“EXPERIENCE IN FLEXIBILIZATION”
BY
TEAM DVC

DAMODAR VALLEY CORPORATION
(Under the Ministry of Power, GOI)

Date: 24.11.2022 Venue: The Park, New Delhi

DAMODAR VALLEY CORPORATION (DVC)

- First Multipurpose River Valley Project of independent India.
- Established on July 7, 1948 by an Act of the Constituent Assembly of India (Act No. XIV of 1948).
- Modelled on the Tennessee Valley Authority (TVA) of the USA.
- Central Government of India and the State Governments of West Bengal and Bihar participate jointly for the purpose of building the DVC

DVC PROJECTS OVERVIEW

Thermal Power Plant:

1. Bokaro TPS (1 X 500 MW)
2. Chandrapura TPS (2 X 250 MW)
3. Durgapur Steel TPS (2 X 500 MW)
4. Koderma TPS (2 X 500 MW)
5. Mejia TPS (4 X 210 MW + 2 X 250 MW +2 X 500 MW)
6. Raghunathpur TPS (2 X 600 MW)

Hydel Power Plant:

1. Maithon HPS (2X20 MW + 1X23.2 MW)
2. Panchet HPS (2X40 MW)
3. Tilaiya HPS (2X2 MW)

FLEXIBILIZATION

- **Flexibility of a Power System: Generation or Demand can be increased or reduced over a timescale ranging from a few minutes to several hours.**
- **Most measures for flexibility: Low minimum Load operation.**

POSSIBLE CHALLENGES

- Higher Boiler Tube Wall Metal temperatures.
- Flame disturbance during ramping up/ramping down.
- Unstable Furnace pressure,
- Stalling of PA Fans at lower load regime.
- Unstable feed water control with Two TDBFPs at low load.
- Low Flue gas temperature at APH.
- Due to corrosion boiler drains may also burst leading to unsafe situation.
- Heat rates typically degrade at partial load due to lower steam parameter (Pr. and temp) and Low Feed water temp at ECO inlet.

POSSIBLE CHALLENGES

- Excess air can cause high dry flue gas loss.
- Difficulties in maintaining Optimum steam chemistry.
- Low Furnace to Windbox dP and subsequent Boiler tube failure in the burner zone.
- Fast & Frequent thermal cycling of components lead to fatigue, creep .
- Failures of boiler tubes caused by cyclic fatigue, corrosion fatigue and pitting .
- Cracking in dissimilar metal welds, headers and valves, and other thick-walled components due to rapid changes in steam temperature.
- LPT last stage blade is prone to failure due to handling of Wet steam.

PRE-CHECKS REQUIRED

- All auto loops should be available and fine tuning of CMC must be carried out to minimize the deviation of parameters
- Attemperator system must give fast response to the changing system demand.
- Optimise minimum coal loading in a mill by fine tuning primary air flow vs. coal flow curve to avoid lean air mixture and possible flame failure tripping.
- Clean air flow test/Dirty air flow test at regular interval to evaluate partially plugged coal pipes and burners
- SADC damper operation should be checked and correct feedback must be made available.

PRE-CHECKS REQUIRED

- Wall blowers and LRSB operation scheduling should be done
- Water chemistry should be available in DCS.
- SCAPH operation to be made through to contain flue gas temperature less than acid dew points
- BTLD should be in healthy condition and in service.
- All TSI feedback should be available in service and in healthy condition.
- MDBFP should be ready and in stand by condition.
- Flame scanners were thoroughly cleaned and calibrated for flame stability.

FLEXIBILITY TEST

- DSTPS Unit 2, DVC was selected by the Central Electricity Authority (CEA) to investigate the flexibilization potential of thermal capacity in the Eastern Region.
- The activities at DSTPS plant were executed jointly with experts from IGEF, Siemens Energy (Germany), Siemens India and VGBe.
- Flexibility tests were conducted at DSTPS with the aim of achieving 40% minimum technical load and ramp rate of atleast 1.5% per minute.
- The test runs were executed from 28 to 31 March 2022 by the Team of DVC, IGEF, Siemens and VGBe experts.
- The tests were planned and carried out in close co-operation with CEA and POSOCO.

MAIN DESIGN DATA OF DSTPS

- **Capacity : 2 x 500 MW**
- **Boiler : Single drum Boiler, Directly fired by pulverized coal, Tilting tangential firing, Sub-critical , Manufactured by BHEL.**
- **Turbine : Single-flow HP turbine, double-flow IP and LP turbines ,Manufactured by BHEL – KWU design**
- **Cooling : Closed cycle with Natural draft cooling tower**

DATE OF TEST PERFORMED

- 28 March’22 : Minimum Load Test [200 MW (or less)]
- 29 March’22 : Minimum Load Test [200 MW (or less)]
- 30 March’22 : Load Ramp Test between 200 and 500 MW
- 31 March’22 : Load Ramp Test between 200 and 500 MW

ACHIEVED

- During the minimum load tests, the plant was operated for two hours at stable minimum load of 160 MW (32% load).
- The highest ramp rate achieved in upwards direction was 12 MW/min and in downwards direction 16 MW/min.

GLIMPSE

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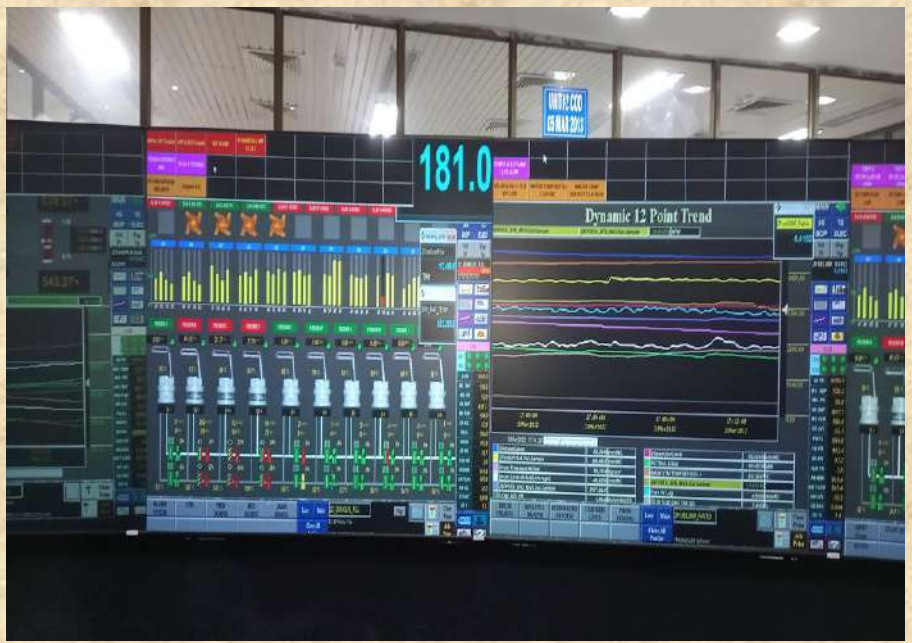
GLIMPSE



GLIMPSE


UNIT#2 COD
05 MAR 2013
155.3
Dynamic 12 Point Trend
0.5199
MAIN
SG
TG
BOP
ELEC

STEPS TOWARDS MINIMUM LOAD

- Unit was running with 505 MW in CMC mode with B,C,D,F,G,H coal mill in service without oil support.
- Load set point reduced in steps of 10 MW from 505 MW.
- At 470 MW: Feeder H taken out,
- At 440 MW: Feeder G taken out,
- At 370 MW: Coal Feeder F taken out of service keeping consecutive mill operation for better flame stability.
- Load was reduced 290 MW gradually keeping lower mills (B, C, D) at minimum coal flow of 45 TPH and was kept for 2 hrs. for stability.

STEPS TOWARDS MINIMUM LOAD

- At 270 MW - as a precautionary measure, TDBFP ACV put into service from CRH, as IP extraction pressure to both TDBFP becomes low at lower load, due to which disturbance in drum level occurs.
- After stability in TDBFP, one TDBFP was unloaded and keep at 3500 RPM then load was further reduced to 250 MW.
- Oxygen set point was slowly raised to 5.5 % and waiting for 15 minutes to attain furnace stability.
- SCAPH was charged to maintain FG, PA & SA temperature.

STEPS TOWARDS MINIMUM LOAD

- Load further reduced in CMC to load 220 MW: One FD Fan was taken out of service and keeping base mills minimum coal flow setpoint to 40 TPH.
- Turbine throttle pressure was reduced manually and machine taken into pressure control mode (limit of minimum load set point of CMC : 200 MW).
- Burner Tilt was adjusted as per requirement to raise RH temperature observing flame stability.
- Manual Damper (SADC) i.e. AA was reduced to 25 % at all four corners to keep wind box DP above 40 mmwcl (BHEL design curve).
- Oxygen set point was further raised to 6.8 % to maintain Wind box dP.

STEPS TOWARDS MINIMUM LOAD

- Slowly Load was reduced to 155 MW.
- At this load, Coal Flow 92 TPH, Coal Ratio 0.593 kg/kwh, MS Pressure 90 ksc, Oxygen Set point 6.8 %, Wind Box dP 20 mmwcl, MS/HRH temp 531/498 Deg C.
- After Stability, achieved 160 MW minimum load without oil support on 30.03.2022.

OBSERVATIONS DURING TEST

AT 55%:

- No such issue at 55% load.
- In transient load condition, drum level fluctuation due to opening of BFP recirculation valve.
- Higher APC due to marginal condition for 2 CEP & 2 CW running.
- Load increase will take longer time if one CW pump is taken out from service.
- Reduction of operating coal mill takes higher time at higher ramp and quantum.
- Frequent load cycles increases fatigue loading of component and may causing Boiler tube leakage in attachment weld failure.

OBSERVATIONS DURING TEST

At 40%:

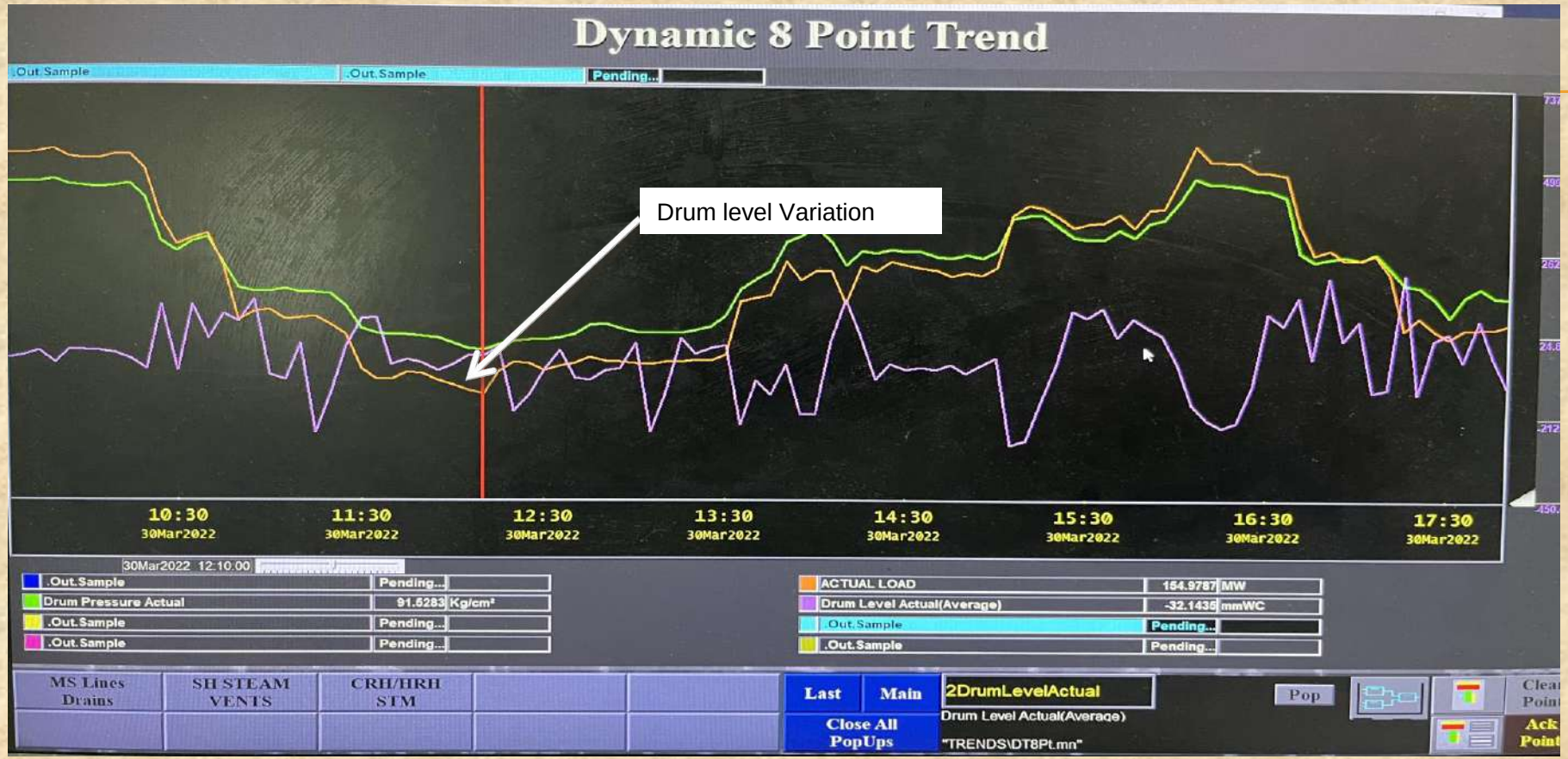
- Flame instability.
- Low wind box pressure hence chance of overheating in Water wall.
- Less Reliability with single FD Fan, BFP, and CEP as any tripping may cause Unit tripping.
- Any tripping of coal mill @ 30% Load, possibility may increase of malfunctioning of control loop including Drum Level .
- TDBFP steam source from CRH: at low load it works good but at higher load with higher CRH pressure, control by TDBFP Aux control valve is difficult.
- Proper tuning of control system required especially SH temp, Drum level.

OBSERVATIONS DURING TEST

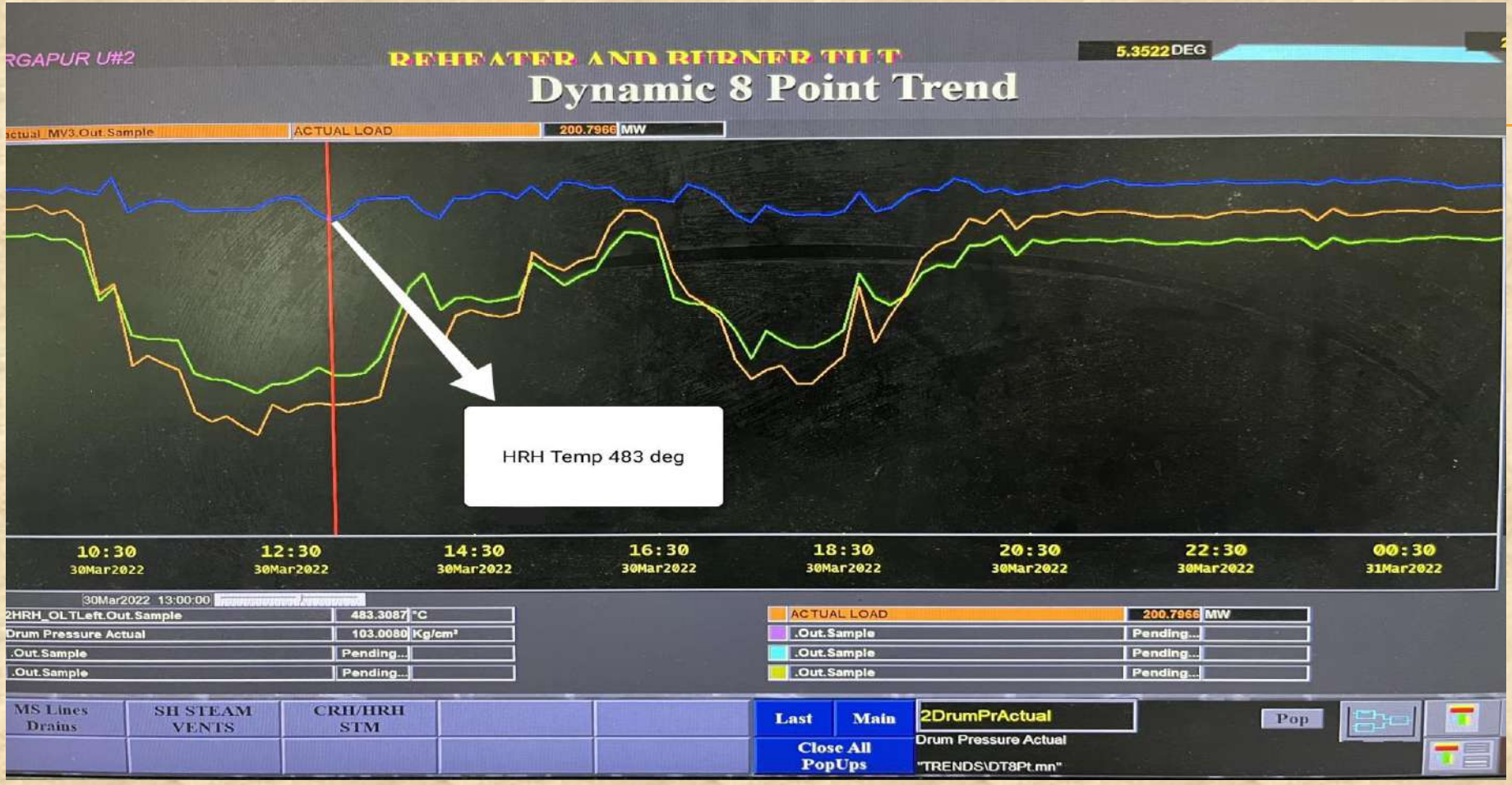
Ramp rate:

- **Up to 1% RAMP rate, no much problem at 55% but sudden change to higher load difficult as number of coal mill to be increased in service.**
- **At 40%, due to less margin, 2% ramp rate is difficult . Also, higher ramp rate can not be achieved as less number of drives are running and starting of required equipment takes time.**

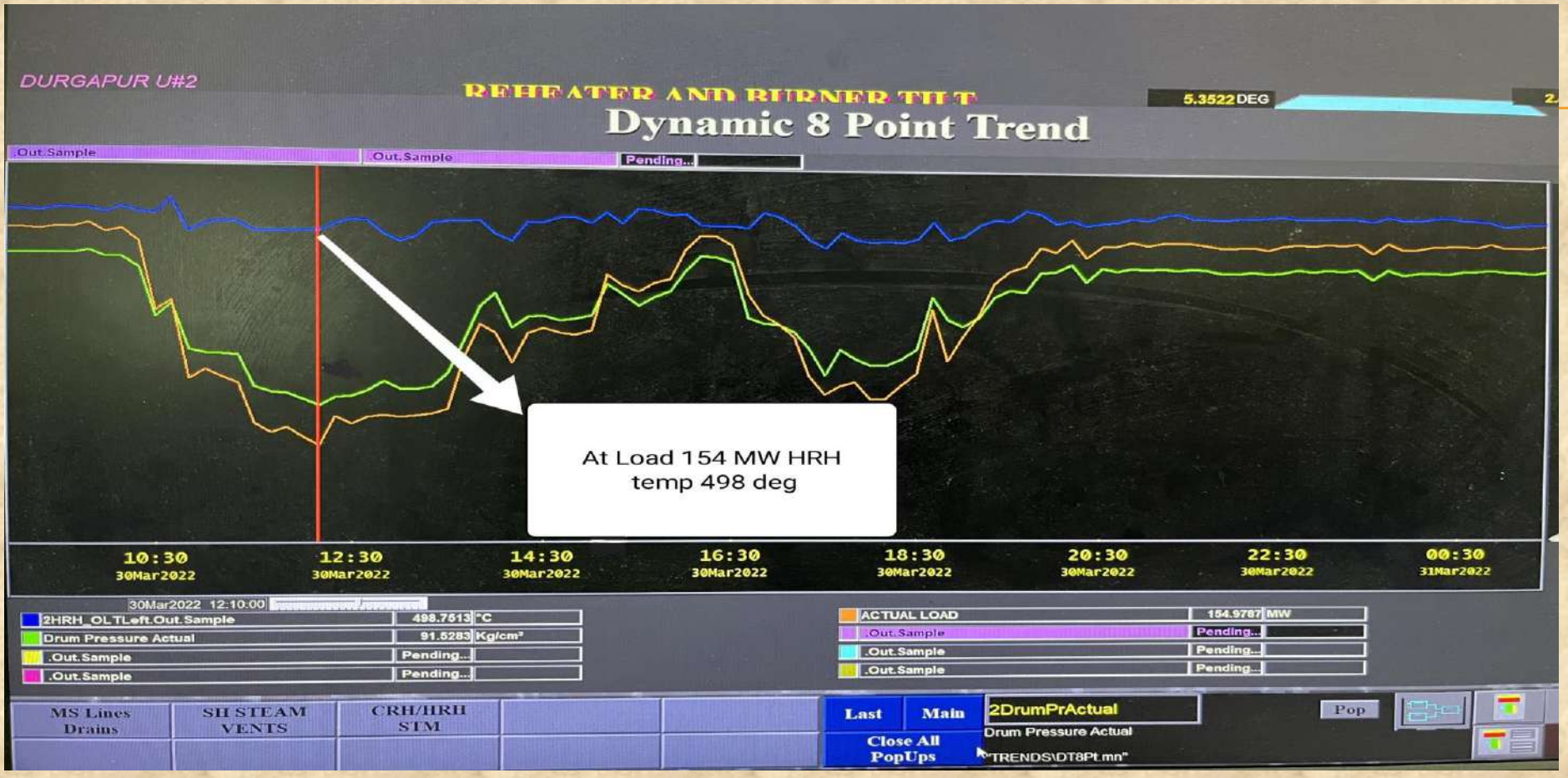
Throughout the trial, Coal Ratio was in the range of 0.55 kg/kWh to 0.60 kg/kWh



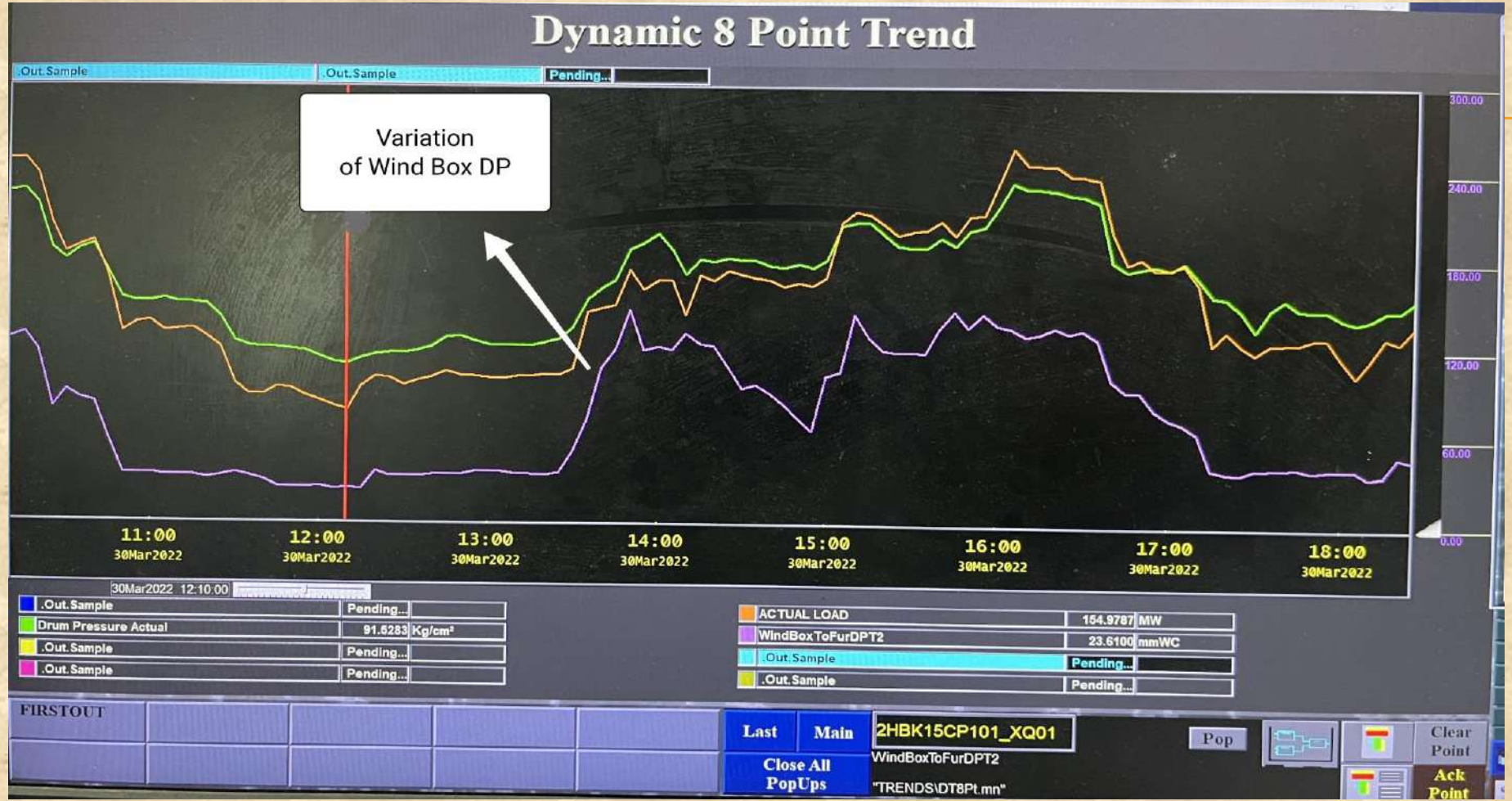
Throughout the trial drum level fluctuated continuously from +90 mmWC to -257 mmWC



At Load 200 MW: HRH Temp Dropped to 483^0C

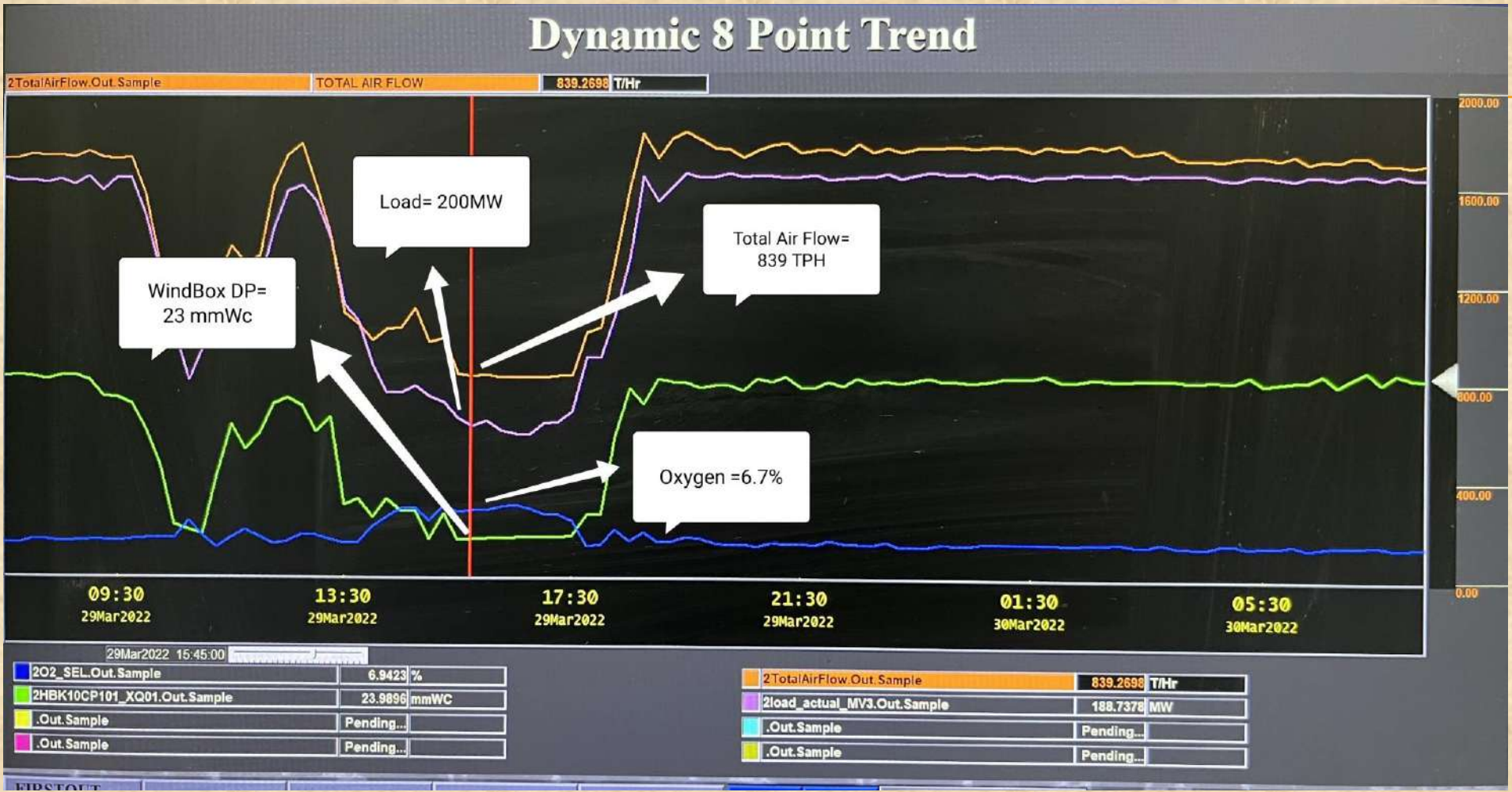


At 154 MW Load: HRH Temperature Increased to 498 ^{0} C



Wind box DP maintained very low. At 154 MW it dropped to 23 mmWC

Dynamic 8 Point Trend



POST TEST OBSERVATIONS

- **Boiler Tube Leakage observed at 18:00 hrs. on 02.04.2022**
- **Affected area : Front Water Wall Tube attached to seal box of Wall Blower no. 4 at 52mtr. And LHS at 55 mtr. Elevation at Inspection door (Attachment welding joint failure.)**

REQUIREMENT

- Automatic Mill Operation (Mill Scheduler) .
- Better tuning of MS/RH Temperature/burner tilting and Drum level Control loop .
- Automated Start of Fans and Pumps .
- Integrated Start up automation.
- Online coal flow measurement system ,
- Conversion of Operation for BFP RC valve from ON-OFF to Modulating type.

धन्यवाद