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## ***Lightning And The Thunder: Smart Meter Upgrade Results In Small Miracle***

*by Paul L. Schimel, P.E*

It's a catchy song, "Thunder," delivered full force by the wailing pipes of Dan Reynolds and his band Imagine Dragons. Feels great loud. Gets you going. And for me there's a much deeper tie to the "Lightning and the Thunder" lyric.

I've been traveling a bit lately. Coming home is truly the best. But on this last trip, I came home to a "smart meter upgrade" truck in my driveway. The gent had the proper ID and a ton of safety equipment—full 40 cal/cm<sup>2</sup> arc flash suit, Class II gloves and protectors, and a full visor. And the stuff was all new and clean like it had seen little use, perhaps fresh out of the training room after the two-hour seminar. And the Lightning and the Thunder wasn't far behind him.

"I am here to upgrade your meter," he says. Okay, so I show him where the meter can is located. I also go inside and kill the mains. I figure it's respectful and courteous to have him perform the upgrade with zero current flow. I then walk outside to keep him company. And this was a chore. It was 5°F with a wicked wind chill....and we were on the windward side, unsheltered.

"You don't need that safety gear to pull that panel," I razed him after explaining my lifelong pursuit of and interest in matters of high-power interactions, power electronics, renewables, etc. And it was as though someone tied to the paranormal was listening. No sooner than I razed him about all that shiny new safety gear the panel flashed over as he was removing the cover to pull the meter.

Whoa! The poor guy got really scared. Having seen a few flashes of my own, his fear showed his lack of training.

Okay, what happened? Is fault cleared? Can/will it happen again? These are the questions I was asking.

His initial comment was that he'd just put everything back together and come back next week with proper staff. I didn't like his idea. Should the arc restrike, it was on the fed side of the meter (read as no protection).....unless you want to count the "shotgun" fuse in series with the 7,200V single-wire earth return (SWER) line feeding the transformer a half mile away. Smart grid or not, that fuse isn't smart enough to see that fault. This means it would then burn, on the side of my house. The fire would propagate up, doing a whole mess of damage. I'd rather not go that route.

Not too long after this event, a support crew rolled up. It turns out all flash incidents must be reported. The act of reporting generated a small miracle. It brought the right people to the job.

The folks on the responding crew were bright. I could tell they had been in action for a long time. Their tools and equipment showed use, which I equate to knowledge. Not foolish wear and tear like using an insulated socket wrench for a hammer or a screwdriver for a chisel, but good, honest wear; like my own tooling shows. If you've been using tools long enough for them to show wear, you aren't new and you are skilled enough to have operated the tool for a long time safely. There is no substitute for that experience, nor can it be transferred in a training room in two hours.

By now I understood the fault, but the "how" part didn't make sense. No one claiming electrical knowledge would have wired that ground rod conductor that close to that hot leg. So why then is it so? How did it move to the point where it touched when perturbed? And this is where the chief electrician, we'll call him Dave, impressed me.

"When the ground freezes and thaws, and the foundation settles, our conductors (which are buried) move," says Dave. "The pipe moves, the box moves. Even if it's only ¼ in., it still moves. That ground rod conductor was originally dressed an inch or so away from the hot terminal, but with all that moving, the ground rod conductor eventually saw some tension and pulled toward the fed terminal".

With that, Dave won my respect and captured my undivided attention.

"It looks like this arced once before," says Dave.

And then it hit me. We had a weird sequence of events on the 7,200-V side of the service involving a fallen tree, a bunch of high-voltage arcing, broken lines, and what ended up being a whopper of a transient surge. It was likely that transient created the first arc event. Thinking back I remember hearing it.

I was machining some aluminum on my mill and I noticed the voltage sag, then heard the tremendous buzz from a couple blocks away. I shutdown the mill and killed the mains. A few moments after I killed the mains, I heard a much louder arc nearby. That was it. The transient surge generated on the high voltage side of our distribution transformer passed through, and that ground rod conductor was in just the right spot for it to arc over to the hot terminal. In other words, that second arc event was on the side of my house! And then the freezing and thawing between the events, combined with the gentle perturbation of moving the meter can cover panel ever so slightly, set off the arc event the tech saw when he attempted to change out the meter.

Dave and I inspected the ground rod conductor carefully. Although there was damage on the aluminum terminal, the ground rod conductor was fine. This stands to reason, as aluminum has a lower melting point and latent heat than copper and would melt first.

Dave stretched out the curly Q, insulated the ground rod conductor with some electrical tape and then some class N Varglass, and moved it well off to the side in anticipation of more movement. Now it's much further away from the hot terminal, and if it ever does work its way over to the terminal again it is well insulated.

While I love the Lightning and the Thunder, and I'm wholeheartedly dedicated to keeping things safe, I have to admit that I not only learned a lot from Dave, but I will forever respect him. The man did a hell of a job. He quickly analyzed the situation and identified the root cause of the failure—something that can't be passed on in a quickie training seminar.

### **About The Author**



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