



# NABHA POWER LIMITED

Best O&M Practices

# Table of Contents

- About the Organization
- RAPH Performance improvement
- Modification of the BFP RC valve
- Laboratory Information Management System in Coal Lab
- Nitrogen blanketing of the Governing Oil Tank
- DCS Single Window Process Safety Checklist
- Logic Forcing Management system
- Energy Management System
- Condition monitoring through acoustic method
- Mobility Applications- Online Plant Parameters in Mobile

# 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)

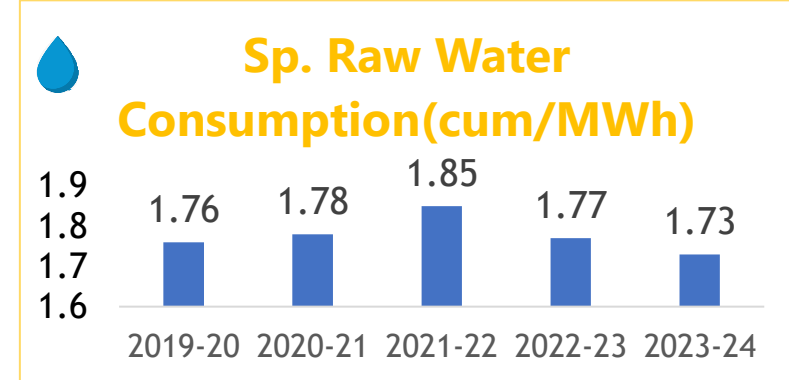
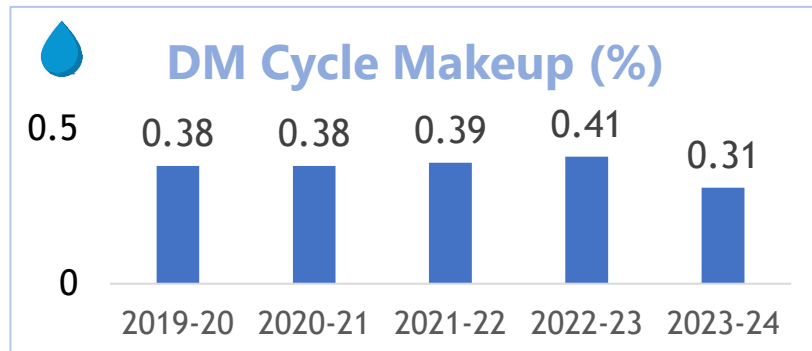
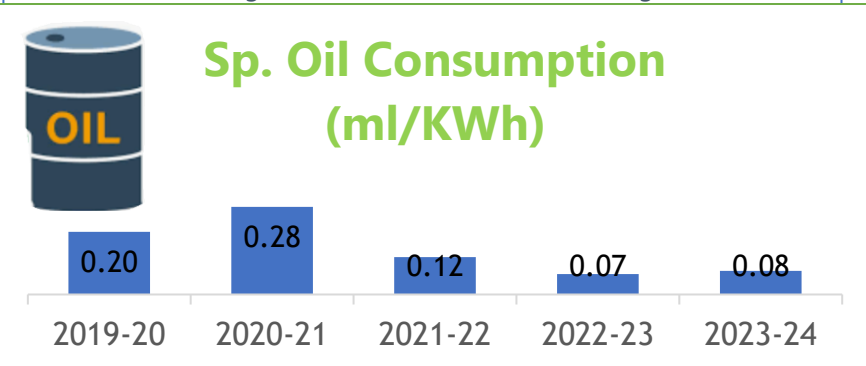
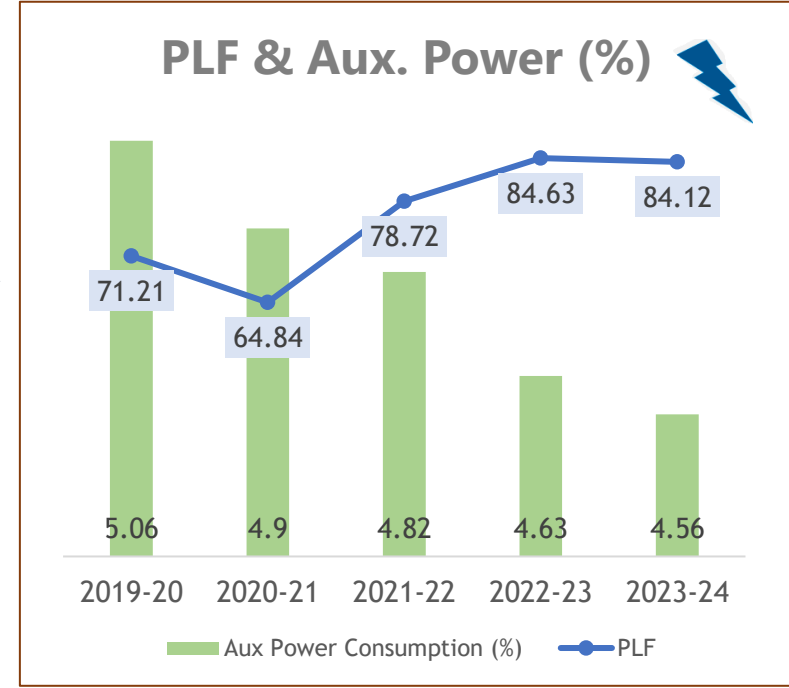
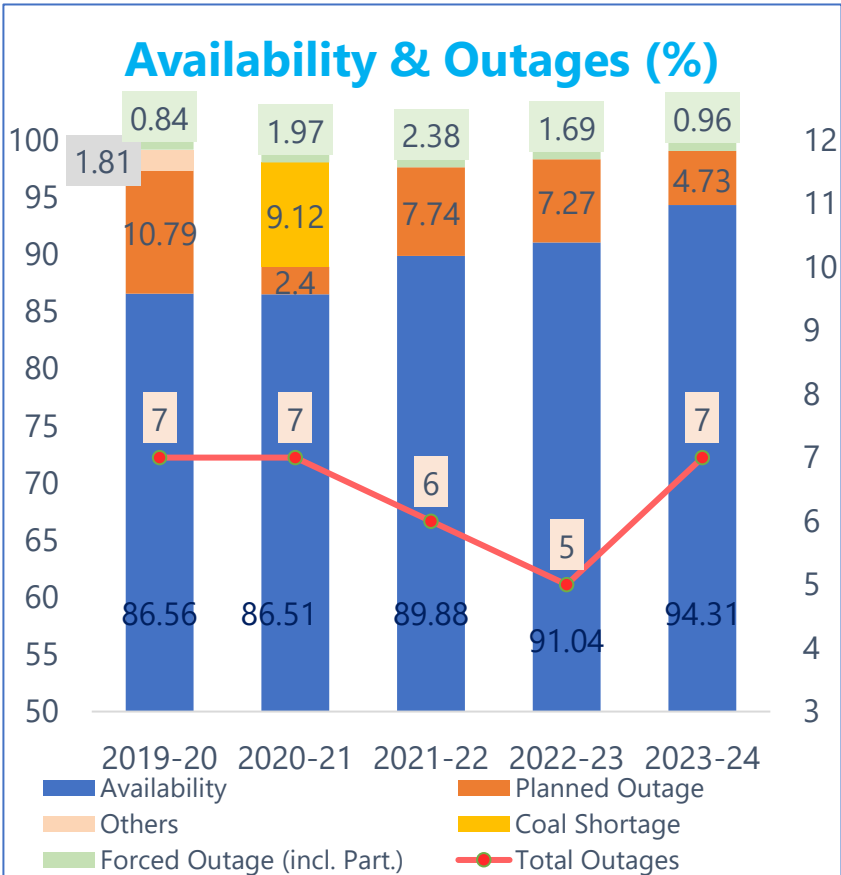


Top of Merit  
Order in the  
State Punjab



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)**



## 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

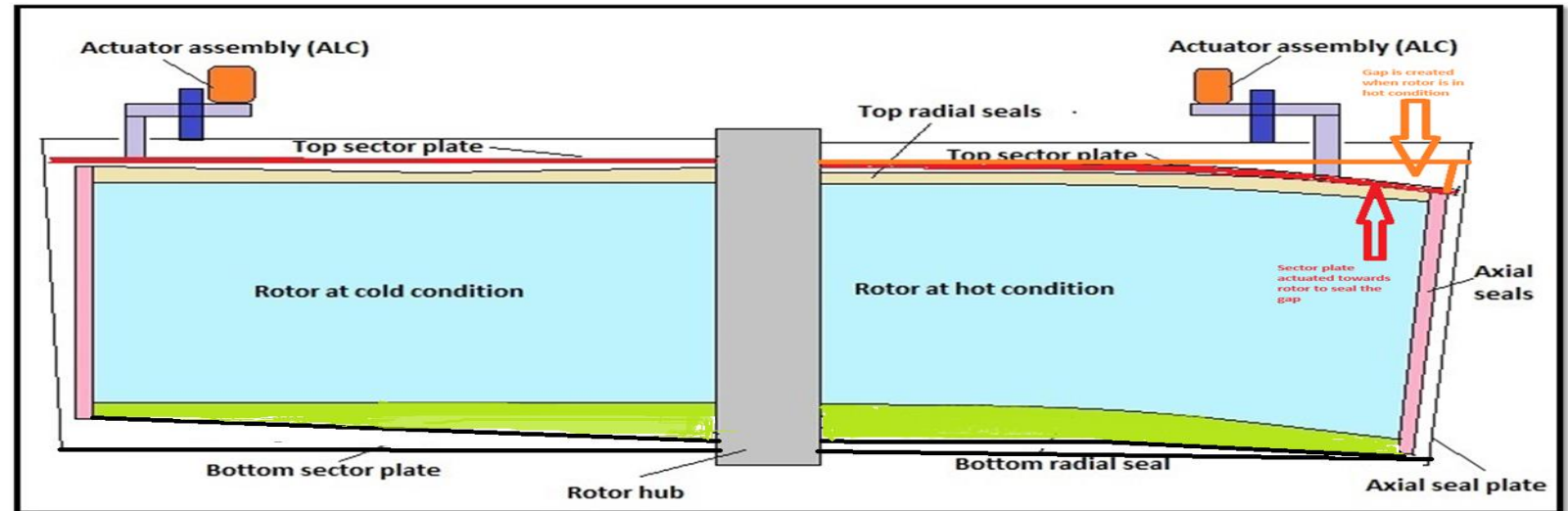
# 1-Modification of Air leakage control system(ALCS)

- 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-

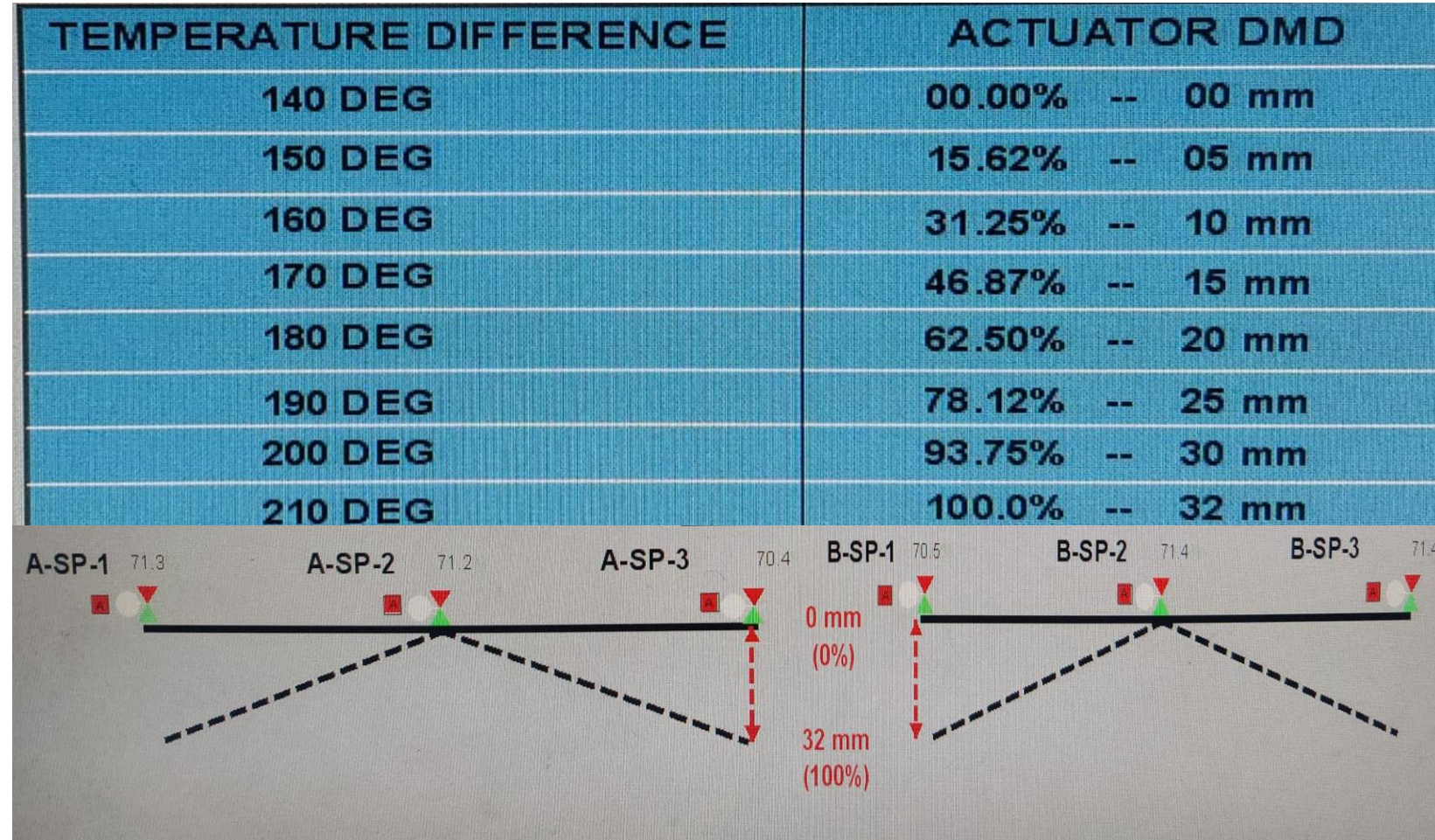
- No access to logic of PLC
- Local control and display
- No abnormality indication in DCS
- Outdoor location near RAPH
- Malfunctioning due to heat and dust.



# 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.



**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.

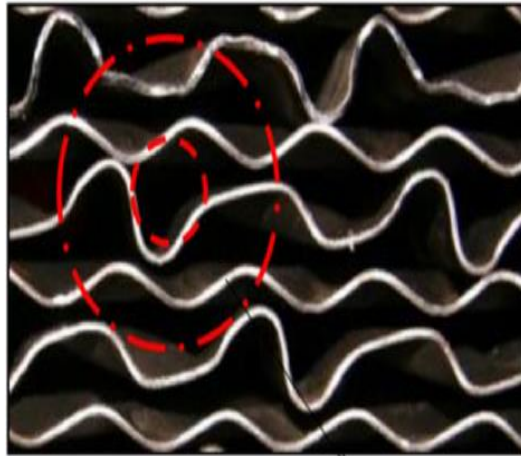
To improve the RAPH performance and to resolve above issues, the heating elements are replaced by new **HC11 profile** high efficient heating elements.



# Basket Modification

***Installed new Profile baskets with more heat transfer area.***

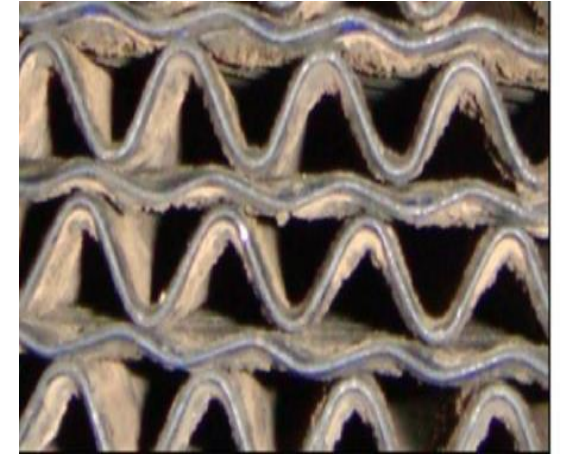
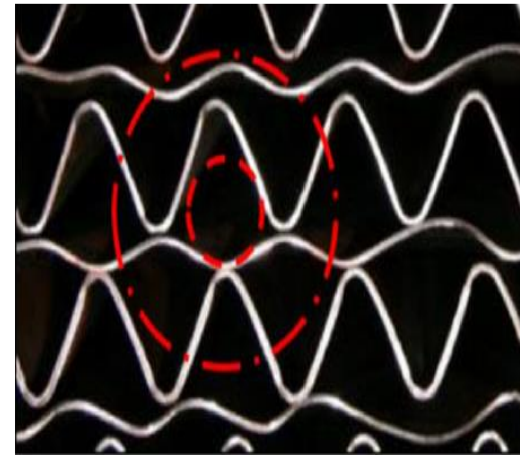
Before (HS8/DU)



Combination of notch-undulated with undulated sheet

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

After (HC11)



Combination of Transverse herringbone pattern of undulated with corrugated sheet

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

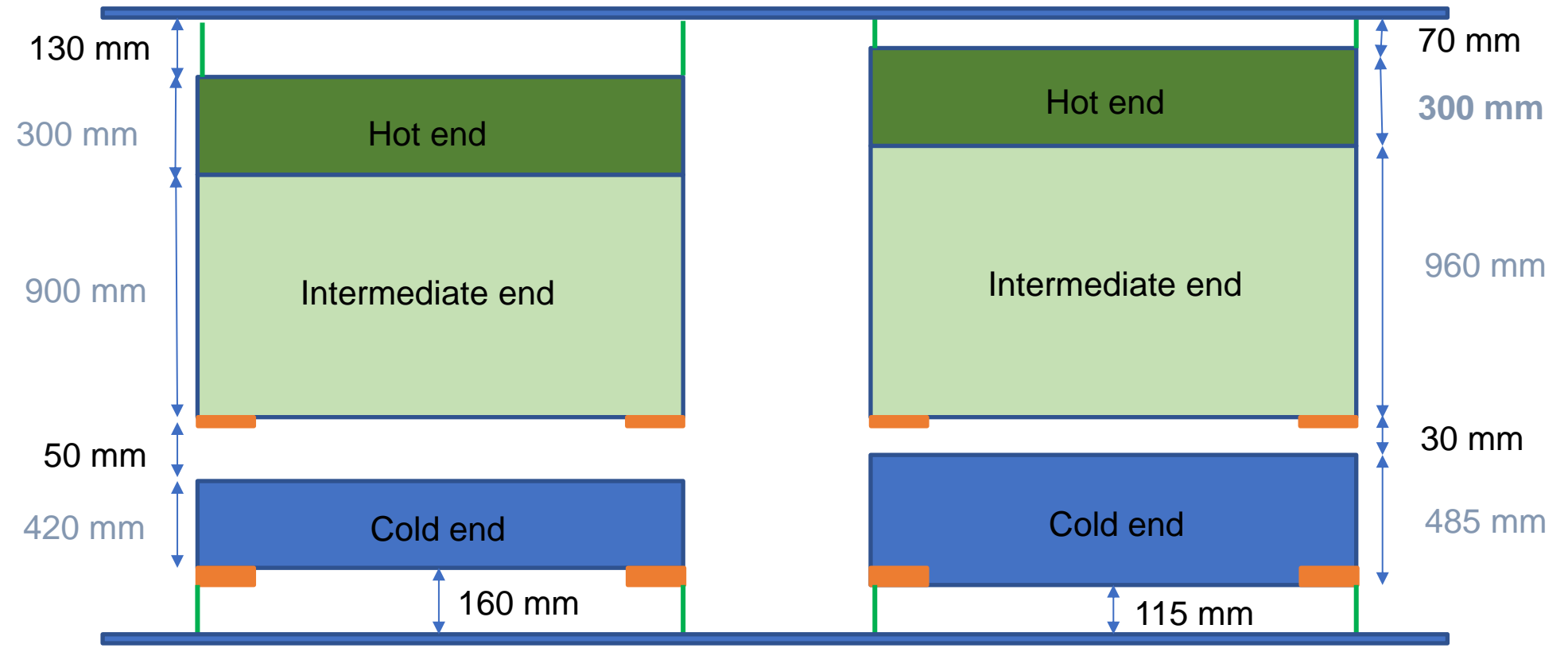
# Basket Modification

Heating surface are increased

Basket Height increased

Before

After



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 %
<b>Total impact on Heat Rate</b>		<b>19.5 kcal/kWh</b>

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.

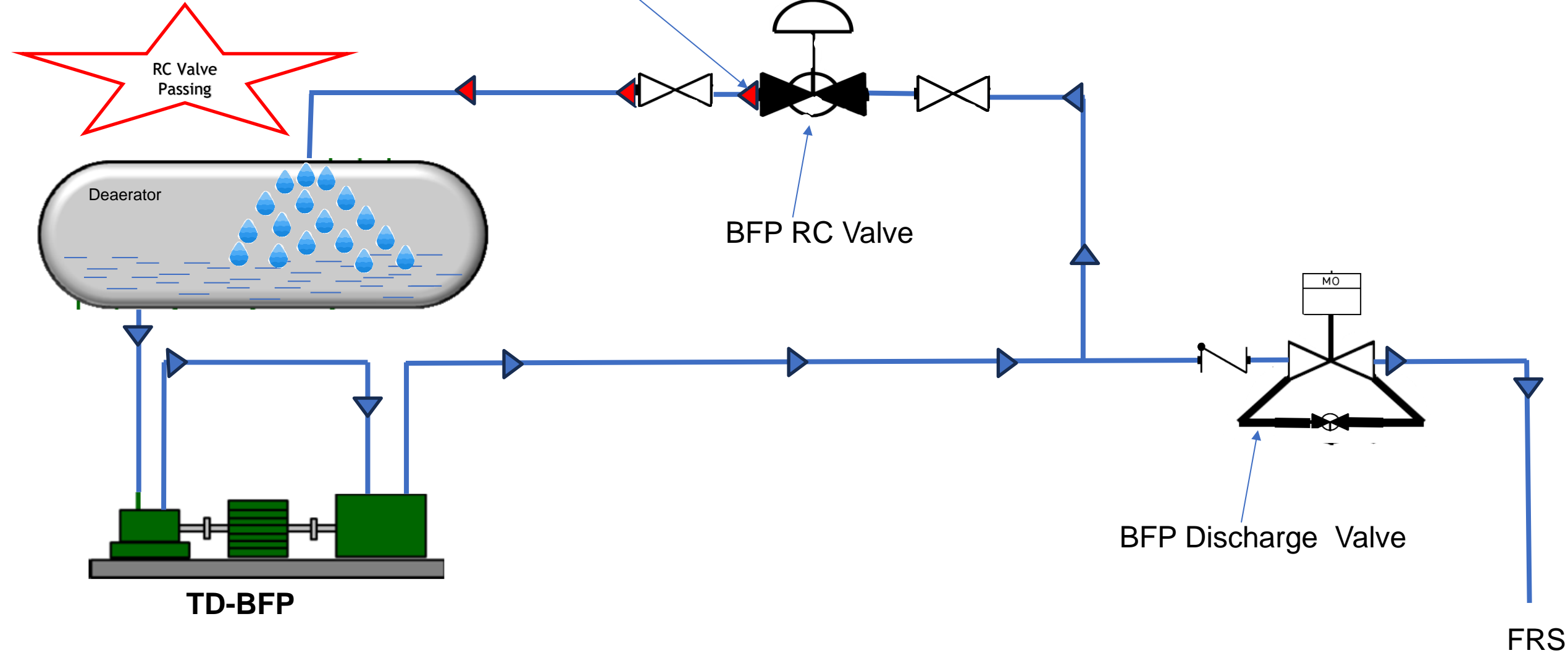
**Impact:** Higher Turbine Cycle Heat Rate

## **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.

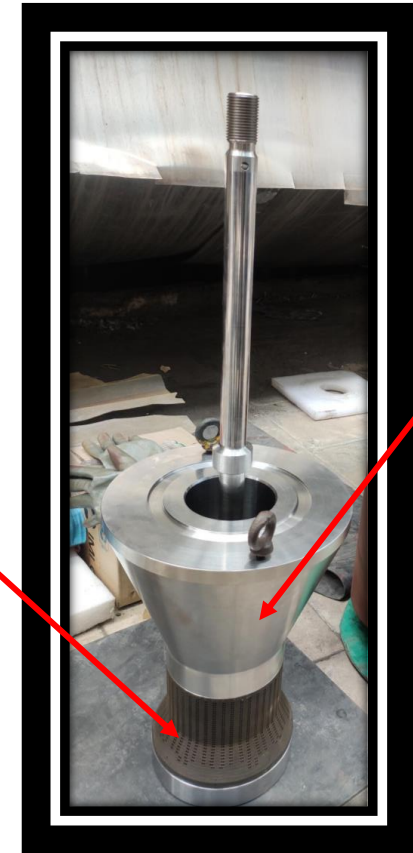
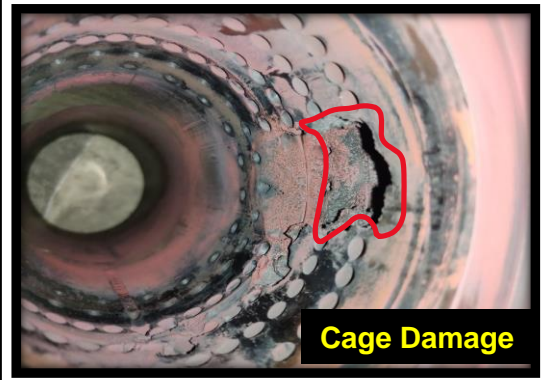
Impact R/C valve passing:  
38 TPH = 1 kcal/kWh  
1 kcal/kWh = 1.5 Crore per Annum

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.



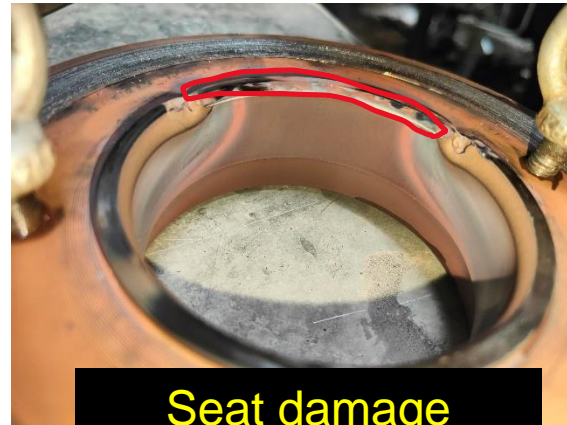
# Modification

- 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



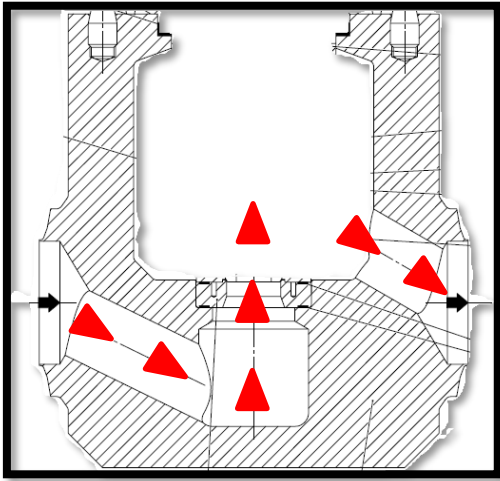
Plug damage

# 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



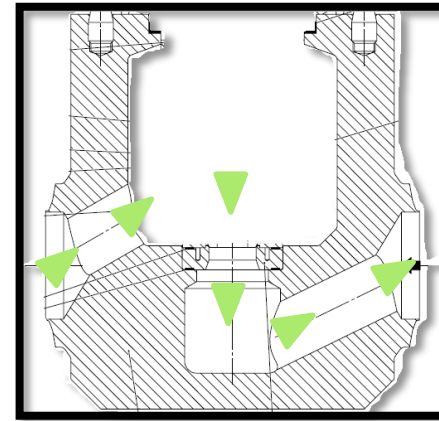
Flow under the plug



**Before**



**Phase-1** Modification



Valve orientation reversed

**Phase-2** Modification



**Phase-2** Modification



# Laboratory Information Management System (LIMS)

# 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.**



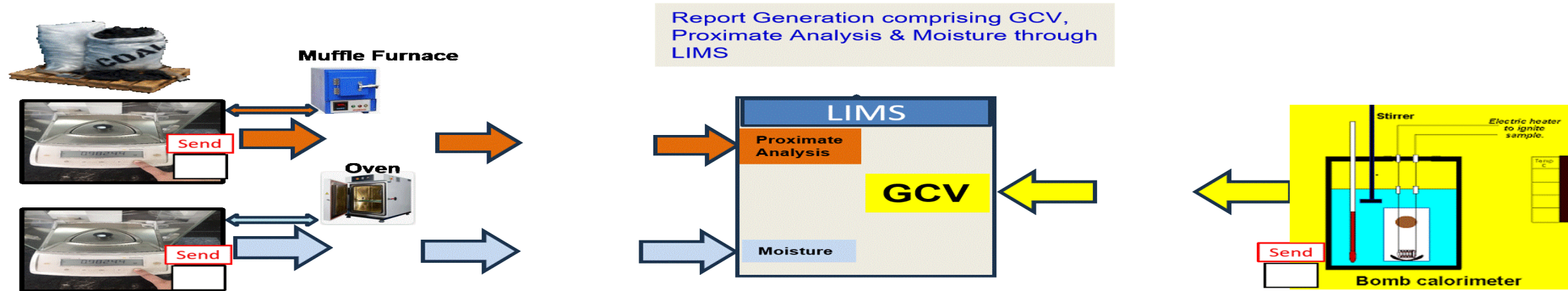
# LIMS - Coal Sample Testing

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

SL No.	Process
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5	GCV measurement by Bomb Calorimeter .
6	Proximate Analysis by Muffle Furnace.
7	Total Moisture measurement by OVEN.
8	Result verification & approval through LIMS. } <b>Report Generation</b>





## 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  $.2 \text{ mgKOH/g}$  , a potential risk of EHC system malfunction and damage.

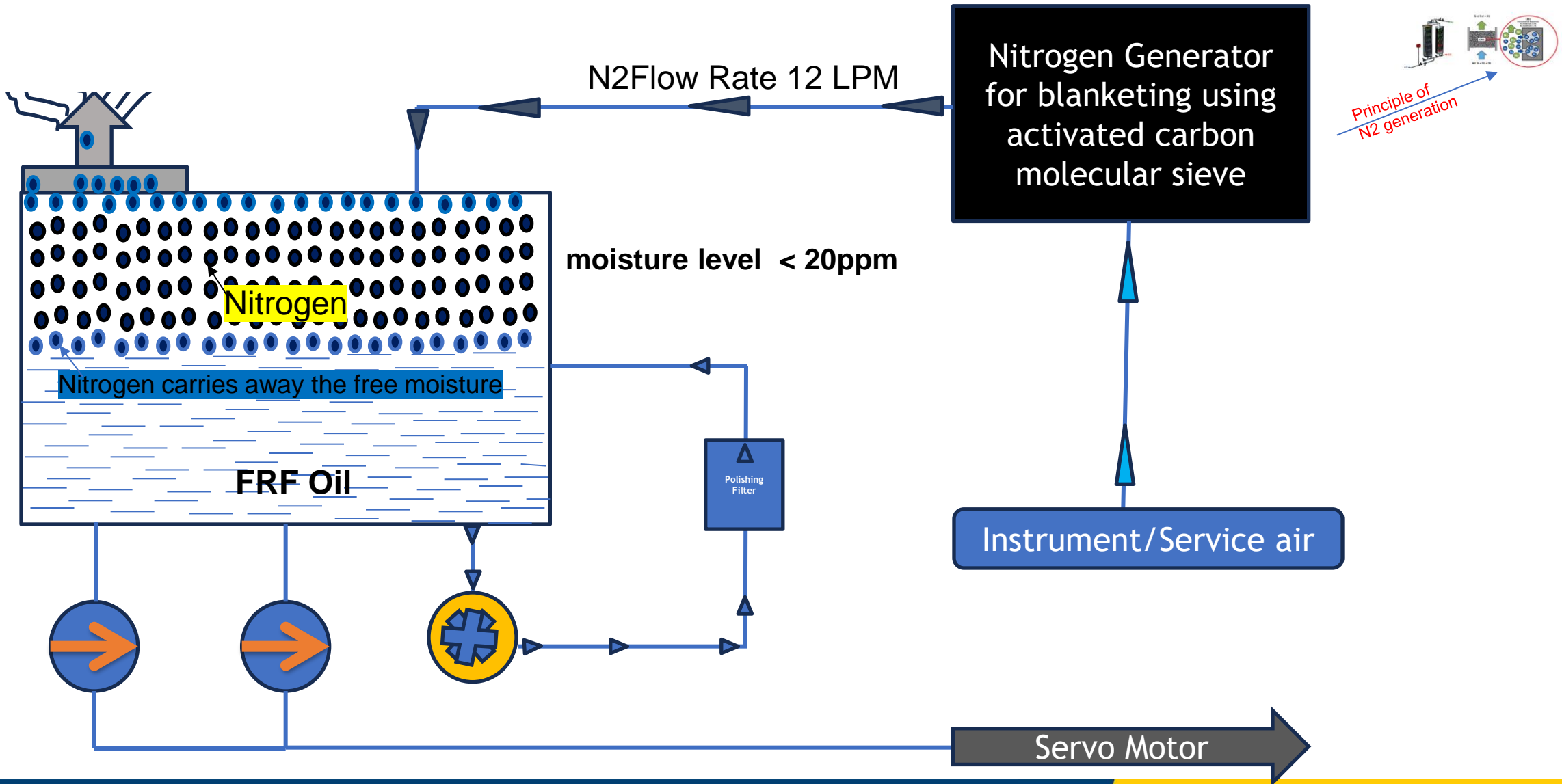
## Solution implemented-

- 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.

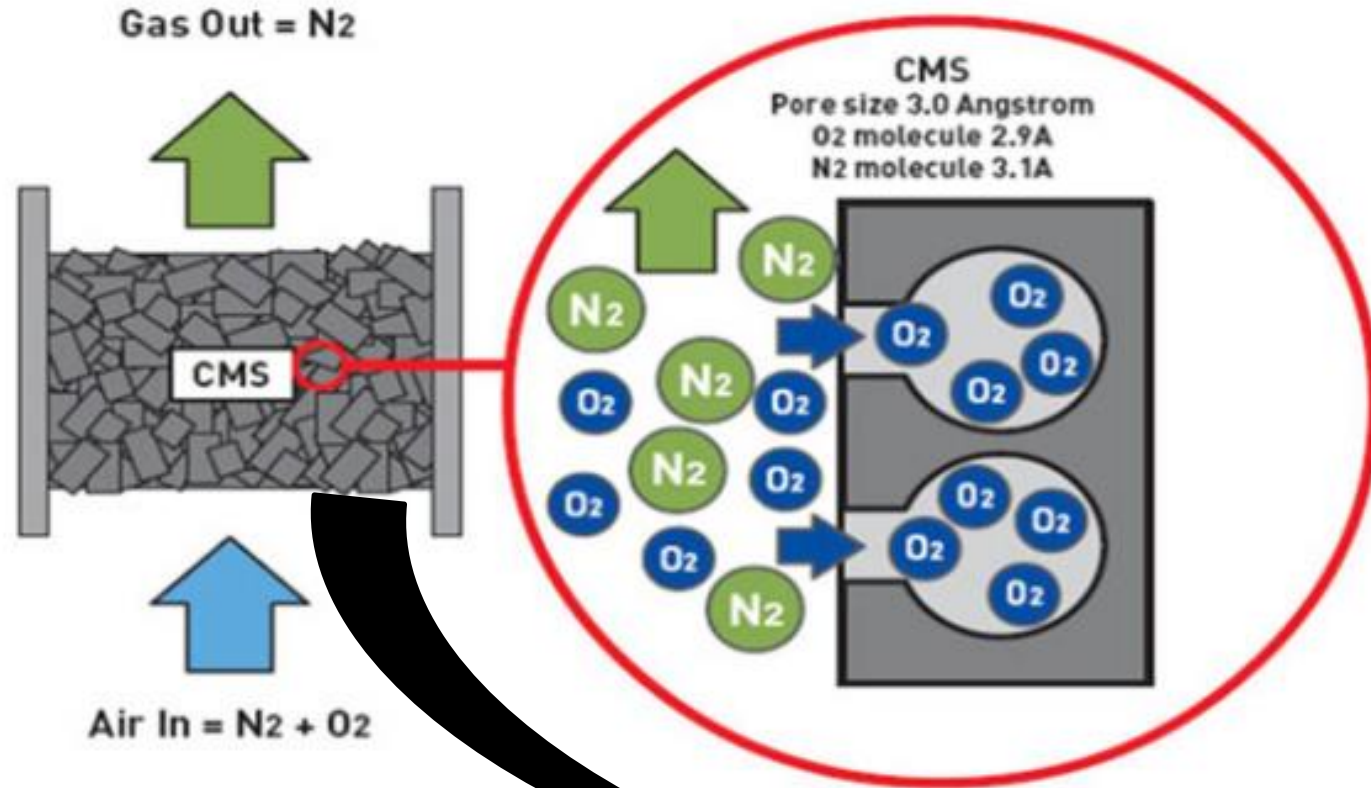
## Result Achieved:-

- 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 N<sub>2</sub> 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.

**PROCESS SAFETY CHECKS AFTER UNIT TRIP/SHUTDOWN**

<b>MFT</b> [Green]	<b>TURBINE TRIP</b> [Green]	<b>US-1A VOLT</b> 11589.6V 11356.4V 11436.7V 11388.3V				<b>US-1B VOLT</b> 11443.3V 11403.7V		<b>TURBINE RPM</b> 2995RPM	<b>ZERO SPEED</b> -0.1rpm					
<b>GEN FCB</b> [Red]	<b>GEN SYNC BREAKER</b> [Red]	<b>EMERGENCY BUS VOLTAGE</b> 416.5V 422.8V 425.3V 422.8V				<b>EDG STATUS</b> [Green]	<b>MILL STATUS</b> [Red]							
<b>TURBINE STOP &amp; GOV. VALVE</b>			<b>RSV EQU. VLV</b>		<b>PA FAN</b>		<b>SCANNER AIR FAN</b>		<b>PSH SPRAY BLOCK VALVE</b>	<b>INTERCONNECTION MOV STATUS</b> [Green]				
MSV LH CLOSE	MSV RH CLOSE	GV LH1 CLOSE	GV LH3 CLOSE	GV RH2 CLOSE	GV RH4 CLOSE	A [Green]	B [Green]	PAF-A [Red]	PAF-B [Red]	AC [Red]	DC [Green]	PRESS 395.0...	1RY SH LEFT MAIN [Green]	BLR INST HDR PRESS 7.1 kgf...
RSV LH CLOSE	RSV RH CLOSE	ICV LH1 CLOSE	ICV LH2 CLOSE	ICV RH3 CLOSE	ICV RH4 CLOSE	MDBFP [Green]	TDBFP-A [Green]	TDBFP-B [Green]	<b>SEAL OIL SYSTEM</b>			1RY SH RIGHT MAIN [Green]	BLR SER HDR PRESS 5.8 kgf...	
<b>MAIN TURBINE DRAINS</b>						<b>CRH NRV</b>		<b>HOTV LOTV</b>		A [Green]	B [Red]	DC [Green]	2RY SH LEFT MAIN [Green]	GLAND STM HDR PRESS 16.4 kgf...
MS LEAD [Green]	RH IL PIPE [Green]	HPT INNER [Green]	HPT OUTER [Green]	HPT EXH-1 [Green]	HPT EXH-2 [Green]	L [Red]	R [Red]	HOTV [Red]	LOTV [Green]	H2 SOP [Red]	SEAL OIL DP 0.84...	1RY SH LEFT STDBY [Red]	GLAND STM HDR TEMP 316.9 degC	
<b>TURBINE EXTRACTION STATUS VALVE CONDITION</b>						<b>TURBINE OIL PUMP</b>		<b>RAPH MOTOR</b>		<b>AMMONIA DOSING PUMP &amp; OXYGEN DOSING SYSTEM MOV</b>			2RY SH RIGHT MAIN [Green]	AUX HDR PRESS 16.4 kgf...
EXT. MOV	DRIP LVL	FCNRV	EXT. PRESS.	NRV U/S SOV	NRV D/S SOV	TOP [Green]	EOP [Green]	A1 [Green]	A2 [Green]	AR SOV [Green]	HP PCV-1 POS 0.1 %	2RY SH LEFT STDBY [Green]	HP LP HYD PRESS 196.7 BAR	
HTR-3 [Red]	73.3mm	[Red]	1.24h	[Green]	[Green]	JOP [Green]	DC JOP [Green]	B1 [Red]	B2 [Green]	AR SOV [Green]	HP PCV-2 POS -0.3 %	2RY SH RIGHT STDBY [Green]	HP PCV-1 POS -0.4 %	
HTR-4 [Red]	96.1mm	[Red]	4.66h	[Green]	[Green]	JOP [Green]	DC JOP [Green]	LOP-A [Red]	LOP-B [Green]	ISO VLV [Green]	LP PCV-1 POS -0.6 %	RH SPRAY-A [Red]	LP PCV-2 POS -0.6 %	
D/A [Red]	2406 Smm	[Red]	11.2h	[Green]	[Green]	JOP [Green]	DC JOP [Green]	IDF-A [Red]	IDF-B [Red]	ISO VLV [Green]		RH SPRAY-B [Red]		
HTR-6 [Red]	103.7mm	[Red]	28.3h	[Green]	[Green]	JOP [Green]	DC JOP [Green]	IDF-A [Red]	IDF-B [Red]	ISO VLV [Green]				
HTR-7 [Red]	81.0mm	[Red]	54.5h	[Green]	[Green]	JOP [Green]	DC JOP [Green]	EDF-A [Red]	EDF-B [Red]	ISO VLV [Green]				
HTR-8 [Red]	99.1mm	[Red]	98.9h	[Green]	[Green]	JOP [Green]	DC JOP [Green]	EDF-A [Red]	EDF-B [Red]	ISO VLV [Green]				

# 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

Forcing ID: ELF3621    Status: NEW    Status date: 07/09/2024 5:46 PM    Created Date: 07/09/2024 5:46 PM    Unit/Area: UNIT 1

Forcing Type: PROTECTION    Forcing Class:    Need for Forcing: FALSE TRIPPING

Description:    Created By: OPR-SCE    Requested Date:    Approved By:    Approval Date:    Implemented Date:    Normalized Requested Date:    Normalized Date/Time:

Requested Dept:    Forcing Requested By:    Implementation Dept:    Implemented By:    Normalization Dept:    Normalized By:    Normalized Requested By:

**Details**

Type of Forcing	Unit/Area	Area	System	Equipment	System Description	Class
PROTECTION	UNIT 1	BOILER	BPS	BOILER	REHEATER PROTECTION	A

Details

Unique Code: 22.292	Area: BOILER	Area Code: BLR
Type of Forcing: PROTECTION	System: BPS	System Code: BPS
Unit: UNIT 1	Equipment: BOILER	Equipment Code: BLR
	System Description: REHEATER PROTECTION	Class: A
	Type of Signal: Digital	Master Forcing Id: UNIT 1-PTC-BLR-BPS-BLR-22292

New Row

New e-Logic Forcing    OPR-SCE

Find Forcing ID    Find Navigation Item    Advanced Search    Save Query

Go To Applications    Available Queries    All Records    Assigned myself    E-LOGIC-SELF ASSIGNMENTS    Forcing ID Descending    Common Actions    New NPLELOGICFORCE    More Actions    Run Reports    e-Logic Status History

E-Logic Forcing    Filter    1 - 20 of 1419

Forcing ID	Description	Status	Status date	Implemented Date	Normalized Date/Time	Created Date	Unit/Area	Requested By
ELF3620	FG-5 CBS (BC-2A side) forcing required.	IMP	07/09/2024 5:34 PM	07/09/2024 5:34 PM	07/09/2024 5:23 PM	07/09/2024 5:23 PM	CHP	CHETAN PALIWAL
ELF3618	WT-01 side pad sensor 3 forcing req	CLOSED	02/09/2024 3:50 PM	02/09/2024 2:23 PM	02/09/2024 3:50 PM	01/09/2024 9:32 PM	CHP	PRASHANT SHARMA
ELF3616	WT-1 Side pad sensor forcing required	CLOSED	02/09/2024 3:51 PM	02/09/2024 2:25 PM	02/09/2024 3:51 PM	20/08/2024 1:33 PM	CHP	CHETAN PALIWAL
ELF3614	TDBFP-2A booster pump suction pressure transmitter-3 value to be hold on current value to arrest leakage from tubing	CLOSED	20/08/2024 7:54 PM	20/08/2024 6:11 PM	20/08/2024 7:54 PM	20/08/2024 1:23 PM	UNIT 2	NAUMAN SALIM KAKKAR
ELF3612	FG-1 CBS forcing required.	CLOSED	26/08/2024 4:44 AM	26/08/2024 3:39 AM	26/08/2024 4:44 AM	26/08/2024 3:30 AM	CHP	AWANISH SINGH P
ELF3611	ILMS-4 belt running feedback ON required.	CLOSED	24/08/2024 8:35 PM	24/08/2024 5:50 PM	24/08/2024 8:35 PM	24/08/2024 5:43 PM	CHP	SAIRAM TUMMALA
ELF3608	CRUSHER-4 NEXT CONVEYOR RUNNING FEEDBACK FORCING REQUIRED	CLOSED	24/08/2024 5:52 PM	24/08/2024 1:35 PM	24/08/2024 5:52 PM	24/08/2024 12:53 PM	CHP	NIKHIL NANDKISHOR
ELF3607	WT-02 drive HPP tripped above 75 degree oil temp.	CLOSED	22/08/2024 9:54 PM	22/08/2024 6:34 PM	22/08/2024 9:54 PM	22/08/2024 6:12 PM	CHP	CHAITANYA SUNIL
ELF3605	1AB conveying line supply Butterfly valve open feedback is required. Butterfly is removed from line for relocating after its inspection and rectification work. Now valve is not in the line so its feedback is required for taking the 1AB conveying line in service	CLOSED	03/09/2024 11:18 AM	02/09/2024 2:29 PM	03/09/2024 11:18 AM	20/08/2024 2:07 PM	AHP	MAYANK MISHRA
ELF3604	FG-7 CBS forcing required.	CLOSED	19/08/2024 11:55 PM	19/08/2024 5:09 AM	19/08/2024 11:55 PM	19/08/2024 4:45 AM	CHP	CHAITANYA SUNIL
ELF3603	Coal feeder-2E no coal on belt protection to be hold, as Mill-2D stopped for schedule calibration	CLOSED	20/08/2024 9:21 AM	13/08/2024 12:16 PM	20/08/2024 9:21 AM	13/08/2024 10:45 AM	UNIT 2	BIRENDRA SHARMA
ELF3602	BC-6A thrust brake engage/disengage fb forcing required.	CLOSED	20/08/2024 12:11 AM	17/08/2024 1:20 PM	20/08/2024 12:11 AM	12/08/2024 9:41 PM	CHP	CHETAN PALIWAL
ELF3601	gh	NEW	10/08/2024 4:03 PM			10/08/2024 4:03 PM	AHP	MAYANK MISHRA
ELF3597	HPH-8 Emergency drain CV is under permit. Alternate drain CV to be used as emergency. Alternate drain CV minimum opening FX to be forced to zero and level valve to be changed to 120mm. Its auto closed command to be forced to zero.	CLOSED	06/08/2024 6:02 AM	05/08/2024 8:31 AM	06/08/2024 6:02 AM	05/08/2024 8:25 AM	UNIT 2	BIRENDRA SHARMA
ELF3596	HPH-8 Emergency drain CV is under permit. Alternate drain CV to be used as emergency. Alternate drain CV minimum opening FX to be forced to zero and level valve to be changed to 120mm. Its auto closed command to be forced to zero.	NEW	05/08/2024 8:18 AM			05/08/2024 8:18 AM	UNIT 2	BIRENDRA SHARMA

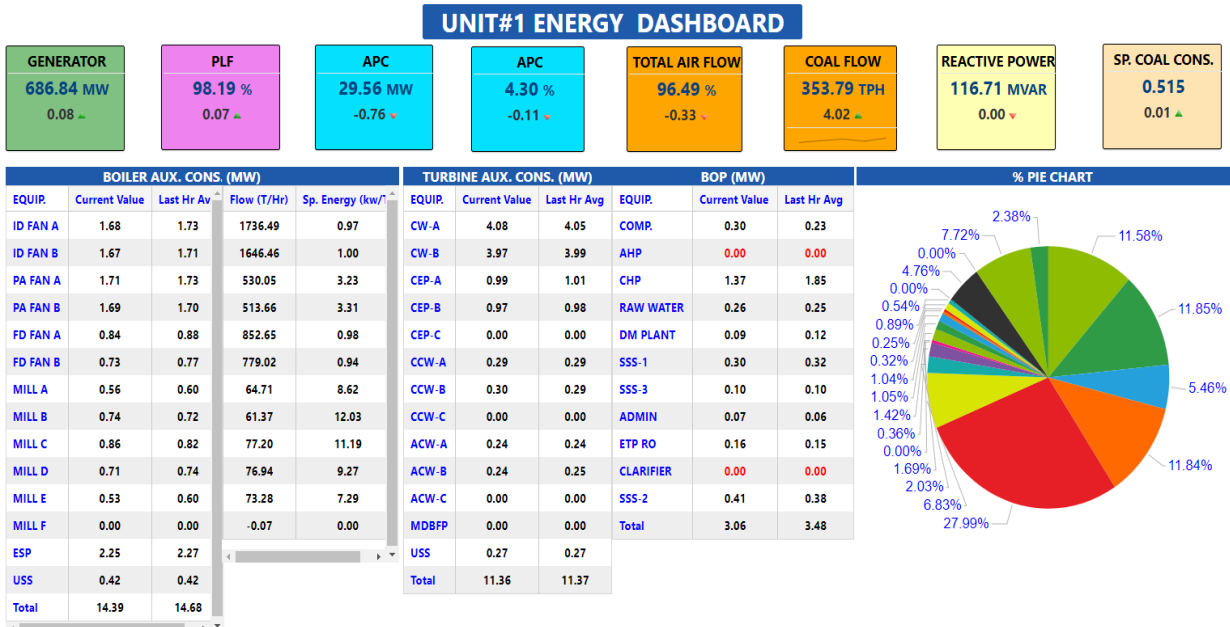
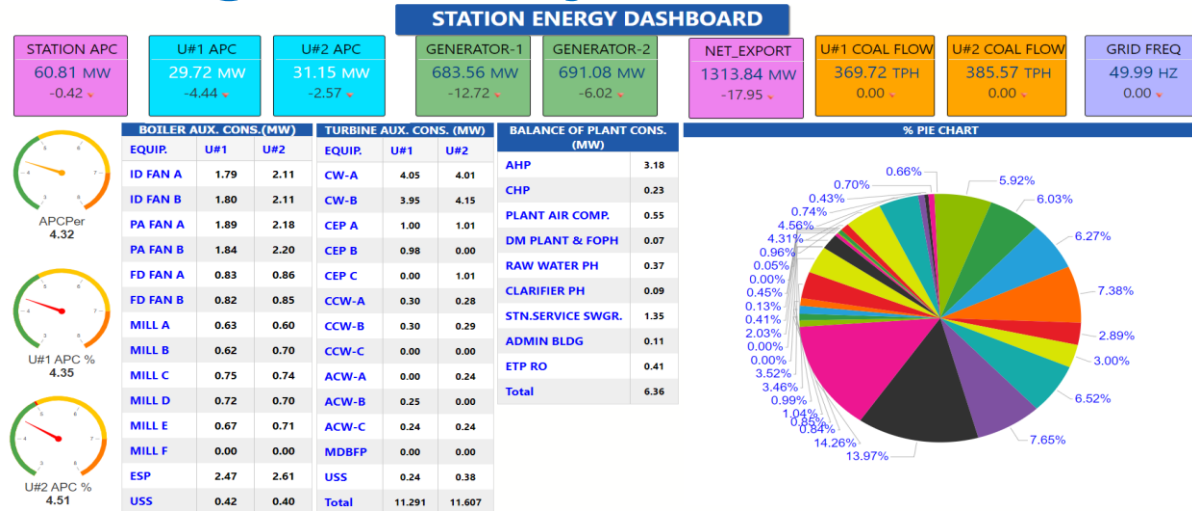
## Energy Management System

### 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

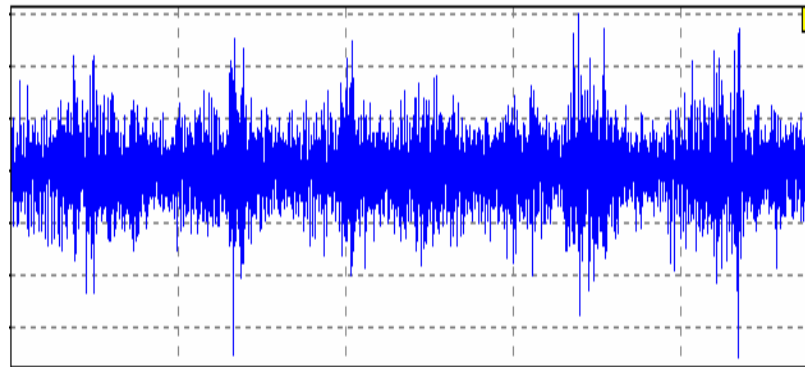
### Drive Level Energy Benchmarking

- ✓ 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

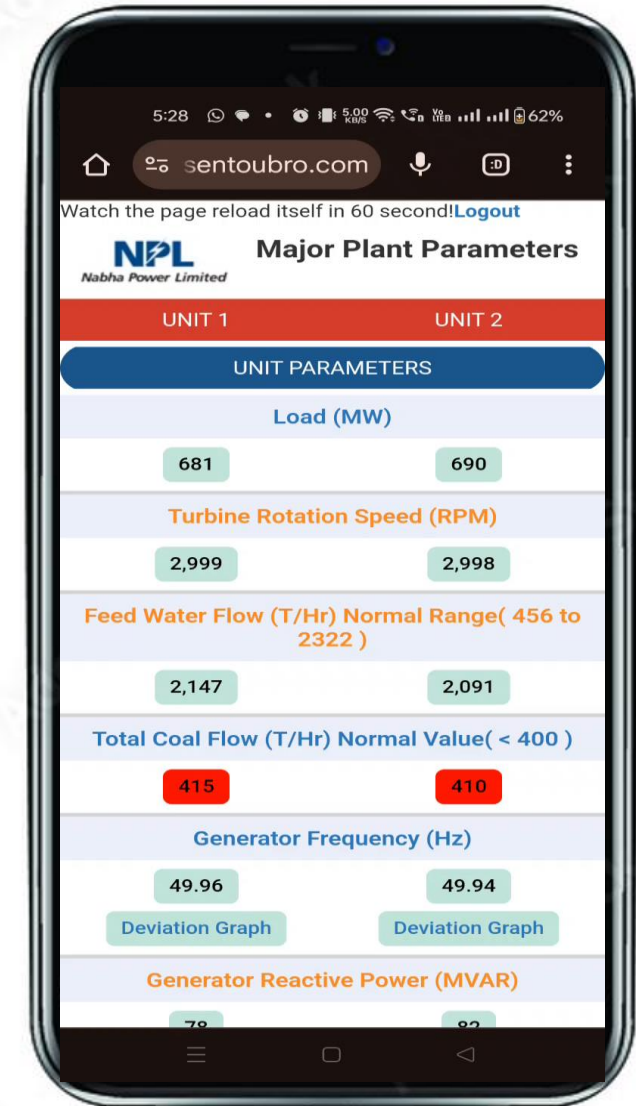
1. Detection of valve passing
2. Detection of electrical fault in Transformers
3. Air Leakage detection
4. Bearing Healthiness detection



# Digitalization Mobility Application

## Plant Vital Parameters

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





A photograph of two business people shaking hands, overlaid on a background of orange and green geometric shapes. The handshake is the central focus, symbolizing agreement and partnership.

# Thank You



National Accreditation Board for  
Testing and Calibration Laboratories

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-8412

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](http://www.nabl-india.org))

Name of Legal Entity: NABHA POWER LIMITED

Signed for and on behalf of NABL.



N. Venkateswaran  
Chief Executive Officer

