NABHA POWER LIMITED

Best O&M Practices

Table of Contents

Organization Profile

First Indigenously Manufactured Supercritical Unit

Availability > 85%

since beginning (last 10 years)

One of the best HR in the country (Design: 2205kcal/kWh)

Top of Merit Order in the State Punjab

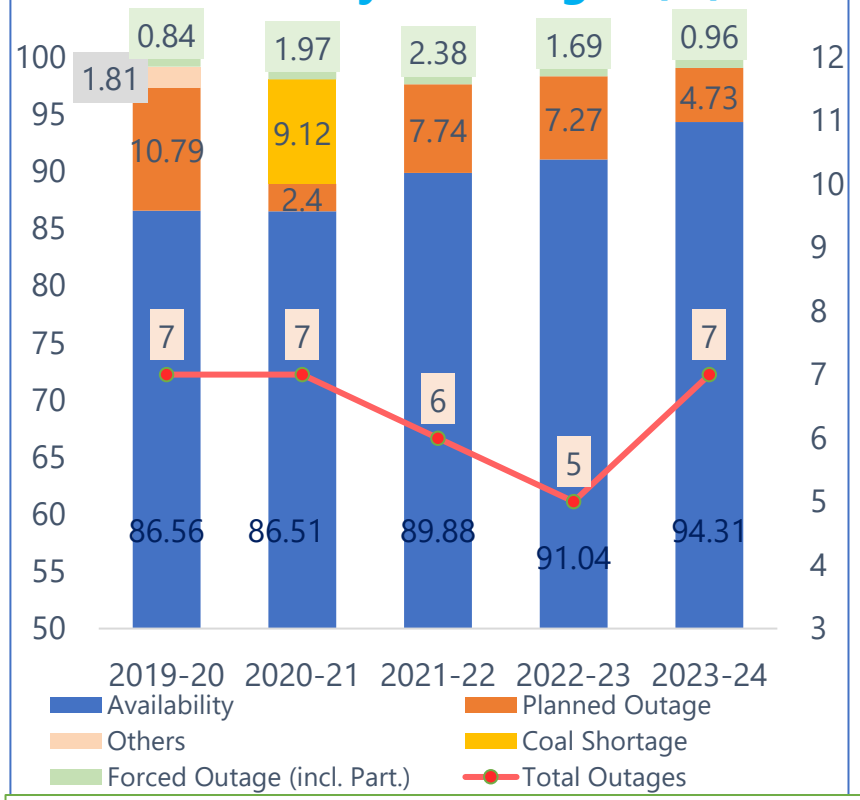
Zero Liquid Discharge

Certified for **ISO 50001:2018 (Energy Management System), ISO 9001:2015 (QMS), ISO 14001:2015 (EMS), ISO 45001:2018 (OHSAS), ISO 17025:2017 (NABL accreditation for Coal lab) and ISO 27001:2013 (ISMS)**

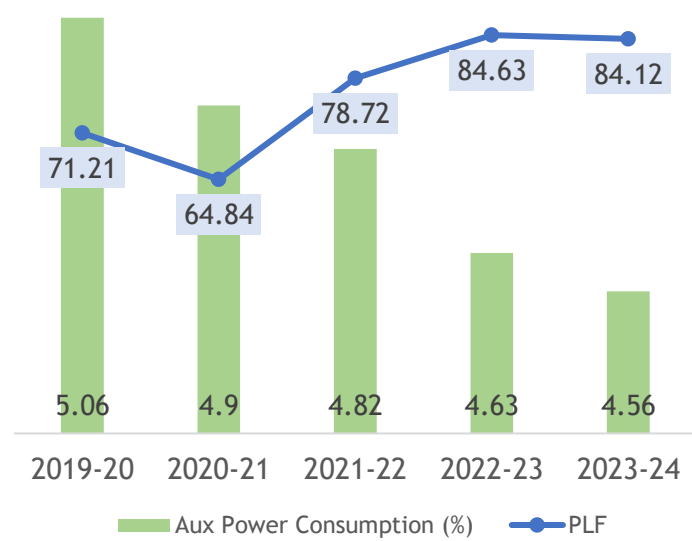
NPL

Five-year performance trends of NPL

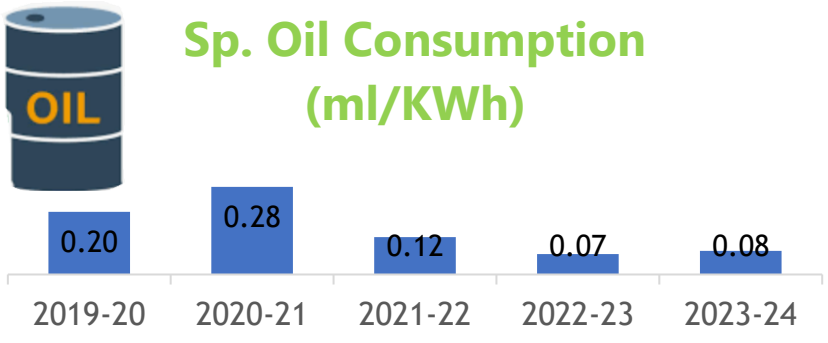
Availability & Outages (%)



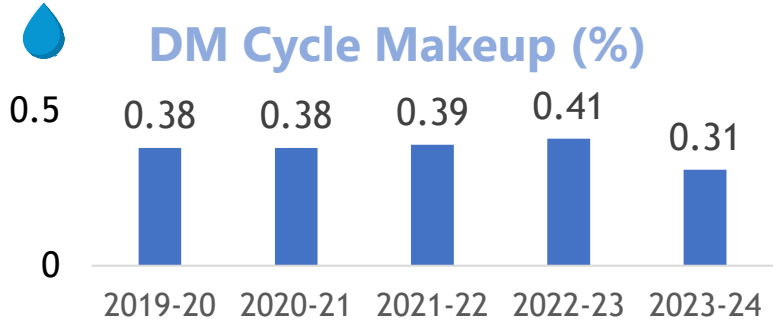
PLF & Aux. Power (%)



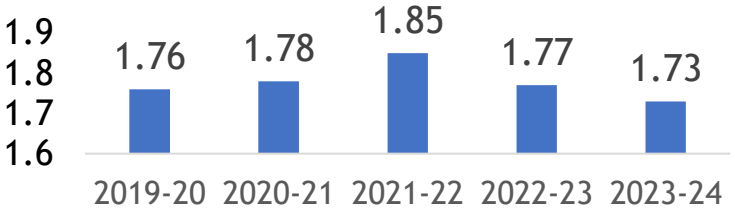
Sp. Oil Consumption (ml/KWh)



DM Cycle Makeup (%)



Sp. Raw Water Consumption(cum/MWh)



RAPH Performance improvement-

The function of the Air Preheater is to preheat the Primary and Secondary air by recovering the waste heat from the boiler flue gas which increases the thermal efficiency of the boiler by reducing the dry flue gas loss.

The most common issues due to which RAPH performance deteriorates are-

- Higher air leakage through seals
- RAPH basket choking

The air leakage and basket choking starts from a base line after overhauling and increases gradually over the time.

In order to improve and sustain RAPH performance following initiatives are taken-

1-Modification of Air leakage control system(**ALCS**)

2-Modification of Heating Element Baskets

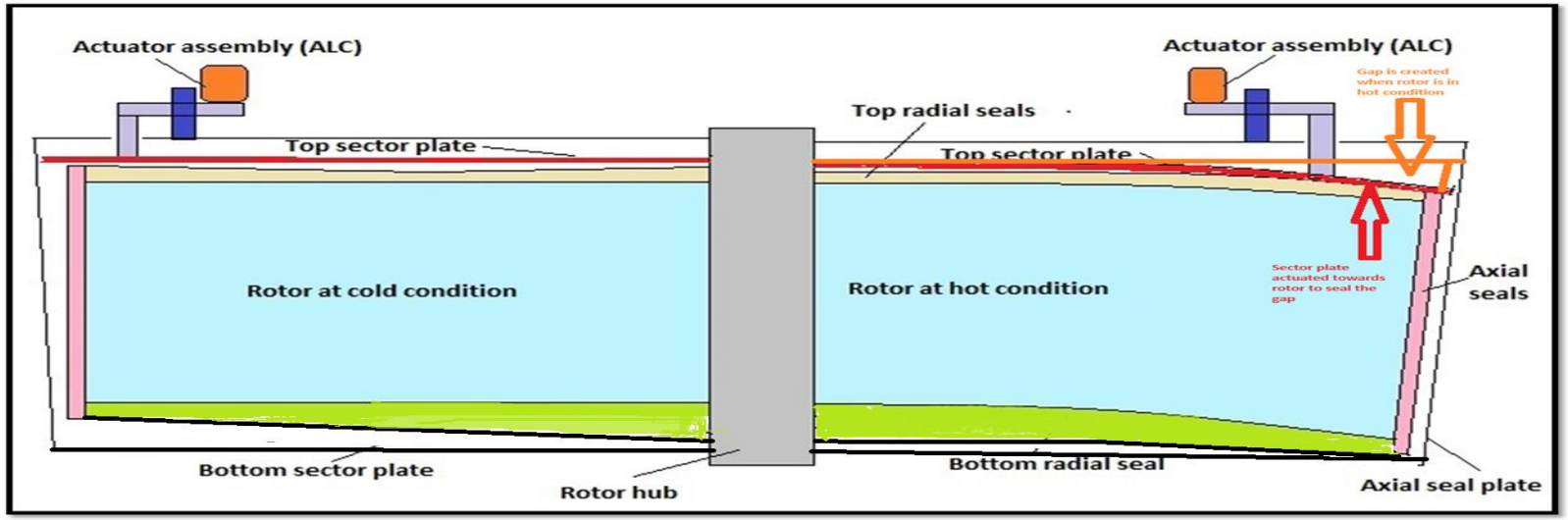
1-Modification of Air leakage control system(ALCS)

- Seal clearance are set at cold condition of the rotor to minimise the seal gap at hot operating condition.
- Top radial seal clearance increase due to downward expansion of rotor which is set at minimum in cold condition.
- The high-pressure air from air stream leaks through the gaps of seals and stationary sealing plate (sector plate and axial seal plate) to gas stream.
- To control the air leakage from top radial seal, we have air leak control system (ALCS) with adjustable top sector plate.
- The top sector plate is fixed at inboard end and free at outboard end.
- An actuator mechanism connected with the sector plate operates the sector plate to control the air leakage.

PLC control of ALCS was not functioning properly and air leakage was 7-10%.

PLC challenges-

- No access to logic of PLC
- Local control and display
- No abnormality indication in DCS
- Outdoor location near RAPH
- Malfunctioning due to heat and dust.

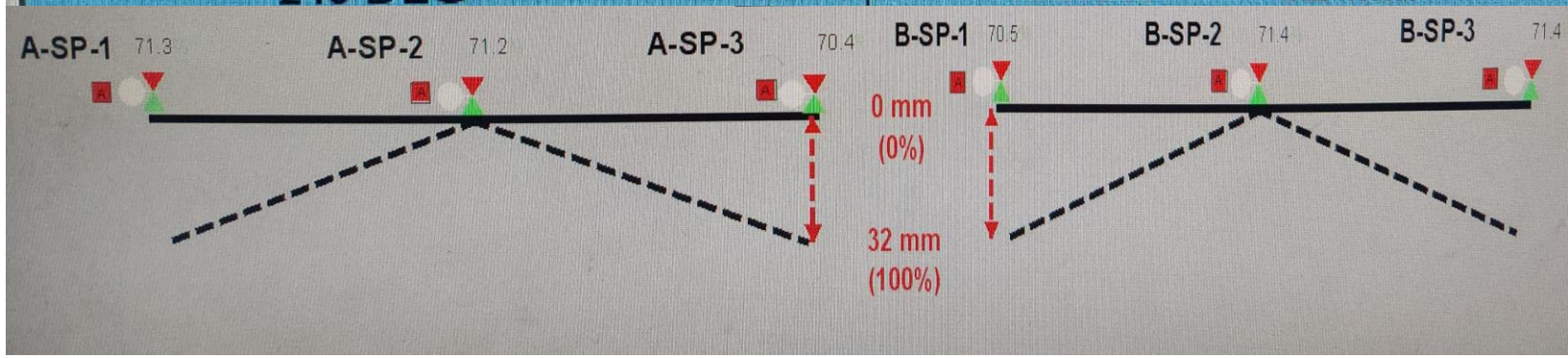


Modification of Air leakage control system(**ALCS**) from PLC to DCS

Highlights-

- Rotor expansion measurement at different flue gas differential temperatures .
- Functional curve between temperatures and sector plate movement developed.
- Programming of Logic, Graphics with real time display of sector plate position corresponding to temperature difference.
- Alarm in DCS for abnormalities in ALCS.

TEMPERATURE DIFFERENCE	ACTUATOR DMD
140 DEG	00.00% -- 00 mm
150 DEG	15.62% -- 05 mm
160 DEG	31.25% -- 10 mm
170 DEG	46.87% -- 15 mm
180 DEG	62.50% -- 20 mm
190 DEG	78.12% -- 25 mm
200 DEG	93.75% -- 30 mm
210 DEG	100.0% -- 32 mm



Air leakage :4.5 to 6%

Basket Modification

Background-

RAPH was running with higher DP due to choking of baskets and fan loadings were at higher side .The heat transfer in the RAH was also not proper resulting in lower hot PA & SA temperature and higher flue gas exit temperature.

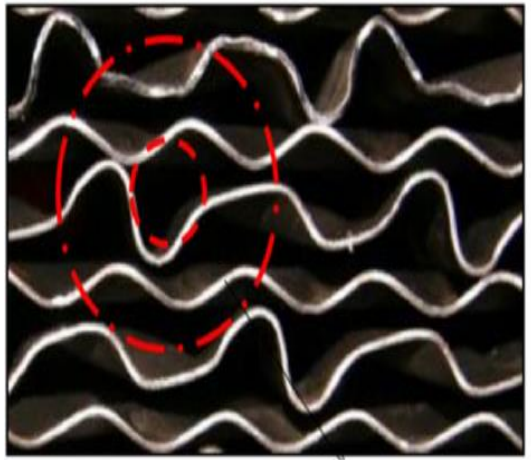
Due to firing of low GCV ROM Coal in place of designed wash coal, the coal flow was increasing by 30% and there was no margin in PA fan to cater additional PA flow demand in Mills.

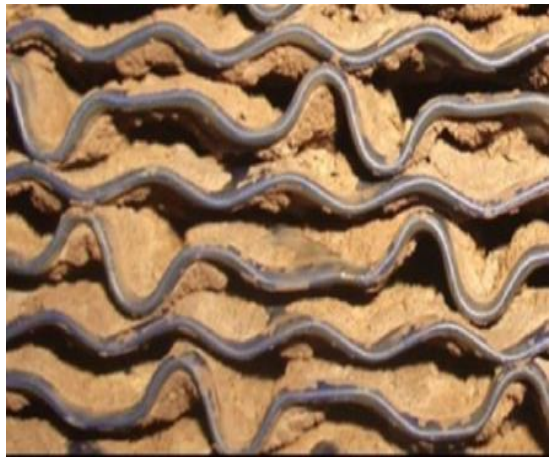
To improve the RAPH performance and to resolve above issues, the heating elements are replaced by new **HC11 profile** high efficient heating elements.

Basket Modification

Installed new Profile baskets with more heat transfer area.

Before (HS8/DU)

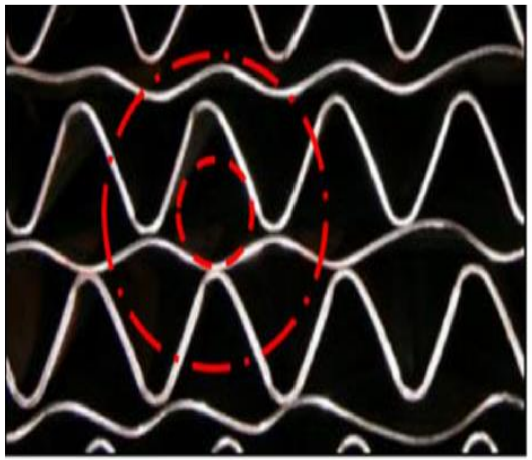


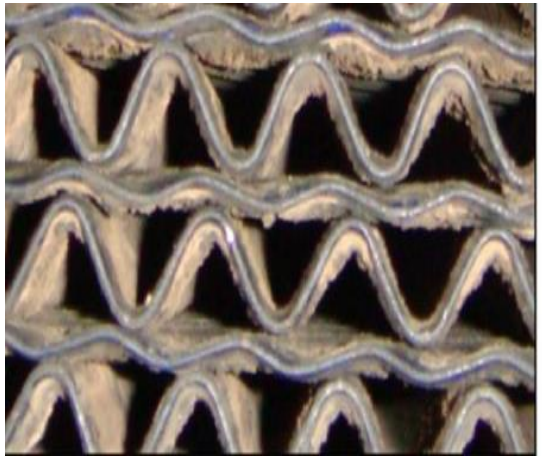


Combination of notch-undulated with undulated sheet

- Higher resistance to flow, Higher pressure drop
- Less cleanability

After (HC11)





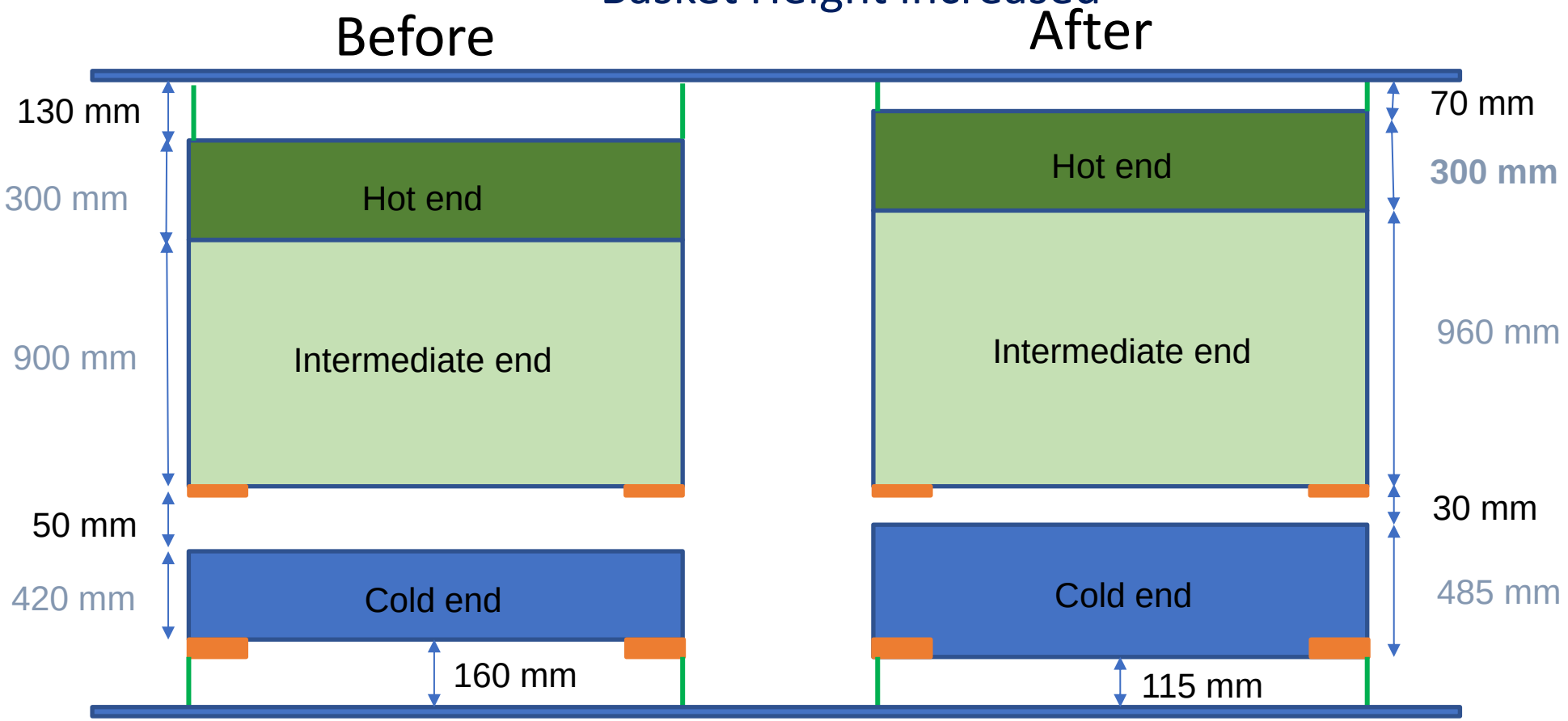
Combination of Transverse herringbon pattern of undulated with corrugated sheet

- Less resistance to flow ,Low pressure drop
- Better cleanability

Basket Modification

Heating surface are increased

Basket Height increased



Heating Surface area- 56344SqM
Baskets Height-1620mm
Weight of basket- 458MT

Heating Surface area- 58314SqM(**1970 SqM,3.5%**)
Baskets Height-1745mm(**125mm,7.7%)**
Weight of basket- 482MT (**24 MT,5%**)

Result of modification

Sr. No.	Description	Improvement
1	Improved in Boiler efficiency due to reduction in Dry Flue Gas Loss	0.56 % (14.5 kcal/kWh)
2	Reduction in Fan power due to lesser DP	38 MWh/day (5 kcal/kWh)
3	Improved margins in PA Fan loading	82 % Blade Pitch reduced to 69 %
	Total impact on Heat Rate	**19.5 kcal/kWh**

Hot PA and Hot SA temperatures increased by 20 Deg C and 15 Deg C respectively.

BFP Recirculation valve modification

Background- There was a recurring issue of RC valve passing within months of valve servicing. Identical damage of cage, plug and seat were observed every time during inspection.

Impact: Higher Turbine Cycle Heat Rate

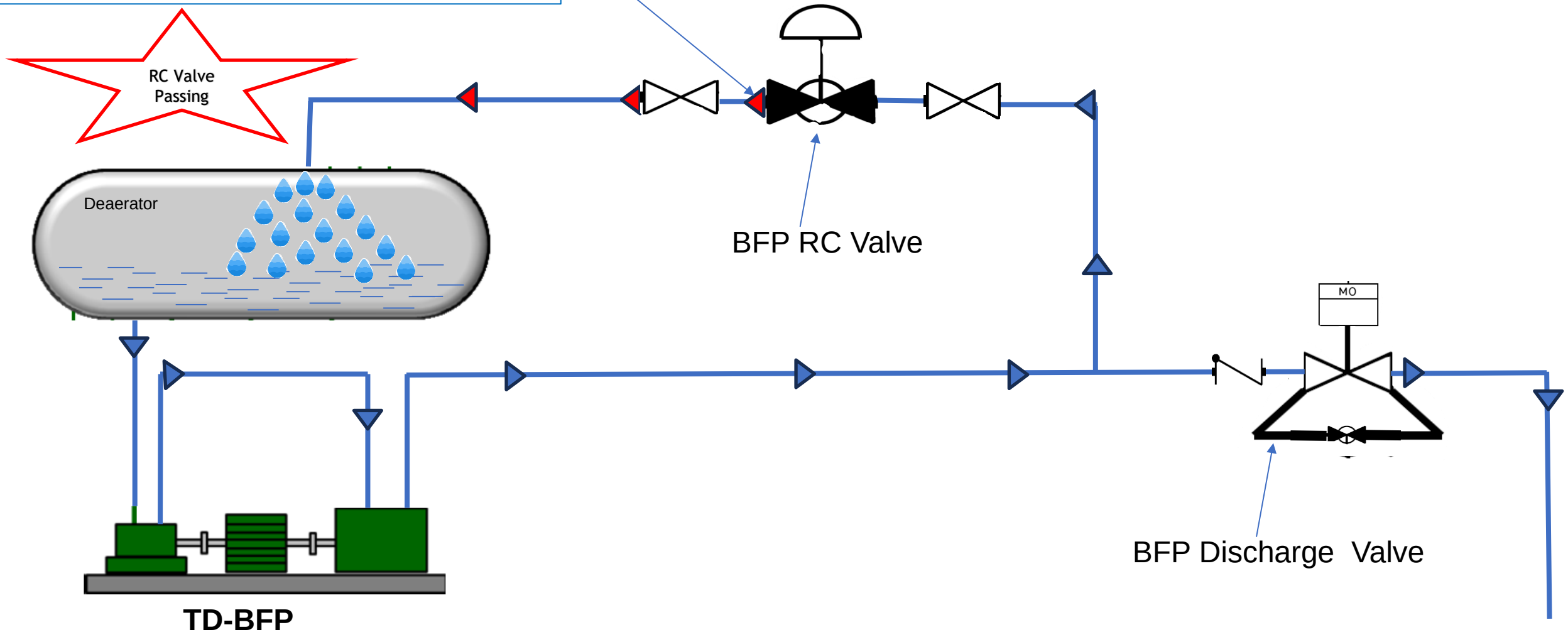
Actions taken-

- RCA of recurring valve passing issue was carried out and the reason of valve failure was due to high trim exit velocity .

- Implemented cost effective reliable solution.

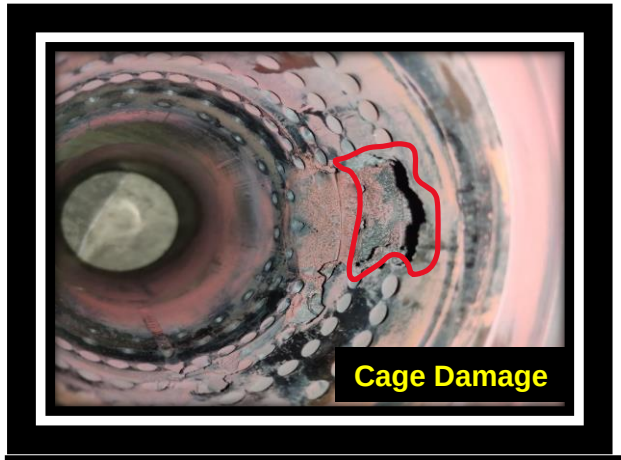
Impact R/C valve passing:
38 TPH = 1 kcal/kWh
1 kcal/kWh = 1.5 Crore per Annum

Flow due to R/C valve passing = 130 TPH (~3.3 kcal/kWh)



Modification

- Replacement of axial flow cylindrical cage with radial flow disc cage.
- Balancing cylinder provided over the cage for its positioning and plug guiding.
- Modified the pressure balancing port to reduce the velocity.

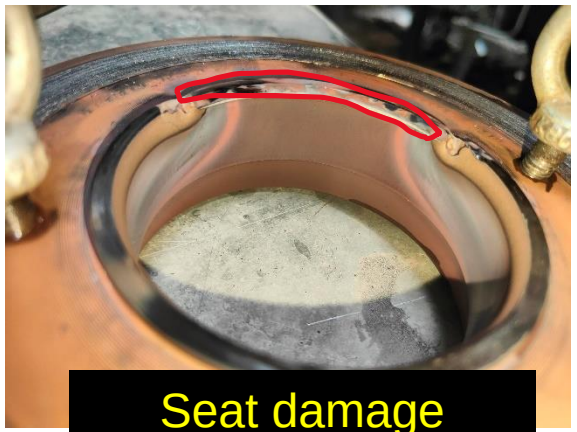


Modification

- Valve dismantled for inspection and failure analysis
  - Cage found intact with no signs of any damage of high trim exit velocity.
  - Minor damage observed on the plug and seat in direction of flow.

On further analysis, identified the issue of trim unbalance due to higher force under the plug of the valve.

No damage to cage



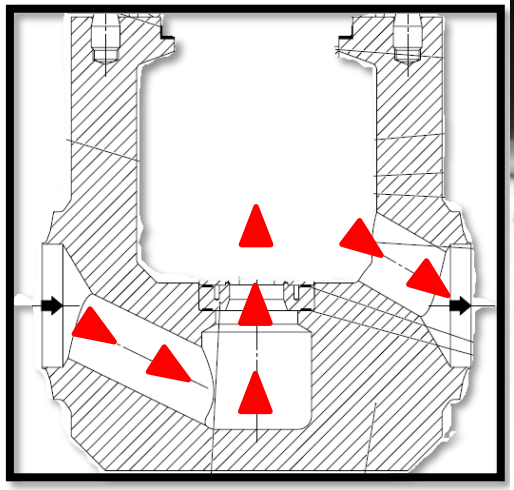
Seat damage

Plug damage

Modification

- Trim set re-designed from under the plug to over the plug type, to minimise the unbalance force during valve operation.
- Redesigned the cage for outer to inner flow.
- Bonnet modified for stem guiding
- Plug-stem modified with Pilot plug.
- Valve orientation reversed.

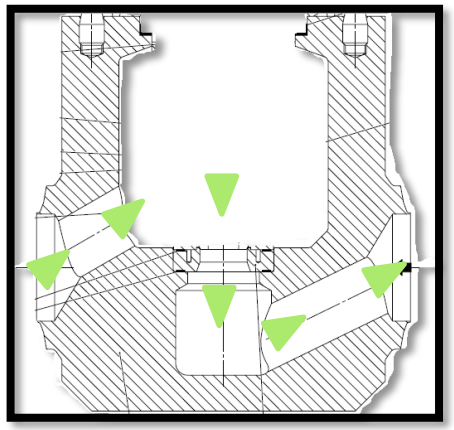
Modification successful and sustaining since December 2023



Flow under the plug

Before

Phase-1 Modification



Valve orientation reversed

Phase-2 Modification

Phase-2 Modification

NPL

Laboratory Information Management System (LIMS)

EPC PROJECTS | HI-TECH MANUFACTURING | SERVICES

LARSEN & TOUBRO

Main Features NPL Coal Lab

- State of Art dedicated Lab for coal testing
- NABL Accredited
- Auto sampling
- Testing & Analysis by the own team

Best Practices in Coal Lab at NPL

1. Sample collection, directly from the conveyor belt through Auto Sampler
2. Sample packing in **fresh single use weatherproof** bags.
3. Proficiency testing for validation of the accuracy of test results.
4. **Implementation of LIMS for test results and report generation.**

LIMS - Coal Sample Testing

SL No.	Process
1	Individual receipt coal rake registered in **LIMS**, bar code generated for each rake.
2	Packing , Storage & Conditioning with Bar Code Tags.
3	Testing assignment to the Chemists by Technical Manager through system
4	Scanning of Bar Code for initiating the Testing and analysis (GCV, Proximate Analysis & Moisture measurement).
5	GCV measurement by Bomb Calorimeter .
6	Proximate Analysis by Muffle Furnace.
7	Total Moisture measurement by OVEN.
8	Result verification & approval through **LIMS.**

Report Generation

LIMS -Coal Sample Testing

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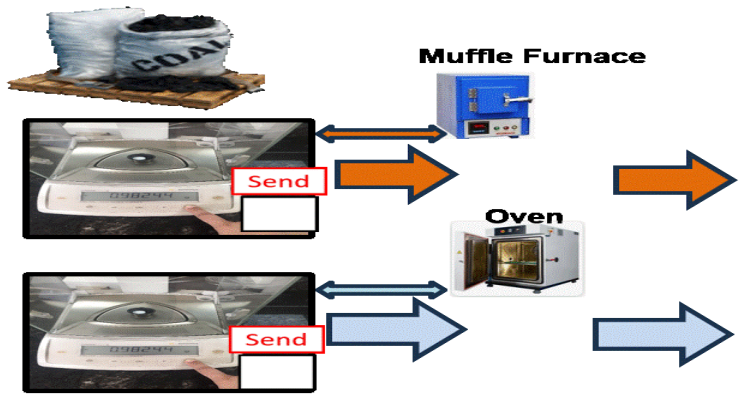
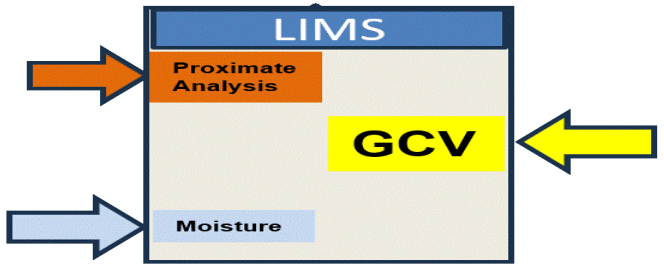
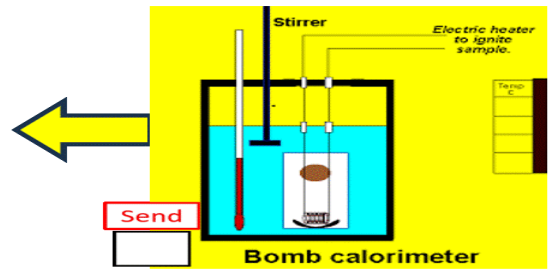
Report Generation



Report Generation comprising GCV, Proximate Analysis & Moisture through LIMS





NPL Nabha Power Limited	**NPL COAL TESTING LABORATORY** Nabha Power Limited, Rajpura Post Box 28, Near Village Nalash Dist. Patiala 140401,Punjab	TC-5412

Test Report

Test Certificate No. : NCTL/FC/24-25/132 Issue Date: 16.08.2024

ULR No. : TC541224000000229F

Issued to : Head Operation
Head Operation Nabha power Rajpura

Sample Description : Coal Sample Received from TP3 (Feed Coal 24hr basis)

Sample Details	Date of Sampling			10/08/2024
	Testing start date			12/08/2024
	Testing completion date			16/08/2024
	Parameters	**Test Protocol**	**Unit**	**Test Results**
As Received Basis(ARB)	Moisture (Inherent)	IS:1350 (Part 1) :1984 RA 2019	%	4.31
	Total Moisture	IS:1350 (Part 1) :1984 RA 2019	%	11.90
	Ash	IS:1350 (Part 1) :1984 RA 2019	%	38.85
	Volatile matter	IS:1350 (Part 1) :1984 RA 2019	%	20.26
	Fixed Carbon	IS:1350 (Part 1) :1984 RA 2019	%	28.99
	Gross Calorific Value	IS:1350(Part-2):2022	Kcal/Kg	3615

----------End Of Report----------

Authorized Signatory

DEBASISH MUKHERJEE
TECHNICAL MANAGER
NPL COAL TESTING LABORATORY, RAJPURA

Note:

1. These reported results actually relate to the above coal samples actually tested at NCTL.
2. Environmental Condition: 25 ± 2°C Temp. & 60 ± 10% RH.
3. This report cannot be reproduced, except in full, without written consent from the laboratory.
4. Sample drawn as per IS 16143 Part 2 & preparation as per IS 16143 Part 4.

Record No: TR-10 Page 1 of 1

Benefits from LIMS

- Sample data confidentiality during testing
- Result manipulation not possible
- Elimination of the human errors
- Accuracy of the data up-to five decimal
- Data backup & Secured on cloud server

Nitrogen blanketing of the Governing Oil Tank

Background-

- Fire Resistance Fluid- Fyrquel EHC N (Phosphate Ester Oil), is a synthetic oil used in turbine governing system due to its unique fire-resistant and self-extinguishing properties.
- FRF oil is hygroscopic in nature and absorbs moisture from the atmosphere through breathers results in high moisture level in the oil.

Impact of high moisture in FRF -

- Increased moisture level in oil results in ester hydrolysis in which the oil breaks down very quickly and produces acid and increases the TAN value of oil.
- Increase TAN value above **.2 mgKOH/g** ,a potential risk of EHC system malfunction and damage.

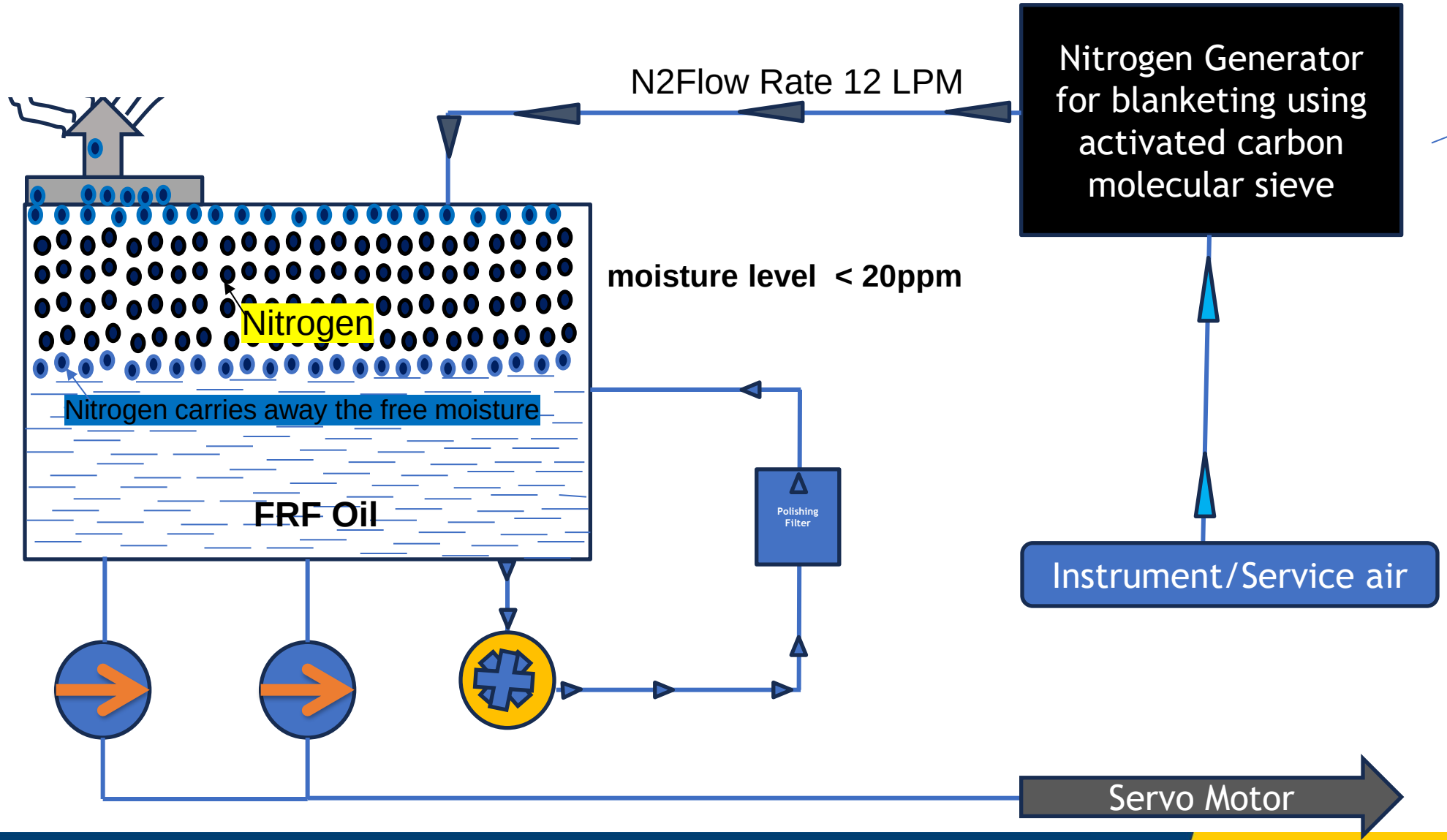
Solution implemented-

- Nitrogen blanketing provided through a portable nitrogen generator over the oil surface in the tank.
- Positive pressure of nitrogen is maintained inside the tank thus prevents the air ingress into the tank.

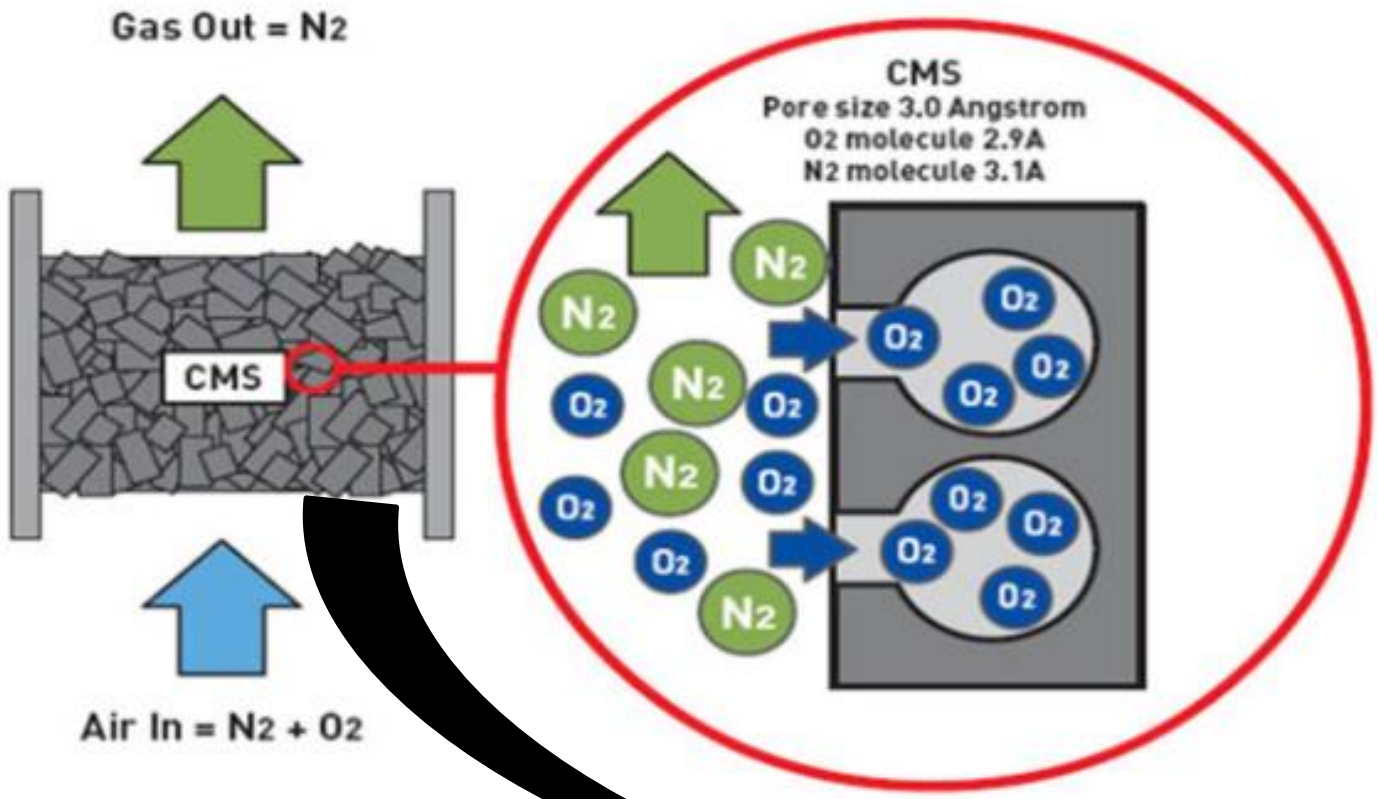
Result Achieved:-

- Lower moisture levels in the range of 20PPM ,
- Controlling the TAN value of the oil.
- **Complete FRF oil replacement is not carried out till date as oil parameters are well within limit.**

Nitrogen Capping in the Fire-Resistant Fluid reservoir



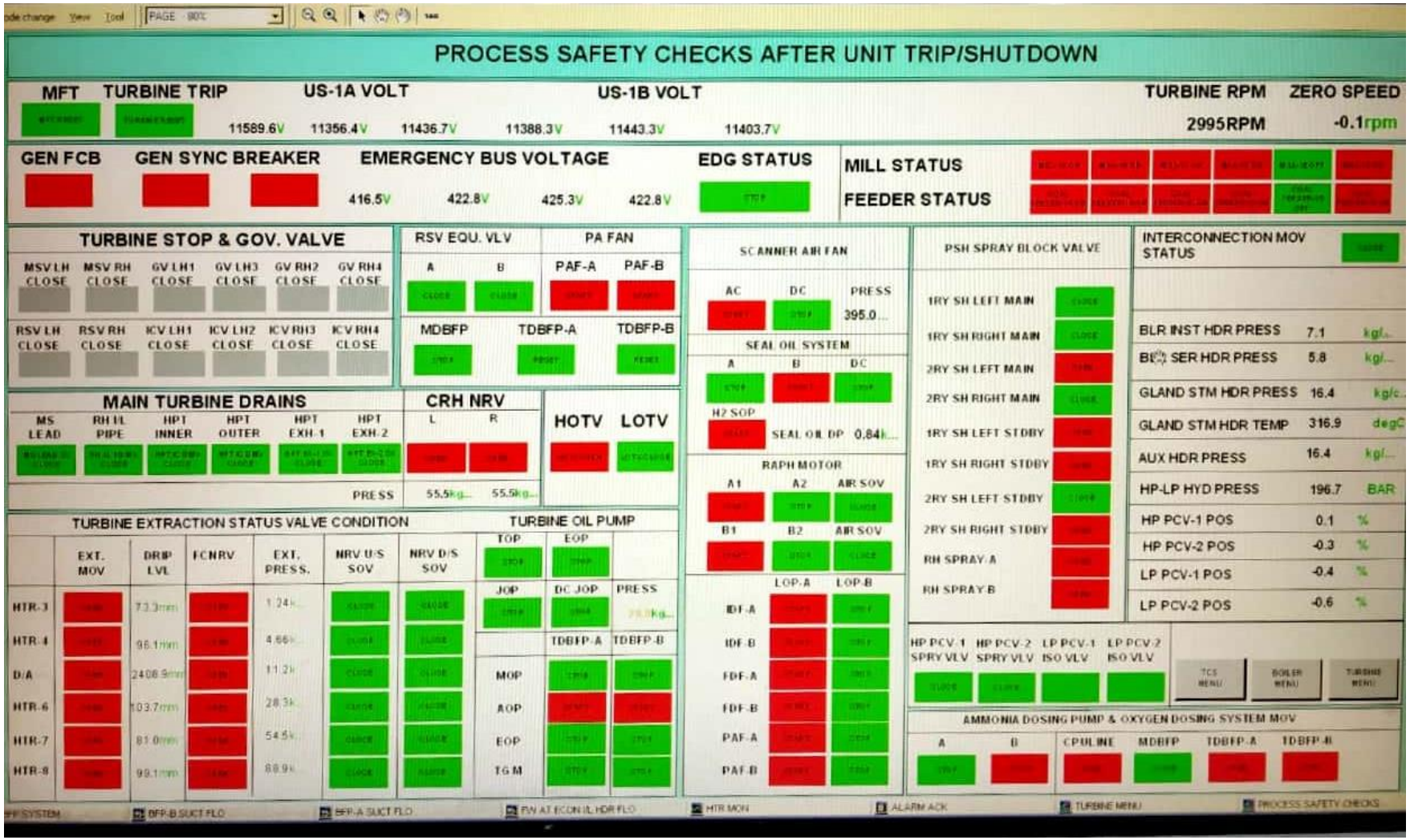
Principle of N2 Generation by Active Carbon Molecular Sieve



DCS - Single Window Process Safety Checklist

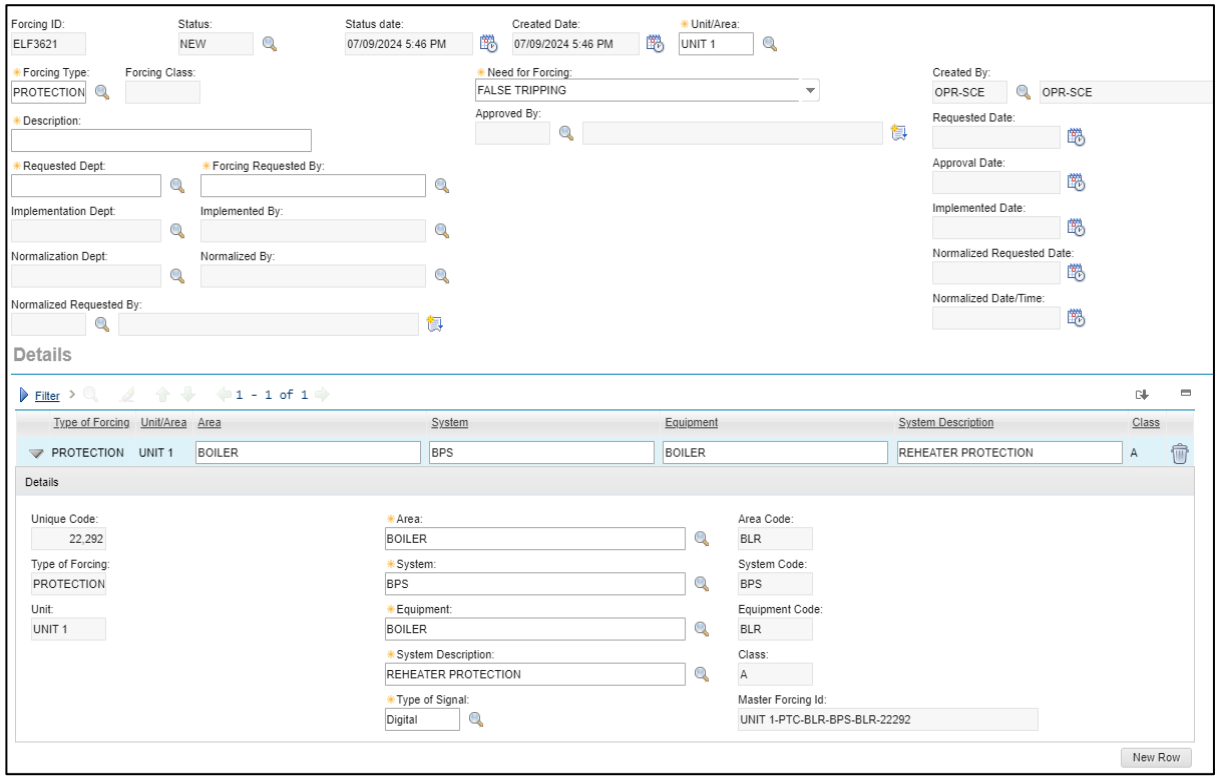
Highlights:

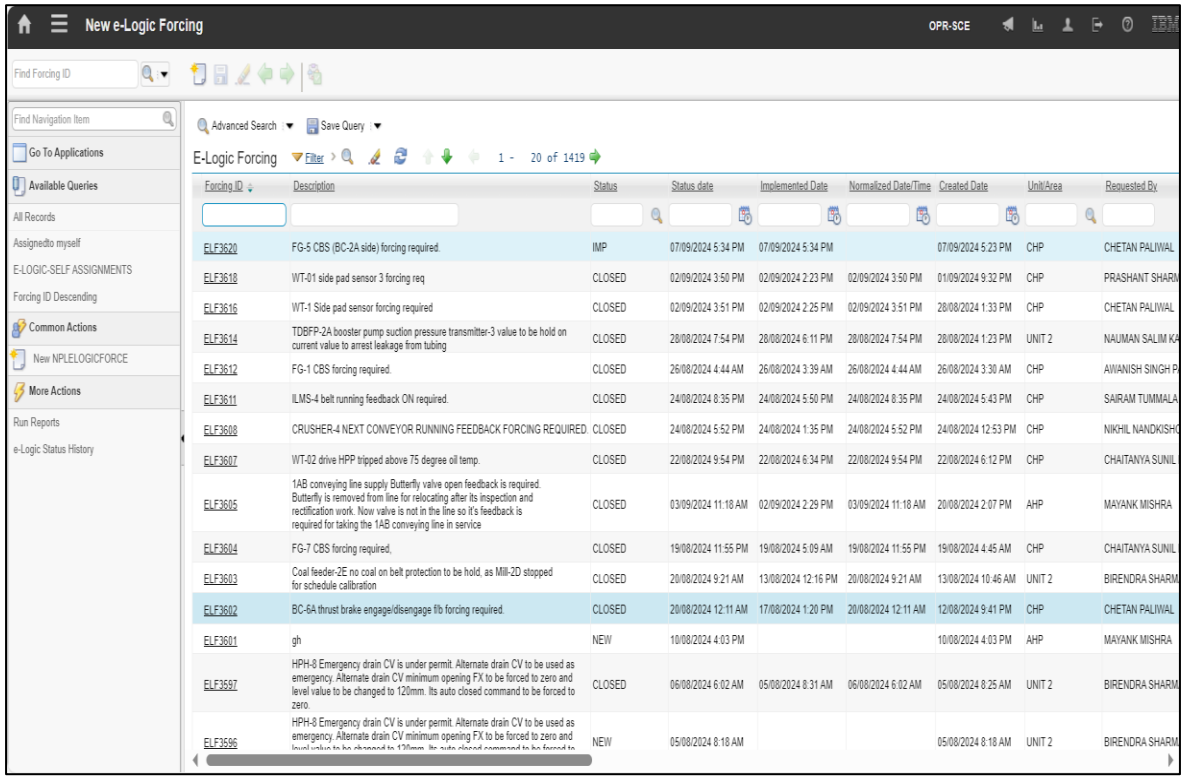
- Single window provided in DCS.
- All safety checkpoints to be checked during Unit trip and shutdown covered.
- Actions can be initiated very quickly.
- Chances of missing-out nullified.
- Efficient monitoring by SCE, UCE and DE.



E-Logic Forcing with Approval System

- Classification based on criticality of Equipments and Activities
- Hierarchy based approval by competent authority as per Criticality on Unit trip & Generation loss
- Weekly discussion on forcing list





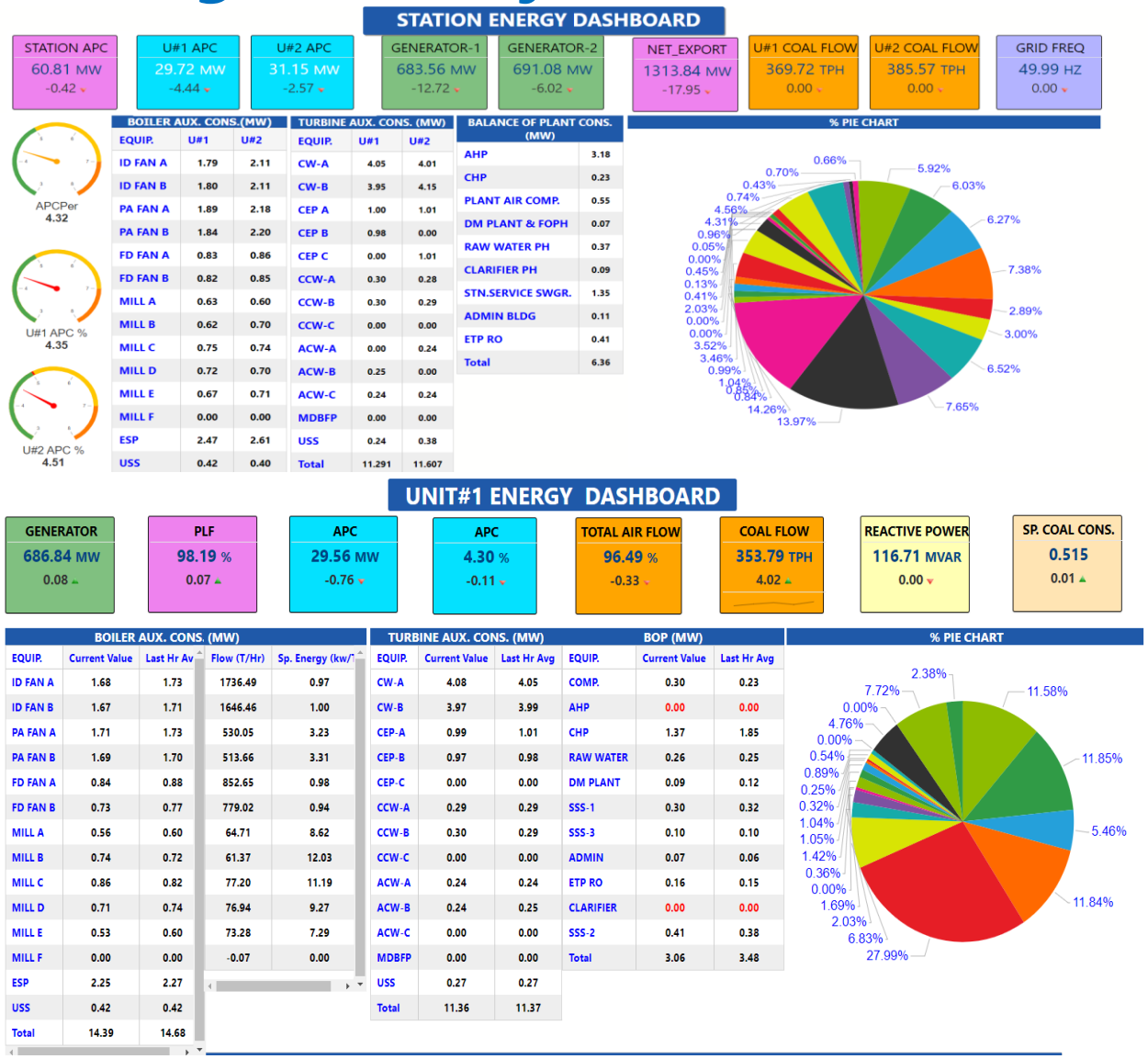
Energy Management System

Energy Management Software

- ✓ System wise energy data monitoring.
- ✓ Realtime alerts pushed to user through email and SMS
- ✓ Daily energy consumption report published automatically, covering deviation from benchmark values for each drive

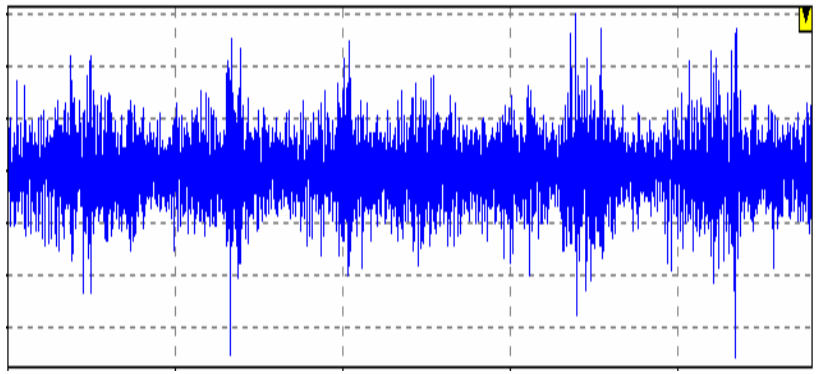
Drive Level Energy Benchmarking

- ✓ Statistical analysis of Historical energy consumption
- ✓ Identified dependent variables and independent variables for formulation of regression equations
- ✓ Defined control variables for efficient utilization equipment/system
- ✓ Deviation reports are generated, and service request is raised to concerned department for carrying out the rectification



Acoustic Condition Monitoring

1. Detection of valve passing
2. Detection of electrical fault in Transformers
3. Air Leakage detection
4. Bearing Healthiness detection

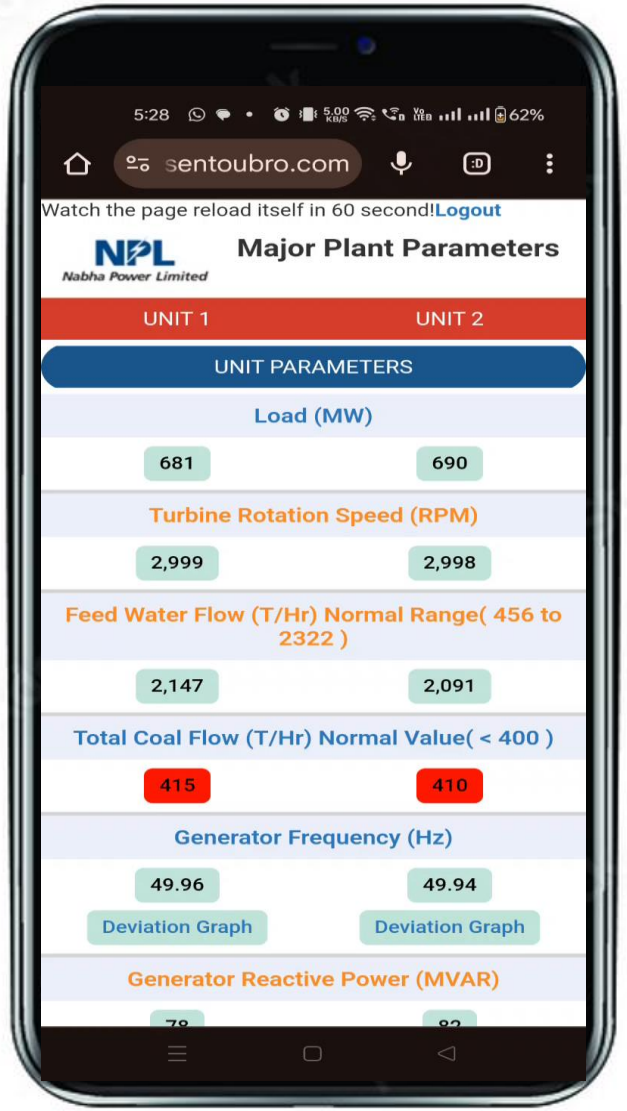


Digitalization

Mobility Application

Plant Vital Parameters

- Real Time Plant Parameter Display
- Data Sync with Live MIS Server
- Refresh every – 60 Sec




Thank
You

National Accreditation Board for Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

NPL COAL TESTING LABORATORY

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

NABHA POWER LIMITED, RAJPURA, PATIALA, PUNJAB, INDIA

in the field of

TESTING

Certificate Number: TC-5412

Issue Date: 31/03/2024 Valid Until: 30/03/2026

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.

(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Entity: NABHA POWER LIMITED

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer