Integration Of Electrical And Electronics Systems And Automation Technologies For Enhanced Efficiency, Reliability And Sustainability in TNPL Soda Recovery Plant Operation

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Submitted to IPPTA Zonal Seminar I'24

26th to 27th Jul 2024

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Introduction

- Importance of operational efficiency in the Pulp and Paper industry
  - Energy-intensive operations
  - Need for continuous improvement
- Overview of TNPL's initiatives in the Soda Recovery Plant
  - Role of Soda Recovery Plant in Paper Manufacturing
  - Importance of integrating advanced technologies
  - Highlight TNPL's Technological advancements
  - Showcase benefits in efficiency, reliability, and sustainability

Case Study 1 - Electrostatic Precipitator (ESP) Enhancement in Recovery Boiler

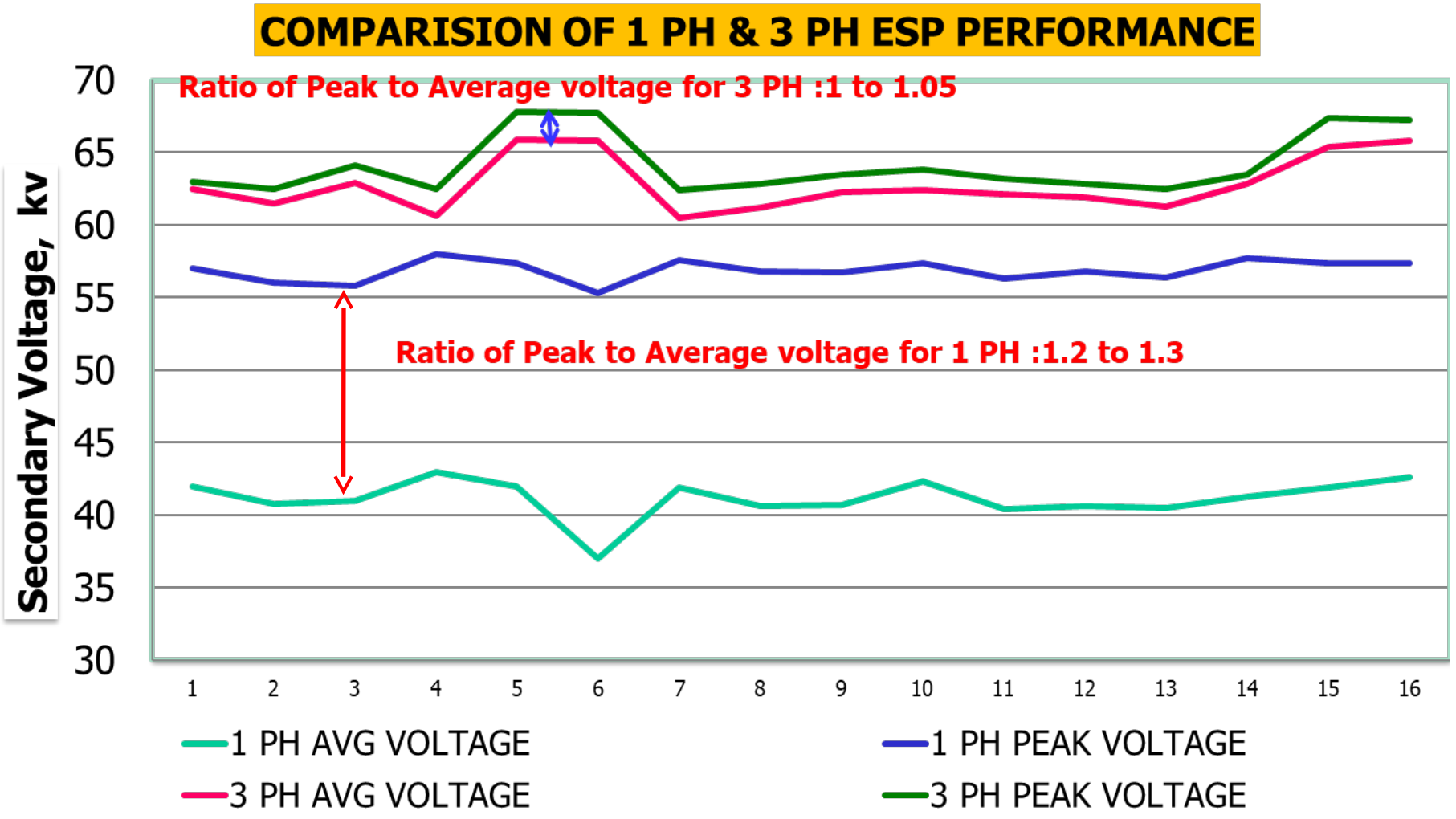
Objective:

- Need to improve ESP performance in Recovery Boilers
- Reduce energy consumption and enhance dust collection efficiency

Project implemented:

- Installed three-phase DC-Transformer Rectifier (DC-TR) with PIACSDC4 Controller.

Average & Peak Voltage of Single Phase TR & three Phase TR



Benefits of the Project

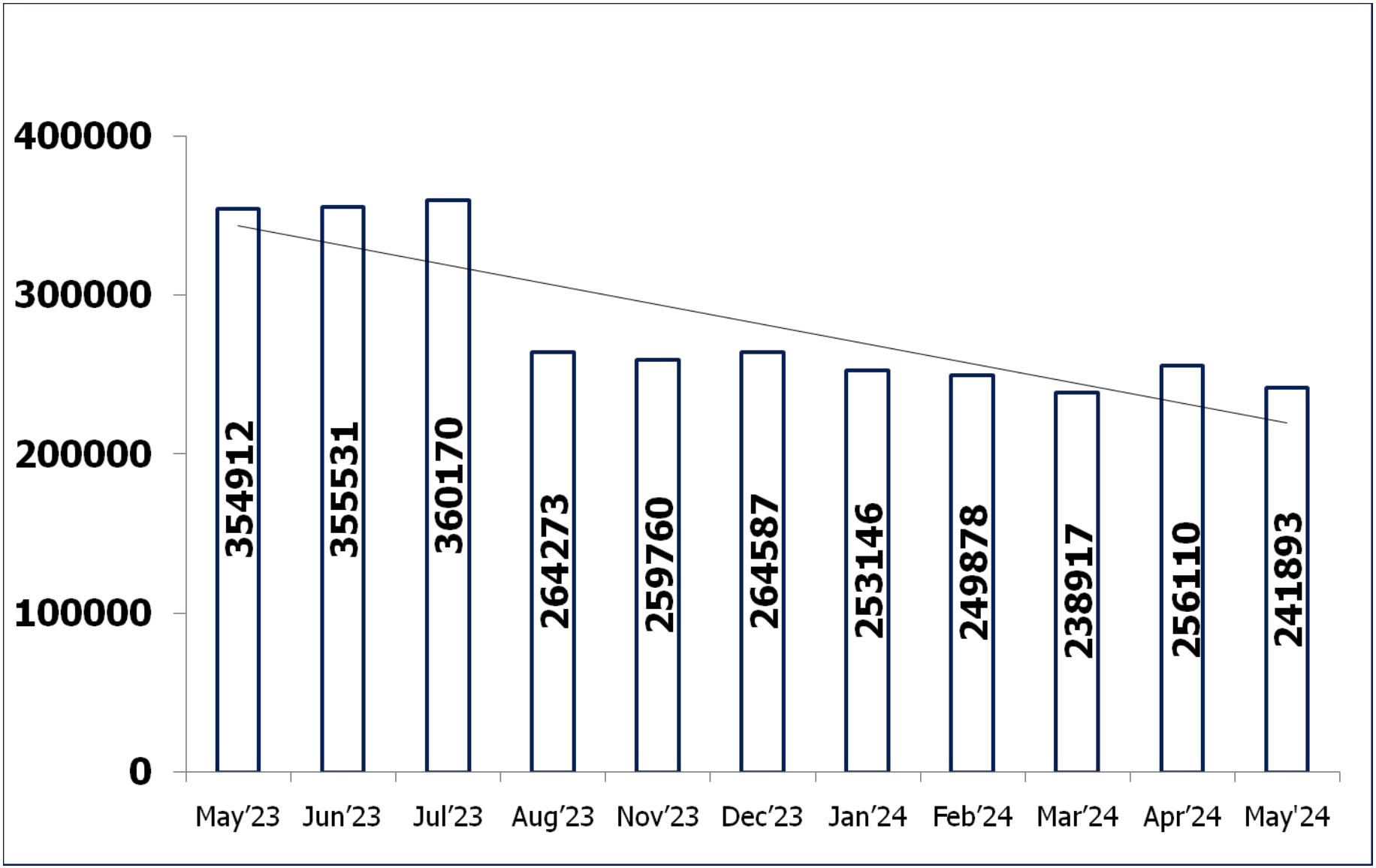
- Over all, the implementation of three-phase rectifier transformers has significantly reduced the dust concentration in the flue gas at the outlet of the ESP to a mere 50 mg/Nm3

- As a result, the ESP's performance has improved and one ESP chamber out of the three can be stopped without compromising the firing capacity. The stopping of one ESP chamber has led to energy savings.

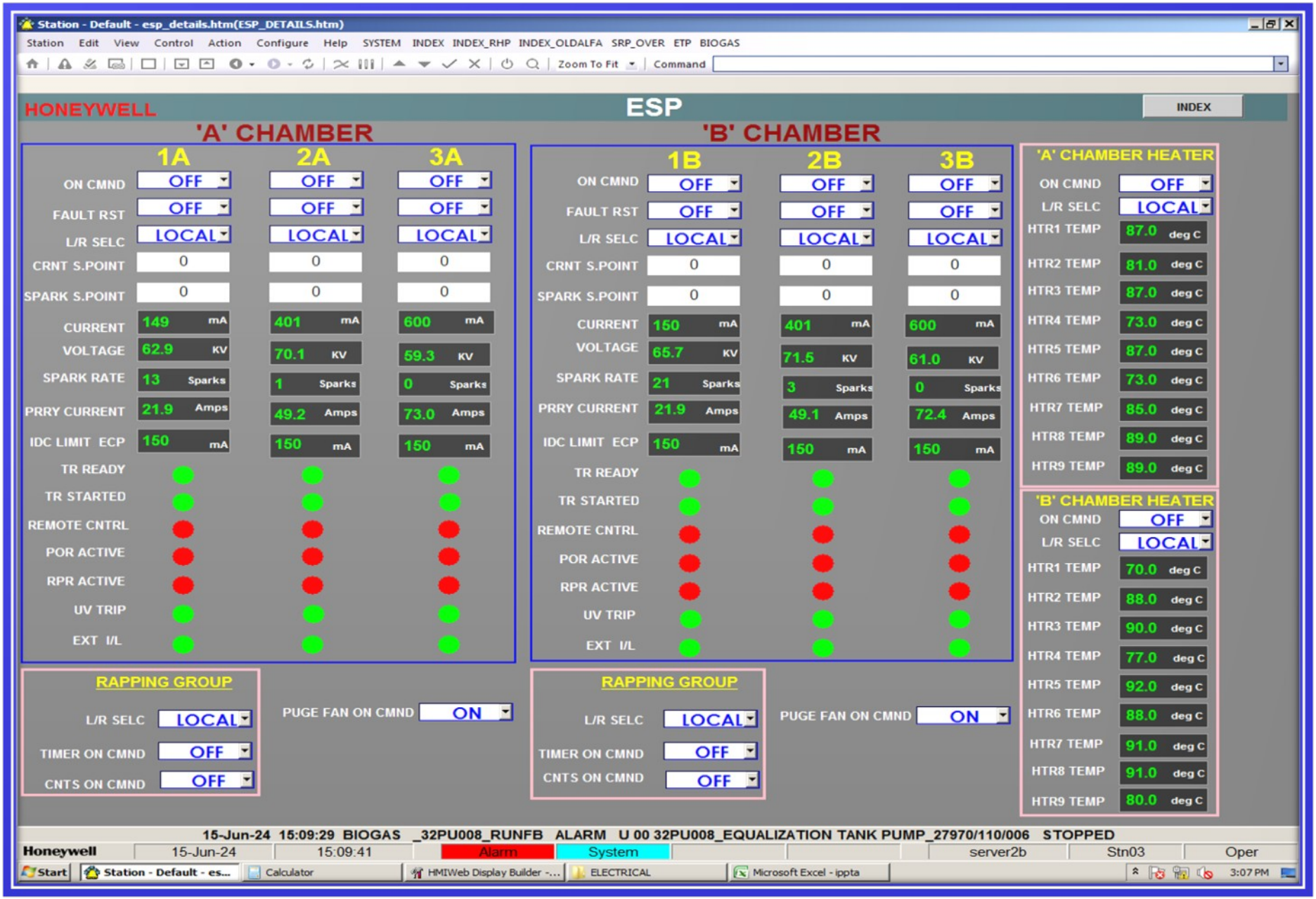
ESP Power consumption:

- Before Recovery Boiler ESP Up-gradation: 3,55,000 KWH/month
- After Recovery Boiler ESP Up-gradation : 2,50,000 KWH/month.
- Net Power Saving = 1,05,000 KWH/month
- Net Cost savings = Rs. 6,30,000/month

Recovery Boiler ESP Total Power Consumption (KWH)



ESP Equipments monitoring in DCS



Case Study 2 - Logic Scheme for Soot Blower Pipe Damage Prevention

Objective:

- To address the risk of Soot Blower Pipe damage due to gear rack failures

Problem Faced:

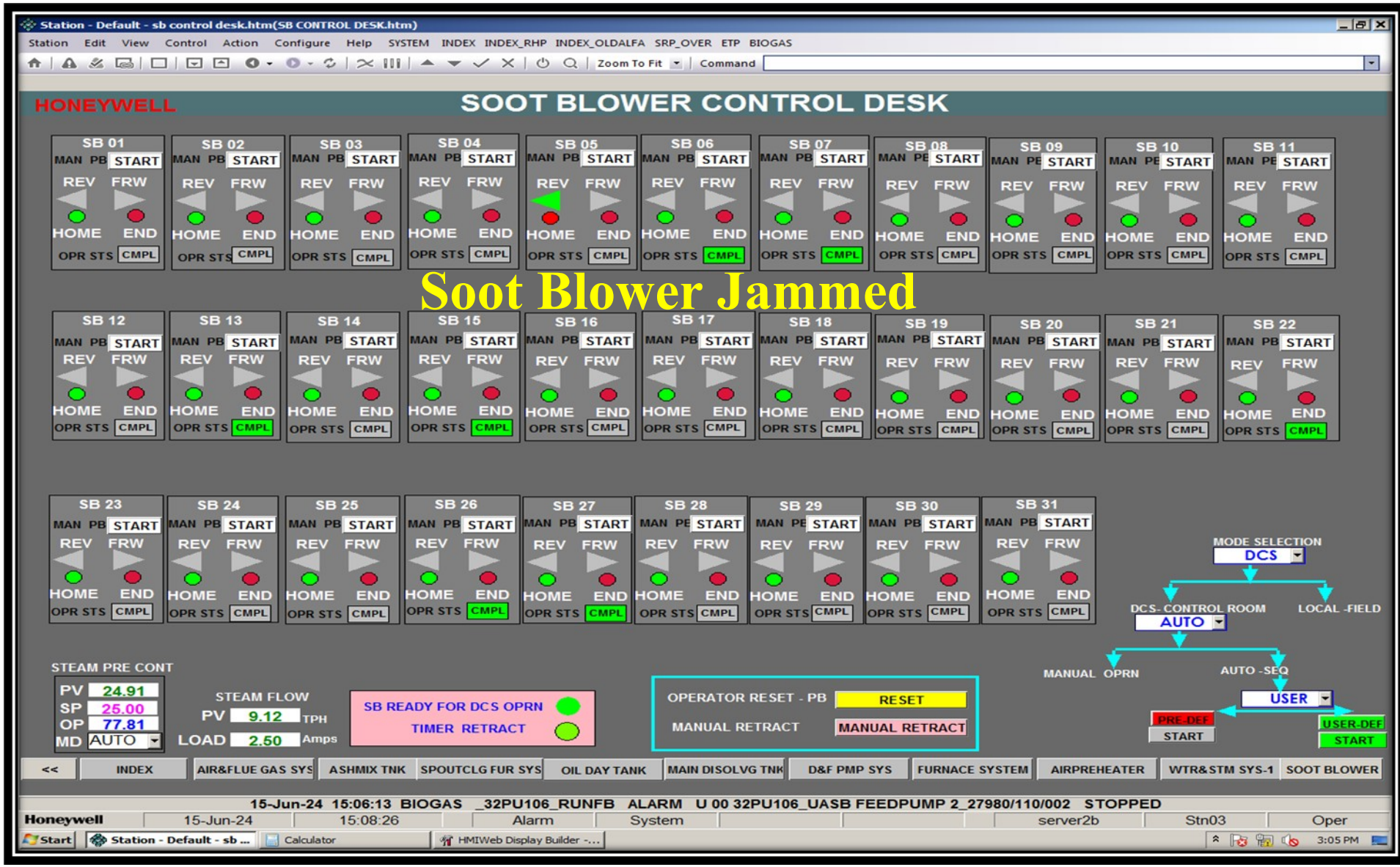
- If the gear rack fails during forward motion, the soot blower carriage can propel uncontrollably and collide with the boiler wall, posing a safety hazard to nearby individuals and causing significant damage to the boiler.
- Additionally, the process of removing and replacing damaged soot blower pipes takes over 16 hours, adversely affecting boiler performance.

Case Study 2 - Logic Scheme for Soot Blower Pipe Damage Prevention

Solution Arrived:

- The proposed scheme incorporates a logic timer that monitors the forward travel of the Soot Blower carriage.
- The total traveling time of the Soot Blower is set as the timer's set point. During this period, if the home position is detected by the limit switch, an alarm is sent to the Distributed Control System (DCS), warning of a potential “Soot Blower pipe jam”.
- Furthermore, if the home position is not reached within the defined time set in the timer, the logic scheme triggers an alarm on the DCS screen indicating "Soot Blower over travel”.

Case Study 2 - Logic Scheme for Soot Blower Pipe Damage Prevention



Benefits of the Project:

Soot Blower lance Pipe saving Cost

- Pipe procurement cost : ₹ 1,50,000
- Pipe replacement cost : ₹ 26,000

- Total Cost benefit : ₹ 1.76 Lakhs/annum

Case Study 3 - Replacement of Limit Switch with Magnetic Sensors

Objective:

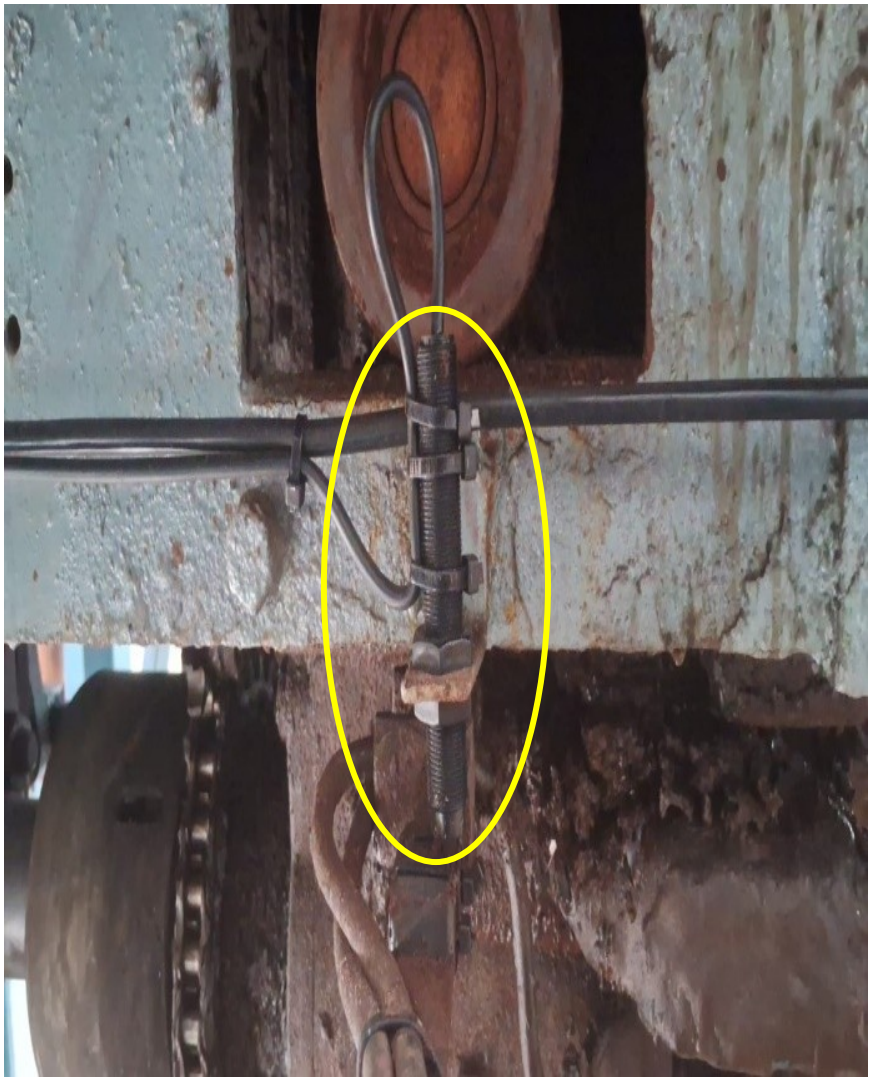
- To address the challenges with snap action limit switches in Soot Blowers (water entry, condensation & Etc.,)

Project implemented:

- Adoption of magnetic sensors for better reliability and cost-effectiveness.

Case Study 3 - Replacement of Limit Switch with Magnetic Sensors

Previous Limit switch in Soot Blower



Present Magnetic Reed Switch in Soot Blower

- The benefits of implementing the magnetic sensor solution for Soot Blower control include

  (a) Reduced downtime,

  (b) Minimised inventory costs,

  (c) Reduced Soot Blower maintenance and

  (d) Improved performance of Soot Blower.

  - Cost of One Limit Switch = ₹ 25000
  - Cost of Magnetic Reed Switch for One Blower = ₹ 1500
  - Net Savings per Blower = ₹ 23500
  - For 30 no's of Blowers = ₹ 7,05,000

Case Study 4 - Proactive Maintenance a for Critical Equipments

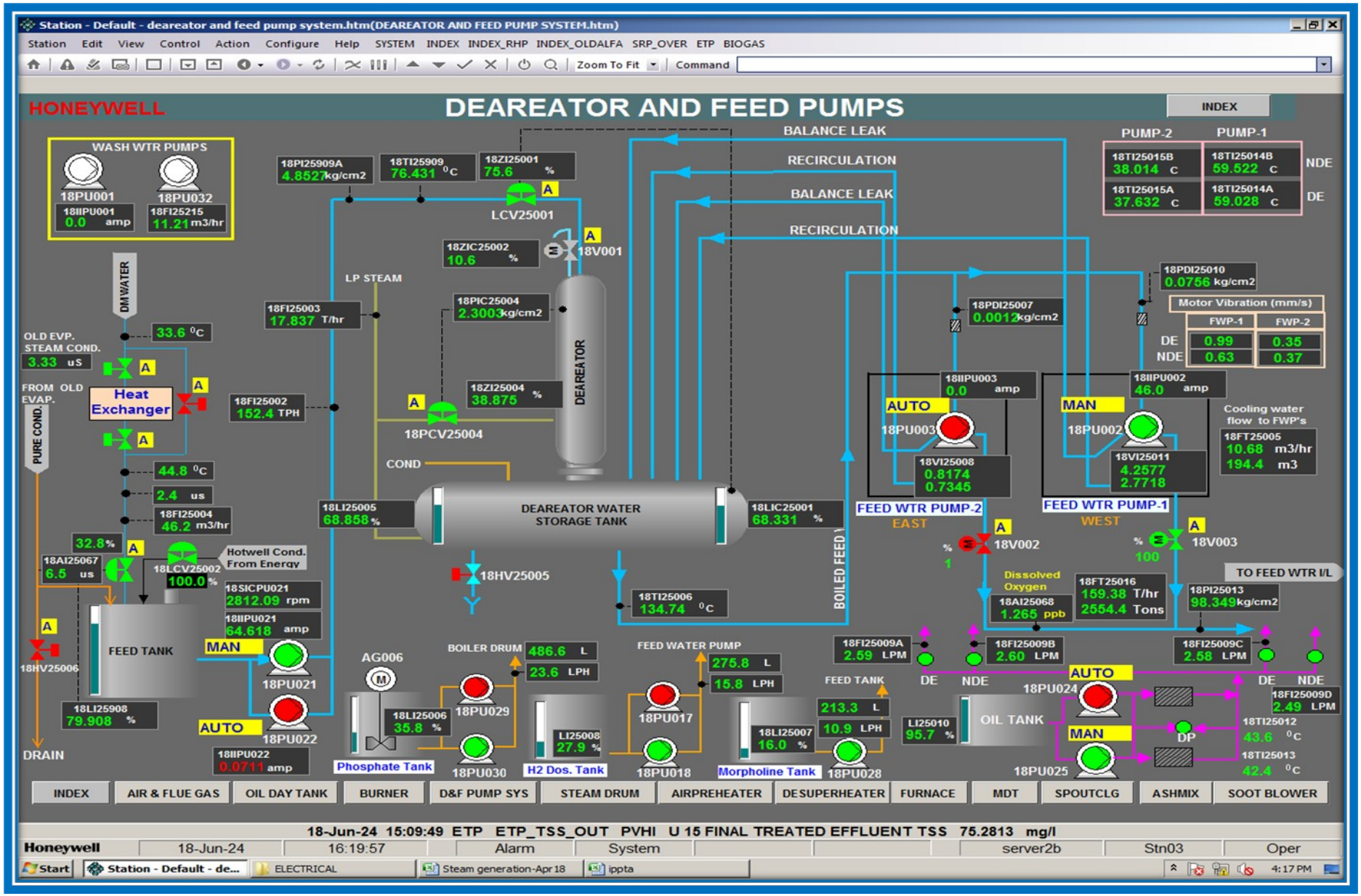
Project implemented:

- PLC-based system for monitoring motor conditions (>315 KW Motors).
- This system includes motor bearing temperature and winding temperature monitors, Motor Vibration Monitoring for both Driven End /Non driven End enabling proactive maintenance of the motors and improving overall uptime

Case Study 4 - Proactive Maintenance of Critical Equipments

CHANNEL NAME	LL	HH	LOW	HIGH	ACTUAL	STATUS
ID_FAN1_DE	20	150	35	80	55.1	OK
ID_FAN1_NDE	25	80	20	150	40.5	OK
ID_FAN1_RPHASE	35	80	20	150	65.6	OK
ID_FAN1_YPHASE	35	80	20	150	66.0	OK
ID_FAN1_BPHASE	40	80	20	150	65.4	OK
ID_FAN2_DE	40	80	20	150	54.3	OK
ID_FAN2_NDE	40	80	20	150	54.7	OK
ID_FAN2_RPHASE	40	80	20	150	92.2	Warning
ID_FAN2_YPHASE	40	80	20	150	73.2	OK
ID_FAN2_BPHASE	40	80	20	150	70.7	OK
ID_FAN3_DE	40	80	20	150	52.1	OK
ID_FAN3_NDE	40	80	20	150	46.5	OK
ID_FAN3_RPHASE	40	80	20	150	60.3	OK
ID_FAN3_YPHASE	40	80	20	150	59.5	OK
ID_FAN3_BPHASE	40	80	20	150	59.2	OK
FWP_1_DE	30	100	20	150	79.8	OK
FWP_1_NDE	30	100	20	150	82.7	OK
FWP_1_RPHASE	30	100	20	150	76.0	OK
FWP_1_YPHASE	30	100	20	150	76.6	OK
FWP_1_BPHASE	30	100	20	150	80.6	OK
FWP_2_DE	30	100	20	150	126.2	Warning
FWP_2_NDE	30	100	20	150	41.0	OK
FWP_2_RPHASE	30	100	20	150	34.3	OK
FWP_2_YPHASE	30	100	20	150	34.3	OK
FWP_2_BPHASE	30	100	20	150	34.4	OK

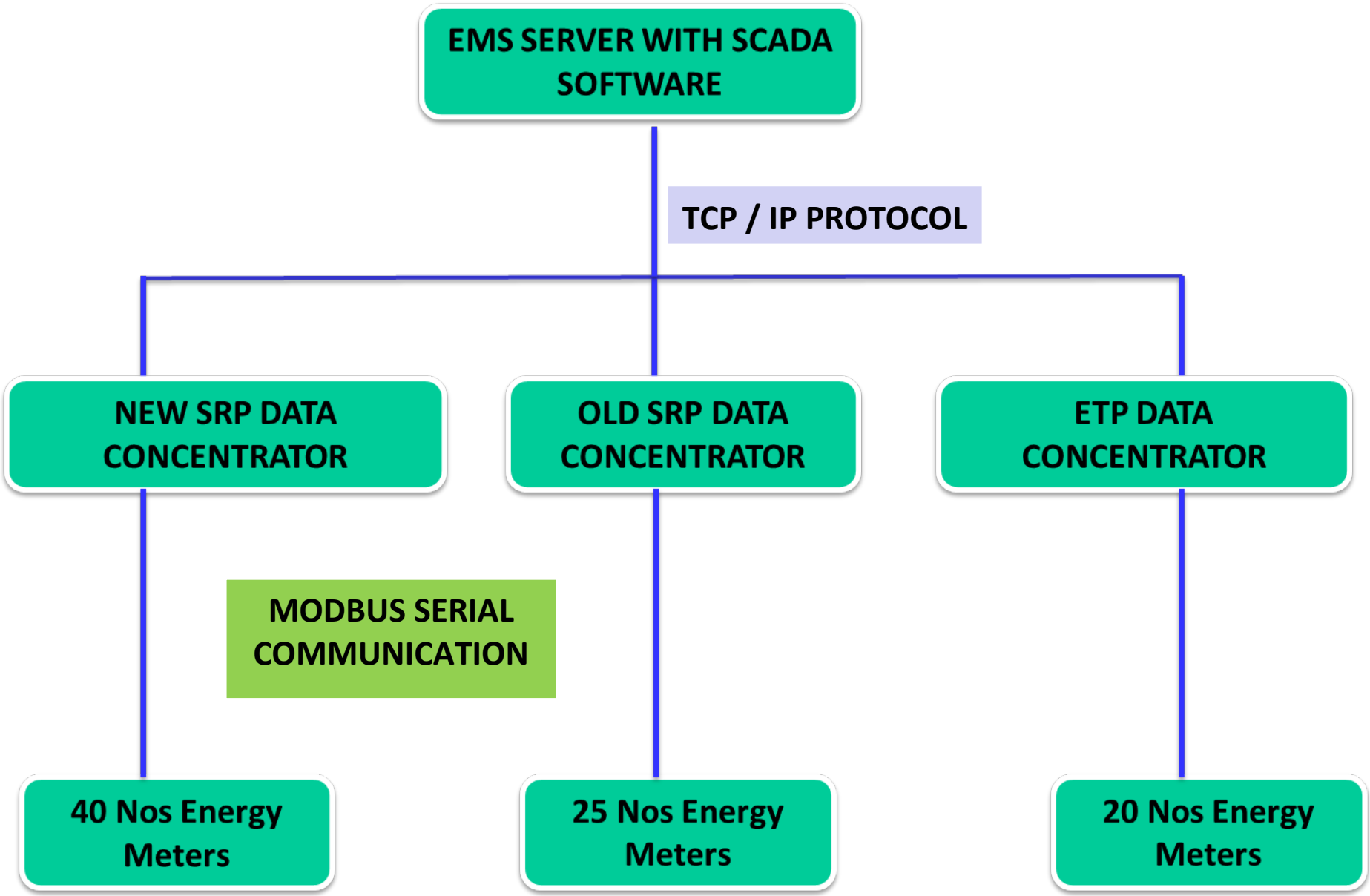
Case Study 4 - Proactive Maintenance of Critical Equipments



Centralized Energy Monitoring System at TNPL

- Furthermore, the integration of the soda recovery plant's power consumption Energy Management System (EnMS) data with the Enterprise Resource Planning (ERP) system has been accomplished.
- This integration allows for easy monitoring of power consumption, facilitating efficient energy management. With access to real-time power consumption data, TNPL can plan and implement energy conservation measures strategically, optimizing energy usage and reducing costs.
- EMS helps us to implement energy conservation projects. Few of the Energy conservation projects listed below:

SRP - Energy Monitoring System Architecture



Case study 4 (a): Provision of VFD for WL Supply Pump 1&2 (216 &217) Motor In Causticizer Plant

Description:

- White liquor being supplied to pulp mill hard wood plant through WL supply pumps (216 & 217).
- If WL tank level reached, then WL line control valve got closed but the supply pump in Causticizer will run continuously
- So, 30kw VFD in WL supply pump (216 & 217) for energy conservation.

Benefits:

- ✓ *Power Saving of 12 Kw/hr is achieved*
- ✓ *Cost saving / annum (lakhs) 4.96*
- ✓ *Investment cost (lakhs) 5.0*
- ✓ *Payback period 1.0 year*

Case study 4 (b): Provision Of VFD For WBL Feed Pump in Evaporator#1 Plant

Description:

- Evaporator#1 WBL feed pump motor (664) running at constant speed (3000rpm) even the Evaporator WBL feed flow varies between min 120 m3 to max 180 m3 through instrument control valve.

- Feed pump motor (664) consume same power during min and max feed rate.

- So, it is proposed to install 37kw VFD in WBL feed pump motor for energy conservation.

Benefits:

- ✓ Motor running load in DOL-55A power consumption/hr - 33kw
- ✓ Motor running load with VFD – 32A power consumption/hr - 23kw.
- ✓ Total Power Saving - 10 Kw/hr
- ✓ Cost saving / Annum – Rs 4.5 Lakhs
- ✓ Investment cost – Rs 5.0 Lakhs
- ✓ Payback period 1.1 year

Case study 4 (c) :Replacement Of SCBL Agitator at Evaporator#1 Plant Motor Power from15kw To 7.5kw

Description:

- Evaporator#1 SCBL tank agitator (01, 02, 03 and 04) motor rating is 15kw, 1500rpm.
- This SCBL agitator was running at a load of 14.5 ~ 16 Ampere (Ideal Load)
- Motor rating reduced to 7.5kw, 1500rpm for trail basis and Now the agitator was running successfully at a running load of 5.4 A

Benefits:

- ✓ For one agitator power saving - 5.5 kw/hr.
- ✓ For 4nos agitator power saving - 22 kw/hr
- ✓ Net Power Saving : 22 Kw/hr
- ✓ Cost saving / Annum : 11.08 Lakhs
- ✓ Investment cost :1.5 Lakhs
- ✓ Payback period :0.1 year

Case Study 5 - VFD Implementation in Lime Kiln's Limestone Crusher

Problems faced	Solution Arrived	Benefits
▪ Frequent tripping / failure of equipment ▪ Additional cost involving (Motor replacement cost, Manpower cost) ▪ Frequent maintenance due to ageing. ▪ Stone feeding operations getting affected due to non availability of equipment.	▪ Stone feeding crusher has been provided with VFD. ▪ Dedicated crusher logic is developed. ▪ Sudden Jamming has been detected by the VFD by continuously monitoring the motor running torque.	▪ Avoiding the ring formation, ▪ Avoiding unplanned shutdown of limekiln ▪ Optimizes power consumption. ▪ Improved equipment reliability and the annual cost savings of Rs 4.4 lakhs make it a valuable investment for the lime production process.

Conclusion

Case Studies Highlighting Success

Financial and Operational Benefits

Cost savings:

- ✓ ₹ 6.3 lakhs/month (ESP),
- ✓ ₹ 1.76 lakhs/year (Soot Blower),
- ✓ ₹ 7.05 lakhs (Magnetic Sensors),
- ✓ ₹ 20.54 lakhs/year (Energy Monitoring).

Overall Impact:

- Achieved TNPL's vision of sustainability.
- Improved energy efficiency and operational optimization.
- Reduced environmental impact through innovative technologies.

Future Directions

- Continued focus on technological innovations.
- Expansion of automation and digital integration.
- Commitment to ongoing efficiency improvements.


Thank
You