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Adopting Automation and Digital Technologies for Enhancing Plant Efficiency and Reliability at Kunatum Papers

Abstract:

With rising input cost the total cost of production keeps on increasing day by day. Companies need to improve their operating efficiencies for reducing their cost of production. In modern world, digitization and automation have opened new routes for improving operating plant efficiencies and improving reliability. Kuantum papers have also has taken a leap in this direction by adopting new digital technologies and automation in the field of Electrical and Electronics for automating process and improving process controls, reducing variations, and improving plant reliability. The following paper discusses those steps and CAPEX projects taken by the company around Electrical, Electronics, Automation and Digital technologies which have resulted in improving plant efficiency and reliability.

Keywords: *Digitization, automation, technology, operating efficiency, reliability, process controls.*

Parveen Goel*
AVP- Elect. Engg.

Adwitiya Gaurav*
Sr. GM – Utility

**Kuantum Papers Ltd.,*
Saila Khurd Hoshiarpur (Punjab)

Introduction

Incorporating new Automation and Digital technologies in the field of Electrical and electronics, has helped Kuantum papers to identify areas of scope of improvement in running plant equipments and improving plant reliability. With these technologies the root cause analysis can be done with better precision, and it also reduces process variations through better monitoring of operating parameters. Kuantum Papers has incorporated various AI tools like Load management systems, Energy management systems, dashboards and advance maintenance practices which have enabled to continuously reduce our operating cost and improve plant reliability. Regular audits of process are very important to identify areas of improvement, hence regular energy audits by CII are being carried out to identify system losses and closing them.

1. IMPROVING ELECTRICAL EFFICIENCY:

a. Energy Audit: Energy audit was conducted by CII to identify the areas of improvement. A total of **41** number of areas of improvement were identified and savings to the tune of approx. **Rs 200 lakh per annum** have been realised till June 2024. The major area of improvements identified as follows:

1. Power saving through VFDs
2. Installation of APFC for power factor improvement.
3. Use of energy efficient equipments
4. Prevention of loss of compressed air in system.
5. Improving boiler operation through saving of energy loss.

b. Use of Energy Efficient Equipment: Following actions have been taken at Kuantum Papers for use of energy efficient Equipments at Kuantum Papers:

- Replacement of Standard Efficiency IE1 motors with Premium Efficiency IE3/IE4 Motors
- Installation of Active Harmonic Filters for harmonic mitigation and Power Factor control
- Installation of Automatic Star Delta converter on underload motors
- Installation of Variable Frequency drives for Power Saving as per CII audit recommendations.
- Installation of Energy Efficient Pumps and Agitators at various plant locations.

Case Study: Use of efficient motors and VFDs for reduction in Power Consumption

- IE1 motors, being less efficient, consume more energy and, consequently, contribute to higher carbon emissions.
- IE3 motors have superior efficiency ensures minimal energy wastage and

significantly lower carbon footprint, aligning with global efforts to combat climate change and promote sustainability.

- Over the last 2 years we have replaced 217 Nos. of IE1 motors with Premium Efficiency IE3/IE4 Motors
- The impact of electric motors on the ecosystem is an important consideration
- Total savings in power by using efficient motors : 1560 KWH/Day

Total 13 Nos. of VFDs have been installed as per CII recommendations

CII Energy Audit VFD Savings Data

Sr. No.	Equipment	Tag No.	Location	Motor Rated KW	Before KW	After KW	Saving (KW)
1	Install VFD for agro storage chest feed pump	555-319M	Pulp Mill	45	35	22	13
2	Install VFD for blending chest feed pump - A (Chest#7)	3101A	PM#3	22	16	9	7
3	Install VFD for blending chest feed pump - B (Chest#30)	3201	PM#3	22	18	11	7
4	Install VFD for blending chest feed pump - C (Concrete tower-1)	3601A	PM#3	11	8	2	6
5	Install VFD for machine chest feed pump (Chest#40)	3702	PM#3	15	12	6	6
6	Install VFD for intermediate chest feed pump (Chest#38)	3701A	PM#3	15	12	4	8
7	Install VFD for Blending chest pump Softwood (Chest#4)	3301	PM#3	15	13	8	5
8	Install VFD for machine chest feed pump	Chest#14	PM#2	15	12	7	5
9	Install VFD for machine chest feed pump	Chest#18	PM#1	18.5	14	8	6
10	Agitator chest no-14 Pump	-	PM#2	22	15	8	7
11	PV Blower	-	PM#2	22	12	6	6
12	Chest no-14 Agitator	-	PM#2	15	7.5	3.5	4
13	PV Blower	-	PM#1	30	21	15	6
				Total Saving (KW)			86
				Total Saving kWh/day			2064

- Total savings in power by using VFD's : 2064 KWH/Day
- Total savings by using efficient motors and VFD's: Rs 77.73 Lakhs/Annum

2. PROCESS AUTOMATION:

a. Advanced Sensors and monitoring system:

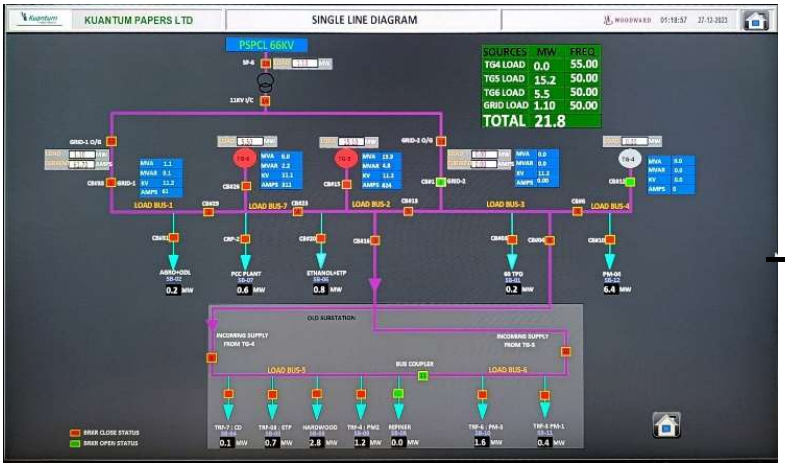
- **Use of Load management system:** Automatic Load shedding is an action to avoid excessive load on Turbines & Grid and give priority-based load shedding to non-critical plants and save the plant from complete Power Failure condition.

CASE STUDY: Reducing Power black outs to Zero through installation of load management

What is load shedding?

Load shedding is an action to avoid excessive load on Turbines & Grid and give priority-based load shedding to non-critical plants and save the plant from complete Power Failure condition.

Types of load Shedding:



LOAD MANAGEMENT SYSTEM

(1) GRID Maximum Demand (MD) based Load Shedding **(2)** Under Frequency based Load Shedding

(3) Source Tripping Load Shedding (Grid & Turbines)

A. GRID Maximum Demand (MD) based Load Shedding

If import load is greater than MD set-point for configured delay time, then

Shed minimum running load in groups connected with grid.

Wait for import decreases below to import md set-point and wait for configured time delay-2.

If yes in point-ii then no tripping command up to next cycle. if no then shed next minimum load and goes back to point-ii.

B. TG Frequency based Load Shedding

System compares bus frequency with configured low frequency set-point. If frequency is less than low frequency set-point for configured delay time, then

I. Shed minimum running load connected with grid.

II. Wait for frequency increases above low frequency set-point and wait for configured time delay

III. If yes in point-ii then no tripping command up to next cycle. If no then shed next minimum load and goes back to

POIN point II.

CASE STUDY: Power event analysis through digitization in power management

- The energy management system enables us to visualize loading of transformers on a single screen.
- It generates an alarm when the loading of any transformer goes above 75 %.
- Necessary actions can be taken on time like load rise monitoring, winding and oil temperature monitoring etc.

C. Source Tripping Load Shedding (Grid & Turbines)

GRID FAILURE:

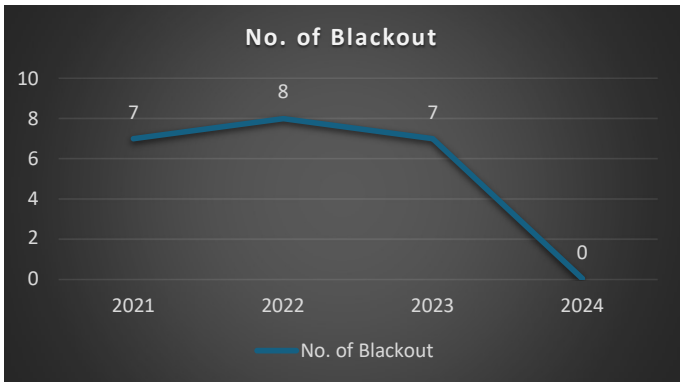
DURING IMPORT CONDITION SUDDENLY GRID BREAKERS OPEN GRID ISLAND BASE STARTS, FIRST CHECK THE IMPORT LOAD ON GRID THEN GENERATE THE SHEDDING COMMAND TO RESPECTIVE SHEDDING BREAKERS OF EQUIVALENT IMPORT LOAD.

TURBINE FAILURE:

1) DURING HOME LOAD/ISLAND MODE PLANT CONDITION SUDDENLY ANY OF TG BREAKER OPEN THE RESPECTIVE(EQUIVALENT) LOAD WILL BE SHED.

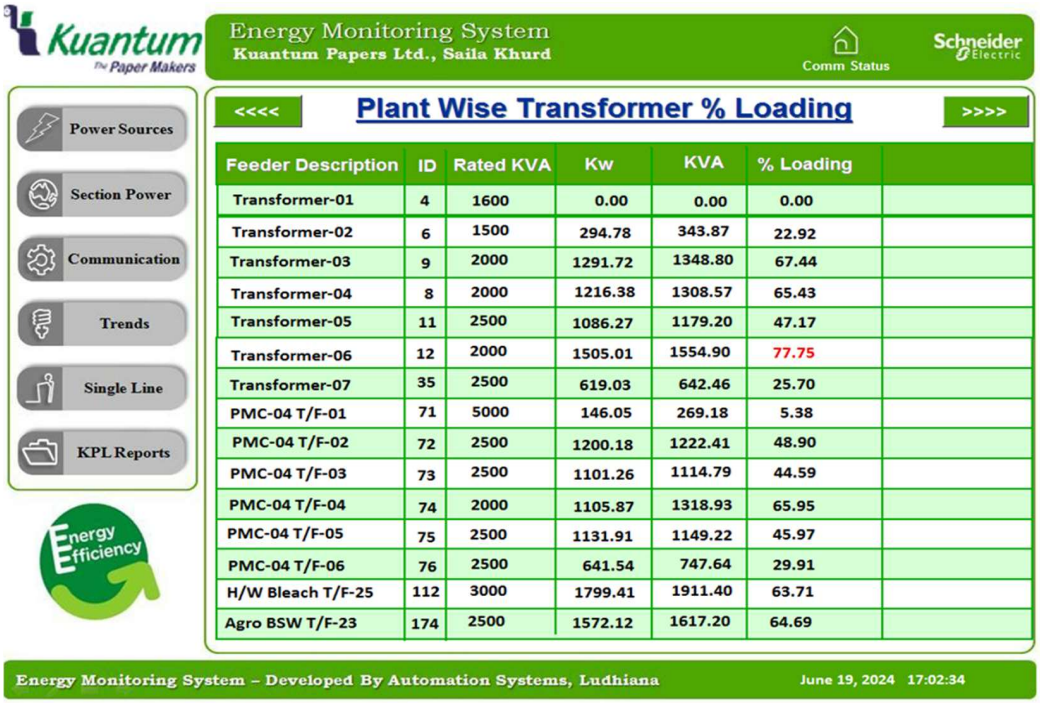
2) DURING SYNCHRONIZED MODE, IF TG TRIPS THEN LOAD SHEDDING SYSTEM, CHECKS THE AVAILABLE MARGIN ON GRID AND TRIPS THE CALCULATED LOAD ACCORDINGLY.

GAINS ACHIEVED



Cost avoidance: 210 Lacs/Annum

- **Use of energy management system:** By implementing an energy management system, we can identify energy-saving opportunities and optimize their energy usage, resulting in significant cost savings and reduced carbon emissions.



Feeder Description	ID	Rated KVA	Kw	KVA	% Loading
Transformer-01	4	1600	0.00	0.00	0.00
Transformer-02	6	1500	294.78	343.87	22.92
Transformer-03	9	2000	1291.72	1348.80	67.44
Transformer-04	8	2000	1216.38	1308.57	65.43
Transformer-05	11	2500	1086.27	1179.20	47.17
Transformer-06	12	2000	1505.01	1554.90	77.75
Transformer-07	35	2500	619.03	642.46	25.70
PMC-04 T/F-01	71	5000	146.05	269.18	5.38
PMC-04 T/F-02	72	2500	1200.18	1222.41	48.90
PMC-04 T/F-03	73	2500	1101.26	1114.79	44.59
PMC-04 T/F-04	74	2000	1105.87	1318.93	65.95
PMC-04 T/F-05	75	2500	1131.91	1149.22	45.97
PMC-04 T/F-06	76	2500	641.54	747.64	29.91
H/W Bleach T/F-25	112	3000	1799.41	1911.40	63.71
Agro BSW T/F-23	174	2500	1572.12	1617.20	64.69

CASE STUDY: Power event analysis through digitization in power management

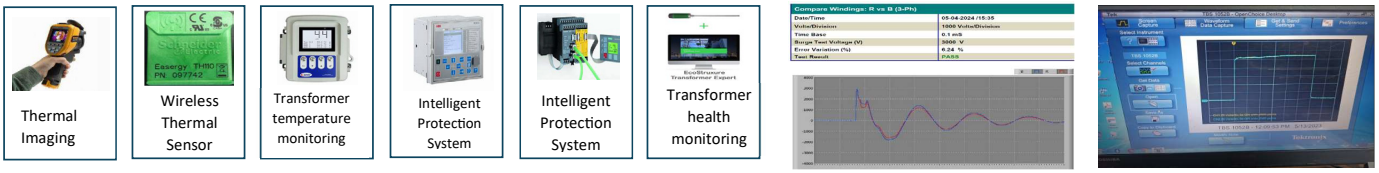
- **The energy management system enables us to visualize loading of transformers on a single screen.**
- **It generates an alarm when the loading of any transformer goes above 75 %.**
- **Necessary actions can be taken on time like load rise monitoring, winding and oil temperature monitoring etc**

- Energy management system enables us to understand the root cause and impact of cascading and chronic power system events and use this information to reconstruct events, respond appropriately and determine cause to prevent potential issues in the future
- Faster cause identification via analytics providing potential cause descriptions of various Power Quality events eliminating need to manually interpret electrical waveforms
- Disturbance Direction Detection (DDD) to identify location of PQ events in our system using power quality meters
- Load Loss Detection (LLD) help us prioritize investigation efforts by understanding amount of impact of events on the system

b. Predictive maintenance:

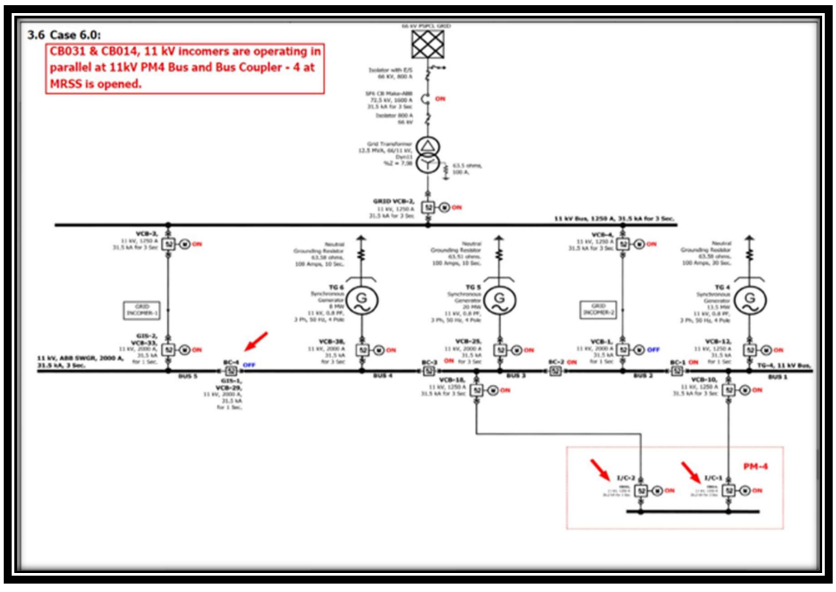
Adopting best instruments for condition monitoring

- For the study of methodologies to detect symptoms of possible failure in electrical equipment.
- It is a complete Health check up to avoid un-expected failures i.e. Maintenance with Intelligence.
- At Kuantum, the instruments we use for condition monitoring are fully automatic, digital, software operated with very high accuracy. Eg. Thermal imaging, intelligent motor control, online vibration analyzers, Intelligent protection system etc.



IOT i.e Integration of Internet of Things devices and sensors to monitor asset health, performance, and environment conditions in real time.

- **Intelligent relay Protection System:** At Kuantum papers we have enhanced the relay coordination efficiency by carrying out Network Modeling, Short circuit Study and Load flow Study through ETAP software.
- It gives us reliable protection in case of critical grid conditions and faults due to environmental influences or faulty operating equipment.



- We have replaced Electromechanical relays with the latest digital relays to have flexibility in relay settings and faster response.

Gains Achieved

a. Achieved Zero Source tripping level in case of earth faults in system.

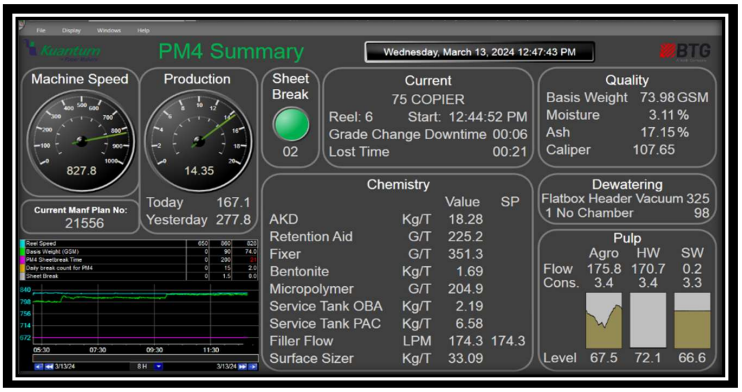
b. Faults are limited to feeder level only.

c. Saving in tripping of multiple plant feeders due to problem in one feeder.

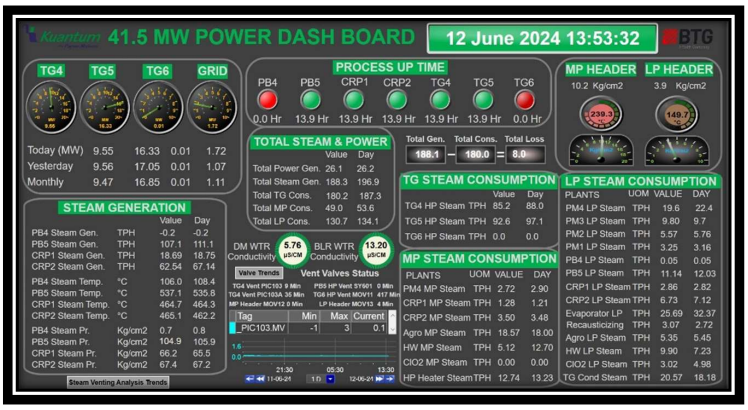
3. DATA ANALYSIS:

CASE STUDY - Incorporating Digital data display and analysis through DATA PARC

- Kuantum papers along with BTG has created dynamic, highly informative dashboards that give an at-a-glance overview of the condition of major process flows and KPIs at our plant.
- We can build dashboards with data from multiple physical sites or from various processes in a single display. Data from traditionally isolated data silos, such as lab quality data, or SAP inventory data, can be pulled in and presented side-by-side for analysis in a single display.
- It Improves our decision-making and troubleshooting capabilities. There are multiple analytical tools to do the analysis and resolve chronical issues in company.
- It quickly transforms critical data into useful information for timely decision-making and root-cause analysis.



Power Plant Dashboard



PM-4 BW Variation Analysis

PM-4 Dashboard

Process improvements achieved through Data Parc:

- Reduced unplanned downtime with Alarms and advanced diagnostic information.
- Through PARC view we can easily access the parameters from other plants that impact our machine parameters.
- By using Centerline, we can make analysis of the data in a single screen.
- Remote Monitoring.
- Simplified trouble shooting.
- Diagnosis and prevention of losses.
- Enhanced knowledge sharing and collaboration.
- Bringing experience and technology together.

CONCLUSION:

- With above actions Kuantum Papers have taken a Giant leap towards energy efficiency by incorporating digital technologies and automation.
- It has enabled Kunatum Papers to reduce its operational cost through improving its operational efficiency.
- Achieved zero plant blackouts with installation of load management system, thus saving of 210 Lacs per annum.
- Saving of 3624 KWH per day through installation of VFDs and upgradation of low efficiency motors.
- Identification and resolution of faults in power system through energy management system and advanced relay protection systems.
- Advanced data monitoring and problem solving through Data parc.
- Reduction in variation of process parameters through Data Parc.

S.No.	Description	DCS	Data PARC
1	Analysis of trends	Limited time duration trends available in DCS	Long time duration trends available in data PARC
2	Analysis of problems	Limited tools are there in DCS	There are many tools available in data PARC for problem analysis like histogram, centreline, tabular, pareto, X-Y plot etc.
3	Trends Time span	Only one second time span trends is there in DCS.	We can capture millisecond trends in data PARC.
4	Multiple trends availability.	Only limited trends in a tab	Multiple trends are there in data PARC.
5	Multiple trends tab in a page	Only single trend tab in a page in DCS	Multiple trends tab available in a single page.
6	Remote Monitoring	Remote monitoring is not available.	Remote monitoring is available.
7	Single point of monitoring	We can check only single location parameters.	We can monitor all areas parameters in data PARC.

Guidance of: Mr. Sushil Khetan & Mr. MN Reddy