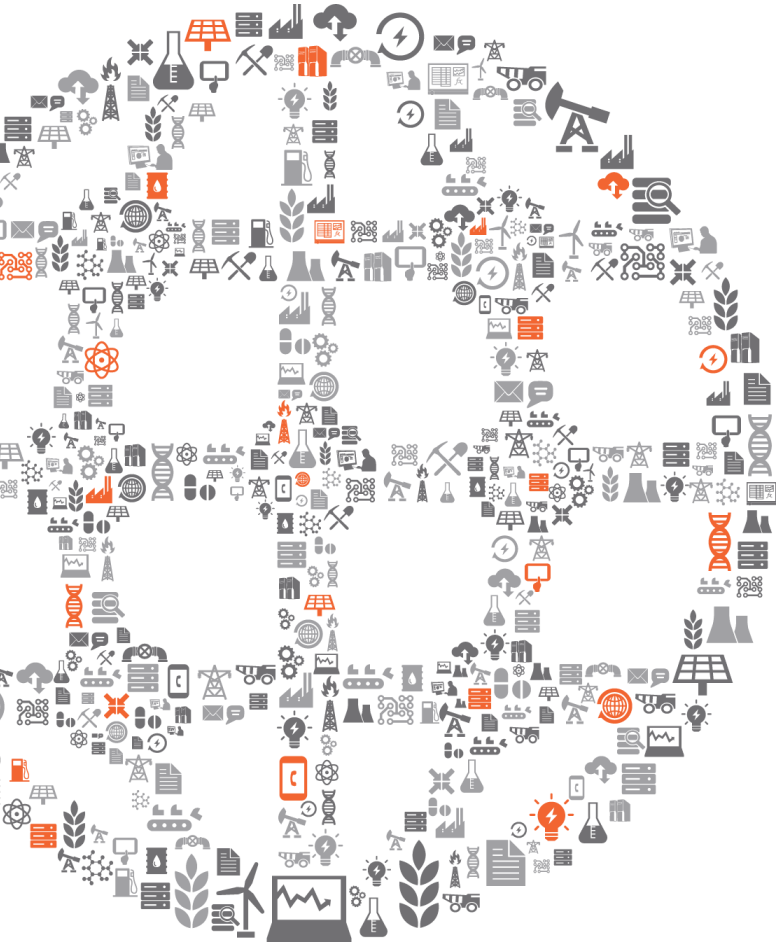


PI SYSTEM FOR OPERATIONAL INTELLEGENCE

Nandita Sahoo
Tata Power

TATA POWER

India’s largest integrated private power utility.

8521 MW Installed capacity (Thermal, Hydro, DG, Solar and Wind)

Presence in entire value chain like Generation, Transmission, Distribution, Fuel sourcing, Logistics and Power trading.

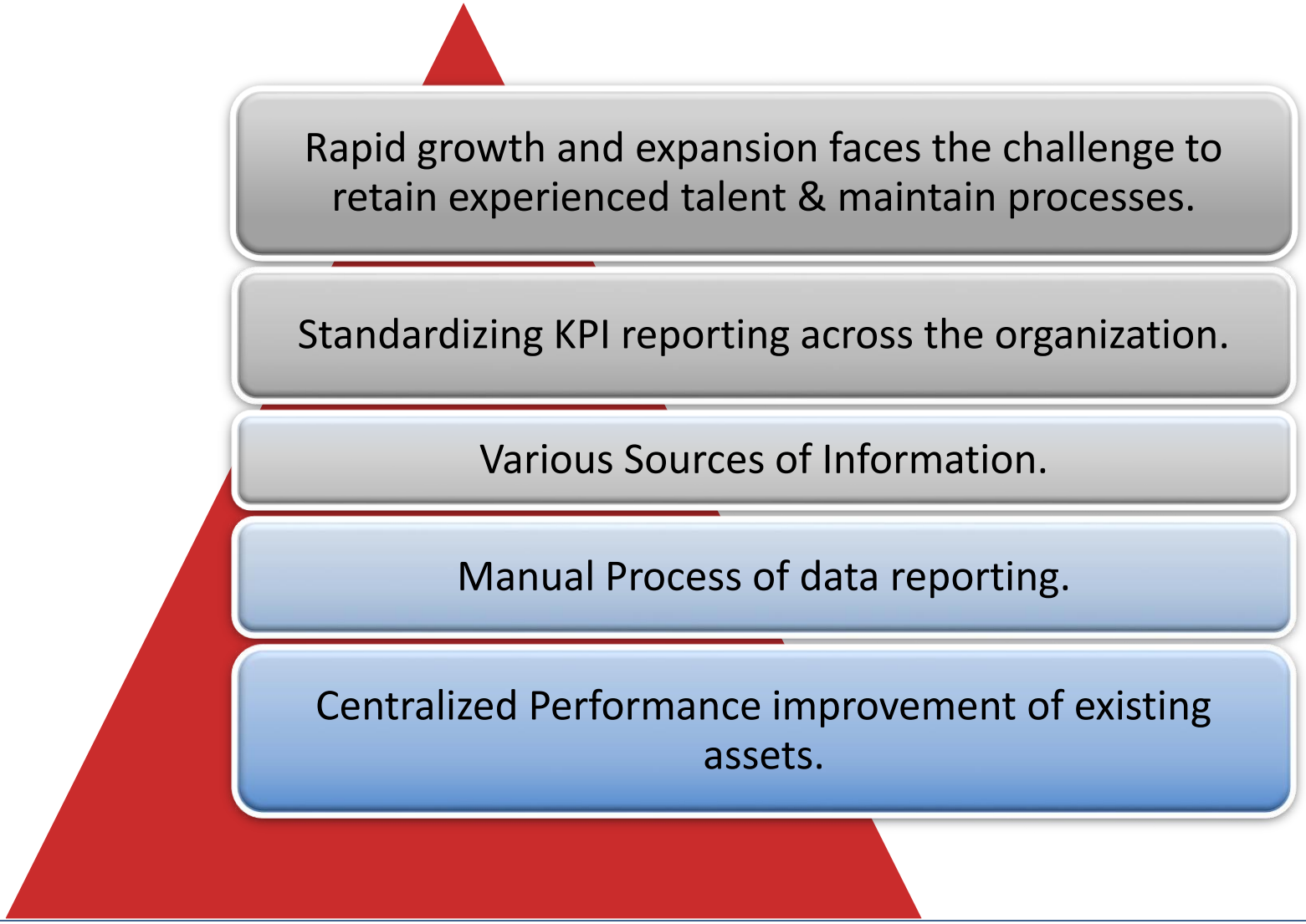
Expanding its horizon beyond India in countries like Australia, Bhutan, Singapore, Indonesia, Africa, Netherlands & the Middle East.

OPERATIONAL INTELLIGENCE

Methods and technology for getting an insight into the business.

- Gain deeper understanding with relevant information.
- Facilitates development of business solutions on the available data.
- Improve overall performance & efficiency.
- Reveal important patterns and analytics derived from correlating events from many sources.
- Leverage live feeds and historical data to find trends and anomalies, and to make more effective decisions based on that information.

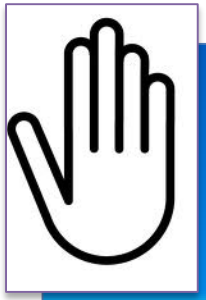
CHALLENGES


Rapid growth and expansion faces the challenge to retain experienced talent & maintain processes.
Standardizing KPI reporting across the organization.
Various Sources of Information.
Manual Process of data reporting.
Centralized Performance improvement of existing assets.

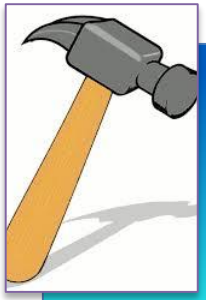
SOLUTION

Better access to data.

Single source of information for local and central monitoring.



Elimination of human error.



New methods and tools for sharing information and analysis respectively.

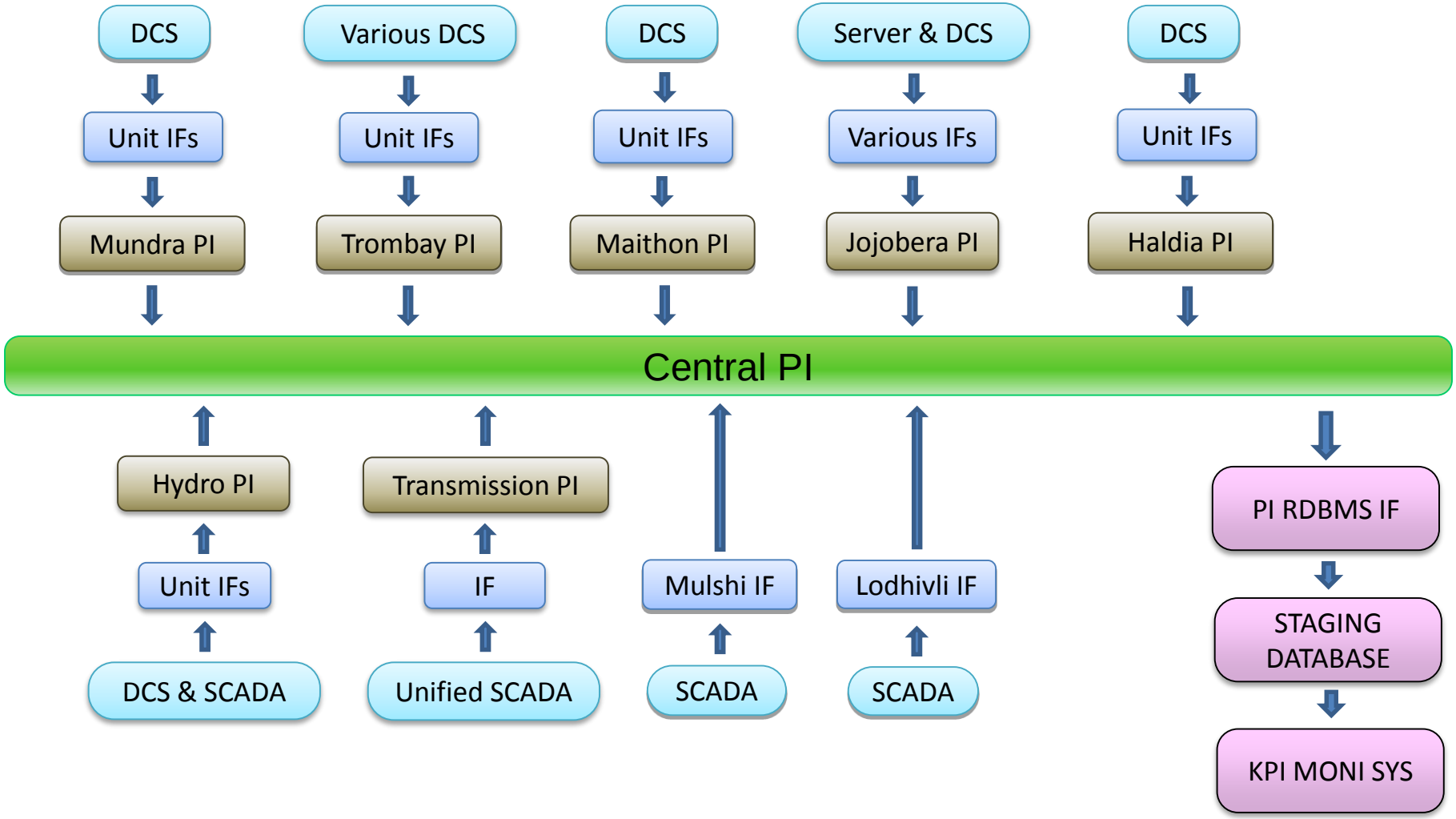
Real time monitoring and Analysis of performance data.

Central Asset Monitoring & Diagnostic Station.

SOLUTION DEPLOYMENT

- PI System
  - Development of business and process analytics and dashboards.
  - Condition based monitoring of Equipment.
  - Identify areas for increased efficiency through Analytics.
  - Real time monitoring and efficiently handle various plant conditions.

ENTERPRISE WIDE ROLLOUT



OPERATIONAL INTELLIGENCE IN TATA POWER

Automation of Enterprise Wide KPIs.

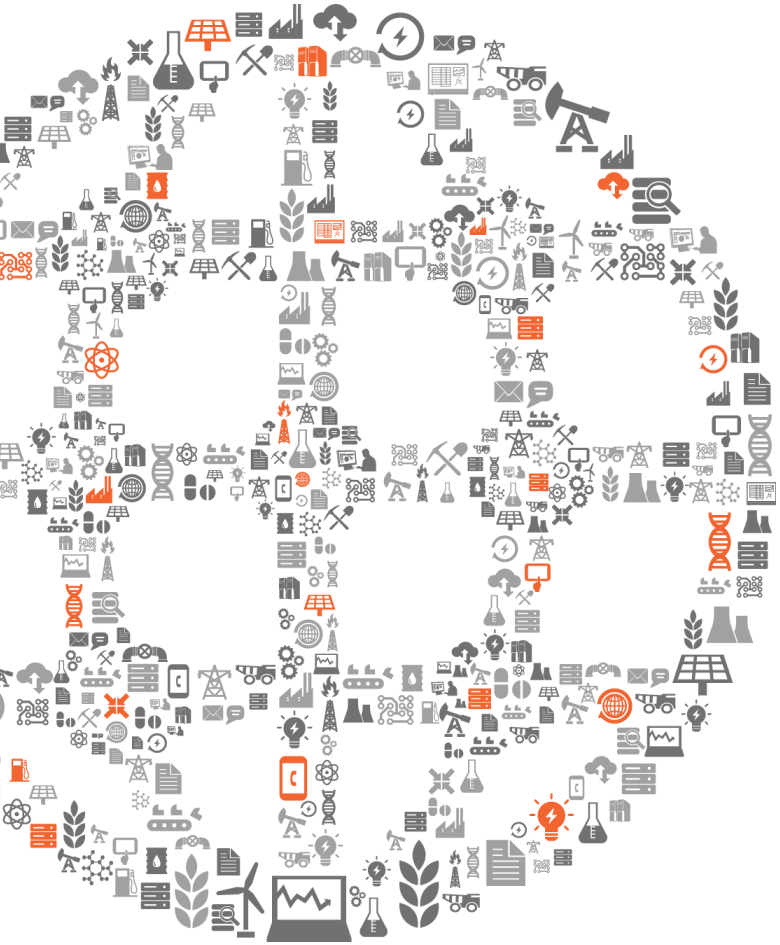
Web based Performance Monitoring.

Integration With SAP.

In-house Business Solution Development.

Plant Performance Analysis.

Central Asset Monitoring Station.



AUTOMATION OF ENTERPRISE WIDE KPI

AUTOMATION OF ENTERPRISE KPI

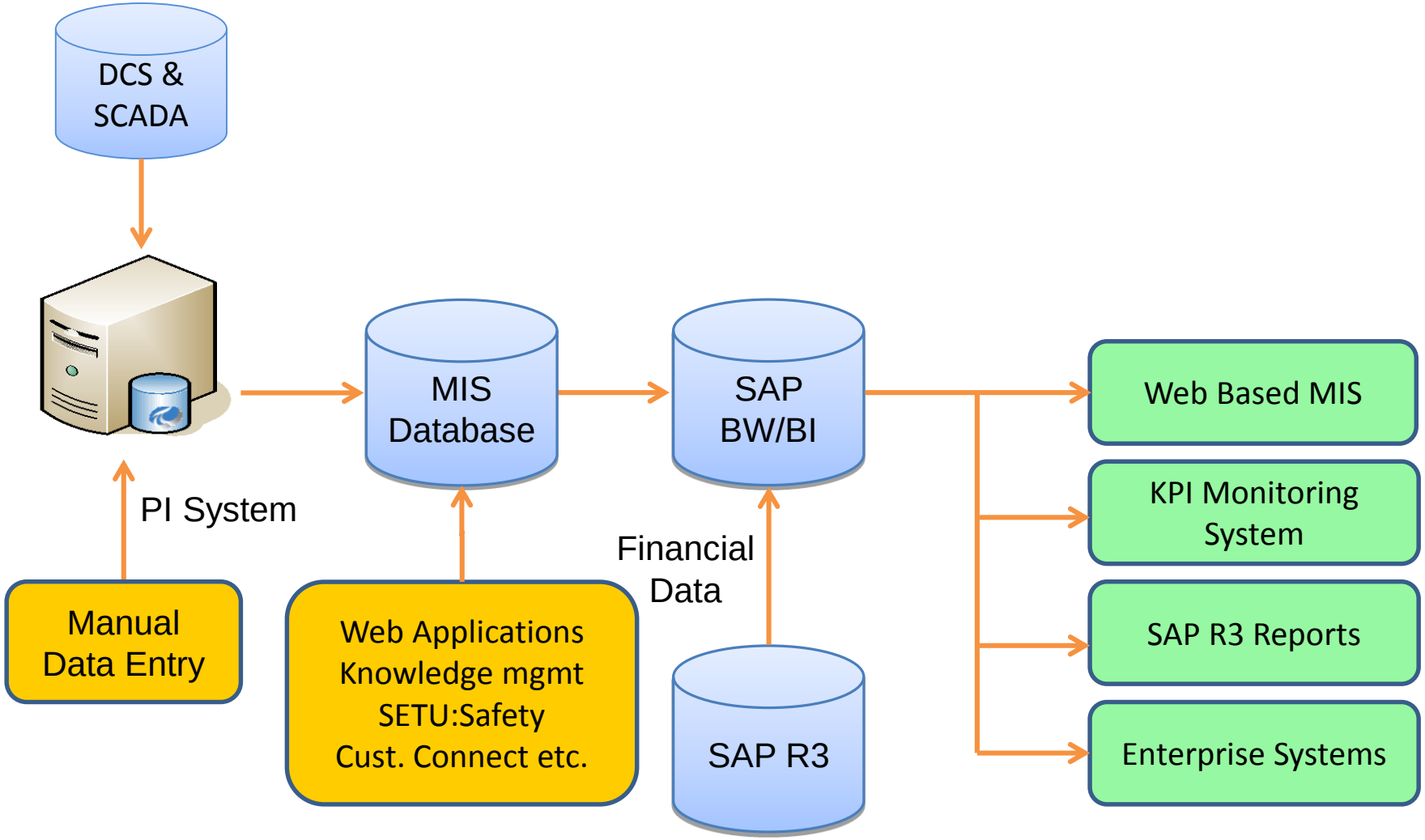
- Enterprise wide Balanced Score Card (BSC) monitored using KPI Monitoring System.

- Automation helps in streamlining the reporting process.

- Complex calculations are developed in PI System and performance measures are reported to Management without any manual intervention.

- PI system the only source of data for operational and environmental parameters KPI.

AUTOMATION OF ENTERPRISE KPI



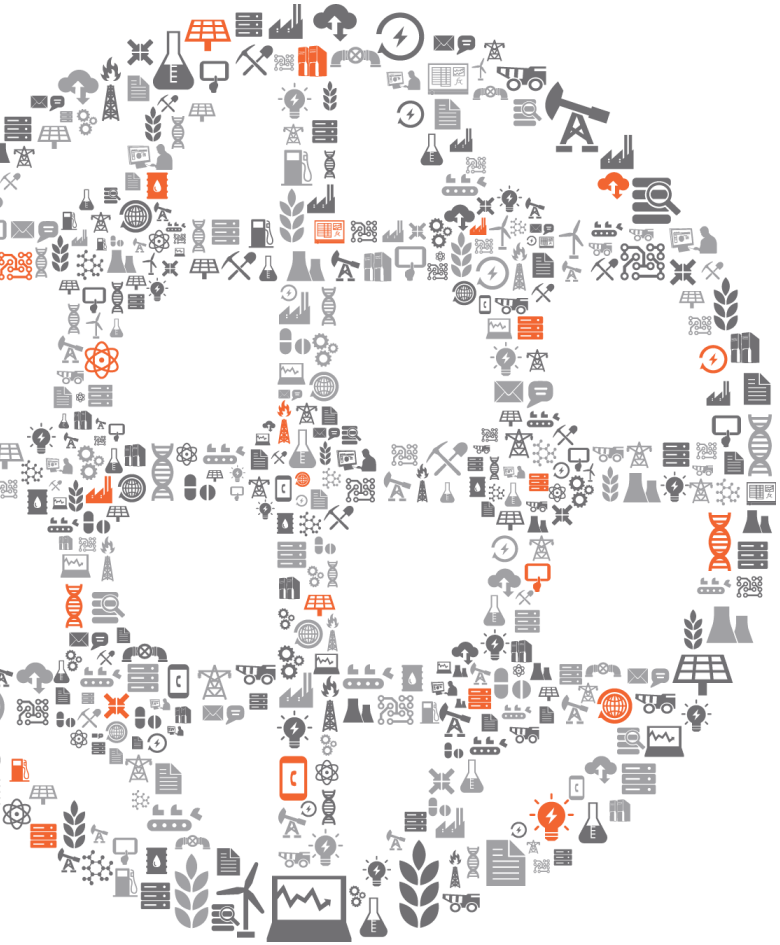
AUTOMATION OF ENTERPRISE KPI

Transmission Grid Availability

- Transmission Grid Availability for entire Mumbai Transmission grid which includes 71 transmission lines and 71 Transformers automated.

- Status of each equipment of Switchyard of all Generation and Transmission stations made available on PI System.

- Sequential calculations developed in PI System for calculating outage details of lines and Transformers. Availability of each line and each Transformer was calculated to provide Grid Availability of entire Transmission grid.



WEB BASED PERFORMANCE MONITORING

WEB BASED PERFORMANCE MONITORING

Online Data Available over Web.

Live Performance monitoring over Web.

Detail commercial and Efficiency Monitoring parameters.

WEB BASED PERFORMANCE MONITORING

TATA POWER

TATA POWER GROUP GENERATION LIVE

27-Jun-13 10:54:00

THERMAL	TROMBAY							MUNDRA					
	TOTAL	U4	U5	U6	U7A	U7B	U8	TOTAL	U10	U20	U30	U40	U50
CAPACITY(MW)	1580	150	500	500	120	60	250	4000	800	800	800	800	800
GENERATION(MW)	981	0	507	223	118	68	249	2798	579	554	550	563	554

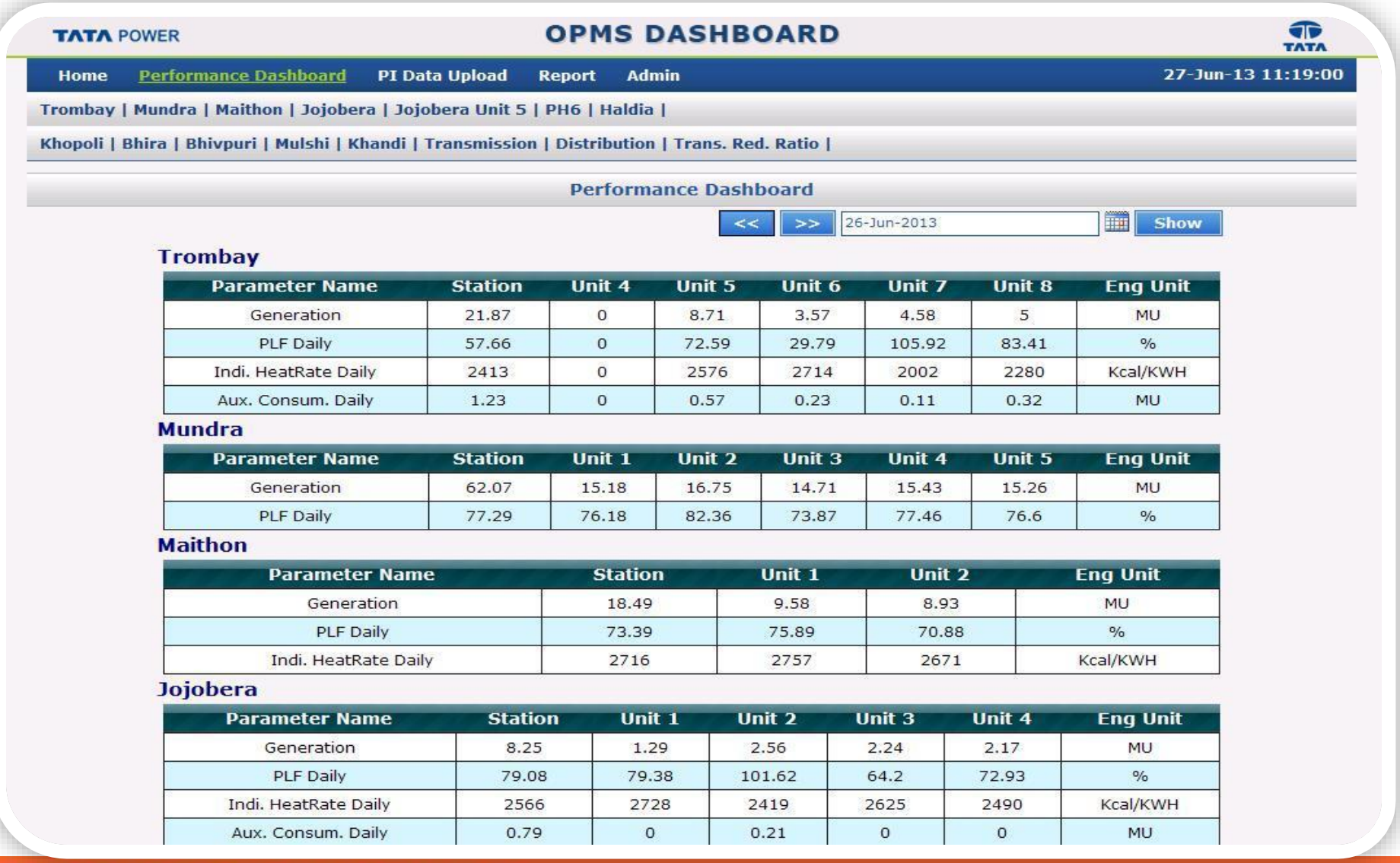
THERMAL	JOJOBERA					IEL			MAITHON			HALDIA			
	TOTAL	U1	U2	U3	U4	TOTAL	U5	PH6	TOTAL	U1	U2	TOTAL	U1	U2	U3
CAPACITY(MW)	428	68	120	120	120	240	120	120	1050	525	525	120	45	45	30
GENERATION(MW)	363	55	105	112	91	163	85	78	729	386	348	103	37	38	28

HYDRO	BHIRA								BHIVPURI								KHOPOLI			
	TOTAL	U1	U2	U3	U4	U5	U6	BPSU	TOTAL	U1	U4	U7	U8	U9	U10	U11	TOTAL	U7	U8	U9
CAPACITY(MW)	300	25	25	25	25	25	25	150	75	12	12	1.5	1.5	24	24	24	72	24	24	24
GENERATION(MW)	169	0	0	0	0	0	0	167	56	0	0	0.2	1.5	20	14	20	72	24	24	24

RENEWABLES	SOLAR					WIND
	TOTAL	MULSHI		MITHAPUR	CARNAC	TOTAL
CAPACITY(MW)	28	1	2	25	0.06	397
GENERATION(MW)	21.6	0.3	0.5	21	0.02	206

GENERATION
TOTAL
8521
5652

WEB BASED PERFORMANCE MONITORING



TATA POWER

OPMS DASHBOARD

TATA

Home | Performance Dashboard | PI Data Upload | Report | Admin | 27-Jun-13 11:19:00

Trombay | Mundra | Maithon | Jojobera | Jojobera Unit 5 | PH6 | Haldia |

Khopoli | Bhira | Bhivpuri | Mulshi | Khandi | Transmission | Distribution | Trans. Red. Ratio |

Performance Dashboard

<< >> 26-Jun-2013 Show

Trombay

Parameter Name	Station	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Eng Unit
Generation	21.87	0	8.71	3.57	4.58	5	MU
PLF Daily	57.66	0	72.59	29.79	105.92	83.41	%
Indi. HeatRate Daily	2413	0	2576	2714	2002	2280	Kcal/KWH
Aux. Consum. Daily	1.23	0	0.57	0.23	0.11	0.32	MU

Mundra

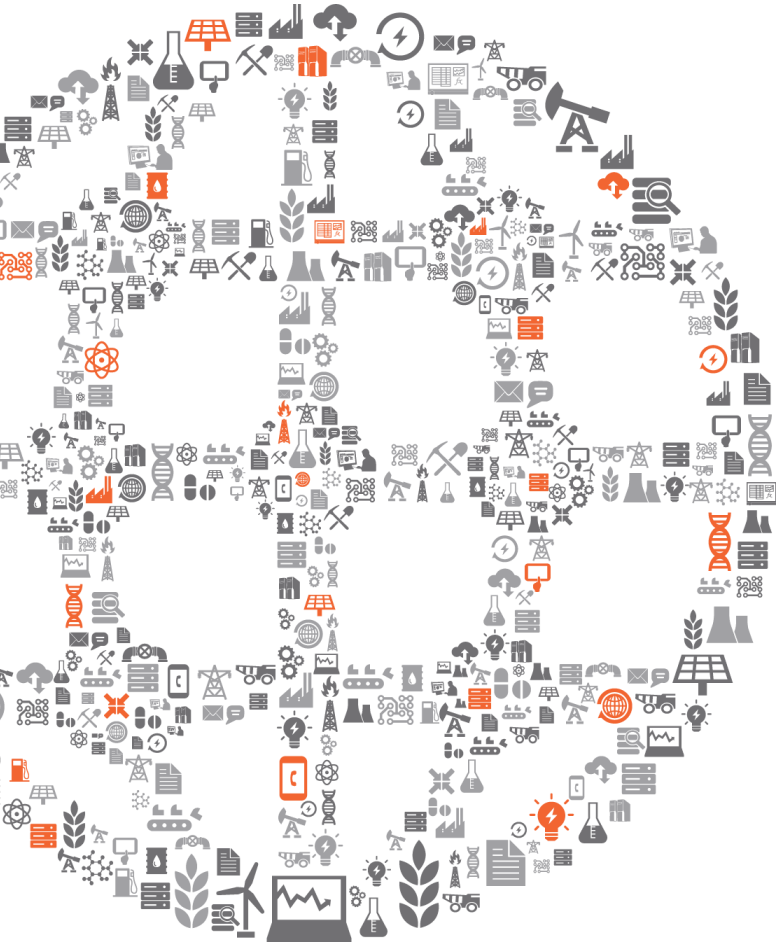
Parameter Name	Station	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Eng Unit
Generation	62.07	15.18	16.75	14.71	15.43	15.26	MU
PLF Daily	77.29	76.18	82.36	73.87	77.46	76.6	%

Maithon

Parameter Name	Station	Unit 1	Unit 2	Eng Unit
Generation	18.49	9.58	8.93	MU
PLF Daily	73.39	75.89	70.88	%
Indi. HeatRate Daily	2716	2757	2671	Kcal/KWH

Jojobera

Parameter Name	Station	Unit 1	Unit 2	Unit 3	Unit 4	Eng Unit
Generation	8.25	1.29	2.56	2.24	2.17	MU
PLF Daily	79.08	79.38	101.62	64.2	72.93	%
Indi. HeatRate Daily	2566	2728	2419	2625	2490	Kcal/KWH
Aux. Consum. Daily	0.79	0	0.21	0	0	MU



INTEGRATION WITH SAP

INTEGRATION WITH SAP-COE

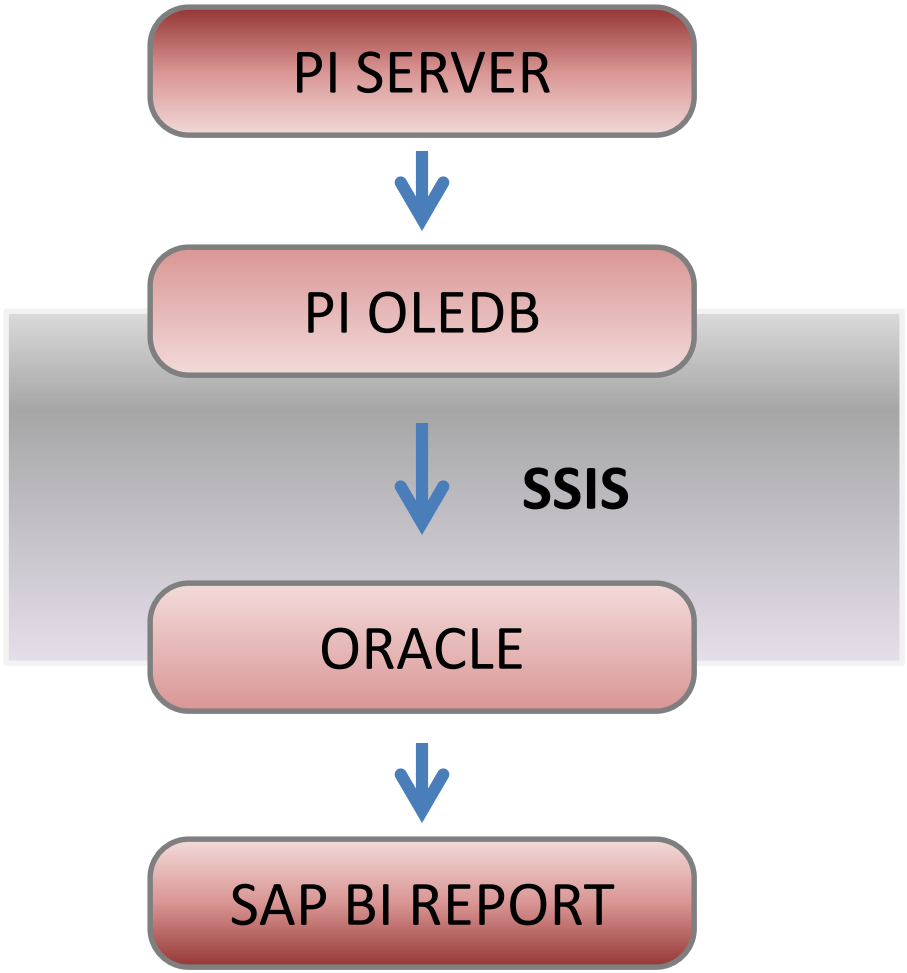
SAP-COE plans to automate performance monitoring drill down using SAP-BI report tools.

Trombay Unit 5 heat rate was decided upon as a pilot project.

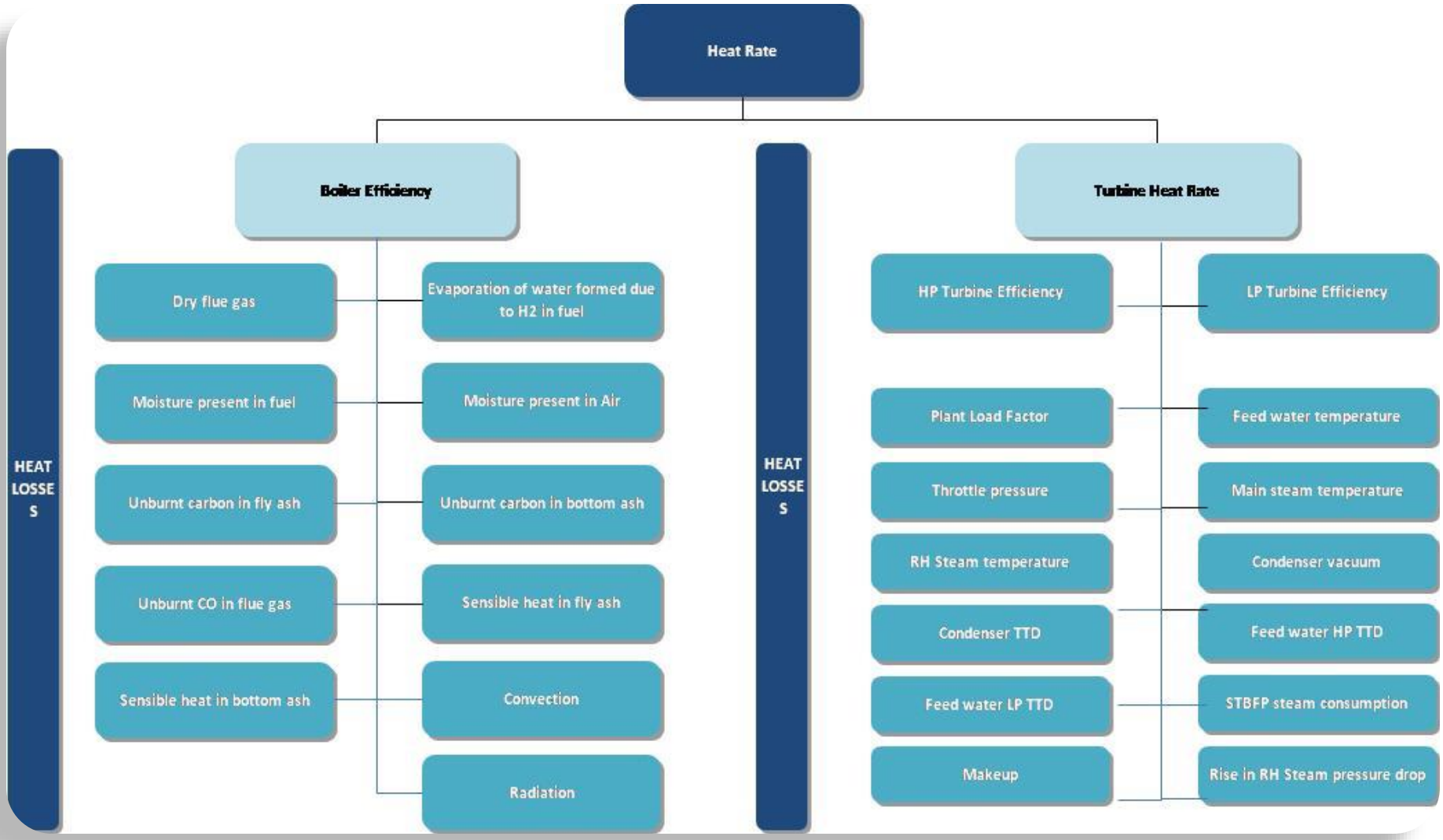
PI system is used for performing automated calculations and data transfer.

Since Steam Tables cannot be deployed in SAP, it was decided to use the steam tables function of PI system for thermodynamic calculations.

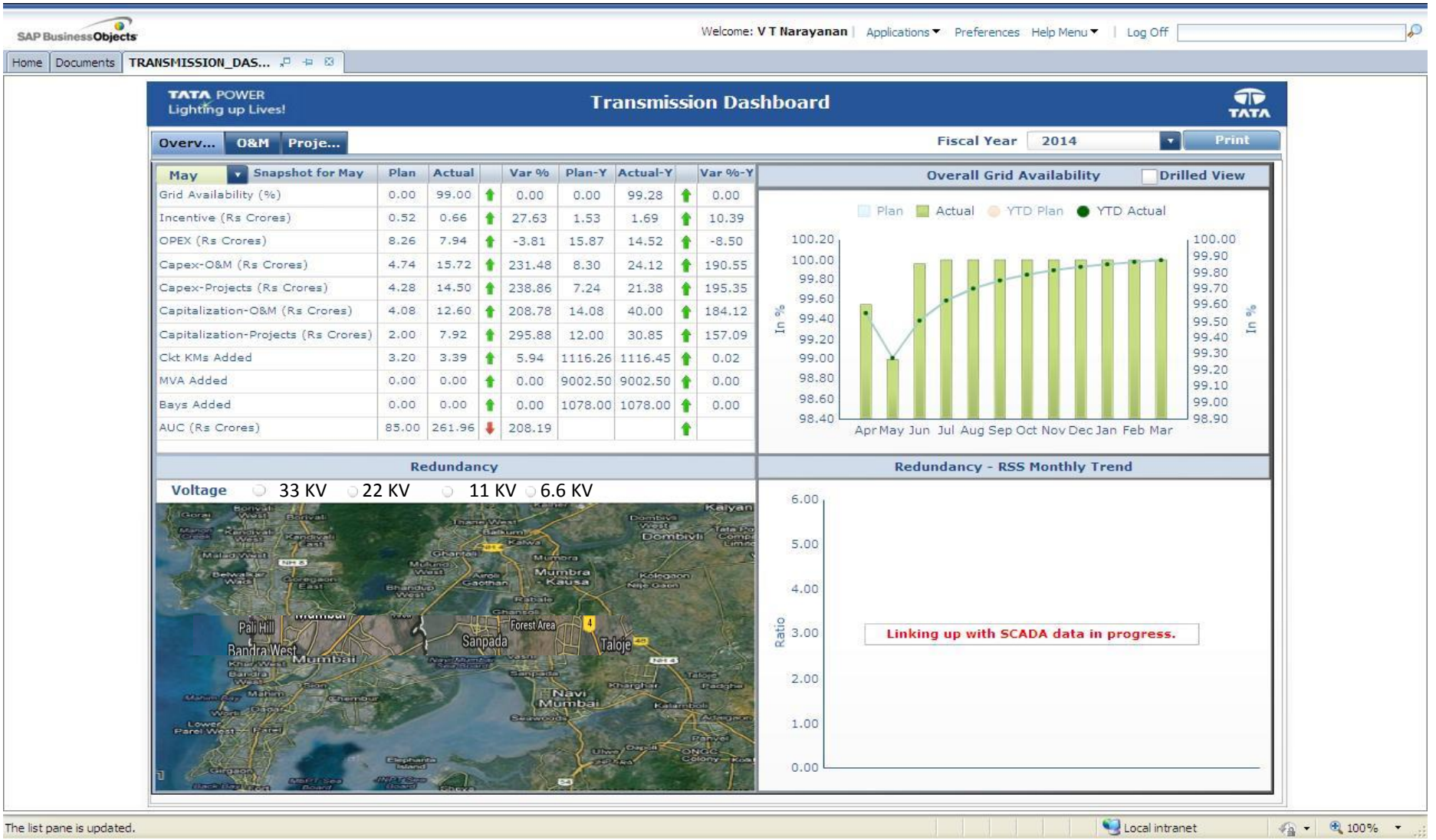
INTEGRATION WITH SAP-COE



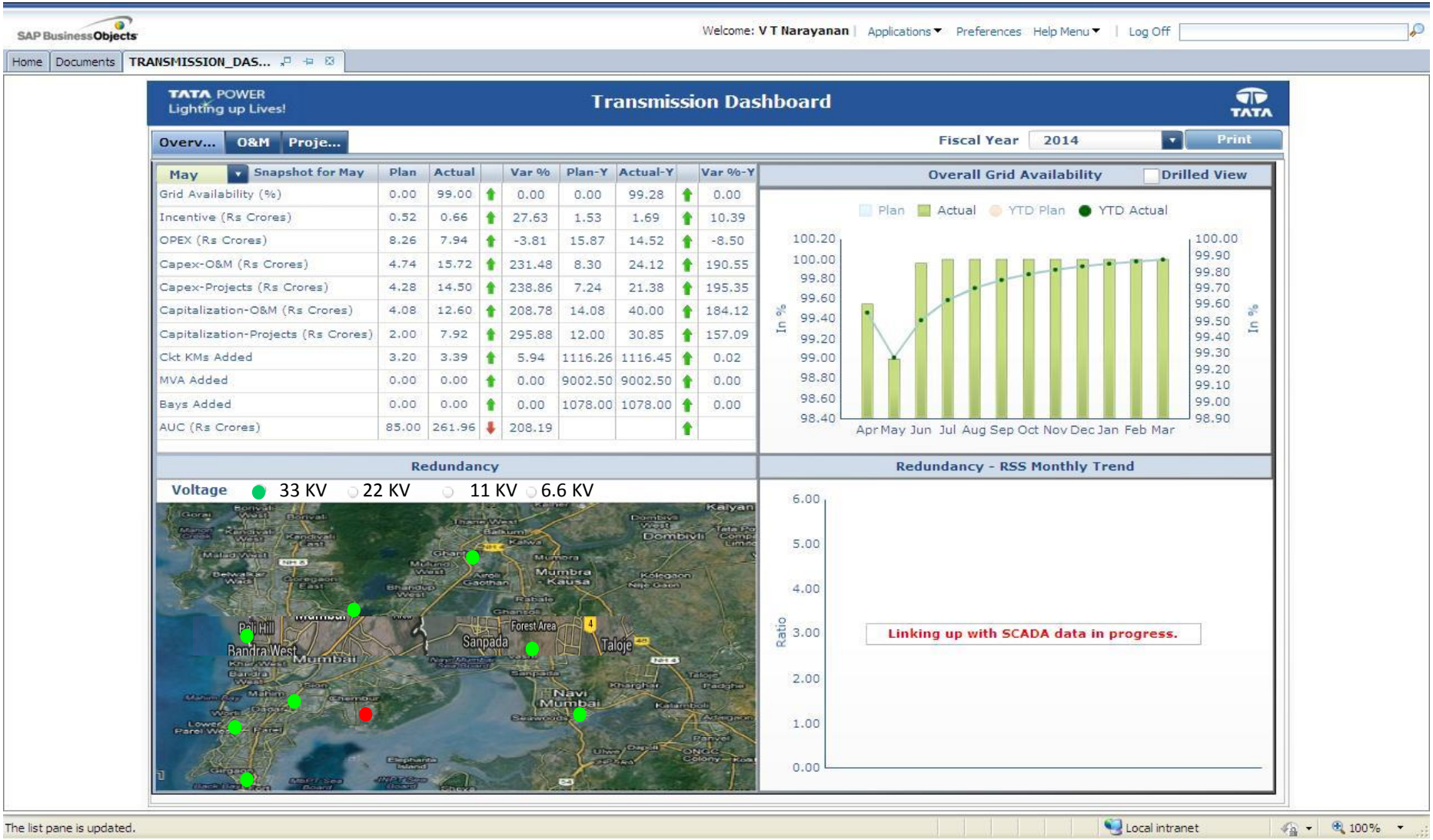
INTEGRATION WITH SAP

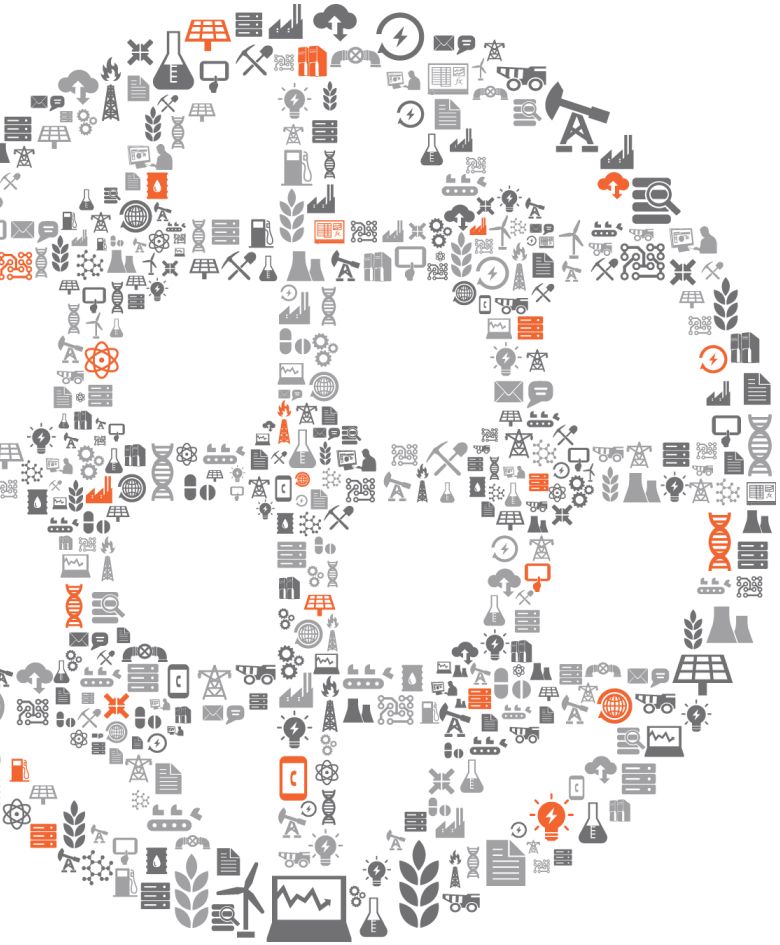


INTEGRATION WITH SAP



INTEGRATION WITH SAP





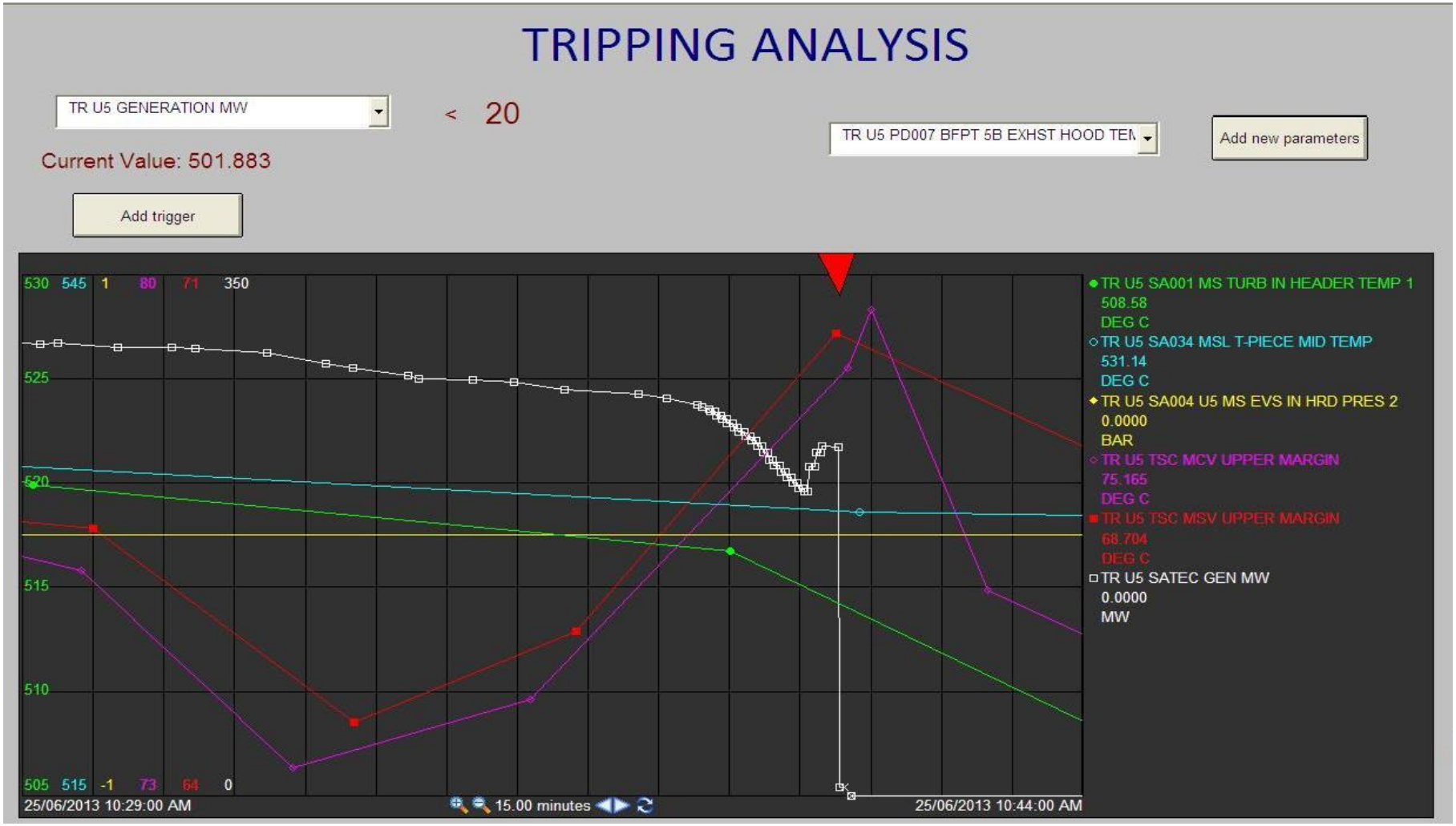
IN-HOUSE BUSSINESS SOLUTIONS

IN-HOUSE BUSINESS SOLUTION

Tripping Analysis

- Developed based on PI System data and features.
- Program developed on VBA Processbook that automatically gives the critical parameters trend during tripping.
- Provision has been kept to add parameter as per requirement.
- Displays and trends made with PI System Graphical tool Processbook.

IN-HOUSE BUSINESS SOLUTION



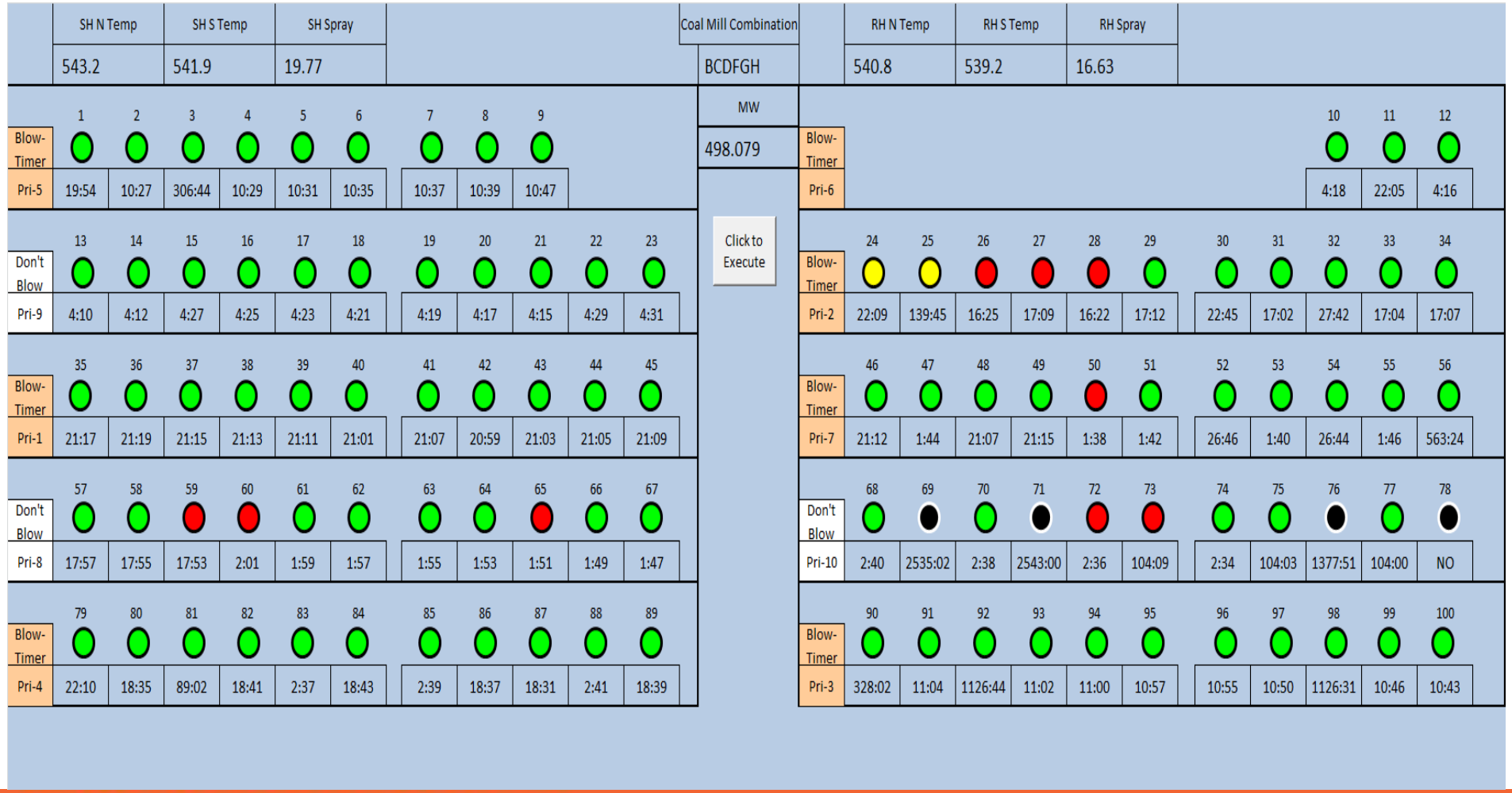
IN-HOUSE BUSINESS SOLUTION

Smart Soot Blowing Solution

- Soot Blowers operated to clean ash deposited on Boiler tubes without overall impact on Boiler efficiency.
- Application developed that analyses effect of individual soot blowers in various conditions.
- A group of most effective soot blowers are suggested to Operators for prioritizing the operation of soot blowers.
- Impact on Boiler Efficiency. Its effect is evident in improvement in SH temp, DM Water consumption and Heat Rate.

IN-HOUSE BUSINESS SOLUTION

Smart Soot Blowing Solution



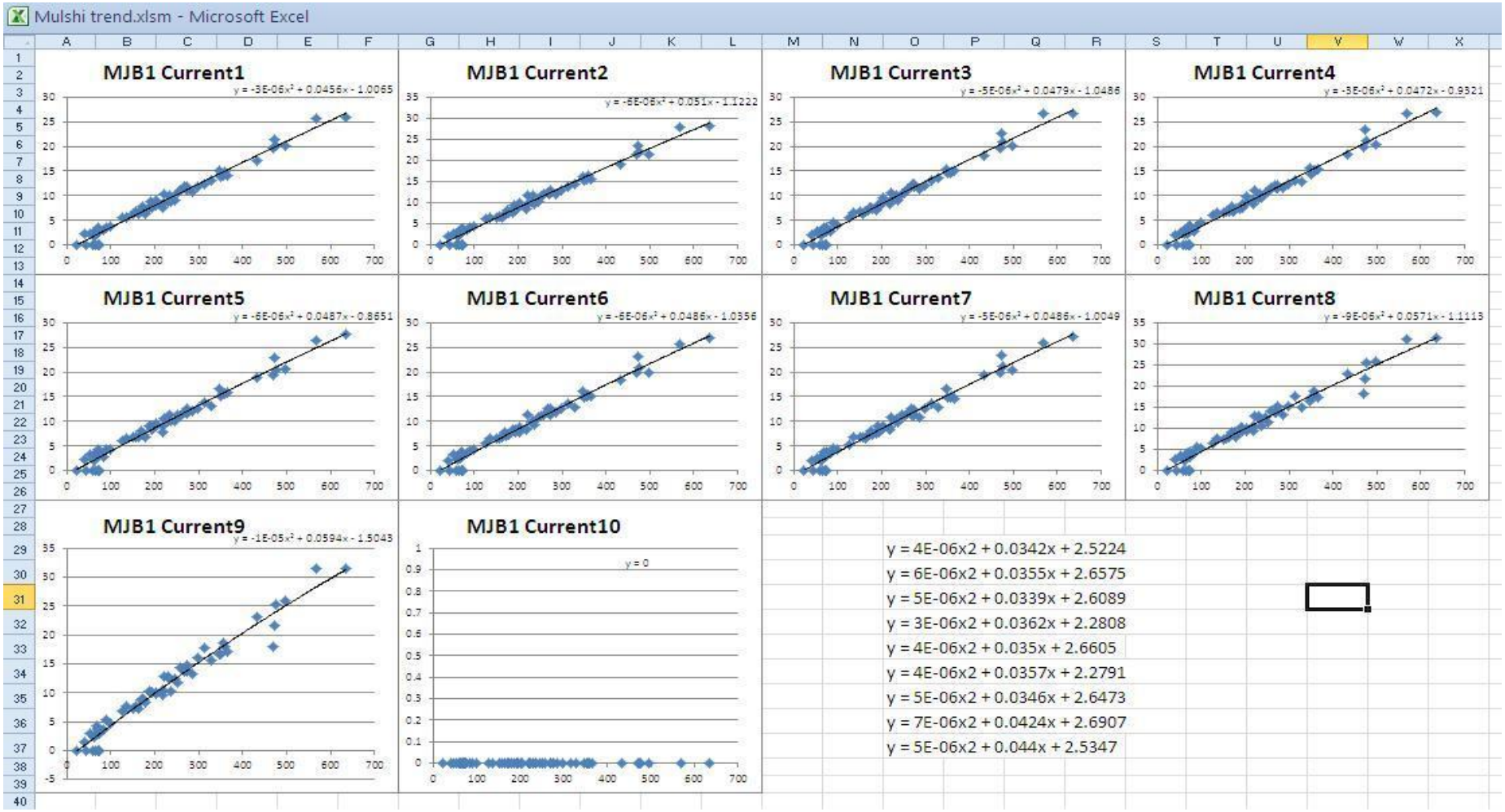
IN-HOUSE BUSINESS SOLUTION

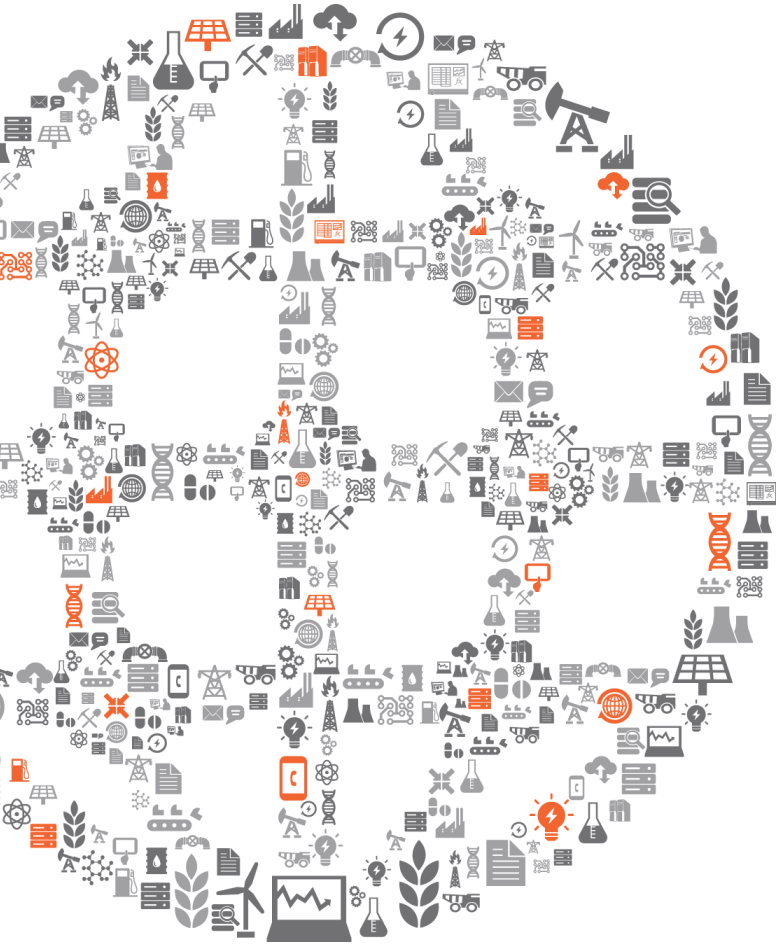
Solar Equipment Monitoring

- Effect of sun rays on Solar PV modules.
- Polynomial Relationship between Solar radiation and current derived Programatically.
- Deviation from polynomial provides alarm for operation engineers to investigate.

PLANT PERFORMANCE ANALYSIS

Mulshi Radiation Analysis





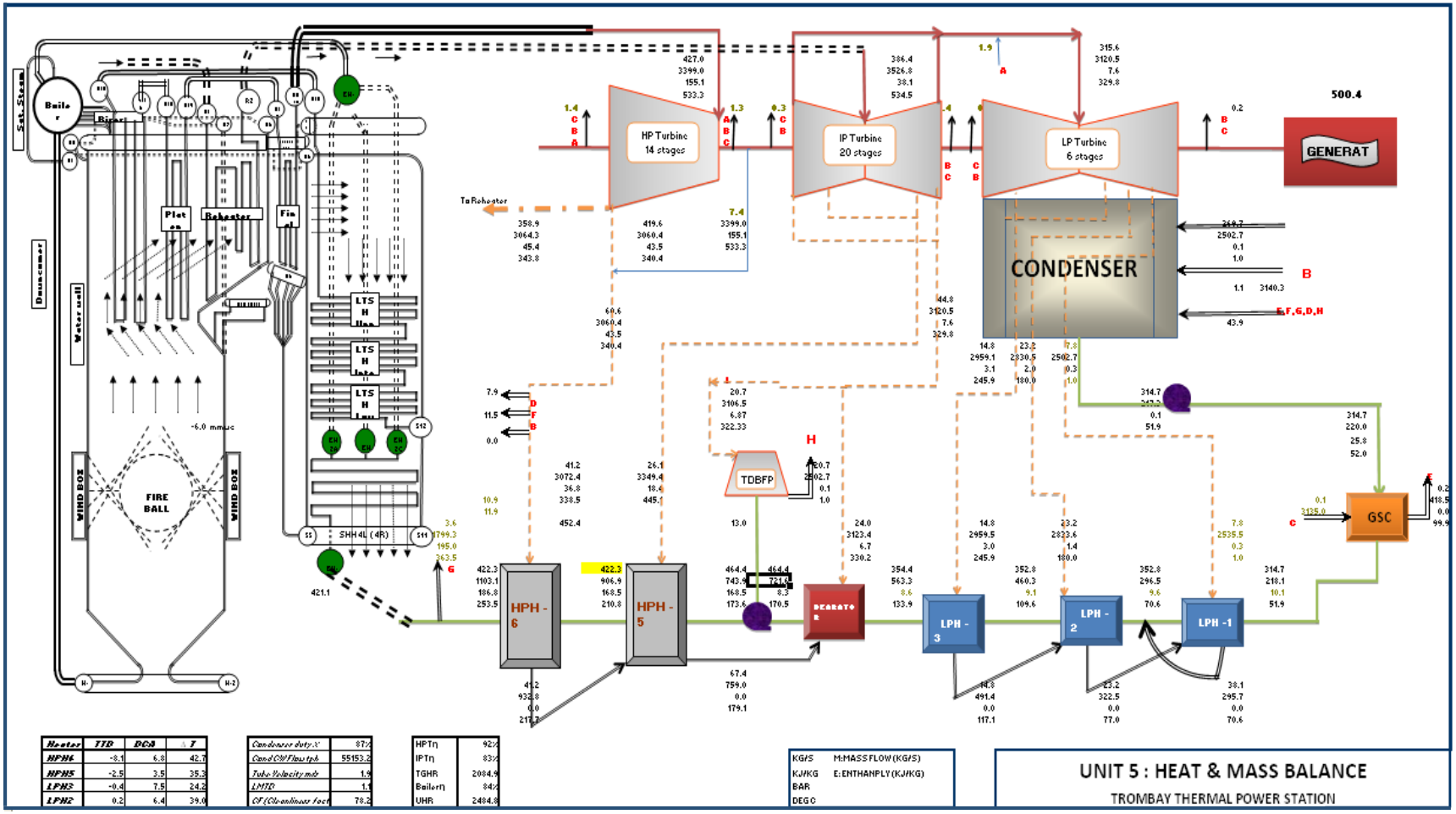
PLANT PERFORMANCE ANALYSIS

PLANT PERFORMANCE ANALYSIS

- Developed Performance Analytics for
  - Thermodynamic Cycle
  - Auxiliary consumption
  - Impact of each Auxiliary equipment on plant performance
  - Equipment performance on Heat Rate

PLANT PERFORMANCE ANALYSIS

Heat Balance Diagram



Heater	TTD	DCA	Δ T
HPH6	-8.1	6.8	42.7
HPH5	-2.5	3.5	35.3
LPH3	-0.4	7.5	24.2
LPH2	0.2	6.4	39.0

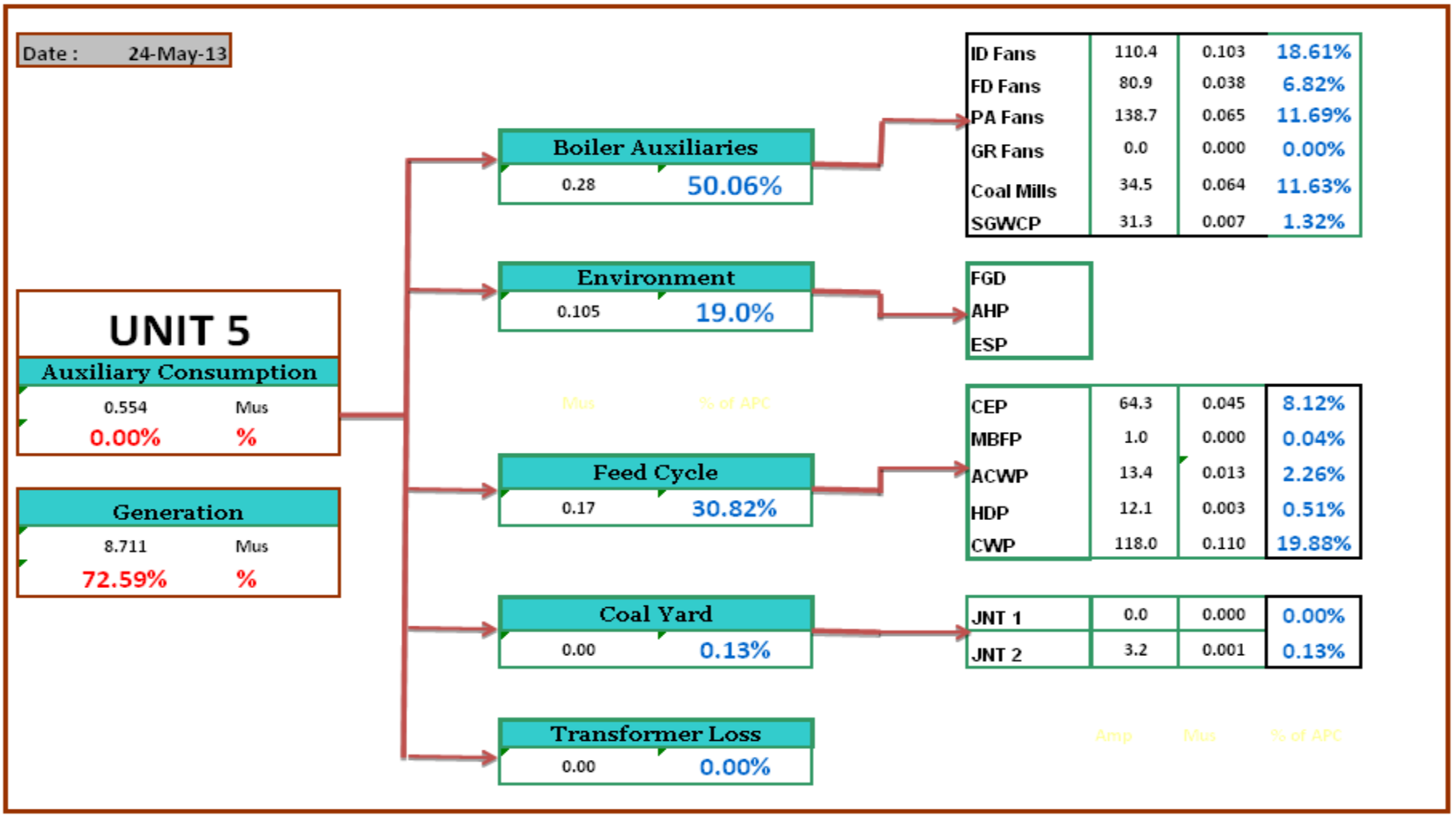
Condenser duty %	87%
Cond CW Flow tph	55153.2
Tube Velocity m/s	1.9
LMTD	1.1
CF (Cleanliness fact	78.2

HPTη	92%
IPTη	83%
TGHR	2084.9
Boilerη	84%
UHR	2484.8

KG/S	M:MASS FLOW (KG/S)
KJ/KG	E: ENTHANPLY (KJ/KG)
BAR	
DEG C	

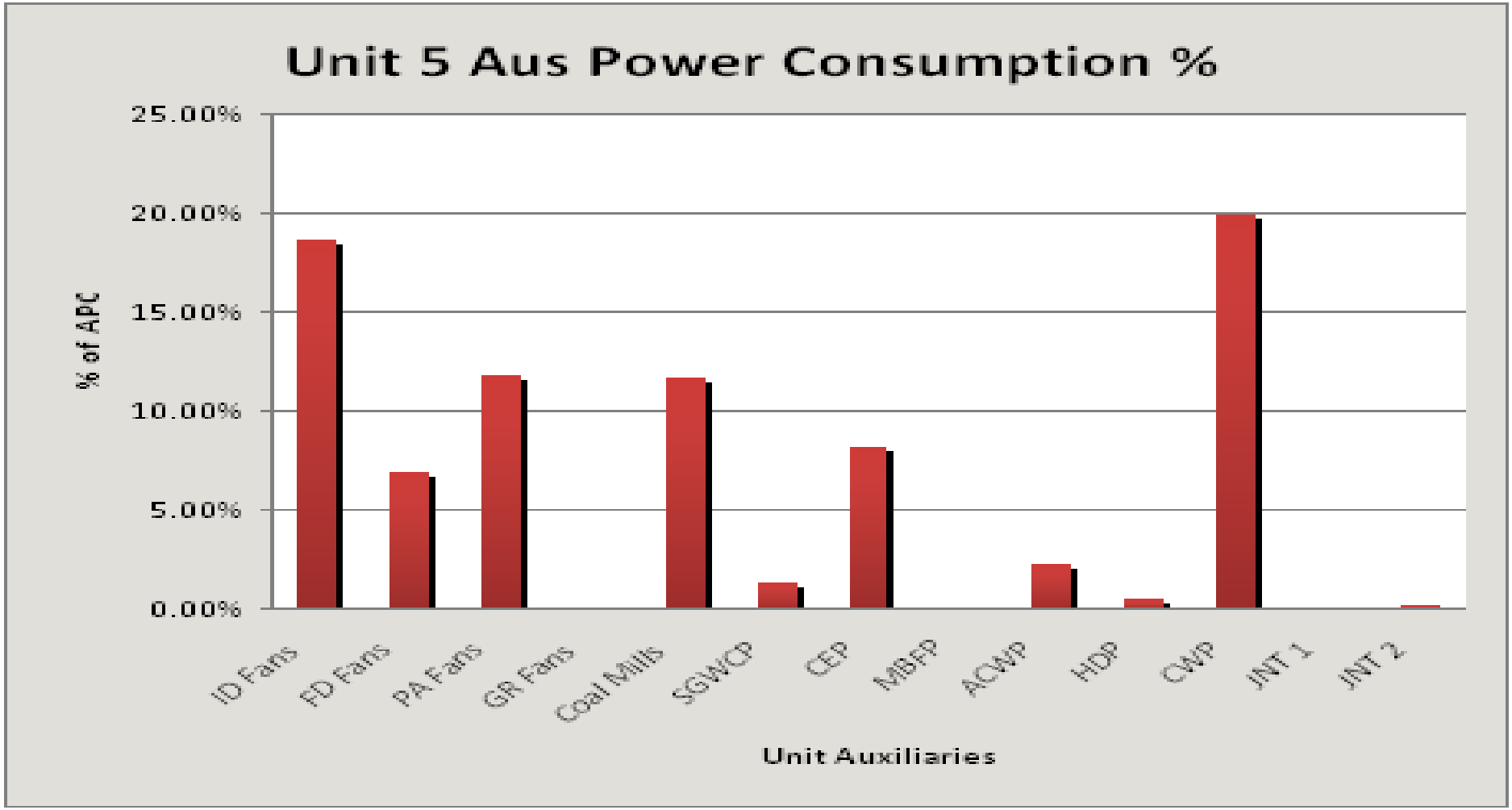
PLANT PERFORMANCE ANALYSIS

Energy Management System - Unit 5



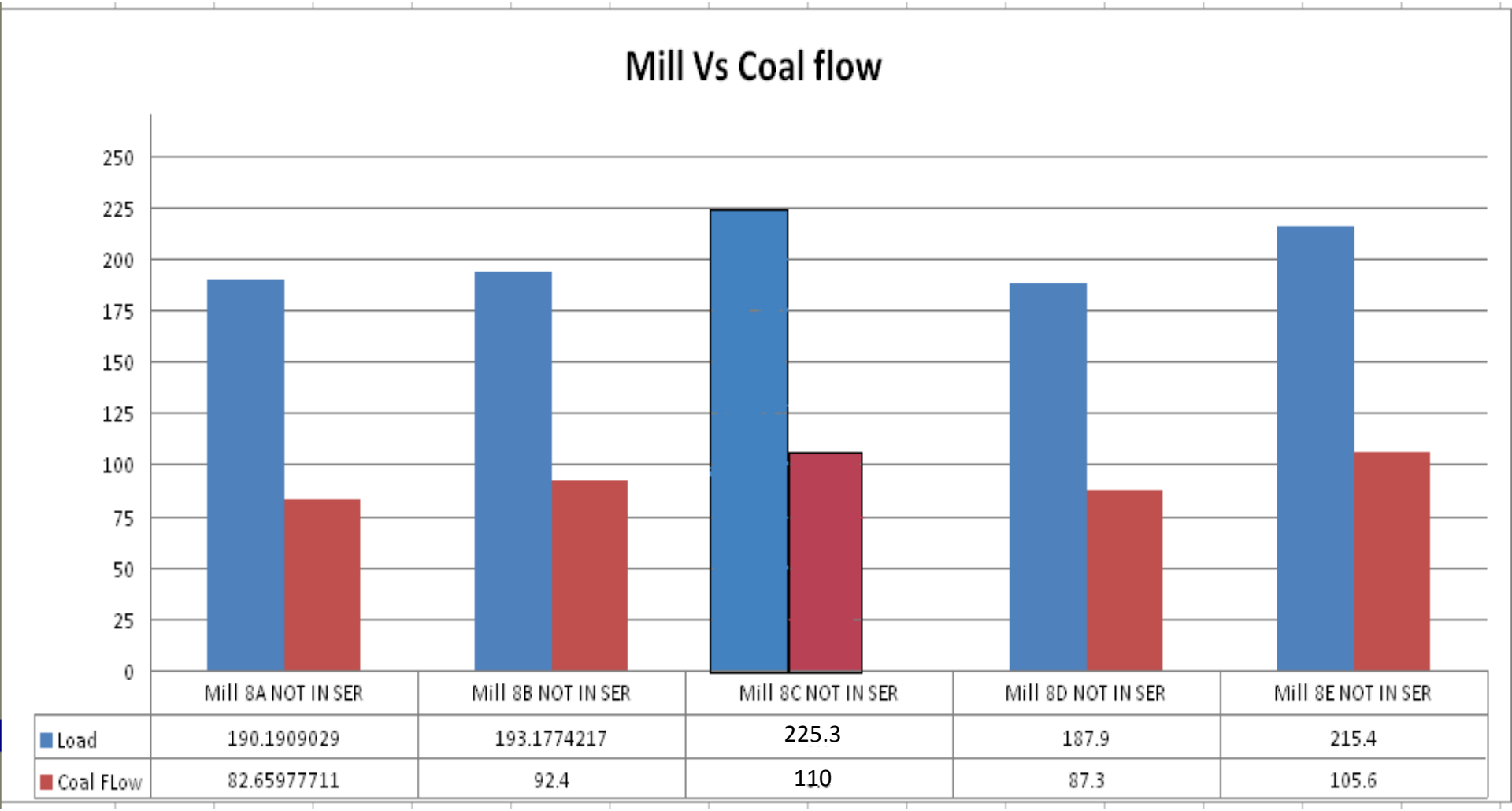
PLANT PERFORMANCE ANALYSIS

Energy Management System - Unit 5

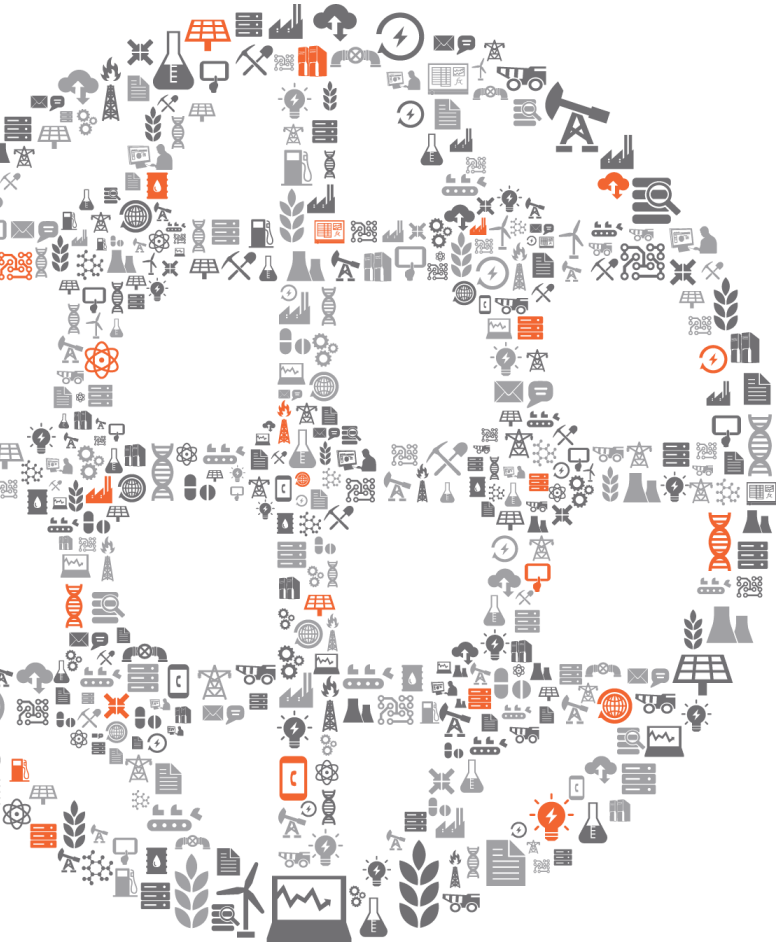


PLANT PERFORMANCE ANALYSIS

Individual Mill Contribution to Heat Rate



	Mill 8A NOT IN SER	Mill 8B NOT IN SER	Mill 8C NOT IN SER	Mill 8D NOT IN SER	Mill 8E NOT IN SER
Load	190.1909029	193.1774217	225.3	187.9	215.4
Coal FLow	82.65977711	92.4	110	87.3	105.6



CENTRAL ASSET MONITORING

CENTRAL ASSET MONITORING

Data from decentralized plants to Centralized location

Facilitates Centralized diagnostics and analytics

Expert advice from centralized location to decentralized locations

QUESTIONS

Thank you

We take pride in Lighting up Lives!