

# Performance Evaluation and Off Design Analysis of the HP and LP Feed Water Heaters on a 3x135 MW Coal Fired Power Plant

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*Abstract:* A typical coal fired thermal power plant with gross capacity of 3x135MW has issues concerning its Regenerative Feed Water Heater System composing of two high pressure heaters (HPH1 & HPH2), one deaerator-feed water tank (DEA) and four low pressure heaters (LPH4, LPH5, LPH6 & LPH7). This study aims to conduct a performance evaluation during full load on each unit's regenerative feed water heaters, both closed and open type, using ASME PTC 12.1 and an analysis on the heater off design condition at 5% load intervals. Off design conditions on a heater occurred on several occasions, where unit is at low load or derating, and may affect overall efficiency of a plant. The parameters needed such as load, extraction steam pressure, heater drain temperature and inlet & outlet feed water temperature on a heater were collected on the Distributed Control System (DCS) at Central Control Room (CCR) station. Other necessary data like steam and drain enthalpies were collected using CATT 3 software or steam tables. There were five tests collected at random dates on each unit where it is in operation. The data result features like Temperature Terminal Difference (TTD), Drain Cooler Approach (DCA) and Temperature Rise (TR) across heater were indicators used to determine and evaluate each heaters performances. Extraction Steam Flow Requirement was also calculated for additional performance verification. The evaluation results at maximum load shows that Unit No.2 HPH1 and HPH2 has lower TTD (4.35°C & 3.39°C respectively) & DCA (-0.37°C & 14.68°C respectively) and a higher TR (21.97°C, 46.94°C) were remarkably good. The results also showed that as the low pressure heaters goes to the last stage heater (LPH4 to LPH7), the TTD was increased on all units. A highest TTD (49.86°C) and lowest TR (2.95°C) on Unit 1 were observed which could be quite alarming and an indication of off design even at full load. The ranges between minimum and maximum load at 5% load intervals showed that HPH1 and HPH2 (TTD & TR) were proportional to the load while LPH4 and LPH5 (TTD) were inversely proportional to load adjustments on all units. The last stage heater, LPH7, on Units 1 and 2 poorly performed during the load adjustments with its TR maintained only around 4°C at any load is an indication of off design condition. A mathematical approach of non-linear regression was also simulated using MatLab R2013A on each heater's TTD, DCA, TR and Extraction steam flow requirement to allow other researcher or performance engineer for future framework. Thus, the results of the tests regarding the performance of regenerative feed water heaters proves that last stage heaters mostly encounter off design and high pressure heaters are the most efficient. Finally, based from the evaluation results, it recommends to inspect or improve the last stage heaters to prevent equipment breakdown and conduct more routine plant performance on regenerative feed water heaters to monitor the heaters degradation or improvement.

*Keywords:* Regenerative Feed Water Heater, Off-design, Coal Fired Power Plant (CFPP), Performance Indicators, TTD, DCA, TR

























2. More routine performance test before and after annual planned outage to monitor equipment degradation or improvement.
3. Include calculation of the feed water heaters efficiency and relate it to the overall cycle efficiency or heat rate performance.

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