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The Next Level for Thermal Performance

Mr. Megawatt

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Apps are Nice, But Brainpower is Better

by Frank Todd, Manager, Thermal Performance

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 office mates are always making fun of my wind up clocks, fountain pens and pocket watches. I know the ribbing is justified, but I also think 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. But I think that's also the good thing about it. It takes some involvement on your part. Sure the clock is your servant, per se, but you have to put something into the deal to keep it 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 seem to have a mind of their own. This forces us to check on them periodically – aka monitoring.

Enter the Apps.

It was not easy to enter the automated life of my iPhone, but without the apps the phone 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 happened at a power plant, but it has been fictionalized so that 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 Frank, we're having some problems 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 was joined by my friend and holder of the company brains, Gregory J. Gigawatt, or Double G. 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," he said.

Apparently they thought it was a turbine problem. I introduced Double G and we proceeded to Jimmy's cube, where there was standing room only. Jimmy showed us his computer. Double G and I were astounded. Jimmy had every thermal performance-monitoring program you could have ever asked for. He had 6 calculations of plant heat rate. The graphs, charts, gui displays and graphic simulations were dizzying. We took a look at the 6 heat rate calculations and noticed that they ranged from 7,000 Btu/kWh to 9,900 Btu/kWh for the same set of data. When we asked about that, Jimmy said 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 6 months. Poor Jimmy thought he had landed in the middle of a crime scene, but we learned 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 data into a spreadsheet. Jimmy did, and we quickly made some graphs.

The first thing we noticed was that everything seemed smooth, too smooth. Double G asked Jimmy if they had data compression on their archive system. "Data compression?" Jimmy seemed confused.

In his gentle way Double G asked Jimmy if he

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could handle the controls, and after a few minutes he determined that the IT folks had set the compression ratios to about 10 percent in order to conserve disk space. At a 10 percent 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 percent.

After going to another computer where more data was available, we started looking in earnest. The 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 search. The heater pressure was also low and Jimmy said that the pressure indicator was not working. After a few hours of data review, we thought it was time to put our new knowledge from the safety video to use and do a plant walk down.

During this walk down 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). Double G 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 piqued; I asked Double G to break out the computer model. It was time to test a hypothesis.

Here are the facts that we uncovered:

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

It was clear that any problem – except a lack of 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, Double G simulated a heater with the steam supply valve closed, and everything lined up like the real plant.

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.

The lesson from this story: 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 might be wondering about the PRB change. You're right, there was an issue, but that's for another article …

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