

## The Meter Itself is the “Hazardous Condition

Posted on October 12, 2016

By William Bathgate, Electrical Engineer

October 12th, 2016

Revised October 13th, 2016

Editor’s Note: In the following article, originally written as a public comment to the Michigan Public Service Commission, Mr. Bathgate considers safety issues with the new electric meters as related to our current discussion of a proposed rule change concerning emergency shutoffs for “hazardous conditions.” Revisions to this article are indicated in blue and consist mainly in the addition of a section dealing with the lack of lightning arrestors in the AMI meters.

Case No. U-18120

Proposed Rule 460.137 — 37(1)(a) & 37(1)(i)

A utility may shut off or deny service to a customer “without notice, if a condition on the customer’s premises is determined by the utility or a governmental agency to be hazardous.”

I hold an electrical engineering and mechanical engineering degree and previously was employed through late 2015 for 8 years at the Emerson Electric Company. While at Emerson Electric I was the Senior Program Manager for Power Distribution Systems and in charge of an RF and IP based digitally controlled high power AC power switching system product line in use in over 100 countries and I was also directly responsible for product certifications such as UL, CE and many other countries electrical certification bodies. I am very familiar with the electrical and electronic design of the AMI meters in use because I was responsible for very similar products with over 1 Million units installed across the world.

I have just reviewed the transcripts of the hearing held in Lansing on this subject and came to realize there were many comments regarding the issues identified from the effects of both the RF emitting AMI meter and the non RF emitting AMI Opt-Out Meter. I have personally tested the RF emissions from the AMI meter and measured that the meter does not send data just a few times a day as the utilities publish. It actually sends an RF pulse about every 4-5 seconds constantly and a longer duration RF emission after midnight running about 3-5 minutes. There is no need for the AMI meter to send a pulse every 4-5 seconds all day just to synchronize and time stamp the clock inside the meter, the meter only needs to send data once a day for 3-5 minutes. All these pulse

transmissions the AMI meter is doing is a complete waste of energy and because it is a short but frequently pulsing signal that is not needed to measure power consumption, it is creating needless health effects and is impacting consumers as evidenced in the testimony. Some consumers have been affected to the point of near death experiences. The Mesh Network design is saturating the environment with RF transmissions mostly for the purpose of the network synchronization not the consumption measurement of power. I could not think of a worse network design for a power measurement device.

After reading the transcripts of the hearing I noticed quite a few comments from people affected to a terrible effect by the RF based AMI meter, and interestingly also the RF turned off Opt-Out Meter. It begs the question why do people also seem affected by the Opt-Out meter? Well I went out and purchased an ITRON

Open Way meter identical to the meter being deployed by DTE. I took the unit apart to examine the circuit design of the three boards inside the meter. Generally the boards seem well made with several important elements lacking or missing.

The switching mode power supply circuit is lacking effective Ground References, Lightning Protection and "Common Mode" EMI filters. The circuit boards are lacking a direct local connection to a Zero voltage potential ground at the meter to sink (ground) the current and voltage oscillations of the circuit boards.

Ground References:

Depending on the soil conditions and a solid or not solid low impedance connection ground point or surface, the ground plane reference (called a rotating return) of the circuit boards may be floating over a Zero voltage potential condition. This will create Electro-Magnetic Interference (EMI) via oscillation of the ground reference return paths. The use of no direct ground reference as in use today is a poor electrical practice with the AMI meter given all the environmental variables leads to a floating ground potential that could cause strong voltage and current ground potentials varying from zero to a worse case of 240 AC volts (due to a direct short). If there was a direct short of the feed wire because of a voltage surge on the input power from a power surge or lightning strike at the pole or where the two feed lines cross each other from a downed tree limb I would fully expect the circuit boards to likely explode or melt.

I have tested several homes for EMI created by the AMI meter and found that the ground environmental conditions dramatically affected the amount of EMI present. In one home I tested it had as a ground reference the copper water line feed from the city water supply. In this home there was very little EMI present as shown on my oscilloscope. In several

another homes that had a standard 8 foot ground rod as the ground reference the EMI measured much, much higher. So there is a relationship of the AMI meter to the environmental reference to ground and EMI even though the circuit boards are not directly connected to a ground rod or ground reference. There was likely a magnetic coupling to earth ground taking place at the home using the water main as a ground reference. In all these homes all other lights, TV's, PC's, phone chargers etc. were disabled so I could avoid other variables affecting the readings. It goes to show that environmental variables can be very different from the test lab to the field environment.

### Lightning:

First I have to say from my prior and current experience in very tall and large antenna arrays for the common house and business; lightning is very unpredictable and it is very costly to install effective lightning protection. Thankfully direct lightning strikes that are affecting the power feed and service entrance is random and less frequent. No commercial circuit board was ever designed to withstand a direct lightning strike. The US DoD has such designs but is very expensive to purchase. TV or commercial radio facilities have as much as \$500,000 or more invested in lightning protection in order to stay on the air during a severe storm. All licensed amateur radio antennas are required by the FCC to have effective ground protection at the base of a tower to shunt a strike to ground. You are actually safer from lightning to be living close to a large metal antenna array because as a general rule lightning tries to reach ground via the shortest and lowest impedance electrical path. It is not uncommon to see a lightning trace zigzag across an electrical path as it seeks the lowest impedance and shortest path to zero potential ground. Note I did not mention the potential for RF exposure which is a separate issue altogether! A neighbor's tall (over 30 Feet) metal antenna will be a shorter path to ground for lightning than your house next door.

In the AMI meter the circuit board that powers the solenoid actuator for the remote power disconnect feeding the power blade connection at the meter box is susceptible to the effects of lightning. When the low voltage DC power source on this circuit board becomes disrupted by a lightning strike and provided that the circuit boards survive the strike at all, this circuit board driven solenoid is subject to highly rapid disruption with a high frequency opening and closing of the remote disconnect contacts causing arcing and burnt contacts within the meter. This is completely undetectable by the consumer and may or may not manifest itself with flickering or dimming lights etc. The lightning may strike from two common sources; at the power pole or/and the surrounding ground area of the business or residence. The common person or business owner may not realize that the home or business ground rod reference wire runs in the middle between the two 240 volt AC power connections within the meter box and continues on to your entrance

breaker panel. This is a minimal form of lightning protection because if the power pole gets hit by lightning the surge will likely jump the air gap between the two power line connections within the meter box and will shunt the lightning via the ground wire to the ground rod. Of course the meter and meter box itself may be damaged from this along with some of your internal house appliances etc. This ground connection was never meant to protect the meter box or your house internal wiring to survive a lightning strike; it is a power safety ground in case your internal house wiring or appliances have a direct short. Though not well known is that lightning can enter a building or home via your phone, DSL or Cable connections. I have learned from several catastrophic events by having my internet connections, TV's and PC's destroyed by a lightning strike many blocks away traveling these connections into the home. While I could not protect the DSL modem or cable modem from damage I could isolate the rest of my network with Ethernet Fiber Media converters. Once I did this I only lost the modem and nothing else downstream from it.

Analog Meters contained no electronic circuit boards and while not 100% immune from the effects of a lightning strike, they are much more tolerant than the AMI meter.

Common Mode EMI:

A "Common Mode" filter attenuates high frequency currents. A common mode filter in this case would look like two coils wrapped around an iron or iron ferrite core either in the shape of a donut or a small cookie bar. This filter is not present in the current circuit design and if it was there the switching circuit which converts 240 Volts AC to 5-10 volts DC would be prevented from sending EMI oscillations back onto the 240 Volt AC wires entering the home.

I am very familiar with the design elements of a switched mode power supply because I had to include "Common Mode" filters into the products I was responsible for while at Emerson Electric to minimize the Electro-Magnetic Interference (EMI) coming from the switching integrated circuit back onto the feeding input AC circuit and the output AC circuit. A clean 50 or 60 Hz is needed and the AC input and AC output had to be void of any oscillation introduced by the switching circuit. I would not have been able to sell the same ITRON switched mode circuit design with the products I managed. I would have been fired for allowing such a condition.

If DTE (or any Utility) was to demand of ITRON, their supplier, to provide a "Common Mode" filtering circuit and tested this design for elimination of EMI and of stray capacitance present in the current design, I believe the troubles with people becoming ill from the Opt-Out AMI meter could be significantly mitigated. This should not be ignored

or taken lightly. There could be a solution to help the people affected by the high frequency oscillations created by the switched mode power supply.

In short lacking a redesign of the AMI meter switched mode power supply the solution for people affected by the AMI meter program is very simple and costs nothing, allow those affected residents and business to retain an Analog meter which is readily available and meets all ANSI and other applicable standards.

Summary:

The MPSC has been asked to grant the Utilities the ability to turn off power to people and businesses without notice for “Dangerous or Hazardous” conditions. Based on my professional examination of the metering technology deployed with AMI meters, the meters themselves are “Dangerous or Hazardous” due to their Lightning vulnerabilities, EMI and RF emissions. There has been a disregard for the health and safety effects of these AMI meters on the general population by the utilities and their AMI supplier. So by their own lack of definition of “Dangerous or Hazardous” all AMI meters deployed at present need to be subject to shut off of service without notice due to “Dangerous or Hazardous” conditions. This may be silly logic on my part but the logic of the proposed rule is equally silly logic and the rule change request should be denied due to lack of definition of what is “Dangerous or Hazardous”. Based on my analysis of the AMI meter and the Analog meter the AMI meter is far more dangerous to the general population than the Analog meter.

In addition I think the MPSC should have a more active role in the technology decisions made by the utilities themselves. In the case of AMI meters the MPSC overlooked this responsibility to assure the utility monopolies are providing a safe metering technology to the consumer and businesses. Based on the effects on the population with people reporting near death experiences and crippling of their bodies with the AMI meters, this decision should be revisited by the MPSC in unison with the various groups that have reported serious issues with this technology. Otherwise the affected population at some time in the future will hold the MPSC directly accountable in a class action law suit which would have to be defended by the State of Michigan using scarce tax dollars for legal expenses. In the Flint Water Crisis the State of Michigan failed to provide proper governance and oversight of the water decisions in Flint costing the State of Michigan many hundreds of millions of dollars and it is far from settled yet.

Does the MPSC not see the similarities of Flint here with the AMI technology that has serious issues that can be simply solved? I do not want my tax dollars spent on defending the MPSC from a class action lawsuit. This requested rule set request is both deceptive

and it is also obvious that the utilities want this rule provision to force every person to comply with whatever they want and bypass the MPSC to do it. This will permit the Utilities to use Social Media posts and other forms of protest criticizing them as a condition that is “Dangerous and Hazardous” and turn off power to shut people up and use the intimidation of shutoff of their power service without notice to deny them their first amendment rights. The public is not that stupid, significant numbers of the public knows the Utilities are going to use this tactic to force every home and business to have an AMI meter or else they will shut off their power without notice, even though there is no Federal or State law that specifically calls for an AMI meter. This AMI technology is specified in Federal law as a voluntary option for consumers not mandatory.

Forcing 100% compliance to AMI metering is not the solution; this will only lead to big legal troubles for the MPSC as a whole and direct legal liability to all individual MPSC members. Based on the testimony already made regarding AMI meter health issues the MPSC needs to step up and fulfill its charter to the residents of Michigan to provide SAFE and reliable power and not leave this to the sole discretion of the utilities. The current AMI meters are not safe, as evidenced of the dramatic testimony of residents that are suffering terribly and the engineering analysis such as I and many others in this field have performed.

If the MPSC approves these rule changes, then the MPSC should disband because your role in governance is of no value, merit or benefit to the citizens of the State of Michigan who are paying your salaries. You would have abrogated your governance role to the utilities to do as they see fit for their own exclusive benefit and no one else.