pay less during early phases of the project when our costs are low, such as in the preliminary development phase, and more as our costs increase. Customer charges will peak during the installation phase then decline steadily after the system installation is complete.

4.3 Appendix C: Sample Meter Inspection Letter

September 2015

Name
Address
Address

Dear Name:

PPL Electric Utilities soon will be sending a contractor to gather some general information on your meter as part of our plan to replace all of our customers' electric meters in coming years. This meter replacement plan recently earned the approval of the state Public Utility Commission.

We are updating our customer service database in advance of the project, and some of the needed information requires our representatives to look at your meter. If your meter is outdoors, you don't need to be there because we can do all of our work from the outside. There also is no charge to you.

Over time, our new meters will give you improved access to data that will help you manage your energy use. They will also help us better detect outages, improving service reliability.

We've hired Grid One Solutions to gather meter information. Their staff will carry proper identification and they are fully trained and authorized to work on our behalf. Their toll-free number is 1-877-887-0358. If you have questions about whether a person who has contacted you represents Grid One Solutions, you can contact PPL Electric Utilities at 1-800-DIAL-PPL (342-5775).

If your electric meter is indoors or in another inaccessible location, please contact Grid One at the number noted above to schedule an appointment. There is no charge for inspection of these meters.

Your meter is scheduled to be replaced late next year. We are committed to keeping all of our customers informed before their meters are replaced. More information on this project is available at **pplelectric.com/newmeters.**

Sincerely,

PPL Electric Utilities

4.4 Appendix D: Sample 45 Day Customer Notification Letter

September 2015

Name
Address
Address

Dear Name:

In the next several weeks, we will be replacing the electric meter on your home as part of our plan to upgrade all our customers' electric meters. Over time, the new meters will give you improved access to data that will help you manage your energy use. They will also help us better detect outages, improving service reliability.

Here's what you can expect during the installation:

- We've hired Grid One Solutions to perform the meter installation. Their staff will carry proper identification and they are fully trained and authorized to work on our behalf. Their toll-free number is 1-877-887-0358. If you have questions about whether a person who has contacted you represents Grid One Solutions, you can contact PPL Electric Utilities at 1-800-DIAL-PPL (342-5775).
- The technician performing the installation will attempt to notify you before they begin working. The installation will take about 10 minutes to complete, during which time you may experience a brief interruption in your electric service.
- You do not need to be home for the installation so long as your meter is outdoors and our technicians have clear and safe access to your meter.
- If your electric meter is indoors or in another inaccessible location, please contact Grid One at the number noted above to schedule an appointment.

We will be in touch again closer to your meter installation date.

We are committed to keeping all of our customers informed before their meters are replaced. More information on this project is available at **www.pplelectric.com/newmeters.**

Sincerely,

PPL Electric Utilities

4.5 Appendix E: Sample Auto Dial Message

Hello, this is PPL Electric Utilities calling with important information about our electric meter on your property.

As you may be aware from our previous communications, we will be replacing the electric meter on your property within the next few days. You may experience a brief service interruption – typically less than a minute - while we complete this work. The technician performing the installation will attempt to notify you before they begin working.

Please remember that if our meter is located indoors, or in another location that is inaccessible, you will need to be present to provide access. Installations will take place from 8AM to 5PM. If your meter is not accessible and you will not be available during these hours over the next few days, please contact 1-877-887-0358 as soon as possible to schedule an appointment.

If our electric meter is already accessible, simply do nothing.

Thank you for your cooperation.

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing has been served upon the following persons, in the manner indicated, in accordance with the requirements of § 1.54 (relating to service by a participant).

VIA E-MAIL AND FIRST CLASS MAIL

Christy M. Appleby, Esquire
Amy Hirakis, Esquire
Hobart J. Webster, Esquire
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Harrisburg, PA 17101-1923

Steven C. Gray, Esquire
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Counsel for CAUSE-PA

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Consultant for Office of Small Business Advocate

Robert A. Reiley, Esquire
Department of Environmental Protection
400 Market Street – 9th Floor
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Counsel for Department of Environmental Protection

RECEIVED
2016 JAN 15 PM 3:19
PA PUC
SECRETARY'S BUREAU

Date: January 15, 2016

Anthony D. Kanagy

C-2018-3004490
PPL Electric Exhibit KD-3
6/25/20

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717-731-1985 Direct Fax
File #: 158811

July 20, 2016

VIA E-MAIL & REGULAR MAIL

Daniel Searfoorce
PA Public Utility Commission
Bureau of Technical Utility Service
Commonwealth Keystone Building
400 North Street, 3rd Floor West
Harrisburg, PA 17105-3265

Re: **Petition of PPL Electric Utilities Corporation for Approval of Its Smart Meter Technology Procurement and Installation Plan**
Docket No. M-2014-2430781

Dear Mr. Searfoorce:

Enclosed please find PPL Electric Utility Corporation's ("PPL Electric") Advanced Metering Infrastructure ("AMI") Customer Privacy Policy. PPL Electric has revised its AMI Customer Privacy Policy to clarify its procedures regarding the web portal at the request of the PPL Industrial Customer Alliance.

As indicated on the attached Certificate of Service, PPL Electric is serving a copy of its AMI Customer Privacy Policy on the parties in the above-referenced proceeding.

Please direct any question regarding this matter to the undersigned.

Respectfully submitted,

Anthony D. Kanagy, Esquire

ADK/skr
Enclosure

cc: Rosemary Chiavetta, Secretary (*letter and certificate of service only*)
Certificate of Service

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing has been served upon the following persons, in the manner indicated, in accordance with the requirements of § 1.54 (relating to service by a participant).

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Department of Environmental Protection
400 Market Street – 9th Floor
Harrisburg, PA 17105
Counsel for Department of Environmental Protection

Date: July 20, 2016

Anthony D. Kanagy

12067542v1

PPL Electric AMI Customer Privacy Policy

1.1 Introduction

PPL Electric Utilities Corporation ("PPL Electric") has developed this Advanced Metering Infrastructure ("AMI") Customer Privacy Policy to describe how customer data collected via AMI ("AMI Data") is protected.

PPL Electric limits AMI Data collection and storage by collecting only information that is necessary for business purposes set forth below and legal or regulatory guidelines. Authorized access to AMI Data is limited to (1) the customers themselves, (2) authorized electric generation suppliers ("EGSs") and/or third party representatives, consistent with retail choice requirements, (3) those PPL Electric employees who require the access to such information for the purposes of performing their jobs, and (4) vendors that are granted access by PPL Electric in furtherance of the uses as explained in the "How we use AMI Data" section.

1.2 What we collect

Through AMI, PPL Electric collects the following AMI Data, as examples:

- Electricity usage data
- Significant event information such as outages, voltage, heat alarms and meter tampering alerts

This AMI Data is collected via (and transported on) the AMI network, which is the data communications path from the meter to the head-end application. AMI Data does not contain any personally identifiable information (customer name, account number, phone number, address, etc.).

1.3 How we protect AMI Data

AMI Data transmitted over the AMI network is secured from intrusion by third parties through PPL Electric's security policies, which include the use of technologies such as (but not limited to) firewalls, encryption, digital signatures, authentication, and access controls – all in alignment with security standards, such as those issued by the National Institute of Standards and Technology (NIST).

As outlined in the section "How we use AMI Data," events or energy usage information will be used within non-AMI systems managed by PPL Electric within its secure environment (such as customer information systems and outage management systems). When the AMI Data is transmitted between AMI and these systems, it is encrypted. These systems all utilize authentication and access controls designed to protect the AMI Data within these systems. The AMI Data remains protected in accordance with standards and guidelines such as the NIST standards while used for these purposes.

PPL Electric periodically performs reviews and assessments to identify threats, vulnerabilities, or risks associated with the AMI network or AMI Data. Any findings as a result of these efforts are addressed in accordance with PPL Electric's security policies. PPL Electric plans to conduct training prior to meter deployment of its employees who will have access to AMI Data on the proper handling of and security procedures with respect to AMI Data.

1.4 How we use AMI Data

AMI supports the automation of standard utility service processes. PPL Electric uses AMI Data for business purposes including, but not limited to:

- Calculating customers' bills

- Providing necessary information to authorized EGSs and/or third party representatives
- Sharing with each customer so that the customer can understand their bills, electric consumption and energy analytics
- Supporting power outage analysis and restoration
- Supporting distribution operations by providing more detailed load and voltage data
- Supporting data analysis to determine aggregated historical peak loads on distribution transformers and conductors
- Aggregating data by retail electricity provider to settle the wholesale market
- Supporting revenue protection activities

AMI Data usage, retention, and disposal are governed by PPL Electric's security policies. PPL Electric does not share AMI Data, except as required or permitted by law, regulatory agencies, or governmental authorities. Notwithstanding the foregoing, if a customer chooses a retail electricity provider and consents to the release of his or her data, PPL Electric also provides the customer's energy usage information to the customer's chosen provider through the PPL Electric web portal. Access to customer data through the web portal is limited to EGSs and representatives authorized by the customer to obtain such data.

While the PUC allows customers to affirmatively opt-out of the Eligible Customer List ("ECL"), the customer data available through the web portal is not tied to the ECL. Accordingly, to allow customers to monitor whether EGSs or third party representatives are appropriately requesting customer data only for customers that have provided authority to obtain such data, PPL Electric will maintain an event log tracking access to customer information for each account. Every time a user submits a request for any data available on the web portal, the request will be logged with the unique user name, supplier name, date/time stamp, and customer account number and

recorded as a successful or unsuccessful attempt. Event log data will be maintained and accessible for at least three years. Additionally, a customer may request event log data for its account(s), which will be provided by PPL Electric within ten days of a customer's request, absent unusual circumstances. If the Company does not provide the customer with the requested data within 10 days, PPL Electric will provide a written explanation of why the data is delayed and an estimated timeframe to fulfill the request.

In addition, PPL Electric recognizes that customer privacy is of paramount importance and will follow the customer privacy and consent provisions of the Commission's order entered on September 3, 2015 in *Submission of the Electronic Data Exchange Working Group's Web Portal Working Group's Solution Framework for Historical Internal Usage and Billing Quality Interval Use* at Docket No. M-2009-2092655. Finally, PPL Electric may share AMI Data in an aggregated and anonymized form as set forth above.

PPL Electric Utilities Corporation

Supplement No. 59
Electric Pa. P.U.C. No. 201
Fifth Revised Page No. 6B
Canceling Third & Fourth Revised Page No. 6B

RULE 2 - REQUIREMENTS FOR SERVICE (CONTINUED)

F. ACCESS

Company employees shall have access at all reasonable hours to customer's premises, without charge, for the purpose of inspecting installations, installing meters, reading, testing, removing, replacing or otherwise maintaining or disposing of any of Company's property.

G. CUSTOMER'S INSTALLATION

The customer's service facilities shall be installed and maintained in accordance with Company's "Rules for Electric Meter and Service Installations". In residential and commercial complexes and multiple occupancy buildings, the owner is responsible for all service entrance facilities including individual service wiring where separate metering for each tenant is required by the Company. Company is not responsible for customer's wiring or equipment. Company is willing to assist customer with advice without incurring responsibility. Company may refuse to commence or continue service when, in Company's opinion, customer's installation is not in proper operating condition or does not conform to this tariff.

(C)

C-2018-3000490
PPL Electric Exhibit KD-5
6/25/20

PPL Electric Utilities Corporation

RULES FOR ELECTRIC SERVICE
RULE 10 - DISCONNECTION AND RECONNECTION OF SERVICE

A. CONTRACT CANCELLATION

(1) Contracts are canceled by Company after the expiration of the initial term thereof, upon notification from the customer, as provided in the contract, that service is no longer required at the premises being supplied.

(2) Contracts are canceled by Company before the expiration of the initial term thereof, at the request of the customer, upon the immediate payment at customer's option of either of the following:

(a) All the remaining obligations under the contract for the initial term.

(b) The charges for service to date of discontinuance as calculated under the tariff provisions applicable for the period of service actually supplied less the sum of payments already made. This option applies only when the customer completely ceases operations and only when Rule 3, Extension of Service, is not involved. Commercial and industrial customers agree that if operations are resumed before the date when the initial term expires, then the initial obligation of contract is considered as still in force.

B. TERMINATION

(1) Termination of service does not constitute cancellation of any contract during the initial term thereof except by Company consent.

(2) The Company may terminate the supply of electric service and remove Company's equipment from customer's premises, upon notice to customer when appropriate, under any of the following conditions:

(a) Nonpayment of an undisputed delinquent account associated with service provided by the Company.

(b) The customer's installation, in Company's judgment, has become dangerous or defective or Company has received notice of such a condition, or the customer's equipment or use thereof may impair the equipment of Company or the service to the other customers.

(c) The Company's property on customer's premises has been interfered with, or evidence is found that the wires, meters, entrance switch or other appurtenances up to and including the point of measurement have been tampered with.

(d) Energy has been used that has not been registered on the meter.

(e) A writ of execution is issued against customer, or the premises at which service is supplied is levied upon, or there is an assignment or act of bankruptcy on the part of customer, and Company has not received any written acceptance of responsibility for continuance of service.

(f) The customer violates any of these rules or any of the terms and conditions of the contract or has made misrepresentations to Company with respect to the use of electric service and customer refuses to correct the situation or execute a contract appropriate for such service.

(Continued)

Supplement No. 227
Electric Pa. P.U.C. No. 201
Fourteenth Revised Page No. 14A
Canceling Thirteenth Revised Page No. 14A

PPL Electric Utilities Corporation

RULE 10 - DISCONNECTION AND RECONNECTION OF SERVICE (CONTINUED) (C)

B. TERMINATION (Continued)

(g) The Company's authorized representatives cannot gain admittance or are refused admittance to the premises for the purpose of reading meters, making repairs, making inspections, or removing Company property, or the customer interferes with Company representatives in the performance of their duties, or the meters or other equipment of the Company are not accessible during reasonable hours.

(h) The customer neglects or refuses to reimburse Company for repairs to or loss of Company's property used to supply service when such repairs are necessitated, or loss occasioned, by negligence on the part of customer.

(i) Failure to post a deposit, provide a guarantee, or establish credit associated with service provided by the Company.

(j) Failure to comply with the material terms of a settlement or amortization agreement.

(k) Fraud or material misrepresentation of identity for the purpose of obtaining utility service.

(l) Unauthorized use of the utility service delivered on or about the affected dwelling or other service location.

(3) The Company shall not terminate, or refuse to restore service to any premises when any occupant residing therein is certified by a physician, physician's assistant or nurse practitioner to be seriously ill or affected with a medical condition which will be aggravated by a cessation of service or failure to restore service.

(4) Except in emergencies, service to residential customers will not be terminated: on Saturday or Sunday; on a bank holiday or the day preceding a bank holiday; on a day, or a day preceding a day, when the Company's business offices are closed, excluding Saturdays; or on a holiday or the day preceding a holiday observed by the Pennsylvania Public Utility Commission.

(5) The customer may avoid termination under the above conditions by eliminating the cause for termination and fulfilling the appropriate conditions for reconnection under Rule 10C hereof prior to termination.

C. RECONNECTION

Whenever a service has been terminated under any of the above provisions, Company will require payment of a $14 disconnection and reconnection charge and will, before reconnection, require customer to eliminate the cause of disconnection and fulfill any of the following conditions associated with service provided by the Company that are reasonably applicable: (C)

(1) Establish credit, make a security deposit, or provide a written guarantee acceptable to Company.

(2) Correct any unsafe or nonstandard conditions in customer's service entrance facilities.

(3) Make full payment of, or arrange time payments for the charges for energy used but not metered and, all costs of Company's investigation and property damage associated therewith, plus the cost of measures considered necessary by the Company to prevent recurrence. These include but are not limited to: cost of tampering investigations, inspections, billing, and corrective action on unsafe equipment.

(4) Make payment of, or arrange for the payment of, all amounts currently due for services provided by the Company according to a settlement or amortization agreement.

PPL Electric Utilities Corporation

Supplement No. 42
Electric Pa. P.U.C. No. 201
Fourth Revised Page No. 8D
Canceling Third Revised Page No. 8D

RULE 4 - SUPPLY OF SERVICE (CONTINUED) (C)

F. CONTINUITY

(1) The Company uses reasonable diligence to preserve continuity of service, but in the event of interruption or curtailment of service, Company shall not be subject to any liability, penalty or payment for or on account of any such interruption or curtailment nor shall the application of the rate schedule to the regular billing period be affected.

(2) The Company may temporarily suspend service for the purpose of making necessary repairs and makes every reasonable effort to notify customers in advance, except in cases of emergency.

G. EMERGENCY LOAD CONTROL

(1) A load emergency situation exists whenever:

(a) the demands for power on all or part of the utility's system exceed or threaten to exceed the capacity then actually available to supply such demands;

(b) system instability or cascading outages could result from actual or expected transmission overloads or other contingencies; or

(c) such conditions exist in the system or another public utility or power pool with which the utility's system is interconnected and cause a reduction in the capacity available to the utility from that source or threaten the integrity of the utility's system.

(2) In such case, the utility shall take such reasonable steps as the time available permits to bring the demands within the then-available capacity or to otherwise control load. Such steps shall include but shall not be limited to reduction or interruption of service to one or more customers, in accordance with the utility's procedures for controlling load.

H. EMERGENCY ENERGY CONSERVATION

An emergency energy conservation situation exists whenever events result or, in the judgment of the utility, threaten to result in a restriction of the fuel supplies available to the utility or its energy vendors, such that the amount of electric energy which the utility is able to supply is or will be adversely affected. In the event of an emergency energy conservation situation, the utility shall take such reasonable measures as it believes necessary and proper to conserve available fuel supplies. Such measures may include, but shall not be limited to reduction, interruption or suspension of service to one or more of its customers or classes of customers in accordance with the utility's procedure for emergency energy conservation.

I. RELOCATION OF FACILITIES

(1) The relocation of customer's facilities due to moving or rearranging Company's facilities at the direction of either the federal, state or local government is the customer's responsibility and expense.

(Continued)

Supplement No. 59
Electric Pa. P.U.C. No. 201
Third Revised Page No. 8E
Canceling First & Second Revised Page No. 8E

PPL Electric Utilities Corporation

RULE 4 - SUPPLY OF SERVICE (CONTINUED)

I. RELOCATION OF FACILITIES (Continued)

(2) The relocation of Company facilities, when done at the request of others, is at the applicant's expense and payment of the Company's estimated cost of the relocation is required in advance of construction. When the request is from an affected property owner and the facilities are on the customer's property, the charges for relocation of distribution system facilities are limited to estimated contractor costs, estimated direct labor and estimated material costs, less an amount equal to any estimated maintenance expense avoided as a result of the relocation. (C)

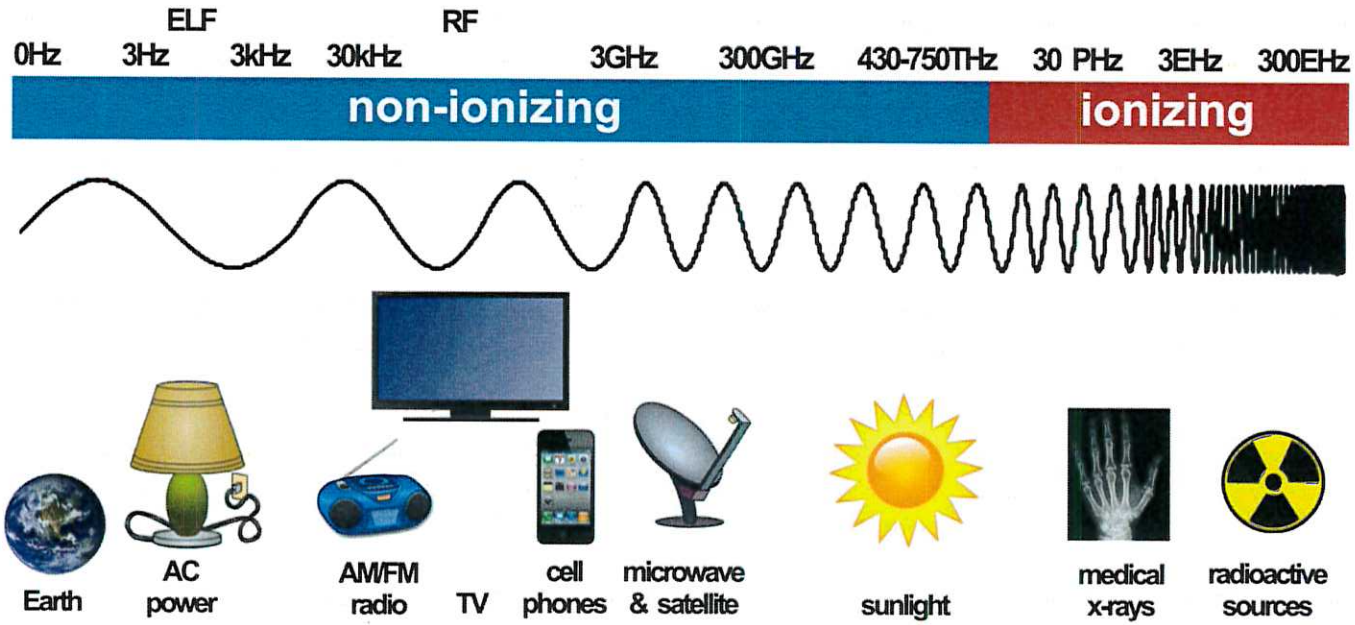
J. EMERGENCY ASSISTANCE

The Company may, upon request, assist in emergencies to correct defects in and make temporary repairs to the customer's installation. Any such assistance shall be accepted by the customer without involving responsibility on the part of the Company.

K. CHANGE IN SERVICE CONDITIONS

The Company may, upon request, make a change in service conditions provided the customer pays the estimated fully allocated cost to be incurred by the Company.

THE ELECTROMAGNETIC SPECTRUM



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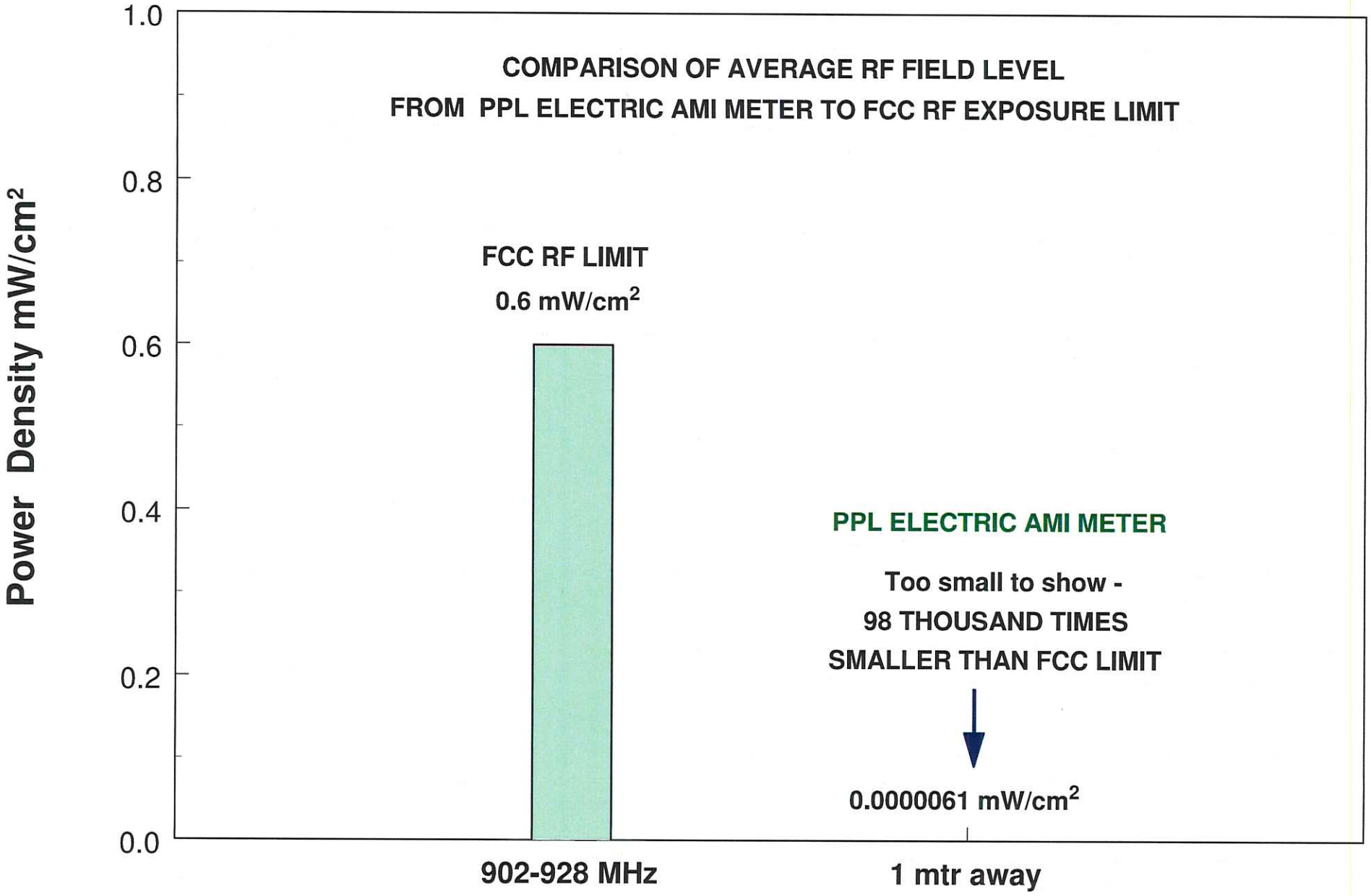

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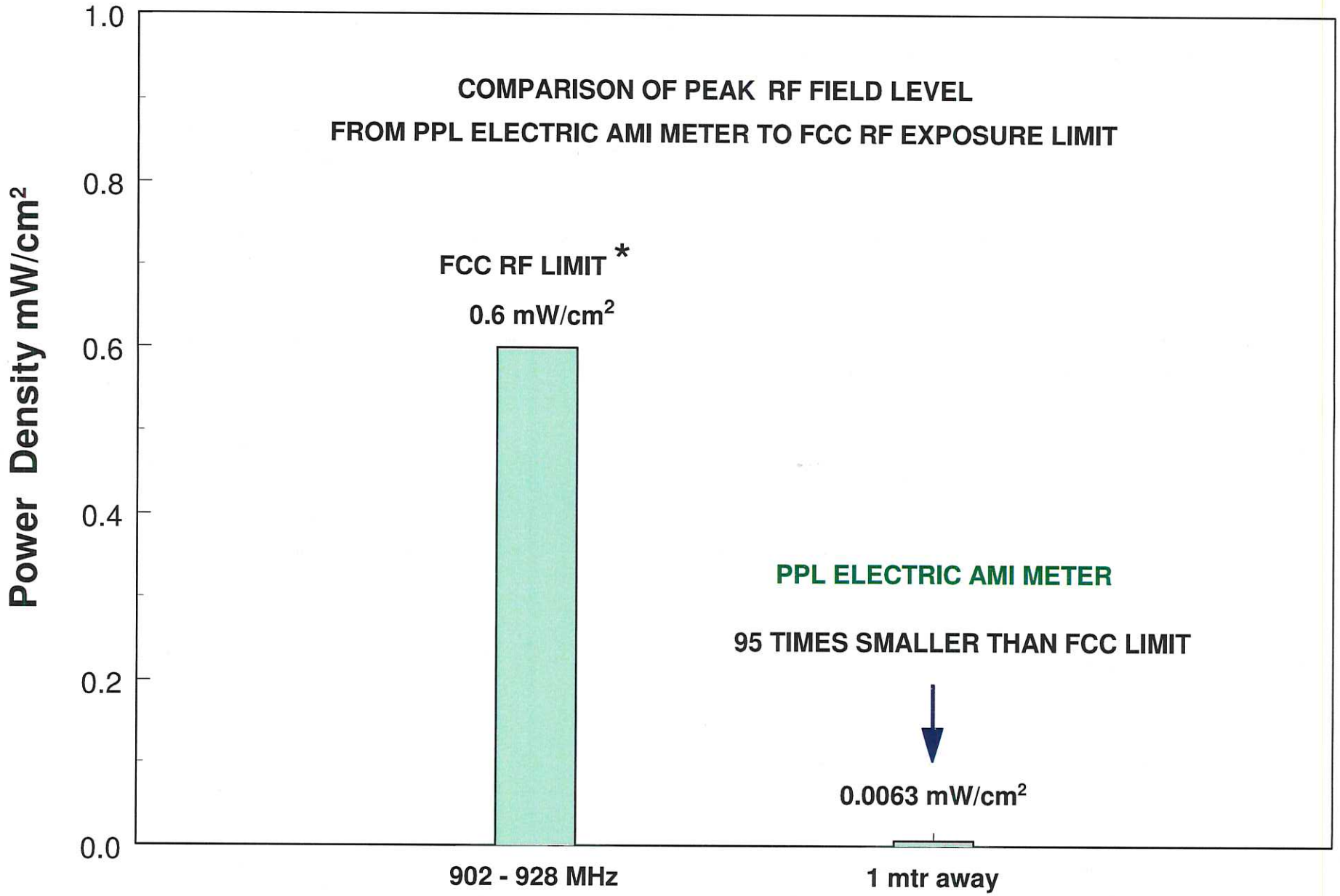

*FCC Exposure Limit is based on 30 minute average not peak levels

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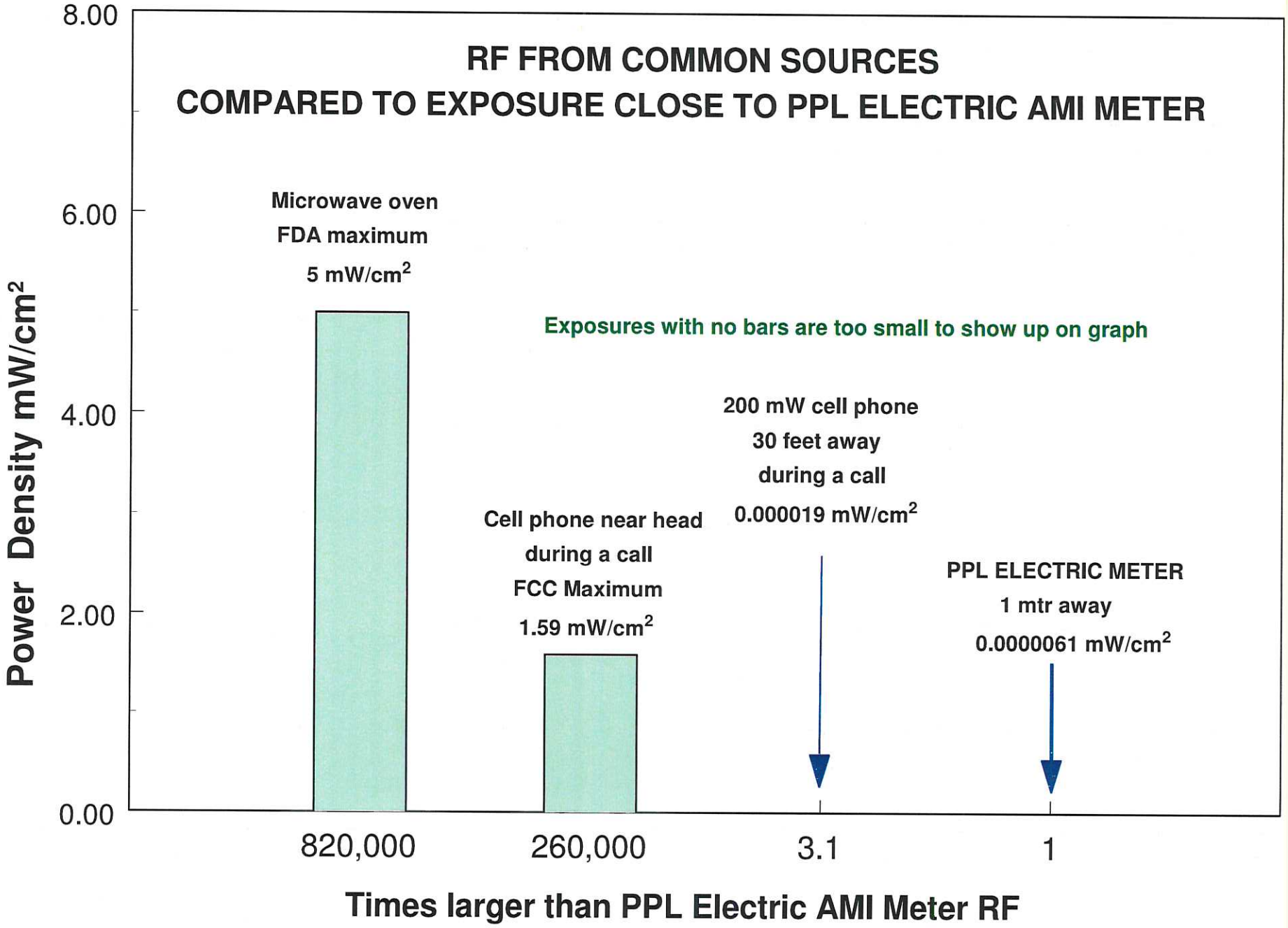

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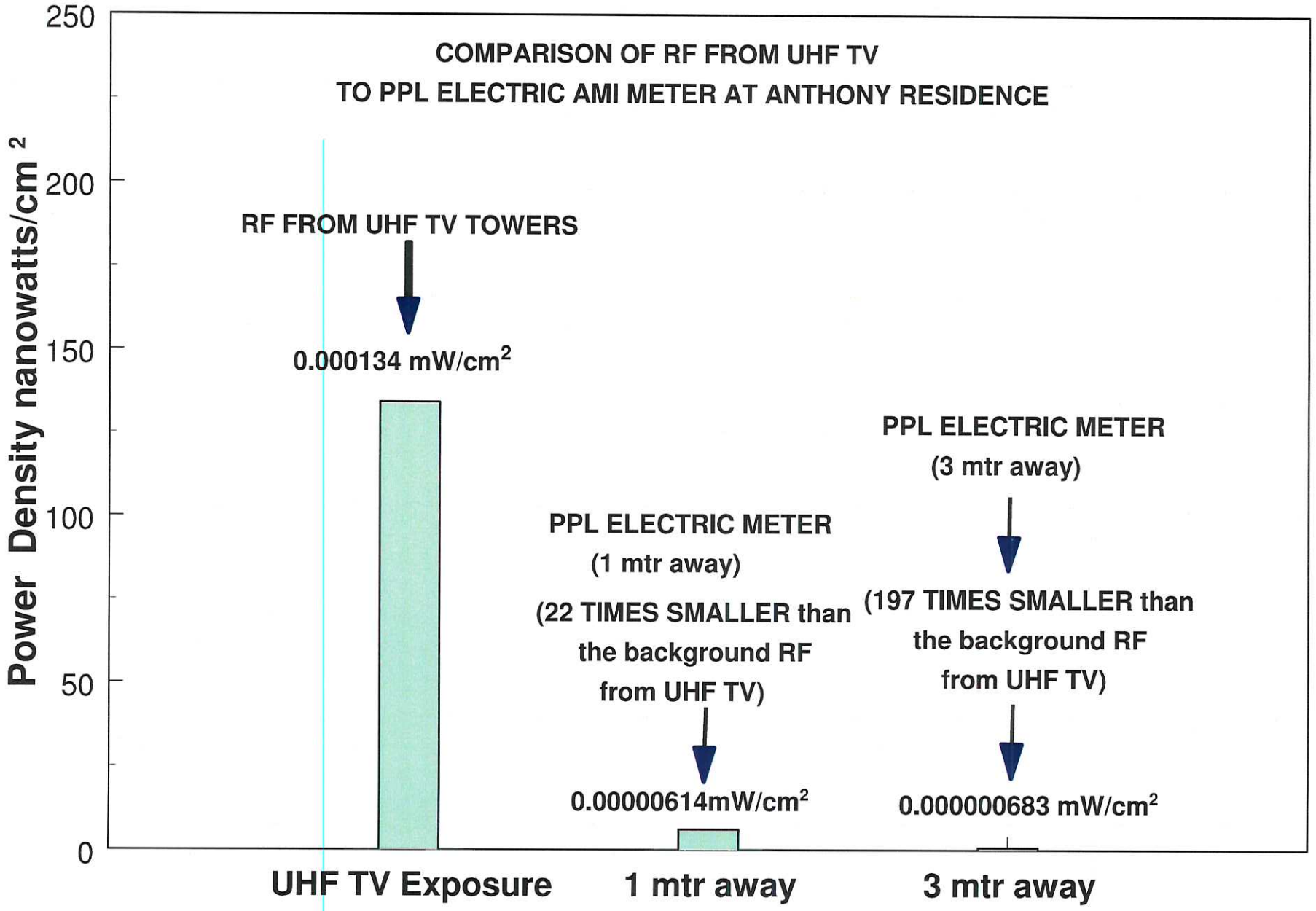

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Public Health Reviews
RF Fields and Claimed Health Effects

World Health Organization 2016
About electromagnetic fields, Summary of health effects

> "Despite extensive research, to date there is no evidence to conclude that exposure to low level electromagnetic fields is harmful to human health." *[p. 2]*
>
> "To date, no adverse health effects from low level, long-term exposure to radiofrequency or power frequency fields have been confirmed" *[p. 2]*

New Zealand Ministry of Health 2015
Interagency Committee on the Health Effects of Non-ionising Fields: Report to Ministers

> "While a great deal of research has been carried out to investigate the potential effects of exposures to RF fields on health, particularly exposures associated with cellphone use, there are still no clear indications of health effects caused by exposures that comply with the limits in the New Zealand RF field exposure standard." *[p. 18]*

European Commission Scientific Committee SCENIHR 2015
SCENIHR Opinion on Potential health effects of exposure to electromagnetic fields

> "Overall, the epidemiological studies on mobile phone RF EMF exposure do not show an increased risk of brain tumours. Furthermore, they do not indicate an increased risk for other cancers of the head and neck region. … Epidemiological studies do not indicate increased risk for other malignant diseases, including childhood cancer." *[p. 5]*

World Health Organization 2014
Electromagnetic fields and public health: mobile phones – Fact Sheet No. 193.

> "A large number of studies have been performed over the last two decades to assess whether mobile phones pose a potential health risk. To date, no adverse health effects have been established as being caused by mobile phone use."

Royal Society of Canada 2014
Expert Panel: A Review of Safety Code 6 (2013): Health Canada's Safety Limits for Exposure to Radiofrequency Fields

> "[T]he Panel has concluded that the balance of evidence at this time does not indicate negative health effects from exposure to RF energy below the limits recommended in the Safety Code." *[p. 10]*

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Public Health Reviews
RF Fields and Claimed Health Effects

Public Health England 2013
Guidance: Wi-fi radio waves and health

> "There is no consistent evidence to date that exposure to radio signals from wi-fi and WLANs adversely affects the health of the general population." *[p. 1]*

Norwegian Institute of Public Health 2012
Low-level radiofrequency electromagnetic fields – an assessment of health risks and evaluation of regulatory practice

> "A large number of studies have examined the possible effects of exposure to weak RF fields (i.e., exposure within the ICNIRP's reference values). The studies have been performed on cells and tissues, and in animals and humans. The effects that have been studied apply to changes in organ systems, functions and other effects. There are also a large number of population studies with an emphasis on studies of cancer risk. The large total number of studies provides no evidence that exposure to weak RF fields causes adverse health effects." *[p. 38]*

United Kingdom Health Protection Agency 2012
Report of Independent Advisory Group on Non-Ionising Radiation

> "In summary, although a substantial amount of research has been conducted in this area, there is no convincing evidence that RF field exposure below guideline levels causes health effects in adults or children." *[p. 4]*

Nordic Radiation Authorities (Danish National Board of Health, Finland Radiation and Nuclear Safety Authority, Icelandic Radiation Safety Authority, Norwegian Radiation Protection Authority, Swedish Radiation Safety Authority) 2009
EXPOSURE OF THE GENERAL PUBLIC TO RADIOFREQUENCY ELECTROMAGNETIC FIELDS - A joint statement from the Nordic Radiation Safety Authorities

> "The Nordic authorities agree that there is no scientific evidence for adverse health effects caused by radiofrequency field strengths in the normal living environment at present. This conclusion concurs with the opinion of international scientific and advisory bodies listed as references below [ICNIRP, 1998 and 2009; WHO, 2005 and 2006; SCENIHR 2009; SSI`s Independent Expert Group on Electromagnetic Fields, 2007]. The Nordic authorities therefore at present see no need for a common recommendation for further actions to reduce these radiofrequency fields." *[p. 4]*

State Health Agency & PUC
Reviews of Smart Meters and Health

State Health Agency Reviews:

North Carolina Department of Health and Human Services, Division of Public Health, Occupational and Environmental Epidemiology Branch 2015

Health Impacts of Advanced Metering Systems (Smart Meters)

> "Non-thermal health concerns evaluated included cancer, reproductive effects, cellular effects, neurological behavioral effects, and electromagnetic sensitivity. There is insufficient evidence to link RF exposures to adverse health outcomes. This is consistent with conclusions of other organizations including the National Cancer Institute, the Centers for Disease Control and Prevention, and the World Health Organization. It is also consistent with smart meter reviews performed by other states." *[Executive Summary]*

Arizona Department of Health, Office of Environmental Health 2014

Public Health Evaluation of Radio Frequency Exposure from Electronic Meters

> "Exposure to electric meters (AMI and AMR) is not likely to harm the health of the public. This conclusion was reached because (1) none of the detected power densities exceeded the FCC standard of 6/Wm2. This standard was determined based on thermal effects, and was set to prevent whole-body heat stress and excessive localized tissue heating; (2) available government assessments and scientific literature indicated that there is no consistent or convincing evidences to support a cause-and-effect relationship related to the exposures to RF frequency (900-930 MHz) used by the smart meters;" *[p. 26]*

Vermont Department of Health 2012

Radio Frequency Radiation and Health: Smart Meters

> "After extensive review of the scientific literature available to date and current FCC regulatory health protection standards, we agree with the opinion of experts:
>
> - The thermal health effects of RFR are well understood, and are the current basis for regulatory exposure limits. These limits are sufficient to prevent thermal health effects.
> - Non-thermal health effects have been widely studied, but are still theoretical and have not been recognized by experts as a basis for changing regulatory exposure limits.
>
> The Vermont Department of Health has concluded that the current regulatory standards for RFR from smart meters are sufficient to protect public health." *[p. 1]*

Maine Center for Disease Control 2010

Maine CDC Executive Summary of Review of Health Issues Related to Smart Meters

> "In conclusion, our review of these agency assessments and studies do not indicate any consistent or convincing evidence to support a concern for health effects related to the use of radiofrequency in the range of frequencies and power used by smart meters. They also do not indicate an association of EMF exposure and symptoms that have been described as electromagnetic sensitivity." *[p. 4]*

State Health Agency & PUC
Reviews of Smart Meters and Health

Public Utility Commission Reviews:

Massachusetts Department of Public Utilities 2014
Investigation by the Department of Public Utilities on its own Motion into Modernization of the Electric Grid

> "The Department takes seriously the testimony and comments that express concern about potential health effects resulting from exposure to RF emitted by certain electric meters. However, after thorough review and consideration of the issue, the Department is unaware of any credible, peer-reviewed scientific studies that demonstrate a direct human health risk from exposure to the low-level RF signals from advanced meters." *[p. 37-38]*

> "We find that many studies referenced by commenters asserting health impacts from advanced meters do not meet this standard and, therefore, cannot be considered credible. For example, many commenters cite the 2007 BioInitiative Report and its update, the 2012 BioInitiative Report. Neither of these reports has been objectively peer reviewed, as noted by international health agencies criticizing them for not being an objective reflection of the current state of scientific knowledge." *[p. 39-40]*

> "In assessing arguments and cited studies, we also consider their consistency with the weight of scientific evidence and determinations made by other jurisdictions. Other jurisdictions that have considered potential health impacts of RF, including regulatory bodies and public health organizations, do not find that RF exposure from advanced meters, operating under established U.S. and international exposure limit guidelines, leads to adverse health effects." *[p. 42]*

> "Some commenters assert that advanced meters pose a particular health threat to individuals with electromagnetic hypersensitivity. We recognize that certain individuals report a heightened sensitivity to RF emissions and attribute illness or other physical symptoms to RF exposure. While we appreciate that their symptoms are serious, based on all of the testimony and the materials we have reviewed we are unable to conclude that RF exposure and, specifically, RF from electric meters, is the cause of those symptoms." *[p. 46]*

Maine Public Utility Commission 2014
Order, Docket No. 2011-00262, Docket No. 2012-00412

> "[W]e find that Advanced Metering Infrastructure (AMI), including the use of "smart meters," as implemented and operated by Central Maine Power Company (CMP or the Company), does not present a credible threat to the health and safety of CMP's customers and, based on the record of this proceeding is, therefore, safe." *[p. 1]*

District of Columbia Public Service Commission 2013
Report of an Investigation into Smart Meters

> "[T]he Commission has found no credible, scientific evidence to show that the level of RF emissions from the Pepco smart meters is a threat to human health." *[p. 4]*

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State Health Agency & PUC
Reviews of Smart Meters and Health

Michigan Public Service Commission 2012

U-17000 Report to the Commission

> "After careful review of the available literature and studies, the Staff believes that the health risk from the installation and operation of metering systems using radio transmitters is insignificant. In addition, the appropriate federal health and safety regulations provide assurance that smart meters represent a safe technology." *[p. 12]*

Texas Public Utility Commission 2012

Report on Health and Radiofrequency Electromagnetic Fields from Advanced Meters

> "Decades of scientific research have not provided any proven or unambiguous biological effects from exposure to low-level radio frequency signals. Further, Staff reviewed all available material and found no credible evidence to suggest that smart meters emit harmful amounts of Electromagnetic Field (EMF) radiation." *[p. 1]*

> "It is important to note that one must use caution when relying solely on the results of individual research studies because conflicts or inconsistencies may exist among the results of other individual studies. Laymen often may not recognize poorly executed studies, or they can misinterpret the results of properly conducted scientific research. Either circumstance may lead a casual observer to draw errant conclusions. Furthermore, it is impossible to scientifically prove absolute safety (the null hypothesis)." *[p. 1]*

> "The 'BioInitiative Report' is an example of a report that received notoriety despite being viewed negatively by the research community. Its contributors are described as a group of 14 scientists, researchers, and public health policy professionals. The stated purpose of the report was to document "bioeffects, adverse health effects and public health conclusions about impacts of non-ionizing radiation." The document was edited by Cindy Sage, an environmental consultant, and Dr. David O. Carpenter, director of the Institute for Health and the Environment at the State University at Albany (New York).

> The report is often cited by opponents of wireless technology, but it was widely criticized by government research agencies and subject matter experts in Australia, Belgium, the European Commission (EC), France, Germany, and the Netherlands. It was also criticized by EPRI and the IEEE. The overall opinion of these institutions was that the report had many shortcomings. Some of the stated criticisms were that the report:

- Provided views that were not consistent with the consensus of science;
- Recommended safety limits that were not supported by the weight of scientific evidence;
- Included selection bias in several research areas;
- Lacked objectivity and balance; and
- Suffered from uneven editing quality.

Some researchers have developed a level of notoriety for their assertions regarding the purported dangers of EMF exposure. Opponents of wireless technology have naturally called upon these people to testify as expert witnesses and this tends to raise their profiles to an even greater degree. These efforts have not always been successful. For example, Carpenter attempted to rely on his work on the BioInitiative Report as one of the qualifications to testify as an expert for intervenors opposed to plans by Hydro Québec, a utility in Canada, to install wireless smart meters on homes and businesses. The regulatory authority for the province, The Québec Energy Board (The Board), stated (translated from French):

> 'The Board has refused to grant the requested expert status on the grounds that David Carpenter is not a doctor, never had clinical experience with patients and has never personally done any research on the effects of RF health.[55] The Board does not, however, reject his testimony in the case because of his knowledge on the research done by others in this field. It therefore accepted this testimony, subject to establishing the probative value to be accorded.'

The Board also did not view Carpenter as independent and unbiased, as required by its rules governing the expectations of expert witnesses. The Board stated (translated from French):

> 'Clearly, the witness Carpenter, expert or not, does not meet the criteria of objectivity which the Board is entitled to expect.'" *[pp. 17-18]*

Public Health Reviews
RF Fields and Claimed Electromagnetic Hypersensitivity

World Health Organization 2016
About electromagnetic fields, Summary of health effects

"Some members of the public have attributed a diffuse collection of symptoms to low levels of exposure to electromagnetic fields at home. Reported symptoms include headaches, anxiety, suicide and depression, nausea, fatigue and loss of libido. To date, scientific evidence does not support a link between these symptoms and exposure to electromagnetic fields. At least some of these health problems may be caused by noise or other factors in the environment, or by anxiety related to the presence of new technologies." *[p. 2]*

***

"Some individuals report "hypersensitivity" to electric or magnetic fields. They ask whether aches and pains, headaches, depression, lethargy, sleeping disorders, and even convulsions and epileptic seizures could be associated with electromagnetic field exposure.

There is little scientific evidence to support the idea of electromagnetic hypersensitivity. Recent Scandinavian studies found that individuals do not show consistent reactions under properly controlled conditions of electromagnetic field exposure. Nor is there any accepted biological mechanism to explain hypersensitivity. Research on this subject is difficult because many other subjective responses may be involved, apart from direct effects of fields themselves." *[p. 2]*

New Zealand Ministry of Health 2015
Interagency Committee on the Health Effects of Non-ionising Fields: Report to Ministers

"Recent reviews of these studies continue to conclude that people who consider themselves unusually sensitive to EMFs are, in fact, unable to detect EMFs, and the occurrence of symptoms appears unrelated to exposures.... There is experimental evidence suggesting a nocebo effect (ie, someone believing that they are exposed, even when they are not) could provoke the symptoms." *[p. 14]*

European Commission Scientific Committee SCENHIR 2015
SCENIHR Opinion on Potential health effects of exposure to electromagnetic fields

"Symptoms that are attributed by some people to various RF EMF exposure can sometimes cause serious impairments to a person's quality of life. However, research conducted since the previous SCENIHR Opinion adds weight to the conclusion that RF EMF exposure is not causally linked to these symptoms. This applies to the general public, children and adolescents, and to people with idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF). Recent meta-analyses of observational and provocation data support this conclusion." *[p. 6]*

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Public Health Reviews
RF Fields and Claimed Electromagnetic Hypersensitivity

The Royal Society of Canada 2014
Expert Panel: A Review of Safety Code 6 (2013): Health Canada's Safety Limits for Exposure to Radiofrequency Fields

> "Idiopathic Environmental Intolerance Attributed to Electromagnetic Fields (IEI-EMF), or Electrical Hypersensitivity, also remains an issue of serious concern that deserves further investigation. However, there is no firm evidence for the hypotheses that people with IEI-EMF can perceive RF energy at levels below the limits in SC6 or that there is a causal link between exposure to RF energy and their symptoms." *[p. 18]*

Norwegian Institute of Public Health 2012
Low-level radiofrequency electromagnetic fields – an assessment of health risks and evaluation of regulatory practice.

> "The relatively extensive literature provides no evidence that exposure to electromagnetic fields is the real cause of the health problems that individuals attribute to electromagnetic fields, whether exposure occurs alone or in combination with other factors that may affect the induction of symptoms. There is also no evidence that individuals with health problems that they attribute to electromagnetic fields are able to detect such exposure." *[p. 37]*

United Kingdom Health Protection Agency 2012
Report of Independent Advisory Group on Non-Ionising Radiation

> "[W]hen taken together the experimental evidence suggests that short-term exposure to RF fields below guideline levels ... does not cause acute symptoms, either in the general public or in people who report being sensitive to electromagnetic fields." *[p. 243]*

International Commission on Non-Ionizing Radiation 2009
Exposure to high frequency electromagnetic fields, biological effects and health consequences (100 kHz-300 GHz)

> "A wide range of subjective symptoms including headaches and migraine, fatigue, and skin itches have been attributed to various RF sources both at home and at work. However, the evidence from double-blind provocation studies suggests that the reported symptoms are not causally related to EMF exposure." *[p. 272]*

Lack of Scientific Objectivity and Reliability

In BioInitiative Report

Health Council of the Netherlands
Review of BioInitiative Report

> "Upfront, therefore, the reason for writing the report was not to give an objective analysis of the current state of science, that would subsequently lead to recommendations. Instead, the aim was to present information to demonstrate why current standards are inadequate." [p. 3]

> "Notably, not all authors are scientists. The methods used to collect literature are not defined. In many cases a selection of the available scientific material has been made, but the selection criterion is not stated." [p. 2]

> "The suggestion that some of the observed biological effects may lead to reduced wellbeing, disease, or even death lacks scientific basis." [p. 3]

> "In view of the way the BioInitiative report was compiled, the selective use of scientific data and the other shortcomings mentioned above, the Committee concludes that the BioInitiative report is not an objective and balanced reflection of the current state of scientific knowledge. Therefore, the report does not provide any grounds for revising the current views as to the risks of exposure to electromagnetic fields." [p. 4]

Australian Centre for Radiofrequency Bioeffects Research (ACRBR)
ACRBR Position Statement on BioInitiative Report

> "The model that most scientific expert bodies in this area (e.g. World Health Organisation (WHO)) employ is to engage independent experts to provide a review and recommendations on an issue. Independent experts are engaged because it is meant to provide an objective evaluation of the issue. This contrasts strongly with the BioInitiative Report, which is the result of the opinions of a self-selected group of individuals who each have a strong belief that does not accord with that of current scientific consensus." [p. 2]

> "Overall we think that the BioInitiative Report does not progress science, and would agree with the Health Council of the Netherlands that the BioInitiative Report is 'not an objective and balanced reflection of the current state of scientific knowledge' (page 4). As it stands it merely provides a set of views that are not consistent with the consensus of science, and it does not provide an analysis that is rigorous-enough to raise doubts about the scientific consensus." [p. 3]

European Commission EMF-NET
Comments on the BioInitiative Working Group Report (BioInitiative Report)

> "There is a lack of balance in the report; no mention is made in fact of reports that do not concur with authors' statements and conclusions. The results and conclusions are very different from those of recent national and international reviews on this topic... If this

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report were to be believed, EMF would be the cause of a variety of diseases and subjective effects, including: Sleeplessness, headache, fatigue, skin disorders and changes in skin sensitivity, loss of appetite, tinnitus, impairment of memory and concentration, Alzheimer's and Parkinson's disease, cardiac problems, changes in brain and nervous systems activity, stress reactions, inflammatory and allergic reactions, genotoxic effects, changes in immune system function, and many types of cancers. None of these health effects has been classified as established in any national or international reviews that assessed biological and health effects from exposures below internationally accepted EMF limits when the whole database of scientific literature is reviewed according to well-accepted international risk assessment methods and criteria (see Annex 1 and 2)." [p. 1]

"Table 1.1 (pp. 34-49) gives the overall conclusions of the BioInitiative Report. None of these conclusions is supported by the major national or international reviews as listed in Annexes 1 and 2, that have made use of the internationally accepted weight-of-evidence approach to study results." [p. 1]

IEEE Committee on Man and Radiation (COMAR)

COMAR TECHNICAL INFORMATION STATEMENT: EXPERT REVIEWS ON POTENTIAL HEALTH EFFECTS OF RADIOFREQUENCY ELECTROMAGNETIC FIELDS AND COMMENTS ON THE BIOINITIATIVE REPORT

"[T]he weight of scientific evidence in the RF bioeffects literature does not support the safety limits recommended by the BioInitiative group. For this reason, COMAR recommends that public health officials continue to base their policies on RF safety limits recommended by established and sanctioned international organizations such as the Institute of Electrical and Electronics Engineers International Committee on Electromagnetic Safety and the International Commission on Non-Ionizing Radiation Protection, which is formally related to the World Health Organization." [p. 348]

"The BIR was written by 14 individuals under the direction of a 4-person organizing committee. Most of its 21 sections are authored by single individuals or (in a few cases) pairs or trios of authors; the section "Key Scientific Evidence and Public Health Policy Recommendations" was written by a pair of individuals and appears to reflect their views only. There is no indication of how the members of the committee were chosen or how balance was provided in the group of contributors, a majority of whom have public records of criticism of existing exposure standards and guidelines." [p. 350-51]

"A major weakness of the BIR is a selective, rather than a comprehensive, review of the literature in various topical areas." [p. 351]

PPL Electric Exhibit DV-1

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6/25/20

Before the

PENNSYLVANIA PUBLIC UTILITY COMMISSION

PPL Electric Utilities Corporation

Smart Meter Technology Procurement and Installation Plan

Docket Nos. P-2014-_____
and M-2009-2123945

June 30, 2014

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I. Executive Summary

PPL Electric Utilities Corporation ("PPL Electric" or the "Company") was one of the first investor-owned utilities in North America to deploy an Automated Metering Infrastructure ("AMI"). The Company deployed its initial AMI solution beginning in 2002, utilizing a Power Line Carrier ("PLC") technology wherein data from meters is transmitted via existing power line infrastructure. Through the course of its initial implementation, which took place from 2002 – 2004, PPL Electric realized several operational and customer benefits including the automation of monthly meter reads for all customers. A Meter Data Management ("MDM") system was added in 2006 to support processing of the meter data being collected from the AMI system and to interface directly with a customer portal. As a result, PPL Electric was one of the first utilities in the country to present hourly usage data to all customers.

In 2009, PPL Electric submitted its Smart Meter Filing as required by the Pennsylvania Public Utility Commission ("PA PUC" or the "Commission") describing compliance with PA Act 129 and the Commission's subsequent Smart Meter Implementation Order. In the proceedings which followed, the Commission determined that PPL Electric's AMI solution was not fully compliant with all legal and regulatory requirements. In particular, the Commission cited the inability of the Company's solution to provide direct access to and use of pricing information, and the need for further evaluation regarding the 15-minute interval data requirement.

- PPL Electric responded by launching a series of pilot programs to evaluate the impact of upgrades and extensions to the PLC AMI solution. In parallel, the Company performed a series of assessments, with industry expertise, to determine the technical limitations of that solution. These assessments and pilots led to several conclusions: The existing PLC AMI solution is not fully compliant with the above-referenced legal and regulatory requirements.

- Components of the existing PLC AMI solution were approaching the end of their useful lives. The Company has witnessed increased meter failure rates over the past several years due to the age of the solution.

- Market assessments and pilot programs conducted by PPL Electric validated the increasingly obsolete nature of PLC technology, which was determined to be limited in both scalability and functionality versus competing AMI technology types. This obsolescence also meant that without a new solution, PPL Electric would be unable to provide the same level of service to its customers as could be provided by peer utilities.

As a result, PPL Electric proposes to implement a Radio Frequency Mesh ("RF Mesh") AMI technology type for its future smart metering solution. The Company believes RF Mesh represents the best technology option that exists in the marketplace today with respect to solution costs, compliance with legal and regulatory requirements, and PPL Electric's current and future business needs.

PPL Electric's proposal is to fully replace its current system with an RF Mesh AMI solution. This includes the replacement of all meters (approximately 1.4 million). The Company is also proposing to replace the supporting systems needed to enable advanced metering functionality,

including the Head End system, the MDM, a Meter Asset Management ("MAM") tool, the Customer Portal tool, and the associated Information Technology ("IT") architecture. The proposed solution also calls for the addition of a Network Operating Center ("NOC") to be implemented prior to deployment. This solution will allow the Company to ensure a high level of operational performance, maintain network and infrastructure integrity, and effectively manage the deployment of the new metering system. Additionally, changes to customer data and billing will require changes to PPL Electric's Customer Information System ("CIS"). An analysis is currently underway to assess the scope of this impact. After completing this analysis, PPL Electric anticipates filing an amendment to this Plan to implement the CIS changes and seek recovery of the associated costs.

A diagram showing these proposed components is provided in Figure 1 – SMP Scope High Level Overview.

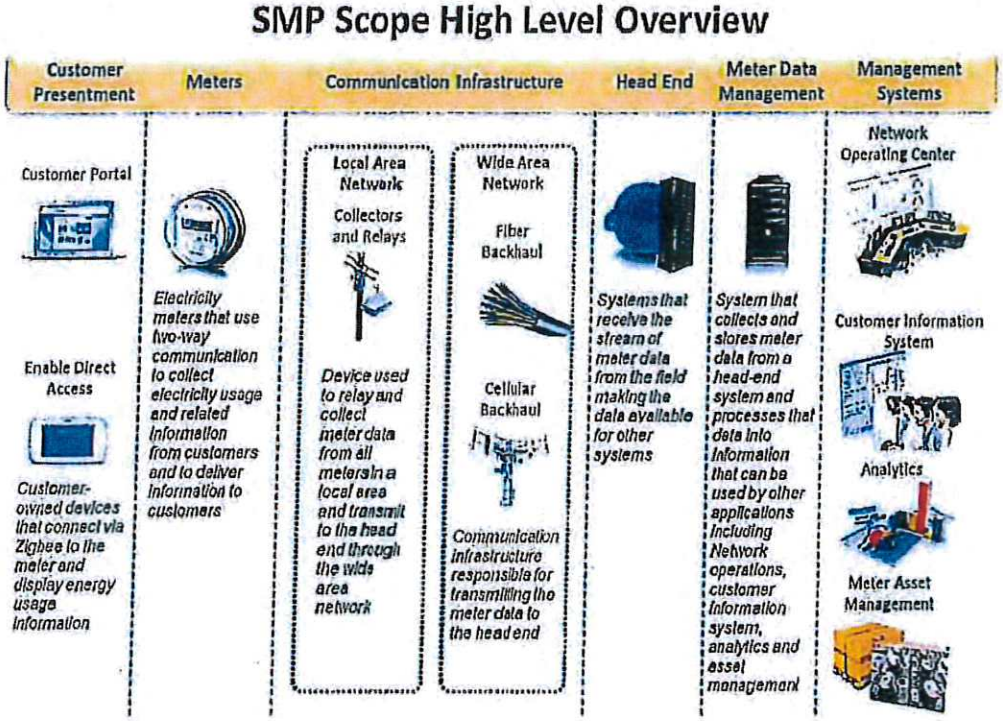

Figure 1 – SMP Scope High Level Overview

The decision to replace the existing solution was based on many factors, including:

Regulatory Compliance

PPL Electric determined, based on the above-referenced pilot programs and assessments, that upgrading the existing PLC AMI solution would not allow the Company to comply with all legal and regulatory requirements. An RF Mesh AMI solution type as proposed herein will allow the Company to meet these requirements.

Additional detail regarding compliance with legal and regulatory requirements is provided in Section III. Technology Assessment.

Solution and Systems

The Company believes that an RF Mesh AMI solution and supporting systems provide the strongest operational performance and the most flexibility for future business and regulatory needs. This type of network provides a solution that is not constrained by the existing distribution network and which allows for flexible expansion opportunities as the Company experiences growth. An RF Mesh solution also provides the capability for proactive messages, such as outage and restoration notification, an improvement over the current system which requires active pinging of the meters to detect power outage status. Additional details regarding the technical capabilities of the solution are provided in Section III. Technology Assessment.

Prudency

For the reasons discussed above, PPL Electric would need to replace the majority of its current meters regardless of the solution chosen. In addition to being non-compliant, the original electromechanical meters (~1.2 million) deployed in the existing solution are no longer available in the market. Based on this and other factors described in more detail in the following chapters, PPL Electric determined that upgrading the PLC AMI solution would not be a prudent expenditure.

Technology Evolution

With its current solution, PPL Electric remains an outlier within the expanding AMI community. Very few Investor Owned Utilities operate a similar technological solution within the US, whereas RF Mesh continues to exhibit industry dominance and expanded growth. An RF Mesh solution therefore provides PPL Electric with a substantial pool of peer companies with which to collaborate and benchmark. This includes the Company's peers in Pennsylvania, all of whom have elected to deploy an RF-based AMI solution to comply with Act 129 and Implementation Order requirements.

Proposed Deployment Schedule and Cost:

With Commission approval, the proposed solution will be deployed beginning with an IT system upgrade to be completed by the end of Q3 2016. Deployment of meters will begin in 2016 and will be implemented in three phases: a solution validation phase in late 2016 and early 2017 to validate full system functionality, deployment processes and field tools, followed by a full deployment phase from 2017 – 2019. The third phase will consist of a two-year system

stabilization period from 2020 – 2021. This phase will be used to optimize system performance and ensure all functionality is delivered. In order to accomplish this timeline, activities to support vendor procurement began in May 2014. PPL Electric will not execute contracts with selected vendors until approval of this Plan by the Commission. Further details on the deployment process are provided in Section V. Implementation Plan.

The full cost of this solution through the deployment timeframe is estimated to be approximately $450 million. This cost is explained in more detail in Section X. Financial Overview. PPL Electric's projection of costs for the various components of the SMP are high level estimates based on data provided by potential vendors in response to the Company's Requests for Information ("RFIs") and further based on the Company's business experience. These high level estimates are subject to change for a variety of reasons, including, but not limited to, increases in vendor prices, changes in project scope, changes in the implementation timeline, unforeseen complications or changes in regulatory requirements. The cost estimates are not precise and will be revised over the life of the project. PPL Electric intends to recover its actual smart meter costs through the Smart Meter Rider whether they are more or less than the Company's initial estimates.

A high-level view of the schedule is shown below in Figure 2 - High Level Program Schedule.

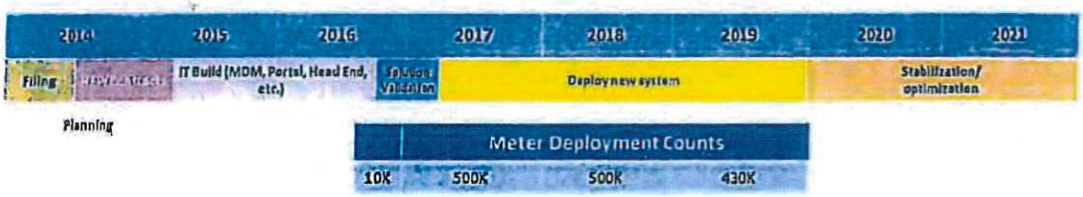

Figure 2 - High Level Program Schedule

Objectives of this Plan

The objectives of this Smart Meter Plan are to:

- Provide a summary update on final pilots conducted by the Company
- Describe the process which led to the proposal to replace the existing PLC AMI solution with an RF Mesh AMI solution
- Provide detail about the key activities needed to select vendors and the proposed timeline for deployment, including when advanced metering functionality will be available to customers
- Describe the Company's plan to implement the RF Mesh AMI solution
- Describe a plan to address cyber security and privacy of customer data concerns
- Discuss organizational impacts
- Discuss program risks and mitigation strategies
- Describe program benefits and present the financial overview and the Company's proposed cost recovery mechanism
- Define the Company's communications strategy

II. PPL Electric Background

PPL Electric provides electric distribution, transmission and default generation services to approximately 1.4 million customers in a certificated service territory that spans approximately 10,000 square miles in all or portions of 29 counties in eastern and central Pennsylvania. PPL Electric is a "public utility" and "electric distribution company" ("EDC") as those terms are defined under the Public Utility Code, 66 Pa. C.S. §§ 102 and 2803.

A. Smart Meter Program History

PPL Electric was one of the first Investor-Owned Utilities in the country to implement an Automated Metering Infrastructure system. The technology chosen for that system was a PLC solution purchased from Aclara. Under PLC technology, the meters are read remotely and the data is transmitted back to PPL Electric through the power line. PPL Electric replaced all meters, built equipment into each substation to collect meter data, and built an IT infrastructure to allow for the collection of data to support a variety of processes, including billing and settlement, and to pave the way for advanced business functionality. This infrastructure incorporated the MV-90 system used for large commercial and industrial customers which was already in place at the time. A MDM system, also purchased from Aclara, was added in 2006 to support processing of the meter data being collected from the AMI system and to interface directly with a customer portal. As a result, PPL Electric was one of the first utilities in the country to present hourly usage data to customers.

In 2008, the legislature adopted Act 129 of 2008 ("Act 129"), which amended the Public Utility Code and inter alia, required all Pennsylvania utilities with over 100,000 customers to deploy smart meters. In particular, Act 129 described smart meter technology as follows:

> *"Smart meter technology" means technology, including metering technology and network communications technology capable of bidirectional communication, that records electricity usage at least an hourly basis, including related electric distribution system upgrades to enable the technology. The technology shall provide customers with direct access to and use of price and consumption information. The technology shall also:*
>
> *(1) Directly provide customers with information on their hourly consumption.*
> *(2) Enable time-of-use rates and real-time price programs.*
> *(3) Effectively support the automatic control of the customer's electricity consumption by one or more of the following as selected by the customer:*
> *(i) the customer;*
> *(ii) the customer's utility; or*
> *(iii) a third party engaged by the customer or the customer's utility*

On June 24, 2010, the Commission issued an Implementation Order directing that a covered EDC's smart meter technology should support the following 15 capabilities:

Mandatory Act 129 Requirements:

1. Bidirectional data communications

2. Reading usage data on at least an hourly basis once per day

3. Providing customers with direct access to and use of price and consumption information

4. Providing customers with information on their hourly consumption

5. Enabling Time of Use (TOU) rates and Real-Time Pricing (RTP) programs

6. Supporting the automatic control of the customers' electric consumption

Additional PA PUC Implementation Order Requirements:

7. Ability to remotely disconnect and reconnect

8. Ability to provide 15-minute or shorter interval data to customers, EGSs, third-parties, and an RTO on a daily basis, consistent with the data availability, transfer, and security standards adopted by the RTO

9. On-board meter storage of meter data that complies with nationally recognized non-proprietary standards such as ANSI C12.19 and C12.22 tables

10. Open standards and protocols that comply with nationally recognized non-proprietary standards such as IEEE 802.15.4

11. Ability to upgrade these minimum capabilities as technology advances and becomes economically feasible

12. Ability to monitor voltage at each meter and report data in a manner that allows an EDC to react to the information

13. Ability to remotely reprogram the meter

14. Ability to communicate outages and restorations

15. Ability to support net metering of customer-generators

Additionally, the Implementation Order established a mechanism for recovery of smart meter deployment costs, provided guidance on required filings and communications pertaining to Smart Meter Implementation and Procurement, and established a transition period for utilities to develop a Smart Meter Plan with requirements to provide smart meters upon customer requests and new construction.

In accordance with the schedule established by the Commission, PPL Electric filed its initial Smart Meter Plan with the Commission on August 14, 2009. In this filing, PPL Electric stated that the then-current system was compliant with the requirements of Act 129 and the

Implementation Order. Therefore, the Company proposed to conduct a series of pilots and evaluations to test and enhance its existing AMI system.

On June 24, 2010, the Commission entered its order in the Smart Meter proceeding. In its order, the Commission revised certain aspects of the Company's Smart Meter Plan and found that PPL Electric's current metering system did not fully comply with the requirements of Act 129. Specifically, the Commission stated that:

> *Since PPL Electric's existing system does not fully meet all Act 129 requirements, it should use the Grace Period Pilot programs to fully develop a Plan, to be filed with the Commission, to fully comply with Act 129*

Following the Commission's Order, PPL Electric undertook a series of pilot programs to test the abilities of the Aclara PLC system and reported to the Commission annually on the status of these pilots. The results of the pilots are discussed in Section III. Technology Assessment.

In addition, PPL Electric conducted a current state assessment of its smart metering system in 2011, including an analysis of the current state architecture and recommendations for the future system. PPL Electric contracted Black & Veatch, a recognized utility consulting firm with substantial experience in smart metering, to support this effort.

On May 4, 2012, the Company filed a petition requesting approval to modify its Smart Meter Plan and to extend its grace period to give the Company additional time to further test and evaluate the most cost-effective ways to meet the Act 129 requirements. *Petition of PPL Electric Utilities Corporation for Approval to Modify Its Smart Meter Technology Procurement and Installation Plan and to Extend its Grace Period,* Docket No. P-2012-2303075 ("May 2012 Petition").

In its Order entered August 2, 2012, the Commission granted an extension until June 30, 2014, for the Company to file its Final Smart Meter Plan.

In December 2012, the Commission entered a further order establishing additional requirements for smart meter plans. *Smart Meter Procurement and Installation*, Docket No. M-2009-2092655, Final Order entered December 6, 2012. Specifically, the Commission directed EDCs to include plans to support exchange of smart meter data between EDCs and Electric Generation Suppliers ("EGSs") and third parties. The order included direction to EDCs to support:

1. Utilization of smart meter data for bill ready and dual billing
2. Providing at least 12 months of account or meter level historical interval usage data via Electronic Data Exchange (EDI)
3. Participation in an EDEWG working group to define a solution for providing hourly interval usage and billing quality interval usage data via a web portal
4. Providing a plan to support meter level hourly interval usage data

In July 2013, PPL Electric contracted with IBM to assist the Company in the alignment of smart meter activities to program goals and a detailed advanced metering technology assessment. Requests for Information were issued to solicit vendor technical and cost information from the marketplace. The Company also performed a financial analysis to support this Plan and

established a Smart Meter Plan Roadmap for the next several years. Details on these assessments are provided in the appropriate chapters of this Plan.

PPL Electric has filed annual updates regarding progress of its SMP since submitting its initial filing in 2009, and has conducted multiple stakeholder meetings to provide updates on the progress of pilot programs and other matters of importance related to the SMP. Representatives from the Office of Consumer Advocate ("OCA"), Pennsylvania Utility Law Project ("PULP"), PP&L Industrial Customer Alliance ("PPLICA"), Reliant Energy, PA Coalition Against Domestic Violence, various Commission representatives, and other interested parties attended one or more of these stakeholder meetings.

The Company will continue to provide annual smart meter plan updates and meet with interested stakeholders in addition to ad-hoc updates basis as necessary and appropriate.

III. Technology Assessment

Following the Commission's June 24, 2010 Order, PPL Electric conducted several pilots to determine if its existing smart metering technology, with significant upgrades, could meet all of the requirements of Act 129 and the Commission's Implementation Order. In addition, PPL Electric evaluated the latest smart metering technologies in the marketplace in order to better understand the differences between upgrading the current system and installing a new one. PPL Electric communicated the status of these pilot programs to the Commission on an annual basis.

In 2013, PPL Electric initiated an evaluation of next generation AMI technologies to assess current and future smart meter technology. The objective of the evaluation was to gain an understanding of new AMI technologies that exist in the marketplace. The assessment focused on several key components of the smart metering system:

- Advanced Metering Infrastructure (AMI) Solution – includes smart meters, communications infrastructure, and head end technology
- Meter Data Management System (MDM)
- Customer Web Presentment Portal
- Network Operating Center (NOC)
- Meter Asset Management solution (MAM)

The technology assessments were conducted simultaneously and in parallel with ongoing pilot programs to determine the feasibility of upgrades to the current system.

A. SMP Pilot Programs

Beginning in 2009, PPL Electric provided annual communications to the Commission on the status of its pilot programs. These communications included Stakeholder Meetings and Annual Reports, the last of which was submitted in 2013. These annual reports included detailed descriptions of each of the pilots, status, and results.

Based on the pilots, PPL Electric concluded that the existing PLC AMI solution was technically limited in its ability to fully comply with legal, regulatory, and future business requirements. A significant barrier to this technology is the limited scalability, in terms of network bandwidth, for future uses. Additionally, the inability of the PLC network to generate proactive alarms and messages from meters, including outage, restoration, voltage, and temperature was also realized through the pilot programs.

Two pilot programs were particularly important to PPL Electric's decision to proceed with an RF Mesh solution. First, the TWACS 20 pilot tested the ability of the existing system to provide 15-minute interval read data as well as other meter-level data (voltage, temperature, etc.). This pilot concluded it would not be possible to read all meters for 15-minute intervals on a constrained substation while still maintaining key performance metrics (e.g. billing read performance, hourly read performance). Second, the In-Home Display pilot project concluded that the Wi-Fi technology utilized in this pilot would need to have some significant hardware and software improvements, which could not be supported by the existing solution, in order to provide an effective In Home Display system to support the direct access requirement.

Based on these results, and others, the Company concluded its current AMI solution could not fully meet the requirements of Act 129.

B. Existing AMI Solution Assessment

Concurrently with early pilots, PPL Electric conducted a detailed assessment in 2011 to determine whether upgrades to its AMI solution could meet current and future business needs. This process considered both the functionality of the AMI solution and the supporting IT architecture. The assessment, which was supported by Black & Veatch, was divided into three areas:

1. Development of current and future requirements;
2. Assessment of how the current Aclara system meets PPL Electric's requirements; and
3. Analysis of proposed upgrades and their ability to meet future requirements.

During this assessment, PPL Electric determined that the system was operating at its maximum realistic throughput at the Company's larger substations due to the increasing bandwidth needs of new smart meter functionality, such as gathering frequent meter reads. Additionally, the assessment concluded that the future system requirements dictated by Act 129 and the Implementation Order would create additional traffic on the communications network. This additional traffic would exacerbate existing problems with bandwidth and would eventually adversely impact system performance.

The Company also explored the specific Act 129 and Implementation Order requirements that would most stress the existing advanced metering infrastructure. These included voltage information, outage information, historical read collection, and interval data collection. It was predicted that the additional data required by more frequent interval data collection would result in quadrupled increase in network traffic alone, which the current system would not be able to support without significant enhancement. This would be especially true for the initiation of 15 minute interval reads, which would result in an approximately four times increase in data traffic.

To address these concerns, the Company concluded that it should explore the following:

1. Extend the useful life of PPL's TWACS system through system upgrade investments
2. Adopt accelerated meter replacement strategy
3. Ensure full vendor support of upgrade development to technology roadmap to limit exposure of future investments

The Company also began considering upgrades to the existing investment and initiated additional pilots to test functionality.

During this period, PPL Electric began experiencing increasingly higher meter failure rates. PPL Electric's meter population consists of both electromechanical and solid state meters. The population demographic is 86% and 14% respectively, A typical mature meter population experiences a low failure rate during the asset life of the meter. An industry standard failure rate for a meter population during its useful life is approximately 0.5%. For PPL Electric's population of 1.4 million meters, a failure rate consistent with the industry standard would realize as approximately 7,000 meter replacements per year. PPL Electric experienced approximately

28,000 failed meters in 2013 – four times the industry standard. The Company expects this trend to continue growing at an accelerated rate. Figure 3 shows PPL Electric's historic meter failure trend.

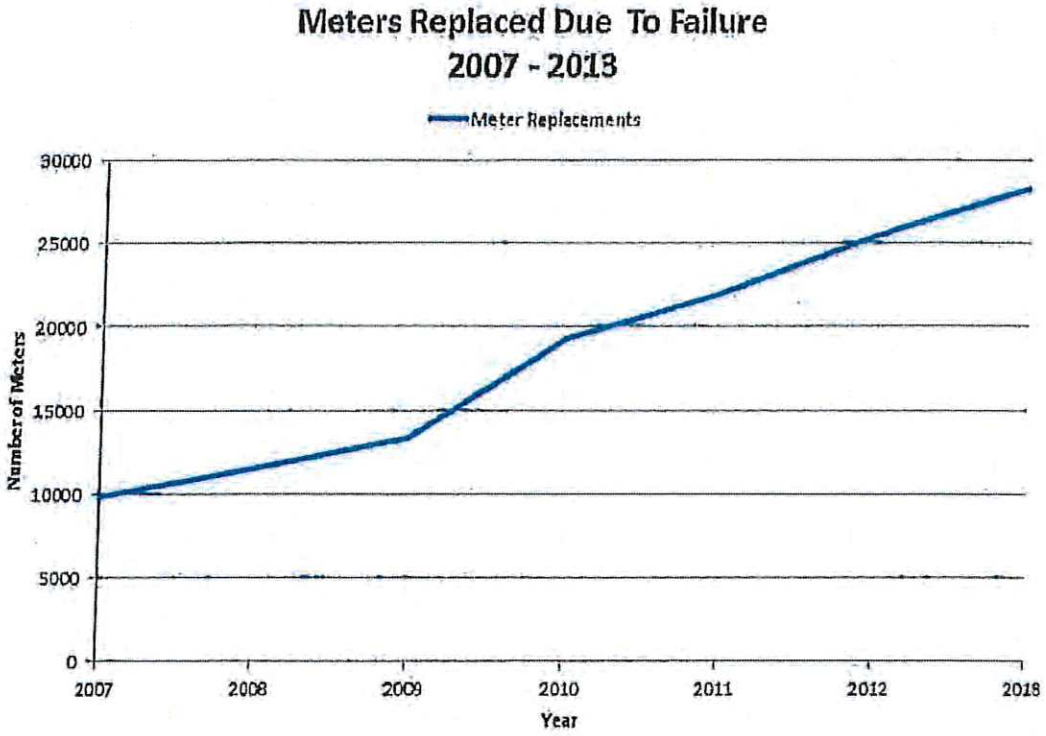

Figure 3 - Historic Meter Failure Rates

An increase in failure rates is most likely attributable to the tendency of this type of equipment to "wear out" over time as electrical components (early generation communication modules) fail due to electrical and thermal stresses. The upward trend in meter failure rates is a leading indicator that meters installed on PPL Electric's system are reaching the end of their useful life. Furthermore, the Company recognizes that AMI communications hardware installed during the initial AMI deployment is the same age as the meter population and is also approaching the end of its useful life. Of note, customers have largely received the benefits of the Company's existing metering system as it is nearing the end of its useful life.

As stated in its 2013 Annual Filing (2013 Annual Smart Meter Filing to the Commission, Docket No. M-2009-2123945), PPL Electric initiated an evaluation of next generation AMI technologies to assess current and future smart meter functionality. The need for an assessment of the AMI solution was motivated by several factors, primarily the non-compliance of the AMI solution as described by the Commission. The objective of the evaluation was to gain a better understanding of new AMI technologies that exist or will exist in the marketplace. Also, the Company wanted to gain additional information about how these technologies could meet the Company's future

requirements. PPL Electric hired IBM for this work and the evaluation consisted of the following areas:

- Development of smart meter goals,
- Technical assessment of mass market and large commercial and industrial metering systems, and
- Technical assessment of IT requirements (including MDM) and network communications

Beginning in late 2013, the Company established the following goals for smart metering and related technologies as described below:

> PPL's smart meter plan will address PA Act 129 and Implementation Order requirements as well as attempt to address current and future business requirements through a 20 year horizon.
>
> PPL's smart meter solution will:
>
> - Encompass new or existing meters, communications networks, integrated system architecture and advanced analytics.
> - Maintain or enhance the customer experience by providing operational functionality consistent with core business requirements and an asset centric business model.
> - Provide a stable, robust, and flexible platform that will facilitate market driven choices for customers through third party market providers (EGSs, CSPs, retailers, etc.).
> - Establish a flexible foundation for possible integration into broader smart grid technologies which may include distribution automation and grid monitoring.

These goals provided important direction for the next stage of the assessment, which focused on the three primary technology types that in aggregate dominate the AMI marketplace in the United States and around the world. These technology types are shown in Figure 4.

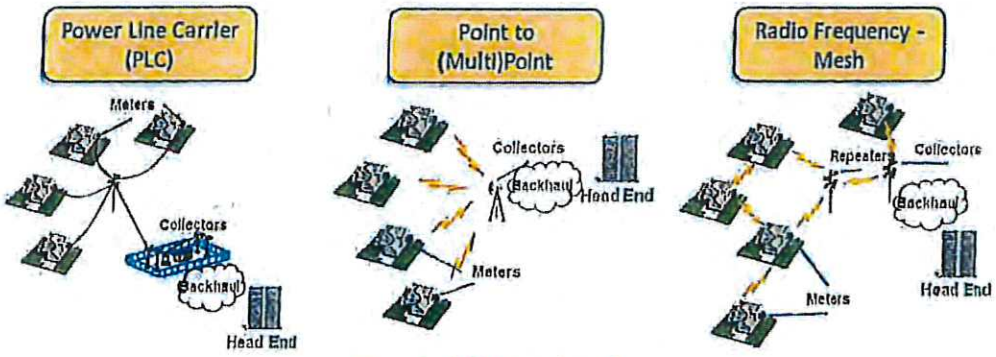

Figure 4 - AMI Technology Types

PPL Electric began with an analysis of the current-state metering solution (PLC) followed by a requirements identification phase. A series of workshops were held with subject matter experts from PPL Electric and IBM. These workshops discussed available solutions, strengths and weaknesses of available technology types, and inter-operability with the Company's current AMI IT infrastructure.

The areas of evaluation focused on technical components of the different solution types. The outcomes of this phase supported the issuance of a RFI.

Following this, the Company generated a high-level list of functional requirements for metering technology, head end technology, and software / information technology. Solution types were evaluated based on vendor RFI responses across several categories. Evaluation categories included compliance with Act 129 and Implementation Order requirements, alignment with the Company's goals for smart metering, financial / commercial risk, meeting functional requirements, meeting IT and network requirements, and resilience / maturity of the proposed system.

Each vendor's RFI solution was evaluated by the Company with input from key business units within PPL Electric. The evaluation process included communications with relevant PPL Electric internal stakeholders, subject matter expertise provided by IBM, and a series of workshops to discuss the received responses. Vendors and technology solutions were evaluated in the categories shown in Figure 5.

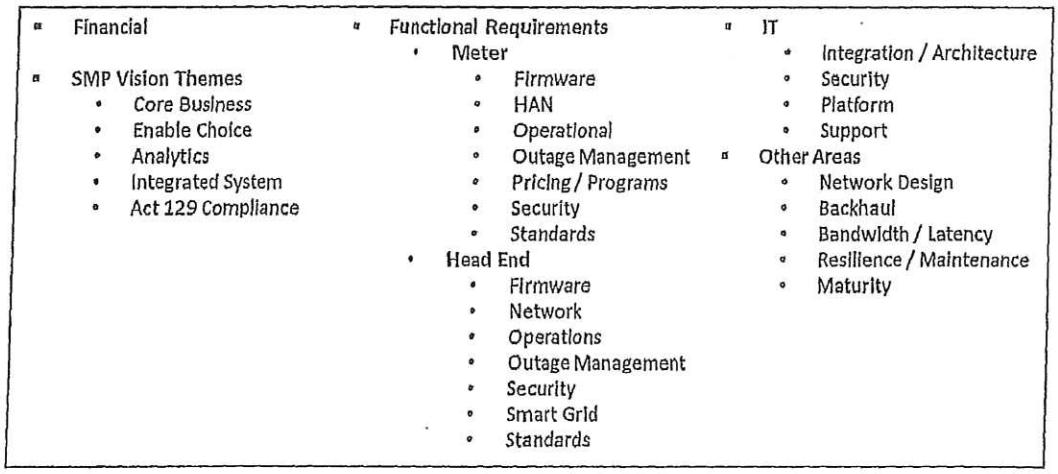

Figure 5 - Evaluation Categories for AMI Solution Evaluation

In addition to technical and business requirements, PPL Electric requested detailed cost information from solution vendors. A financial analysis was performed based on the submitted cost data, and forms the basis for the anticipated total solution cost. A detailed description of the financial analysis, including the overall solution costs, is provided in X. Financial Overview.

As a result of these evaluations, the Company proposed the adoption of a new technology type for its future metering system. Specifically, the proposal is to replace its current system with an RF Mesh solution type.

Based on the Technical Assessment, PPL Electric concluded the existing PLC technology has limited ability to meet current regulatory and future business requirements. Furthermore, the pilots performed by the Company have shown expansion of the PLC technology to meet requirements is in some cases high-cost and high-risk. For example, the ability to meet the regulatory requirement to provide 15-minute interval data requires a high degree of network bandwidth. This in turn would place unreasonable stress on the bandwidth of the current system. The current system vendor has created a roadmap to address these issues. However, in some cases, such as Home Area Network ("HAN") technology, no solution has been shown to be commercially viable.

The Technical Assessment evaluation also showed that the market share of PLC technology in North America has been steadily declining since PPL Electric first deployed its current system in 2002. Since 2002, several large utilities in North America have chosen to deploy RF-based systems and have developed best practices and lessons learned from their deployments; PPL Electric plans to leverage these practices through site visits, through collaboration meetings with peer utility companies, and by retaining consultants who have experience with deployments of RF Mesh solutions. Additional detail in this regard is provided in Section VIII. Program Risks. It is the Company's belief that an RF Mesh solution is the optimal alternative for the Company and its customers.

An RF Mesh solution will meet Act 129 and Implementation Order requirements in addition to the future business needs of the Company. PPL Electric plans to undergo a thorough vendor selection process to select the key partners for this deployment; this process is described in detail in Section IV. Vendor Selection for Future Technologies.

C. MDM Assessment

In parallel with the effort to solicit information for an AMI solution, PPL Electric conducted a similar effort to obtain market information for an upgrade to the existing MDM system. This assessment was completed with support from Black & Veatch.

PPL Electric's MDM has provided initial capabilities to process smart meter data, but is currently not capable of supporting the full breadth of Act 129's stated functionalities without significant development, upgrading, and customization. Thus, PPL Electric needed to effectively address these risks while also addressing the increased functional requirements defined by Act 129.

In order to accurately address the requirements of Act 129 and the evolving business needs of the utility, PPL Electric assessed the MDM functionality currently used by each internal stakeholder group. The Company used this information to create a baseline of current business needs into which was integrated the new Act 129 requirements. Future requirements for Smart Meter data from these internal operations as well as those expected to support the growing needs of retail markets were also considered.

In performing this evaluation of MDM alternatives and determining a prudent, cost effective strategy to meet Act 129 requirements, PPL Electric established three (3) underlying principles to guide the process. These guiding principles included:

1. Compliance with Act 129 requirements: The recommended MDM solution strategy must, first and foremost, enable the Company to fully support all of the Act 129 functional requirements as set out in the Act itself and the supporting Implementation Order.
2. Enable future operational performance improvements: As PPL Electric transitions to a future state of operations, the MDM solution must not only replace current functionalities and enable the required Smart Meter functionalities, but must also support advanced, future operational capabilities to continue to improve the Company's operational effectiveness in supporting Retail Market participants and efficiently managing the distribution system.
3. Mitigate risks: The recommended MDM solution strategy must help PPL Electric mitigate future risk associated with evolving future business needs and potential technology obsolescence.

PPL Electric examined possible MDM solutions that could accomplish the requirements set out by Act 129 and support the Company's future business needs. PPL Electric completed a detailed effort to understand and document all of the key functional capabilities currently supported by the Company's MDM, the operational problems currently encountered, the requirements that are associated with compliance with Act 129 functional capabilities, as well as the future capabilities needed to fulfill the Company's future needs.

Several actions were taken in support of this effort. First, PPL Electric developed a set of common MDM requirements, utilizing the Company's consultant and based on previous experience with other utilities core MDM capabilities. Additional requirements were compiled based the Company's initial MDM implementation in 2005 and based on previous PPL Electric smart meter pilot projects (described in detail in Section III. Technology Assessment). The Company also conducted detailed workshops to fully discover, review, and establish the full breadth of stakeholder requirements for meter data processing within PPL Electric.

Based on the detailed MDM requirements documented, PPL Electric developed a RFI that was issued to potential MDM vendors. The RFI described the Company's objectives, Act 129 compliance requirements, current situation, the three potential implementation scenarios, the desired optional capabilities, and the cost details desired. The RFI was issued to PPL Electric's current MDM vendor to get a complete understanding of its suggested approach to support the additional capabilities required by Act 129, correct current deficiencies which impede effectiveness, and implement the ability to support the Company's future needs. The RFI was also issued to the other top five MDM vendors in the industry as identified by PPL Electric's consultant.

PPL Electric reviewed each vendor's RFI response and assessed the capability of each MDM solution in meeting the Company's stated MDM requirements.

This provided a basis of confidence for PPL Electric to judge whether its current requirements, the Act 129 requirements, or its future requirements were:

a. Commercially viable to be delivered completely from at least one vendor
b. Reasonable across all of the vendors so as to provide for a competitive vendor selection process in the future

PPL Electric conducted four days of detailed workshops to examine each vendor's response to each of 215 specific requirements across 15 functional categories. These categories included the following:

- Synchronization of Data & Asset Management
- Field Activities & Work Order Management
- AMI Deployment Support
- AMI Data Management
- Validation, Estimation, and Editing (VEE)
- Billing Support
- Real Time Operations
- Revenue Protection
- Exception Reporting
- Load Research
- Retail Energy Supplier Support (Forecasting, Settlement, PLC)
- Planning & Engineering
- Customer Data Presentment
- Demand Control/Demand Response Support
- Outage Management

PPL Electric reviewed all of the requirements which directly related to Act 129 functional requirements as well as those which contained interdependence on any potential new AMI system. Following the initial receipt and evaluation of the responses from the vendors, PPL Electric scheduled detailed, on-site reviews of each vendors proposed solutions and live demonstrations of each vendor's commercial MDM product. These on-site visits served to validate the Company's understanding of the proposed solutions and confirm its assessment of the commercial availability and viability of potential solutions to meet current and future business needs, including the requirements of Act 129.

Finally, any remaining cost information was reviewed with the vendors to ensure PPL Electric had a sound understanding of the expected costs of implementing the proposed MDM solutions.

Based on the detailed pricing information provided by the vendor responses, PPL Electric was able to determine the estimated costs that may be incurred to implement the potential MDM solutions. These cost estimates were based on the following inputs:

- Vendor-specific costs as detailed directly within each vendor's response
- Estimates of system hardware costs based on typical PPL Electric internal IT costs
- Estimates of internal PPL Electric program support costs required to support the deployment of a new MDM system based on role types and projected basis of efforts
- Estimates of probable system integration costs based on deployments by other, like sized utilities deploying new MDM systems

Based on this detailed cost model, PPL Electric was able to estimate costs associated with the various implementation scenarios.

The deployment of a new MDM system at PPL Electric will require the migration of existing MDM capabilities and databases from its existing system. To address the incremental complexity of replacing an existing system, the Company developed an initial, high level deployment plan. The plan establishes sequencing, phasing, and alignment of a new solution deployment. The plan also begins the process of providing planning and cost timing insights and will be updated pending a final MDM solution selection

The assessment concluded that maintaining, upgrading and customizing PPL Electric's existing MDM solution poses significant risks of obsolescence. In addition, the existing solution provides the least ability to comply with PPL Electric's requirements (including Act 129). PPL Electric's proposal is to replace the existing MDM currently in use with a new MDM solution. A new solution will better address the Act 129 requirements and PPL Electric's business needs.

D. Customer Portal Assessment

A similar effort was conducted in parallel with the AMI and MDM assessments to evaluate the upgrade of the Company's customer portal system ("Energy Analyzer"), which presents energy usage information to customers via a web interface. Energy Analyzer was deployed to customers in June 2007. Concerns around a plateau in customer engagement and the dated nature of the tool prompted a marketplace assessment of customer portal vendors in late 2013.

The assessment process was carried out by first developing high-level requirements for the new PPL Electric Energy Analyzer tool in both customer service and IT areas, followed by an evaluation of web-based tools and a recommendation. Teams for this assessment were created and divided into:

- Communications and Education
- Market Research
- Customer Call Centers
- Business Account Specialists
- Customer Programs
- Customer Contact – Technology
- Advanced Metering
- Application Development

The Company developed a series of over 40 requirements for inclusion in an RFI. These included examples such as the ability to set up home audit and appliance recycling appointments, the ability to make recommendations to homeowners based on usage profiles, including PPL Electric rebates / state / federal programs, push messaging, and the ability to view prior customer bills for both customers and customer service representatives using the tool.

The Company identified vendor strengths and weaknesses through the RFI process and will issue a detailed RFP to customer portal vendors as part of the smart meter program. For details on this, see Section IV. Vendor Selection for Future Technologies.

The Customer Portal assessment concluded that an upgrade to the existing system will be necessary to support regulatory and business requirements.

E. Assessments of Other Systems

In addition to the assessments discussed above, the Company also completed assessments for NOC and MAM systems.

PPL Electric began exploration of a situational awareness and real-time analytics platform for its AMI solution in 2013. The Company met with various peer utilities to discuss their approach to a NOC, which would provide those capabilities. Utilities met with included PECO, Duke Energy, and Florida Power & Light. In addition to discussions with its peers, PPL Electric also held several in depth discussions with vendors regarding their capabilities and current customers.

The Company received high-level proposals from two NOC vendors, which included a proof-of-concept approach to trial technology and determine its efficacy prior to purchasing a full system. Pricing information was also collected from these proposals and that information was included in the financial analysis for the smart meter plan, which is described in more detail in Section X. Financial Overview. The Company plans to explore a NOC proof-of-concept in or around August 2014 using its existing PLC system. The results from the proof-of-concept will be used as inputs into the NOC vendor procurement process.

PPL Electric's current asset management systems only track meters and associated communication modules internal to meters. During the AMI assessment discussed above, it was determined that a future system should be capable of tracking additional installed devices, such as network devices (i.e., routers, collectors), and have the capability to track instruments such as transformers.

In addition, an upgrade to the MAM system would allow for additional features such as software and firmware tracking. With the regulatory requirement to support over-the-air upgrades to meter hardware, additional tracking of software and firmware will be required in order to account for versions, base lining, and revision tracking as upgrades are deployed. Additionally, an upgraded MAM will provide testing beyond accuracy; the current system only accounts for standard accuracy testing and does not have the capability to store test results from additional smart meter attributes such as remote disconnect. The Company also plans to utilize the upgraded MAM to store installation test results from test performed in accordance with 52 Pa. Code § 57.20(g). The Code states the public utility shall inspect service watthour meters for proper connection, mechanical condition, and suitability of location within 90 days of installation.

F. Regulatory Compliance

PPL Electric's current PLC solution is comprised of two different vintages of meters for its residential and small commercial customers. Approximately 86% of the total meter population consists of 2002 vintage electromechanical meters with a communications module. These meters do not comply with many of the Act 129 and Implementation Order requirements. The remaining 14% consists of upgraded solid-state electronic meters, which are also unable to meet all of the requirements. A summary of the compliance of the current PLC solution versus the proposed RF Mesh is shown in Table 1.

Table 1 - Summary of Compliance of Current PLC Solution versus Proposed RF Mesh Solution

Requirement	Current PLC Solution		Proposed RF Mesh Solution
	Electro-mechanical Meters (86% of population)	Solid-State Electronic Meters (14% of population)	
1. Bidirectional data communications	✓	✓	✓
2. Reading usage data on at least an hourly basis once per day	✓	✓	✓
3. Providing customers with direct access to and use of price and consumption information	✗	✗	✓
4. Providing customers with information on their hourly consumption	✓	✓	✓
5. Enabling TOU rates and RTP programs	✓	✓	✓
6. Supporting the automatic control of the customers' electric consumption	✓	✓	✓
7. Ability to remotely disconnect and reconnect	✗	✓	✓
8. Ability to provide 15-minute or shorter interval data to customers, EGSs, third-parties, and an RTO on a daily basis, consistent with the data availability, transfer, and security standards adopted by the RTO	✗	✗	✓
9. On-board meter storage of meter data that complies with nationally recognized non-proprietary standards such as ANSI C12.19 and C12.22 tables	✗	✓	✓
10. Open standards and protocols that comply with nationally recognized non-proprietary standards such as IEEE 802.15.4	✗	✓	✓
11. Ability to upgrade these minimum capabilities as technology advances and becomes economically feasible	✗	✓	✓
12. Ability to monitor voltage at each meter and report data in a manner that allows an EDC to react to the information	✓	✓	✓
13. Ability to remotely reprogram the meter	✗	✓	✓
14. Ability to communicate outages and restorations	✓	✓	✓
15. Ability to support net metering of customer-generators	✗	✓	✓

Throughout the technical and financial assessments detailed in the sections that follow, PPL Electric paid close attention to ensure that a new technology type will be able to meet all six of the minimum requirements set forth under Act 129 and the nine additional smart meter requirements set forth in the Commission's Implementation Order.

PPL Electric will ensure that these requirements are communicated to potential vendors as part of the vendor solicitation process, which will begin in Q3 2014. The following section provides details for each of the 15 requirements:

Act 129 Requirements:

1. Bidirectional data communications

The current PLC solution only allows for polling the meters and does not support proactive communications from the meters to the head end in real time. An RF solution will allow both push and pull notifications to and from meters. Additionally, an RF network will allow near-real time communications to be proactively sent by a meter to the head end and will enable last-gasp technology in the event of a loss of power to the meter.

2. Reading usage data on at least an hourly basis once per day

The current PLC solution enables this functionality by posting data to the customer web platform approximately 31-33 hours following the day, due to load constraints, data validation, and process reads. An RF solution and MDM replacement will enable the ability to record data on any scheduled interval. Data can be collected every 8 hours (or more frequently if necessary) and then processed. An upgraded MDM will also allow for continuous data processing.

3. Providing customers with direct access to and use of price and consumption information

The current PLC solution does not meet this requirement, and the Company is not aware of technology that is able to effectively provide this functionality through its PLC metering system. For RF-based communications meters, Zigbee has become the de facto industry standard, and all vendors being considered use this communications protocol to enable communications to a HAN device.

4. Providing customers with information on their hourly consumption

See (5) below.

5. Enabling TOU rates and RTP programs

The current PLC solution meets this requirement through the use of electromechanical retrofitted meters, which record hourly interval usage and demand to enable TOU and RTP billing. An RF solution would also meet this requirement. Any constraints would be consequences of back-end systems such as the CIS or MDM. Thus, an upgraded MDM system would provide additional support for this technology.

6. Supporting the automatic control of the customers' electric consumption

The current PLC solution complies with this requirement. Automatic load control is enabled by a signal on the electrical wave. Depending on the vendor solution, an RF system would allow for the same type of control through the Zigbee communications protocols or the solution's RF network.

PA PUC Implementation Order Requirements:

7. Ability to remotely disconnect and reconnect

The current PLC solution meets this requirement but requires meters with remote service switches to be installed in order to comply. The Company has completed a pilot using this technology, which is described in Section III. Technology Assessment, and subsequently has changed its standard meter to include this functionality. All RF-based solution vendors being considered comply with this requirement and have successfully demonstrated its functionality.

8. Ability to provide 15-minute or shorter interval data to customers, EGSs, third-parties, and an RTO on a daily basis, consistent with the data availability, transfer, and security standards adopted by the RTO

PPL Electric conducted a pilot in 2010 and 2011 to assess the capability to provide 15-minute interval data on a consistent basis using power line meters that have the capability to be configured for 15-minute data collection at the residential and Small Commercial and Industrial ("C&I") customer level. Currently, the Company provides sub-hourly 15-minute interval data for all its Large C&I customers. Residential customers are also provided with hourly interval data. In order to measure and record sub-hourly usage for all residential customers through the power line carrier system, the Company would need to upgrade the meters of approximately 1.2 million customers to newer electronic meters. However, the PLC system would be severely constrained in collecting the 15-minute interval data for all customers as tested in the pilot program. Furthermore, the current IT platform and systems are not built to process and store this amount of data. An RF solution would eliminate bandwidth issues associated with providing this data, while also enabling the functionality assuming that the required back office functions (e.g., an upgraded MDM system) are in place. The Company plans to deploy a solution which supports this functionality at the meter level, but will not build out the information technology platform to currently support this functionality due to cost and lack of market needs.

9. On-board meter storage of meter data that complies with nationally recognized non-proprietary standards such as ANSI C12.19 and C12.22 tables

The current PLC solution does not comply with this requirement as the current electromechanical retrofitted meters would have to be replaced with electronic meters. All RF-based solution vendors being considered comply with this requirement, but differ in how they approach the various standards involved. PPL Electric will evaluate RF solution capabilities in support of nationally-recognized non-proprietary standards.

10. Open standards and protocols that comply with nationally recognized non-proprietary standards such as IEEE 802.15.4

The current PLC solution does not fully comply with non-proprietary standards. The majority of meters currently installed use proprietary vendor communications standards. Only recent purchases of solid-state meters comply with ANSI C12.19 in the meter. All RF-based solution vendors being considered are compliant with non-proprietary standards.

11. Ability to upgrade these minimum capabilities as technology advances and becomes economically feasible

The characteristics of the current PLC solution make it increasingly difficult to upgrade due to restrictions with the PLC infrastructure. Furthermore, assessments and pilots conducted by the Company have revealed that it is already pushing the limits of PLC technology. An RF solution

would comply with these capabilities and in some cases can provide functionality enhancements over time and as requirements evolve.

12. Ability to monitor voltage at each meter and report data in a manner that allows an EDC to react to the information

The current PLC solution uses electromechanical meters retrofitted with modules that calculate voltage manually, causing a potential loss in accuracy compared to more modern, electronic meters. Additionally, constraints with the current PLC infrastructure limit the frequency of voltage monitoring due to bandwidth constraints. An RF solution would include the use of electronic meters, which will allow voltage information to be reported on designated intervals and provided in a near-real-time basis.

13. Ability to remotely reprogram the meter

The current PLC solution limits support of remote programming capabilities. Some functionality changes to meter measurement and register mapping are possible, but there is no capability for meter firmware updates or major functional measurement changes. RF solutions fully support remote programming of all functions and operating system firmware and provide bandwidth availability through the communications network to enable this functionality.

14. Ability to communicate outages and restorations

The current PLC solution requires polling (pinging) the meter to obtain power status. The current solution does not allow for "last gasp" or power restoration messages to be sent proactively by the meters, so the system is unable to proactively report an outage and restoration. The current system does have the ability to poll time-stamped outage information from the electronic meters. An RF solution allows for the existing pinging capability, while also using meters which have "last gasp" and power restoration messages. These messages can allow meters to proactively report an outage and restoration.

15. Ability to support net metering of customer-generators

The current PLC solution supports net metering of customer-generators by swapping the normal retrofitted electromechanical meter with an electronic meter. An RF solution would also enable this functionality with the accompanying support of back-end systems including the CIS.

Additional Requirements from the Commission's December 2012 order:

1. Utilization of smart meter data for bill ready and dual billing
2. Providing at least 12 months of account or meter level historical interval usage data via EDI
3. Participation in an EDEWG working group to define a solution for providing hourly interval usage and billing quality interval usage data via a web portal
4. Providing a plan to support meter level hourly interval usage data

1. Utilization of Smart Meter Data for Bill Ready and Dual Billing

PPL Electric currently utilizes Smart Meter data for bill ready and dual billing.

2. Providing at least 12 Months of Account or Meter Level Historical Internal Usage Data Via Electronic Data Exchange

PPL Electric currently provides historical interval information at the aggregate account level via EDI and will continue to do this.

3. Participation in an EDEWG Working Group to Define a Solution for Providing Hourly Interval Usage and Billing Quality Interval Usage Data Via a Web Portal.

PPL Electric is currently participating in the EDEWG Working Group.

4. Providing a plan to support meter level hourly interval usage data

PPL Electric currently captures historical hourly or 15-minute interval usage information at the meter level. In the Company's Supplier Web Portal, this information is shown at the aggregate account level and also at the aggregate meter level. PPL Electric will continue to do this under the SMP.

IV. Vendor Selection for Future Technologies

PPL Electric will follow a staged approach to vendor selection, as shown in Figure 6. This approach has been used successfully by the Company for previous vendor selection efforts.

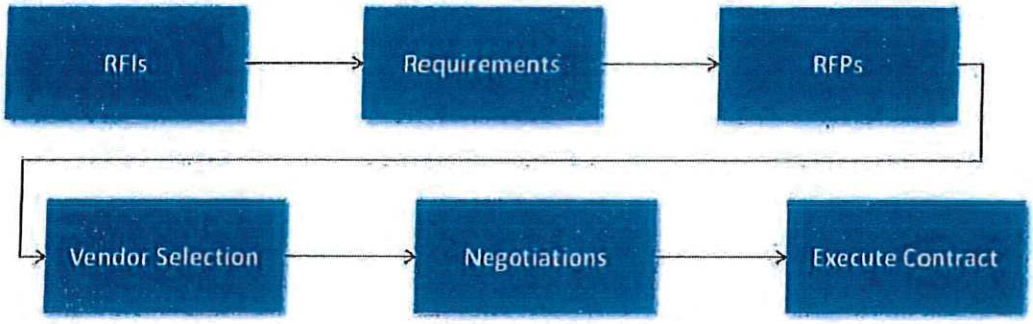

Figure 6 - Vendor Selection Process

In 2013, PPL Electric completed the RFIs stage. The RFI process and results are described in Section III. Technology Assessment. This stage included identifying smart meter technology types and evaluating strengths and weaknesses. This was followed by the creation of an RFI document, which was sent to the identified vendors. Evaluations of the responses were conducted and used as inputs into the solution decision process, which included the financial analysis.

RFIs were issued for three components of the upgraded smart meter solution: AMI Solution (including meter hardware, head end technology, and communications infrastructure), MDM, and the Customer Portal technology.

Following submission of PPL's Smart Meter Filing and this Plan, PPL Electric plans to solicit vendors for responses to a RFP for components of the smart meter solution. RFPs will be issued in two phases to capture the needed vendor support. The first phase of the issued RFPs will include:

- AMI System (including meters and head end software)
- MDM
- Customer Portal
- NOC
- Project Management Office ("PMO")
- System Integrator ("SI")
- MAM

The second phase will include:

- Deployment Vendor
- Secondary Meter Vendor

PPL Electric intends to issue detailed RFPs, which will ask vendors to comply with a series of requirements. These requirements will be divided into business, functional, and technical categories and will comprehensively describe the needed features for the AMI solution. A detailed requirements gathering phase is needed in order to ensure that the issued RFPs are comprehensive from both regulatory compliance and business need perspectives. This phase is underway and is using a workshop-based approach to meet with subject matter experts from the Company's organization and to gather system requirements from them. PPL Electric began the process of requirements gathering for the AMI Solution, MDM, Customer Portal, and NOC RFPs in May of 2014.

Following requirements gathering, the Company will create comprehensive RFP documents to issue to the vendors.

In parallel, the Company will establish scoring criteria for the RFP responses. PPL Electric will work with its internal supply chain organization and external consultants to devise a vendor scoring mechanism for the RFPs. PPL Electric plans to notify the Commission of vendor selection upon completion of that effort.

PPL Electric will select vendors using its established supplier selection methodology. This will include a detailed evaluation and scoring of the received RFP responses, evaluation of vendor pricing, requests for vendor follow-up as needed, and oral presentations. The Company may request vendors to demonstrate performance of their communications or metering hardware and software in a lab environment to aid in the selection process.

Following vendor selection, PPL Electric will hold negotiations with the vendor to agree on the terms of the contract. This process will include discussion of and consensus on terms, pricing, service level agreements, support levels, schedule execution, warranty terms, key personnel, and other topics.

Finally, responsible parties from both PPL Electric and the selected vendor's organization will execute the contract. The Company does not propose to seek Commission approval of actual vendors, but the process set forth herein. Further, the Company will not execute contracts with vendors until final approval of its SMP.

V. Implementation Plan

PPL Electric will deploy its upgraded AMI solution from 2016 – 2021. This deployment will include the building of back office IT systems, lab and field testing, a controlled solution validation phase, and a full deployment phase during which all current meters will be replaced. The deployment will be followed by a two-year stabilization period to optimize system operation. A timeline showing these steps is provided in Figure 7 - Implementation Timeline and Estimated Functionality.

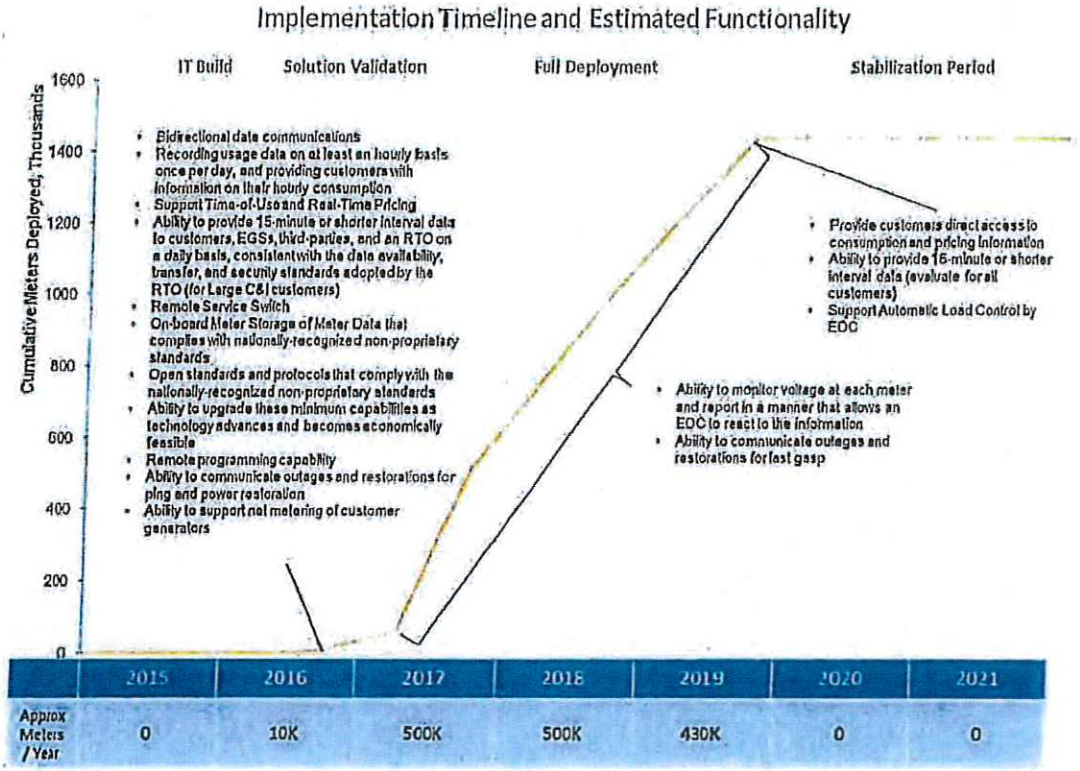

Figure 7 - Implementation Timeline and Estimated Functionality

Act 129 and the Commission's Implementation Order outline 15 specific requirements to be met by smart metering systems. These requirements, and a description of how the Company's proposed solution complies with them, are detailed in Section III. Technology Assessment.

PPL Electric plans to enable this functionality in a phased approach to coincide with the components of the deployment described above. A staged approach will, in addition to reducing risk around the implementation of a new technology type, provide PPL Electric with the ability to validate components of the technology as they are deployed.

Additionally, following the end of the stabilization period in 2021, the Company will continue investigating advanced functionality beyond the 15 requirements mentioned above, including

furthering analytics capabilities and identifying synergies with its distribution automation network.

A. Workstreams and Program Roadmap

To successfully establish a business and technical foundation for the new system, PPL Electric held a series of workshops in 2013 and 2014 to develop a draft program roadmap. This roadmap identifies the required teams, or workstreams, for the program, establishes a timeline of activities needed from 2014 – 2021, and recognizes interdependencies across those activities. The roadmap is shown in Figure 8 - Smart Meter Program Milestone Roadmap.

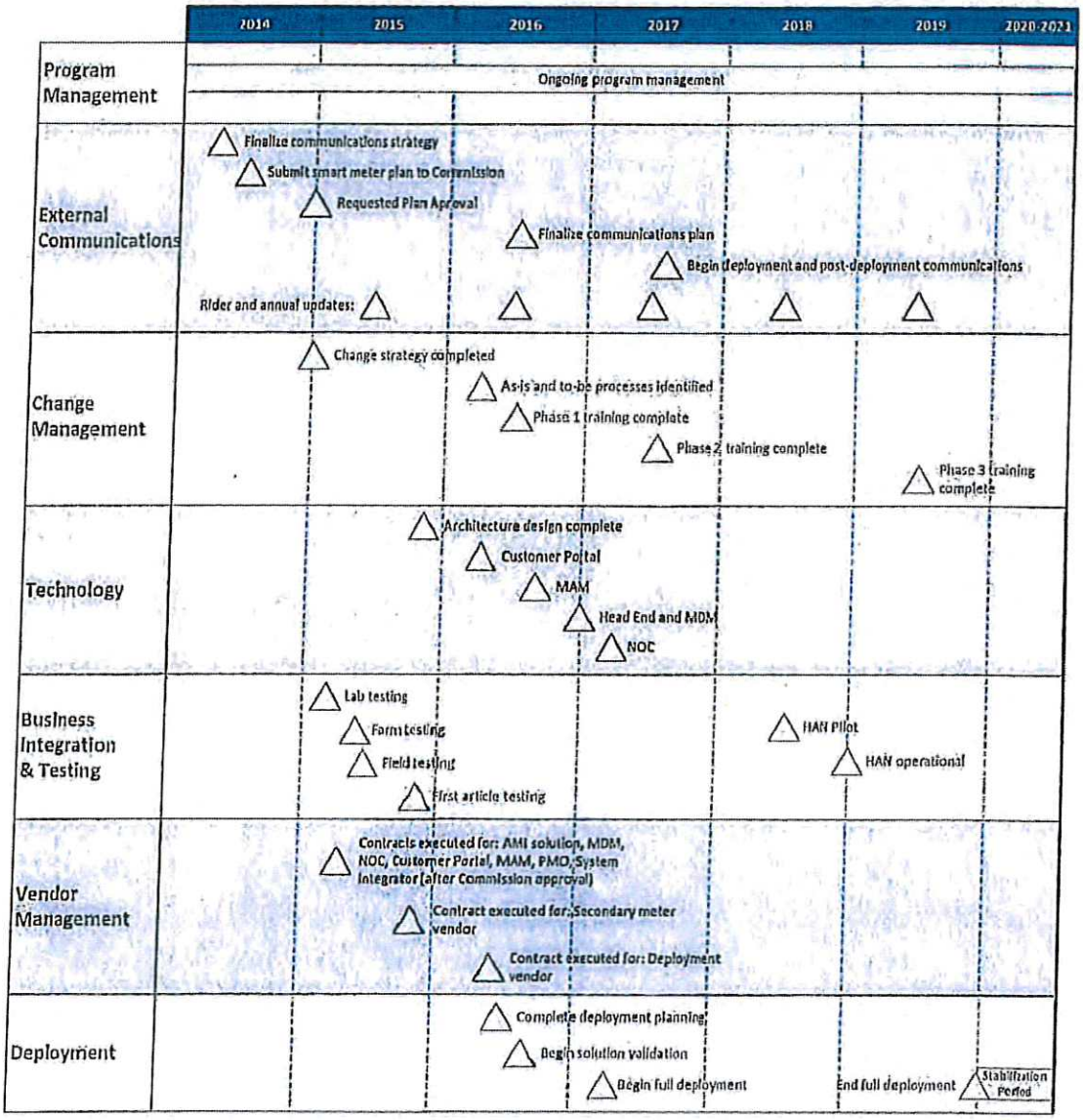

Figure 8 - Smart Meter Program Milestone Roadmap

B. Program Management Office (PMO)

The PMO will be responsible for successful completion of Smart Meter Program objectives. It will focus on program governance, planning and scheduling, financial analysis and fiscal management, and risk management.

During 2014, the PMO will be established and will be focused on establishing program governance guidelines, organizational design and staffing. Following 2014, governance will include executive sponsor meetings and weekly project meetings with workstream leaders to capture program risks, issues, and to serve as a coordination meeting for the program. PPL Electric also has established a smart meter steering committee composed of leaders around the business to provide strategic direction for the smart meter program. The PMO will have responsibility for reporting to this committee and for relaying its feedback to the workstream leaders.

Planning and scheduling is also a critical requirement for a successful deployment. The Company has to date maintained a project schedule and will continue this practice and will incorporate major roadmap activities into a multi-year project plan. This plan will be continually refined as vendors are brought on board and as project schedules change. The project plan will be used by the program management office to ensure scope, schedule, and budgets of tasks are effectively managed.

Finally, the PMO will also maintain activities related to program risk management. This will include the establishment of a risk management process aimed at tracking risk to the overall SMP program. This will include categorizing risks, assigning risk owners, and identifying mitigation strategies. It will also establish a recurring process to review these risks with the appropriate owners and business subject matter experts. This risk methodology will leverage industry-accepted processes.

C. External Communications

The External Communications workstream will be dedicated to communications activities related to the smart meter program. To support this workstream's activities, the Company has created a communications strategy (see Section XI. Communications Strategy) which describes the major communications activities related to the smart meter program which will take place through 2021.

This workstream will also be responsible for ongoing communications with customers and the Commission, preparing annual smart meter plan updates for the Commission, and for conducting regular market and peer utility research to ensure that the program is aware of the latest news and industry expertise for AMI.

D. Change Management

Change Management is defined as the set of activities for managing the impact of new technologies on the business. Its overall objective is to effectively manage integration of new technology into customer and/or business processes associated with the new technology. The Change Management workstream will have responsibility for both internal communications and the organization change management requirements which will arise due to the smart meter program. In particular, this workstream will lead internal PPL Electric efforts related to

socialization of the smart meter plan and will also be responsible for identifying organizational impacts across PPL Electric's business units. Areas will include changes arising due to the addition of a Network Operating Center, new communications infrastructure, and new smart meter functionality such as remote disconnect and "last gasp" abilities.

The Change Management workstream will work to create a detailed strategy for change management in the latter half of 2014, and then will begin identifying job role impacts and be responsible for creating job aids and training materials for PPL Electric employees before the deployment period begins. This workstream will also provide ongoing support in the form of communications materials for internal discussions, presentations, and training workshops.

It is anticipated that the deployment of a new metering system will allow for improvements in current business processes and, thus, in parallel the Change Management workstream will, also manage the many business process activities that will take place through the program's life. Each stage of business process redesign will use a phased approach, beginning with identification of impacted business areas and processes, detailed workshops to decide on process redesign with impacted business units, implementation of process changes, and finally training and refinement of processes. Figure 7 - Implementation Timeline and Estimated Functionality shows this phased release approach.

E. Technology

The Technology workstream will oversee the IT aspects of the smart meter program. This will include the IT design, build, and test phases for the meters, communications network, NOC, MDM, and any other supporting technologies. This workstream is a critical component deployment planning time period; new, upgraded, IT infrastructure will be required to ensure that data captured by the RF meters is carried to the appropriate systems for billing, settlement, analytics, and other core business functionalities.

Activities in the IT workstream began with the architecture assessment conducted in 2011 (discussed in Section III. Technology Assessment) and continued through early 2014 with additional evaluation of the architecture and estimates of the timing needed for the design, build, and test phases for the smart meter program. IT activities will follow a staged functionality approach; systems will be built and released in stages over the deployment period. The sequenced rollout provides full compliance with Act 129, the Implementation Order, and PPL Electric's business requirements by 2021. This staged approach also provides a method for risk mitigation.

The timeline for IT build was determined based on the planned meter deployment schedule, which calls for 10,000 meters to be deployed in late 2016 as part of the Solution Validation (explained in additional detail below). As the purpose of the Solution Validation is to test the final versions of the IT systems and deployment tools, it is necessary that these systems be in place at that time. Consequently, the IT design and build process will begin in Q1 2015, with work progressing through September 2016 to support the Solution Validation period.

The IT system creation process will use a standard software development life cycle approach, the phases of which will include: definition, discovery, design, development, deployment, and debrief. Testing of IT systems will follow a similar approach in environments, beginning with unit testing before progressing to functional testing and then integration testing. Unit testing will

test specific functionality and features, functional testing for processes around multiple features, and integration testing across systems and for testing of end-to-end functionality.

F. Business Integration and Testing

The Business Integration and Testing (BIT) workstream will manage all lab and field testing related to the smart meter program.

This workstream will begin with a planning phase for lab and field testing in late 2014, followed by design and setup of the meter lab in Q3-Q4 2015. Following this, testing activities will commence with solution testing including activities around radio frequency (RF) network design based on PPL Electric's service territory geography. Following selection of a meter hardware vendor, this workstream will focus on developing and implementing processes around first article testing, meter provision, lot acceptance testing, and other related activities. Meter and communications testing will continue through the Solution Validation phase and through Full Deployment to support first article testing and lot acceptance testing.

In addition to an enhanced IT infrastructure, the proposed AMI solution will require new capabilities in the area of meter and network communications. To date, PPL Electric's AMI solution has utilized a PLC technology. PLC allows for meter data to be sent across the existing distribution network where it is collected at the substation level by devices called collectors before being relayed to the Head End system and other appropriate back office systems. However, the proposed new solution will utilize a RF Mesh network type. In an RF Mesh network, meters communicate wirelessly with each other and with collectors located in the vicinity. These collectors then relay information over a backhaul network to the Head End system, which then "routes" the data as needed to the MDM, Customer Information System for billing, and others. PPL Electric plans to design a network to take advantage of the Company's fiber optic assets which are currently being built and expected to be available at all substations by 2016. Where collectors are able to be co-located with substations, the system will use this fiber backhaul. In areas where this is not the case, the Company plans to use a cellular backhaul system.

Due to the transitional nature of PPL Electric's deployment from a PLC to an RF technology type, the Company will be required to manage and operate dual systems throughout the deployment period. Meter and communication infrastructure for PLC will be maintained so long as it is required in a given geographic area, and technology will be transitioned to RF as those meters and systems are deployed. In the same vein, PLC meters which fail prior to the scheduled RF upgrade will be replaced with PLC meters, until the infrastructure to support RF meters become available in that geography.

PPL Electric will also test the communications network and determine an optimal network design. Much of this information will be leveraged by the chosen vendor for the AMI Solution, who will be able to provide tools for network design and data flow optimization to aid in the establishment of a robust communications network. Optimization of the network will also leverage industry best practices observed from currently-operating RF AMI systems at peer utilities, and subject matter expertise from PPL Electric's organization.

Lab testing will focus on several key testing types:

- Component Testing – Will verify that components meet functional, technical, and business specifications and criteria
- Functional Testing – Will verify that the smart meter solution (including meter and communications network) meet functional, technical, and business specifications and criteria
- Integration Testing – Will verify that criteria are met across systems and applications, e.g., from meter communications network into PPL Electric's back office systems (Head End, Meter Data Management)
- Communication Testing – Will verify end to end communications
- Security Testing – Will verify security protocols and procedures, and compliance with standards and PPL Electric's security requirements

PPL Electric also has developed a strategy to address in-service and removed watthour meter testing during full deployment in years 2017 to 2019. In regard to in-service periodic testing of watthour meters, the Company will appropriately adopt its current sample process to ensure that in-service testing continues to meet or exceed the requirements contained in 52 Pa. Code § 57.20(e).

In regard to testing removed watthour meters during full deployment, the Commission's Implementation Order exempted all electric distribution companies required to install smart meter technology from compliance with 52 Pa. Code § 57.20(h), which states, "A service watthour meter which is removed from service shall be tested for "as found" registration accuracy." Nevertheless, the Company will implement a "Deployment Sample Process" to identify a statistically significant random sample of removed meters. This sample of removed meters will be flagged for registration accuracy testing and returned to the Company's meter test lab as they are removed from service by the deployment vendor.

In addition, PPL Electric will hold all removed meters for two billing cycles before allowing them to be retired. This will allow any customer billing concerns to be addressed and provide the ability to locate the stored meter for accuracy testing.

G. Vendor Management

This workstream will have management of all vendor-related activities. A detailed description of the vendor needs is provided in Section IV. Vendor Selection for Future Technologies.

This workstream began work in May 2014 with a detailed requirements gathering phase for the first set of vendors, which include the AMI Solution (Meter hardware, Head End technology, communications technology), MDM, NOC, and Customer Portal vendors.

Work will continue through 2014, with an expected vendor selection by Q1 2015 to align with the expected Commission approval of this filing. Simultaneously, the workstream will begin work on selection of vendors for the PMO, System Integration, and a secondary meter hardware vendor. It is expected that this second set of vendors will be selected by Q2 2015. Additionally, a deployment vendor will be solicited in Q4 2015 with selection at the end of Q1 2016.

Once vendors are chosen, this workstream will have all responsibility for the day-to-day management of vendor related processes. This will include onboarding and offboarding of

vendor personnel, processing of vendor invoices, and management of vendor contracts and change requests. The Vendor Management workstream will also serve as a point of contact for vendors regarding issue escalation to the program.

PPL Electric plans to utilize industry best practices for the vendor solicitation and management processes and will leverage its internal supply chain and procurement organization to templates and guidelines for vendors in the SMP.

H. Solution Validation Phase

Deployment of meters will begin with a "Solution Validation" phase, which will start in late 2016 and will include a total deployment of up to 50,000 meters. The purpose of the Solution Validation phase will be to use the processes and tools planned for full deployment with a limited meter population and slower deployment rate. Limiting the meter population and deployment rate will allow for fine tuning of the metering and communications network following the field testing described above.

PPL Electric will develop a strategy for the Solution Validation phase which will identify specific aspects of the deployment plan to be optimized. These will include geographic area deployment plans, cross-dock and warehousing strategy, use of deployment vendor field tools, work management process optimization, safety program compliance, hard-to-access customer processes, and other aspects of the deployment. Each of the identified optimization areas will be measured as appropriate, and the Company will ensure that the Solution Validation phase results are successful before commencing with Full Deployment. This phase will also include testing of business processes such as billing, remote disconnect functionality, and others.

I. Full Deployment

Full Deployment will begin in 2017 following the Solution Validation phase and will continue through 2019. To fully deploy the remaining approximately 1.4 million meters in the PPL Electric service territory, it will require an average deployment rate of around 2,000 meters/day. Network and communications infrastructure (collectors, backhaul equipment) will be deployed ahead of meter hardware. This will allow for newly-installed meters to become operational on an existing communications network and will mitigate potential communications issues.

Processes for deployment will rely on the tools offered by the chosen deployment vendor, industry best practices and PPL Electric's experience with previous large projects of this nature. To aid in this, the Company plans to create a detailed deployment plan which will address all major components of the deployment. This will include:

- Deployment Vendor Contracting Strategy – Processes for development, execution, and management of deployment vendor contract. This will include strategy for managing vendor terms and accountability structures in the contract, as appropriate.
- Geographic Deployment Plan and Sector Selection – Location-based deployment plan for meter deployment across the PPL Electric service territory. This will also align geographies to timing of deployment during the Solution Validation and Full Deployment phases.
- Regional Readiness and Transition – Pre-deployment strategy at the district level to ensure preparedness for incoming deployment.

- Sector Acceptance Criteria – Checklist for activities required prior to approving deployment in a particular sector, i.e. certain level of read rates, mitigation of all communication issues, etc. This effort will include strategy for handoff of the solution on a sector-by-sector basis from the deployment team to PPL Electric operations.
- Supply Chain and Logistics – Procurement strategy and logistics, including strategies for location of cross-docks and warehouses, mobile project management requirements, and movement of hardware across the PPL Electric service territory.
- Workforce Management Strategy – Management of deployment contractors and personnel, including badging, training, on- and off-boarding, and safety procedures.
- Risk Identification and Mitigation Strategy – Strategy to manage risk associated specifically with the deployment project. This will be closely tied to the Program Risk management process mentioned above, but will focus on the deployment.
- Communications Network & Meter Installation Strategy – Strategy for installation of network and meter communications network. This will use the network design mentioned above to develop an optimal timing for installation of the communications infrastructure.
- Safety Plan – Plan describing safety policies and procedures required by all deployment personnel in alignment with PPL Electric's existing safety requirements.

PPL Electric intends to create this detailed plan beginning in 2015 and will communicate its details with the Commission as it is finalized.

J. Stabilization Period

Following the completion of deployment in 2019, the system will enter a two-year stabilization period (through 2021). This stabilization period will continue the process of fine-tuning the mesh network and back office systems. This time period will also be used to deploy any final system enhancements or upgrades prior to full operationalization in 2022.

During the deployment time period, PPL Electric will simultaneously operate the systems needed to support the upgraded system as described above, and will continue to operate current PLC systems. Meters and communications will be "cut over" from the PLC network to the RF network based on a cutover process which will be developed by the Company as part of the deployment planning process. The Stabilization Period will act as the final cutover from PLC to RF, and will serve as the time period during which any PLC-related systems no longer needed to support the RF AMI solution will be decommissioned.

This time period will also be used for refinement of business processes changes which were implemented throughout the deployment project. Additionally, PPL Electric recognizes that there may be some meters in hard to access locations or challenged radio frequency environments – where an RF signal may not propagate well due to geographical or other constraints. The Stabilization Period will address installations of these meters.

K. Post Grace Period Customer Requests and New Construction

PPL Electric is proposing to continue to install its existing PLC meters for customer requests and new construction in each geographic region of its service territory until it has extended the RF Mesh network to that geographic location. Thereafter, PPL Electric will install RF Mesh meters for customer requests and new construction in the geographic location. If PPL Electric were to

install RF Mesh meters in a geographic location before the appropriate communications systems are in place, it would have no way to read the RF Mesh meters in these areas. PPL Electric believes that this approach is reasonable for several reasons, including:

- PPL Electric is unique in that it already has an AMI solution that delivers some of the customer benefits required by Act 129 and the Commission's Implementation Order. For example, customers already benefit by having access to hourly energy usage information, receive very few estimated bills due to the high meter reading performance of the existing system, and have meters that support net generation.
- The number of new construction customers that may be impacted is estimated at an average of 7,200 per year based on historical growth. The Company does not expect a significant number of customers to request a smart meter in advance of their scheduled deployment. The total number of potentially impacted customers over the life of the deployment (2014 – 2019) is estimated at 40,000.
- The Company is proposing to deploy an RF Mesh AMI solution and will be doing so based on geographic area, which will be the most efficient use of resources for deployment. New construction customers within geographic areas where RF Mesh network coverage exists will receive RF Mesh smart meters. Those customers that are outside of the geographic deployment area would receive an advanced PLC meter which would be changed during the normal deployment process, expected to be completed by 2019.
- PPL Electric already has a fully automated metering system and no longer has manual meter readers. As a result, the Company would still need to read those meters installed during the Post Grace Period. It would be imprudent, costly and resource intensive to develop micro RF networks to read these meters. Likewise, it would be imprudent and resource intensive to develop manual meter reading processes for a small number of customers.

VI. Cybersecurity and Data Privacy

A. Background

PPL Electric maintains a strong commitment to cyber security and data privacy, continually investing through its people, processes and technology. PPL Electric recognizes that in order to mitigate today's, and anticipate tomorrow's cyber risks and threats, we must maintain and enhance a "defense in depth" cyber security plan. Our cyber security strategy must encompass the wide range of assets and environments vital to support critical infrastructure and vital business functions, such as Smart Meters.

1. People

PPL Electric maintains an cyber security focused workgroup (Information Assurance Group – IAG), comprised of individuals who are trained, certified and experienced in information and cyber security. Investment in, and ongoing assessment of our cyber skills is vital to the success of our cyber security function. PPL Electric's employees work with business and IT partners to implement and monitor the necessary layers of cyber defenses. Our personnel hold and maintain several IT industry standard security certifications, and actively pursue additional relevant intelligence and training. Several team members hold federal security "Secret" level clearances, and actively participate in security forums, peer sharing groups, vendor partnerships, industry organizations, and state and federal avenues for information and intelligence sharing. This level of engagement and skills development enables the team to keep up with emerging threats, defenses design, and evolving technologies, such as with technologies that support Smart Meters and RF Mesh architectures. PPL Electric also contracts as needed with experienced cyber security consulting firms, or engages objective assessors to perform security skills, design, and operational assessments, and includes evaluations of our program compared to cyber security frameworks. As a Company with assets across the US and in the United Kingdom, we also can draw upon expertise and knowledge from colleagues in Kentucky and the UK.

2. Process

PPL Electric personnel leverage internal security policies, standards methodologies, and procedures. These internal elements are derived from security best practices from a variety of proven sources, congruent with the relevant security requirements and nature of the assets/information to be protected, such as Smart Meters. For example, the Company's cyber security program is not only well rooted in the National Institute of Standards and Technology (NIST) security standards, but also has benefited from ongoing assessments against other mainstream cyber security frameworks. With the recent release of a new NIST cyber security framework, and the increased presence of Department of Energy's Cybersecurity Capability Maturity Model, PPL Electric continues to look to best practice guidance for novel and effective ways to protect the company's assets from current and emerging threats.

3. Technology

PPL Electric has a strong commitment to investing in cyber security technology to support its defenses in depth. Along with the technology investments such as Smart Meters that enable enhancements in areas such as improved reliability, customer satisfaction, communications, and mobility, PPL Electric's cyber defenses must keep pace. With the qualified staff in place, who

develop and follow strong and proven processes aligned to best practices, the functional and security technology can work together to provide secure results.

B. Purpose

This section serves as an introductory outline of the cyber security plan to address cyber security threats and vulnerabilities with respect to data confidentiality, availability, and integrity for the proposed smart meter plan.

When evaluating the risk and possible repercussions of a cybersecurity event, PPL Electric will consider not only the potential impact to the flow of power to customers, but also the intended flow of data through the Company's system(s). Security and privacy recommendations will be designed to provide an acceptable level of protection for the continued confidentiality, integrity, and availability of the data that is stored, processed, and transmitted through the system, as well as PPL Electric's continued ability to control the flow of power to customers.

The likelihood that any potential adversary will attack PPL Electric's Advanced Metering Infrastructure (AMI) is dependent upon three general areas; desire to attack the system, the capability to conduct an attack, and the opportunity to attack. The desire to attack is based on the overall system awareness of the attacker and the perceived value of the information stored, processed, or transmitted over the Company's data paths. If a potential attacker determines that the value of the data warrants an attack, they must develop the capability to launch an attack. Finally, even with desire and capability, the attacker must be presented with the opportunity to launch an attack. PPL Electric will undertake efforts to limit the capability and opportunity of potential attackers. Completion of a comprehensive Security Architecture Review will identify the current security risks to AMI, and a specific set of recommendations will be developed that, when implemented, will directly affect the opportunity and limit the capability of an attacker. The approaches identified in this document further enhance the protection provided to the AMI system. Development and implementation of the smart meter plan's specific policies and procedures, along with application of the hardware configurations to be recommended as part of the cyber security design, represent a holistic approach to cyber security that will enable PPL Electric to make informed cyber security and data privacy decisions for the smart meter plan as standards, guidance, and policies continue to evolve.

C. Organizational Commitment

PPL Electric has company-wide operating processes in place to ensure reliability and a robust security environment which will be used for the Smart Meter Project. The Company will utilize an integrated project team approach that will be led by PPL Electric Utilities, which has the ultimate responsibility for the reliability of the Advance Meter Infrastructure (AMI) system. Figure 9 identifies the relevant internal organizations and a list, albeit not exhaustive, of their responsibilities with respect to AMI cyber security.

Responsible Organization	Responsibilities
PPL Electric Utilities	• Primary responsibility for secure, reliable operation of the AMI System including security of the smart meters • Total system and security responsibility and accountability • Disaster Recovery and Business Continuity Planning • Asset Identification and Management
Human Resources/ Corporate Security	Personnel: • Screening, qualification, and requalification • Background Checks • Training • Access Control • Physical Security requirements
Information Assurance Group	• Data Loss Prevention • Anti-Malware Management • Perimeter & Remote Access Protections • Encryption • Logical Access Controls/Identity Management • Password Management • Intrusion Detection • Incident Detection • Vulnerability Scanning & Remediation • Penetration Testing/Security Risk Assessment • Secure Code Reviews • System Hardening • Distributed Denial of Service (DDoS) protections • Disaster Recovery and Business Continuity Planning • Security Education, Awareness and Training • Security Patch Management • Cyber Security Incident Response • Vendor Security Assessment • Other focus areas identified as needed

Figure 9 - Organization Cyber Security Responsibilities

D. Approach to Cyber Security

To ensure cyber security risks are adequately addressed, PPL Electric will utilize its project management methodology to aid in creating cyber security controls, processes and procedures. This process is a risk management-based approach for identifying, quantifying, and mitigating risks throughout a project's lifecycle. This approach enables the Company to understand and manage the threats and risks in its current operations, as well as to identify potential future risks and develop appropriate mitigation plans. The manner in which the cyber security and data privacy components of this project integrate with the project lifecycle process is included in Figure 10.

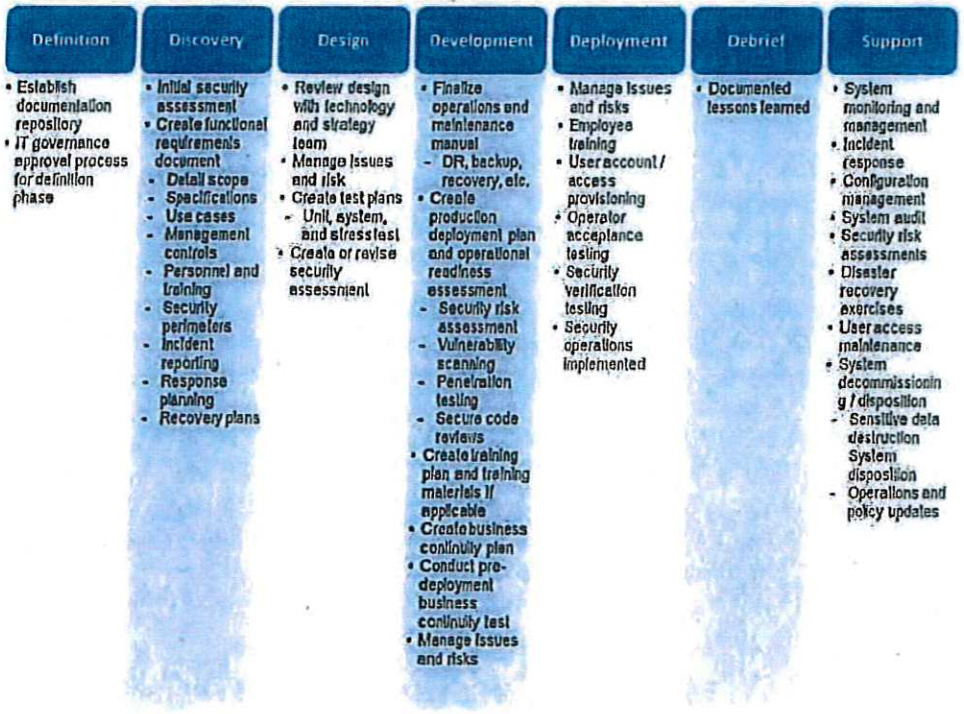

Figure 10 - PPL Project Management Methodology Process

E. Vendor Cyber Security Requirements Assessment

AMI System equipment provided by third party vendors will be evaluated for compliance with Cyber Security Requirements derived from PPL Information Security Standards and appropriate industry security standards and frameworks. This evaluation process will continue throughout the development lifecycle, and is outlined in Figure 11 below.

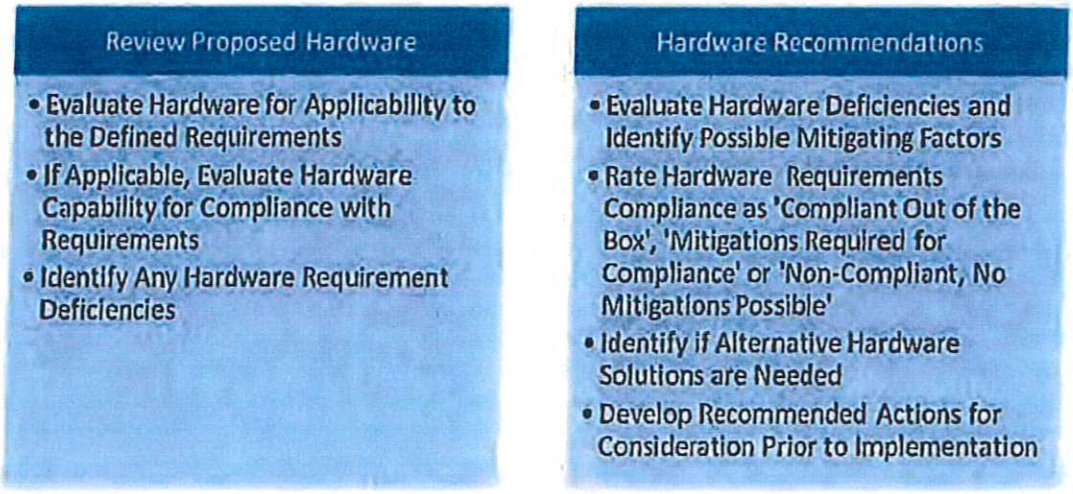

Figure 11 - Vendor Cyber Security Requirements Assessment

Any changes to the hardware solutions planned will be evaluated via this process, and recommendations will be presented prior to implementation. In the event that a component cannot meet the Cyber Security Requirements, PPL Electric will evaluate the risk and its mitigation options as part of the Security Risk Assessment process.

F. Cyber Security Operations

The project management methodology extends to operational support of the cyber security environment. To that end, the smart meter program will implement monitoring, logging, and incident reporting. PPL Electric plans to implement intrusion detection systems and processes to provide alarming and notification of security events. Additionally, the Company's Computer Security Incident Response Team (CSIRT) will utilize existing tools, capabilities, and procedures to provide timely response and recovery from security incidents. Upon notification that a security incident may have occurred, or is likely to occur, an alert is sent to the Information Assurance Group (IAG). IAG assesses the incident and, if necessary, assembles a CSIR Team comprised of subject matter experts relevant to the specifics of the incident. The response team prepares an action plan, mitigates the security incident, and assembles documentation in accordance with PPL Electric incident response procedures. These procedures will be reviewed and updated, if necessary, during the AMI cyber security design process. PPL Electric currently has in place policies and procedures for managing user access, performing system audits, reviewing system logs, etc. to maintain cyber security vigilance. These policies and procedures will be augmented, if need be, to address any new or unique risks or issues associated with AMI. In addition, updates and patches to infrastructure devices and systems will be managed using the existing Configuration and Change Management Standard. This standard requires that major upgrades and patches must include a security risk assessment prior to operational implementation.

PPL Electric has in place both Disaster Recovery (DR) and Business Continuity (BC) plans that are regularly tested by means of DR and BC drills. These plans will be updated to encompass the

AMI systems, and DR and BC drills will be conducted as part of operational readiness testing to verify plan effectiveness.

G. Risk Assessment, Testing, and Quality Assurance

In addition to the project management methodology, the Smart Meter Project will create a Risks Register document, and any cyber security or data privacy related risks will be entered and managed accordingly.

Test plans will be developed and executed to ensure that cyber security functions operate as designed. Figure 12 below depicts PPL Electric's approach to system security testing.

Figure 12 - System Security Testing Process

IAG will be responsible for identifying and mitigating security risks and ensuring that the fielded systems meet the requirements and configuration as prescribed in PPL Electric Information Security Standards, and include the following activities:

Security Risk Assessments

The Security Risk Assessment ("SRA") is a review that provides a baseline for the development of risk mitigation actions needed to protect the utility's systems and environments. It is conducted using a well-defined set of information security standards, guidelines, and industry best-practices. The SRA activities will include: 1) System characterization (both operational and technical), 2) Threat identification, 3) Vulnerability identification, and 4) Risk Determination/Valuation.

Using the guidelines provided by Federal Information Processing Standards ("FIPS") and NIST among others, the Security Risk Assessment will determine the potential impact of threats and vulnerabilities to the Confidentiality, Integrity and Availability ("CIA") of the project's data and systems. This impact determination, combined with an assessment of threat probability, will form the basis for risk-weighted mitigation planning.

Vulnerability Scans

Vulnerability scans are conducted on the operational system, prior to deployment and post-deployment, to ensure the system adheres to the cyber security design. This quality assurance check is conducted using automated tools and manual scanning to verify configuration items such as: firewall rules, port configurations, password structure and complexity, user authentication and access permissions, etc.

Penetration Testing

Penetration testing is the best indicator of real-world vulnerability to cyber-attacks, both internal and external. Conducted by objective, experienced and knowledgeable "Certified Ethical

Hackers," this activity determines the degree to which the systems are vulnerable to a variety of cyber-attacks. The team will conduct a series of targeted attacks from the smart meters to the AMI systems and document the gaps and vulnerabilities discovered. These gaps and vulnerabilities will be managed and/or mitigated by the project team.

H. Data Privacy

As part of the project management methodology, one of the first steps of the initial security assessment is to determine the type of data so that the appropriate security controls are planned for. For the Smart Meter Project, IAG will also follow "Guidelines for Smart Grid Cybersecurity: Vol. 2, Privacy and the Smart Grid" recommendation sand conduct a privacy impact assessment (PIA) before any deployment. The PIA will help the project team with the following:

Identifying and managing privacy risks: Conducting an exercise to identify potential privacy risks early in the project demonstrates good governance and business practice.

Avoid unnecessary costs: By undertaking an assessment early in the project to identify potential privacy risks, it will allow the project team to consider any safeguards as part of the project budget and thereby avoids unexpected costs after deployment.

Meeting legal requirements: Conducting the assessment provides the opportunity to ensure that any privacy risks are identified early, and thereby implementing the appropriate controls that will allow for ensuring the implementation adheres to legal requirements. This also applies when engaging a third party, where the data owner is responsible for ensuring the appropriate controls are in place to protect personal data.

I. Standards

As noted, the Smart Meter Project will leverage emerging interoperability and security standards, including, but not exclusive to those developed by the NIST.

Throughout the Smart Meter Project lifecycle, security requirements, processes and procedures will leverage the following standards:

Security Requirements Creation	NIST SP 800-53 "*Recommended Security Controls for Federal Information Systems and Organizations*"
Security Risk Assessment Methodology	NIST SP 800-30 "*Risk Management Guide for Information Technology Systems*", NIST SP 800-60 "*Guide for Mapping Types of Information and Information Systems to Security Categories*", and FIPS 199 "*Standards for Security Categorization of Federal Information and Information Systems*"

Vulnerability Identification	NISTIR 7628 "*Guidelines for Smart Grid Cyber Security: Vol. 2, Privacy and Smart Grid*"
Security Testing Methodology	NIST SP 800-115 "*Technical Guide to Information Security Testing and Assessment*"

J. Impact on Overall AMI Security

Protection of AMI is accomplished via multiple layers of network, personnel, and physical security barriers. If compromises to the system were to occur, the location of that compromise would determine the impact on the overall AMI security. While there are numerous endpoint devices in the AMI network, compromise of one device would have a lower overall impact than a compromise of the AMI Systems. These levels of compromise are represented in Figure 13, with red representing the highest potential impact.

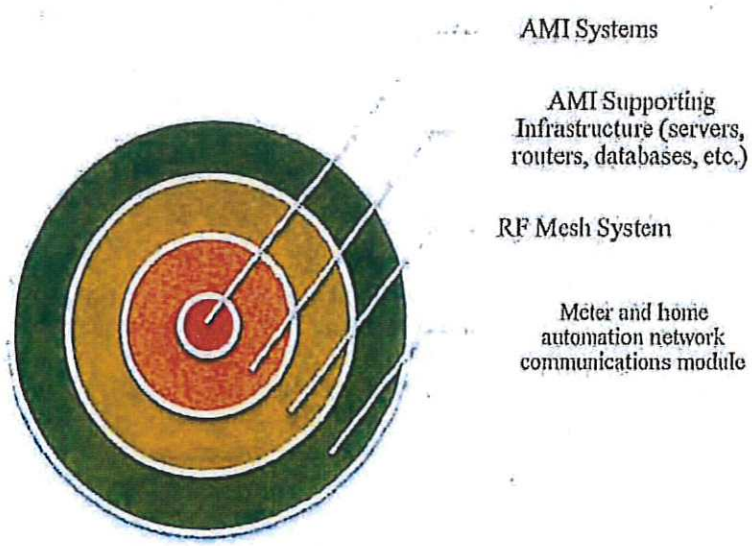

Figure 13 - Potential Impact to Overall Grid Security

The smart meter plan will be implemented with Cyber Security and Data Privacy as a cornerstone of the project. The increased scrutiny of the AMI systems and network, the interfaces with new smart devices, and reviews and updates to existing policies, procedures, and operational concepts is expected to maintain the overall security posture of AMI.

VII. Organizational Impacts

PPL Electric recognizes that the proposed AMI solution upgrade from a PLC-based to an RF Mesh system will require organizational change. During its initial deployment in 2002, the Company developed an organizational impact plan and has begun the process of doing the same for the new deployment in 2016.

In 2013, the Company undertook an organizational assessment to evaluate the impact of the upgraded AMI solution on the organization. This assessment was divided into three areas:

- Change Impact Analysis – evaluation of areas of anticipated business change and the subsequent impacts, if any, to PPL Electric
- Governance Method – method for leadership and accountability organizations for the smart meter program implementation
- High-Level Resource Plan – resource count estimates based on the above in order to determine needs for the smart meter program

A. Change Impact Analysis

The change impact analysis began with identification of the implications associated with each evaluated solution offering. This was done in tandem with the Technical Assessment (see Section III. Technology Assessment), and used information provided by vendors and through subject matter expertise from IBM and others. This was used to gather high-level costs of the various technology types (RF Mesh, Point to Point, Power Line Carrier) from an organizational point of view.

Following this, the Company identified business units within PPL Electric's organization that will likely be affected by the transition to an upgraded AMI system. For each process area, impacts were determined and categorized according to people, processes, technology, and organization. The result was an organizational impact analysis which documented expected changes to the organization due to smart meter program activities.

Based on this framework, the Company first identified organizational impacts that would be present regardless of the chosen solution type. Information from vendor RFI responses allowed the Company to identify technology-specific organization impacts, taking into account the unique differences between Power Line Carrier (PLC), Radio Frequency Mesh (RF Mesh), and Point-to-Point (P2P) network types. For example, both RF Mesh and P2P networks topologies require skilled RF technicians for system maintenance, which represents a new skill set for PPL Electric's organization.

Following the submission of this filing in 2014, PPL Electric will continue this assessment and begin planning for the creation of training materials and training as part of a larger change management effort. This is described in detail in Section V. Implementation Plan).

B. Governance Method

The Organizational Assessment also included a review of governance models typical of large AMI deployment projects. In this review PPL Electric re-evaluated its governance structure during its first AMI deployment and reviewed industry best practices around AMI governance

provided by IBM and peer utilities. An initial governance structure for the Project Management Office (PMO) was created, and this will continue to be refined as requirements for vendor support are created in the coming months. A picture of the proposed governance structure is shown in Figure 14.

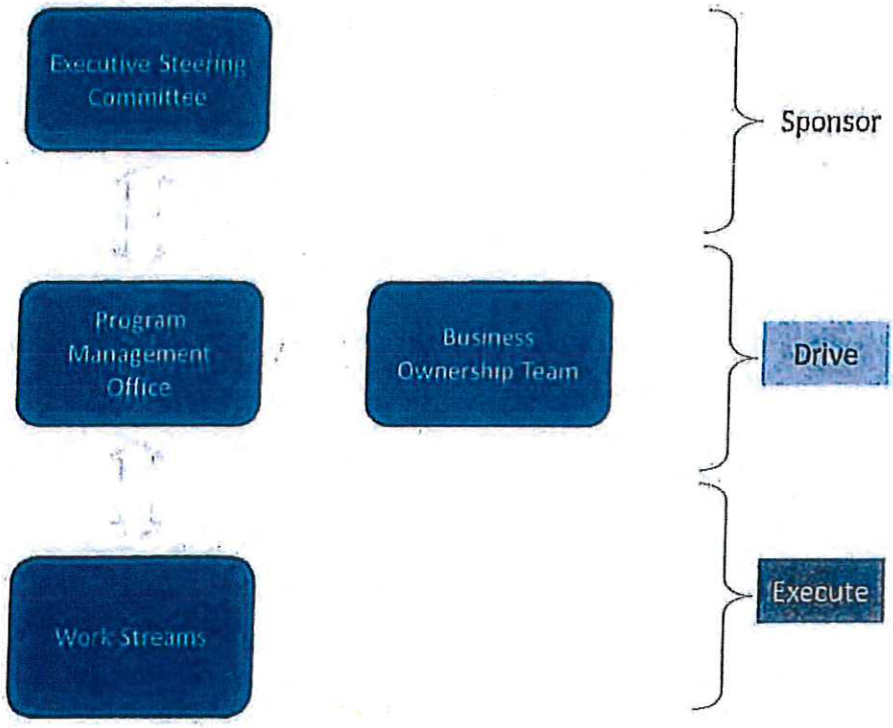

Figure 14 - Proposed Smart Meter Program Governance Model

Executive Steering Committee

The Executive Steering Committee will be responsible for providing strategic direction, issue resolution, and making program-level decisions. This group will also champion the program's budget and resource request within PPL Electric's business, and enable cross-business lines of communication as appropriate. This committee will also provide sponsorship and leadership for the SMP program.

Program Management Office

The Program Management Office will manage SMP program resources and provide day-to-day management and oversight of the SMP program. This will include oversight of the workplan and coordination of program risks, issues, and status updates. This group will also be responsible for communicating SMP program vision, goals, and strategic priorities to team members and will escalate issues coming out of the program as necessary.

Business Ownership Team

The Business Ownership Team will have ownership of the SMP program. This will include participation and expertise into SMP program decisions as they impact ongoing and future business operations. This group will also ensure availability and involvement of required subject matter experts and will communicate decisions made at the business unit level which will affect the SMP program. This team will be accountable for conflict management and will provide input and guidance into the risk mitigation and issue resolution process.

Workstreams

Workstreams will be responsible for the execution of SMP program workplan tasks, work products, and deliverables. These groups will communicate program status and budget requirements to program management, and maintain workstream-specific issues, risks, and mitigations plans.

C. High-Level Resource Plan

The final stage of the Organizational Assessment was the creation of a High-Level Resource Plan. The information from the analysis described above was used to create estimates of resources needed to support the pre-deployment, deployment, and post-deployment activities. The Company prepared representative ranges of head counts as related to job role from industry data collected from peer utilities' programs.

These estimates were refined as the decision to proceed with an RF Mesh solution was made, and will continue to be refined leading up to the deployment time period. The Company also plans to request that vendors provide detail around head counts required to operate their systems as part of the RFP process which will take place in Q3 – Q4 2014. This detail will be used in refining head count estimates. A detailed description of that process is in Section IV. Vendor Selection for Future Technologies.

VIII. Program Risks

A. Risks

PPL Electric's Smart Meter Plan represents a significant investment which is spread across several years. The Company recognizes that the SMP will impact many key stakeholders, both internal and external, and that an upgraded AMI solution brings with it the need for a comprehensive risk assessment and management process. As such, the Company has identified several program-wide risks based on their possible impact to the program and PPL Electric's business. These risks are described in detail below, followed by an explanation of mitigation steps being taken to address them.

- New regulatory or legislative requirements
- Resource availability and skill sets
- Customer perception and education
- Vendor performance
- Technology obsolescence
- Complexity of IT efforts
- Replacement of mature AMI systems and data migration

New regulatory or legislative requirements

A risk exists around unanticipated requests related to smart meter technology by regulatory or legislative bodies. Depending on their nature these may alter the schedule, scope, or budget of PPL Electric's Smart Meter Plan. Examples include the requirement to allow customer to opt-out of advanced metering functionality, accelerated supplier switch, changes in required smart meter functionality, and implementation of new legislation and / or regulation related to smart metering and energy efficiency, and additional changes in technology standards.

Resource availability and skill sets

A risk exists around availability of skilled resources needed for PPL Electric to successfully complete the work required prior to and during the new smart meter deployment. The selection of an RF communications type will bring with it the need for new skillsets to PPL Electric's business. Additionally, a large number of resources will be needed from vendors and the Company in order to guarantee the success of the SMP. The Company will need to assess these risks and develop resource plans using employees and contractors to mitigate the risk.

Additionally, PPL Electric will continue to operate the installed PLC communications system, MDMS, MAM and customer portal as required through the plan implementation. The Company plans to maintain the current level of service to customers served by the legacy systems. Resources will be required to operate the existing systems through plan implementation. This resource need is considered in PPL Electric's resource planning process.

Customer perception and education

PPL Electric's customers have experienced many of the benefits of the required smart meter technology since 2004, when PPL Electric completed its first AMI deployment. The choice to proceed with an RF communications technology results in the need for some additional education for PPL Electric's customers on this new technology type. Additionally, the upgraded

AMI solution will bring some new smart meter functionality to customers. The Company will ensure that customers receive appropriate communications on the new smart meter functionality as it is deployed.

Vendor Performance

A risk exists around ensuring that the vendors chosen to support the AMI solution provide adequate hardware, software, and services, and that performance in these areas is commensurate with the expectations of the Company. There is additional risk created around the integration of vendor systems with one another, in particular as related to vendor-provided software for disparate components of the solution.

Technology Obsolescence

There is a risk that elements of the chosen technology type may become obsolete during the course of the smart meter program. Multiple types of technologies for AMI exist in the marketplace today, and this technology is within a highly evolving area which has experienced significant change over the last 10 years. It is likely that these changes will continue in the years to come.

Complexity of IT efforts

The upgraded AMI solution involves a large-scale IT project to support the various back-office systems needed to ensure successful operation. Multiple corporate systems, some not specifically related to smart metering, will be affected by the AMI solution upgrade. This includes the installation of new vendor-purchased systems, the creation of integration points to existing systems, and the data conversion needed to enable successful communications across systems. This will require a comprehensive rebuilding of the current IT architecture across PPL Electric and several testing and release cycles prior to system optimization.

Replacement of mature AMI systems and data migration

In addition to the effort required to implement the RF Mesh AMI solution, there will be IT complexity due to the simultaneous operation of both the PLC and RF Mesh solutions as the Company transitions from the former to the latter. This transition brings unique challenges to the Company, including the migration of customer data from existing systems to new ones, the development of processes for operating of multiple AMI solutions simultaneously, and the maintaining of high meter read rates throughout the deployment time period.

Furthermore, PPL Electric is unique among its peers by being one of the first utilities to encounter this challenge, as many other utilities have not yet upgraded from one AMI solution to another. As a result, the Company expects limited benchmarking and industry experience with this effort.

B. Mitigations

To mitigate risk throughout the duration of the Smart Meter Plan, PPL Electric will do the following:

- Conduct ongoing risk management and mitigation
- Participate in site visits with vendors and peer utilities

- Engage industry expertise and external program support
- Deploy a flexible AMI solution
- Strategic timing of AMI technology solution implementation
- Use a staged deployment approach to manage the impact of the new solution
- Use a phased approach to test and operationalize advanced functionality
- Due diligence through requirements design and vendor planning
- Customer engagement and education

Conduct ongoing risk management and mitigation

PPL Electric has created an ongoing risk management process to track and manage the program risks mentioned above and others as they are identified. This process includes identifying of risks and evaluation of the possible impacts, in addition to creating mitigation plans to manage them. Furthermore, the Company is leveraging the extensive experience it gained during the installation of its first AMI solution in 2002, and from successfully operating that system to this day. The lessons learned from the first deployment have been used repeatedly in the strategy for the proposed AMI solution upgrade. These have included insights into scheduling, effective use of pilot programs to trial new functionality, lessons regarding technology obsolescence, and comfort with high read rates from an automated metering infrastructure.

Participate in site visits with vendors and peer utilities

In addition to the lessons learned from its own prior deployment, the Company will continue to engage with vendors of smart meter technology and peer utilities that have used those vendors for their own deployments. This engagement will take the form of attending industry conferences, in-person site visits, and conference calls and other meetings to gain insights and learn best practices for specific solution types.

As PPL Electric is recommending an RF Mesh solution, it will focus on site visits with utilities that have successfully deployed and operated this type of AMI technology. Site visits will allow the Company to learn first-hand the possible issues and risks associated with the solution and will include insights into the challenges of overcoming RF propagation in geographic areas similar to the Company's (urban / suburban / mountains / flat terrain). Additionally, PPL Electric anticipates that it will gain strong insights into the optimization of RF networks and plans to leverage these best practices with its own Network Operating Center and deployment management processes.

Visits with vendors will allow for similar insights from a different lens – providing a view of the details of RF technology and learning first-hand what can be done to ensure successful use of an RF technology for PPL Electric's AMI solution. This will also allow the Company to structure vendor contracts in such a way that vendor performance risk is mitigated.

Engage industry expertise and external program support

Beginning as early as 2009, PPL Electric retained external consultants from Black & Veatch experienced with smart meter deployments to assist in evaluations of the current state AMI solution. The Company continued this practice in 2013-2014 with the engagement of IBM. PPL Electric will continue the practice of soliciting vendors who have high levels of experience with the chosen AMI solution, including technology vendors for solution hardware: meters, head end

technology, NOC, and MDM. Vendor contracts will be written considering lessons learned from AMI programs at peer utilities.

Hardware vendors will also be required to submit to industry-approved testing processes, to ensure compliance with nationally-recognized credentials and measures for security, safety, and operation. PPL Electric will also conduct its own vigorous testing in both lab and field environments. Lab and field testing will include detailed end-to-end testing of meters and communications.

Engaging external support will allow the Company to mitigate a variety of risks, including resource availability through the use of external staff augmentation for project staff and potential operation of the legacy AMI system. Contracted services will also be used to mitigate risk during the meter deployment through the use of a Company-chosen meter deployment vendor to conduct physical meter installations at customers' premises. Vendor support may also be leveraged for IT integration efforts.

Deploy a flexible AMI solution

PPL Electric's choice of an RF technology type allows for technical flexibility versus other technology types. RF technology has seen high adoption rates for AMI solutions in recent years. Based on the Company's assessment completed in 2013, an RF solution type also allows for integration with distribution automation and advanced analytics capabilities.

A flexible solution type also mitigates several of the risks mentioned above. New requests from regulatory or legislative bodies will be easier to respond to with a system that is more flexible, and the risk of technology obsolescence is mitigated through the use of a widely-adopted technology type. It is noted that PPL Electric's peers in Pennsylvania have all chosen to deploy RF-based AMI solutions to comply with Act 129 requirements.

Strategic timing of AMI technology solution implementation

As described in the SMP Roadmap contained in Section V. Implementation Plan, PPL Electric plans to complete the required IT and business process review to implement an IT system architecture change and install a new AMI head-end, MDMS, MAM, NOC and customer portal prior to meter deployment in 2017. This is a significant IT and business effort that will require external vendor support. The intent of adopting this aggressive IT build is to minimize potential re-work involved with integrating RF mesh communication systems and meters to the Company's existing AMI systems. This plan improves program efficiency, but makes IT system implementation a critical path item in the schedule requiring adequate support from the PMO and external system integrator.

Use a staged deployment approach to manage the impact of new functionality

As described in Section V. Implementation Plan, deployment will begin in the second half of 2016 with a Solution Validation period. This phase is designed to ensure that the system is functional end-to-end prior to beginning full deployment.

Beginning with full deployment in 2017, smart meter functionality will be staged through 2019 to accommodate IT build timeframes and to allow for proving out of functionality to support Act 129 and Implementation Order requirements.

Use a phased approach to test and operationalize advanced functionality

PPL Electric has been very successful in using pilot programs and proof of concepts to trial new features prior to operationalization and has successfully demonstrated this since 2009 when it began its Smart Meter Plan. The Company will continue this practice during the Smart Meter Program by identifying advanced functionality that could be supported by the upgraded AMI solution, and carefully plan for and stage that functionality.

This approach will be used for new functionality enabled by the AMI solution that is not already operationalized within PPL Electric's business. This will include redesigning business processes to fully utilize meter data, such as voltage, temperature, "last gasp" / power restoration messages, and other message alerts. Additionally, expanded or new functionality such as remote disconnect and HAN devices will be staged throughout the deployment period. Some of the later-stage applications of the new AMI solution, include integration with distribution automation, the use of advanced analytics, and other areas as identified by future business requirements.

Due diligence through requirements design and vendor planning

PPL Electric has already begun the process of developing detailed business requirements for vendor RFPs which will be issued later this year. These requirements will contain business and functional areas required for compliance by vendors involved in the RFP process. PPL Electric will include compliance with the determined requirements as part of the scoring of vendors during the RFP evaluation process and prior to selecting a vendor for the major components of the upgraded AMI solution. Additional detail on the vendor selection process is in Section IV. Vendor Selection for Future Technologies.

Detailed requirements, along with clear roles and responsibilities, establishing service level agreements, and having a disciplined program management approach will help to mitigate risks related to vendor performance and integration.

Customer engagement and education

PPL Electric recognizes that the proposed RF Mesh AMI solution is a new technology both for itself and for its customers. As such, the Company will prepare educational materials to ensure that customers are educated on the benefits and uses of the technology. This education will include details regarding the protection of customer data, and the security measures put in place by the Company to protect both customer and business data in its IT systems and communications networks.

IX. Program Benefits

As an early adopter of AMI technology, PPL Electric has realized significant benefits from installing the current system. The most significant benefit achieved was from the elimination of physical meter reading operations for all of its electric customers as well as associated meter reading support equipment, vehicles, and systems. The Company also realized benefits from improved reliability in customer billing and outage management. Additionally, the Company has been piloting and implementing projects to enhance its PLC metering system and processes as part of its original smart meter implementation plan submitted in August 2009. Some of these pilots, such as remote connect/disconnect, voltage and momentary monitoring, and validating outage durations have been implemented and are delivering benefits by enhancing operations, outage management and customer service, albeit on a limited basis. Other pilots that were implemented, such as developing a supplier portal, providing customers with price and usage information, and implementing a meter data management warehouse and analytics platform have improved the Company's ability to provide information to customers and suppliers. An additional set of pilots such as 15 minute interval data, replacing wired communications with cellular backhaul for meter data, and upgrading meter data collection equipment with new processing boards were implemented to test the PLC system on its ability to deliver Act 129 functionality, lower operating costs, and improve meter reading performance.

Having already realized benefits from its earlier smart meter installation and pilots, PPL Electric will include any additionally realized benefits associated with the proposed smart meter deployment plan in subsequent base rate cases. The proposed Smart Meter Deployment Plan will provide a foundation to realize future customer and operational benefits. Expected benefits include reduced meter services support, decreased call center volumes, improved outage management, improved identification, and cost recovery of unaccounted-for energy.

In the area of meter services, the proposed AMI solution will include remote connect / disconnect switch functionality that will reduce the number of physical visits associated with voluntary and involuntary service reconnections and terminations. The Company will use this functionality in accordance with all applicable rules and regulations. The Company will respond remotely to customer connect and disconnect requests in a timelier manner thereby increasing customer satisfaction in the process. Additionally, the replacement of an aging meter population (characterized by an increasing meter failure rate) with a brand new meter population has the added benefit of reducing the Company need to respond to meter replacements due to failures. As such, any reduction in physical visits will also result in a reduction in labor costs, vehicle and mileage costs, and other support equipment costs such as hand held devices.

Operating benefits may accrue due to a reduction in the number of incoming calls to the customer call center. After an anticipated increase in call volumes during the initial deployment period due to customer questions about the new meters, there is an expected lower net steady state of call volumes. Most of the decrease is expected to be from reduced customer calls inquiring about a timely reconnection of service, after payments they have made related to a non-pay disconnect.

Additional benefits are also expected in the area of power quality, due to further development of the ability to monitor and analyze momentary outage and voltage issues. The ability to get information more frequently and across all smart meters will enhance our ability to analyze and

proactively resolve distribution problems prior to customers notifying us about an issue. This will enable PPL Electric to better serve customers and utilize maintenance resources more effectively.

Outage management processes will be improved as PPL Electric introduces "last gasp" and power restoration message capability within the upgraded AMI solution. These capabilities will enable faster detection of outages and will speed power restoration processes. The upgraded AMI solution will also be able to provide near real-time outage status for individual meters. This will more accurately reflect the current state of restoration activity and allow resources to be utilized more effectively such that "OK on Arrival" occurrences (i.e. a power outage is restored on a separate, previous outage ticket) can be identified before a field crew is sent to a premise. As a result, the Company will be able to more effectively deploy and coordinate emergency restoration resources. This has the potential of translating into decreased time spent on storm restoration and reducing overtime and contractor expenditures.

AMI systems coupled with advanced analytic capabilities will allow for improved tracking of unaccounted-for energy, such as theft and tampering, by improving the ability to identify energy usage anomalies and correlating various events. The reduction of energy consumption on inactive accounts will also be realized by having the ability to remotely disconnect these premises, in accordance with applicable regulatory requirements, where otherwise it would have been imprudent to dispatch a crew due to costs and other work priorities. The end result is a customer benefit from a more equitable system where the true responsibility of payment is borne by the parties responsible for the energy usage.

The upgraded AMI solution will support enhanced customer self-service. The direct access capabilities of the new meters will enable In Home Displays through which customers can view and analyze near real time usage information. Additionally, the upgraded customer portal will enhance customers' capabilities to analyze their energy history, review and compare promotions and rate plans, view and pay their bills online, and request start, stop, or transfer of service. Self-service may also improve operating efficiencies by decreasing customer call volume.

Another benefit from AMI systems coupled with advanced analytical capabilities is an improvement to distribution load management and other processes through the application of voltage and load monitoring. This monitoring will provide pertinent information for maintaining electrical system reliability, proactive correction of customer voltage issues, improved distribution load management, and improved accuracy of electrical equipment health monitoring. The aggregated meter data can also provide valuable input to the electric system planning process.

The proposed AMI solution enables several societal benefits such as decreased emissions by facilitating a competitive marketplace. Decreased emissions of CO_2 can result from lower energy consumption and less mileage due to fewer premise visits. The AMI system can facilitate a competitive marketplace by enabling in home customer displays, thereby influencing peak purchases and as a result applying downward pressure on energy prices in spot markets.

The benefits of implementing the SMP are difficult to quantify. For example, when implementing the remote connect/disconnect functionality, the Company anticipates reduced service visits to customers' premises. However, the Company may not necessarily reduce its

staff to account for this functionality but may use its resources to perform other activities. The Company may also experience lower call volume, but it is not possible to predict with any accuracy a precise amount that this would reduce the Company's operating expense. In addition, many of the benefits will not be fully realized until the SMP is implemented.

Due to the uncertainty and difficulty in quantifying operational savings associated with implementing the SMP, the Company proposes to reflect any savings associated with the SMP in future base rate cases as these savings are reflected in the Company's operations.

X. Financial Overview

A. Costs

In response to Act 129 and the Commission's subsequent Implementation Order, PPL Electric initiated an assessment and planning effort in preparation for the implementation of smart meters and AMI technologies. A key input supporting planning was the creation of a cost model ("Financial Analysis") to estimate and analyze the future operating costs and capital expenditures associated with the deployment. The analysis covered the period beginning in 2014 and through the end of the stabilization period, i.e. 2021.

The data underlying the financial analysis were gathered through an assessment process involving RFIs from vendors, industry experience, subject matter experts from PPL, and consulting support from IBM. The data were reviewed and updated in an iterative process throughout 2013 and 2014. Activities performed in the development of the Financial Analysis included:

- Defining the scope and components of the smart meter program
- Gathering relevant operational data and smart meter project projections
- Evaluating and validating data
- Identifying key smart meter project financial analysis modeling variables and assumptions
- Developing the analytical modeling structure
- Constructing a detailed view of the smart meter project financial analysis
- Reviewing the Business Case results with PPL Electric stakeholders and management

The financial analysis included in this chapter is based on the 3-year recommended deployment schedule. This schedule anticipates all smart meter infrastructure will be built and all smart meters installed by the end of the year 2021. Based on this analysis, the total estimated cost of implementing this plan (2014-2021) is $449.3 million, $407.9 million for capital expenditures and $41.4 million for Operations and Maintenance (O&M).

Table 2 shows a summary of the Company's costs by major cost category, and Figure 15 - 8-Year Cost Schedule shows an 8-year cost schedule from 2014 – 2021.

Table 2 - Cost Summary ($ Millions, Nominal 8 years)

Category	Capital	O&M	Total
Meter	$284.9	$0.0	$284.9
Network & Network Management	$31.4	$7.9	$39.3
Information Technology	$53.0	$24.7	$77.7
Systems Integration	$8.8	$0.0	$8.8
Program Management	$23.2	$5.4	$28.6
Communications/Change Management	$6.6	$3.4	$10.0
Totals	$407.9	$41.4	$449.3

PPL Electric –Smart Meter Plan
June 30, 2014

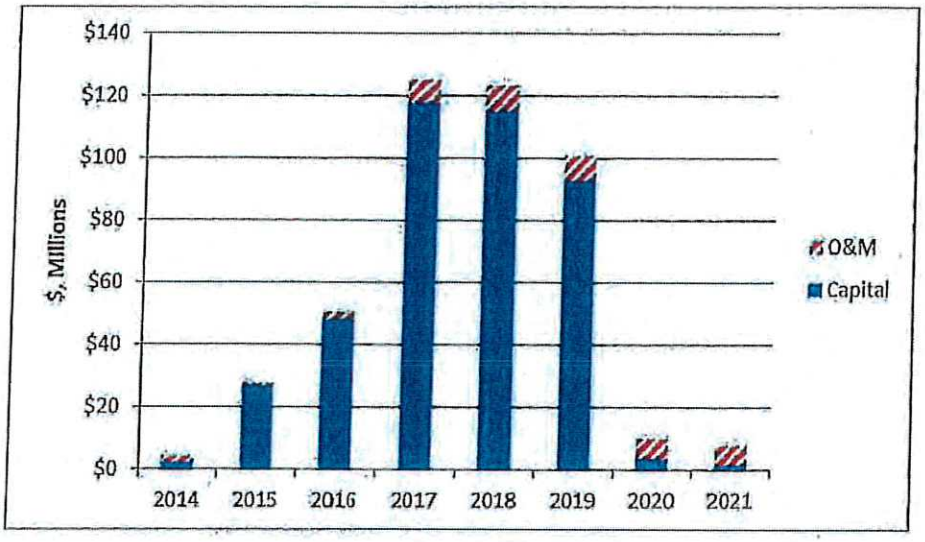

Figure 15 - 8-Year Cost Schedule

PPL Electric's projection of costs for the various components of the SMP are high level estimates based on data provided by potential vendors in response to the Company's RFIs and further based on the Company's business experience. These high level estimates are subject to change for a variety of reasons, including but not limited to, increases in vendor prices, changes in project scope, changes in the implementation timeline, unforeseen complications or changes in regulatory requirements. The cost estimates are not precise and will be revised over the life of the project. PPL Electric intends to recover its actual smart meter costs through the SMR whether they are more or less than the Company's initial estimates.

B. Scope & Assumptions

The financial analysis assumes an 8-year timeframe, starting with the beginning of the Post-Grace Period on July 1, 2014 and continuing through the end of the stabilization period in 2021. The Business Case assumes a 3-year deployment schedule that will commence in 2017. Additional Assumptions include:

- Annual work hours per Full Time Equivalent (FTE): 2080 hours (52 forty-hour weeks)
- Communications infrastructure will be deployed prior to meter deployment in each specific geographic area
- Costs for the following were based on RFI responses:
  - Meters
  - Network communications
  - Head end
  - MDM
  - Portal
- Costs for the following were based on PPL Electric and industry experience:
  - Program management
  - Change management and communications
  - IT support

- System integration

- The decision to purchase in home customer devices such as displays, smart thermostats, etc. will be left to the customer, as such no costs associated with these devices have been included.
- The analysis assumes 100% deployment; customers will not have an option to opt out
- A deployment vendor will be used for deploying meters in the field
- Prior to deployment, meter base related repairs are assumed to be needed on 3% of the meter population. The cost to repair each issue is estimated to be $1500

C. Overall Program Costs

The costs incurred to implement this plan have been grouped into the following cost categories: (i) Meter; (ii) Network & Network Management; (iii) Information Technology; (iv) Systems Integration; (v) Program Management; (vi) Communications/Change Management. Within each of these categories, the costs were further broken down as either capital or O&M within the years over which these costs would be incurred. The costs have been presented on a nominal basis over an 8 year analysis period. A graphical representation of these costs is shown in Figures 17 and 18.

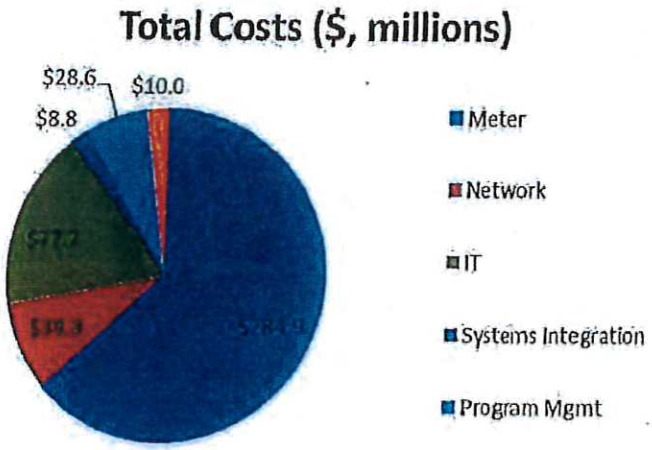

Figure 16 - Total Cost Breakdown

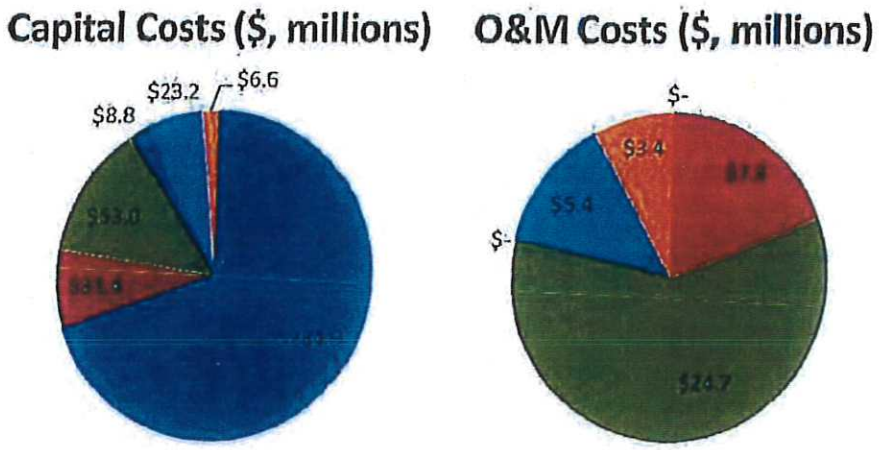

Figure 17 - Capital and O&M Cost Breakdowns

The capital costs constitute approximately 91% of the total costs and the O&M costs constitute the remainder of the total costs. A breakdown of costs in capital and O&M categories is shown in Figure 17. The cost estimates are based on program components described below:

D. Costs by Program Component

1. Meter

Total estimated cost: $284.9 million

Capital: $284.9 million

O&M: $0.0 million

The most significant component of the meter cost is the $193.8 million equipment cost for the approximately 1.4 million meters. A deployment vendor would be used to deploy meters at an average installation cost of $12.50 per meter and will total $20.0 million. Another component of the meter cost is related to repair of customer meter bases prior to full deployment totaling $67.2 million. Other items that are included in the total meter cost are associated with meter testing, meter failures, and customer growth.

2. Network & Network Management

Total estimated cost: $39.3 million

Capital: $31.4 million

O&M: $7.9 million

The network equipment costs which include repeater and collector costs will be $9.9 million. The model assumes approximately 2,900 repeaters and 600 collectors will be needed. The total

costs to deploy and install the network communications system will be $3.9 million and will include $2.6 million for project management, network planning and engineering, training, and testing and $1.3 million for equipment installation in the field.

In addition to the costs associated with the installation of a network communications system, there will be additional costs to monitor and run a smart meter NOC totaling $6.7 million. Other components of the network and network management costs include backhaul, annual component failures, and annual maintenance.

3. Information Technology

Total estimated cost: $77.7 million

Capital: $53.0 million

O&M: $24.7 million

Costs associated with software, hardware, vendor support and internal IT resources are all part of the Information Technology costs. The software costs of Head-End, MDM, Portal and Meter Asset Management System total $33.0 million while the associated hardware costs are $7.2 million. Resource costs including incremental internal PPL IT resources and external vendor support are $37.4 million.

4. System Integration

Total estimated cost: $8.8 million

Capital: $8.8 million

O&M: $0.0 million

The system integration category captures the costs associated with coordinating and managing the implementation of the different IT packages in an optimal manner. Associated tasks include providing overall architectural guidance and design, supporting security requirements, facilitating integration across the disparate systems and comprehensive test plan development and execution.

5. Program Management

Total estimated cost: $28.6 million

Capital: $23.2 million

O&M: $5.4 million

The program management category captures the costs associated with overseeing the entire program through the end of 2021. The responsibilities associated with this category include program leadership, project management, requirements gathering, deployment planning, vendor management and business process development and redesign. The PMO costs associated with external consultant support is also incorporated into this category.

6. Communications/Change Management

Total estimate cost: $10.0 million

Capital: $6.6 million

O&M: $3.4 million

The estimated communications and change management costs cover two categories – training costs totaling $1.4 million and stakeholder communications costs totaling $8.6 million. Training costs include costs associated with both the development of training guides and modules as well as the delivery of training. The costs associated with communications incorporate costs for the development of smart meter plan related materials for all stakeholders as well as costs to deliver relevant education and messages through the appropriate channels in accordance with the timeframes outlined in the Communications Strategy.

XI. Communications Strategy

A critical component of the Smart Meter Plan will be a series of communications activities related to the deployment project, education of customers for smart meter technology, and other communications with various communities and regulatory agencies.

PPL Electric's communications related to the Smart Meter Plan will ensure that customers are informed about AMI benefits and the installation experience, including when they can expect new meters. The Company also intends to provide sources of information about AMI, and contact information for scheduling installation appointments. These activities will also include addressing any concerns (security, privacy, health effects, etc.) about the program.

In addition to customer-facing communications, PPL Electric will educate and inform employees, stakeholders, members of the media, public officials, and other audiences about why PPL Electric is upgrading to advanced meters.

The smart meter team has identified a series of key messages which will be part of the Company's communication strategy. These messages will be tailored to specific audiences and timeframes as part of a comprehensive communications plan. The Company plans to develop this comprehensive plan following approval of this SMP filing and prior to beginning deployment. The comprehensive plan will also leverage information provided by selected vendors for the AMI solution. PPL Electric will communicate the comprehensive plan with the Commission upon completion.

A. Key Messages

- PPL Electric Utilities proposes to upgrade its existing advanced meters to provide additional capabilities, improving service to customers and complying fully with Act 129.
- The new system will:
  - Comply with Act 129 and Implementation order requirements, including enabling customers to receive real-time pricing information.
  - Support home area networks, providing additional real-time information to customers regarding energy usage and cost.
  - Support operational improvements, including remote connect / disconnect and outage detection and restoration.
- After thorough study, we have determined that we will propose an RF solution, as opposed to our current Power Line Carrier system.
- Based on current analysis, we expect the project cost will range between $425 and $450 million.
- We expect to deploy the meters between 2017 and 2019.

B. Key Audiences

- PPL Electric customers
- Smart Meter Stakeholder Group
- Elected officials
- Other PPL Electric employees in Pennsylvania
- Media

- Public or community groups, such as chambers of commerce, consumer organizations, low income advocacy groups, etc.
- Financial/investment community
- IBEW 1600 leaders/contractors
- PPL Electric Retirees
- EGSs

C. Key Channels

- Dedicated internet website which will contain program information, Frequently Asked Questions (FAQs), and contact information
- Education for call center representatives
- Meetings with communities and public leaders
- Direct mail and E-Mail messaging
- Customer bill inserts
- On-premise notifications (during deployment)

A successful communications plan will rely on several key strategies. PPL Electric will leverage proven communications strategies used during its initial deployment of smart meters and will ensure employees have the information they need to understand the reason for new advanced meters and to communicate with family, friends and neighbors. Additionally, PPL Electric will conduct necessary consumer research to understand/refine messages and to ensure messages and supporting information are appropriately targeted

As part of its communications strategy, PPL Electric will create a detailed communications plan for deployment communications.

D. Deployment Communications

PPL Electric will also create communications materials related to the deployment of upgraded smart meters from 2017 – 2019. These communications will focus on notifications to customers of the deployment schedule, including proactive notifications prior to premise visits to install the upgraded meters. PPL Electric will follow a staged process to communicate deployment activities to customers:

1. 90 days prior to installation

During this phase, PPL will notify customers that deployment is being planned in their region or geographic area. This communication will include education about the upgraded smart metering system and website information to access additional detail via the dedicated microsite. Also during this phase, PPL Electric will, as appropriate, hold meetings with public leaders, and conduct other outreach sessions to proactively educate customers prior to installation.

2. 60 days prior to installation

PPL Electric will continue customer education and outreach efforts during this phase. These efforts will also include additional FAQs developed in tandem with the deployment vendor to address any customer concerns.

3. 30 days prior to installation

During this phase PPL Electric will send direct mail and E-mail notifications to customers reminding them of the upcoming premise visit to install an upgraded smart meter. The Company will provide an estimated timeframe for the day(s) during which the installation will take place.

4. Post-installation

PPL Electric will use contracted deployment vendors for the installation, which will take place according to a standardized process. Following the installation of an upgraded smart meter, PPL Electric will notify customers of the premise visit via a door hanger or other similar mechanism.

One week after the installation, PPL Electric will provide a survey to customers requesting feedback regarding the installation experience and the value of any provided communications materials. Customers will also be able to provide this feedback via the microsite.

XII. Cost Recovery

PPL Electric proposes to recover smart meter technology costs through its Smart Meter Rider consistent with the provisions of Act 129.

A. Current Smart Meter Plan Cost Recovery

In its 2009 Smart Meter Plan filing, PPL Electric proposed recovery of Smart Meter technology costs through a rider. In accordance with the Commission's Order at Docket No. M-2009-2123945, the Company implemented a separate mechanism, the Smart Meter Rider ("SMR"), on January 1, 2011 and, since that time, has filed quarterly informational reconciliations and annual 1307(e) reconciliations. PPL Electric includes a financial update and rate filing in its annual Smart Meter Plan filings in August of each year and has submitted proposed SMR changes to take effect in the following calendar year in addition to reconciliation of the Company's SMR charges from the previous year.

Currently, PPL Electric recovers the annual budgeted amount of all costs required for the Company to implement its approved Smart Meter Plan during a compliance year. The SMR is applied on a non-bypassable basis to charges for electricity supplied to customers who receive distribution service from the Company. It is applied to Residential and Small Commercial and Industrial (C&I) customers on a $/kWh basis and to Large C&I customers on a $/bill basis. The annual budgeted amount is the sum of all direct and indirect capital (e.g., return of and return on applicable smart meter-related investment) and operating costs (e.g., applicable O&M and taxes), including all deferred design and development costs and general administrative costs required to implement the Company's SMP in the compliance period.

PPL Electric proposes to continue recovering through the SMR the cost of the pilot programs and any associated over or under recovery.

In the 2013 filing, PPL Electric stated that the Final Plan will propose recovery of any additional AMI costs, subject to Commission approval as an adjustment to the SMR.

B. Proposed Smart Meter Plan Cost Recovery

PPL Electric is proposing modifications to its Smart Meter cost recovery mechanism.

The Company is proposing that the SMR be stated as a per-customer charge for all Residential, Small C&I and Large C&I customers. This price will be updated quarterly and will be based on historical, actual data for the prior three-month period with a one-month lag. PPL Electric will continue to file quarterly informational reconciliations and annual 1307(e) reconciliations.

PPL Electric proposes to continue recovery of annual costs required for the Company to implement its approved Smart Meter Plan during a compliance year. Qualifying plan development and implementation expenses incurred during 2014 will be deferred and recovered over three application years. The SMR will be applied on a non-bypassable basis to charges for electricity supplied to customers who receive distribution service from the Company. The amount eligible for recovery is the sum of all direct and indirect capital (e.g., return of and return on applicable smart meter-related investment) and operating (e.g., applicable O&M) costs,

including all deferred design and development costs and general administrative costs required to implement the Company's SMP in the compliance period.

The Company will include in its calculation the costs of eligible plant additions and operating costs that have not previously been reflected in PPL Electric's rates or rate base. Thereafter, the SMR will be updated on a quarterly basis to reflect eligible plant additions placed in service during the three-month period ending one month prior to the effective date of each SMR update. PPL Electric will also include in its calculation operating costs for the three-month periods ending one month prior to the effective date of each SMR update.

The SMR will be subject to annual reconciliation based on a reconciliation period consisting of the twelve months ending December 31 of each year. The revenue received under the SMR for the reconciliation period will be compared to PPL Electric's eligible costs for that period. The difference between revenue and costs will be recouped or refunded, as appropriate, in accordance with Section 1307(e), over a one-year period commencing on April 1 of each year. If SMR revenues exceed SMR-eligible costs, such overcollections will be refunded with interest. If SMR-eligible costs exceed revenues, such undercollections will be collected with interest. Interest on over/under-collections will be calculated at the residential mortgage lending specified by the Secretary of Banking in accordance with the Loan Interest and Protection Law (41 P.S. §§ 101, et seq.).

The Company's return shall be calculated using PPL Electric's actual capital structure and actual cost rate for long-term debt as of the last day for the three-month period ending one month prior to the effective date of the SMR and subsequent updates. The cost of equity will be the equity return rate approved in PPL Electric's last base rate proceeding that is less than three years old. If, however, the last base rate case is more than three years old, the quarterly return on equity calculated and recommended by the Bureau of Technical Services for the Distribution System Improvement Charge in the then most recent Quarterly Earnings Report will be utilized until a return on equity is determined in a subsequent base rate case. Supporting data for each quarterly update will be filed with the Commission and served upon the Commission's Bureau of Investigation and Enforcement, the Bureau of Audits, the Office of Consumer Advocate, and the Office of Small Business Advocate at least ten (10) days prior to the effective date of the update.

C. Unrecovered Costs of Assets to be Replaced

PPL Electric's proposed SMR does not include an adjustment for recovery of the costs of its existing meters. The Company proposes to continue depreciating its existing meters using their current depreciation schedule and to continue to recover depreciation on existing meters through its distribution base rates until the next distribution rate case. In its next base rate case, PPL Electric will propose to accelerate the period over which it will recover the remaining unrecovered investment in AMR. PPL Electric will propose a recovery period that coincides with the completion of the new meter deployment period throughout its territory to recover its AMR investment that remains unrecovered as of December 31 of the fully projected future test year included in that rate case.

Appendix A

Appendix A: Glossary of Terms

ADIT - Accumulated Deferred Income Taxes

AMI - Automated Metering Infrastructure: technology that, among other capabilities, eliminates the need for manual meter reading by incorporating advanced communications systems into grid components

ANSI - American National Standards Institute

ANSI C12.19 - American National Standard for Utility Industry End Device Data Tables

ANSI C12.22 - American National Standard for Interoperability among Smart Meters and Communication Devices

BC - Business Continuity: Part of PPL's operational readiness testing

BIT - Business Integration and Testing: Workstream for managing all lab and field testing related to the smart meter program

C&I - Commercial and Industrial: Large customers

CIA - Confidentiality, Integrity and Availability

CIS - Customer Information System: Back end system

CISSP - Certified Information Systems Security Professional

CISM - Certified Information Security Manager

CSIRT - Computer Security Incident Response Team

CSP - Customer Service Provider

Customer Portal - System which presents energy usage information to customers via a web interface. Portal was first deployed to PPL customers in June of 2007

DDoS - Distributed Denial of Service: Cyber-attack where one system is compromised by concentrated signals from multiple systems

DR - Disaster Recovery: Part of PPL's operational readiness testing

DHS - Department of Homeland Security

DoE - Department of Energy

DSIC - Distribution System Improvement Charge: A PUC-allowed surcharge on utility billing to fund the replacement of crucial aging infrastructure

EDC - Electric Distribution Company

EDI - Electronic Data Exchange

EDEWG - Electronic Data Exchange Working Group

EEI - Edison Electric Institute: Association of all shareholder-owned electric companies in the U.S.

EGS - Electric Generation Supplier

Electro-Mechanical Meters - Traditional rotating-disk electrical meter

ES-C2M2 - Electricity Subsector Cybersecurity Capability Maturity Model

ES-ISAC - Electricity Sector Information Sharing and Analysis Center

FBI - Federal Bureau of Investigation

FERC - Federal Energy Regulatory Commission

FERC OEIS - Office of Energy Infrastructure Security

FTE - Full Time Equivalent

HAN - Home Area Network

IAG - Information Assurance Group

IBEW - International Brotherhood of Electrical Workers

IEEE - Institute of Electrical and Electronics Engineers

IEEE 802.15.4 - Standard for low-power wireless networks (e.g., Zigbee)

IHD - In Home Displays

ISO - Independent System Operator

IT - Information Technology

KWh - kilowatt hour, the standard energy consumption unit for electricity meters

MAM - Meter Asset Management

MDM - Meter Data Management system: System that supports processing of meter data collected from the AMI system and interfaces directly with a customer portal

NERC - North American Electric Reliability Corporation

NERC CIP - Critical Infrastructure Protection

NIST - National Institute of Standards and Technology

NOC - Network Operating Center

O&M - Operation and Maintenance

OCA - Office of Consumer Advocate

P2P – Point-to-Point

PA PUC - Pennsylvania Public Utility Commission

PCADV - PA Coalition Against Domestic Violence

PECO - Energy Company in Philadelphia, subsidiary of Exelon.

PIA - Privacy Impact Assessment

PLC - Power Line Carrier: technology wherein data from meters is transmitted via existing power line infrastructure

PMO - Project Management Office

Post Grace Period – Denotes the time period following the end of the Grace Period for smart meter deployments as defined by the Commission. For PPL Electric, the Post Grace Period begins following the submittal of its final SMP

PPLICA - PP&L Industrial Customer Alliance

PUC - Public Utility Commission

PULP - Pennsylvania Utility Law Project

Reliant Energy - Power Utility located in Texas, a subsidiary of NRG Energy

RFI - Request for Information

RF Mesh - Radio Frequency Mesh

RFP - Request for Proposal

RTO - Regional Transmission Organization

RTP - Real-Time-Price

Smart Meter Technology – As defined in Act 129, metering technology and network communications technology with the fundamental capabilities of bidirectional communication, recording electricity usage on at least an hourly basis, and providing customers with direct access to and use of price and consumption information.

SMP - Smart Meter Plan

SMR - Smart Meter Rider

SRA - Security Risk Assessment

SI - System Integrator

TOU - Time-of-Use

TWACS - Two-Way Automatic Communications System: PLC AMI solution from Aclara, utilized in PPL's initial AMI deployment and in PPL Electric's current solution.

VEE - Validation, Estimation, and Editing

Zigbee - Low-power wireless technology based on the IEEE 802.15 standard

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Kathleen R. Anthony	:	
	:	
v.	:	C-2018-3000490
	:	
PPL Electric Utilities Corporation	:	

DIRECT TESTIMONY OF CHRISTOPHER C. DAVIS, Ph.D.

PPL Electric Statement No. 1

September 30, 2019

C-2018-3000490
1
6/25/20

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Christopher C. Davis and my business address is Department of Electrical and Computer Engineering, University of Maryland, 2124 Jeong H. Kim Engineering Building, College Park, MD 20742.

Q. WHAT IS YOUR OCCUPATION?

A. I am a scientific researcher and teacher in Physics and Electrical Engineering, particularly Electromagnetics, which includes radio frequency (RF) electromagnetics.

Q. WHERE ARE YOU EMPLOYED AND WHAT IS YOUR POSITION?

A. I am the Minta Martin Endowed Professor of Engineering and Professor of Electrical and Computer Engineering at the University of Maryland in College Park, Maryland.

Q. PLEASE DESCRIBE YOUR EDUCATIONAL BACKGROUND.

A. As an undergraduate, I attended Trinity College at Cambridge University in England, where I earned a BA with Honors in Natural Sciences. I subsequently earned a Diploma with Distinction for Advanced Studies in Science (Physics) at the University of Manchester in England and a Masters in Natural Sciences (Physics) at Trinity College, Cambridge University. I earned my Ph.D. in Physics at the University of Manchester and completed a Post-Doctoral Fellowship in Applied and Engineering Physics at Cornell University.

Q. PLEASE BRIEFLY DESCRIBE YOUR PROFESSIONAL EXPERIENCE.

A. I have been a full Professor at the University of Maryland for over 30 years, and I have been teaching and conducting research on Physics, Electric Engineering and Electromagnetics at the University for over 40 years. I have also served as the Associate

Dean of the School of Engineering at the University of Maryland and have been a Senior Visiting Fellow in the Department of Physical Chemistry at Cambridge University.

Q. WHAT DO YOU TEACH AT THE UNIVERSITY OF MARYLAND?

A. I teach many subjects in the fields of Physics and Electrical Engineering, particularly Electromagnetics, including RF electromagnetics. I teach undergraduates and graduate students who are pursuing Master's and Doctorate (Ph.D.) degrees. I also have supervised the research of 73 students who earned Master of Science or Ph.D. degrees in electrical engineering, physics or biophysics.

Q. WHAT TYPE OF SCIENTIFIC STUDIES HAVE YOU CONDUCTED?

A. I have conducted many scientific studies in the fields of physics, biophysics, and electrical engineering, and particularly studies on electromagnetics, bioelectromagnetics, and RF electromagnetics, bioelectromagnetics and dosimetry.

Q. HAVE YOU AUTHORED ANY SCIENTIFIC PUBLICATIONS IN YOUR AREAS OF EXPERTISE?

A. Yes, I have authored or co-authored 255 articles published in peer-reviewed scientific journals (principally reporting on studies I conducted), two books, twelve book chapters, and 321 papers presented at scientific conferences. Among those publications are two book chapters and 24 articles published in peer-reviewed scientific journals on RF fields. I have also presented 55 papers at scientific conferences on RF fields.

Q. HAVE YOU DONE ANY RESEARCH ON RF FIELDS OF THE TYPE PRODUCED BY THE ADVANCED METERING INFRASTRUCTURE ("AMI") METERS BEING USED BY PPL ELECTRIC UTILITIES CORPORATION ("PPL ELECTRIC")?

A. Yes, I have conducted a substantial amount of research on RF fields of the type produced by the AMI meters being used by PPL Electric.

Q. HAVE YOU SERVED ON ANY SCIENTIFIC COMMITTEES THAT EVALUATE RESEARCH RELATED TO ELECTROMAGNETIC FIELDS?

A. Yes, I have served on the Institute of Electrical and Electronic Engineers (IEEE) Committee on Man and Radiation (COMAR) and as chair of the Subcommittee on Radio Frequency Fields, which consists of experts who examine the scientific research on RF fields and evaluate the IEEE exposure guidelines.

Q. DO YOU REVIEW RESEARCH PAPERS SUBMITTED BY OTHER RESEARCHERS TO SCIENTIFIC PUBLISHERS FOR PUBLICATION?

A. Yes, I review papers for a number of scientific publishers, including the American Industrial Hygiene Association Journal, Australian National Health Research Council, Bioelectromagnetics, Cambridge University Press, Radiation Research, Biochimica et Biophysics Acta, Biopolymers, Environmental Biophysics, Applied Physics Letters, The British Council, IEEE Journal of Quantum Electronics, IEEE Journal on Selected Areas in Communication, IEEE Transactions on Biomedical Engineering, International Journal of Modern Physics, Journal of Applied Physics, Journal of Manufacturing Science and Engineering, Microelectronic Engineering, Ohio Board of Regents, Radiation and Environmental Biophysics, Physiological Measurement, Physics in Medicine and

Biology, Environmental Biophysics, the National Institutes of Health, and the National Science Foundation.

Q. HAVE YOU BEEN INVITED TO PRESENT SCIENTIFIC TALKS ON ELECTROMAGNETICS AND BIOELECTROMAGNETICS?

A. Yes, I have been invited by several institutions to present talks about the science of electromagnetics and bioelectromagnetics, including: The Johns Hopkins University Applied Physics Laboratory; Stanford University; universities in Canada, Denmark, Korea, Turkey, Taiwan, England, and Australia; the Korean Institute of Science and Technology; the Los Alamos National Laboratory; the National Bureau of Standards; the National Institute of Standards and Technology; the U.S. Food and Drug Administration; and the NASA Goddard Space Flight Center.

Q. HAVE YOU SERVED AS A CONSULTANT TO ANY GOVERNMENTAL AUTHORITIES ON RF FIELDS?

A. Yes, I have provided expert advice on both power frequency and RF fields, including dosimetry and proposed mechanisms for biological effects other than heating to the United Kingdom Health Protection Agency, the U.S. National Institutes of Health and the U.S. Food and Drug Administration's Center for Devices and Radiological Health.

Q. HAVE YOU RECEIVED ANY HONORS OR AWARDS FOR YOUR TEACHING AND RESEARCH?

A. Yes, I have received a number of honors and awards for teaching and research, including being selected as a Fellow of the Institute of Electrical and Electronics Engineers and a Fellow of the Institute of Physics, and a fellow of SPIE (The International Society for Optics and Photonics.)

Q. IN LIGHT OF YOUR EDUCATION, TRAINING AND EXPERIENCE, WHAT ARE YOUR FIELDS OF EXPERTISE THAT RELATE TO YOUR TESTIMONY ABOUT SMART METERS IN THIS CASE?

A. Physics, Biophysics, Chemistry, Electrical Engineering, Electromagnetics, Bioelectromagnetics, and Radio Frequency Bioelectromagnetics and Dosimetry.

BACKGROUND ON RF FIELDS

Q. WHAT IS AN RF FIELD?

A. In the context of electromagnetics, fields are areas around an object where an electric and magnetic component can be detected. An easy way to understand fields is to think about the gravitational field we have on Earth, or the cool temperature field near an open refrigerator. An RF field is the field produced when an object sends a signal at a frequency in the radio frequency range, most commonly for radio communications.

Q. DID YOU PREPARE AN EXHIBIT TO ILLUSTRATE DIFFERENT TYPES OF ELECTROMAGNETIC FIELDS, INCLUDING RF FIELDS?

A. Yes, my exhibit CD-1 is a representation of the electromagnetic spectrum, which shows sources of different types of electromagnetic fields along the spectrum. The spectrum starts at zero Hz (a measure of frequency or cycles per second) on the left side of the page and runs up into the millions and billions of Hz on the right side. The lower frequency fields have the longest wavelengths and the lowest energy, while the higher frequency fields, such as x-rays and gamma rays have the shortest wavelengths and the most energy. Along this spectrum there are two fundamental categories of electromagnetic fields: Non-ionizing and Ionizing radiation. RF fields are located in the lower energy, non-ionizing portion of the electromagnetic spectrum, which consists of lower frequency waves that do

not have enough energy to break chemical bonds including the chemical bonds in DNA. There are a number of types of lower frequency fields, from Extremely Low Frequency (produced from the electricity we use), to RF fields (the section above the images of the AM/FM radio, the television, cell phone and satellite dish), and up to Infrared (e.g., used by TV remote controls), none of which has enough energy to break the chemical bonds in DNA and therefore is in the Non-ionizing Radiation category. The Ionizing radiation category consists of the sources of waves that have enough energy to break chemical bonds in DNA, such as medical x-rays and other radioactive sources.

Q. SHOULD RF FIELDS BE CALLED "RADIATION"?

A. "Radiation" is a scientific term that describes how energy travels from a source, i.e., it "radiates" out from the source. An example of radiation is the waves that radiate out in a circle when a stone is tossed into a pond. TV and radio broadcast towers, powerlines, appliances, home wiring, and TV remote controls all produce fields that radiate. NASA has a good and simple statement about radiation on its website: "Radiation is energy that travels and spreads out as it goes – the visible light that comes from a lamp in your house and the radio waves that come from a radio station are two types of electromagnetic radiation." However, referring to RF fields as a form of "radiation" can sometimes be used to confuse or scare people into thinking about radio signals as though they are harmful like sources of ionizing radiation, which they are not.

Q. HOW DO THE TERMS "RADIO FREQUENCY" AND "MICROWAVES" RELATE TO EACH OTHER?

A. The frequency range for RF fields is from 3 kHz (kilo Hertz) to 300 GHz (giga Hertz). Microwaves are the part of the RF range between 300 MHz and 3GHz. Therefore, all

microwaves are RF waves. When the term "microwaves" is used in communicating about devices with people who are not physicists or electrical engineers, it can incorrectly imply that the device has the same properties as microwave ovens. Microwaves ovens produce a RF wave that is intense enough to quickly heat biological matter to a very high temperature. Other than microwave ovens, however, devices that use RF fields in the microwave portion of the RF range typically do not produce a wave that is intense enough to heat biological matter. Smart meters are a good example of those kinds of devices. They operate in the microwave frequency range but do not produce a wave that is intense enough to heat biological matter. Smart meters are not little microwave ovens. In communicating with people who are not physicists or electrical engineers, unless I am talking about the properties of a microwave oven, I use the term RF to avoid giving a false impression that a particular device produces a wave that produces the thermal effect of a microwave oven.

RF FIELDS FROM AMI METERS BEING USED BY PPL ELECTRIC

Q. DO THE AMI METERS BEING USED BY PPL ELECTRIC PRODUCE A TYPE OF ELECTROMAGNETIC FIELD?

A. Yes, the meters send low level radio signals and produce RF fields which are a natural result of sending radio signals.

Q. DO THE AMI METERS BEING USED BY PPL ELECTRIC PRODUCE RF FIELDS ALL THE TIME?

A. No, an AMI meter only produces RF fields when it sends a radio signal. The total daily time of RF signaling from the AMI meters used by PPL Electric is 84 seconds over the course of 24 hours, with individual signal durations of only 46 to 63 milliseconds.

Q. WHEN THE AMI METER IS NOT SENDING AN RF SIGNAL, DOES AN RF FIELD REMAIN NEAR THE METER?

A. No. RF fields move away from the source of transmission – in this case the AMI meter – at the speed of light. When the meter is not signaling, there is no RF field surrounding or near the meter.

Q. ARE THE RF FIELDS FROM THE AMI METERS BEING USED BY PPL ELECTRIC IONIZING RADIATION?

A. No, as I explained above, RF fields do not have the energy to break chemical bonds in DNA and therefore are Non-ionizing.

Q. DOES THE AMI METER BEING USED BY PPL ELECTRIC PRODUCE PULSED RF FIELDS?

A. No, the AMI meter being used by PPL Electric does not produce pulsed RF fields. The AMI meter being used by PPL Electric produces sinusoidal RF fields, which are physically different fields from pulsed fields.

Q. DOES THE AMI METER BEING USED BY PPL ELECTRIC PRODUCE "DIRTY ELECTRICITY"?

A. "Dirty electricity" is a non-scientific term that sometimes is used to refer to electrical characteristics (harmonics and transients) that can be found on household wiring. These can be from many sources, such as the rotating generators used to produce electricity at power stations, other systems connected to the electric grid, or the use of certain appliances and devices in the home such as light dimmers or even in neighboring houses sharing the same distribution system. Harmonics and transients are typically are very small compared to the fundamental 60 Hz alternating current electric power. AMI meters

do not generate electricity, do not generate harmonics and transients that are significant compared to the harmonics and transients that are already present on the 60 Hz power coming into the home, and do not interfere with the operation of household wiring.

Q. IS THERE A SCIENTIFICALLY RELIABLE BASIS FOR DETERMINING WHETHER THE LEVEL OF RF FIELDS FROM THE AMI METERS BEING USED BY PPL ELECTRIC IS SAFE?

A. Yes, the Federal Communications Commission (FCC) has determined safe "Maximum Permissible Exposure Limits" for non-portable devices, including smart meters, which transmit RF signals. The FCC exposure limits are based on exposure guidelines from the U.S. National Council on Radiation Protection and Measurements (NCRP) and the American National Standards Institute (ANSI/IEEE). Based on scientific studies those expert organizations analyzed, both organizations identified the threshold level (i.e., lowest level) of RF exposure at which a potentially adverse biological effect could occur, which was found to be at a level at where there can be tissue heating. Then they applied safety factors that resulted in lower exposure levels that they adopted as their exposure guidelines. In addition, in adopting its exposure limits, the FCC consulted with the U.S. Food and Drug Administration, the Environmental Protection Agency, the Occupational Safety and Health Administration, and the National Institute of Occupational Safety and Health, and each supported the FCC setting its exposure limits based on the exposure guidelines issued by those expert organizations.

Q. DOES THE FCC RF EXPOSURE STANDARD TAKE INTO ACCOUNT THE RESULTS OF RESEARCH ON NON-THERMAL LEVELS OF RF EXPOSURES?

A. Yes. The FCC RF exposure standard is based on exposure guidelines developed by expert scientific organizations, which took into consideration studies of both thermal exposure levels (those that can produce heating) and non-thermal levels (those that are lower and do not produce heating). The FCC is aware of the research on non-thermal RF fields and has specifically concluded that for RF "levels lower than those that would produce significant heating, the evidence for production of harmful biological effects is ambiguous and unproven." The FCC also notes that the research on RF fields continues to be monitored and assessed on an ongoing basis. The FCC explains the reasons for its view on non-thermal effects as follows: "A number of reports have appeared in the scientific literature describing the observation of a range of biological effects resulting from exposure to low levels of RF energy. However, in most cases, further experimental research has been unable to reproduce these effects. Furthermore, since much of the research is not done on whole bodies (in vivo), there has been no determination that such effects constitute a human health hazard." The FCC's reasons for its position are scientifically sound and reflect the consensus of independent scientists who are expert in RF bioelectromagnetics.

Q. HAVE FEDERAL AGENCIES IN THE UNITED STATES CONCLUDED THAT THE FCC'S RF EXPOSURE GUIDELINES ARE INADEQUATE TO PROTECT THE PUBLIC?

A. No. A number of federal agencies, such as the U.S. Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), and the National Institute on

Occupational Safety and Health (NIOSH) work with the FCC on RF issues. The EPA, FDA and NIOSH websites on RF issues include links to the FCC website on RF safety and do not say that the FCC exposure limits are inadequate to protect public health. For example, the EPA website says that "the FCC sets exposure limits for the electromagnetic radiation emitted by smart meters," and provides a link to the FCC website.

The FDA website on cell phones and RF fields does not make any statements about the FCC standards being inadequate to protect public health. Instead, the FDA concludes that 1) RF fields from cell phones have not been linked to any health problems, 2) non-thermal levels of RF fields have not been shown to cause health effects, and 3) the scientific research does not show any danger to health for any cell phone user, including children and teenagers. The FDA says:

"The weight of scientific evidence has not linked cell phones with any health problems. Cell phones emit low levels of radiofrequency energy (RF). Over the past 15 years, scientists have conducted hundreds of studies looking at the biological effects of the radiofrequency energy emitted by cell phones. While some researchers have reported biological changes associated with RF energy, these studies have failed to be replicated. The majority of studies published have failed to show an association between exposure to radiofrequency from a cell phone and health problems." https://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/CellPhones/ucm116282.htm

The FDA also says:

- "Whereas high levels of RF can produce health effects (by heating tissue), exposure to low level RF that does not produce heating effects causes no

known adverse health effects." https://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/CellPhones/ucm116282.htm

- "The scientific evidence does not show a danger to any users of cell phones from RF exposure, including children and teenagers." https://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/CellPhones/ucm116331.htm

Q. BASED ON YOUR REVIEW OF THE SCIENTIFIC RESEARCH ON RF FIELDS AND BIOPHYSICAL MECHANISMS, IS THERE A CREDIBLE BIOLOGICAL MECHANISM BY WHICH RF FIELDS COULD CAUSE EFFECTS IN HUMANS OTHER THAN THROUGH TISSUE HEATING (THERMAL EFFECTS)?

A. No, there is no reliable scientific basis for a mechanism by which RF fields could cause effects in the human body other than through heating, i.e. a thermal effect. As explained below, the RF fields from the AMI meter being used by PPL Electric are far too low to cause a heating effect.

Q. IS THERE GENERAL ACCEPTANCE IN THE SCIENTIFIC COMMUNITY OF ANY BIOLOGICAL MECHANISM BY WHICH RF FIELDS COULD CAUSE EFFECTS IN HUMANS OTHER THAN BY THERMAL EFFECTS?

A. No, there is no generally accepted mechanism by which RF fields could cause biological effects in the human body other than through heating, i.e. a thermal effect.

Q. DID YOU CALCULATE THE LEVELS OF RF FIELDS FROM THE AMI METERS BEING USED BY PPL ELECTRIC?

A. Yes, PPL Electric provided me the specifications for RF functionality of the Landis & Gyr AMI meters, and from those specifications I calculated the RF field levels from the meters.

Q. DO THE RF FIELD LEVELS FROM THE AMI METERS BEING USED BY PPL ELECTRIC COMPLY WITH THE APPLICABLE FCC RF EXPOSURE LIMIT?

Yes. My exhibit CD-2 shows that the RF field levels from the AMI meters being used by PPL Electric more than comply with the applicable FCC RF exposure limit for the radio in the AMI meters. The FCC exposure limit is based on a 30-minute average exposure, and the 30-minute average RF field level from the AMI meters being used by PPL Electric is 98,000 times smaller than the FCC exposure limit.

Q. DID YOU ALSO CHECK HOW THE PEAK RF FIELD LEVELS FROM THE PPL ELECTRIC AMI METERS COMPARE TO THE FCC EXPOSURE LIMITS?

A. Yes, my exhibit CD-3 shows that the peak RF field level from the AMI meters being used by PPL Electric is 95 times lower than the FCC exposure limit for 30-minute average exposure. However, for purposes of comparison to the FCC limits, the 30-minute RF average exposures shown in my exhibit CD-2 are the appropriate measure, and these are 98,000 times lower than the FCC limits.

Q. DO THE RF FIELDS FROM THE AMI METERS BEING USED BY PPL ELECTRIC PRODUCE A HEATING EFFECT?

A. No, the level of RF fields from the AMI meters being used by PPL Electric is far too low to cause a thermal or heating effect. RF fields at this level do not cause thermal effects

and, based on my review of the extensive body of scientific research on RF fields, there is no reliable basis in physics or biophysics to conclude that these very low level RF fields are capable of causing non-thermal effects.

Q. IS THERE ANYTHING UNUSUAL ABOUT THE RF FIELDS FROM THE AMI METERS BEING USED BY PPL ELECTRIC?

A. There is nothing unusual about the RF fields from the AMI meters being used by PPL Electric. The RF fields from the AMI meters being used by PPL Electric are the same types of RF fields that are used for radio communications by many common everyday devices, such as radios, garage door openers, baby monitors, portable phones, Wi-Fi, and other wireless communications devices.

Q. DID YOU COMPARE THE LEVEL OF RF FIELDS FROM THE AMI METERS BEING USED BY PPL ELECTRIC TO THE LEVEL OF RF FIELDS THAT PEOPLE ARE EXPOSED TO FROM OTHER SOURCES?

A. Yes, my exhibit CD-4 shows that the RF fields from a number of sources that people are commonly exposed to are much higher than the level of RF fields from the AMI meters being used by PPL Electric. Exhibit CD-4 shows that the RF fields 30 feet away from a person using a cell phone are 3 times larger than the RF fields from the AMI meters. Exhibit CD-4 also shows that the RF fields from using cell phones near the head can be over 260,000 times higher than the RF fields from the AMI meters, and the RF exposures from microwave ovens can be over 820,000 times larger than the RF fields from the AMI meters.

Q. HOW DO THE RF FIELDS FROM THE AMI METERS BEING USED BY PPL ELECTRIC COMPARE TO THE RF EXPOSURES CAUSED BY TELEVISION BROADCASTING AT THE ANTHONY RESIDENCE AT 505 NORWAY PLACE, BETHLEHEM, PENNSYLVANIA?

A. There are five television broadcast towers within a radius of 50 miles of 505 Norway Place, Bethlehem, PA that use RF fields to transmit UHF television signals to that part of Lehigh County. Based on the locations of these towers and their power outputs, I calculated the level of RF fields that these facilities use to transmit UHF TV signals to the Anthony residence at 505 Norway Place in Bethlehem and which therefore exist as background levels of RF fields at that address. My exhibit CD-5 shows that the RF fields at 3 meters from the AMI meter being used by PPL Electric are 197 times smaller than the background RF exposure from UHF TV broadcasting at the Anthony residence.

Q. IN HER RESPONSES TO DISCOVERY, MS. ANTHONY PROVIDED INFORMATION SHOWING THAT SHE USED HER CELL PHONE FOR 274 MINUTES OVER A 6-MONTH PERIOD. HOW DOES THE AMOUNT OF RF EXPOSURE MS. ANTHONY RECEIVED FROM USING HER CELL PHONE OVER THIS PERIOD COMPARE TO THE RF FIELDS FROM THE AMI METER BEING USED BY PPL ELECTRIC?

A. The amount of RF exposure Ms. Anthony received from using her cell phone near her head over a 6-month period is 103,569 times higher than the RF 3 meters from the meter over a 6-month period.

Q. HOW LONG WOULD MS. ANTHONY HAVE TO BE NEAR AN AMI METER TO GET RF EXPOSURES EQUIVALENT TO THE RF EXPOSURES SHE GOT FROM USING HER CELL PHONE?

A. Based on 274 minutes of cell phone calls over a 6 month period and assuming she held her cell phone at her head, Ms. Anthony would have to stay within 1 meter of her AMI meter for 103,569 years to get an equivalent amount of RF exposure from the AMI meter. If Ms. Anthony used her cell phone with a headset or earphones, she would need to stay within 1 meter of her AMI meter for 259 years to get a level of RF exposure equivalent to the RF exposure she got from using her cell phone. This does not take into account the RF exposures she received from using her cell phone to send over 1,500 texts during this same period.

Q. HAVE YOU FORMED ANY OVERALL EXPERT OPINIONS ABOUT THE RF FIELDS FROM THE AMI METERS BEING USED BY PPL ELECTRIC?

A. Based on my education, training and experience in Physics, Biophysics, Chemistry, Electrical Engineering, Electromagnetics, Bioelectromagnetics, and RF Bioelectromagnetics and Dosimetry, my review of the scientific research on RF fields, and my calculations of RF field levels, I have formed the following overall expert opinions:

The levels of RF fields from the AMI meters being used by PPL Electric are extremely low (98,000 times lower than the RF exposure safety limits established by the FCC) and are many times lower than the RF fields people are commonly encounter from everyday sources, including the background levels of RF fields at the Anthony residence at 505 Norway Place, Bethlehem, PA.

There is no reliable scientific basis in physics, biophysics, bioelectromagnetics or RF bioelectromagnetics to conclude that the very low levels of RF fields from the AMI meters being used by PPL Electric can or will cause any adverse thermal or non-thermal biological effects in people.

Q. DO YOU HOLD THE OPINIONS SET FORTH IN YOUR TESTIMONY TO A REASONABLE DEGREE OF SCIENTIFIC CERTAINTY?

A. Yes, I do.

Q. DOES THAT CONCLUDE YOUR DIRECT TESTIMONY AT THIS TIME?

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

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Kathleen R. Anthony	:	
	:	
v.	:	C-2018-3000490
	:	
PPL Electric Utilities Corporation	:	

DIRECT TESTIMONY OF MARK A. ISRAEL, MD

PPL Electric Statement No. 2

NON-PROPRIETARY VERSION

June 15, 2020

C-2018-3000490
2
6/25/20

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Mark A. Israel. My business address is Israel Cancer Research Fund, 52 Vanderbilt Avenue, Suite 1510, New York, NY 10017.

Q. WHAT IS YOUR OCCUPATION?

A. I am a medical doctor, a researcher, and the Executive Director of an international non-profit medical research foundation. Over the course of my 40 year medical career, I have been responsible for the diagnosis and treatment of patients, the conduct of medical and biological research, and the direction and management of a major medical care center delivering care and treatment to thousands of patients each year.

Q. WHERE ARE YOU EMPLOYED?

A. In 2018, I was appointed Executive Director of the Israel Cancer Research Fund in New York, which is an international charitable fund that raises private donations for medical and scientific research programs. I am also a Professor Emeritus of Medicine, Pediatrics, and Molecular and Systems Biology at the Dartmouth Medical School.

Q. PLEASE DESCRIBE YOUR EDUCATIONAL BACKGROUND.

A. I received my undergraduate degree from Hamilton College in 1968. I then earned my medical degree from the Albert Einstein College of Medicine in 1973. After earning my MD degree, I completed my internship and residency at Children's Hospital Medical Center in Boston, which is the principal pediatric teaching hospital of Harvard Medical School. After completing my residency, I joined the National Institutes of Health (NIH) as a researcher studying infectious diseases and the molecular genetics of cancer. At NIH, I completed post-graduate training in pediatric oncology, the area of medicine that involves the diagnosis, care, and treatment of cancer in children.

Q. PLEASE BRIEFLY DESCRIBE YOUR PROFESSIONAL EXPERIENCE AS A MEDICAL DOCTOR.

A. I conducted research and treated patients at NIH, first in the National Institute of Allergy and Infectious Diseases and then at the National Cancer Institute (NCI). Throughout my 14 years at NIH, I also served as an officer in the Public Health Service, rising to the rank of Captain. I became the Head of the Molecular Genetics Section of the Pediatrics Branch at NCI, where we conducted research on the molecular genetics of childhood cancer. Our research characterized specific genes responsible for the cause of certain cancers in children. Our work also contributed to improvements in the diagnosis and treatment of childhood cancer, as well as early developments in the field of cancer gene therapy.

In 1989, I joined the University of California at San Francisco (UCSF) School of Medicine, where I became the Director of the Preuss Laboratory of Molecular Neuro-oncology and the Kathleen M. Plant Distinguished Professor. The Preuss Laboratory was a major brain cancer research laboratory. At UCSF, I treated patients, taught medical students and directed a medical research laboratory.

In 2001, I became the Director of the Cancer Center at the Dartmouth Medical School and the Dartmouth Hitchcock Medical Center. The Cancer Center is a major health care facility that provides medical care to more than 5,000 new patients each year. As Director, I coordinated the multidisciplinary treatments provided by medical doctors, surgeons, radiation therapists, nurses and other staff, and managed numerous research programs, with a collective annual budget for the Cancer Center of more than $250 million. I also oversaw the development and implementation of the Center's public health and

disease prevention programs in New England. In July 2019, I was designated the Director Emeritus of the Cancer Center.

Q. ARE YOU A BOARD CERTIFIED PHYSICIAN?

A. Yes, I am a board certified pediatrician.

Q. ARE YOU LICENSED TO PRACTICE MEDICINE?

A. Yes, I am licensed to practice medicine in New Hampshire and California.

Q. HOW LONG HAVE YOU BEEN CONDUCTING MEDICAL RESEARCH AND IN WHAT AREAS?

A. I have been conducting medical research for 40 years. I have done medical research in a wide variety of areas, including systems biology, biochemistry, cell biology, cancer, molecular biology, and molecular genetics.

Q. HOW LONG HAVE YOU BEEN A TEACHER AND WHAT TYPES OF STUDENTS AND SUBJECTS HAVE YOU TAUGHT?

A. I have been a teacher for more than 30 years and I have taught medical students, graduate students, interns, residents, and practicing physicians subjects in a number of fields, including endocrinology, immunology, hematology, neurology, cardiology, biochemistry, cell biology, genetics, molecular genetics, medical oncology, and radiation oncology.

Q. HAS ANY OF YOUR RESEARCH BEEN PUBLISHED IN SCIENTIFIC JOURNALS?

A. Yes, I have published 250 medical research studies in peer-reviewed scientific journals such as the *New England Journal of Medicine, The Proceedings of the National Academy of Sciences, Cancer Research,* and *Nature,* among others. I have also written chapters in medical textbooks, such as the section on brain cancer in the widely used *Harrison's*

Principles of Internal Medicine, and I am a co-Editor of the textbook *The Molecular Basis of Cancer.*

Q. ARE YOU A MEMBER OF ANY PROFESSIONAL ORGANIZATIONS?

A. I am a member of a number of professional organizations, including the American Association for Cancer Research and the American Society for Clinical Oncology, among others. I have also served on a number of boards for professional organizations, such as the Board of Directors of the Association of American Cancer Institutes and the Executive Committee of the Board of Directors of the Foundation for the Advancement of Education in Science.

Q. IN THE COURSE OF YOUR PROFESSIONAL CAREER, DO YOU REVIEW SCIENTIFIC LITERATURE ON TOPICS ON WHICH YOU DO NOT PERSONALLY CONDUCT RESEARCH?

A. Reviewing scientific publications on topics other than one's own research is an important part of scientific work, and I have done it throughout my medical career. For example, I have served as a reviewer of research proposals for major research organizations such as the NCI, Cancer Research UK, German Cancer Aid, the Israel Cancer Research Fund, and the Medical Research Council of New Zealand. I also for many years have served as an assistant editor for various scientific and medical journals and have conducted peer-review of articles submitted for publication to leading journals such as *Clinical Cancer Research, Neuro-Oncology, Cancer Research,* and others.

Q. HAVE YOU BEEN AWARDED ANY HONORS IN YOUR PROFESSIONAL CAREER?

A. I am an elected Fellow of the American Association for the Advancement of Science, an elected member of the Association of American Physicians, and an elected member of the American Society for Clinical Investigation, each of which is recognition by my peers of the scientific merit of my work and my commitment to advancing medical science. I have been asked to provide scientific advice and direction to a number of organizations by serving on their advisory boards, such as the Science Advisory Board for the Yale Cancer Center, which I chaired for almost a decade, and the External Advisory Boards for the Children's Cancer Research Institute at the University of Texas Health Science Center, the University of Nebraska Eppley Cancer Center, the Carbone Cancer Center at the University of Wisconsin, and the National Brain Tumor Society, among others. I have also served on the Board of Scientific Counselors for the NCI. During my work at the NCI, I was awarded two U.S. Public Health Service commendation medals, and I received an honorary degree from Dartmouth in 2004. In 1998, I received the Farber Award, which is awarded annually by the American Association of Neurological Surgeons for excellence in cancer research. In 2014, I received the C. Everett Koop Courage Award for the pursuit of evidence-based medicine.

Q. IN THE COURSE OF YOUR WORK, HAVE YOU DEVELOPED MEDICAL EXPERTISE IN WHETHER ELECTROMAGNETIC FIELDS CAUSE, CONTRIBUTE TO, OR EXACERBATE DISEASES OR OTHER ADVERSE HEALTH EFFECTS?

A. Yes.

Q. WHAT LED YOU TO DEVELOP EXPERTISE IN THAT TOPIC?

A. After I completed my pediatric training at the Boston Children's Hospital at Harvard Medical School, I pursued medical research at NIH where I became interested in cancer research, particularly molecular genetics and neuro-oncology. I continued that work in the Pediatric Branch of the National Cancer Institute (NCI), where I later became head of the Molecular Genetics Section. During that time I also continued to see pediatric cancer patients as an officer in the U.S. Public Health Service. The parents of patients occasionally asked me whether exposure to power lines and electric appliances could be the cause of their child's cancer, so I examined the research, informed them, and continued to follow the research. Later, parents of patients began asking me whether using cellphones could cause cancer, so again I examined the research, informed them, and continued to follow that research. (The research has examined not only cancer but also many other diseases and conditions, and has involved many of the areas in which I teach or have done medical research.) I have continued to systematically follow the research on those topics for more than 30 years.

Q. WHAT ARE YOUR FIELDS OF EXPERTISE THAT ARE RELEVANT TO THIS PROCEEDING?

A. Medicine and medical research, including particularly as related to RF fields and health.

Q. ARE YOU TESTIFYING ON BEHALF OF ANY SCIENTIFIC OR MEDICAL ORGANIZATION WITH WHICH YOU ARE AFFILIATED?

A. No, I am offering my testimony in my individual capacity as a medical doctor and a researcher.

Q. WHAT WERE YOU ASKED TO DO IN CONNECTION WITH THIS PROCEEDING?

A. I was asked to conduct an independent evaluation of the published, peer-reviewed scientific research on radio frequency ("RF") fields and the medical conditions or concerns raised by Ms. Anthony.

MEDICAL EVALUATION

Q. DOES THE AMENDED COMPLAINT FILED BY MS. ANTHONY CLAIM SHE HAS DEVELOPED AN ILLNESS OR MEDICAL CONDITION AS A RESULT OF EXPOSURE TO RF FIELDS FROM AN ADVANCED METERING INFRASTRUCTURE ("AMI") METER BEING USED BY PPL ELECTRIC UTILITIES CORPORATION ("PPL ELECTRIC")?

A. **[BEGIN CONFIDENTIAL]**

[END CONFIDENTIAL]

Q. HAVE YOU EVALUATED ANY MEDICAL RECORDS FOR MS. ANTHONY OR ANYONE LIVING AT HER ADDRESS?

A. **[BEGIN CONFIDENTIAL]**

[END CONFIDENTIAL]

Q. HOW DID YOU CONDUCT YOUR MEDICAL EVALUATION IN THIS MATTER?

A. I conducted standard computerized searches for studies on RF fields and health effects published in peer-reviewed scientific journals. I identified, reviewed and evaluated these studies in the same manner as I evaluate scientific studies in the course of my professional activities. In any large body of laboratory research, such as the hundreds of studies conducted on RF fields, there are likely to be some contradictory findings, with some studies reporting biological effects that cannot be replicated or confirmed in other studies by independent researchers. Replication of claimed results is a key concept in scientific research and when effects are reported it is important to determine if these effects can be reproduced consistently by researchers from other laboratories. Findings reported in any particular study are not considered scientifically reliable in the absence of robust results that can be reproduced by other laboratories. I also considered recent reviews of the studies by public health authorities and their expert panels.

Q. PLEASE SUMMARIZE THE FINDINGS OF YOUR MEDICAL EVALUATION.

A. Many hundreds of studies on RF fields have been published over the past several decades, far too many to describe them each here. Many studies have been conducted to determine

whether RF fields have a causative or contributory role in a wide variety of diseases and conditions. Three groups of controlled laboratory studies of RF fields provide a reliable basis for determining whether RF fields have the capability to cause or contribute to adverse health effects in animals. Those groups of studies are particularly informative because they address fundamental biological functions that are very sensitive to any disruption: genetics, reproduction, and growth and development. Good examples of well-designed and well-conducted studies of this type are Ogawa (2009), Sommer (2009), and Takahashi (2010). In the Ogawa (2009) study, pregnant rats were exposed to RF fields during gestation. No adverse effects of RF exposure were observed on any reproductive and embryo-toxic parameters such as number of live fetuses, dead or resorbed embryos, placental weights, sex ratios, weights or external, visceral or skeletal abnormalities of live fetuses, indicating a lack of detectable genetic damage to the embryos. In the Sommer (2009) study, male and female mice were exposed to RF fields 24 hours a day for their lifetime. Their development and fertility were tracked over four generations by examining histological, physiological, reproductive, and behavioral functions. The result of this 24 hour a day, lifetime exposure over four generations was that the RF fields had no harmful effects on the fertility and development of the animals. In the Takahashi (2010) study, laboratory rats and their offspring were exposed to RF fields for 20 hours a day during gestation and lactation. The study examined the effects of RF fields on growth, gestational condition and organ weights for dams and survival rates, development, physical and functional development, hormonal status, memory function, and reproductive ability of the first generation offspring along with embryo-toxicity and teratogenicity in the second

generation offspring. The study found that the exposures to RF fields had no effects on growth or development.

There is also a substantial collection of controlled animal laboratory studies of whether RF fields cause or contribute to the development of cancer. Good examples of well-done studies are La Regina (2003), Anderson (2004), and Smith (2007). The La Regina (2003) study sought to determine whether long-term exposure to RF fields from cell phones increased the incidence of cancer in laboratory rats. Animals were exposed to RF fields for 2 years and the incidence of cancer was compared to the incidence of cancer in a non-exposed control group. No significant differences were found for any cancer in any organ between the exposed and non-exposed animals, including blood system cancers such as leukemias. The Anderson (2004) study also examined whether cancer incidence in laboratory rats would be affected by exposures to RF fields. Pregnant rats were exposed to RF fields and then 700 of their offspring received additional RF exposures over two years. The RF exposed animals had no increases in tumors or clinical signs of cancer, including leukemias, when compared to non-exposed animals. The Smith (2007) study is another long-term animal study in which more than 1,000 laboratory rats were exposed to RF fields for up to 104 weeks. The researchers found no difference in the incidence of cancer development in the RF exposed animals compared to non-exposed animals. In this study, the bone marrow of the RF exposed animals was examined and no evidence of leukemia was reported.

Based on the body of scientific research showing no consistent and reproducible effects from RF fields on cancer or other adverse health effects, the World Health Organization (WHO) has concluded that "no adverse health effects have been established

as being caused by mobile phone use." Similarly, the US Food & Drug Administration (FDA) has concluded that "the available epidemiological and cancer incidence data continues to support the Agency's determination that there are no quantifiable adverse health effects in humans caused by exposures at or under the current cell phone exposure limits." (Based on the information in Dr. Davis' testimony in this case, the RF exposures from the AMI meters being used by PPL Electric are far lower than the RF from cell phones.)

A number of other public health authorities have examined studies of RF fields and cancer and reach conclusions similar to those of the WHO. These include, for example, the Nordic Radiation Authorities (Denmark, Finland, Iceland, Norway, Sweden) (2009), the International Agency for Research on Cancer (IARC) (2011), the Norwegian Institute of Public Health (2012), Public Health England (2013), the Royal Society of Canada (2014), the New Zealand Ministry of Health (2015, 2018), the European Commission's Scientific Committee on Emerging and Newly Identified Health Risks (2015), the Swedish Radiation Safety Authority – Scientific Council on Electromagnetic Fields (2016, 2018, 2019, 2020), and the Health Council of the Netherlands (2016). My exhibit MI-1 provides additional information on the conclusions reached by these and other public health entities about RF fields and health.

In addition, several U.S. State public health authorities have investigated whether RF fields from smart meters pose any public health risk. These include the Maine Center for Disease Control (2010), the Vermont Department of Health (2012), Arizona Department of Health, Office of Environmental Health (2014), and North Carolina Department of Health and Human Services, Division of Public Health, Occupational and

Environmental Epidemiology Branch (2015). These evaluations by State public health authorities conclude that RF fields from smart meters do not pose a public health risk. There also have been a number of investigations by Public Utility Commissions about the safety of smart meters. My exhibit MI-2 provides additional information on the conclusions reached by these public health entities and public utility commissions about smart meters and health.

In sum, my evaluation of the body of scientific research found no reliable medical basis to conclude that non-thermal RF fields cause or contribute to the development of any diseases or illnesses.

Q. DID IARC OR THE WHO CONCLUDE THAT RF FIELDS FROM SMART METERS CAN CAUSE CANCER?

A. No, they did not. IARC is an agency of the WHO. In 2011, IARC convened a group of scientists to examine whether RF fields cause cancer. The evaluation of this group found that RF fields from mobile phones were "possibly carcinogenic" based on what it described as "limited evidence," but did not find that RF fields from mobile phones were either "carcinogenic" or even "probably carcinogenic" under the IARC classification system. The 2011 IARC review did not classify RF fields from smart meters as being carcinogenic, probably carcinogenic or even possibly carcinogenic. Instead, IARC concluded that for environmental exposures to RF fields, including RF fields from smart meters, the research was "inadequate" to reach conclusions about cancer causation. Later in 2011, the WHO, while acknowledging the IARC finding, issued a statement emphasizing that the scientific research has not established the existence of any adverse effects caused by RF fields used for wireless communications. Thus, the WHO concluded that, "A large number of studies

have been performed over the last two decades to assess whether mobile phones pose a potential health risk. To date, no adverse health effects have been established as being caused by mobile phone use." The WHO did not refer to RF fields from smart meters as being carcinogenic, probably carcinogenic or even possibly carcinogenic.

Q. ARE YOU FAMILIAR WITH THE TERMINOLOGY "ELECTROMAGNETIC HYPERSENSITIVITY"?

A. I am familiar with the terminology, which is sometimes used to characterize a wide-range of self-reported symptoms some people claim are caused by RF fields. These symptoms have been described as including headaches, dizziness, body aches, buzzing in ears, eye floaters, difficulty concentrating, memory loss, sleep disturbance, nausea, abdominal issues, palpitations, nervousness, fatigue, and lethargy, among others. A WHO working group has recommended that these symptoms be described as "Idiopathic Environmental Intolerance", in which "idiopathic" means "cause unknown." This is because, as pointed out by Rubin (2010), the theory of electromagnetic hypersensitivity "is controversial" and "most mainstream medical bodies maintain that there is not sufficient evidence to support this theory and that the symptoms experienced by sufferers are unrelated to the presence of electromagnetic fields." I therefore consider "Idiopathic Environmental Intolerance" (IEI) a more appropriate and medically neutral term to use in a medical evaluation.

Q. WHAT DO THE STUDIES SHOW ABOUT WHETHER IEI IS CAUSED BY EXPOSURE TO RF FIELDS?

A. Reliable studies dating back to at least 2002 and also recent reviews of the studies by experts and reviews by expert panels of public health authorities have found IEI and the variety of symptoms attributed to it are not caused by exposure to RF fields. Studies to

determine whether reporting of symptoms is related to exposure are called "provocation studies." A good example is a study by Hietanen (2002) which examined whether people claiming to be hypersensitive to RF fields could actually sense the presence of fields. The study used a double-blind design in which neither the subjects nor the researchers knew when there was or was not an actual RF exposure. The study found that the subjects reported more symptoms during non-exposure than during actual RF exposure, and that none of the test subjects could distinguish actual RF field exposure from non-exposure. The study concluded that subjective adverse symptoms or sensations perceived by the test subjects were not the result of RF exposure. A later study by Rubin (2010) undertook a systematic review of 46 provocation studies involving 1,175 individuals who reported IEI. The study found that the results of this body of research show that people claiming IEI symptoms from RF fields could not replicate the claimed effect under controlled laboratory conditions. Rubin concluded that "despite the conviction of IEI-EMF sufferers that their symptoms are triggered by exposure to electromagnetic fields, repeated experiments have been unable to replicate this phenomenon under controlled conditions." Another study, Eltiti (2015), was designed to determine if RF fields affected the well-being of individuals who claimed to have electromagnetic hypersensitivity, compared to those who did not. The researchers found that people who claimed electromagnetic hypersensitivity reported lower levels of well-being when they knew they were being exposed to RF fields, but when they did not know if they were being exposed, their reports of symptoms were not associated with RF fields. The researchers concluded that this result "indicates that it is IEI-EMF individuals' belief that exposure to RF EMFs will cause harm, rather than actual exposure itself, that results in the presence of symptoms in IEI-EMF individuals." Other recent

studies (Eltiti 2018, Verrender 2018) have found that individuals who believed they were being exposed to RF fields reported increased subjective health symptoms regardless of whether they were actually exposed to RF fields. This relationship between the belief of exposure and the reporting of symptoms has been described as a "nocebo effect". As the Eltiti (2018) study concluded, "a nocebo effect provides a reasonable explanation for the presence of symptoms in IEI-EMF and control participants."

Q. IS IT GENERALLY ACCEPTED IN THE MEDICAL COMMUNITY THAT IEI AND THE VARIETY OF SYMPTOMS ATTRIBUTED TO IEI ARE CAUSED BY EXPOSURE TO RF FIELDS?

A. No, it is not, based on findings by such public health entities and expert panels as the United Kingdom Health Protection Agency (2012), the Royal Society of Canada (2013), the New Zealand Ministry of Health (2015), and the European Commission's Scientific Committee on Emerging and Newly Identified Health Risks (2015). For example, the New Zealand Ministry of Health (2015) concluded that "Recent reviews of these studies continue to conclude that people who consider themselves unusually sensitive to EMFs are, in fact, unable to detect EMFs, and the occurrence of symptoms appears unrelated to exposures…." Similarly, the European Commission's Scientific Committee on Emerging and Newly Identified Health Risks (2015) found that "The symptoms that are attributed by people to RF EMF exposure can sometimes cause serious impairments to a person's wellbeing. However, research conducted since the previous Opinion adds weight to the conclusion that RF EMF exposure is not the cause of these symptoms. This applies to the general public, children and adolescents, and to people with IEI-EMF. Recent meta-analyses of observational and provocation data support this conclusion." The WHO has

concluded that "There is little scientific evidence to support the idea of electromagnetic hypersensitivity." These findings of these reports from public health entities and expert panels show that the theory of IEI caused by exposure to RF fields has not been generally accepted in the medical community. My exhibit MI-3 provides additional information about the conclusions on IEI by these and other public health entities.

Q. DOES THE SCIENTIFIC RESEARCH SHOW THAT RF FIELDS CAUSE OR CONTRIBUTE TO HIGH BLOOD PRESSURE (HYPERTENSION)?

A. A number of studies have evaluated whether exposure to RF fields causes or contribute to high blood pressure or hypertension. Good examples include Braune (2002), Black (2003), Tahvanainen (2004) and Barker (2007). This body of research does not show that changes in blood pressure and other measures of cardiovascular function are related to RF fields.

Q. BASED ON YOUR MEDICAL EVALUATION, HAVE YOU FORMED AN OPINION ABOUT WHETHER RF FIELDS FROM THE AMI METERS BEING USED BY PPL ELECTRIC CAUSE OR CONTRIBUTE TO HIGH BLOOD PRESSURE (HYPERTENSION)?

A. My medical opinion is that there is no reliable scientific basis to conclude that exposure to RF fields from the AMI meters being used by PPL Electric cause or contribute to high blood pressure or hypertension.

Q. DOES THE SCIENTIFIC RESEARCH SHOW THAT RF FIELDS CAUSE OR CONTRIBUTE TO HEART PALPITATIONS?

A. There have been a number of studies that have examined whether RF fields at the frequencies used by cell phones affect heart rates (Tahvanainen 2004; Nam 2006; Choi 2014). In the Tahvanainen (2004) study, 32 human volunteers were exposed to RF at cell

phone frequencies and their heart rates were compared to their rates when they were not given RF exposures. The study found no significant changes in heart rates when the subjects received RF or sham exposures. In another more recent study, the heart rates of the volunteer subjects and reported heart palpitations were compared after exposure to RF fields at cell phone frequency and after sham exposures (no RF fields) (Choi 2014). The researchers found no significant effects on heart rates or reported palpitations related to the RF exposures.

Q. BASED ON YOUR MEDICAL EVALUATION, HAVE YOU FORMED AN OPINION ABOUT WHETHER RF FIELDS FROM THE AMI METERS BEING USED BY PPL ELECTRIC CAUSE OR CONTRIBUTE TO HEART PALPITATIONS?

A. Yes, my medical opinion is that there is no reliable scientific basis to conclude that exposure to RF fields from the AMI meters being used by PPL Electric cause or contribute to heart palpitations.

Q. DOES THE SCIENTIFIC RESEARCH SHOW THAT RF FIELDS CAUSE OR CONTRIBUTE TO THE DEVELOPMENT OF HAIRY CELL LEUKEMIA?

A. No, the body of research does not provide a reliable scientific basis to conclude that RF fields from AMI meters would cause, contribute to or exacerbate hairy cell leukemia.

Q. [BEGIN CONFIDENTIAL]

[END CONFIDENTIAL] IS THE BIOINITIATIVE REPORT A SCIENTIFIC STUDY THAT WAS PUBLISHED IN A PEER REVIEWED SCIENTIFIC JOURNAL?

A. No, it is not.

Q. ARE YOU AWARE OF ANY CRITICISMS OF THE BIOINITIATIVE REPORT?

A. Yes. The lack of scientific objectivity in the BioInitiative Report has been criticized by a number of public health authorities and expert groups, such as the Health Council of the Netherlands (HCN), which concluded that: "In view of the way the BioInitiative report was compiled, the selective use of scientific data and the other shortcomings mentioned above, the Committee concludes that **the BioInitiative report is not an objective and balanced reflection of the current state of scientific knowledge**. Therefore, the report does not provide any grounds for revising the current views as to the risks of exposure to electromagnetic fields." (Emphasis added) The co-editor of the BioInitiative Report (Dr. Carpenter) has admitted that the document is not a consensus scientific review by an expert panel, and that the authors of the various chapters in the document were selected based on their known beliefs about EMF/RF fields. Additional criticisms from the HCN and other expert groups are provided in my exhibit MI-4. Based on my review of the BioInitiative Report, the significant inconsistency of its findings with those of major science reviews from credible public health entities (as described in my testimony above) and my own evaluation of the scientific research, I agree with those criticisms. The BioInitiative Report does not provide a reliable scientific basis for reaching conclusions about RF fields and health.

Q. ARE YOU AWARE OF THE RF LEVELS ASSOCIATED WITH THE AMI METERS BEING USED BY PPL ELECTRIC?

A. Yes, I have reviewed the information presented in the testimony of Dr. Christopher Davis.

Q. BASED ON YOUR EDUCATION, TRAINING AND EXPERIENCE AS A MEDICAL DOCTOR AND MEDICAL RESEARCHER, HAVE YOU FORMED AN EXPERT OPINION ABOUT WHETHER THE RF FIELDS FROM AN AMI METER BEING USED BY PPL ELECTRIC WILL CAUSE OR CONTRIBUTE TO THE DEVELOPMENT OF ILLNESS OR DISEASE?

A. Yes, I have.

Q. WHAT IS THAT EXPERT OPINION?

A. Based on my medical education, training and experience, and my evaluation of the scientific research, in my expert opinion there is no reliable medical basis to conclude that RF fields from the AMI meter being used by PPL Electric will cause or contribute to the development of illness or disease.

Q. IN YOUR EXPERT MEDICAL OPINION, WILL THE RF FIELDS FROM THE AMI METER BEING USED BY PPL ELECTRIC AT THE ANTHONY RESIDENCE CAUSE OR CONTRIBUTE TO ADVERSE HEALTH EFFECTS?

A. In my expert opinion, there is no reliable medical basis to conclude that RF fields from the AMI meters being used by PPL Electric at the Anthony residence would cause, contribute to, or exacerbate any adverse health effects, **[BEGIN CONFIDENTIAL]**

[END CONFIDENTIAL]

Q. DO YOU HOLD YOUR EXPERT OPINIONS IN THIS CASE TO A REASONABLE DEGREE OF MEDICAL CERTAINTY?

A. Yes, I do.

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

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

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Kathleen R. Anthony	:	
	:	
v.	:	C-2018-3000490
	:	
PPL Electric Utilities Corporation	:	

DIRECT TESTIMONY OF KEVIN DURKIN

PPL Electric Statement No. 3

September 30, 2019

C-2018-3000490
3
6/25/20

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Kevin Durkin, and my business address is 2 N. 9th Street, Allentown, PA 18101.

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 Project Manager on PPL Electric's Meter Replacement Project.

Q. WHAT ARE YOUR DUTIES AS PROJECT MANAGER?

A. I am primarily responsible for managing PPL Electric's Meter Replacement Project Business Integration and Change Management. In this role my responsibilities include, but are not limited to, oversight of internal communications in regards to the meter replacement project across PPL Electric's different business lines. I am also responsible for interacting with PPL Electric's customers who have specific meter replacement question and/or concerns.

Q. WHAT IS YOUR EDUCATIONAL BACKGROUND?

A. I graduated from Muhlenberg College in 2015 with a Bachelor's in Business Administration. I also am currently enrolled in Lehigh University's Master's of Business Administration program.

Q. PLEASE DESCRIBE YOUR PROFESSIONAL EXPERIENCE.

A. I have been employed by PPL Electric since January 2004 in several positions. I have been employed in my current role as a Project Manager for PPL Electric from December 2014 to the present. Before that, I was a Supervisor Technical Training from July 2013 to December 2014, a Supervisor Field Training from April 2010 to July 2013, and a Transmission and Distribution ("T&D") Field Manager from November 2009 to April 2010. I also held various T&D foreman positions for PPL Electric's Lehigh Region from August 2006 to November 2009 and was a journeyman lineman for PPL Electric from January 2004 to August 2006. Prior to being employed by PPL Electric, I worked in various journeyman lineman positions for PECO Energy Company from May 1987 to January 2004.

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

A. Yes, I have testified in other Commission proceedings involving the Company's new automated metering infrastructure ("AMI") meters.

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

A. My testimony will: (1) provide an overview of the Formal Complaint filed in this proceeding; (2) describe the Company's communications policies concerning the deployment of the new AMI meters as well as provide details on the customer communications between PPL Electric and Kathleen R. Anthony ("Complainant"); (3) explain the Company's policies and practices related to collecting data from the new

AMI meters and protecting that data from unauthorized access or public disclosure; (4) address issues related to termination of service if the Company is denied reasonable access to its AMI meter; and (5) explain the tariff provisions governing the relocation of the Company's meter to an alternate location.

Q. ARE YOU SPONSORING ANY EXHIBITS WITH YOUR TESTIMONY?

A. Yes, I am sponsoring the following exhibits:

- PPL Electric Exhibit KD-1 – The Company's account contact history for the Complainant's account;
- PPL Electric Exhibit KD-2 – PPL Electric's AMI Program Communications Plan;
- PPL Electric Exhibit KD-3 – PPL Electric's AMI Customer Privacy Policy;
- PPL Electric Exhibit KD-4 – Rule 2(F) of PPL Electric's tariff;
- PPL Electric Exhibit KD-5 – Rule 10(B)(2)(g) of PPL Electric's tariff; and
- PPL Electric Exhibit KD-6 – Rule 4(I)(2) of PPL Electric's tariff.

A. OVERVIEW OF COMPLAINT

Q. HAVE YOU REVIEWED THE FORMAL COMPLAINT FILED BY THE COMPLAINANT?

A. Yes.

Q. WOULD YOU PLEASE GENERALLY DESCRIBE THE ISSUES RAISED IN THE COMPLAINT?

A. The Complainant is contesting the planned installation of the Company's new AMI meter at her service address. As described in the written testimony of Donald Vinciguerra (PPL Electric Statement No. 4), the Complainant currently has a powerline carrier ("PLC") meter installed at her property. Pursuant to Act 129 of 2008 ("Act 129"), orders issued by the Pennsylvania Public Utility Commission ("Commission"), and PPL Electric's Commission-approved Smart Meter Plan, the Company must replace the existing PLC meter with the new AMI meter. The Complainant also has raised allegations regarding the existing PLC meter.

B. CUSTOMER COMMUNICATIONS

Q. IN YOUR POSITION, ARE YOU FAMILIAR WITH THE COMMUNICATIONS BETWEEN THE COMPLAINANT AND PPL ELECTRIC'S CUSTOMER SERVICE REPRESENTATIVES?

A. Yes, I am. As the Project Manager for Business Integration and Change Management, I oversee communications with both internal and external stakeholders, which includes communications with PPL Electric's customers related to the AMI meters. Therefore, in my position with PPL Electric, I am very familiar with the Company's communications with the Complainant.

Attached to my testimony as PPL Electric Exhibit KD-1 is a copy of the Company's account contact history for the Complainant's account. This is a Company record that details activities on the account as well as communications between PPL Electric's customer service representatives and the Complainant. The account contact history is made at or near the time of customer contacts by someone with knowledge, the

record is kept in the regular course of PPL Electric's business, and the making of this record is a regular practice of the Company.

Q. DOES THE COMPANY HAVE ESTABLISHED POLICIES FOR COMMUNICATING WITH CUSTOMERS ABOUT THE INSTALLATION OF NEW AMI METERS?

A. Yes. Pursuant to the Commission's September 3, 2015 Order approving PPL Electric's Smart Meter Plan at Docket No. M-2014-2430781, the Company filed an "AMI Program Communications Plan" on January 15, 2016. In general, the AMI Program Communications Plan outlines the processes by which PPL Electric will communicate with stakeholders and customers about the deployment of the Company's new AMI meters. A copy of the AMI Program Communications Plan is attached hereto as PPL Electric Exhibit KD-2.

Q. WOULD YOU EXPLAIN THE NOTIFICATIONS SENT TO CUSTOMERS UNDER THE AMI PROGRAM COMMUNICATIONS PLAN?

A. Of course. As seen on pages 13 through 15 of the AMI Program Communications Plan, there are several notifications sent to customers before the new AMI meter is installed. Approximately 45 days before the meter replacement, a letter is sent to the customer notifying him or her of the planned replacement. This is generally referred to as the six-week letter. Then, approximately 21 days before the meter replacement, another letter is sent to the customer about the planned replacement. This is generally referred to as the three-week letter. Aside from these letters, an automated phone call is made to customer

one day before the meter replacement, which also notifies the customer about the meter replacement.

Q. WERE THE SIX-WEEK AND THREE-WEEK LETTERS YOU MENTIONED SENT TO THE COMPLAINANT?

A. Yes. As seen on page 1 of the account contact history (PPL Electric Exhibit KD-1), the Complainant was sent the six-week and three-week letters on October 9, 2017, and October 30, 2017, respectively.

Q. BASED ON YOUR REVIEW OF THE COMPLAINANT'S ACCOUNT CONTACT HISTORY, HAS PPL ELECTRIC COMPLIED WITH ITS ESTABLISHED COMMUNICATIONS POLICY?

A. Yes.

C. COLLECTION AND PROTECTION OF CUSTOMER DATA

Q. DOES PPL ELECTRIC HAVE ESTABLISHED POLICIES RELATED TO THE INFORMATION GATHERED FROM THE NEW SMART METERS?

A. Yes. On July 20, 2016, as a part of its Smart Meter Plan proceeding, PPL Electric filed its "AMI Customer Privacy Policy." This policy generally describes: (1) the data collected by the new AMI meters and network ("AMI Data"); (2) the steps taken by PPL Electric to protect the AMI Data; and (3) the ways in which the Company uses AMI Data. A copy of the AMI Customer Privacy Policy is attached hereto as PPL Electric Exhibit KD-3.

Q. WHAT AMI DATA DOES THE COMPANY COLLECT?

A. PPL Electric collects electric usage data and significant event information, such as outages, voltage, heat alarms and meter tampering alerts. The AMI Data does not contain any personally identifiable information, such as the customer's name, account number, phone number, or address. The AMI Data also does not contain any information about natural gas or water usage at the premises.

Q. DOES THE COMPANY COLLECT ANY SPECIFIC INFORMATION ABOUT THE USE OF AN INDIVIDUAL APPLIANCE AT THE PREMISES?

A. No. The Company only collects information about the total electric usage at the premises. The information does not differentiate between the use of any specific appliance or appliances.

Q. HOW DOES THE COMPANY PROTECT THE AMI DATA FROM UNAUTHORIZED ACCESS OR PUBLIC DISCLOSURE?

A. AMI Data transmitted over the AMI network is secured from intrusion by third parties through PPL Electric's security policies, which include the use of several technologies and practices, such as firewalls, encryption, digital signatures, authentication, and access controls. Further details on the Company's cybersecurity and privacy practices and protocols are addressed in the written testimony of Don Vinciguerra (PPL Electric Statement No. 4).

Q. IN WHAT WAYS DOES THE COMPANY USE THE AMI DATA?

A. As stated in PPL Electric's AMI Customer Privacy Policy, PPL Electric uses the AMI Data for business purposes, including, but not limited to: (1) calculating customers' bills; (2) providing necessary information to authorized electric generation supplier and/or third party representatives; (3) sharing with each customer so the customer can understand his or her bills, electric consumption, and energy analytics; (4) supporting power outage analysis and restoration; (5) supporting distribution operations by providing more detailed load and voltage data; (6) supporting data analysis to determine aggregated historical peak loads on distribution transformers and conductors; (7) aggregating data by retail electricity provider to settle the wholesale market; and (8) supporting revenue protection activities. Further, PPL Electric does not share AMI Data, except as required or permitted by law, regulatory agencies, or governmental authorities.

Q. HAS THE COMPANY BEEN COMPLYING WITH ITS AMI CUSTOMER PRIVACY POLICY?

A. Yes. The Company follows all of the practices and procedures outlined in the AMI Customer Privacy Policy.

D. TERMINATION OF SERVICE

Q. HAS THE COMPANY EVER SENT THE COMPLAINANT A TERMINATION NOTICE IN CONNECTION WITH THE COMPANY'S METER REPLACEMENT?

A. No.

Q. WOULD PPL ELECTRIC BE PERMITTED TO ISSUE THE COMPLAINANT A TERMINATION NOTICE IF SHE DENIES THE COMPANY REASONABLE ACCESS TO ITS METER?

A. I have been advised by counsel that the Company would be permitted to issue a termination notice if it is denied reasonable access to its meter. As stated in Rule 2(F) from the Company's Commission-approved tariff, "Company employees shall have access at all reasonable hours to customer's premises, without charge, for the purpose of inspecting installations, installing meters, reading, testing, removing, replacing or otherwise maintaining or disposing of any of Company's property." A copy of Rule 2(F) is attached hereto as PPL Electric Exhibit KD-4.

Further, Rule 10(B)(2)(g) of PPL Electric's tariff states that the Company is authorized to terminate service when: (1) its "representatives cannot gain admittance or are refused admittance to the premises for the purpose of reading meters, making repairs, making inspections, or removing Company property"; (2) "the customer interferes with Company representatives in the performance of their duties; or (3) "the meters or other equipment of the Company are not accessible during reasonable hours." I have been advised by counsel that this tariff provision is consistent with both Section 1406(a)(4) of the Public Utility Code, 66 Pa. C.S. § 1406(a)(4), and Section 56.81(3) of the Commission's regulations, 52 Pa. Code § 56.81(3). A copy of Rule 10(B)(2)(g) is attached hereto as PPL Electric Exhibit KD-5.

E. ALTERNATE METER LOCATION

Q. WOULD PPL ELECTRIC BE WILLING TO RELOCATE THE NEW AMI METER TO AN ALTERNATE LOCATION?

A. Yes, PPL Electric would be willing to relocate the new AMI meter to an alternate location if there is a location that is mutually-acceptable to both the Company and the Complainant. However, my understanding is that the Company's Commission-approved tariff would require the Complainant to bear the expenses associated with relocating the meter's location. Although the meter is owned by the Company, the customer owns the meter base and the facilities beyond the point of interconnect. Therefore, the customer would have to bear the costs of extending the customer-owned facilities to a new location. As for the Company-owned facilities, my understanding is that the customer would have to bear the estimated expenses of relocating those facilities. Specifically, Rule 4(I)(2) of the Company's tariff states, "The relocation of Company facilities, when done at the request of others, is at the applicant's expense and payment of the Company's estimated cost of the relocation is required in advance of construction. When the request is from an affected property owner and the facilities are on the customer's property, the charges for relocation of distribution system facilities are limited to estimated contractor costs, estimated direct labor and estimated material costs, less an amount equal to any estimated maintenance expense avoided as a result of the relocation." A copy of Rule 4(I)(2) is attached hereto as PPL Electric Exhibit KD-6.

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

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

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Kathleen R. Anthony	:	
	:	
v.	:	C-2018-3000490
	:	
PPL Electric Utilities Corporation	:	

DIRECT TESTIMONY OF DONALD VINCIGUERRA

PPL Electric Statement No. 4

September 30, 2019

C-2018-3000490
4
6/25/20

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Donald Vinciguerra, and my business address is 2 North 9th Street, Allentown, PA 18101.

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 Project Manager.

Q. WHAT IS YOUR EDUCATIONAL BACKGROUND?

A. I have a Bachelor of Science degree in electrical engineering technology from Pennsylvania State University.

Q. PLEASE DESCRIBE YOUR PROFESSIONAL EXPERIENCE.

A. I have been employed by PPL Electric for approximately 18 years. I have been in my current position for the past 4 years. Prior to that, I led PPL Electric's automation team for three years, where I was responsible for building the Company's distribution automation program. Prior to that, I spent 8 years working for corporate information technology ("IT") as a supervisor of network operations. I also spent 3 years working for PPL Telcom.

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

A. Yes, I have testified in other formal complaint proceedings related to PPL Electric's automated metering infrastructure ("AMI") meters.

Q. WHAT ARE YOUR DUTIES AS A PROJECT MANAGER?

A. My primary responsibility is to oversee the construction and installation of the AMI Radio Frequency ("RF") Mesh network. This includes communications from the new RF Mesh meters back to PPL Electric's head end systems. I also oversee the Company's removal of the old Power Line Carrier ("PLC") system.

Q. HAVE YOU REVIEWED THE FORMAL COMPLAINT FILED BY KATHLEEN R. ANTHONY ("COMPLAINANT")?

A. Yes.

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

A. My testimony will: (1) provide details on the development and implementation of PPL Electric's Smart Meter Technology Procurement and Installation Plan ("Smart Meter Plan"), under which the Company must replace its existing PLC meters with RF Mesh meters; (2) explain the Company's policies and practices related to protecting data transmitted by the RF Mesh meters from unauthorized access or public disclosure; (3) address issues related to the safety of the RF Mesh meters, including fire safety; (4) address the accuracy of the RF Mesh meters; and (5) address allegations about the RF Mesh meters connecting with customers' appliances.

Q. ARE YOU SPONSORING ANY EXHIBITS WITH YOUR TESTIMONY?

A. Yes, I am sponsoring PPL Electric Exhibit DV-1, which is a copy of PPL Electric's Commission-approved Smart Meter Plan.

A. SMART METER PLAN

Q. WOULD YOU PLEASE DESCRIBE THE COMPANY'S SMART METER PLAN?

A. The Company's Smart Meter Plan is a Commission-approved plan under which PPL Electric must deploy the new RF Mesh meters and metering system. Specifically, the Smart Meter Plan sets forth details on the procurement and deployment of the new RF Mesh meters and metering system, including, among other things, technology assessment, implementation, data privacy, cybersecurity, and vendor management. A true and correct copy of the Company's Commission-approved Smart Meter Plan is attached hereto as PPL Electric Exhibit DV-1.

Q. WOULD YOU PLEASE PROVIDE SOME BACKGROUND THAT LED TO THE FILING AND APPROVAL OF THE SMART METER PLAN?

A. Of course. The Company originally deployed AMI meters and metering system between 2002 and 2004. These AMI meters were a part of the PLC metering system.

On November 14, 2008, Act 129 of 2008 became effective and required electric distribution companies ("EDCs") to file smart meter technology procurement and installation plans with the Commission within nine months. On June 24, 2009, the Commission issued its *Smart Meter Implementation Order*, which set forth requirements

for the smart meter plans and procedures for the submission, review, and approval of the smart meter plans. *See Smart Meter Procurement and Installation*, Docket No. M-2009-2092655 (Order entered June 24, 2009).

On August 14, 2009, PPL Electric filed its initial Smart Meter Plan in compliance with Act 129 and the Commission's *Smart Meter Implementation Order*. The Company contended that its existing PLC system met the requirements under Act 129 and the *Smart Meter Implementation Order*. However, the Commission held that PPL Electric's existing PLC meters did not fully meet these requirements. *See Petition of PPL Electric Utilities Corporation for Approval of Smart Meter Technology Procurement and Installation Plan*, Docket No. M-2009-2123945, p. 24 (Order entered June 24, 2010) ("*2010 Smart Meter Order*"). Accordingly, the Commission directed PPL Electric to develop a new Smart Meter Plan that would deploy new AMI technology that fully met these requirements. *See id.*

On June 30, 2014, PPL Electric filed its new Smart Meter Plan intended to comply with all the requirements of Act 129 and the Commission's *Smart Meter Implementation Order*. To meet these requirements, the Company proposed RF Mesh meters and metering system. On September 3, 2015, the Commission entered its Opinion and Order approving the new Smart Meter Plan, as modified, finding that unlike the Company's existing PLC meters, the new RF Mesh meters met the requirements of Act 129 and the Commission's *Smart Meter Implementation Order*. *See 2015 Smart Meter Order*.

Q. WERE YOU INVOLVED IN THE DEVELOPMENT OF THE INITIAL AND FINAL SMART METER PLANS?

A. Yes, I was.

Q. WOULD YOU PLEASE DESCRIBE THE PLC METERS THAT WERE INSTALLED PRIOR TO THE NEW AMI METERS?

A. Sure. The PLC meters, often referred to by customers as "analog meters," utilize the power lines as a means of communication. Specifically, a pulse from the PLC meter is encoded on the 60 Hertz ("Hz") line frequency, which identifies the designated meter as well as that meter's energy consumption data so that the Company can record the data to the proper account. I note that the PLC meters do not emit RF fields because they do not contain a radio transmitter. Also, PPL Electric installed the PLC meter for the Complainant's account on October 21, 2002.

Q. WOULD YOU PLEASE DESCRIBE THE NEW RF MESH METERS BEING DEPLOYED BY THE COMPANY?

A. Unlike PPL Electric's previous PLC system that used the customer's actual wires, the RF Mesh meters enable the Company to receive data from the customer's meter wirelessly. The individual RF Mesh meters are used as relay points to transmit data back to PPL Electric utilizing a 900 megahertz ("MHz") frequency. The RF Mesh meters will only transmit for approximately 84 seconds per day total with durations of individual transmissions lasting only milliseconds. These transmissions will include data such as daily energy consumption and 15 minute interval load profile data, which include metrics

like temperature and voltage. Also, the transmissions can include alarms/alerts that indicate power outage/restoration notices or overheating warnings. For the Complainant, the specific model of the new RF Mesh meters that will be installed is the Landis + Gyr E350 FOCUS AXR-SD meter. The Federal Communications Commission ("FCC") ID for the new AMI meter is R7PEG1R1S2.

Q. WOULD YOU PLEASE DESCRIBE THE PERIOD IN WHICH THE NEW RF MESH METERS WILL BE DEPLOYED?

A. PPL Electric completed its IT functions related to the new AMI meters around the third quarter of 2016. The Company is currently in its deployment phase for the new AMI meters, which began in 2017. Under the Smart Meter Plan, PPL Electric is scheduled to finish its deployment of the new AMI meters in 2019.

Q. IS PPL ELECTRIC ALLOWED TO INSTALL ANY OTHER TYPE OF METER BESIDES THE RF MESH METER UNDER ITS SMART METER PLAN?

A. No. I have been advised by counsel that PPL Electric must install the RF Mesh meters pursuant to its Commission-approved Smart Meter Plan.

B. PROTECTION OF CUSTOMER DATA

Q. ARE YOU FAMILIAR WITH THE COMPANY'S PRACTICES AND PROTOCOLS RELATED TO THE PROTECTION OF CUSTOMER DATA COLLECTED THROUGH THE NEW AMI METERS?

A. Yes. Safeguarding the customer's data starts right at the meter. As the project manager involved in evaluating the AMI technology, it was my responsibility to ensure the meters and communication protocol met or exceeded all national standards. I was highly involved in the creation of PPL Electric's cybersecurity policy, ensuring the new AMI network met or exceeded industry standards for cybersecurity.

Q. WOULD YOU PLEASE DESCRIBE THE COMPANY'S PRACTICES AND PROTOCOLS RELATED TO THE PROTECTION OF CUSTOMER DATA COLLECTED THROUGH THE NEW AMI METERS?

A. Cybersecurity was one of the cornerstones of PPL Electric's Smart Meter Plan. As referenced in Mr. Durkin's testimony, PPL Electric takes several steps to protect against unauthorized public disclosure or access to the AMI data, which include the use of technologies such as firewalls, encryption, digital signatures, authentication and access controls. Data collected within the meters is protected through proprietary-based applications and five levels of password protection. Prior to transmission, the data is highly encrypted utilizing advanced security appliances. Once the data reaches the Company's head systems, the data is further protected through means of firewalls and user role functions. These user role functions limit the availability of data and functions to only what the user's job requires, and even within these roles, the user is only granted a security key that allows access for that day.

Q. WHAT IS A FIREWALL?

A. A firewall is defined as a part of a computer system or network that is designed to block unauthorized access while permitting outward communication.

Q. WHAT IS ENCRYPTION?

A. Encryption is defined as the process of converting information or data into a code, especially to prevent unauthorized access.

Q. ARE THE COMPANY'S CYBERSECURITY POLICIES AND PRACTICES CONSISTENT WITH THE NATIONAL STANDARD FOR THE INDUSTRY?

A. Absolutely.

C. SAFETY AND FIRE CONCERNS

Q. WOULD YOU PLEASE COMMENT ON ALLEGATIONS THAT THE NEW AMI METERS POSE SAFETY AND FIRE CONCERNS?

A. Of course. First, I observe that the new AMI meters meet the standards issued by the American National Standards Institute ("ANSI") and Underwriters Laboratories ("UL"), specifically ANSI C12.10 and UL 2735. Second, when selecting the new AMI meter, safety was a paramount concern of PPL Electric. Accordingly, the Company held the new AMI meters to a higher standard than the national standards and even conducted independent testing with a third party of the potential new AMI meters. The Landis + Gyr RF Mesh meter selected by the Company was the best performer in all of these tests and met PPL Electric's stringent requirements. The testing was mainly designed around

the meter baseplate material and its capacity to withstand a temperature equal or greater than 160 degrees Celsius.

Q. WOULD YOU PLEASE COMMENT ON ALLEGATIONS THAT AMI METERS HAVE CAUSED OR CONTRIBUTED TO FIRES?

A. Yes. Through the Company's testing, PPL Electric was able to determine and simulate the root cause of the vast majority overheating issues. It was determined as a loose or broken connection within the customer-owned meter base. To establish a connection between the customer-owned meter base and the Company-owned meter, the meter has metal blades that are inserted into spring loaded jaws within the customer's meter base. Over time, these jaws may become bent or broken creating air gaps that would yield improper electrical connection. Under certain conditions, these air gaps would create micro-arcing and lead to an elevation of temperature.

Q. HAS THE COMPANY TAKEN ANY STEPS TO ADDRESS POTENTIAL ISSUES WITH LOOSE OR BROKEN CONNECTIONS BETWEEN THE METER BASES AND METER JAWS?

A. Yes. The Company has expanded its inspection criteria and trained its installers to perform enhanced inspections that include: (1) checking for signs of wear or detachment on the customer's facility; (2) carefully removing the meter ensuring facility hardware is intact; (3) inspecting the removed meter for signs of pitting or discoloration (an indication of micro-arcing); (4) inspecting the meter base's jaws for signs of pitting, discoloration, or separation; and (5) inspecting the meter and meter base generally for

loose and broken parts and tightness. Moreover, as mentioned previously, PPL Electric tested the AMI meters' baseplate material to ensure they could withstand a temperature equal or greater than 160 degrees Celsius, in case any micro-arcing were to occur.

Q. ARE THE AMI METERS BEING DEPLOYED BY PPL ELECTRIC EQUIPPED WITH ANY SOFTWARE OR MECHANISMS THAT ADDRESS ISSUES WITH OVERHEATING?

A. Yes. The meter's temperature is sent to the Company in 15-minute intervals. PPL Electric monitors the meter's temperature data, so it can track the meter's temperature and identify any current issues or problematic trends. Moreover, there is a heat alarm, so when the temperature of the meter hits an established 85 degree Celsius level, the Company is alerted of the issue. When PPL Electric determines there may be an issue or when the heat alarm is triggered, the Company dispatches personnel to investigate. I note that the Complainant's currently-installed PLC meter does not have these capabilities.

Q. ARE YOU AWARE OF ANY FIRES BEING CAUSED BY THE LANDIS + GYR E350 FOCUS AXR-SD METER?

A. No. PPL Electric has deployed over 1 million of these meters in its service territory, and I am aware of none of them causing any fires.

Q. IS IT YOUR POSITION THAT THE NEW AMI METERS POSE ANY SAFETY OR FIRE HAZARDS?

A. Absolutely not.

D. ALLEGATIONS OF INACCURATE BILLING

Q. WOULD YOU PLEASE COMMENT ON ALLEGATIONS THAT THE NEW AMI METERS INACCURATELY RECORD ELECTRIC USAGE AND INCREASE CUSTOMERS' BILLS?

A. These allegations are incorrect. In fact, the new AMI meters are more accurate than analog meters. Specifically, an analog meter uses a mechanical dial to record electric usage, which can slow over time. This leads to the meter under-recording the usage that is consumed at the property. In contrast, the Company's new AMI meters use a digital process to record the electric usage, which does not deteriorate over time. Therefore, when the analog meters are replaced with the new AMI meters, customers may incorrectly perceive the AMI meters as over-recording their usage, when in reality the analog meters were under-recording the customers' usage. Moreover, all of the new AMI meters are tested for accuracy before being deployed in the field, and customers can request a meter test pursuant to the Commission's regulations and the Company's tariff if they believe the meter is recording usage inaccurately.

E. ALLEGATIONS ABOUT THE METERS CONNECTING WITH CUSTOMERS' APPLIANCES

Q. WOULD YOU PLEASE COMMENT ON ALLEGATIONS THAT THE NEW AMI METERS WILL CONNECT WITH CUSTOMERS' APPLIANCES?

A. The new AMI meter does come equipped with a 2.4 gigahertz ("GHz") ZigBee radio, which, if activated, enables the meter to connect with a customer's specific ZigBee enabled devices through a home area network ("HAN"). However, the meter can only

transmit the total power that is consumed through the meter. It cannot independently calculate or transmit specific information concerning individual devices in the home. Moreover, the ZigBee radio is only turned on upon customer request. Therefore, if a customer does not want to enable this functionality, the customer can simply choose to never have the Company activate the ZigBee radio.

Q. WOULD THE COMPANY KNOW WHICH APPLIANCE IS USING ELECTRICITY EVEN IF THE ZIGBEE RADIO IS ACTIVATED?

A. No. As explained in Kevin Durkin's direct testimony (PPL Electric Statement No. 3), the AMI meter only collects the total electric usage at the service address. It does not distinguish between which appliances are being used by the customer. Only the customer would have access to this type of information through the use of the HAN, which could calculate the difference in power consumption as individual appliances are turned on and off.

Q. WOULD THE COMPANY BE ABLE TO CONTROL A CUSTOMER'S APPLIANCE EVEN IF THE ZIGBEE RADIO IS ACTIVATED?

A. No.

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

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