AKXA TECH PVT. LTD.

"Energy Efficiency Optimization by Reducing Process Fluctuations"

No/Low CAPEX approach for KPI improvement

–Steel Plant Case Studies

www.akxatech.com
contact@akxatech.com
+91-9243209569

About AKXA

COMPANY

Research Driven, Result Oriented, Technocrat Promoted, Founded in 2016, part of 11+ MUSD Group.

(25+ person years of R&D on process performance enhancement techniques & tools)

TEAM

Qualified, Widely Experienced Multi-disciplinary Team of PhDs and Engineers

(100+ person years combined experience in local & overseas companies, optimization projects)

OFFERING

High end Data Analytics, Decision Support, Performance Enhancement Products & Services

(Data driven, AI Algorithm based, Process Monitoring / Diagnosis / Optimization, IoT Tools)

CLIENTS

Tested, Proven and Well Appreciated by Continuous Process Industries

(20+ domestic & international clients, 8 different sectors, 10+ Countries)

Recognized as Innovative Product

Approved by GoI (DIPP 2649)

Collaboration with IIT Madras

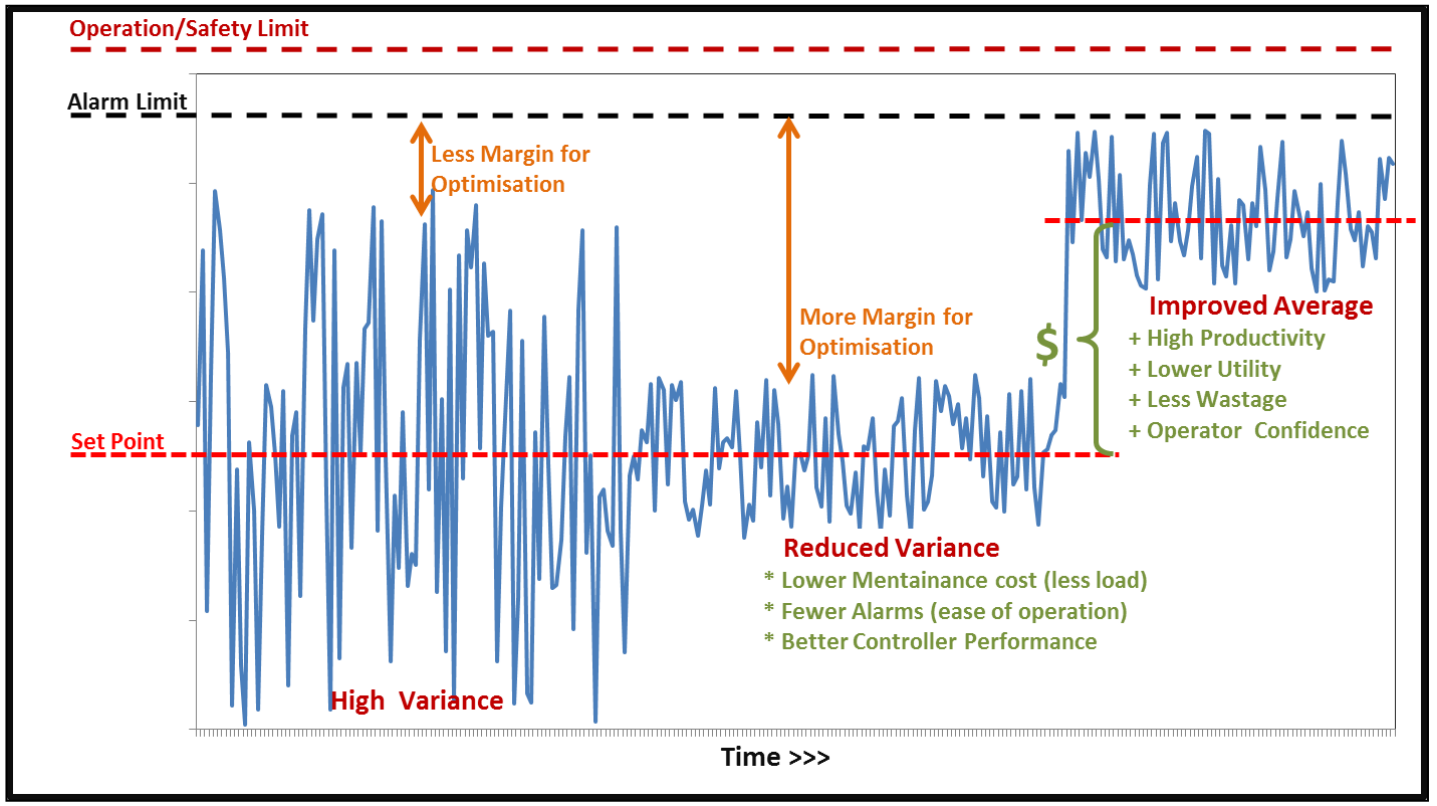
Promoted by (35+ yrs of Engg. Service)

Key Focus Areas for Process Industry

REDUCE fluctuations >> CREATE margins >> OPTIMIZE processes

(with ZERO or MINIMAL CAPEX)

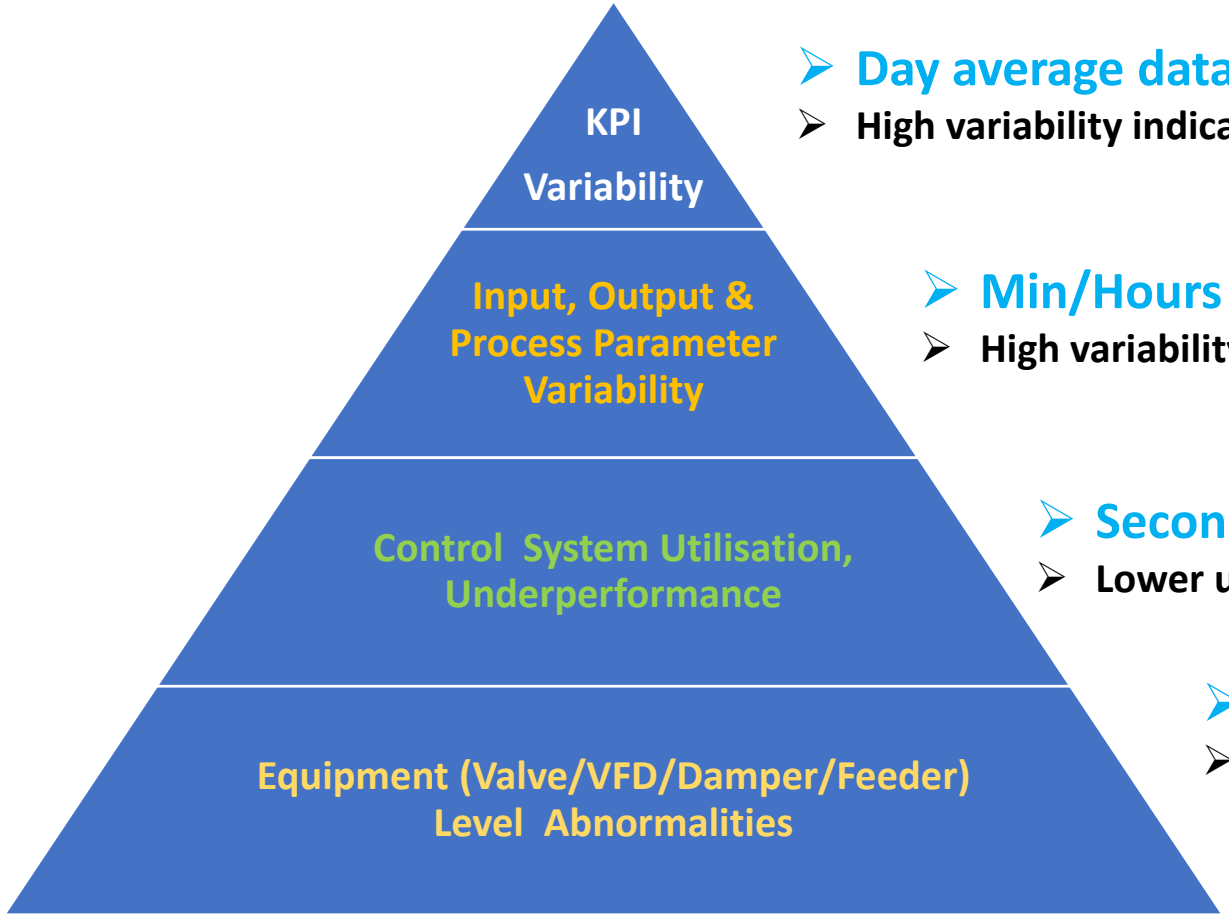
High Variance → **Inconsistent KPI** → **Less confidence**



FLUCTUATIONS LIMIT EFFICIENCY

Solution Approach

:: FLUCTUATION AUDIT / ASSESSMENT APPROACH ::



- **Day average data** for Key Performance Indicators
- High variability indicates gaps/scope for improvement

- **Min/Hours scale data** for major I/O & process parameters
- High variability gives confidence for further checks

- **Seconds scale data** for PV/SP/OP variables
- Lower utilisation, underperformance establishes reasons

- **Seconds scale data** for Valves/VFD/Dampers
- Control Equipment Limitations, non-linearity and abnormal responses are detected

ALL CONTINUOUS PROCESS | OEM AGNOSTIC | DIFFERENT TIME and SPACE SCALES | STANDARDISED APPROACH | MULTIVARIATE ANALYSIS

Products and Service Offerings

Harnessing Data >> Extracting Knowledge >> Creating Value

PRODUCTS AND SERVICES

- Process Monitoring
- Process Control
- Process Optimisation

MONITORING

- Process Variability
- Controller Performance
- Equipment Health
- Sensor Analysis

CONTROLLING

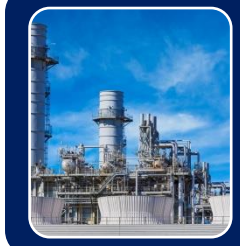
- PID Tuning
- Feed Forward Logic
- Smart Combustion Control
- Supervisory control

OPTIMIZING

- Productivity
- Energy Efficiency
- Equipment Reliability
- Quality Consistency

SUSTAINABLE SOLUTIONS

- Energy Efficiency
- Productivity improvement
- Quality consistency
- Equipment reliability



INDUSTRY FOCUS

- Continuous process plants
- Process utility equipment
- Data analytics + IoT solutions

INDUSTRIES / PROCESS PLANTS : we can contribute

Services and Automated Decision Support Tools for

Productivity Optimisation, Energy Efficiency Enhancement and Quality Consistency

CEMENT, MINERAL & METAL PROCESSING

FERTILIZER & PESTICIDE, PHARMA

PULP PROCESSING & PAPER / BOARDS

GLASS & CERAMICS

POWER PLANTS CAPTIVE / CO-GEN

ANY CONTINUOUS PROCESS PLANT

10+
Analytics & IoT products

5
Core Industrial Sectors

10+
Countries

150+
Plants Served

450+
Assets Investigated

~10%
Energy Savings Achieved

vedanta
transforming elements

JSW Steel

Coromandel
FUTURE POSITIVE

UltraTech CEMENT

ITC Limited

SAINT-GOBAIN

TITAN CEMENT GROUP
Europe/US

DANGOTE
Africa

INTERNATIONAL PAPER

Binani 3B the fibreglass company
BRAJ BINANI GROUP

ACC

VICAT

INSEE
SEA, Srilanka

Cipla

FUJAIRAH CEMENT INDUSTRIES

Significant contributions of AKXA – STEEL PLANT and Utilities

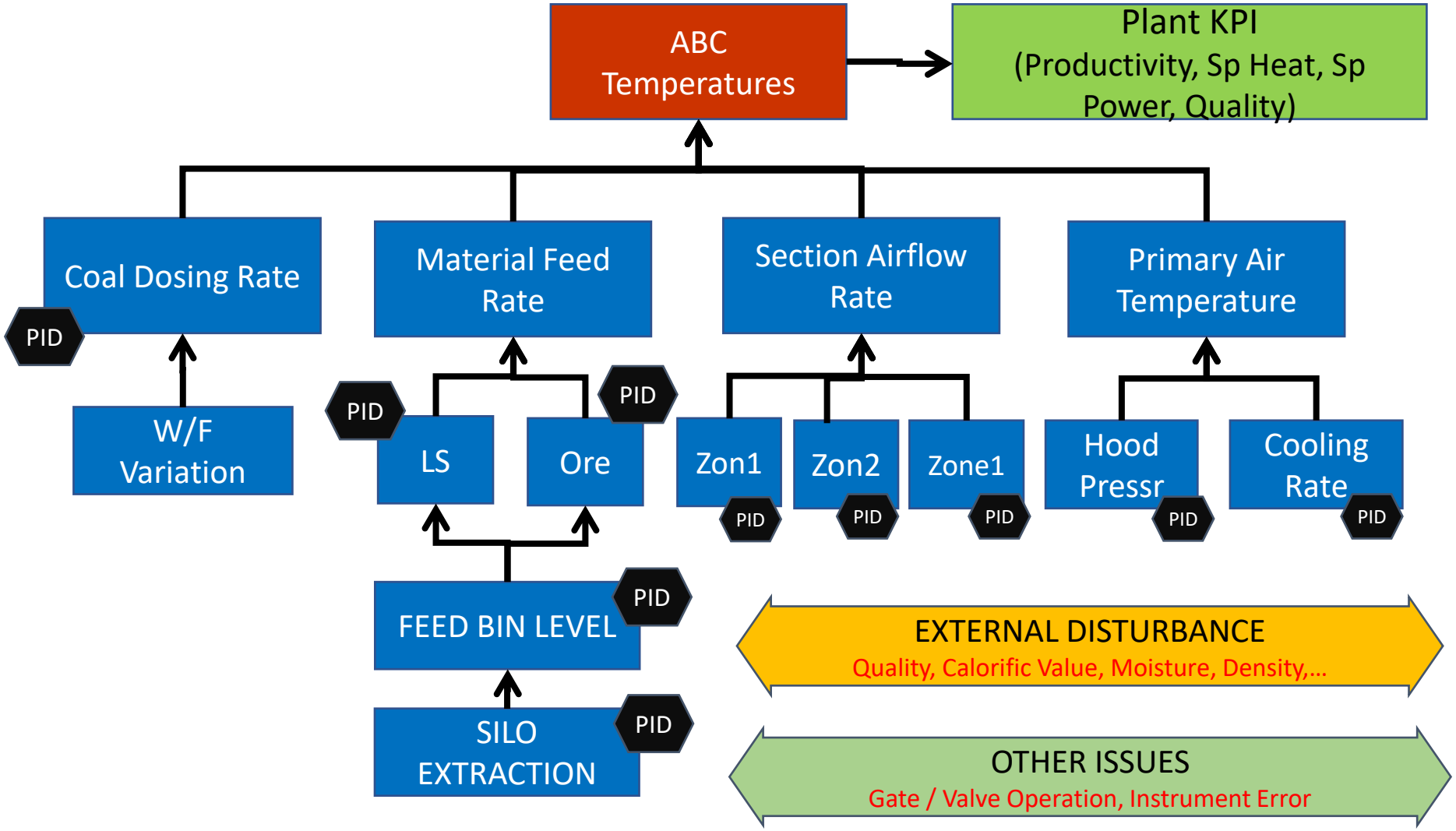
AREA	ASSESSMENT / DIAGNOSIS & OPTIMISATION FOR	Expected BENEFITS
Kiln, PIG Iron, SID, GMS Section	• Raw Mix Feeding (Weigh Feeder Variability) • Coal/Coke Feeding variability • Kiln Outlet draft/temperature regulation.. • Waste Heat Distribution System Variation	• 10-25% reduction in fluctuations • Enhanced TPH / reduced Sp. Power • Quality Consistency • 1% reduction in BFG flaring.
Waste Heat Recovery (CPP)	• Feed Gas Temperature fluctuations. • **Drum Level** fluctuation (Two or Three Element Operation). • Zone wise (Attemptator) Temperature control • **Primary, Secondary Air and ID Fan operation.** • Boiler Feed Pump Operation.	• Stable Burning • Higher Steam throughput • Stable Emissions
Turbine House and Auxiliaries	• Condensate Level regulation • Steam pressure fluctuations • Cooling Tower Flow/Pressure regulation.	• Lower Pressure shocks • Stable Levels • Higher efficiency.
General Equipment	• Stiction in Fan Dampers, **Actuators**, Valves • Sluggishness in **Weigh feeders**, Solid Flow Meters • Abnormal **VFD** operation in motors	• Preventive Mentainance • Improved Equipment Efficiency & Life
Refractory Management	• **Refractory Management by AKXA Tech digitCHECK tool** • **Intensive Areas like** Blast Furnace, CONARC FURNACE , STEEL LADLE, TORPEDOES,CAST HOUSE, HOT METAL LADLE etc.	• Generates alarm in case of deviation • Component Tracking & its location • Capture the equipment condition

IMPACT OF OPTIMakx ® + deltAKX ® INTERVENTION (no CAPEX required)

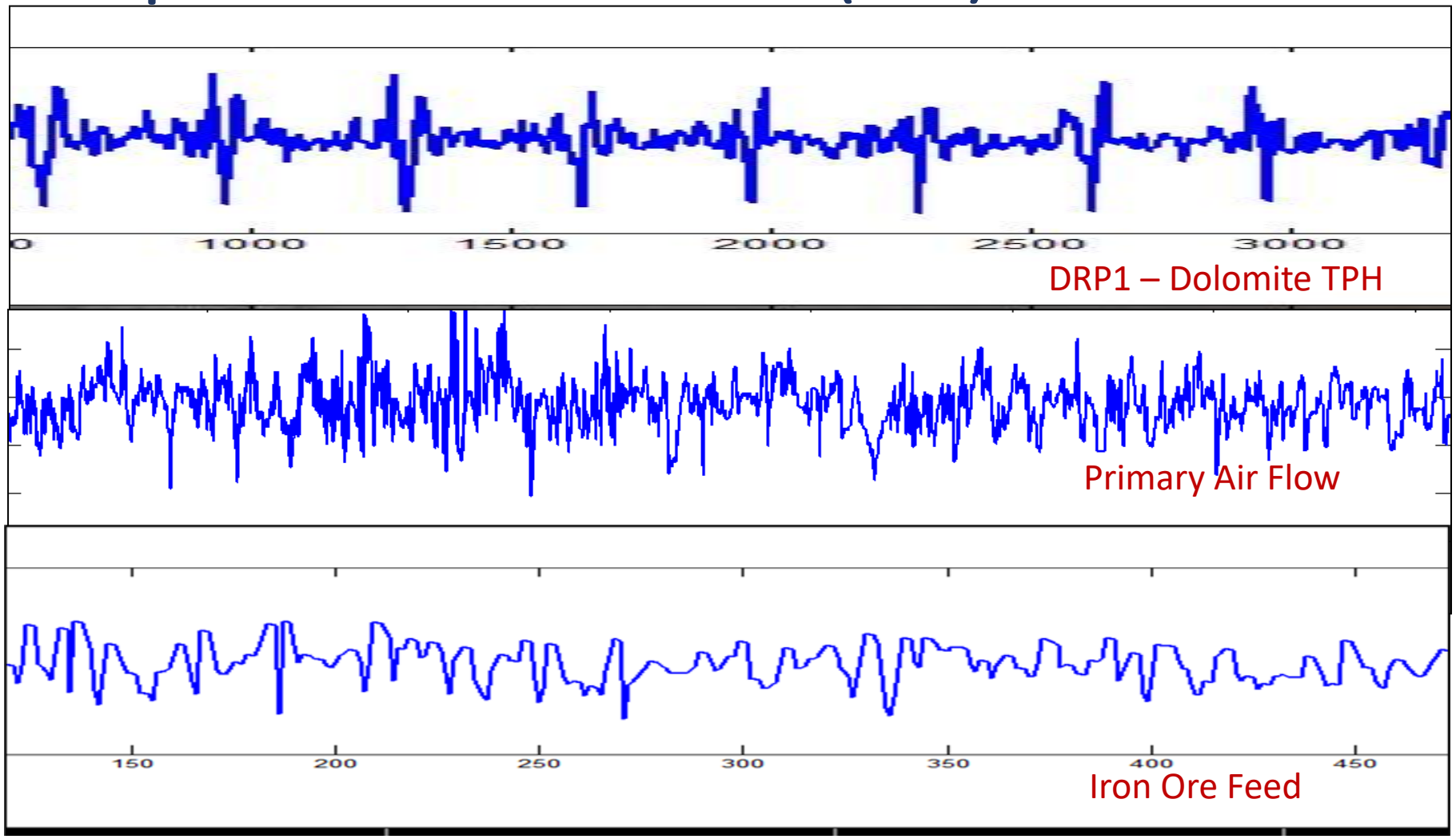
SECTOR/AREA	CASE ESTABLISHED	IMPACT
Gas Mixing Station	Auto Utilisation increased to 100% and COG, BFG and MG Pressure variation reduced by more than 30%	**1% reduction in Flaring Gas 74,000 MJ/day ,~ USD 53,000/Yr**
POWER Plants /BOILER	1% Reduction in Heat Rate ~ Fuel consumed/Unit Power	***Fuel Saving Co-Gen Plant lower CO2 emission***
Oxygen/Nitrogen Plants	4% increase in Purity + Lower Utility consumption	***USD 2,00,000 /Yr Savings : for 20 TPD gas plant***
Compressors /VFD	15% lower Electricity + Lower Pressure Variation	***~ USD 20,000 /Yr for Typical 1000 CFM compressor***
Process Plant CONTROLS	25% Reduction in Process Variability and Response Time	***5 to 10% Energy Saving @ Pay Back Period < ONE YEAR***

Case Studies

Plant Wide Fluctuations – Audit Work – Steel Sector



Sample Variations in DRI (SID) section

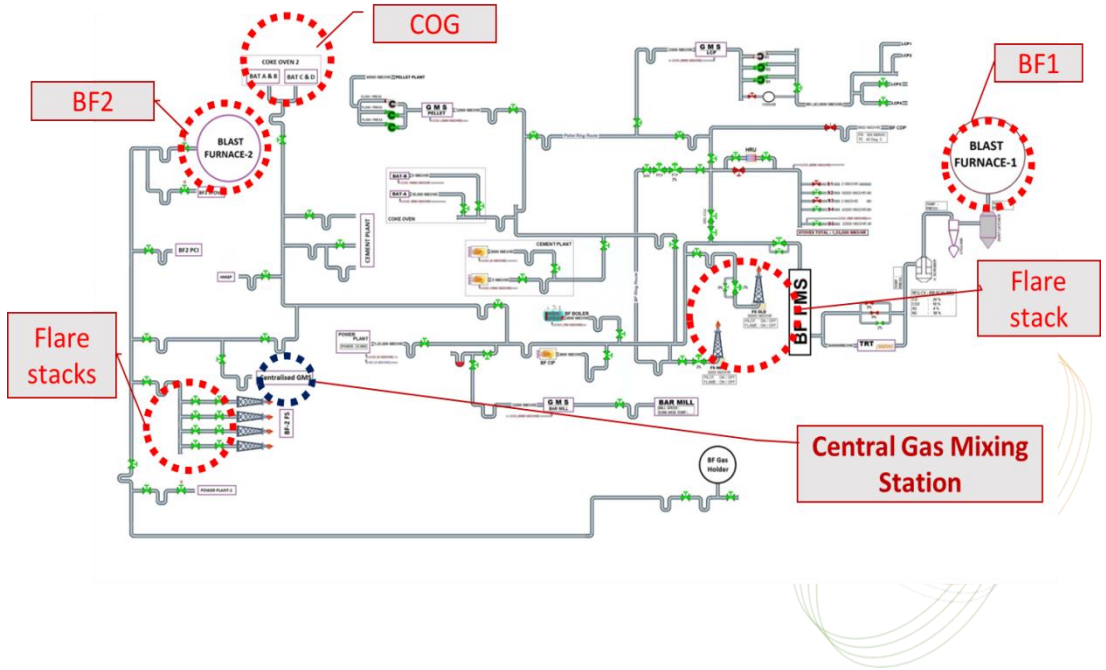


In INPUT parameters >> beyond benchmark
(feeder and fan VFD optimisation required)

Scope to reduce variability >> 20 to 25%
Potential impact >> 3 to 5% reduction in SHC/SEC

Case Study 1: “Process Fluctuation Assessment and Control System Optimization of Gas Mixing Station at Steel Plant”.

Steel Plant : BFG,COG and Gas Mixing Station Network



Input Disturbances to Central Gas Mixing Station>> which are coming from BF1 and BF2 ,Coke Oven Gas generation ,BF1 and BF2 Stoves operation and BFG stacks Flaring .

TOOL Used: OPTIMakx® - PID (version 5.2) – off line assessment

Overall Observation:

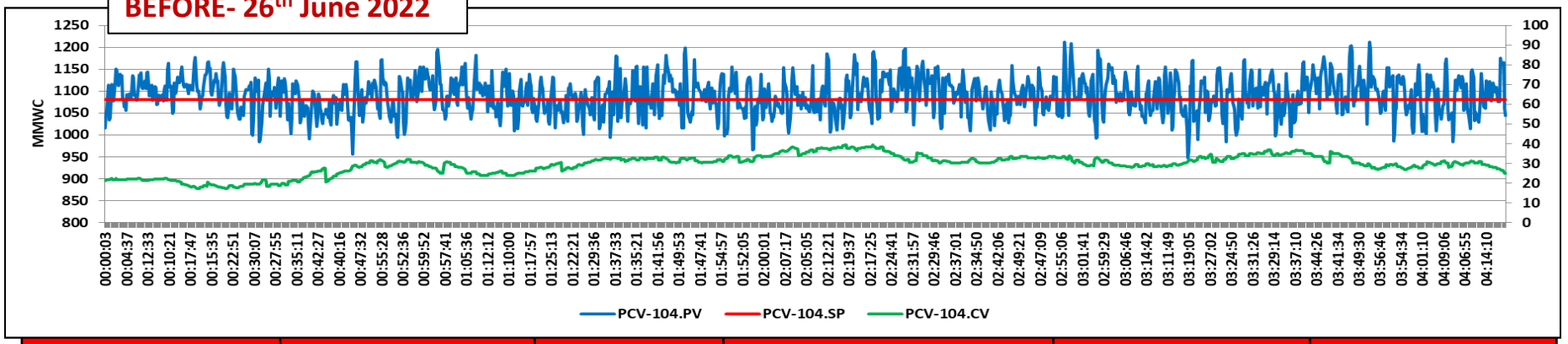
- **Abnormal Fluctuations** : in all key variables (Blast Furnaces gas (BFG) pressure, Gas Mixing Station (GMS) flow, pressure, quality (Calorific Value.)
- **Repeating Patterns** : that can be assigned to identifiable root cause (BFG disturbances)
- **Low AUTO Asset Utilisation** : Key control loops are in MANUAL, responses are sluggish

Actions Taken ::

- Taking all critical PID loops in AUTO mode
- Data collection (PV/SP/OP) using digitEYES tool – 1 sec interval for 14 hrs.
- **Root cause assessment for PID abnormality** (using different measures like controller error, output stagnation index, out of control %, control element travel index etc using OPTIMakx)
- Detection of issues like PID tuning, control valve sluggishness, external disturbance –etc
- PID tuning activity for optimising AUTO PID performance
- PV filter implementation to avoid external disturbances coming from BF gas input
- Remote monitoring and Review of PID performance for sustenance
- Suggested Feed Forward logic for further optimisation of the system

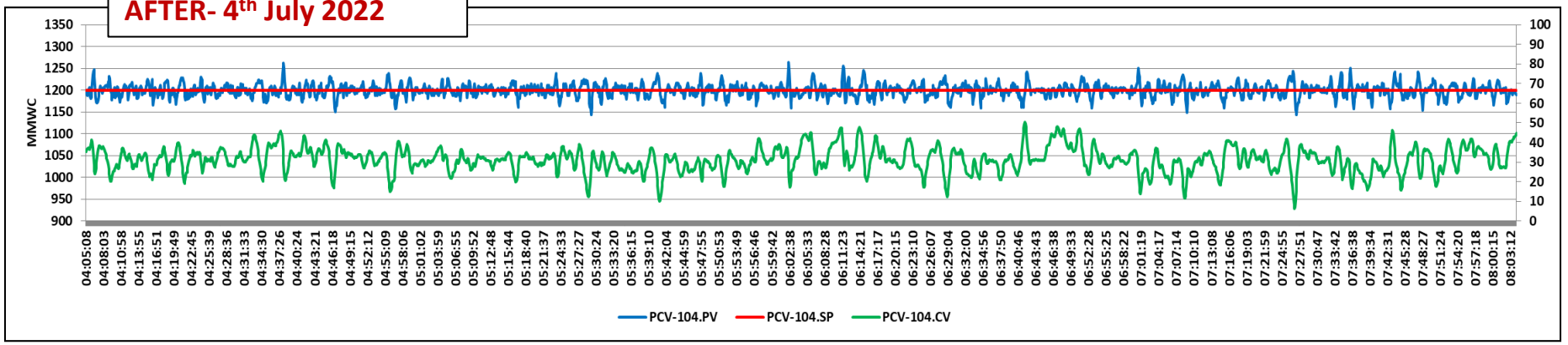
Central Gas Mixing Station – Coke Oven Gas Pressure control performance

BEFORE- 26th June 2022



Controller	Diagnosis	Avg.Abs.Err.%	OP Stagnant.Idx %	Overshoot %	Out of Control %
COG Pressure	Sluggish Tuning	3.30	90	8.3	80

AFTER- 4th July 2022



Controller	Diagnosis	Avg.Abs.Err.%	OP Stagnant.Idx %	Overshoot %	Out of Control %
COG Pressure	Not Applicable	0.50	10	1.5	0

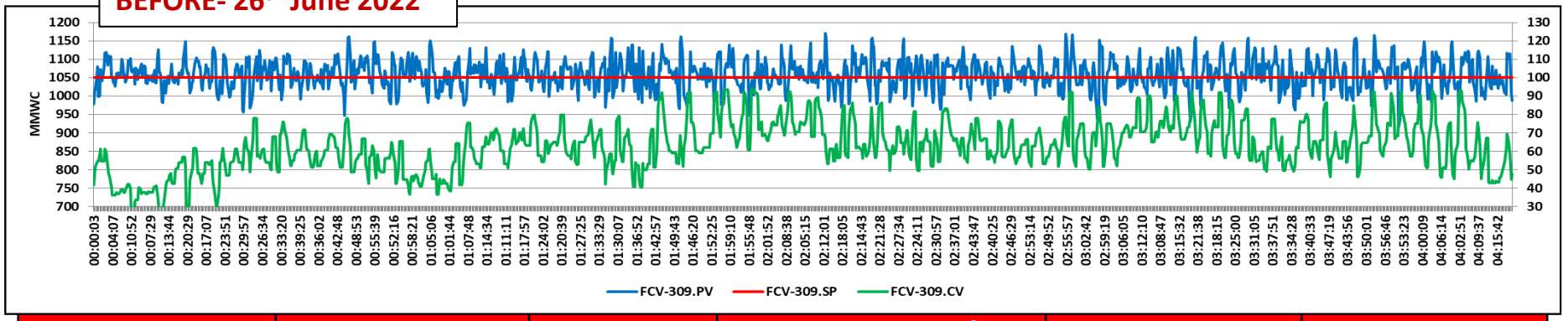
>> Auto Utilisation increased to 100%

>> Coke Oven Gas Pressure variation improved by more than 80% from the Base Case.

IMPACT: Better Process Stability, Consistent Mixed gas pressure and CV

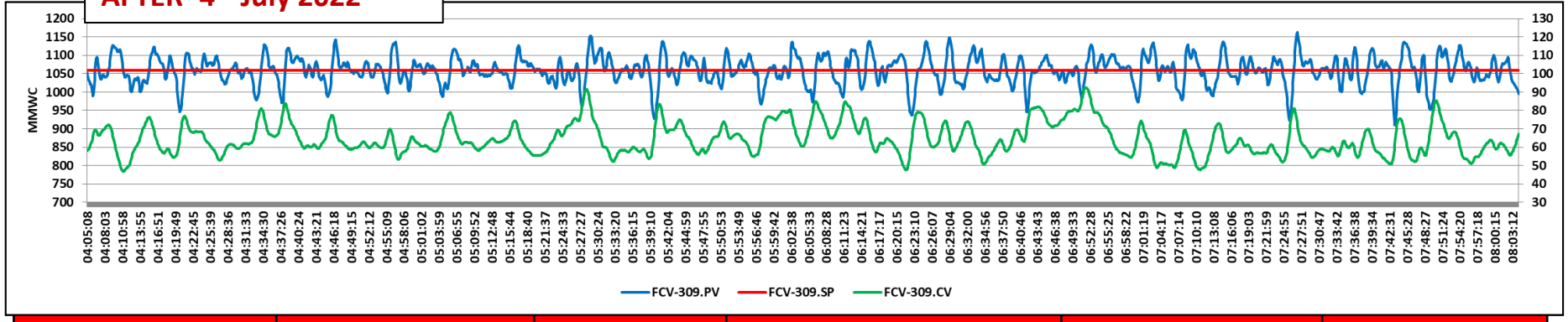
Gas Mixing Station -Mixed Gas Pressure control performance

BEFORE- 26th June 2022



Controller	Diagnosis	Avg.Abs.Err.%	Ctrl.Elem.Travel/hr	Overshoot %	Out of Control %
MG Pressure	Aggressive Tuning	3.70	1182	8.3	63

AFTER- 4th July 2022



Controller	Diagnosis	Avg.Abs.Err.%	Ctrl.Elem.Travel/hr	Overshoot %	Out of Control %
MG Pressure	Not Applicable	2.60	200	3.5	10

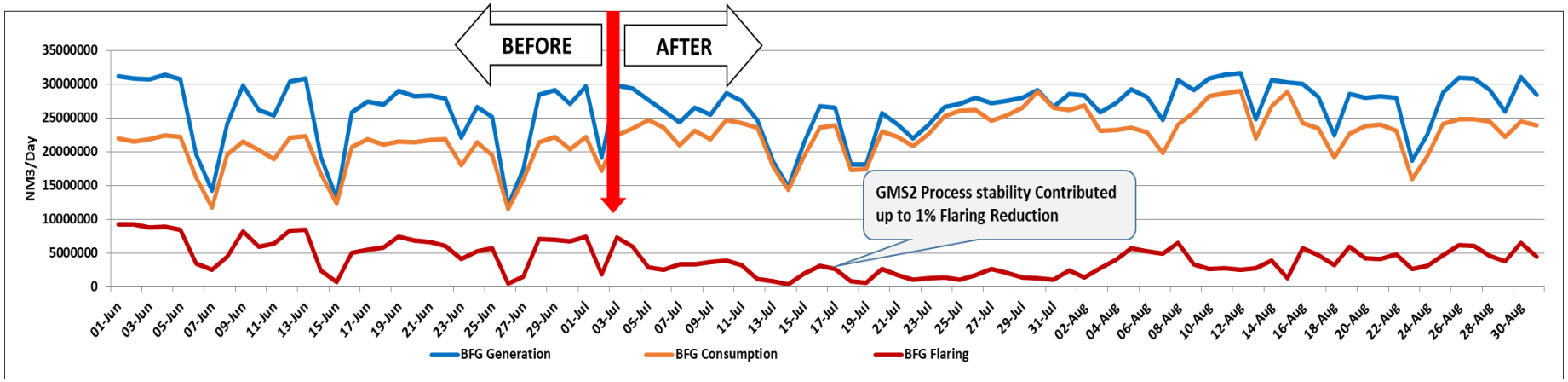
>> Auto Utilisation increased to 100%

>> Mixed Gas Pressure controller Performance Improved by more than 30%

>> Control Valve (2100 mm) Movement Reduced more than 80%

>> IMPACT: * Process Stability for optimum down stream operation, Improved Control Valve Health

Overall Impact.



Overall Plant KPI Data						
Flaring Results	BEFORE (6st June to 26th June,2022)			AFTER (3rd July to 22nd July,2022)		
	Average	Std. Dev	Variability%	Average	Std. Dev	Variability%
BFG Generation(NM3/day)	2,44,14,202	5637820	23.09	2,40,51,670	42,29,464	17.58
BFG Consumption(NM3/day)	1,91,71,809	3497058	18.24	2,14,10,109	29,88,186	13.96
BFG Flaring(NM3/day)	52,42,393			26,41,562		

Centralised GMS KPI Data								
Productivity Improved	BEFORE (6st June to 26thJune)			AFTER (3rd July to 22nd July)			Impact on Gas Vol.	% Increase
	Average	Std. Devi	Variability%	Average	Std. Dev	Variability%		
BFG (Nm3/day)	15,91,717	203885	12.81	16,14,578	1,93,209	11.97	22860	1.44
COG (Nm3/day)	9,64,416	125583	13.02	9,80,361	1,04,012	10.61	15945	1.65
Total MG(Nm3/day)	25,56,134	323441	12.65	25,94,939	2,89,089	11.14	38805	1.52

Overall IMPACT of Optimization activity (long term effect : ~20 days operation).

>> PRDUCTIVITY :: Net increase of additional 22,860 Nm3/day usage in GMS (+1.44%)

>> RECOVERY :: ~1% reduction in Flaring Gas (heat savings) = 74,000 MJ/day >> Rs. 44 Lakh/Yr

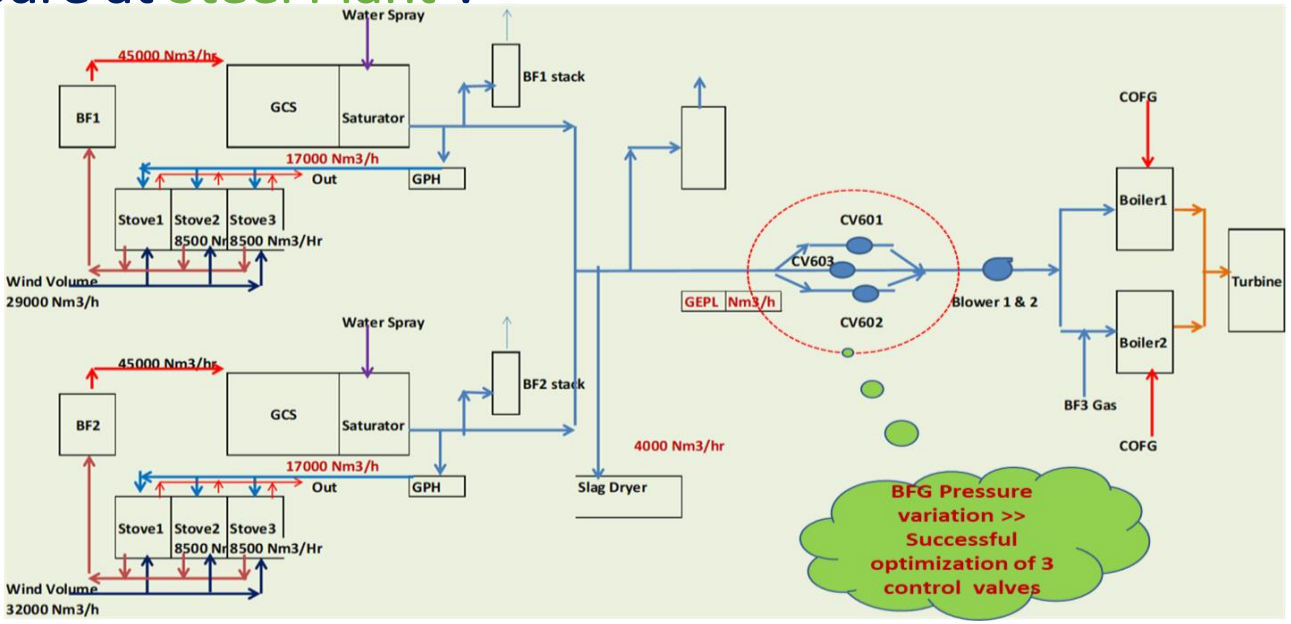
(@3.24 MJ/Nm3 calorific value for BF gas, 250 day/year operation, @ price 0.24 Rs/MJ heat equivalent fuel)

Case Study 2: "Process Fluctuation Assessment and Control System Optimization of Blast Furnace Gas Pressure at Steel Plant".

ISSUE: Continuous fluctuations of BFG line pressure in GEPL line with Variability of 23%.

Data Collection : New Tags were configured in MES system for collect second scale process variable data from BF1, BF2, GEPL and CV 601,602,603 operations.

Data Analysis : Preliminary analysis is done establish the variability in key process input and effect variables (GEPL pressure) and valve operations. Reasons for higher variations are diagnosed



Before Case Data Assessment and Observations:

- Valve Saturation + Manual Mode Issue >> It was observed that most of the time CV601 and CV602 are getting saturated and the biggest valve CV603 is fixed at 60% in manual mode.
- This builds up the GEPL line pressure and ultimately leads to Flaring as the pressure increases – specially during higher gas input from BF1 and BF2 sections.

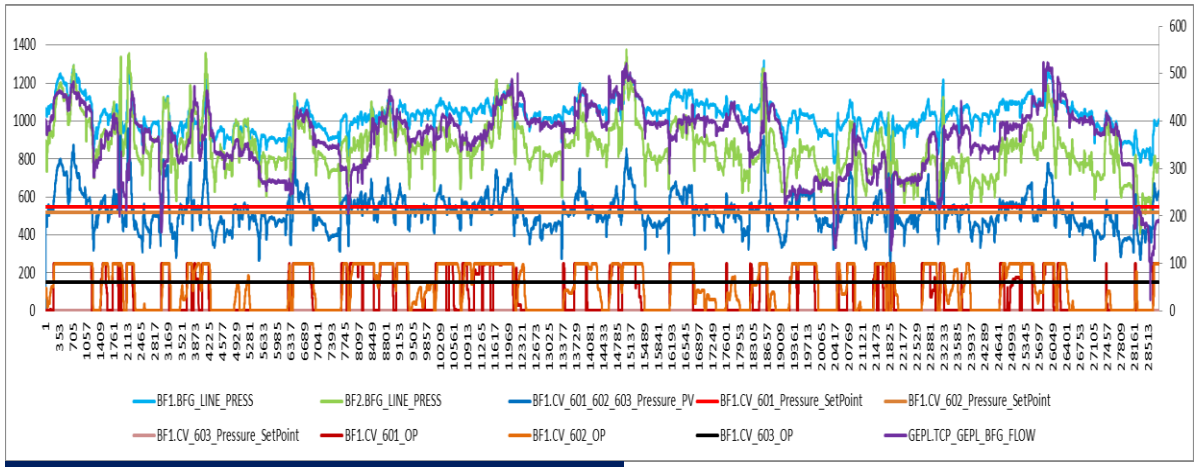
Action Taken : New Logic implemented for CV 603 AUTO operation, All three loops CV601.CV602 and CV603 optimized.

RESULT :

- After Clearance from Vedanta Team for full load operation of the Power plant on 3rd February 2021 performance was observed during GEPL BFG supplying to Power Plant1 with plant running on full load up to 26MW with GEPL flow of 48700 Nm3/Hr .
- Overall GEPL BFG pressure variability has reduced by 41.4%.
  (Base case BFG line pressure Variability was 23% >> reduced to 13.46%)

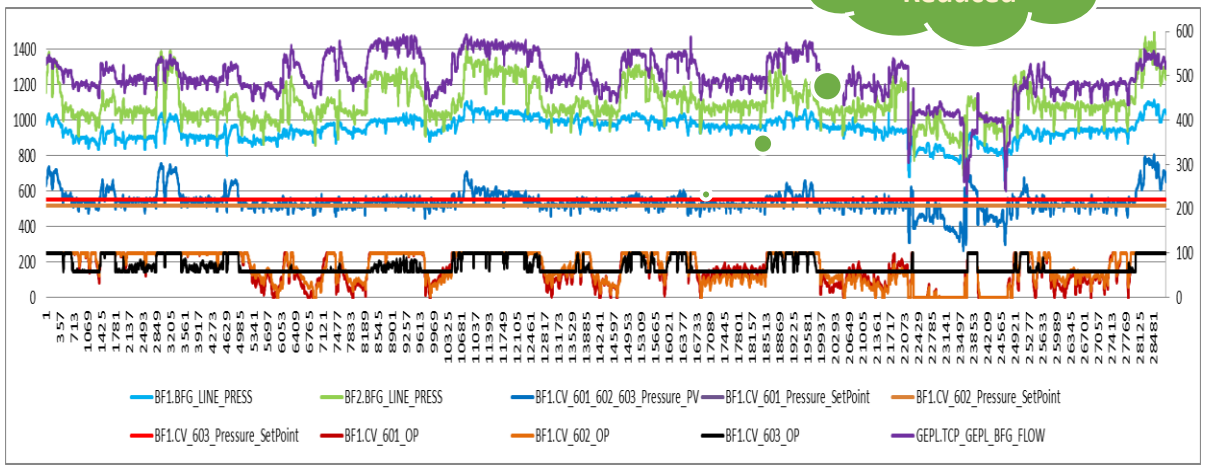
Before/After BFG Line pressure controllers and Flare Stacks Valves performance Trends

BEFORE : BASE CASE TREND

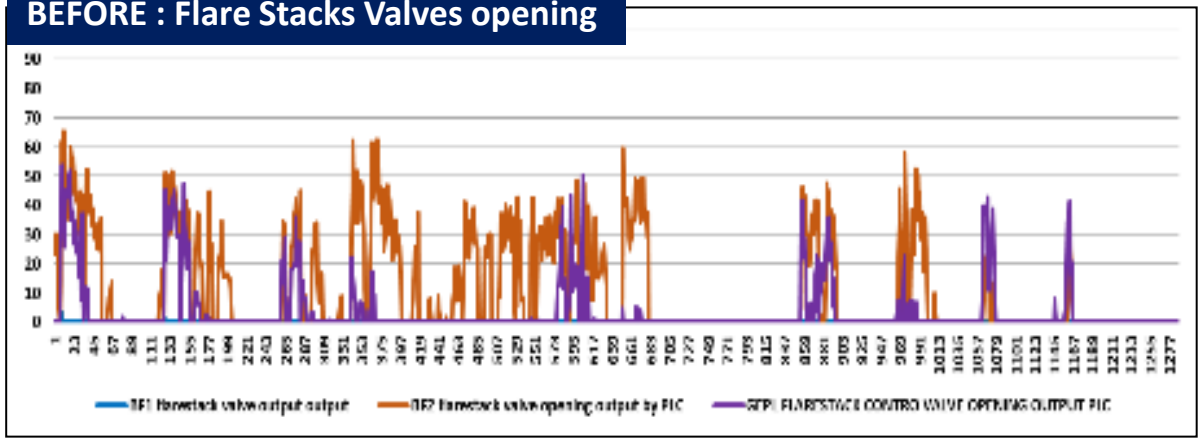


AFTER : TREND

BFG Pressure Variation Reduced

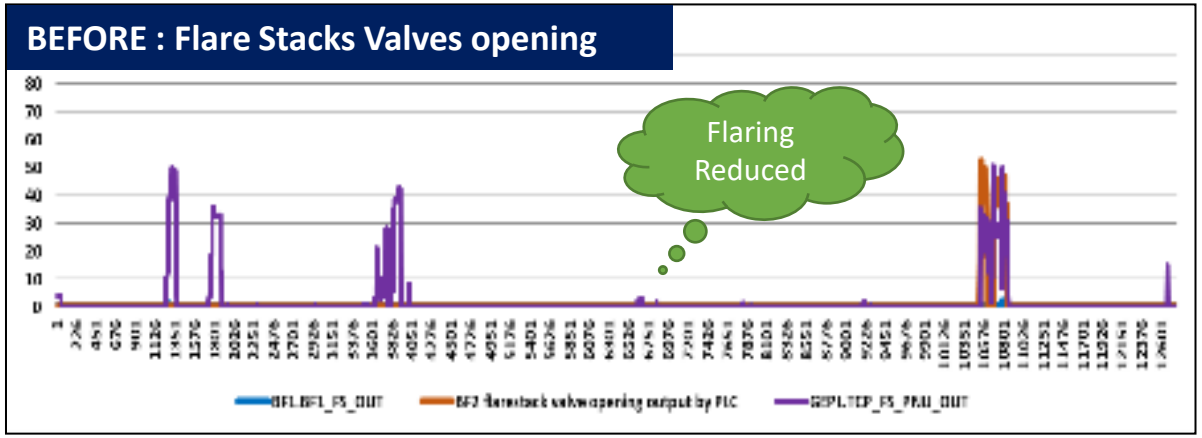


BEFORE : Flare Stacks Valves opening



BEFORE : Flare Stacks Valves opening

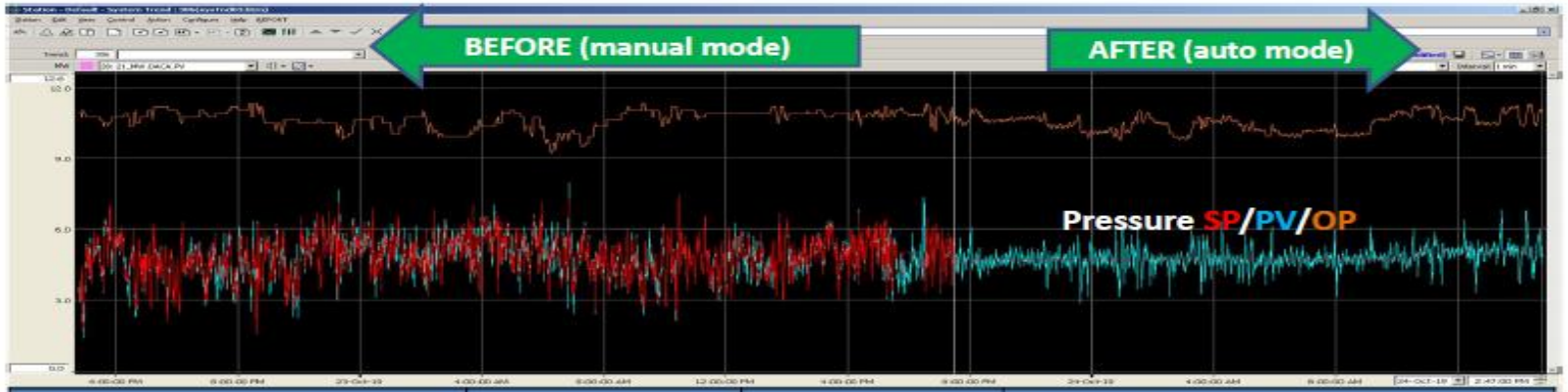
Flaring Reduced



Continuous Operation of Control valves 601,602 and 603 as per New logic reduced the BFG pressure Variability to 13.46 % (from Base Case of 23%)

Case Study 3 – Boiler Operation : Optimization

- Boiler draft control AUTO optimisation
- Excess oxygen regulation optimisation
- Steam pressure variability reduction

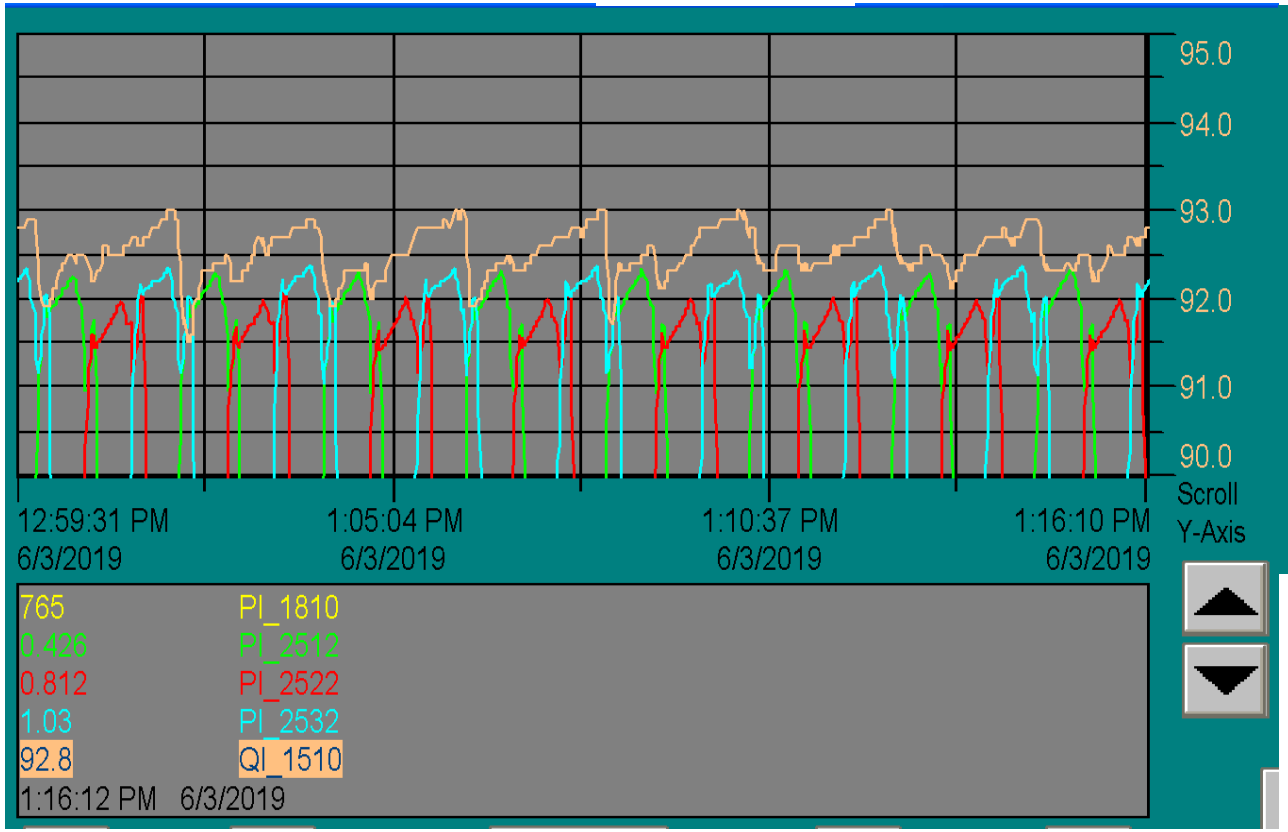


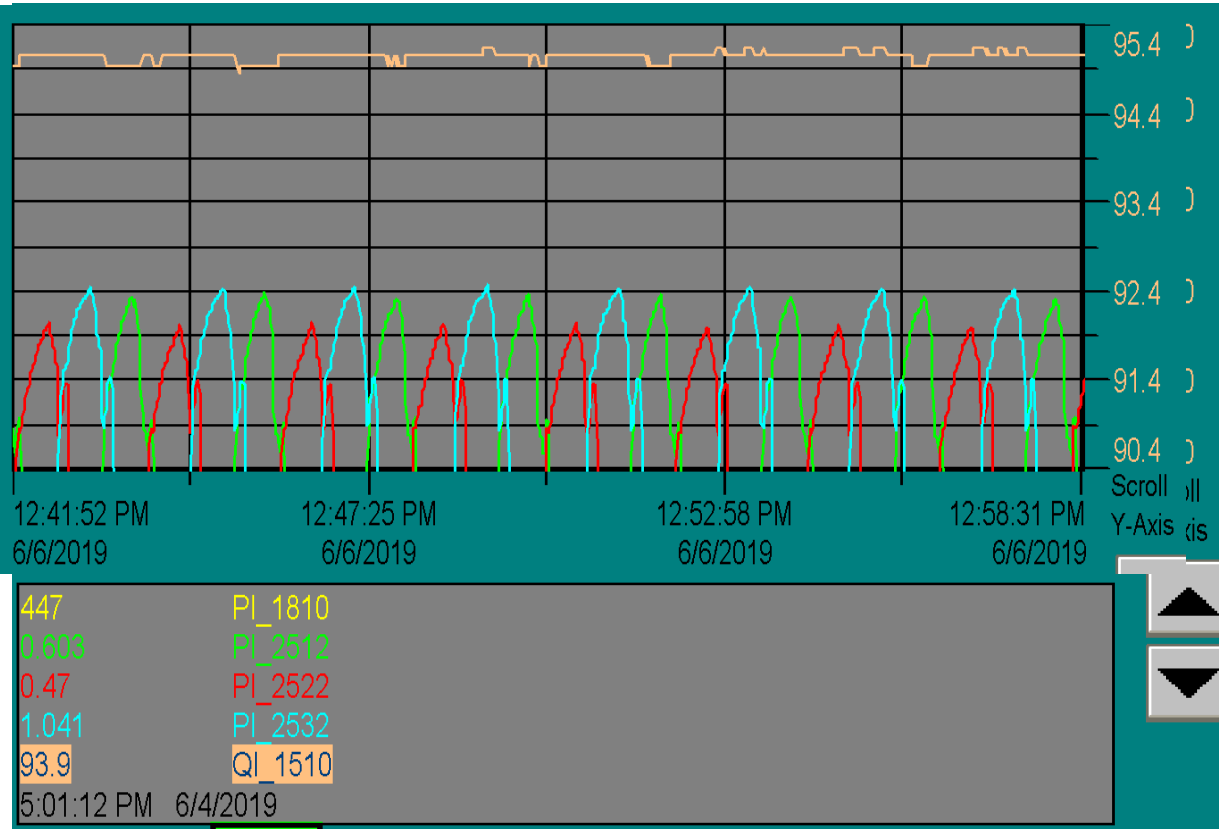
Parameter	BEFORE	AFTER	Remarks
Observation Period	24 hrs	20 hrs	23rd Oct 7pm to 24th 3pm
PID status	Fully Manual	100% AUTO	Settings Tuned(P = 3.5,I = 1,D=0)
Pressure (AVG, SD, Variability)	-2.39, ±1.3, **57%**	-2.25, ±0.7, **29%**	~50% reduction in variability
Avg. Controller Error %	40.8 %	18.25 %	Stable in AUTO, Benchmark (20%)
Positive Pressure Counts	31 (2.7% of time)	5 (0.4% of time)	More confidence, SP lowered to -2, OP limits increased (60 -85%)

- 8% reduction AUXILIARY POWER
- Upto 15 kCal/unit heat rate reduction

Case Study 4: Oxygen Plant Trouble Shooting : O_2 Purity Improvement....

BEFORE → **AFTER**

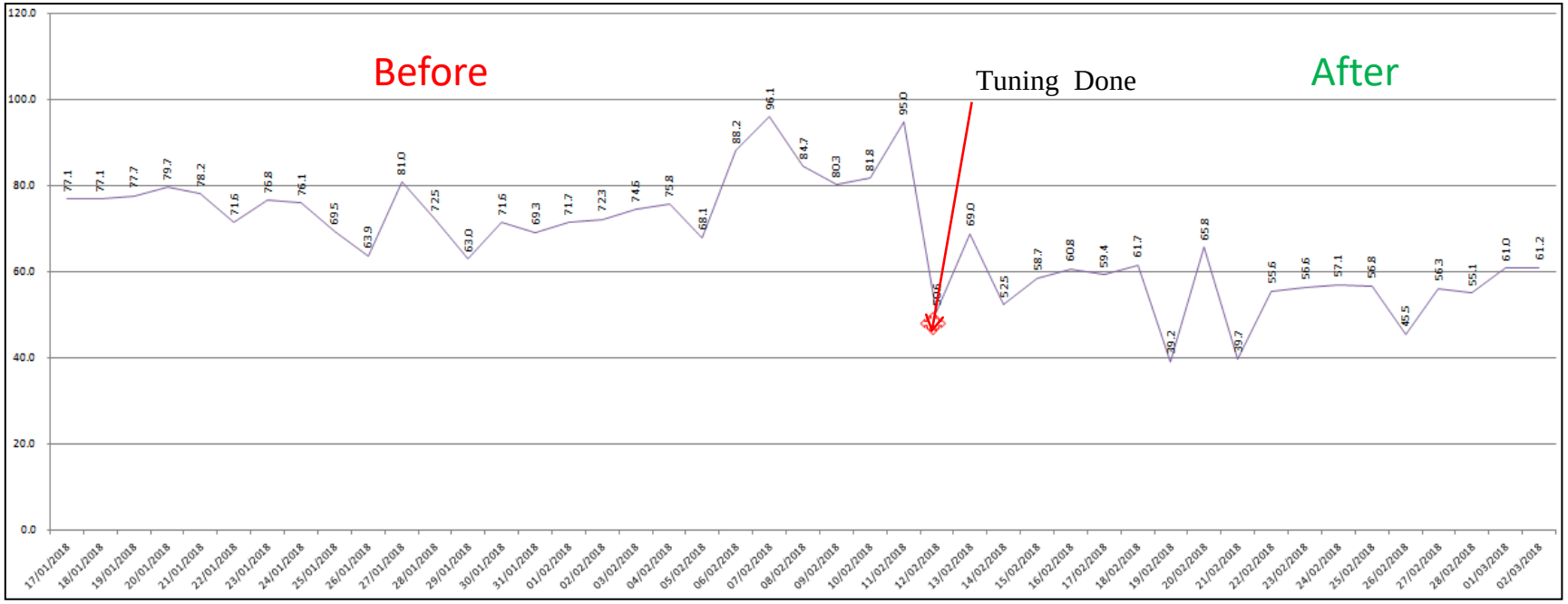




Impact / Benefit	Units	BEFORE (base Case)	AFTER (>90 days avg.)	REMARKS
Average Oxygen Gas purity	%	92.5	95.2	93.5 Required
External Liquid O_2 consumption	Nm^3 / day	4400	800	>85% reduction
Nearly Rs. 50,000/day saving, ZERO CAPEX				

Case Study 5 – Effect of VFD setting Optimization for Compressor

Day average Motor Load (kW) (Before & After) : trend over 1 month



17% Lower kW @ 90 kW compressor >> 300-350 units/day

(SIMILAR OUTCOMES ARE POSSIBLE WITH ALL MAJOR VFD Drives in the Plant VFD with Fans, Blowers, Pumps - etc)

OPTIMakx – usage / commercial options

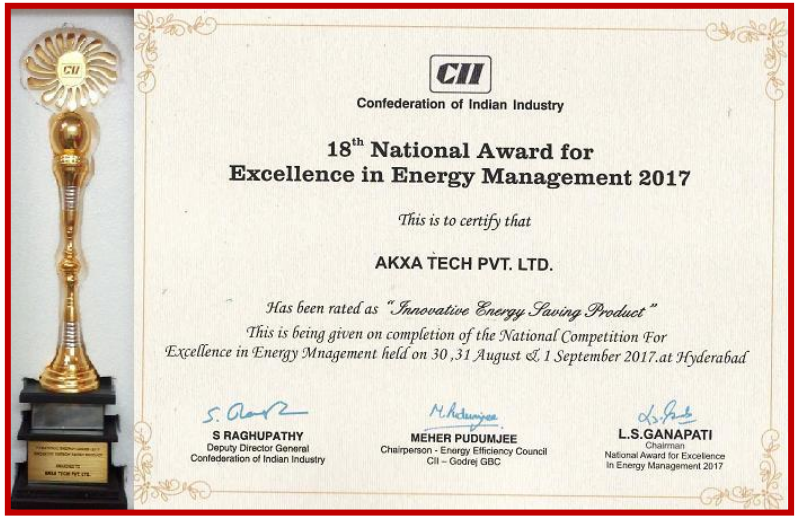
- **TRAINING** (on site, customized workshops, offsite at IITs)
- **AUDIT SERVICES** (site visit, benchmarking, scope identification)
- **ONE TIME OPTIMIZATION** (OTO – OPTIMakx Diagnosis, Fluctuation Mitigation)
- **ANNUAL CONTRACT** (continuous improvement, assured benefits)
- **SUBSCRIPTION** (SAS mode, Remote Access, IoT based Alerts)
- **PRODUCT** (Portable Device, onSite Installation, Corporate Licensing)
- **CASE SPECIFIC PROJECTS** (Troubleshooting, Optimisation, WCM, Industry 4.0, Virtual Sensors, Early Warning Systems, Predictive Models)

THANK YOU

"Give us chance

to bring the BENEFITS of INNOVATIVE CONCEPT and DATA ANALYTICS TECHNOLOGY

to your PROCESS PLANT.."



CONTACT:

Dr. Raghuraj K. Rao
Head - Technical Services
email : raghuraj.rao@akxatech.com
Call : +91-9243209569

Mr. Nagesh Nayak
Business Development Head
nagesh.nayak@akxatech.com
+91- 9320266009

Mr. Bhairu Lohar
Sr.Manager- Technical Services
bhairu.lohar@akxatech.com
+91- 8446439797