Unit Stable Operation at 40% Minimum Technical Limit

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Abstract— India is planning to increase the renewable generation capacity to 175 GW by 2022. Due to increasing renewable energy penetration in the grid, Flexibilization is the new paradigm in thermal power generation, which is aimed at converting baseload stations into flexible generators.Based on the concept and importance of its strata, Maithon Power Limited Unit 2 has been selected by CEA-Ministry of Power, to conduct the flexi test in Eastern Region. It is second plant after NTPC Dadri to conduct the test in collaboration with IGEF.

Index Terms— IGEF, Mill, TDBFP, SCAPH, Feeder, Load

1 Introduction

Maithon Power Limited have 2 Units of 525 MW each with total installed capacity of 1050MW. Unit#2 has been selected by CEA-Ministry of Power, to conduct the flexi test in Eastern Region.

The Load Test Procedure was segregated into two parts

a. Coal Flow measurement through variable orifice in Coal Mill D
b. Demonstration of Minimum Load operation at 40%

Minimum Load Test was conducted in relatively controlled conditions as mentioned below and under supervision of experts. Good quality coal has been fired (SCC maintained 0.60-0.62kg/kWh) during minimum load test & ramp test. Three adjacent mills were in operation [BCD]. Prior to test, these mills maintenance job completed & was ensured in fittest condition. Prior to each test, AGC & RGMO was kept intentionally OFF to prevent any load variations. RRAS & SCED were also stopped during the test periods. SA Steam coil air preheater [SCAPH] was charged at low load. Additional auxiliary steam supplied from adjacent unit. Variable orifice was installed in Mill 2D & coal flow distribution among all the four coal pipe was tried to equalize.

In Mill 2D variable orifice & coal flow measurement were installed in all the 4 coal pipes. This mill selected as it will be operated throughout the load operation regime. It enabled individual pipe coal flow measurement & velocity measurement through Mill 2D.

On 20th July, Coal Damper Test was carried out in Mill 2D at full load. Unit load was maintained full at Specific coal consumption of 0.696kg/kWh. Mill 2D feeder loading was kept in manual at feeder demand of 84% & its average coal flow was 58TPH.

The 40% MTL operation test was planned between 20.07.2021 to 27.07.2021 with number of activities planned on each day. On 20th July, Coal Damper Test was carried out in Mill-2D at 525 MW with a specific coal consumption (SCC) of 0.696 kg/kWh. Feeder loading of Mill-2D was kept in manual at a demand of 84% and its average coal flow was 58 TPH.

On 22nd July, Minimum Load Test (40%) to 210 MW was carried out in Turbine Follow Mode with a specific coal consumption (SCC) of 0.63 kg/kWh.

2. Pre-test conditions:

Load : 290 MW (55% load)

Coal Flow : 182 TPH (SCC=0.63)

MS Pressure: Manual at 140 kg/cm2

Mill Combination preferred: B, C, D, E (44 TPH,46 TPH,44 TPH and 42 TPH of coal feeding)

Burner Tilt: Manual control

MS/HRH Temp: Auto control.

- 0.5% O2 reduction by providing a bias of -0.5% at 10:40 hrs. There was no change in APH outlet flue gas temp after O2 was reduced from 4.91% to 4.41%. Same was reverted to 4.91%.
- 10 kg/sq.cm MS Press reduction (140 kg/sq.cm to 130 kg/sq.cm) from that of the sliding press at 11:02 hrs. There was no change in APH outlet flue gas temp with reduction in MS pressure.
- SH Spray in Auto and BT increased to 68% from 55% at 11:29 hrs. There was no change in APH outlet flue gas temp. BT was again reduced to 55%.
- SCAPH was taken in service at 12:20 hrs
- Recirculation valve of TDBFP-2A was opened at 290 MW and further load drop to 275 MW. Increase in SA temp from 350C/350C to 660C/860C. FGET at APH outlet increased to 129.60C/127.70C Fluctuation in drum level was in the range of +120 to -218 mm which was manually controlled.
- BT was reduced to 50% from 55%. Load was reduced to 275 MW in CMC at 12:50 hrs and further reduction to 255 MW. MS press was 123 kg/sq.cm. LTSH metal temp crossed the alarm limits (4600C).
- At 255 MW, TDBFP-2A was taken out of service. MCV and ACV of TDBFP-2B opened to 100% to cater the feedwater flow due to low extraction steam press.
- Feeder-2E speed was reduced to minimum. Switch over to Turbine Follow mode at 240 MW. MS press SP was 110 kg/sq.cm where actual press was 109 kg/sq.cm.
- At 13:55 hrs, Mill-2E was taken out of service. Load drop from 240 MW to 210 MW at 14:08 hrs. Feeder speed of B, C and D were reduced by 5% manually to reach 210 MW Load=210 MW, MS press=107 kg/sq.cm was kept for 1 hour for stabilizations.

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3 Challenges Faced

There were many first-time actions that were taken that has never been done before

- Variable orifice were fitted in Coal Mill D to understand the Coal flow distribution in different coal pipes and also to adjust according to the furnace stability needs.
- SCAPH was charged to pre heat the secondary air in running Unit. Generally, SCAPH is charged during Unit start Up to control the Flue Gas Exit Temperature. Charging SCAPH in Low Load Condition enabled to maintain higher Exit Temperature.
- 210 MW (40%) was reached with TDBFP (Steam Driven Boiler Feed Pump) for the first time. Generally during Unit shutdown MDBFP (Motor Driven Boiler Feed Pump) is taken in service which has a better control over the Drum Level. This time TDBFP was kept in service and Drum Level was managed manually instead of Auto Control.
- 3 Mills were kept in service for continuous operation for the first time. Generally, 4 Mills are kept in service at Low Load condition for better flame and furnace stability.

4 Critical success Factor

- Regular brainstorming sessions were conducted between MPL team and IGEF team and operational historical data was shared with them to find out the major pain areas during low load operation
- Detailed SOP was prepared for low load operation with multiple revision
- Data was captured of major efficiency and reliability parameters for future reference and a detailed report was prepared to capture the learnings from the entire activity

5. How long this practice has been in place, with multiple rounds of improvement over the years

- BHEL Units like Maithon are prescribed for Minimum Load of 65%

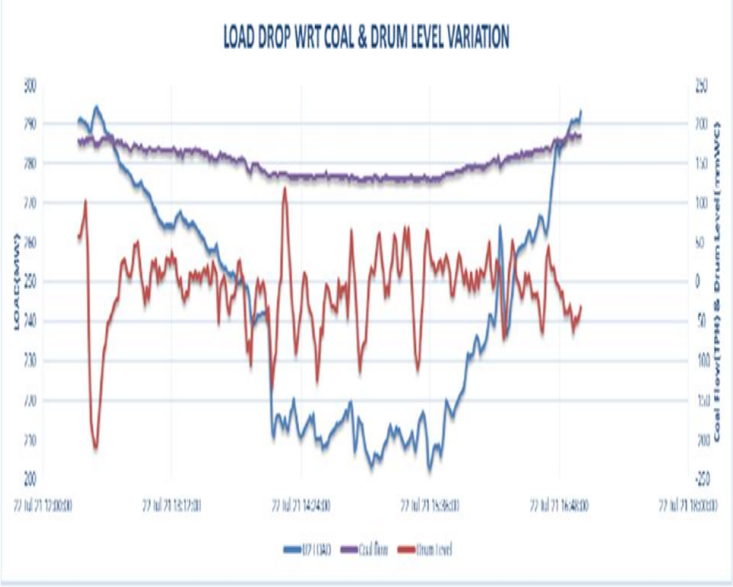
- In FY21 strict regulation came in place to reduce Minimum Load to 55%. It was done in house and the challenges were mitigated with in house innovative solution
- In FY22 draft regulation came that all thermal Power Plants have to achieve Minimum Load of 40% within next three years and it set the context for this project. Maithon Unit 2 was selected by CEA for the trial operation.

6 RECOGINATION AND REWARDS WON FOR THE PRACTICES

- Maithon Unit 2 was second Power Plant in India to achieve 40% stable Operation and it was observed and appreciated by regulatory bodies like CEA, POSOCO
- IGEF twitter handle also mentioned MPL achievement

7 DASHBOARDS, CHARTS/GRAPHS AS ANNEXURES (BEFORE AND AFTER COMPARISON)

7.1



7.2

Drum Level at 190 MW

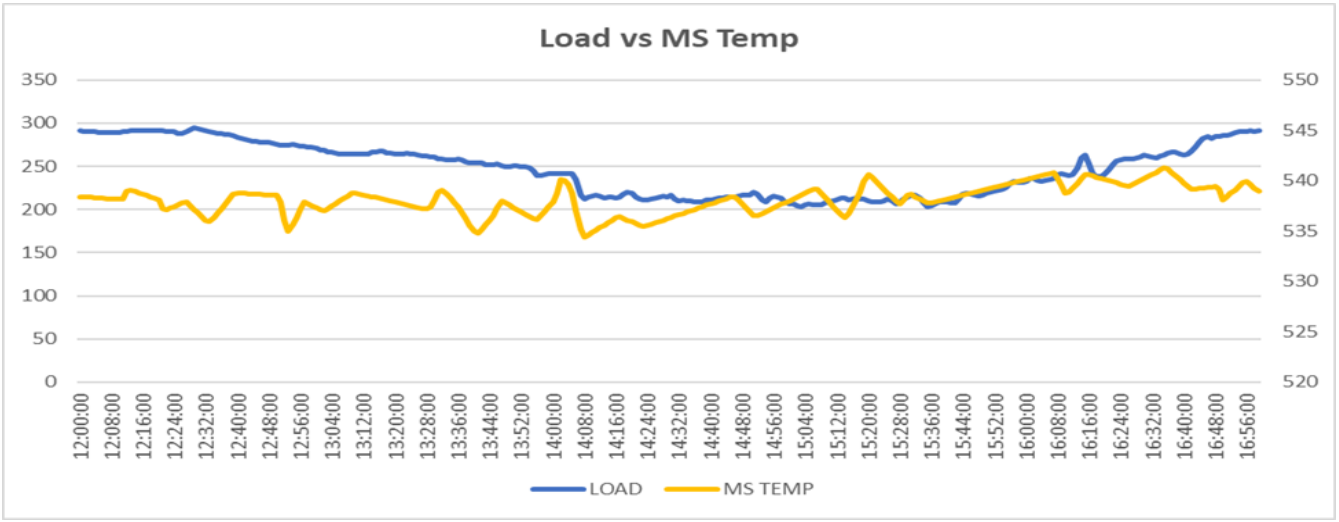
Flame Intensity at 190 MW

7.3

Parameters	Before	After
Load	290	260
MS Pressure	119	113
SH temp	538	540
RH temp	532	526
SH spray	40/63	40/49
RH spray	2/0	2/0
Burner tilt	50	50
Coal flow	167	146

Parameters	Before	After
Load	225	210
MS Pressure	106	105
SH temp	534	537
RH temp	528	520
SH spray	29/37	29/38
RH spray	2/0	2/0
Burner tilt	50	50
Coal flow	128	121

7.4



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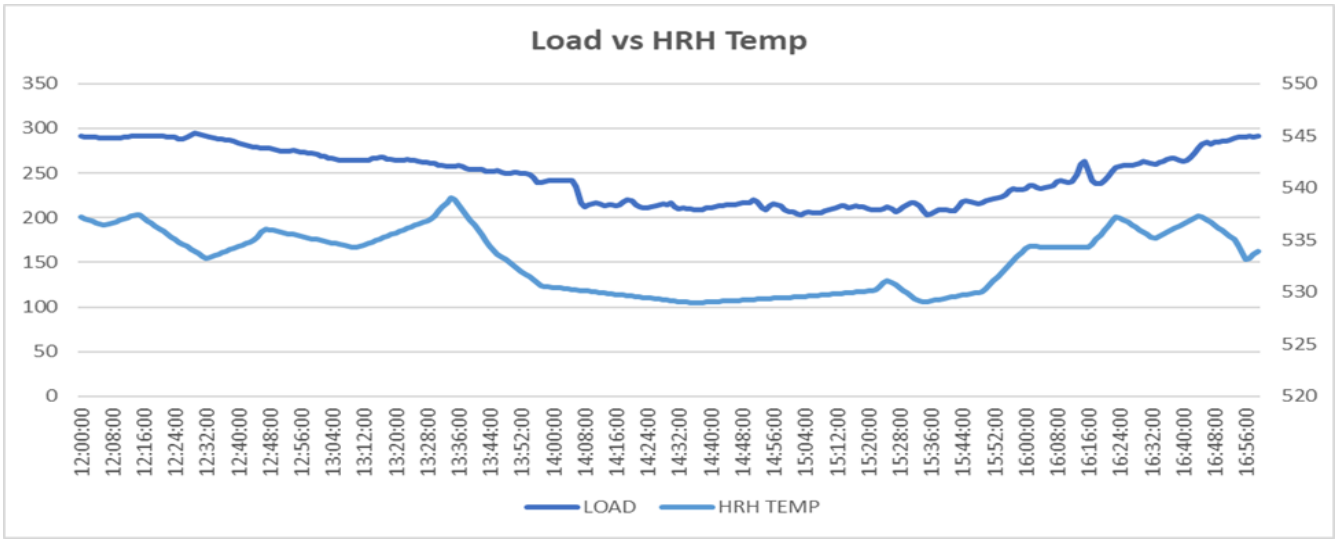

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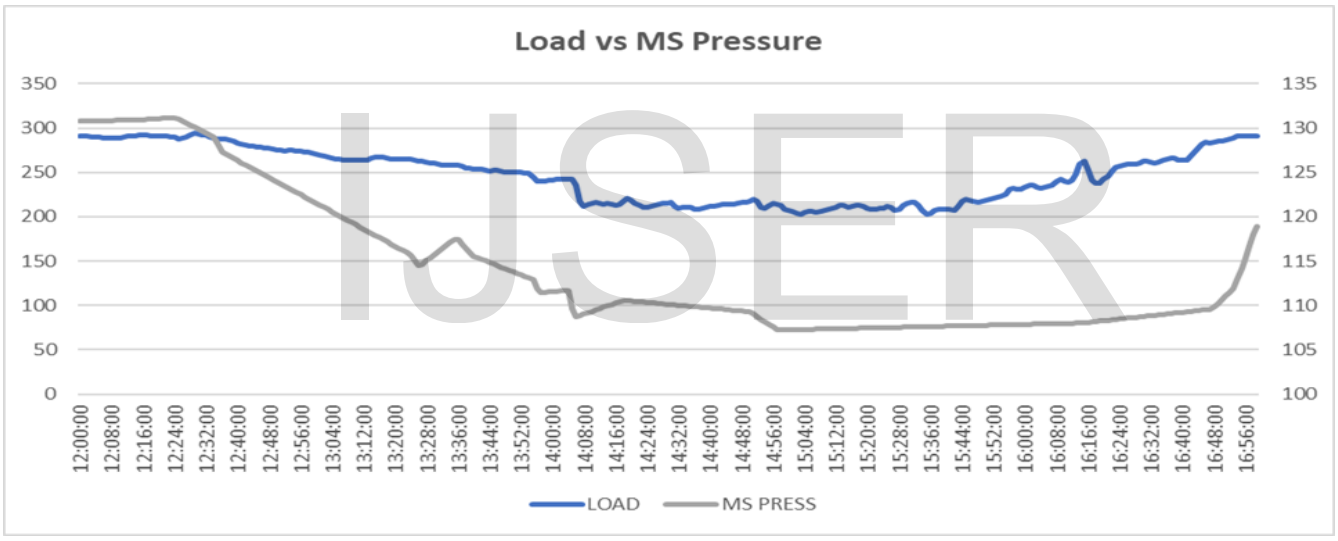

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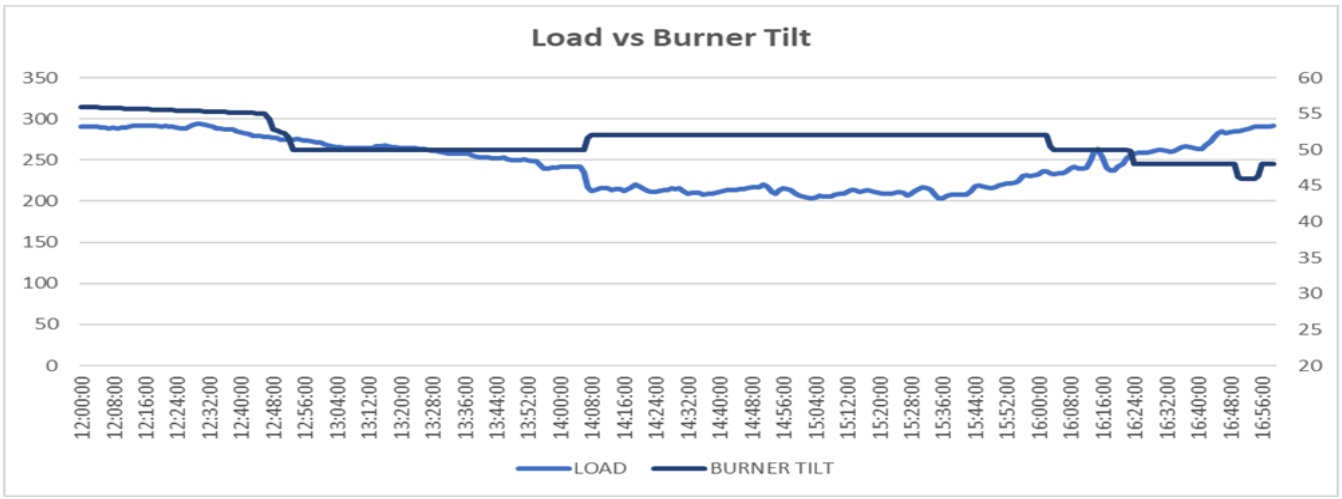

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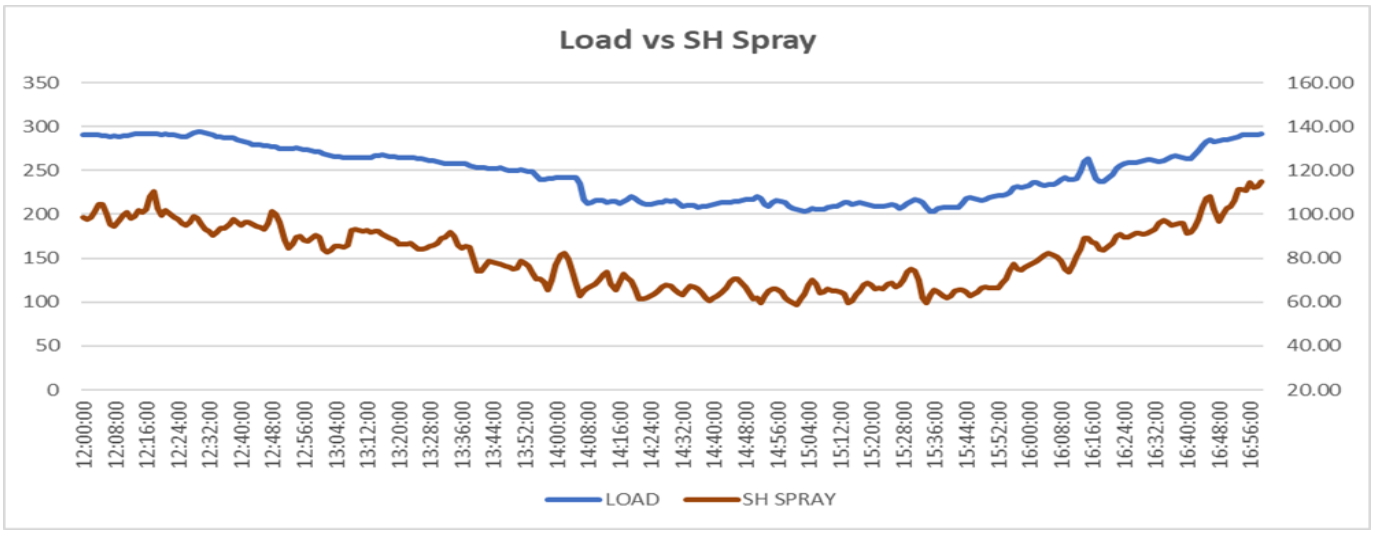

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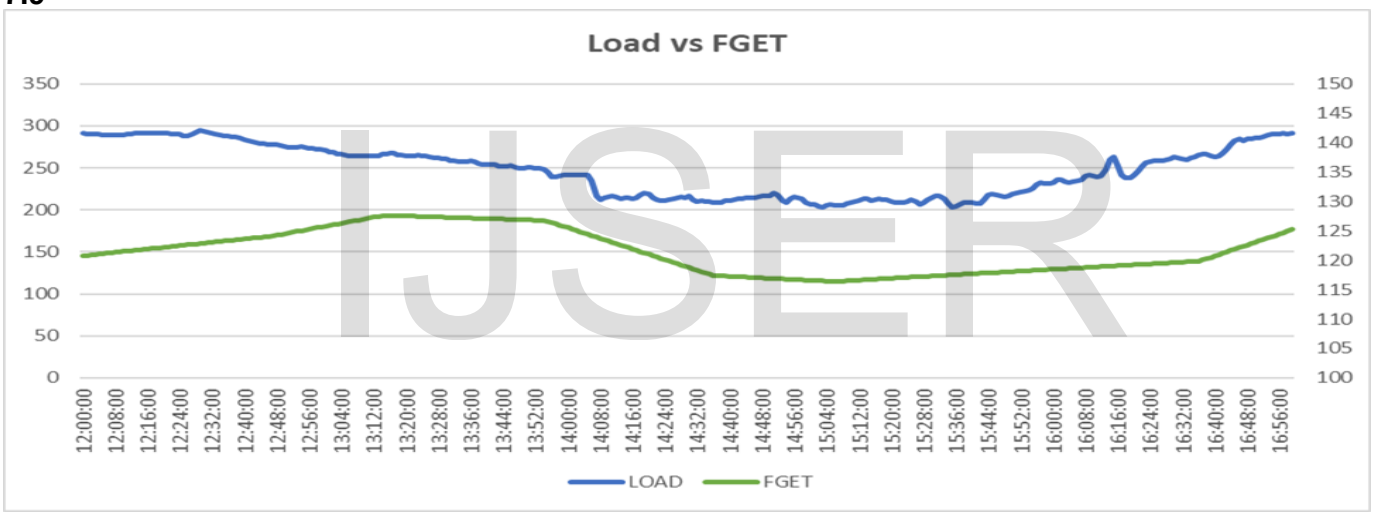
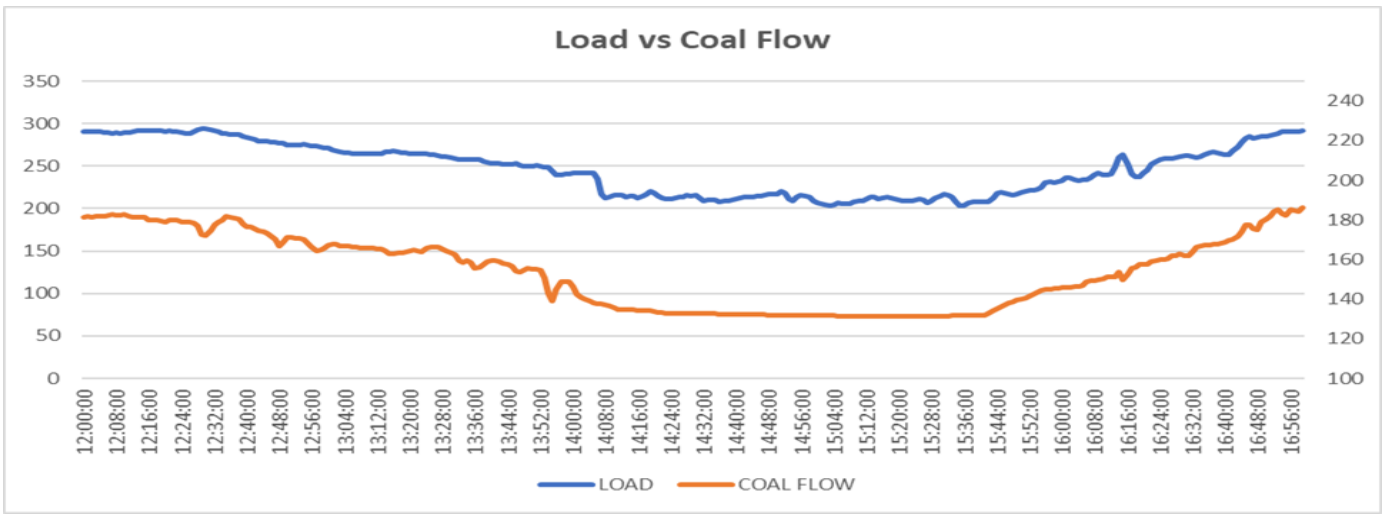


7.10



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