Perhaps this article is a result of my reluctance to keep up with the electronic times. My kids say we live in a well and my officemates are always making fun of my wind up clocks, fountain pens and pocket watches. I will agree that the ribbing is justified but I believe there is a bit of truth to be learned from every eccentricity. The bad thing about a wind up clock is that you have to wind it every day. The good thing about a wind up clock is you have to wind it every day. It takes some involvement on your part. Sure the clock is your servant but you have to put something into the deal to keep the thing working.

In our power plants we like things to be automatic and take care of themselves. If pump seals could always remain sealed and feedwater heaters could always be at the right level life would be wonderful. However, pump seals often leak and feedwater heaters can sometimes have a mind of their own. This forces us to check on them periodically; we call that monitoring. Enter the Apps. Imagine the suffering with my entrance into the automated life of an iphone. Without these apps the phone needs to do all the wondrous things it is supposed to it is useless (you even need an app to make a call! Who needs a brain, just get an app.) The following story is an example of how this applies to a power plant. This story actually occurred at a power plant but it has been fictionalized so even those involved will not recognize it.

It was a cold New Jersey morning and as I walked into the office I noticed that the little indicator light on my phone was blinking. So even before I picked up my clock for its morning wind, I listened to the message. “Hey, Mr. Megawatt, we seem to be having some problems here at our plant and my manager wants someone from more than 50 miles away to come out and give us an opinion.” So I picked up my clock, gave it a wind, and cleared my schedule; I was on my way to BTU City Electric Station.

As my plane landed in BTU international airport I met my sidekick and holder of the company brains, Gregory J Gigawatt (we call him GG). We had previously reviewed the plant thermal kit and piping and instrumentation drawings so we had a good idea of what we were dealing with. As we exited the safety video booth (they always give me the creeps) we met a budding young engineer named Jimmy with a serious frown. “Hi, thanks for coming, I just got out of a meeting with plant management and they asked if you had an answer yet.” Apparently they thought it was a turbine problem. I introduced GG and we proceeded to Jimmy’s cube where there was standing room only. Jimmy showed us his computer. GG and I were astounded. Jimmy had every thermal performance-monitoring program you could have ever asked for. He had six calculations of plant heatrate. The graphs, charts, gui displays and graphic simulations were dizzying. We took a look at the six heatrate calculations and notice that they ranged from 7000 Btu/kWh to 9900 Btu/kWh for the same set of data. When we asked about that Jimmy indicated that they were all guaranteed to be accurate by the vendors. He told us that he did not have any alarms but that their output was lower than before the outage.

So we sat down and asked some specific questions about what had changed in the last six months. Poor Jimmy thought he had landed in the middle of a crime scene. After we clicked off the bright light (GG is always the good cop) we came away with the fact that after the outage they had changed their fuel to Powder River Basin (PRB). We asked Jimmy to get us the latest analysis and moved on to the plant data.

Jimmy proceeded to feverishly click around on his "apps" and after an hour or so I asked him if we could just download the stuff into a spreadsheet. Jimmy did that and we quickly made some graphs. The first thing we noticed was that everything seemed smooth, too smooth. GG asked Jimmy if they had data compression on their archive system. Jimmy said, "data compression?" In Gregs gentle way he asked Jimmy if he could fly for a little and after a few minutes GG had determined that the IT folks had set the compression ratios to about 10% in order to conserve disk space. At a 10% compression ratio the only thing you could monitor was if the plant had tripped or not. We told Jimmy that we would kick in a 1 terabyte disk that would hold about 10 years of plant data and he could have his IT department reset the compression ratios to about 0.1%.

After going to another computer where more data was available we started looking in earnest. First thing we noticed was there was very little temperature rise across the second point feedwater heater. Normally this heater should have about a 50 °F temperature rise but it now had about 13 °F. I wrote that down in my little black book and we continued our perusal. The heater pressure was also low and Jimmy said that the pressure indicator was not working. After a few hours of data review we felt it was time to put our new knowledge from the safety video to use and do a plant walk down.

During this walkdown we walked over to the heater in question and noticed that the extraction supply to the heater indicated open (this is why they said that the pressure indicator was not working). GG pointed out that it is odd that the temperature and the pressure indicator would fail at the same time. From the plant data we also noted that the temperature rise to the downstream heater was very high. Now our curiosity was peaked; I asked GG to break out the computer model; let's test a hypothesis.

Here are the facts that we uncovered:

1. Temperature rise across the heater was low.
2. Pressure of the heater shell was low
3. Heater Drain Valve was indicating almost closed
4. Heater Extraction Supply Valve was indicating open.
5. Heater emergency dump valve was indicating closed and the downstream temperature was low.
6. Computer model simulations indicate that the plant data is consistent with the heater being out of service.
7. Temperature rise across downstream heater was high.

It was clear that any problem except no steam getting to the heater would have to have multiple failures so referring to "Occam's razor" we decided to suggest the simplest answer. The Steam Valve was actually closed when it indicated open.

Using a model we developed for the plant GG simulated a heater with the steam supply valve closed and everything lined up like the real plant.

Computer model Heater Comparison Date	Heater Temp Rise (°F)	Condenser Pressure ("Hga)	Gross Power (MWe)
Pre event	60.6	2.68	215.5
Post event	6.9	2.73	213.1
delta	-53.7	0.05	-2.4

Data was collected before and after the outage where the anomaly occurred. A set of data at a common load and backpressure was chosen to represent operation before and after the event. The model had a set main steam flow that was representative of the plants general operating load. Plant data was selected based on similar condenser pressures to remove any variation related to the low pressure turbine last stage efficiency. Only the main steam flow, back pressure and affected feedwater heater tube side outlet temperatures were set. All other parameters were dynamic in the model. The heat rate calculated by the computer model is based on gross power but does not include boiler efficiency effects. For this comparative study there were no sprays or boiler blow down.

One would think that management would have been happy not to tear apart their turbine but they gave Jimmy a hard time about it. Fortunately Jimmy stuck to his guns and reminded them that this was a recommendation from someone more than 50 miles away who owned (and sometimes wears) a tie. As it turns out, the next outage they looked at the valve and the stem had separated from the disc.

To sum it up; Jimmy had all the tools one could ask for but they could not do the job for him. My iphone apps are a great thing but as I just learned while using the level app you have to keep your brain engaged and not let the software make your logic fuzzy (pun intended). You may be thinking that we did use an app (the computer model) but that was used after the brain, it's always the order of things that's important. You also may be wondering about the PRB change, your right there was an issue but that's for another article…..