

Cooler Approach (DCA) is the drain temperature minus the entering feedwater temperature. Abnormal heater levels and fluctuating drain control valve positions may be caused by increasing heat duty from a flow unbalance or upstream heater bypassed, or a tube leak. Level control valve positions should be monitored to determine deviations from their normal position. Tube pluggage should be quantified and symptoms of excessive tube leakage identified.

**2-3.9.3.4 Boiler Feed Pump.** BFP performance may not have a significant impact on unit heat rate, but it will impact the capability of a unit to obtain full load.

BFP performance is monitored in the same way as any type of centrifugal pump. It is important to know the basis for the manufacturer's pump performance curve with respect to extraneous flows into and out of the pump, such as seal water injection (SWI) and balancing drum leakoff (BDLO).

For normal pump performance degradation over time, a standard should be established for each pump to determine rebuild cycle, preferably based on deviation from design head. In addition to the general pump performance from a capacity standpoint, high SWI and BDLO flows indicate wear by problems in the seal area, and will help in establishing work scope for pump rebuilds.

Monitoring pump performance is also useful to help detect related problems that affect pump system performance, but are not caused by that pump's degradation. Two common problems that affect pump flow-rate are recirculation loop flow and uneven flow-rate through parallel pumps.

(a) Recirculation loop: Most BFP's have a recirculation flow-path that opens to protect the pump from over-pressure during periods of very low flow-rate at start-up and very low-load. If the recirculation valve is open or leaking through, then the pump has to handle extra flow-rate for no benefit. This will consume extra pump power, and could limit the maximum output of the unit if pump capacity cannot handle extra flow-rate.

(b) Parallel pumps with uneven flow-rate: In a system with parallel pumps, performance degradation on one pump causes uneven flow-rate through the parallel pumps, and increases the power consumed by all pumps in the system. The better performing pump will flow more than its share of the system flow to produce same head as the poorer pump. Individual flow measurements per pump can help diagnose which pump has a problem, or else pumps may have to be taken out of service individually to determine which pump has a problem.

For turbine-driven boiler feed pumps, the boiler feed pump determines the amount of power required by the boiler feed pump turbine. In order to monitor the performance of the boiler feed pump, the extraction flow to the feed pump turbine should be quantified either through direct measurement or a first stage pressure/steam flow curve relationship. HP extraction steam leakage to the turbine should also be monitored using the first stage pressure as an indicator.

**2-3.9.3.5 Moisture Separator Reheater (MSR).** The Moisture Separator Reheater (MSR) is a nuclear cycle balance of plant component located between the HP and LP turbine sections. Its purpose is to remove moisture from the HP turbine exhaust and add superheat to the cycle steam