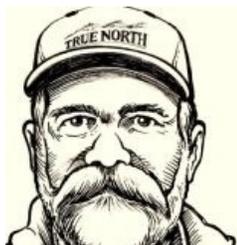




The Next Level for Thermal Performance

Mr. Megawatt
As featured in *EnergyTech Magazine*



Data, Risk and Turbines

by Frank Todd, Manager,
Thermal Performance

We all have had to make a decision based on information that we were not quite sure was reliable, knowing

that the decision could cost us quite a packet (English slang for a whole lot of money). Do I spend my last 20 paychecks on fixing the septic tank, or do I take the risk when all the relatives come for the 4th of July celebration? At least, that's what the plumber said. Of course, he would have been wearing a leisure suit and white patent leather shoes if he had been selling me a car. I think he used the word "volcano" somewhere in his description.

This was the case we were faced with at Jersey Jungle Power Station (JJPS). JJPS is located in scenic downtown Jersey Jungle, think Gotham at its worst. Therefore, when the plant manager at the other end of the line said, "We had better be right," visions of a horse's head in my bed came to mind. Greg Gigawatt was off somewhere in Idaho eating a potato, but I had to have some muscle for this one, so I asked Brian the BTU Buster to jump in his Miata, meet me in the New Jersey office and I'd make him an offer. When going up against JJPS, I needed someone who looked the part. I then put in a call to Jonny Joule, who has a talent for looking tough, but thinking like a pencil neck.

We arrived at the plant in a black Lincoln Town Car with darkly tinted windows. The three of us exited the car simultaneously looking like the Men in Black. Vito, the plant engineer, took us into the office where there was a distinct smell of gravy (that's Italian for spaghetti sauce) wafting through the halls. We sat around a large oval table with what looked like trap doors under each specifically colored seat, except for the one at the head of the table. As we sat down, I asked if they would be offended if we took off our sunglasses so we could see the data. In walked the plant manager with a trail of personnel who had the appearance of henchmen.

"Gentlemen," said Mr. Gangone, the plant manager, "We are pleased that you have come to help us with our little problem. We have full confidence that you will be able to give us a satisfactory result.

Please do not disappoint us."

Brian, Jonny and I looked at each other and gave a simultaneous gulp.

Vito then laid the facts out before us. The plant had been experiencing a steady decrease in heat rate since its last start up and some of the engineers thought that it might be the turbines. As you know, taking apart the turbine is a very ex-

pensive undertaking; therefore it would not be received well if it turned out nothing was wrong. A couple of the tough guys started to sweat. So Mr. Gangone had asked us to bring in some help to verify that it was indeed necessary to open the turbine during the next outage. With summer peak demand approaching, Mr. Gangone needed to recover this lost generation.

As we walked out of the room, all three of us knew that we had better get this right!

Brian asked Vito for the following information to get started on the evaluation:

- Thermal kit
- 2005 Post outage performance test report
- Previous turbine outage report
- The usual set of plant drawings
- Complete list of available computer points

Once we looked at the documents, we asked them to provide some historical plant data for evaluation. This data was analyzed and the measured gross load was corrected to standard conditions. The corrected gross load from the 2005 outage was 417 MW and 384 MW for 2007. This is a difference of 33 MW; it is estimated that 26 MW of the 33 MW difference is due to degraded HP efficiency and reduced steam flow through the turbine. The estimated 26 MW could be recovered if the HP turbine efficiency and the steam flow are returned to design. The remaining lost capacity appeared to be a result of higher dummy packing leakage, as well as some IP efficiency issues. Plant data for April 5-6, 2005, and Aug. 13-14, 2007, was analyzed and the measured gross load was corrected to standard conditions.

HP turbine efficiency was 4.40 percent lower than design after the April 2005 outage, and continued to degrade an additional 3.60 percent to August 2007. The 2007 HP turbine efficiency was 8.00 percent lower than design and indicates the HP turbine condition is degraded.

The IP turbine efficiencies for 2005 and 2007 were 8.50 percent and 7.70 percent higher than design respectively, and indicated higher than design dummy packing leakage. It was not possible to quantify the amount of the dummy packing leakage with the plant data, and therefore it was not possible to calculate the actual IP turbine efficiency. The actual condition of the IP turbine was unknown, but based on the apparent degradation of the HP turbine as indicated by the reduction of the HP turbine efficiency, it was probable that some degradation had occurred to the condition of the IP turbine as well.

The boiler feedwater flow in 2007(2,972,091 lb/hr) was 14 percent lower than design (3,014,900 lb/hr) and 6 percent lower than the 2005 (3,170,125 lb/hr) boiler feedwater flow. The 2005 boiler feedwater flow measurement was 5 percent higher than design and therefore the measurement was suspected to be in error. The 1st stage pressure is an indicator of

Continued

flow through the turbine. The 2005 1st stage pressure (1,756 psia) is essentially at design (1,764 psia). The 2007 1st stage pressure (1,666 psia) is 5 percent lower than design, and the 2005 1st stage pressure. It appeared that from the 2005 outage to the 2007 outage, the turbine flow passing area had decreased, resulting in a reduction of steam flow through the turbine. The likely cause of the decreased flow passing area was deposits in the turbine.

So after we quadruple checked the data, amassed an arsenal of graphs, tables and charts and dramatically increased our life insurance policies, we walked back into the big room with the trap doors under the chairs. Mr. Gangone walked in, sat down and started fiddling with this array of push buttons that were the color of each of our chairs. (We hadn't noticed that feature before.)

"Gentlemen, you have had a few days to review our situation and I am hoping that you have some good news for me" Mr. Gangone said.

Brian and Jonny looked over at me with a distinct look of dread, so I waded in.

"Mr. Gangone," I said in the most confident Italian sounding voice I could muster, "We believe that we have identified the possible problems with your plant efficiency and have the following observations recommendations:

- Reduction of steam flow through the turbine as indicated by the reduction of the boiler feedwater flow measurement and the 1st stage pressure measurement. Reduction of steam flow through the turbine is likely caused by a reduction in the flow passing area due to deposits.
- Degradation in the condition of the HP turbine as indicated by the reduction of the HP turbine efficiency. HP turbine degradation causes could be deposits, spill strip damage, inter-stage packing damage and foreign object damage.
- Dummy packing leakage higher than design, as indicated by the higher than design IP efficiency. Higher than design dummy packing leakage is caused by damaged dummy packing.
- Degradation in the condition of the IP turbine is suspected, although the actual IP efficiency is unknown due to the higher than design dummy packing leakage. IP turbine degradation causes could be deposits, spill strip damage, inter-stage packing damage and foreign object damage."

I added, "We recommend that at the next HP IP turbine outage, they inspect, clean and repair the HP and IP steam path, including inspection and repair of the dummy packing. We believe that this is an accurate evaluation and are willing to stake our reputations on it."

Mr. Gangone told us he appreciated our work and was also willing to stake our reputations – among other things – on it.

So a few months later, when we received a rather suspicious looking package from JJPP, it was opened with more than a slight bit of fear and trepidation. However it turned out to be a collectors' edition of "The Godfather," so we knew things came out well.

Jersey Jungle Station had just completed its outage and inspected the HP IP turbine. The HP IP turbine was found to have considerable deposits throughout. HP turbine spill strips were damaged.

HP turbine inter-stage packing was rubbed and the teeth were flattened. The upper and lower IP dummy packing was found to be heavily damaged; the packing was badly rubbed and the teeth were flattened. The IP turbine was found to have considerable deposits throughout. IP turbine spill strips were damaged and IP turbine inter-stage packing was rubbed and the teeth flattened.

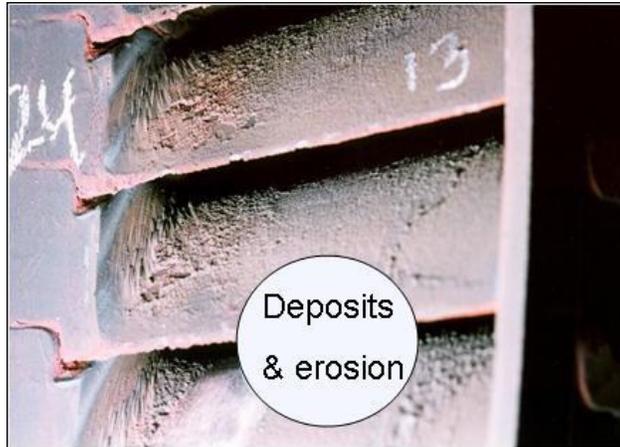
During this outage Jersey Jungle Station performed the following:

- Removed the deposits from the HP IP blades and blade rings
- Repaired the HP dummy packing
- Replaced spill strips
- Replaced IP dummy packing

When they got back to power, JJPS had returned to normal and we could all sleep a little easier. As engineers, our job sometimes calls for a little bit of risk taking. It is important that we take the time to evaluate the data well enough to reduce the

risk as much as possible. But there will always be some amount of risk involved. Fortunately for us, on this job none of our wives collected on those big insurance policies we took out.

Mr. Megawatt is Frank Todd, manager of Thermal Performance for True North Consulting. True North serves the power industry in the areas of testing, training and plant analysis. Todd's career, spanning more than 30 years in the power generation industry, has been centered on optimization, efficiency and overall Thermal Performance of power generation facilities.



Contact Us!

TRUE NORTH CONSULTING THERMAL PERFORMANCE

694 Hardingville Rd
Monroeville, NJ 08343
856-391-3347
856-391-1105 (fax)

fdt@tnorthconsulting.com

Check out our website: www.tnorthconsulting.com