Power Station Feed Water System Assessment

Comprehensive Hydraulic Capability Study

The Challenge: A large East Coast power producer experienced an unexplained 30 MW output loss in one of its units while operating at reduced loads. Poor boiler feed booster pump availability was also a significant problem in the unit. Plant engineers needed to quickly identify the root causes of these conditions and implement corrective action.

The Solution: A hydraulic study performed by Flowserve engineers revealed significant operational deficiencies in the feed water and low pressure (LP) heater drain systems and found the root cause of the derated performance to be the heater drip pump. To recover the lost 30 MW output, Flowserve advocated replacing the current heater drip pump with a smaller vertical inline model fitted with a variable frequency drive unit (VFD). To redress other system deficiencies, Flowserve recommended hydraulically rerating the boiler feed water and condensate extraction pumps and replacing the split boiler feed booster pumps. These changes resulted in increased equipment availability and unit production.

The Maintenance and Modifications Supervisor at the plant said, “Flowserve’s system review has enabled us to make maintenance and operations decisions based on real data and analysis, rather than assumptions and history.”

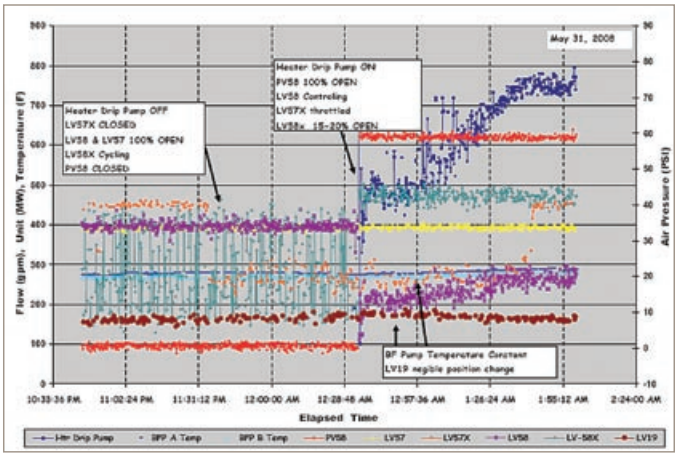
While running on a single train operation, a large U.S. power station on the Eastern seaboard observed an unexplained 30 MW derate in its 800 MW Unit 3. This loss was noticed when a rerated power turbine was brought online. The situation was compounded by maintenance problems that reduced boiler feed booster pump availability. With the prospect of losing an estimated revenue of $470 000 (U.S.) per month, the company engaged Flowserve to investigate the causes and recommend corrective action.

Taking a system approach, Flowserve engineers performed a comprehensive hydraulic study of the Unit 3 feed water and LP heater drain systems. Wireless technology was employed to obtain field performance data under varying unit loads, producing a high-resolution profile capable of capturing transient operating conditions. Flowserve engineers used this data to validate hydraulic models of the systems.

Findings:

Analysis of the model revealed the 30 MW derate was caused by the LP heater drain system. In particular, they found:

- The heater drip pump was underperforming the OEM curve by 15% due to reduced system demand.
- The heater drip tank was undersized, causing excessive dump valve cycling to maintain the desired level, as shown by the blue line in the chart below.
- As a result, hot water from the heater drip system was being dumped into the condenser instead of the feedwater system, reducing the thermal efficiency of the plant.
- Power generation was being limited by both boiler feed booster pumps which were performing 9-10% under their OEM curves.
- Due to internal wear, both condensate extraction pumps were operating at 10% reduced efficiency.
- Despite having just been repaired, boiler feed pump B was underperforming 12%. Boiler feed pump A was scheduled for repair, but was found to be performing satisfactorily.



Detail of Heater Drip Pump Start

Recommendations:

To redress the unit's derate condition, Flowserve engineers proposed the following actions, representing an estimated cost savings of $11.7 million (U.S.) over five years:

- Replace the current heater drip pump with a lower capacity vertical inline model fitted with a VFD. The VFD will allow the pump to operate at varying system demands. The estimated energy cost savings is $1.3 million (U.S.) per year.
- Repair the boiler feed booster pumps to optimize the hydraulic selection closer to BEP. The estimated cost savings for two pumps is $1.1 million (U.S.) over five years.
- Hydraulically rerate the two condensate extraction pumps to improve performance. Estimated cost savings due to increased efficiency is $350 000 (U.S.) over five years.
- Hydraulically rerate boiler feed pump B to recover 12% loss in performance. The estimated energy cost savings is $752 000 (U.S.) per year.
- Push out scheduled maintenance of boiler feed pump A, but continue to monitor it.

For the long term, Flowserve engineers advised replacing the existing axially split boiler feed booster pumps with radially split Flowserve HDX pumps which have better hydraulic efficiency and do not require bearing cooling water. The estimated payback is less than one year and the projected cost savings is $2.7 million (U.S.) over five years.

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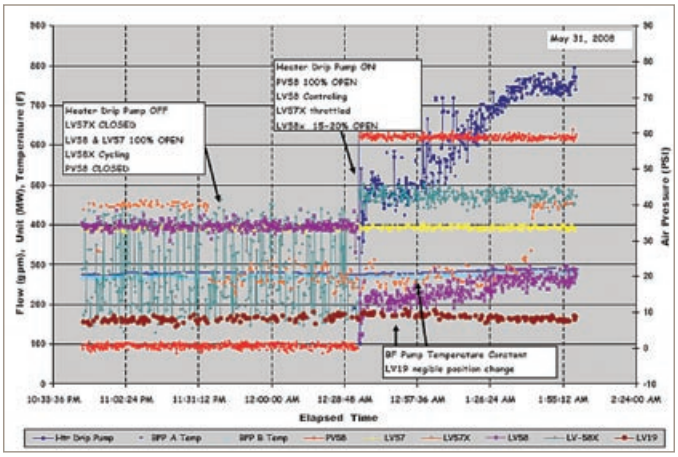

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