ENGINEER REPORT

IN THE SUPREME COURT OF PENNSYLVANIA
MIDDLE DISTRICT

RE: No. 34 MAP 2021, *Povacz, M, et al. v. PUC*
Associated Case(s):
35 MAP 2021 Consolidated
36 MAP 2021 Consolidated
37 MAP 2021 Consolidated
38 MAP 2021 Consolidated
39 MAP 2021 Consolidated
40 MAP 2021 Consolidated
41 MAP 2021 Consolidated
42 MAP 2021 Consolidated
43 MAP 2021 Consolidated
44 MAP 2021 Consolidated
45 MAP 2021 Consolidated

Engineer Report – Smart Meters Operation & RF Emissions

Purpose of Statement

1. My name is Erik S. Anderson, P.E. I am a forensic electrical engineer working on root cause failure analysis of matters that cause loss of property, personal injury, and loss of life.

2. I am submitting my expert opinion regarding the operation of smart meters and digital meters and in support of the *amici*.

Credentials

3. I am the president of an engineering firm that offers professional engineering and investigation services across the United States and manufactures current transformers.[1]

4. It is my expert opinion that these smart and digital meters cause a significant amount of radio-frequency (RF) "noise" on homes' electric wiring system, thereby transforming them into a whole house antenna.

5. I have a Bachelor's of Science degree from North Dakota State University, Fargo, North Dakota, in Electrical and Electronic Engineering. I am a licensed Professional Engineer in the states of Minnesota, Illinois, Arizona, Wisconsin, Indiana, Iowa, New Mexico, Texas, Louisiana, California, Kentucky, Michigan, and Nevada. I am a licensed Class A Master Electrician in the state of Minnesota. I also hold a Private Investigator License in Arizona and I am a Certified Fire and Explosion Investigator.

6. I have 30 years of experience as a forensic engineer. I have over 20 years of experience of design and manufacture of current transformers. I have been involved in many thousands of matters concerned with determining the root cause of failures of electrical devices that may have caused a loss of property, personal injury, or loss of life. I have given expert witness testimony in approximately 113

[1] https://www.aenpi.com/

separate matters. I personally have tested smart meters and given expert testimony regarding their operation and emissions. My *curriculum vitae* is attached (Exhibit 1).

7. As a designer and manufacturer of transformers, their operation is one of my main areas of expertise. Switch Mode Power Supply modules used by smart and digital meters are merely another type of transformers. I have investigated the involvement of the operation of the Switch Mode Power Supply in these meters and their involvement in the creation of radio frequency (RF) emissions.[2]

8. My expert determination principally relies on my own smart meter testing. I do also rely on reviews by other experts, their' testing reports and my professional education and vast experience.

Smart Meter Operation

9. Smart meters create intense exposure to pulsed radio frequencies (RF) in a few ways. RF antennas are embedded within the smart meter to transmit data usage to utility companies and/or to communicate with other smart meters or with other "smart" devices like home thermostats. These antennas emit pulsed RF radiation. The various radiofrequencies emitted by these antennas also conduct through the home electric wiring. RF "wire conducted" frequencies come also

[2] An explanation of what are radio frequencies and about the electromagnetic spectrum can be found in the scientists' statements which is also attached to the *amicus* brief as well as in the *amicus* brief itself.

from the conversion process from alternating current (AC) to direct current (DC) handled by the Switch Mode Power Supply (SMPS).[3] Non-transmitting digital meters also use SMPS, and therefore they too create RF, even though they do not contain a transmitting RF antenna for communications. These radio frequencies are transmitted on the residence's electrical distribution system and conduct over the internal wiring, thereby turning the home into a whole-house antenna.

RF Emissions from the Transmitting Antennas

10. The RF antennas that wirelessly transmit the consumer's electrical power usage data to the utility company use frequencies in the 900 MHz & 2,400 MHz range. These emissions are intense and can occur often, up to 190,000 times a day.[4] From my experience and testing done by others, these meters transmit more times than the electric companies report. This can easily be shown by measuring the emissions with a simple RF meter.

11. "Isotrope Wireless,"[5] which provides industry and municipalities with design, specification, evaluation, and construction support for wireless facilities, tested smart meters in three houses.[6] This testing showed that RF emission from the smart meters' transmitting antennas could be detected throughout the house and

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[3] In some meters the conversion is done using capacitators instead of SMPS.

[4] https://childrenshealthdefense.org/pa-amicus-sage-smart-meters/.

[5] https://www.isotrope.im/about-2/.

[6] https://childrenshealthdefense.org/pa-amicus-isotrope/.

were "well above" the ambient RF radiation levels.[7] These pulsed RF emissions exceed the absolute energy output limits[8] stated in Federal Communications Commission (FCC) guidelines (if the emissions are not averaged over a 30-minute exposure as prescribed by those guidelines).[9]

RF from Wireless Antennas Enter the House's Electrical System

12. The Isotrope testing also showed that the house's electrical wiring conducted substantial levels of the RF emissions at 915 MHz – the communications-related frequency for that meter[10] – and this frequency was then radiated from outlets (electrical power delivery points) and along the house wiring (branch circuitry).

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[7] https://childrenshealthdefense.org/pa-amicus-isotrope/#page=12.

[8] https://childrenshealthdefense.org/pa-amicus-sage-smart-meters/#page=3.

[9] On August 13, 2021, the Court of Appeals for the DC Circuit ruled that the FCC's 2019 decision that its guidelines adequately protect the public's health are arbitrary, capricious and not evidence-based. The Children's Health Defense is a Petitioner in this case. *Envtl. Health Tr., et al v. FCC*, Nos. 20-1025, 20-1138, 2021 U.S. App. LEXIS 24138 (D.C. Cir. Aug. 13, 2021). The opinion specifically questioned whether the FCC's testing procedures adequately captured the effect of pulsation or modulation. 2021 U.S. App. LEXIS 24138, *12, *29.

[10] Smart meters use a variety of frequencies for communications depending on the manufacturer's choice. PECO's meters operate at around 901 MHz. They also contain a "Zigbee" antenna that can be turned on and then communicate with nearby wireless smart devices. Zigbee uses 2400 MHz band.

13. Thus, the pulsed RF emissions from the smart meter's transmitting antenna not only enter the house wirelessly but also enter into and are conducted along the house's electrical wiring

RF "Noise" From the Switch Mode Power Supply

14. Other RF frequencies besides the RFs from the transmitting antennas, also enter the house electric system. In my testing I have witnessed and analyzed smart meters' effects on the incoming electrical power voltage waveform. These frequencies are a byproduct of the AC/DC conversion process which is done by the Switch Mode Power Supply (SMPS). The conversion process is necessary because utility service employs alternating current whereas the electrical components in smart meters use direct current.[11]

15. SMPS converts the 240 Volt AC power coming into the meter from the main power transformer, into the much lower DC voltage that the electronic devices require to function. The rapid back-and-forth conversion process used to remove the "alternating" aspect creates *unintended* RF frequencies. The on/off, back-and-forth, pulses can occur up to 150,000 times per second, which means frequencies of up to 150,000 Hz (150 KHz[12]), are created. These kilohertz

[11] Smart meters also rely on AC for some of the non-electronic functions they perform.

[12] 1,000 Hz is a kilohertz ("KHz"). 1,000,000 Hz is a megahertz ("MHz"). 1,000,000,000 Hz is a gigahertz ("GHz").

frequencies are within the RF band of frequencies.[13] Most of the observed "noise" spikes are in the range of 2 to 50 kHz (2,000 to 50,000 Hz).[14] The switching RF "spikes" are variable, and they are being imposed on the 60 Hz house electricity wave,[15] creating significant unintended RF "noise."

16. These frequencies are present all the time but are worse when less electricity is being used (e.g., at night) and when the smart meter's electronics need more power, for example, when transmitting RF bursts to the utility. These RF transmission bursts cause spikes over the electric wiring, and they are created because the SMPS has to suddenly supply more DC power.

Digital Meters Use SMPS and Therefore Also Created Unintended RF

17. Digital meters also use SMPS. Therefore, even though they do not contain an RF communications antenna, the AC/DC conversion process creates significant and variable RF spikes over the electrical wiring, which is then radiated into the house.

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[13] FCC defines RF as frequencies between 3 KHz – 300 GHz.

[14] Finding of Fact 87 in *McKnight v. PECO* (once of the cases on hold below) states that "PECO's AMI meters do not produce 5 Hz, 3 kilohertz, or 5 megahertz fields. (April 13, Tr. 75-76)." While I have some doubt this is actually so, this finding does not rule out emissions in the other frequencies I list.

[15] Electricity comes to the house at a frequency of 60 Hz.

Analog Meters Do Not Have SMPS and Do Not Create RF Spikes

18. In contrast, unlike wireless smart meters and digital meters, analog meters do not contain an SMPS or other electronic components that create unintended RF frequencies. No AC/DC conversion is necessary, and unlike smart and digital meters, analog meters have a separate wired grounding rod that eliminates much of the "noise" that may come from the energy feed.

19. The images below compare a smart meter like that used by PECO[16] with an analog meter. The red waveform is the 60 Hz house electricity frequency. The yellow waveform indicates the RF frequencies imposed over the 60 Hz. **Image 1**shows that an analog meter does not create RF spikes. **Image 2** shows the smart meter causing significant RF spikes "noise" over the 60 Hz frequency house electric wiring system. [17]

[16] https://childrenshealthdefense.org/wp-content/uploads/pa-amicus-bathgate-pa-smart-meters.pdf. Pages 17-18.

[17] https://childrenshealthdefense.org/wp-content/uploads/pa-amicus-bathgate-pa-smart-meters.pdf#page=14.

Image 1: Analog Meter – No RF Spikes

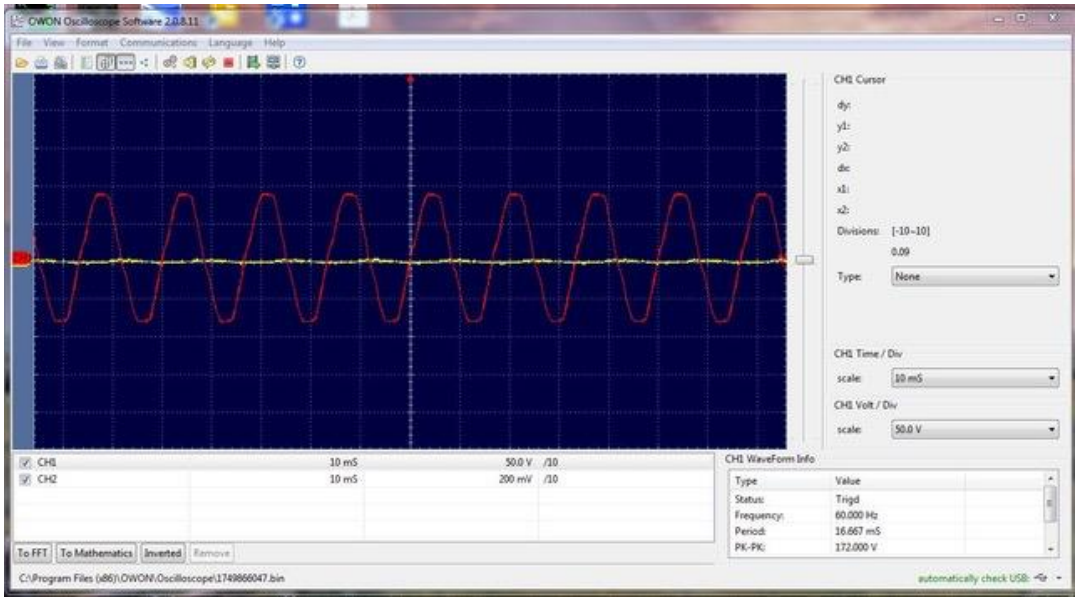
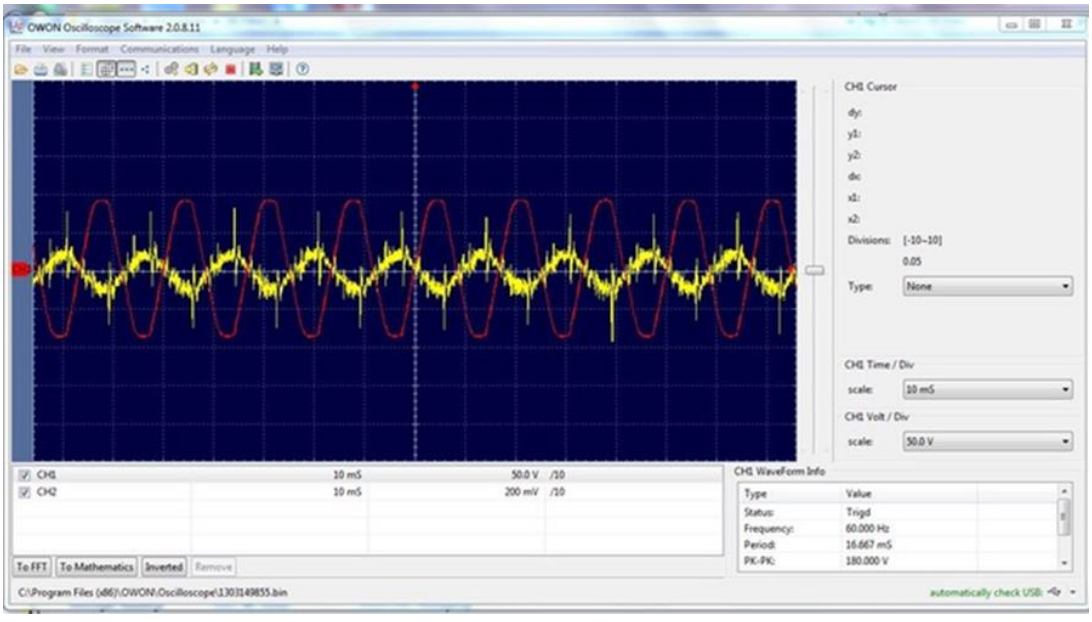


Image 2: Smart Meter – Intense RF spikes.



My Smart Meter Testing:

20. My test setup consisted of a meter socket enclosure suitable for 120/240 Volt, single-phase, three-wire connection. A smart meter, Landis & Gyr,

Gridstream RF, Focus AXR-SD, Form 2S, CL200, 240 V, 3 W, 60 Hz, power meter was used.[18] The voltage waveform was captured with a Fluke 215C Scopemeter. One input to the Scopemeter was connected to the incoming voltage, 120 Volts-to-Ground, unfiltered. The other input to the Scopemeter was connected to the incoming voltage with the 60 Hz waveform filtered out. A radiofrequency emissions meter was also used to indicate when an RF signal increase was detected.

21. When the test equipment was connected to the incoming power, the waveform of the incoming electrical power was observed. The 60 Hz signal was recognized as the dominant frequency with some noise observed on the waveform. The 60 Hz was filtered out to analyze the noise on the signal.

22. When the smart meter was not connected, the noise level was approximately 45 milliVolts at its peak. When the smart meter was added to the circuit, the noise on the 60 Hz sine wave was noticeably larger, approximately 85 milliVolts. This is nearly double the amount of noise than without the smart meter.

23. The dominant frequencies are in the range of 2 to 50 kHz. These are the frequencies that the "smart meter" generates when it is transmitting.

[18] PECO uses this meter, or one quite like it. R995a, 1046a.

Conclusion and Opinion

24. There is no doubt that smart and digital meters create pulsed RF emissions and these emissions, from the smart meters' antennas and the RF created by the SMPS, both enter the house's electric system. The result is that the entire house is transformed into a radiating RF antenna.

25. Any meter with a switch mode power supply will create RF frequencies in the Kilohertz range that enter the electrical wiring system of the house. Smart meters and digital meters inject significant levels of RF onto the home's electrical distribution system.

26. This report is based on information learned to date. I reserve the right to amend, clarify, or change my opinions based on more work or information learned.

Respectfully Submitted:

Erik S. Anderson, P.E.

ENGINEER REPORT – Exhibit 1

ANDERSON ENGINEERING OF NEW PRAGUE, INC.
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ERIK S. ANDERSON

Registered Professional Engineer

REGISTRATION:

Licensed Professional Engineer

State of Minnesota	1991	21471
State of Illinois	1999	062052733
State of Arizona	2003	39627
State of Wisconsin	2008	39418-006
State of Indiana	2008	PE.10809314
State of Iowa	2008	18758
State of New Mexico	2008	19001
State of Texas	2009	102714
State of Louisiana	2009	PE.0034787
State of California	2010	105359
State of Kentucky	2012	28492
State of Michigan	2013	6201060247
State of Nevada	2013	022690

Other Licenses:

Licensed Class A Master Electrician – State of Minnesota	1995	AM005344
Private Investigator – Arizona	2011	1615601
Private Detective – Illinois	2017	115.002549
Private Investigator – Minnesota	2019	PDC 2098
Certified Fire and Explosion Investigator (NAFI -CFEI)	2012, 2017	17853-9760

EDUCATION:

B.S. in Electrical and Electronic Engineering
North Dakota State University, Fargo, North Dakota, 1987.

Chemical Engineering Course Work
University of Minnesota, Minneapolis, Minnesota, 1981-1983.

CONTINUING EDUCATION:	Hazardous Materials: HAZWOPER: 40-hour worker 2008 Annual 8-Hr. HAZWOPER Refresher Course: 2009, 2010, 2011, 2012, 2013, 2014, 2015
	Asbestos Awareness: 05/09, 3/14, 09/16, 01/2020
	Annual Fire Investigation Seminar Instructor Maricopa AZ: 04/08, 03/09, 03/12, 03/13
	Minnesota Chapter IAAI Fire & Arson Conference 3/88, 3/89, 3/90, 3/01, 3/05, 3/06.
	Instructor: Fire/Arson Level 3 Mesa, Arizona, 10/03.
	Illinois Chapter IAAI Northern Zone Winter Seminar Instructor: Electrical Appliance Fires, 2/03.
	Completed Code & Code Change Class Minnesota Electrical Association – National Electrical Code 1/99, 2/01, 1/03, 1/05, 1/07, 1/09, 1/11, 2/13, 5/15, 2/17, 3/19, 2/21
	Illinois Chapter IAAI Fire Investigation Conference Instructor: Forensic Electrical Engineering Principles & Practices, 9/99.
	Graduate Course Work, University of Minnesota Minneapolis, Minnesota, 1995-1997.
	Master Electrician Course, Hennepin County Technical College, Eden Prairie, Minnesota 3/95.
	Completed Designing Electrical Systems for Hazardous Locations University of Wisconsin-Madison, 4/92.
	Completed Electrical Fires Accidental and Deliberate Sponsored by Georgia Chapter of IAAI, 12/91.
	Completed Fire and Arson Investigation Course, Nebraska State Fire & Arson Investigators Conference, 10/87
EXPERIENCE: 01/05 - Present	Anderson Engineering of New Prague, Inc., Phoenix, AZ President & Forensic Electrical Engineer. Responsible for all aspects of business operations including engineering services to clients, product testing, fire investigation, and failure analysis.

Our case load also includes construction defect cases involving the evaluation of the workmanship of the electrical subcontractor and personal injury cases involving electric shock and/or electrocutions.

4/87 – 1/05 Anderson Engineering of New Prague, Inc., New Prague, MN
Electrical Engineer. Responsible to client for engineering services including product testing, fire investigation, and failure analysis.

Midwest Current Transformer, Division of Anderson Engineering of New Prague, Inc., New Prague, MN.
Designer, manufacturer, and quality control engineer of current transformers.

1/84 - 11/84 O.S. Anderson Engineering, Inc., New Prague, MN.
Research and Design Coordinator. Duties included work on transponder design for communications system through earth.

6/83 - 9/83 Koch Refinery, Southeast St. Paul, MN. Conducted ultrasound testing on oil refinery systems.

1981 & 1982 (Summers) O.S. Anderson Engineering, Inc., New Prague, MN.
Assistant Engineer. Designed software for and compiled data of E-fields generated by high voltage transmission lines, assisted in investigations of various cases involving questions of product liability.

PROFESSIONAL AFFILIATIONS:
Member Institute of Electrical and Electronic Engineers.
Member National Society of Professional Engineers.
Member Minnesota Society of Professional Engineers.
Member International Association of Arson Investigators.
Member National Fire Protection Association.
Member National Association of Fire Investigators.
Member American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

EXPERT TESTIFYING WITNESS:

Arbitrations:	02
Depositions:	91
Trials:	27
Arizona Corporation Commission	01