“The Emperor has No Clothes” or “What happened to my Cooling Tower’s Blowdown?”

Have you ever noticed a serious production problem, but hesitated to mention it because it might not be well received by plant management. Plant management sometimes has different objectives and priorities in addition to plant efficiency. They have to communicate to CEOs, the board of directors and to shareholders and investors. They sometimes are in the unenviable position of being the bearers of bad news to some very important people. What if you were the plant manager of new 500 MW coal fired power plant and you were told that the cycle efficiency was poor? What if the back pressure on the new plant’s turbine was higher than design and you may have to derate the unit? What if your new “state of the art” cooling tower was operating poorly? These are huge dollar issues that eventually have to be addressed however unpleasant.

Sometimes the “emperor has no clothes” message is left to the lowliest of the technical staff and sometimes to outside vendors. One of the first clues to the seriousness of the problem was the lower than design amount of cooling tower blowdown.

Knowing that a 500 MW power plant was recirculating about 250000 gpm to a open recirculating cooling tower and that the basin water temperature was too high and that turbine backpressure was a real concern. (See diagram of typical cooling tower flowrates for a 500 MW power plant)

The amount of blowdown was estimated by the plant chemist and the water treatment specialist. The evaporation factor (EF) was estimated and the cycles of concentration (COC) was known. A design estimate of the EF was .70 and the COC was 4.5. The estimated design blowdown was 1000 GPM or roughly 1.4 MGD. The problem that we needed to address was that the actual blowdown from the cooling tower was less than half of the design blowdown. After checking and rechecking our numbers and our calculations our conclusion was that the cooling tower was not efficiently evaporating water. Pointing out that a new cooling tower at a new 500 MW station was not efficient was not good news for anyone.

As it turns out that the station engineer was coming to the same conclusion and was scheduling a Cooling Tower performance test about the same time.

What was going on? Well a couple of problems were discovered. One was a design problem and one was a difficult water chemistry problem. First the design problem. The cooling tower was a new design “low profile tower” about two-thirds the heigth of a standard open recirculating tower. The tower was filled with “corrugated” plastic Munters’ fill but the evaporation rate for the shorter version of the tower was inadequate to provide the evaporation needed for the MW rating of the plant. To compensate the plant engineer increased the cooling tower fan speed. This helped quite a bit but did not completely solve the poor design issue with the cooling tower.

Secondly, the water chemistry issue was identified and quantified. Makeup to the cooling tower was untreated surface water from a river fed storage basin. Seasonally the makeup water had high turbidty and suspended colloidal river solids. This resulted in deposits fouling the cooling tower packing

material. Once the deposit in the fill began to occur restoring the fill cleanliness and efficiency required a lot chemical and several operational modifications.

Both the design and the water chemistry problems combined to create the “emperor has no clothes” and “What happened to my blowdown?” scenario.

A few years later when I was no longer involved with the plant I was traveling through the area I decided to take a little side trip to see the power plant and their new 500 MW sister plant built on the same site. I was a little surprised but shouldn’t have been to see two new identical “full size” Marley cooling towers supplying each of the 500 MW plants. Sometimes the message is heard but it takes some time.