BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Alan Schmukler	:	
	:	
v.	:	C-2017-2621285
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PPL Electric Utilities Corporation	:	

DIRECT TESTIMONY OF CHRISTOPHER C. DAVIS, Ph.D.

PPL Electric Statement No. 1

February 15, 2018

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 71 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 252 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.

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 CD1 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. 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. MR. SCHMUKLER SAYS THAT THE RF FIELDS FROM THE AMI METER BEING USED BY PPL ELECTRIC ARE "PULSED" FIELDS. 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. 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). Based on scientific studies those expert organizations analyzed, both organizations identified the same 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. The FCC continues to consider whether there are adverse biological effects from non-thermal RF exposure levels. The FCC states that the scientific evidence for adverse biological effects from non-thermal RF exposure levels remains "ambiguous and unproven."

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 CD2 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 CD3 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 CD2 are the appropriate measure, and these are 98,000 times lower than the FCC limits.

Q. MR. SCHMUKLER SAYS HE MEASURED RF FIELDS OF "UP TO 0.18 WATTS/METER SQUARED" FROM HIS NEIGHBOR'S AMI METER. HOW DOES THAT LEVEL COMPARE TO THE FCC'S EXPOSURE LIMIT?

A. The peak RF field Mr. Schmukler reports having measured (0.18 Watts/meter squared, which converts to 0.018 mW/cm^2) is 33 times lower than the FCC exposure standard of 0.6 mW/cm^2. Based on the levels reported by Mr. Schmukler, it appears he made his measurements by holding his meter within several inches of the AMI meter. It also appears Mr. Schmukler used a "Cornet ED88T" meter for his measurements. This is a low-cost consumer grade device that is marketed for around $170 on some anti-smart meter activist websites. The meter has the words "ElectroSmog meter" stamped on its housing. This is not a professional quality RF survey meter (which can cost $5,000 or more). Even with professional quality meters in a controlled laboratory setting, it is challenging to measure very short duration (thousandths of a second) RF fields, such as those from the AMI meter being used by PPL Electric. I consider the RF field calculations I made based on the AMI meter's known RF output levels to be a more reliable assessment of the RF exposure.

Q. MR. SCHMUKLER SAYS THAT "SMART METERS BEING ON 24 HRS PER DAY EXPOSE RESIDENTS TO 160 TIMES THE RADIATION OF A CELL PHONE." IS HE CORRECT?

A. No, he is not. The RF exposure from the AMI meter being used by PPL Electric is of very short duration (a total of 84 seconds over 24 hours) and not a constant exposure. As my exhibit CD4 shows, the RF exposure from a cell phone used at the head is 260,000 times higher than the average RF levels 1 meter from the AMI meter being used by PPL Electric. Mr. Schmukler's statement is based on the Hirsch document identified as Mr. Schmukler's exhibit 15. I have reviewed Mr. Schmukler's exhibit 15. It is not a peer-reviewed scientific study, it is not even a complete copy of the Hirsch document and it does not provide data to substantiate the highly inaccurate overestimation of RF exposures from a smart meter (an overestimation by multiple thousands of times).

Q. MR. SCHMUKLER CLAIMS THAT THE AMI METER BEING USED BY PPL ELECTRIC WILL "PLACE HIGH FREQUENCY VOLTAGE TRANSIENTS ON HOUSE WIRING ENDANGERING OCCUPANTS." IS HE CORRECT?

A. No, he is not. The AMI meter being used by PPL Electric does not generate electrical power, does not produce additional harmonics over and above what is already coming into the meter, and does not interfere with the operation of house wiring. The AMI meter measures the electrical power flowing into and being used in a building, and in that regard behaves no differently than older mechanical meters. The very low amplitude RF signals generated by the power supplies in modern electronics are largely filtered out and are heavily attenuated by resistance when they try to travel along house wiring. That is why, when we want to transmit RF signals for cable TV, we use coaxial cables and not

ordinary house wiring. Typical household appliances can generate RF fields that are much larger than those generated by AMI meters.

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 CD4 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 CD4 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 CD4 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 IN LEOLA, PENNSYLVANIA?

A. There are eight television broadcast towers within a radius of 50 miles of Leola that use RF fields to transmit UHF television signals to that part of Lancaster 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 Leola and which therefore exist as background levels of RF fields in Leola. My exhibit CD5 shows that the RF fields at 3 meters from the AMI meter being used by PPL Electric are 16.7 times smaller than the background RF exposure from UHF TV broadcasting at 199 Strawberry Street, where Mr. Schmukler resides.

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 in Leola, Pennsylvania.

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.

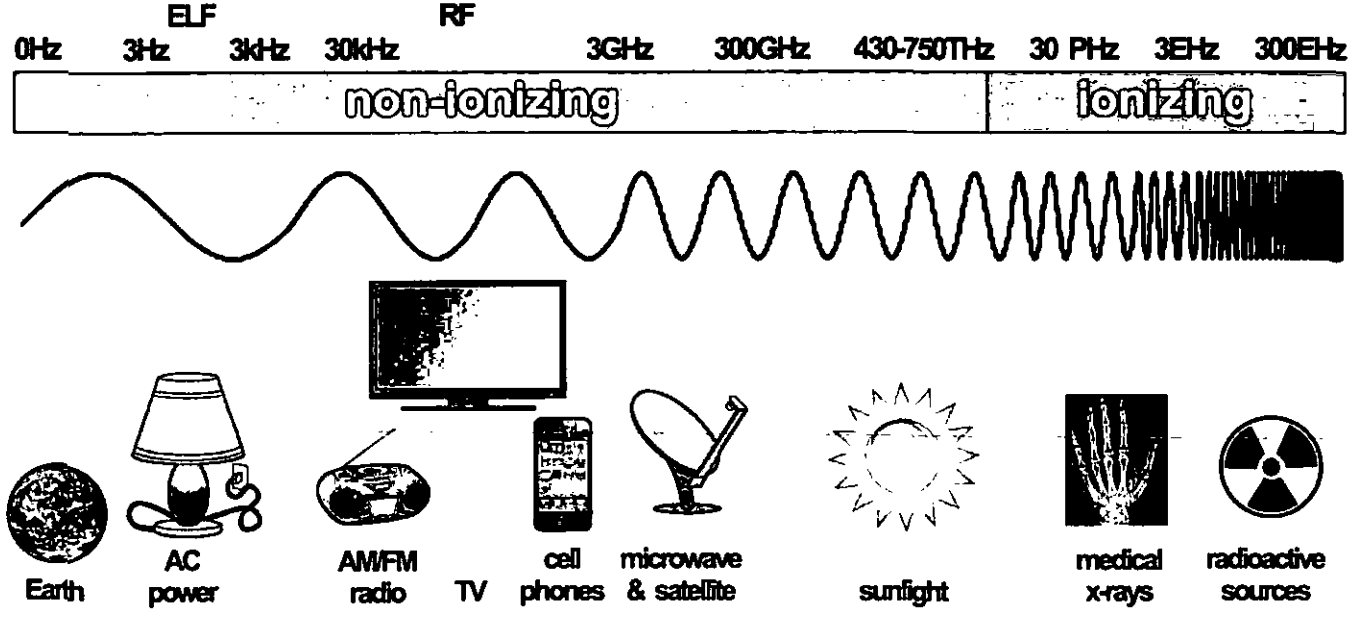
Q. DO YOU HOLD THE OPINIONS SET FORTH IN YOUR TESTIMONY TO A REASONABLE DEGREE OF SCIENTIFIC CERTAINTY?

A. Yes, I do.

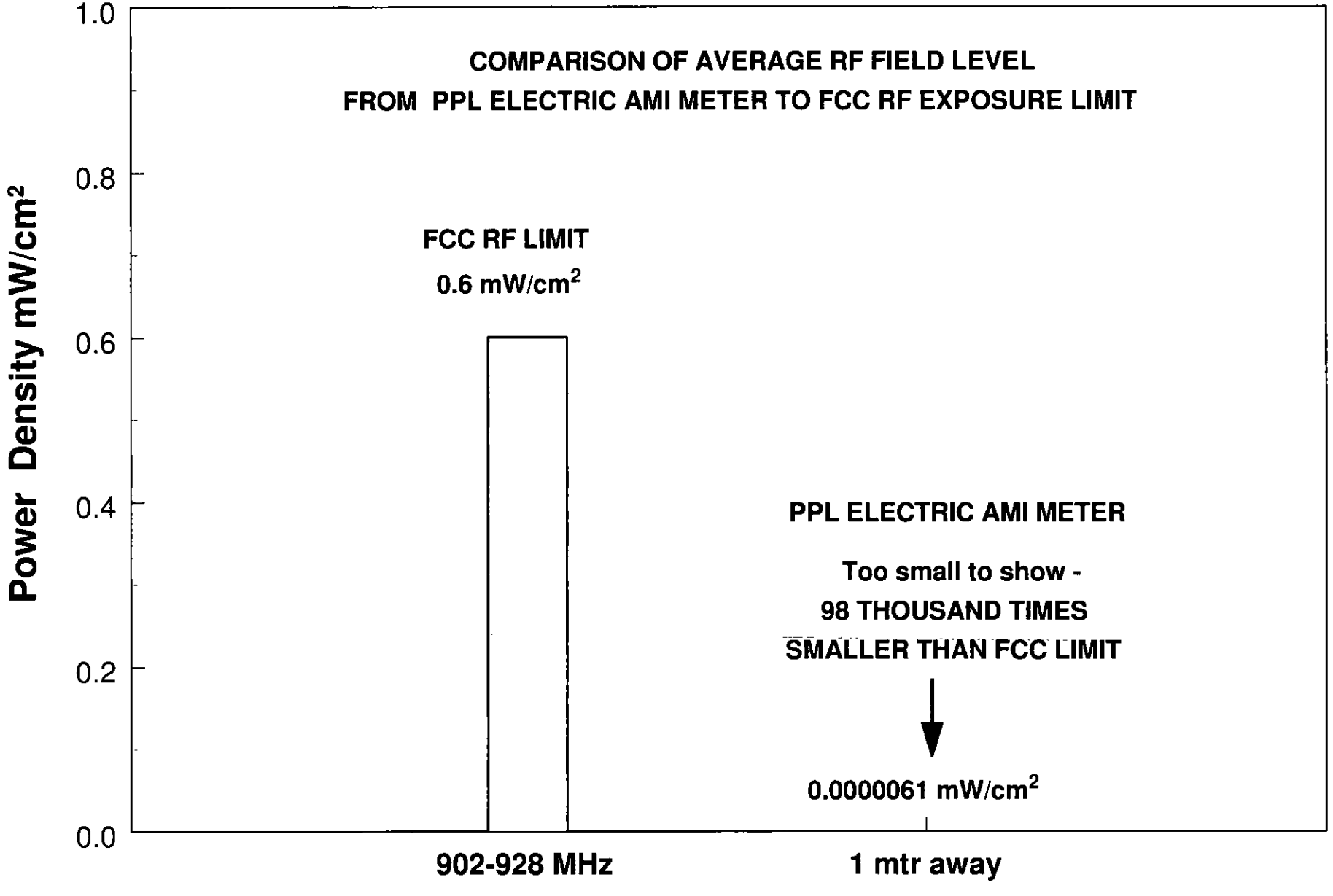
Q. DOES THAT CONCLUDE YOUR DIRECT TESTIMONY AT THIS TIME?

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

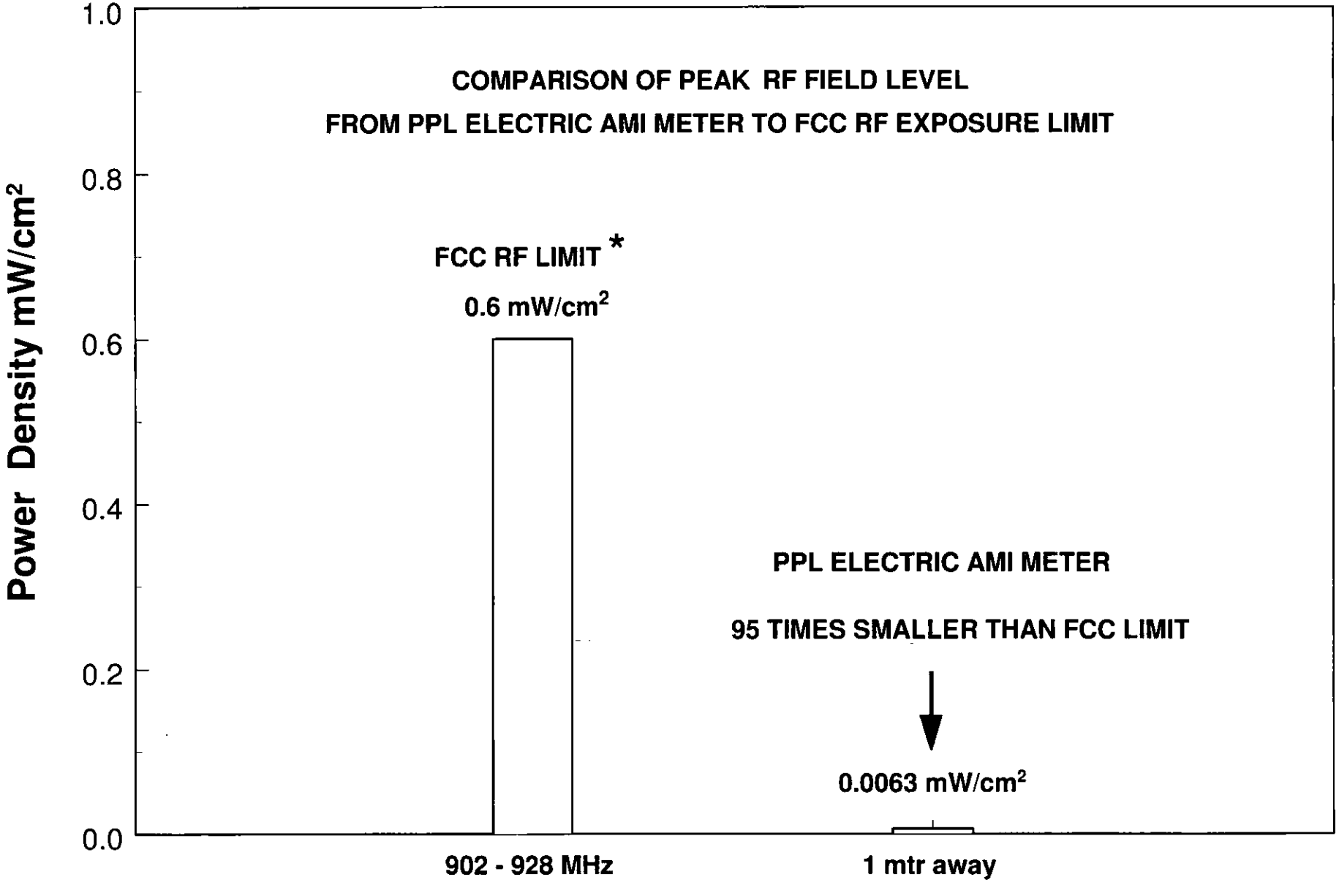
THE ELECTROMAGNETIC SPECTRUM



PPL Electric Exhibit CD1 - Schmukler

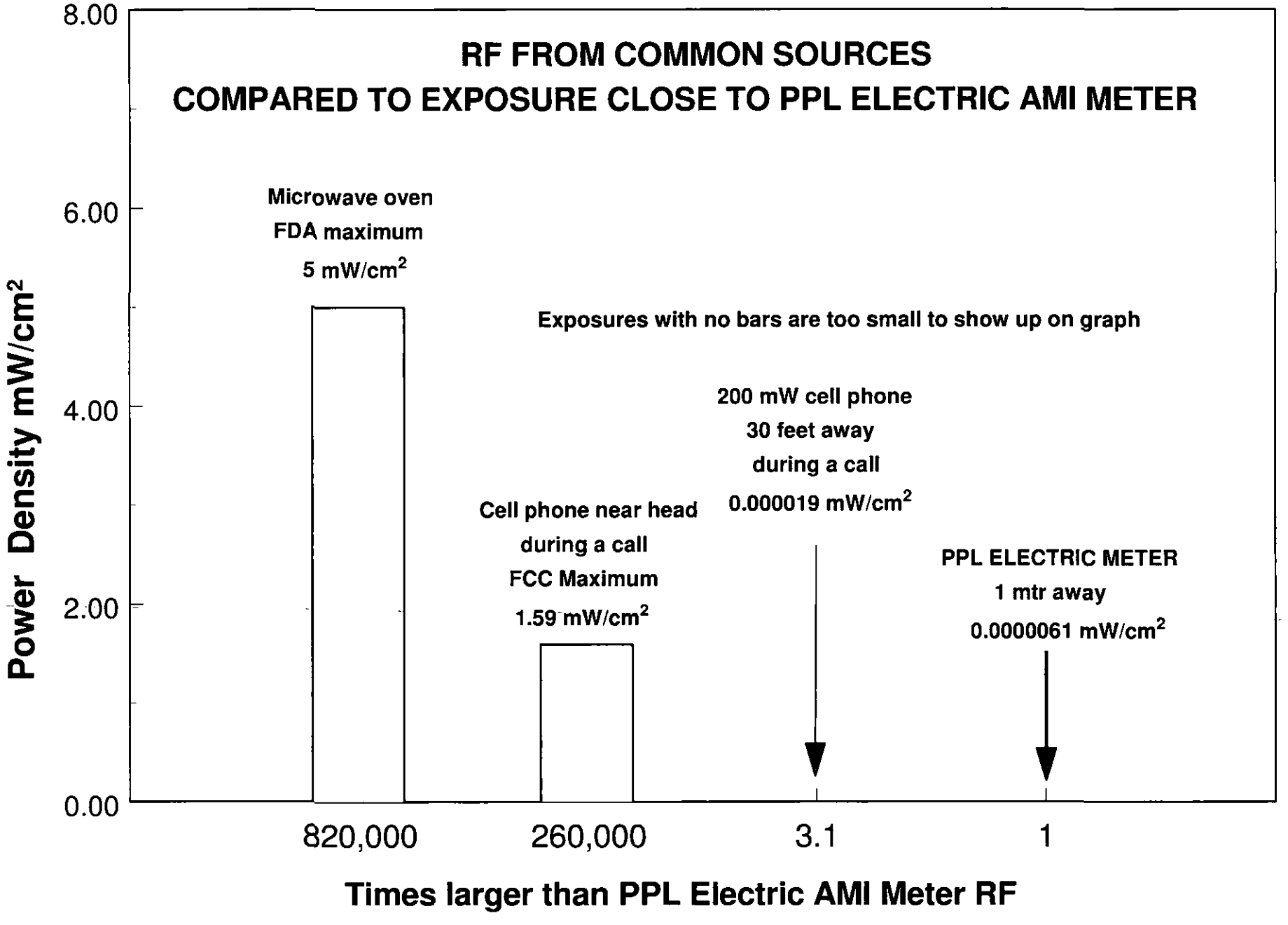


PPL Electric Exhibit CD2 - Schmukler

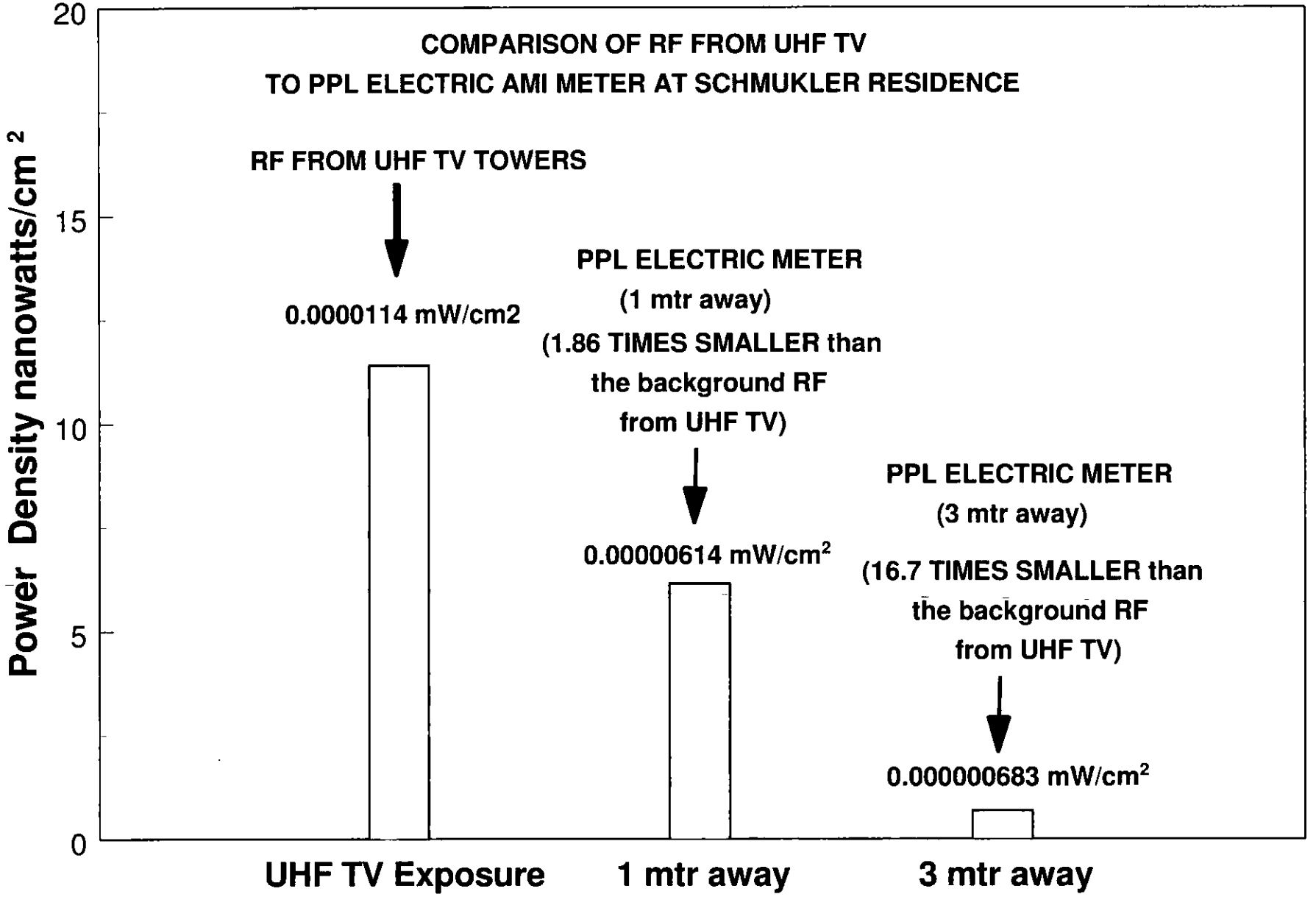


*FCC Exposure Limit is based on 30 minute average not peak levels

PPL Electric Exhibit CD3 - Schmukler



PPL Electric Exhibit CD4 - Schmukler



PPL Electric Exhibit CD5 - Schmukler

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	:	
PPL Electric Utilities Corporation	:	

DIRECT TESTIMONY OF MARK A. ISRAEL, MD

PPL Electric Statement No. 2

February 15, 2018

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Mark A. Israel. My business address is Dartmouth Medical School, 1 Medical Center Drive, Lebanon, NH 03756.

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. I have recently been 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 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.

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 over 245 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, the American Society for Clinical Oncology, and the Society of Neuro-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 Mr. Schmukler.

MEDICAL EVALUATION

Q. WHAT MEDICAL CONDITIONS DOES MR. SCHMUKLER CLAIM HE WILL DEVELOP 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. The Complaint that Mr. Schmukler filed with the PUC states that he has been "electromagnetically sensitive for the last 30 or so years." The Complaint also states that Mr. Schmukler has "severe chronic insomnia". The materials prepared by Mr. Schmukler also say that he becomes "mentally foggy" when he is exposed to "electromagnetic fields".

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. My medical evaluation focused on the condition Mr. Schmukler claims to have, EHS, which is a term 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, nervousness, fatigue, and lethargy, among others. A World Health Organization (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. ARE THE SYMPTOMS LISTED BY MR. SCHMUKLER SIMILAR TO THE SYMPTOMS THE WORLD HEALTH ORGANIZATION DESCRIBES AS IEI?

A. Yes, the symptoms listed by Mr. Schmukler are consistent with IEI as described by the WHO.

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) 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 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."

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...." 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.

Q. MR. SCHMUKLER SAYS HE EXPERIENCES INSOMNIA – DID YOU REVIEW ANY RESEARCH ON RF FIELDS AND SLEEP QUALITY?

A. Yes, there have been a number of studies on whether exposure to RF fields from everyday sources such as cell phones and radio communications towers adversely affects sleep quality. For example, a study by Mohler (2012) evaluated whether over the course of a year perceived sleep quality in a large group of subjects was affected by wireless phone use and/or exposures to RF fields from environmental sources such as cell phone and radio broadcast towers. This study included measurements of RF field exposures for a portion of the subjects. The researchers found no adverse effects on sleep related to greater use of wireless phones or higher levels of RF fields in the home. Other studies also have found no adverse effects on sleep quality related to exposure to RF fields from cell phones or RF communications towers (Herr 2005; Mohler 2010; Danker-Hofpe 2011). Similarly, laboratory studies with human volunteers exposed to RF fields have found no consistent adverse effects on sleep quality from to RF exposures (Nakatani-Enomoto 2013)

Q. DID YOU REVIEW ANY OTHER RESEARCH RELATED TO RF FIELDS AND HEALTH?

A. Yes. 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. 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 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.

Based on the body of scientific research showing no consistent and reproducible effects from RF fields on cancer or other adverse health effects, the WHO has concluded

that "no adverse health effects have been established as being caused by mobile phone use". (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), IARC (2011), the United Kingdom Health Protection Agency (2012), the Norwegian Institute of Public Health (2012), Public Health England (2013), the Royal Society of Canada (2014), the New Zealand Ministry of Health (2015), 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), and the Health Council of the Netherlands (2016).

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), the Arizona Department of Health, Office of Environmental Health (2014), and the 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.

In sum, my evaluation of the body of scientific research found no reliable medical basis to conclude that RF fields cause or contribute to the development of any diseases or illnesses.

Q. *HAVE YOU SEEN ANY MEDICAL RECORDS FOR MR. SCHMUKLER?*

A. The only medical record I have seen for Mr. Schmukler is a 3-page discharge summary from the National Institutes of Health (NIH) dated 1981 which lists a diagnosis of Phase Lag Sleep Disorder.

Q. DOES THE 1981 NIH DISCHARGE SUMMARY PROVIDE ANY INFORMATION ABOUT RF FIELDS BEING A CAUSE OF MR. SCHMUKLER'S SLEEP DISORDER?

A. No, the 1981 NIH discharge summary does not mention RF fields or any form of electromagnetic fields.

Q. DOES THE 1981 NIH DISCHARGE SUMMARY INCLUDE A DIAGNOSIS THAT MR. SCHMUKLER IS ELECTROMAGNETICALLY SENSITIVE?

A. No, the 1981 NIH discharge summary does not include a diagnosis of electromagnetic sensitivity or mention it in any way.

Q. DOES THE 1981 NIH DISCHARGE SUMMARY STATE THAT THERE WOULD BE FOLLOW-UP EVALUATION OF MR. SCHMUKLER'S SLEEP DISORDER?

A. Yes, the 1981 NIH discharge summary states that Mr. Schmukler is to keep in contact with NIH physicians and is to return to NIH for continued evaluation and treatment.

Q. *HAVE YOU SEEN ANY MEDICAL RECORDS ABOUT THIS CONTINUED EVALUATION AND TREATMENT OF MR. SCHMUKLER?*

A. No, I am not aware that any further medical records from Mr. Schmukler.

Q. DO MR. SCHMUKLER'S EXHIBITS INCLUDE LETTERS FROM SOME HEALTH CARE PRACTITIONERS?

A. Mr. Schmukler's exhibits include four letters. One is from a doctor who practices family medicine in Lancaster. His letter states that Mr. Schmukler was diagnosed with "electromagnetic sensitivity" many years ago, but does not say when the diagnosis was made, who made it, what medical examination and medical criteria were involved in the diagnosis, or what course of treatment, if any, has been provided by medical professionals since the diagnosis including by the author of the letter. This is important because there are no established medical criteria for the diagnosis or treatment of IEI. The other three letters provided by Mr. Schmukler are from homeopathy (alternative medicine) practitioners, one located in California, one located in Jaipur, India and one located in Mumbai, India. None of these letters provide any useful diagnostic medical information and they have the appearance of reiterating information that likely was provided by the patient.

Q. SECTION 4 B OF MR. SCHMUKLER'S COMPLAINT LISTS THREE STUDIES ON MELATONIN: BURCH (2002), CLARK (2007) AND RAPOPORT (2011). HAVE YOU REVIEWED THOSE STUDIES?

A. I have reviewed the Burch (2002) and Clark (2007) studies. The Rapoport (2011) study was published in a Russian language journal and I do not speak or read Russian.

Q. DO THE BURCH (2002) AND CLARK (2007) STUDIES SHOW THAT RF FIELDS CAUSE ADVERSE EFFECTS ON MELATONIN LEVELS?

A. No, they do not. The Burch (2002) study examined melatonin excretion in male electric utility workers who had occupational exposures to power frequency fields and used cell

phones. The researchers found no consistent statistically significant effects on melatonin levels in the workers based on cell phone use. The Clark (2007) study looked at pre-menstrual or postmenstrual women with exposures to power frequency fields and RF fields. The study found that exposures to RF fields had no effect on melatonin levels in the women.

Q. HAVE YOU REVIEWED THE EXHIBITS PROVIDED BY MR. SCHMUKLER?

A. Yes, I have.

Q. ARE ANY OF THE EXHIBITS PROVIDED BY MR. SCHMUKLER SCIENTIFIC STUDIES?

A. No. Some of his exhibits list, summarize or characterize studies but no actual complete scientific studies are included in his exhibits.

Q. MR. SCHMUKLER SAYS HIS EXHIBIT 4 IS AN ARTICLE SHOWING THAT ELECTROMAGNETIC SENSITIVITY IS A DISABILITY UNDER THE AMERICANS WITH DISABILITIES ACT. IS HE CORRECT?

A. Mr. Schmukler's Exhibit 4 is a mix of selected passages from the Introduction to a 2006 report titled "Indoor Environmental Quality" that was prepared by the National Institute of Building Sciences (NIBS) for the Architectural and Transportation Barriers Compliance Board (Access Board). The NIBS states on its website that it is "a non-profit, non-governmental organization." The complete "NIBS report is available online at: https://www.access-board.gov/research/completed-research/indoor-environmental-quality/introduction?highlight=WyJlbGVjdHJvbWFnbmV0aWMiLCJlbGVjdHJvbWFnbmV0aWNhbGx5Il0.

In his exhibit, Mr. Schmukler excluded language from the same page of the report's Introduction that makes clear that the Access Board did not adopt any building access rules based on accommodating claimed disabilities from electromagnetic sensitivity:

> "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." (emphasis added)

Q. MR. SCHMUKLER'S EXHIBIT 11 IS AN ARTICLE THAT REFERS TO A STUDY CONDUCTED BY THE NATIONAL TOXICOLOGY PROGRAM (NTP). HAVE YOU REVIEWED EXHIBIT 11?

A. Yes, I have. This exhibit is an incomplete version of a May 2016 article from an online website called Microwave News. The article comments on partial and preliminary research results that NTP released in 2016. The exhibit does not include the study, which has not yet been published in a peer-reviewed journal. NTP made public a draft technical report of this study and a companion study in February 2018, which are expected to be presented at a public meeting for review and comments before being finalized and then possibly submitted for publication in a peer-reviewed scientific journal. The May 2016 Microwave News article that is Mr. Schmukler's Exhibit 11 is not itself a scientific study and does not address the NTP draft technical reports that were released in February 2018. At present, because these are draft and incomplete reports that are subject to change, it

would not be appropriate or responsible to rely on them as a basis for conclusions about the scientific research.

Q. MR. SCHMUKLER'S EXHIBIT 13 IS A DOCUMENT TITLED "INTERNATIONAL EMF SCIENTIST APPEAL". IS THIS A SCIENTIFIC STUDY?

A. No, it is not. It is a petition prepared by advocates who want the United Nations and the World Health Organization to adopt different exposure standards for "non-ionizing electromagnetic fields" including RF fields. This is not a scientific document and it does not provide scientific data that can be used to reach a reliable conclusion about RF fields and health.

Q. MR. SCHMUKLER'S EXHIBIT 16 IS A PORTION OF A DOCUMENT TITLED "BIOINTIATIVE 2012". IS THIS A SCIENTIFIC STUDY?

A. No, it is not. It appears to be a portion of the "BioInitiative Report" which is a set of opinions prepared by the authors of the report's chapters. These include Dr. David Carpenter, who is also the author of the letter listed as Mr. Schmukler's Exhibit 10. The lack of scientific objectivity in the BioInitiative Report has been criticized by a number of public health authorities, including the Health Council of the Netherlands, which concluded that "the BioInitiative Report is not an objective and balanced reflection of the current state of scientific knowledge." The BioInitiative Report (Exhibit 16), the International EMF Scientist Appeal (Exhibit 13), the Carpenter letter (Exhibit 10), the statement from the American Academy of Environmental Medicine (Exhibit 14), the lists and descriptions of studies and other materials taken from activist websites (Exhibit 5 – from neilcherry.nz; Exhibit 6 – from electrosensitivity.co; Exhibit 7 – from es-uk.info;

Exhibit 8 – from saferemr.com; Exhibit 18 – from ehtrust.org) are examples of the many materials available on the internet that to a non-scientist may have the appearance of scientific information but do not reflect controlled, balanced and reliable scientific assessments.

Q. AS A MEDICAL DOCTOR AND MEDICAL RESEARCHER, WOULD YOU RELY ON THESE MATERIALS TO REACH MEDICAL CONCLUSIONS ABOUT RF FIELDS AND HEALTH?

A. No, I would not. These exhibits are not scientific studies, do not represent a balanced assessment of the scientific research on RF fields, and do not provide scientifically reliable or useful data for reaching conclusions about RF fields and the causation of any symptom or health effect.

Q. MR. SCHMUKLER'S EXHIBIT 17 IS A PRESS RELEASE FROM THE INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC) ABOUT ITS 2011 EVALUATION OF RF FIELDS AND CANCER. DID THE IARC 2011 REVIEW CONCLUDE THAT RF FIELDS FROM SMART METERS CAN CAUSE CANCER?

A. No, it did not. IARC is an agency of the World Health Organization (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 referred to as "limited evidence," but not that RF fields from mobile phones were either carcinogenic or even "probably" carcinogenic. IARC did not refer to RF fields from smart meters as being carcinogenic or possibly carcinogenic. Later in 2011, the WHO, while acknowledging the IARC finding, issued a

statement 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 or possibly carcinogenic.

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 MR. SCHMUKLER's RESIDENCE CAUSE OR CONTRIBUTE TO ADVERSE HEALTH EFFECTS?

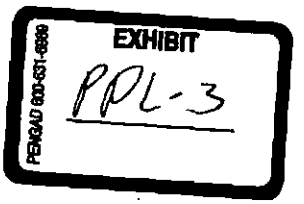
A. In my expert opinion, there is no reliable medical basis to conclude that RF fields from the AMI meter being used by PPL Electric would cause, contribute to, or exacerbate the symptoms listed by Mr. Schmukler or any other adverse health effects.

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

PPL Electric Utilities Corporation

Smart Meter Technology Procurement and Installation Plan

RECEIVED
APR 2 2018
PA PUBLIC UTILITY COMMISSION
SECRETARY'S BUREAU

Docket Nos. P-2014-_____
and M-2009-2123945

June 30, 2014

Table of Contents

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.

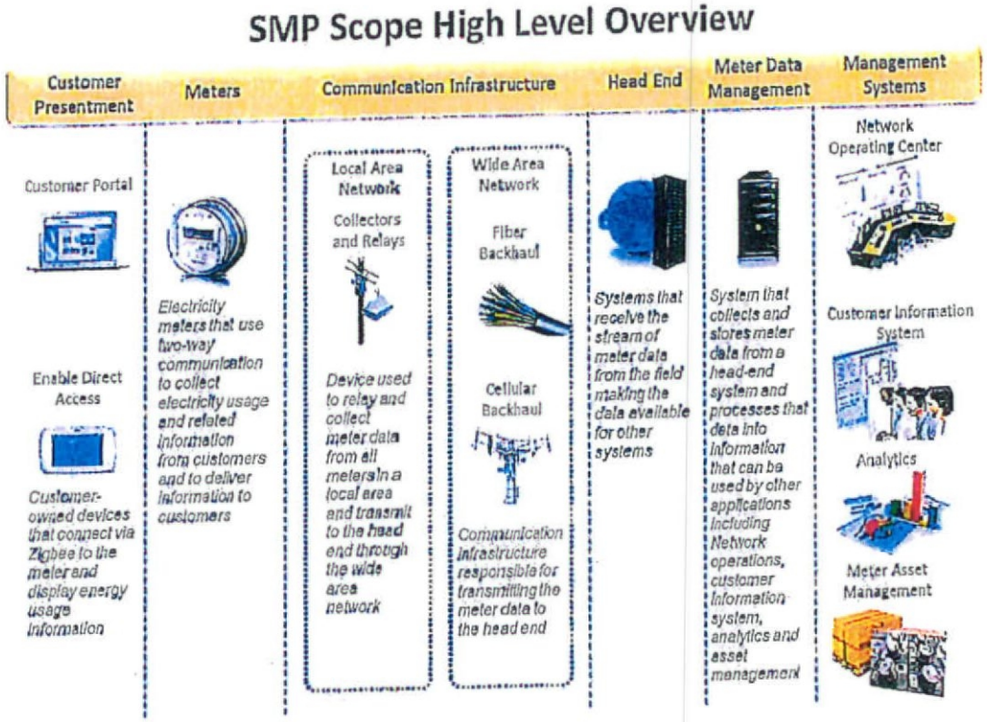


Figure 1 – SMP Scope High Level Overview

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.

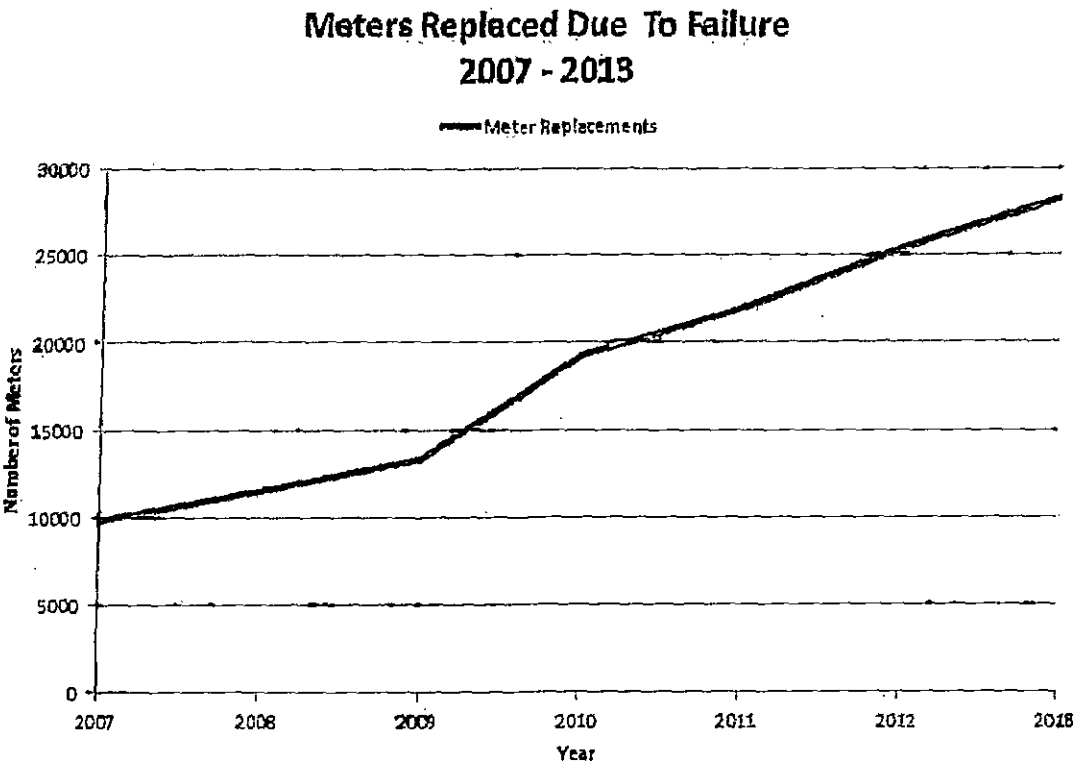


Figure 3 - Historic Meter Failure Rates

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.

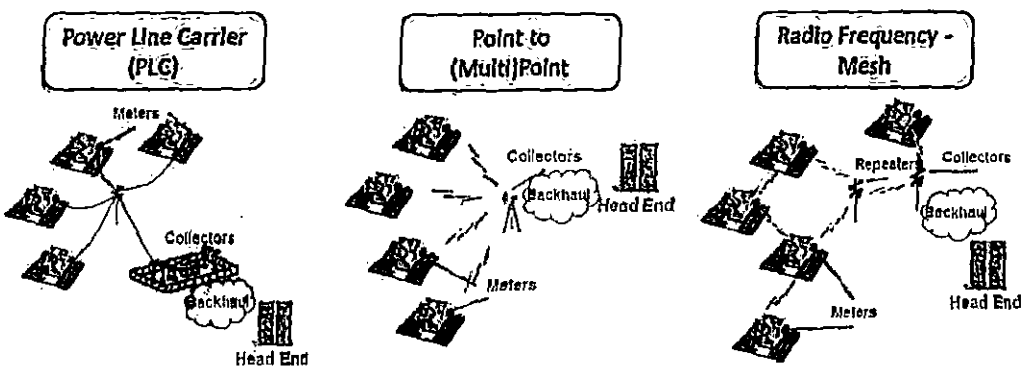


Figure 4 - AMI Technology Types

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.

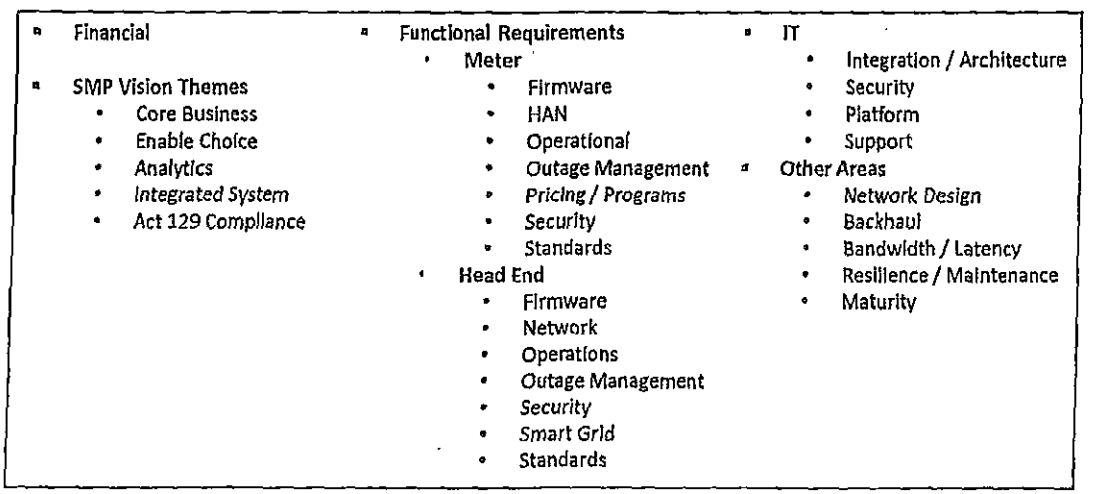


Figure 5 - Evaluation Categories for AMI Solution Evaluation

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.

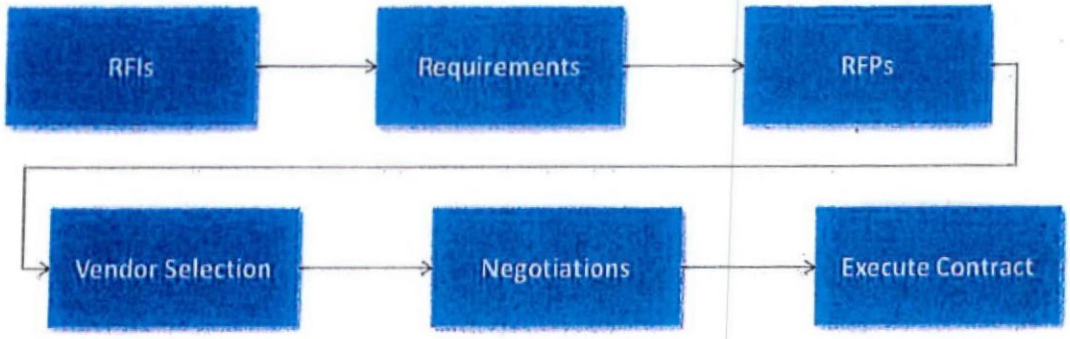


Figure 6 - Vendor Selection Process

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.

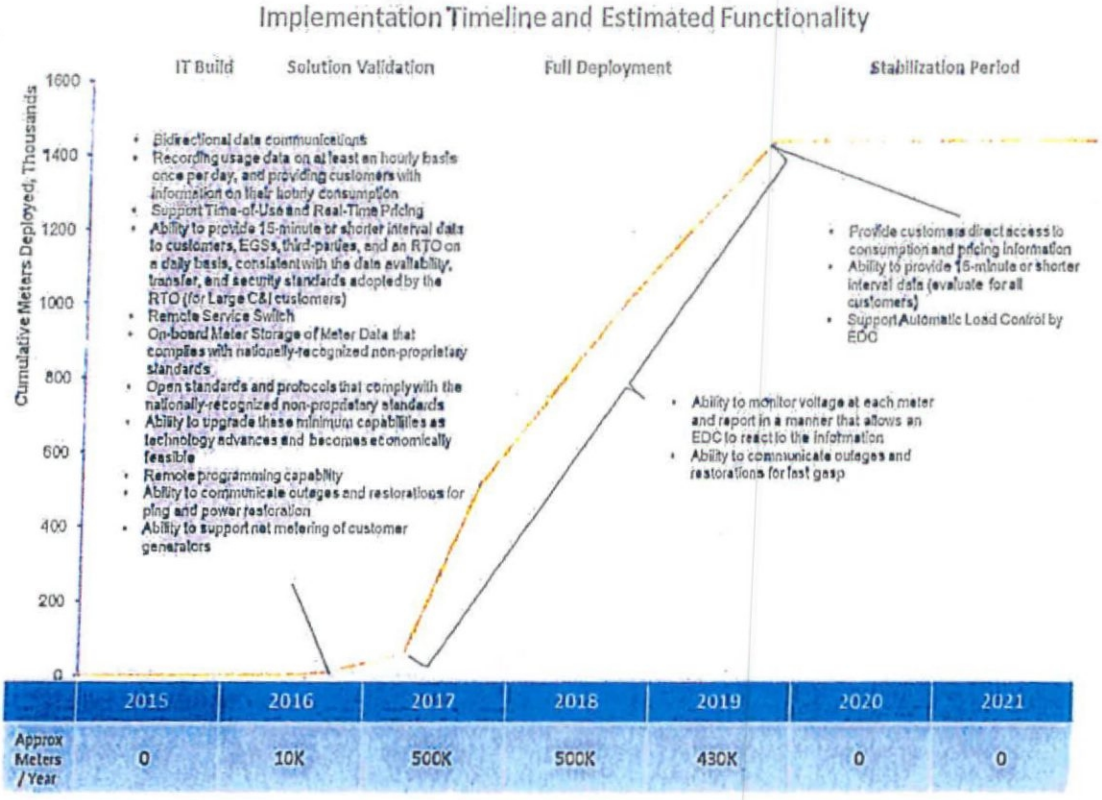


Figure 7 - Implementation Timeline and Estimated Functionality

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.

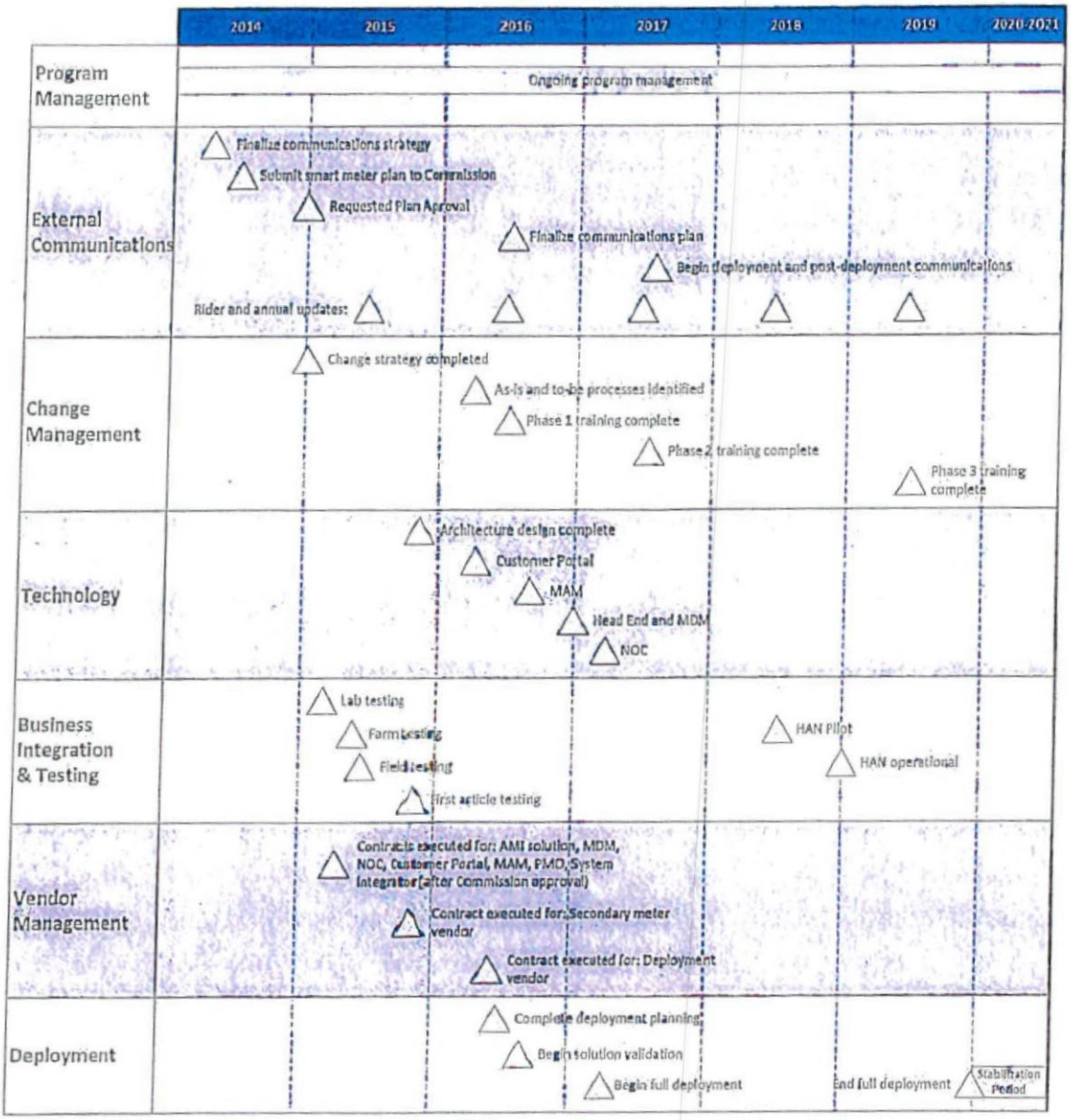


Figure 8 - Smart Meter Program Milestone Roadmap

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.

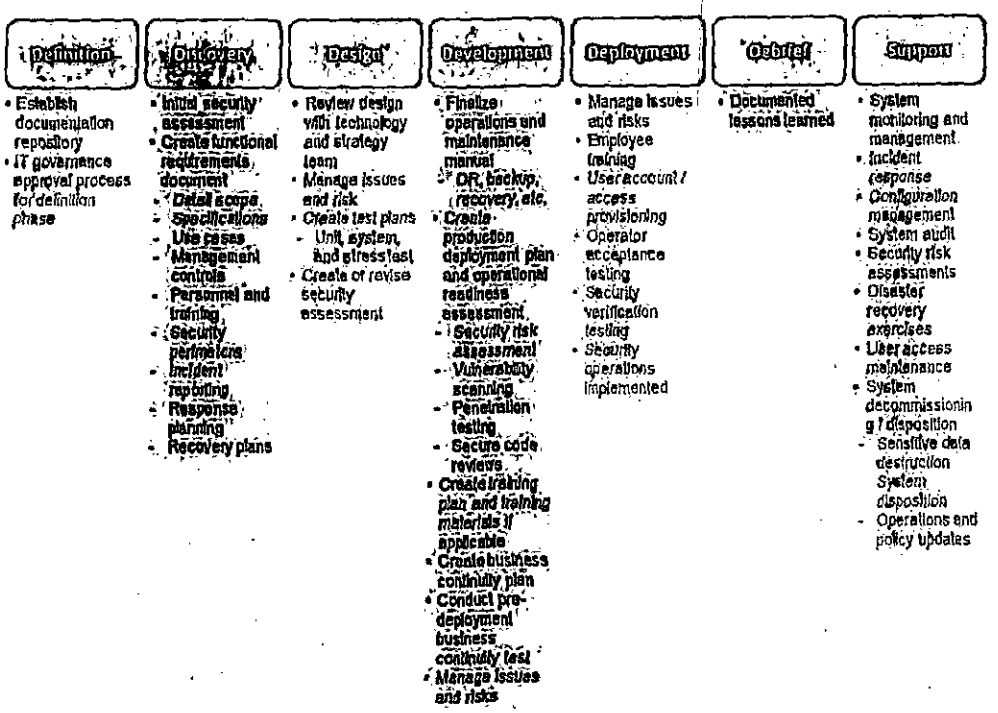


Figure 10 - PPL Project Management Methodology Process

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.

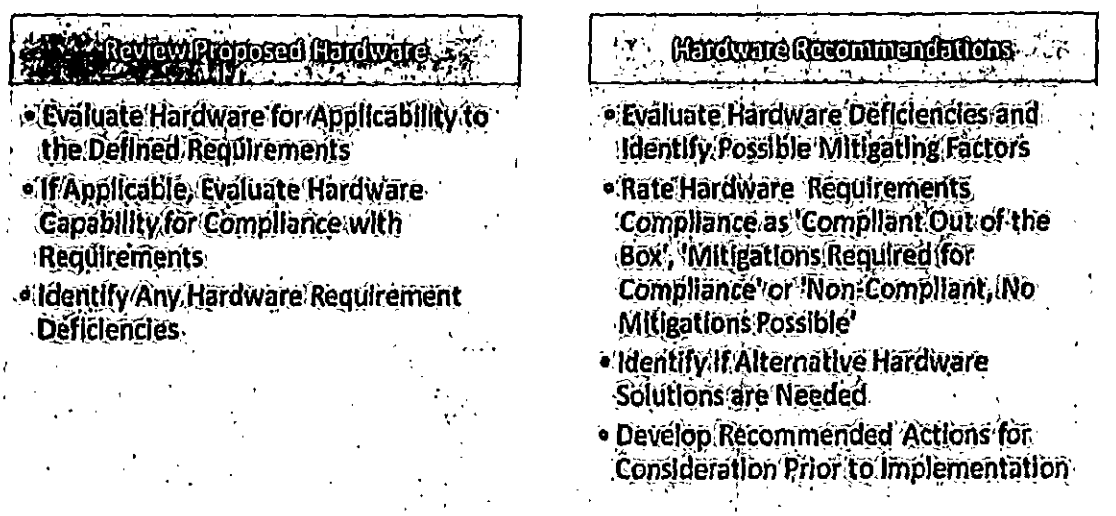


Figure 11 - Vendor Cyber Security Requirements Assessment

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.

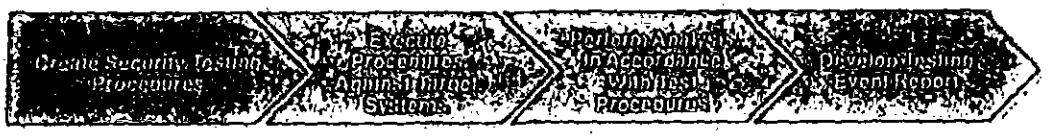


Figure 12 - System Security Testing Process

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.

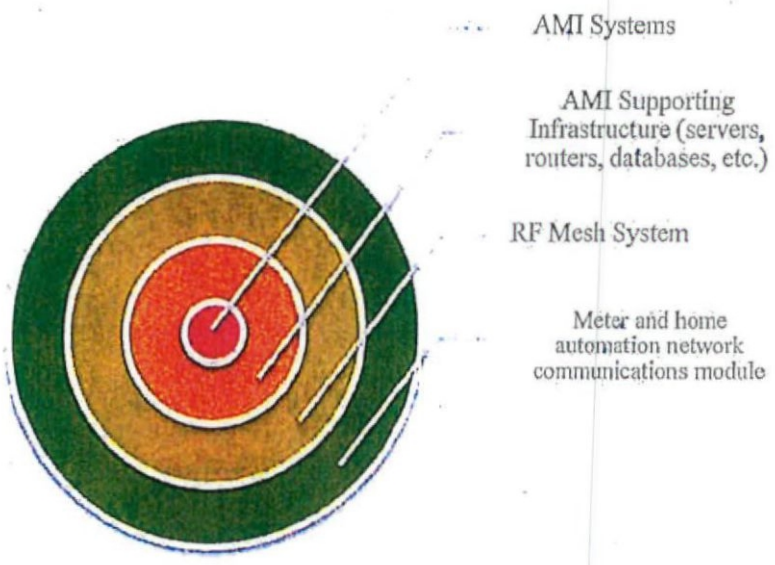


Figure 13 - Potential Impact to Overall Grid Security

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.

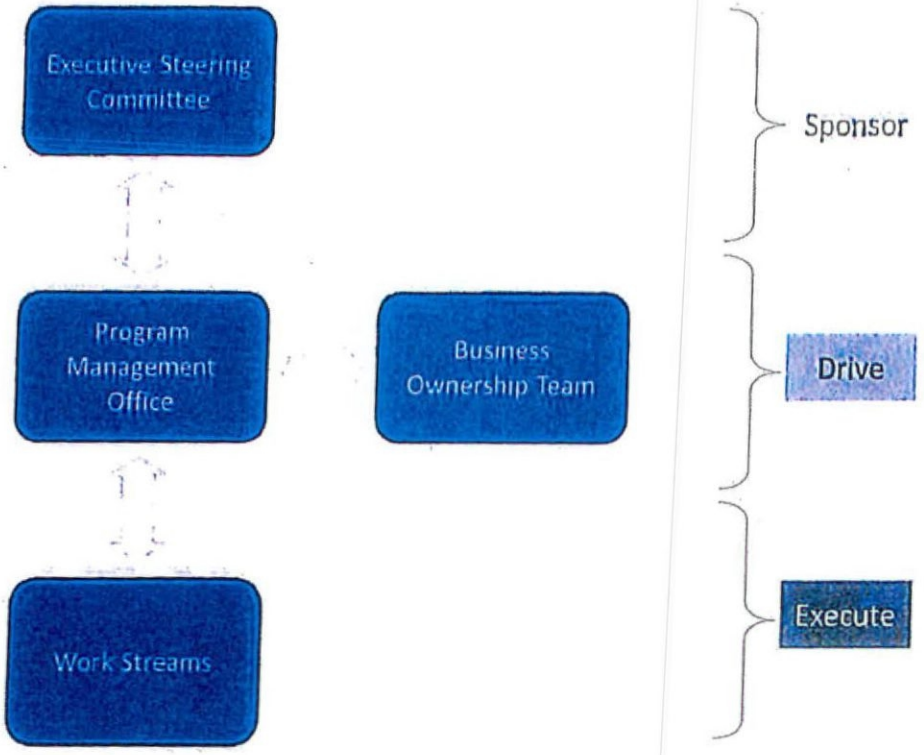


Figure 14 - Proposed Smart Meter Program Governance Model

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

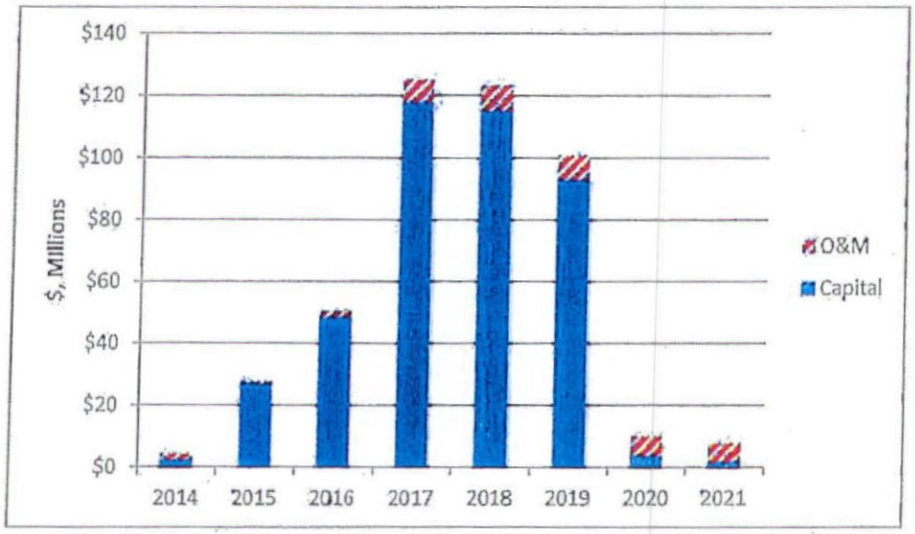


Figure 15 - 8-Year Cost Schedule

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.

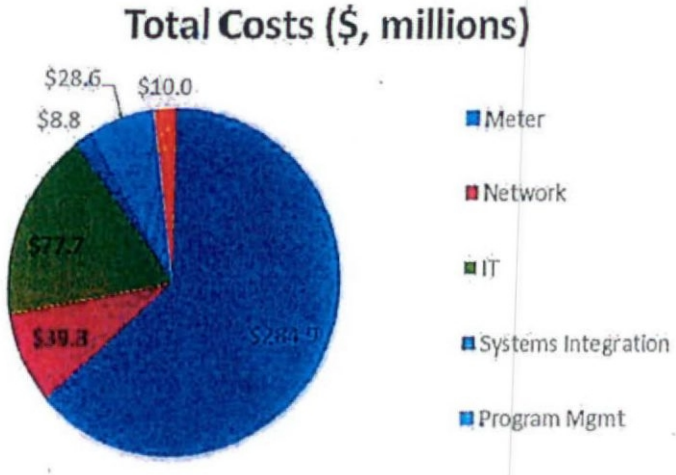


Figure 16 - Total Cost Breakdown

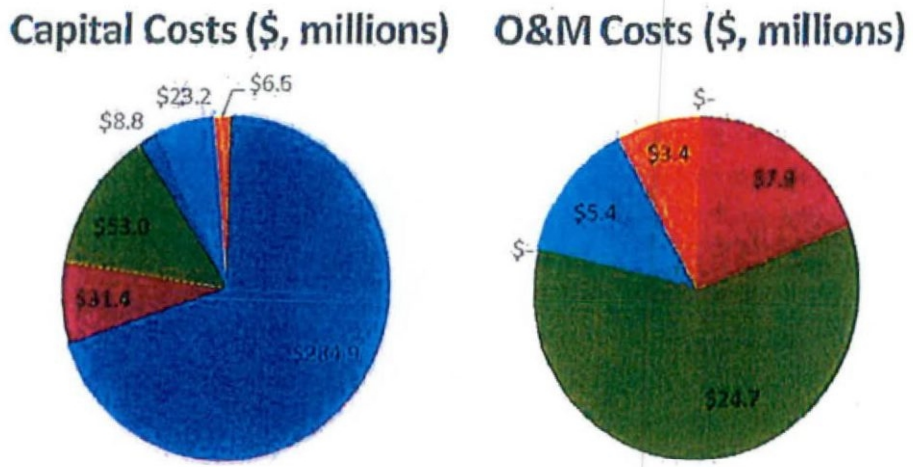


Figure 17 - Capital and O&M Cost Breakdowns

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

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EXHIBIT
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January 15, 2016

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PA PUBLIC UTILITY COMMISSION
SECRETARY'S BUREAU

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

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PPL Electric Utilities Corporation

AMI Program
Communications Plan

January 15, 2016

Table of Contents

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.*

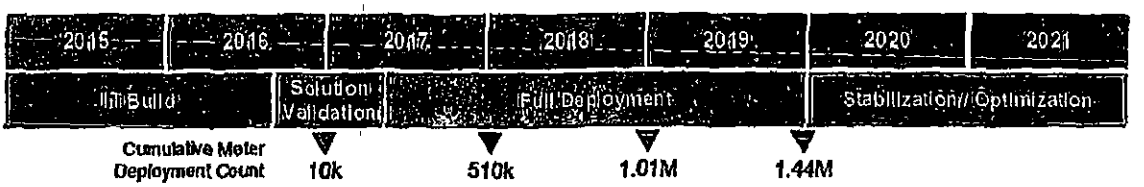


Figure 1: High Level Program Schedule

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.*

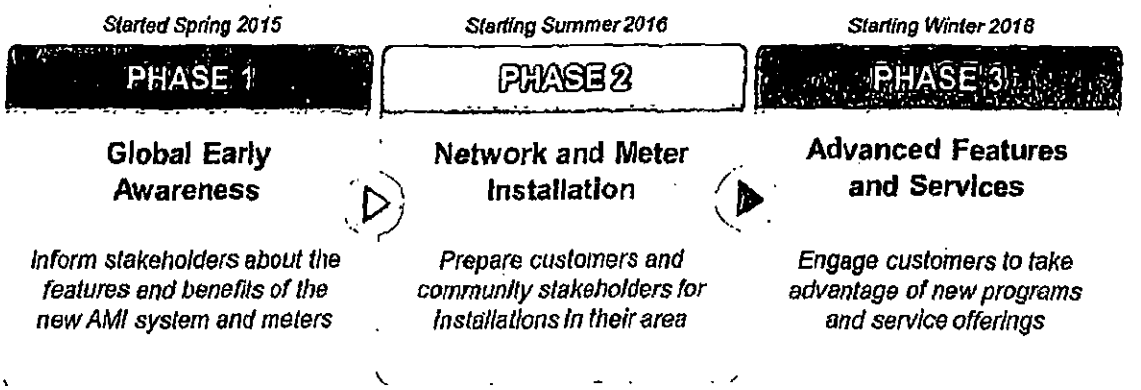


Figure 2: Communications Phases

- 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.

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*.

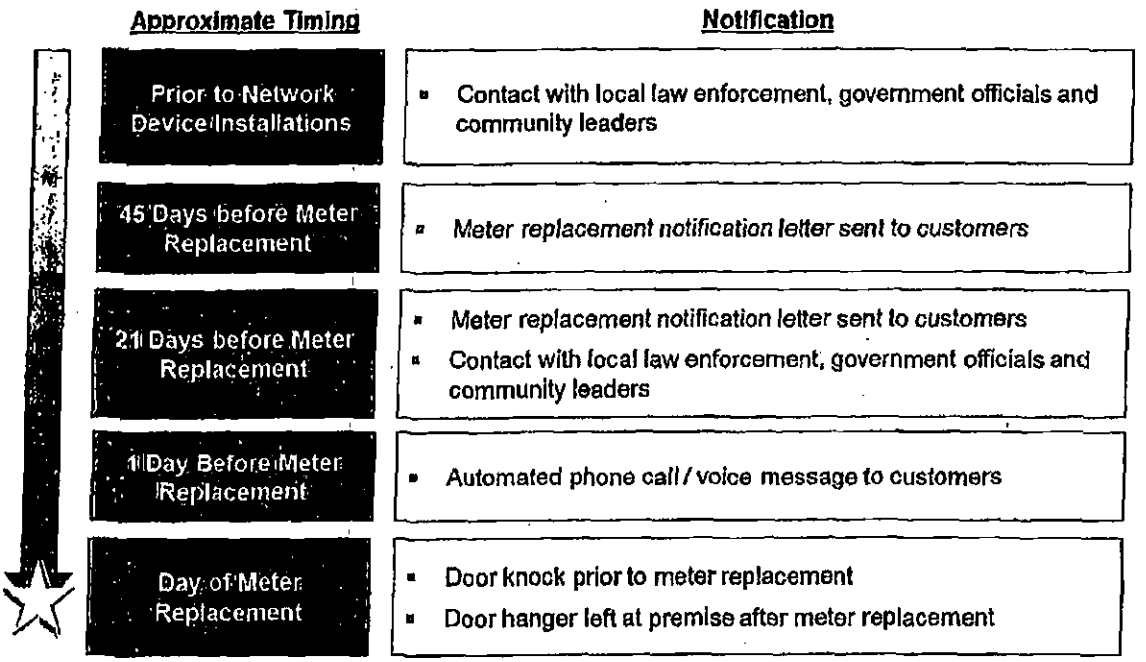


Figure 3: Deployment Notifications

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.

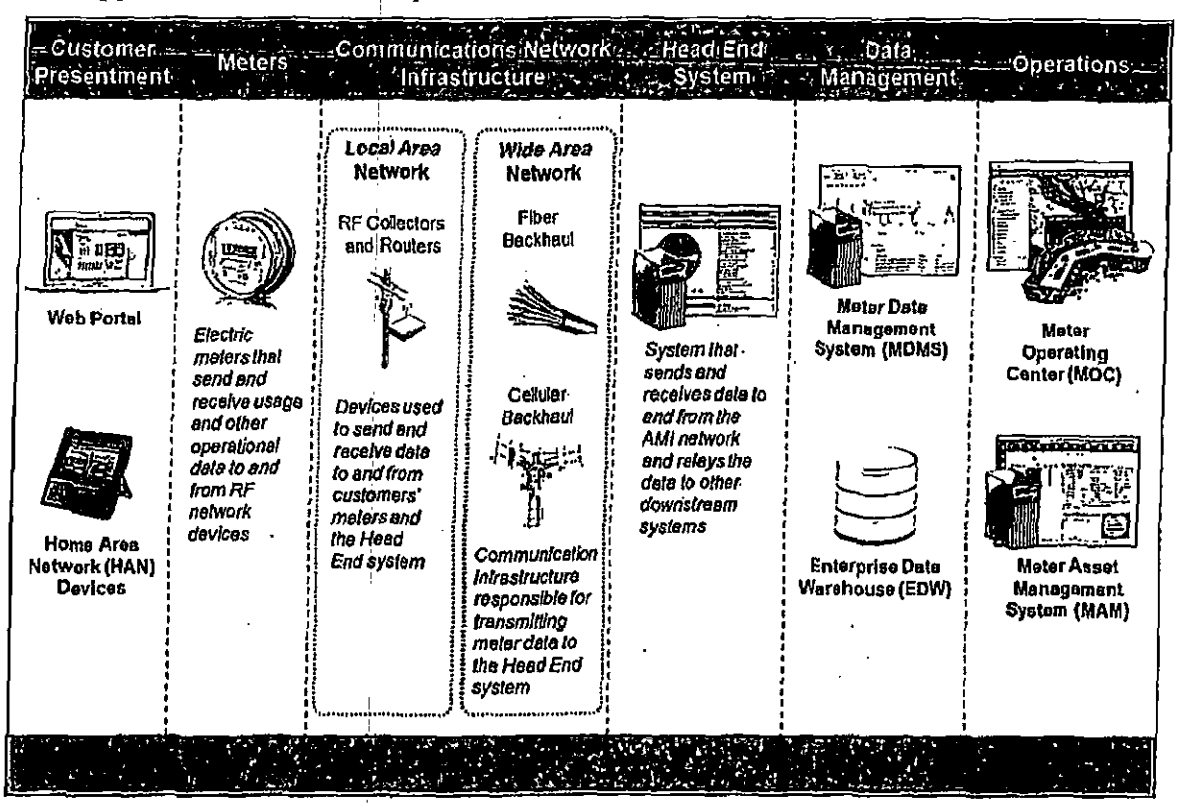
PPL Electric's contact center and / or the deployment vendor's contact center will address customer calls using information provided in the FAQs and integrated messaging document. If the customer still wants more information, the CSR will transfer the call to their supervisor. The contact center supervisors 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



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
Office of Consumer Advocate
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Date: January 15, 2016

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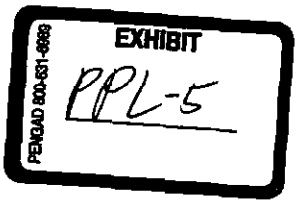

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July 20, 2016

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).

VIA E-MAIL AND FIRST CLASS MAIL

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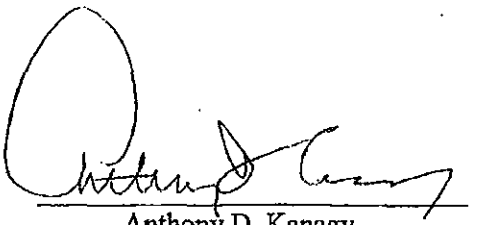

Anthony D. Kanagy

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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.

Supplement No. 59
Electric Pa. P.U.C. No. 201
Fifth Revised Page No. 6B
Canceling Third & Fourth Revised Page No. 6B

PPL Electric Utilities Corporation

RULE 2 - REQUIREMENTS FOR SERVICE (CONTINUED)

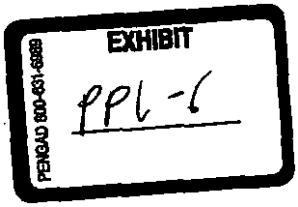
F. ACCESS

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)



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)

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.

Supplement No. 42
Electric Pa. P.U.C. No. 201
Fourth Revised Page No. 8D
Canceling Third Revised Page No. 8D

PPL Electric Utilities Corporation

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)

(C) Indicates Change

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.