



ELECTRONOTES

WEBNOTE 12

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ANOTHER ONE FOR THE CASEBOOK OF TROUBLE SHOOTING

A month or two ago I attended my 50th reunion of my high-school graduation. As part of the agenda we attended the 2013 graduation ceremony as honored guests. Any feeling we might have had about being excessively old was dispelled first by the presence of so many grandparents of the current graduates, but more fundamentally by the attendance of a lady who was there for her 80th anniversary of her graduation in 1933. We got polite applause – she got a standing ovation, or course.

None the less probably after the age of 30 or so most of us feel obliged to say how things were done, or at least how they were done differently (better?) in the “old days”. So here I recall the fact that in the old days we often repaired items that had become inoperative. Today we just throw them out and order a replacement online, probably better and cheaper. Understandably so. As it has become less and less economical (or impossible) to repair something, so too have the skills (mindset) associated with trouble shooting waned.

I have kept a “catalog” of a class of trouble shooting events, going back to my 2nd year at college (so – just after HS graduation) . I have told this story before. It was an event where I had added a jack to my roommates FM radio so that it could be used as an FM tuner. This worked fine, but as for the radio itself (heard through the original speaker) the sound was badly distorted. All I did was attach the jack to the top of the volume control – a short length of wire. The distortion did not go away even when there was no cable in the jack. Used as a tuner, the sound was fine. I was positive that the jack could not be the problem. My roommate, a music major, who incidentally worked for Moog a few years later, was not so sure I knew what I was doing.

Thus began my fascination with the association of two unique events occurring “simultaneously” with no apparent connection – what we call “coincidence” of course. Because causality is thereby not suggested (let alone evident, let alone even plausible) we tend to feel the events are independent. It is the conflict between two things that both seem unlikely: (1) that two independent events were closely related in time, and (2) that any possible causal relationship seems unlikely if not impossible. I have also noted that often additional evidence is right there, which we ignore.

In the case of the radio, the additional evidence was that when I put Ken’s radio back together, I was missing one of the lockwashers. Probably I looked a few second and thought “who needs a lockwasher anyway”. Well, the lockwasher had been grabbed by the speaker magnet, and was rubbing against the cone; hence the scratchy distortion. There was a connection (almost always there is) and there was additional evidence (there almost always is).

So. Two days ago when I got up and was about to make coffee with the microwave, the microwave was off. The stove clocks and kitchen lights worked. Why had that breaker failed? I went down to check the breaker, pulled the string for the light over the box, and nothing. Using a flashlight, no breakers were popped. Soon enough I found, as the reader has likely guessed, that half my circuits were out because one of the two phases was dead. Why?

Plenty of suspects. Two weeks ago, the power company, which is relocating poles and services, had moved several poles a foot or two and relocated the transformer. This new and much closer (300 feet closer to me) transformer was welcome. I expected I might no longer notice my refrigerator dimming the lights when it clicked on, let alone my neighbor’s refrigerator coming on. Indeed, that was the case. But now, one phase had stopped. Faulty new transformer, or bad connection giving up early.

There was another suspect. For several hours workers from the natural gas side of the utility had been digging in front of my property, as they are relocating the gas line as well. In fact, that seems most likely. So I go out and ask them if they had hit the power lines. “Your service is overhead”, he tells me pointing up through the trees. But he soon realizes that it is my neighbors lines that are overhead, mine comes down the pole into the ground. So had they cut the line? Nope.

For one thing, where they were digging was still 15 feet from where I thought the underground lines were. Indeed, his locator showed the power lines away from the gas line digging. Now, knowing that they had not hit the line and reported it, it was time to call the company for the electrical outage. The gas-line digging was just a distraction.

When the power guys showed up, they pulled my meter and sure enough, said that one phase was out. They checked with my neighbor with the overhead wires, and she had all circuits. Her lines were connected a few inches beyond mine. I asked them to check at the top of the pole to see if the connecting taps were secure. They were, and both phases were 120 volts up there. So the guy says “Do you want the bad news or the bad news.” I said that I would settle for the bad news. He said that my undergrounds had a defect and that I would have to call an independent contractor. That sounded like a lot of money. Also, I was quite certain it was WRONG. I said I was “not buying that” and that the problem was almost certainly associated with their moving the pole. He must have heard the ring of truth somehow.

So they got out a shovel and started to dig around the pole (the soil was still loose gravel). In the mean time I went back with the other guy to plug my meter back in. I asked him to use his multimeter to measure the actual voltages. The good phase was 120 volts, and the bad one was: NOT 120 volts. Actually it was 71 volts, but this was not under load anymore, so most readers of this note will quickly recognize that the 71 volts is consistent with a busted conductor which none the less has some resistive path (like wet soil) between the severed ends. At this point, I would have loved to have taken a length of wire and bridged the meter slots. I would guess the voltage would have gone to near zero (probably I had at least one light bulb of something on for that phase). But I didn't get to suggest that experiment. He was plugging the power meter back in, to the same effect, but I could not measure the voltage with the power meter in.

As we were going back to the roadside, the digger was saying “I found the problem – when you put the meter back in smoke comes out of the hole.” At this point, the hot side coming down the pole was fully hot, and the loads in my house (coming back out to the road) were looking like ground, so the soil was a resistor with 120 volts across it. Smoke, steam, or some mixture was the result. I went to eat lunch, and 10 minutes into (a cold) lunch the power came back on. I went out and the guy told me the power was back on, and they were off to the next job. No one said “We should have listened to you” and that would have been nice, but why should they listen to a customer. They had no way initially of knowing I did know something about electricity, and trouble shooting. And I guess they did listen as I pushed them in the right direction. Fair enough.

I had hoped they would show me the defective wire, but they didn't. Looking around in the evening, however, I found one end that they had cut off and just dropped (see photos). The metal at the break (aluminum in this case) was gone completely, and the plastic insulation had melted, and it just looked ugly (compare to second photo of other end). Exposed aluminum, water, and likely some road salt and gotten to some nick in the wire they had damaged drilling the new hole for the pole. Note that this is exactly where we should have guessed the flaw was based just on likely occurrences.



So this is interesting and fits the contention that two unusual events in some degree of proximity are likely related. Here we had two unusual events: it is rare that they move a pole close to my property (not since well before we moved here), and it is rare that only one phase goes out when power goes out (like I have never seen it). So anyone should be suspicious even if you know nothing of electricity. Another part of my collection of cases relates to the “additional evidence” which was available but too often ignored (like the momentary realization that one lockwasher was missing).

Here, the evidence was a flickering. As I said, I anticipated that because the moved transformer was almost directly connected to my service, the lights would no longer dim when the refrigerator comes on. True enough – they didn’t. But I had noticed a

different sort of flickering in my office, but not in the bedroom. Not enough to cause one worry, but something that struck me funny as I was anticipating a very stable voltage. I was also sensitive to any flicker because I worry about “time-bomb” CFL’s which I am trying to phase out (see earlier notes). But what’s a little flickering.



So that’s the story for the casebook. But I do wonder what would have happened if I had not been an EE. What if it were the guy next door? Oops – bad example; Pete is an EE too, and would have done what I did – probably better. But you get the idea. Would the contractor have located the problem in minutes? Would the power company have reimbursed me for the contractor’s charges once they learned it was their fault? Better not to find out.