



A Maharatna Company

CC EOC

Secunderabad

Advanced control & automation in power sector -Raj Seth, DGM (Project Engineering-C&I)



Role of Advanced control & automation



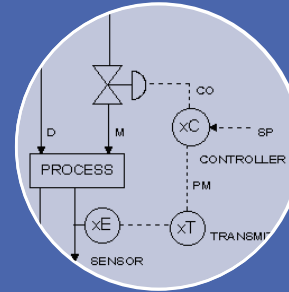
Advanced control & automation in NTPC



Flexible operation



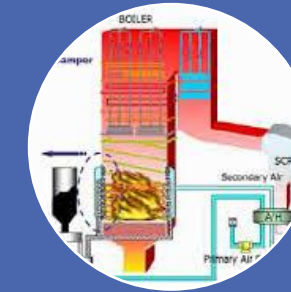
Grid security through improved frequency control



Improved plant O&M
Reducing lifecycle cost



Enhanced Safety & OT
Cybersecurity posture



Improved Productivity



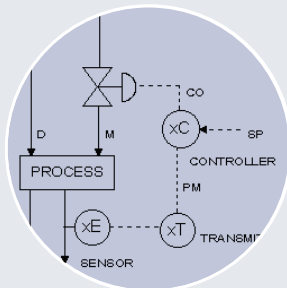
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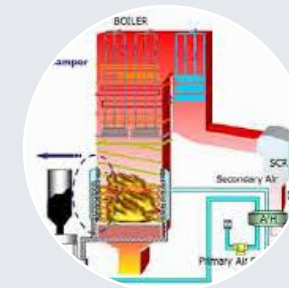
Grid security
through
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Enhanced
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posture



Improved
Productivity

Advanced control & automation



Interfaced with existing DCS

SH/RH temperature control for excursion reduction in modified sliding pressure operation (STO)

Unit control for faster ramp up/ramp down reducing throttle pressure deviations (URO)

Closed loop combustion optimization to improve marginal contribution (CO)

Optimum soot blowing based on heat transfer coefficients & self cleaning factor

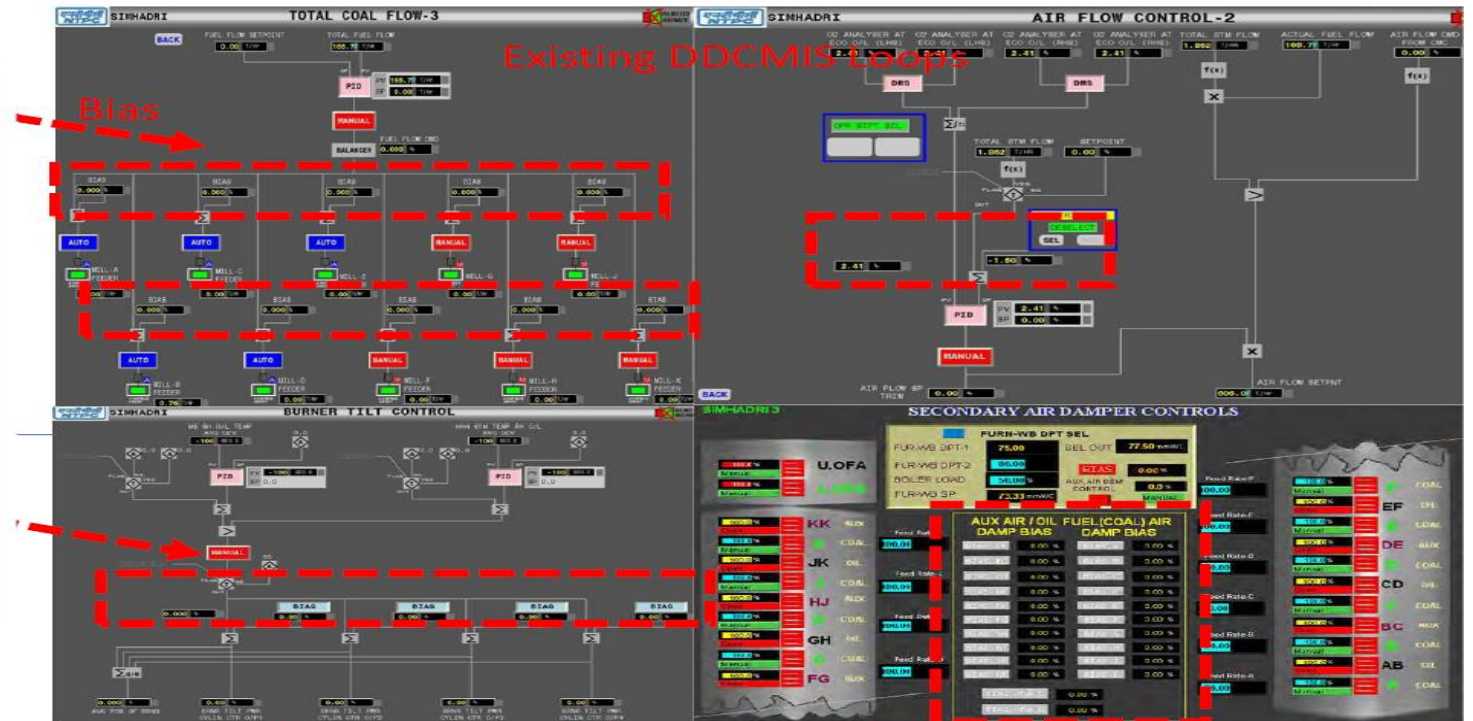
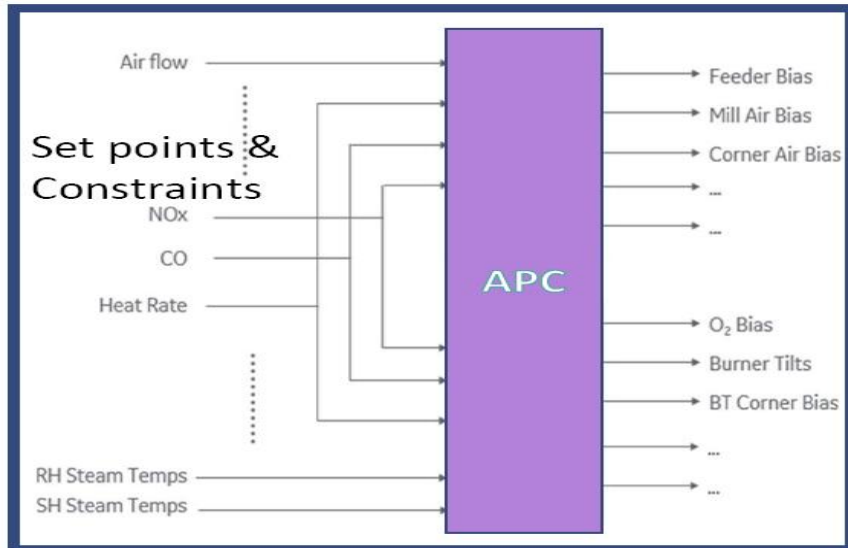
Tighter control of steam temp., pressure,
improved heat rate-
at Simhadri-II (2*500 MW)



Advance Process Control (APC)

- Non-linear process, dynamic behaviour, influenced by multiple unit parameters
- **Steam Temperature Optimizer (STO)**
- **Combustion optimization (CO)**
- **Unit Response Optimization (URO)**
- **Soot blowing optimization (SBO)**
- ✓ Fuzzy logic or Neural network-based controller
- ✓ State-space controller with self-adaptation of internal parameters
- ✓ Generates bias

Advance Process Control



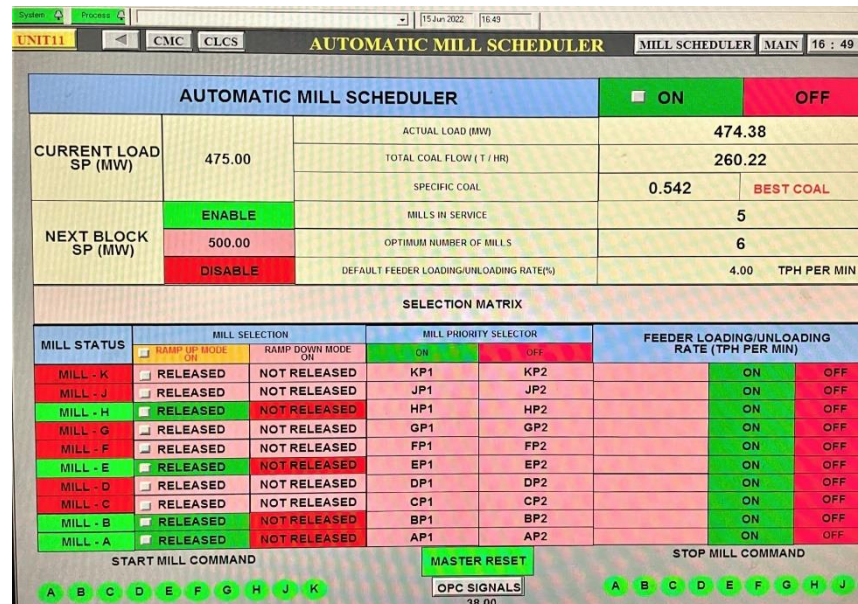
Thermal units Ramping through Automation and Scheduling of mills in Flexible Operation Regime (TRANSFORM)

Objectives of TRANSFORM:

- 1) Automatic selection of mills for start-up/shutdown.
- 2) Automatic start-up/shutdown of coal mills during load ramping operation
- 3) Automatic loading/unloading of feeders at optimum rate

Design aspects:

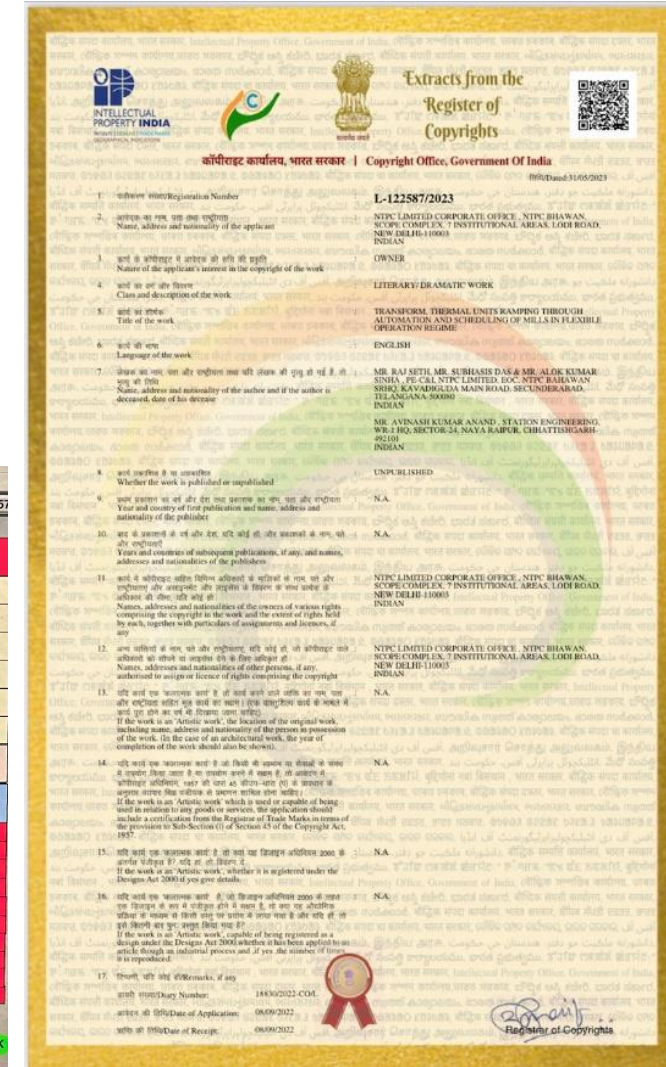
- ✓ Optimum no. of mills for different coal quality
- ✓ Timely cut-in/cut-out of mills.
- ✓ Imitates Best operator actions and intelligence.



CURRENT LOAD SP (MW)		ACTUAL LOAD (MW)	TOTAL COAL FLOW (T / HR)	SPECIFIC COAL
475.00		474.38	260.22	0.542 BEST COAL

NEXT BLOCK SP (MW)		MILLS IN SERVICE	OPTIMUM NUMBER OF MILLS	DEFAULT FEEDER LOADING/UNLOADING RATE(%)
500.00	ENABLE	5	6	4.00 TPH PER MIN
	DISABLE			

MILL STATUS	MILL SELECTION		MILL PRIORITY SELECTOR		FEEDER LOADING/UNLOADING RATE (TPH PER MIN)	
	RAMP UP MODE	RAMP DOWN MODE	ON	OFF	ON	OFF
MILL - K	RELEASED	NOT RELEASED	KP1	KP2	ON	OFF
MILL - J	RELEASED	NOT RELEASED	JP1	JP2	ON	OFF
MILL - H	RELEASED	NOT RELEASED	HP1	HP2	ON	OFF
MILL - G	RELEASED	NOT RELEASED	GP1	GP2	ON	OFF
MILL - F	RELEASED	NOT RELEASED	FP1	FP2	ON	OFF
MILL - E	RELEASED	NOT RELEASED	EP1	EP2	ON	OFF
MILL - D	RELEASED	NOT RELEASED	DP1	DP2	ON	OFF
MILL - C	RELEASED	NOT RELEASED	CP1	CP2	ON	OFF
MILL - B	RELEASED	NOT RELEASED	BP1	BP2	ON	OFF
MILL - A	RELEASED	NOT RELEASED	AP1	AP2	ON	OFF



Extracts from the Register of Copyrights

Copyright Office, Government of India

1. Serial Number/Registration Number: L-122587/2023

2. Author's Name, Address and Nationality of the Applicant: NTPC LIMITED CORPORATE OFFICE, NTPC BHAWAN, SCOPE COMPLEX, INSTITUTIONAL AREAS, LODH ROAD, NEW DELHI-110003, INDIA

3. Nature of the Applicant's Interest in the Copyright of the Work: OWNER

4. Title of the Work: TRANSFORM, THERMAL UNITS RAMPING THROUGH AUTOMATION AND SCHEDULING OF MILLS IN FLEXIBLE OPERATION REGIME

5. Language of the Work: ENGLISH

6. Name, Address and Nationality of the Author and if the Author is deceased, Date of his Decease: MR. RAJ SETHI, MR. SUBHASI DASA & MR. ALOK KUMAR SINGHA, PE-C&I, NTPC LIMITED, LOC, NTPC BAHAWAN, SCOPE COMPLEX, INSTITUTIONAL AREAS, MAIN ROAD, SECUNDERABAD, TELANGANA, 500003, INDIA

7. Name, Address and Nationality of the Person in Possession of the Work: MR. ANVASH KUMAR ANAND, STATION ENGINEERING, WR-1 HQ, SECTOR 24, MAYA RAIPUR, CHHATTISGARH-492101, INDIA

8. Whether the work is published or unpublished: UNPUBLISHED

9. Year and Country of First Publication and Name, Address and Nationality of the Publisher: NA

10. Year and Country of Subsequent Publications, if any, and Name, Address and Nationality of the Publisher: NA

11. Name, Address and Nationality of the Owners of Various Rights Comprising the Copyright in the Work and the Extent of Rights Held by each, together with particulars of assignments and licenses, if any: NTPC LIMITED CORPORATE OFFICE, NTPC BHAWAN, SCOPE COMPLEX, INSTITUTIONAL AREAS, LODH ROAD, NEW DELHI-110003, INDIA

12. Name, Address and Nationality of the Person in Possession of the Work, including Name, Address and Nationality of the Person in Possession of the Work, in the Case of an Architectural Work, the Year of Completion of the Work should also be shown: NTPC LIMITED CORPORATE OFFICE, NTPC BHAWAN, SCOPE COMPLEX, INSTITUTIONAL AREAS, LODH ROAD, NEW DELHI-110003, INDIA

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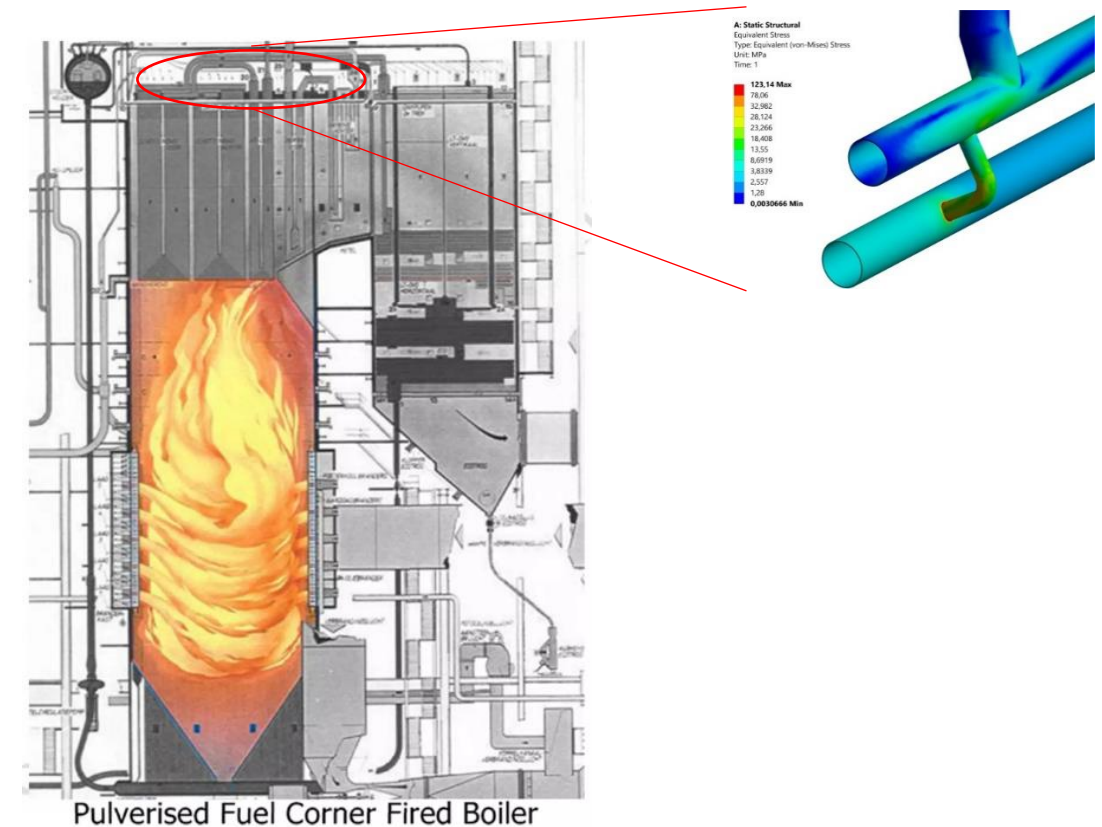
Boiler and Turbine health monitoring system

■ Boiler health monitoring system:

- Assessing boiler's remaining life by accounting for fatigue and creep damage
- Monitoring stress in boiler thick-walled components

■ Equivalent operating hours of turbine:

- Monitors stresses due to startup & shutdowns and load cycling



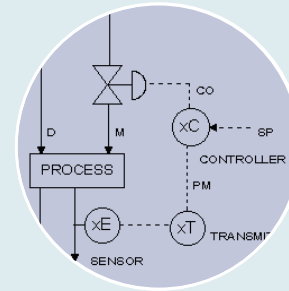
Advanced control & automation in NTPC



Flexible
operation



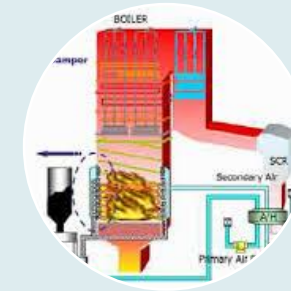
Grid security
through
improved
frequency
control



Improved
plant O&M
Reducing
lifecycle cost



Enhanced
Safety & OT
Cybersecurity
posture



Improved
Productivity

Advanced control & automation

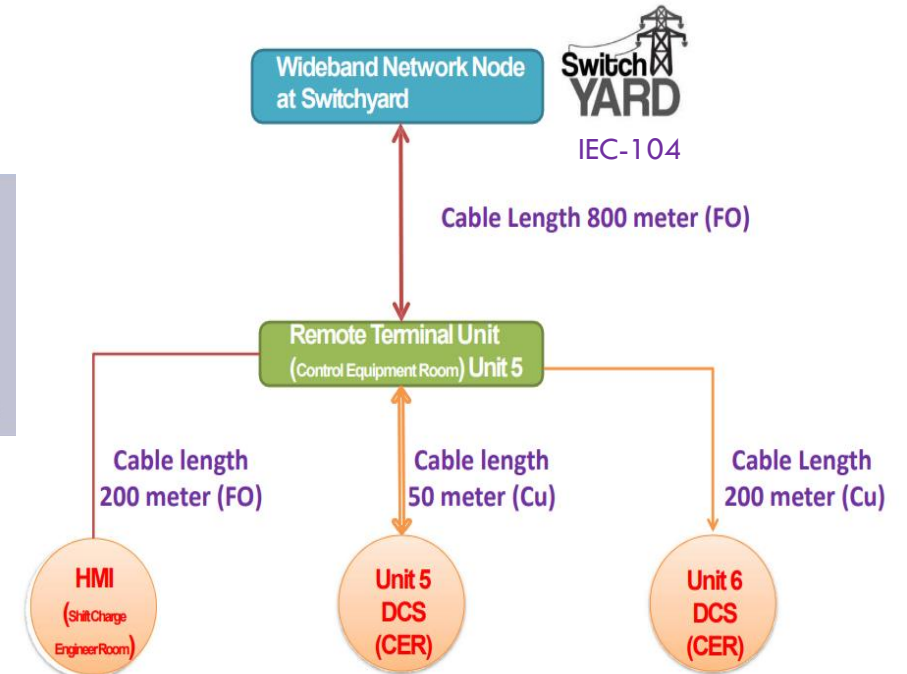
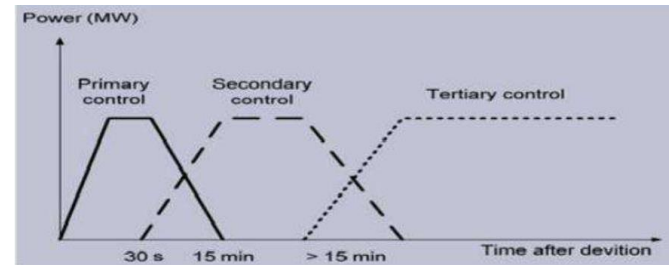
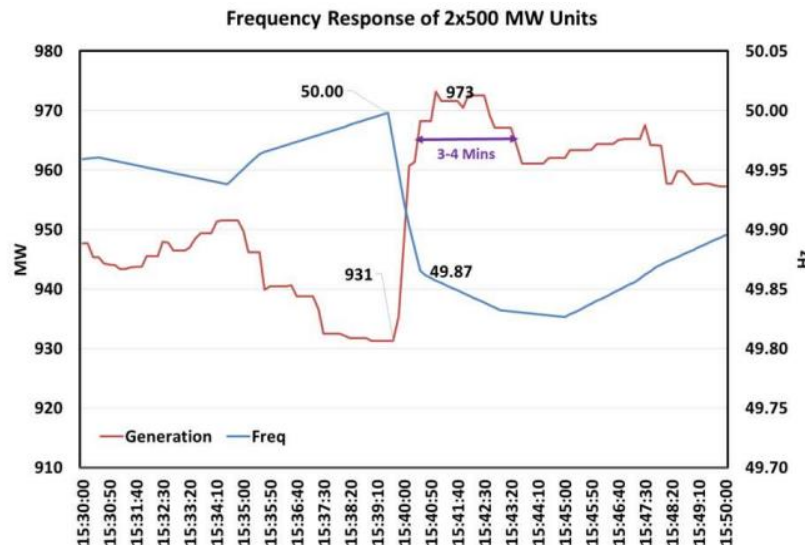


Primary Reserve Ancillary Services (PRAS)

- Restricted Governing Mode of Operation (RGMO)
- Free Governing Mode of Operation (FGMO)

Secondary Reserve Ancillary Services (SRAS)

- Automatic Generation Control (AGC)
- Load demand from RLDC



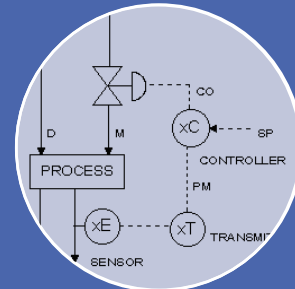
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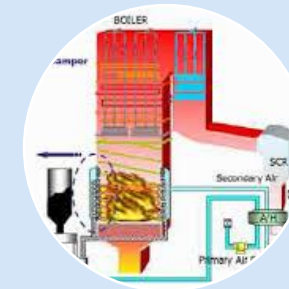
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Improved plant O&M
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Cybersecurity posture



Improved Productivity

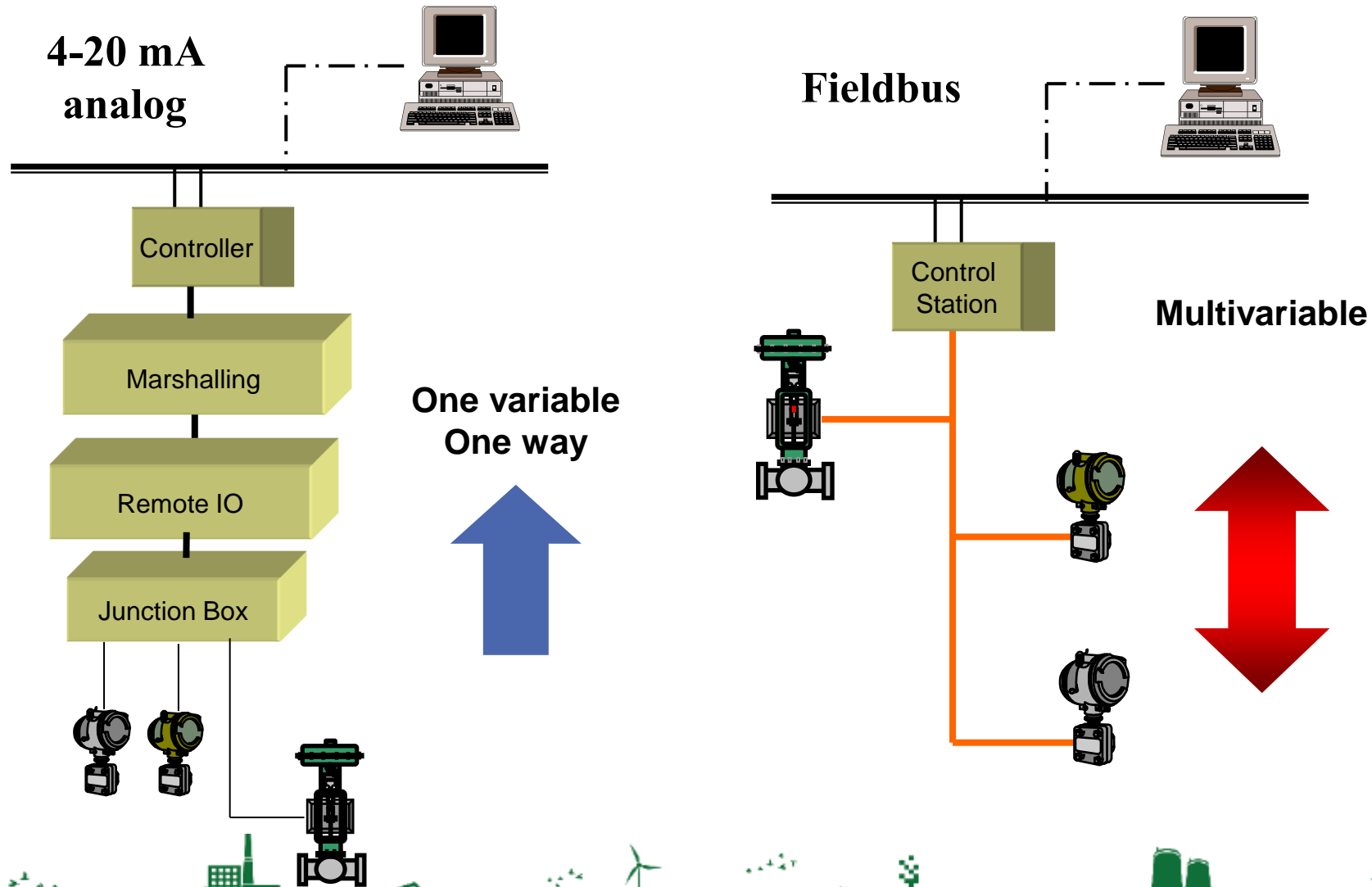
Advanced control & automation



Fieldbus based DCS, Actuators, Instruments



An all-digital multi-drop bi-directional serial bus that connects microprocessor-based control and Intelligent field devices



Reduced installation effort

- Reduced cabling, Faster commissioning

Increased reliability

- Greater Signal Fidelity
- Easier troubleshooting

Reduced system footprint

- Reduced hardware

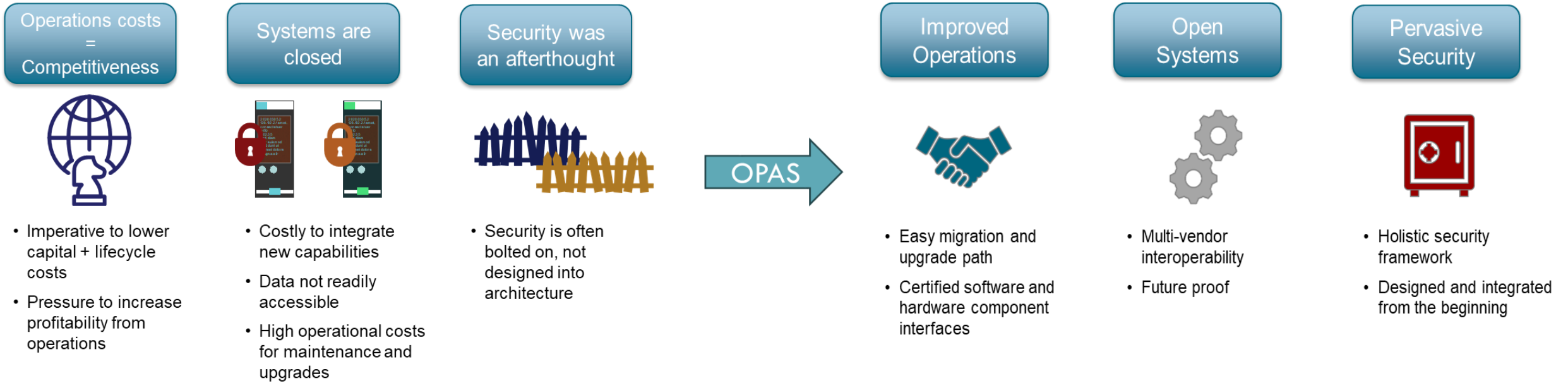
Flexible design

- Easily expanded or modified in the future.



Open Process Automation Standard (OPAS)

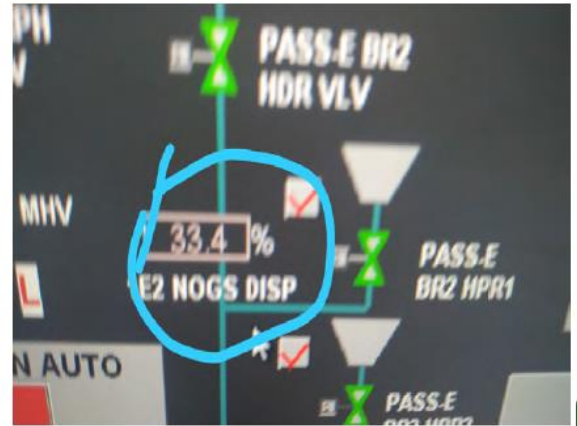
- Group of industry end users, suppliers, integrators, academia, and standards organizations.
- Evolve an open architecture and specification, develop Standard of Standards
- Open, interoperable and secure architecture for industrial process automation systems.



Naturally Occurring Gamma Sensors (NOGS)

NOGS Sensors installed at Economizer hoppers for volumetric measurement of Ash quantity

Quantity/ Level of Fly Ash	∞	Number of Gamma Ions
Number of Gamma Ions	∞	CPS on the NOGS Sensor
CPS on NOGS Sensor	∞	4-20mA output / Relay

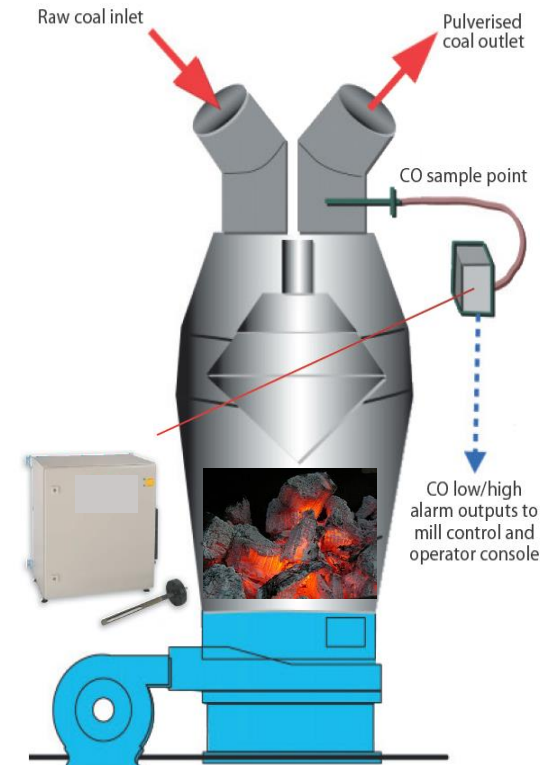
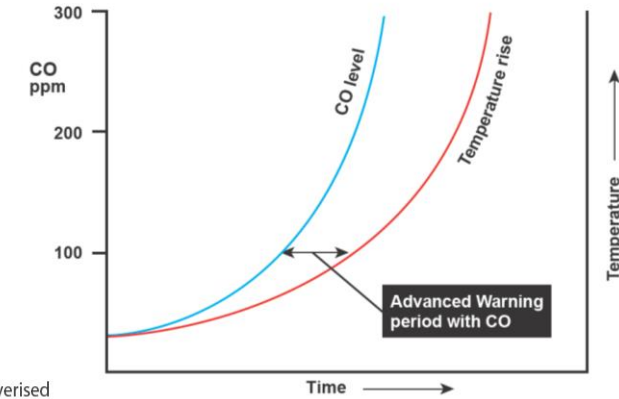


CO based mill fire detectors

- Biomass-High volatile content
- Enhances fire-explosion risk in mills
- Smouldering combustion increase CO levels
- Mill outlet Temperature increase after spontaneous combustion
- Early fire detection POC: CO based fire detectors



HOW IT WORKS | FIRE ADVANCED WARNING - CO VS TEMPERATURE



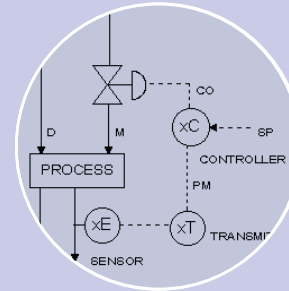
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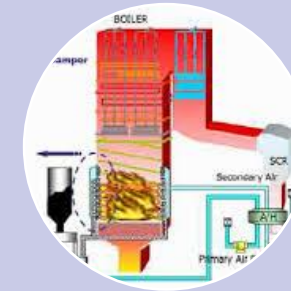
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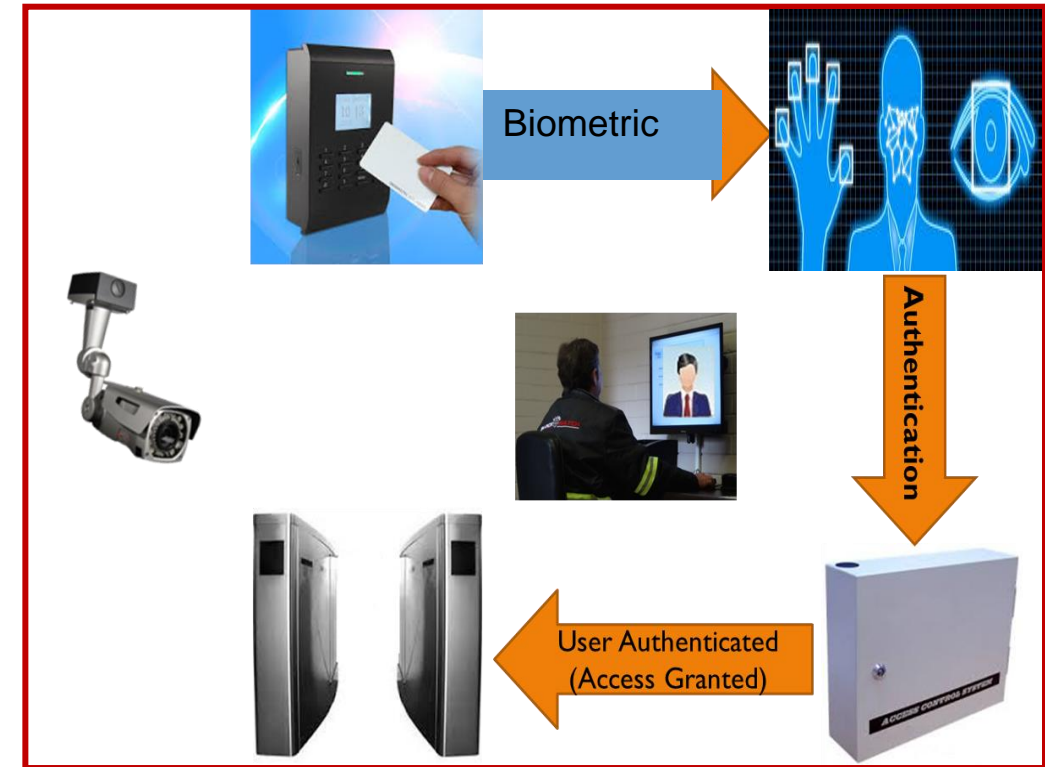


Improved Productivity



CCTV with analytics, Access control and Drone based Surveillance

- CCTV with video analytics
 - ✓ Video motion detection
 - ✓ Object classification & Tracking
 - ✓ PPE analytics (for fixed cameras in switchgear rooms)
- Drone based surveillance:
 - ✓ For monitoring project activities
 - ✓ Erection progress
- Biometric based Access control:
 - ✓ For central equipment room
 - ✓ Programmer room



- Compliance measures for Guidelines/directives from CEA/CERT-in/NCIIPC.
- Upgradation of obsolete/legacy systems
- Implementation of Cyber security suite comprising of
 - Asset inventory & **Anomaly detection** solution: deep packet inspection at purdue layers 1,2 & 3 providing **Continuous Threat Detection**.
 - **Security information and event management (SIEM)**: Monitoring of logs/events etc. at a plant level Dashboard, uses machine learning to **detect unusual user and entity behavior**
 - Malware protection by strict **application whitelisting**
 - Unidirectional data transfer across OT-IT using Hardware enforced **Data diode solution**
 - Centralized patch management using **Windows server update service**
 - Centralized user management by **Active directory/Domain controller** & role-based access control
 - Backup & recovery solution: copies of every single system on the network have a full system state backup



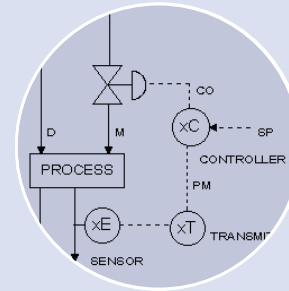
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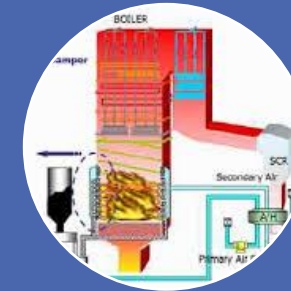
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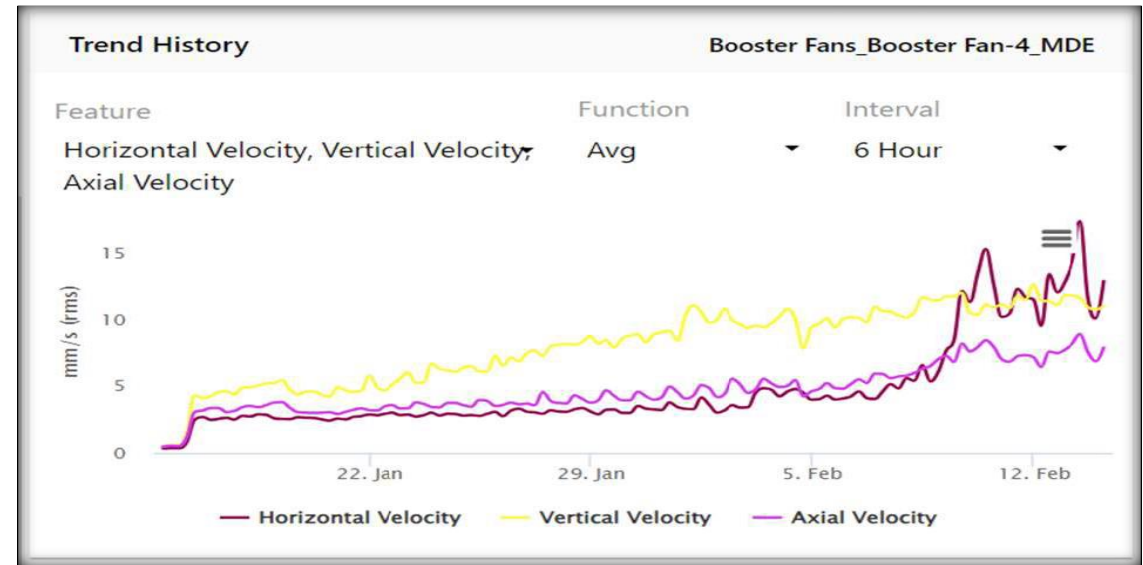
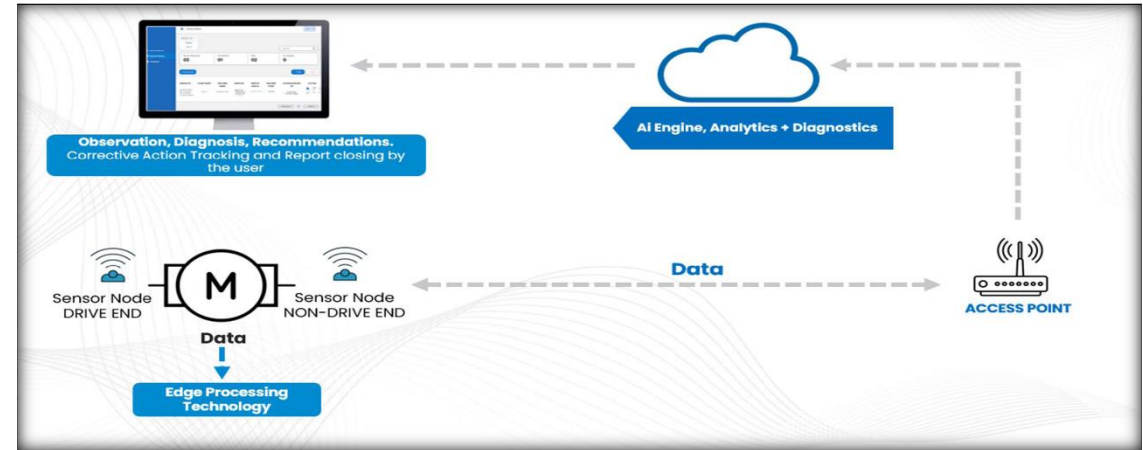
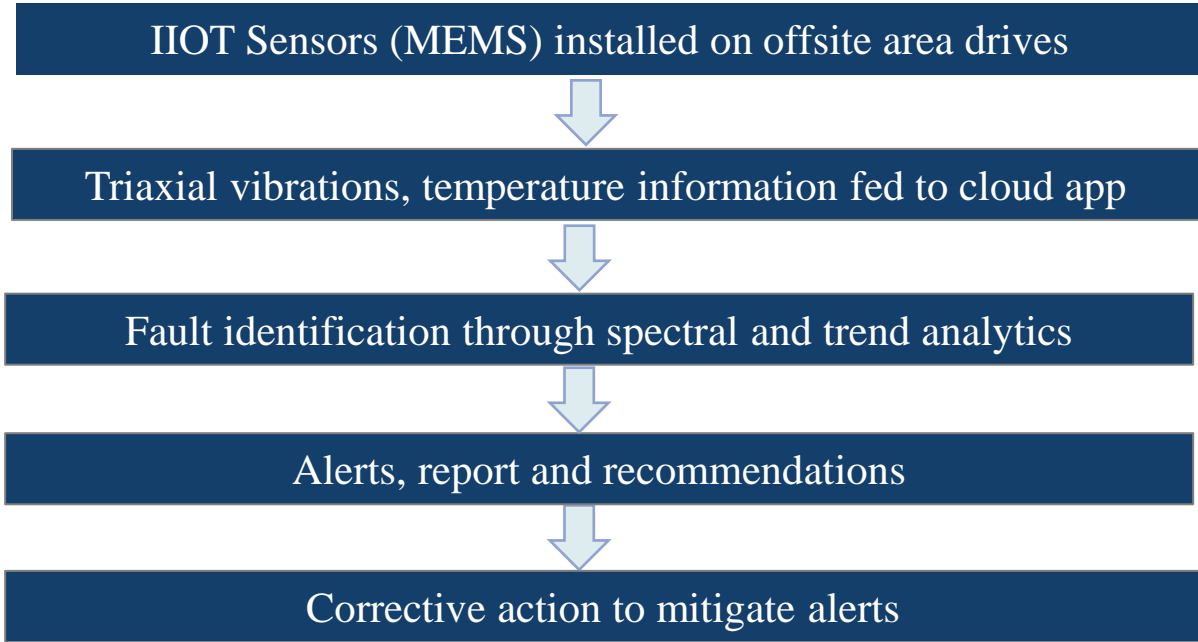
Enhanced
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Improved
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IIOT based Predictive Maintenance Solution



- Continuous health monitoring without human intervention**
- Advanced diagnostics:** Reduces need of expert vibration engineer
- Reduced Downtime:** Early warning helps minimize equipment downtime.
- Cost Savings:** Reduces emergency repairs, prevents unnecessary replacements



Coal Transportation System



Mines data is captured at Mine exit along with GPS installation



Automated Gate-Pass



Vehicles enters the plant without human intervention.

Plant Queue

Security check and exit



Controlled & Sequential Movement



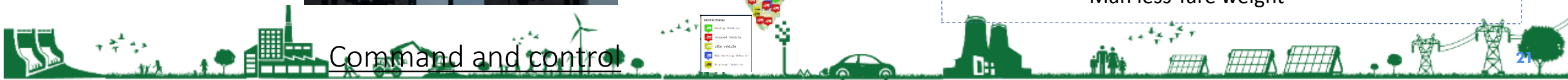
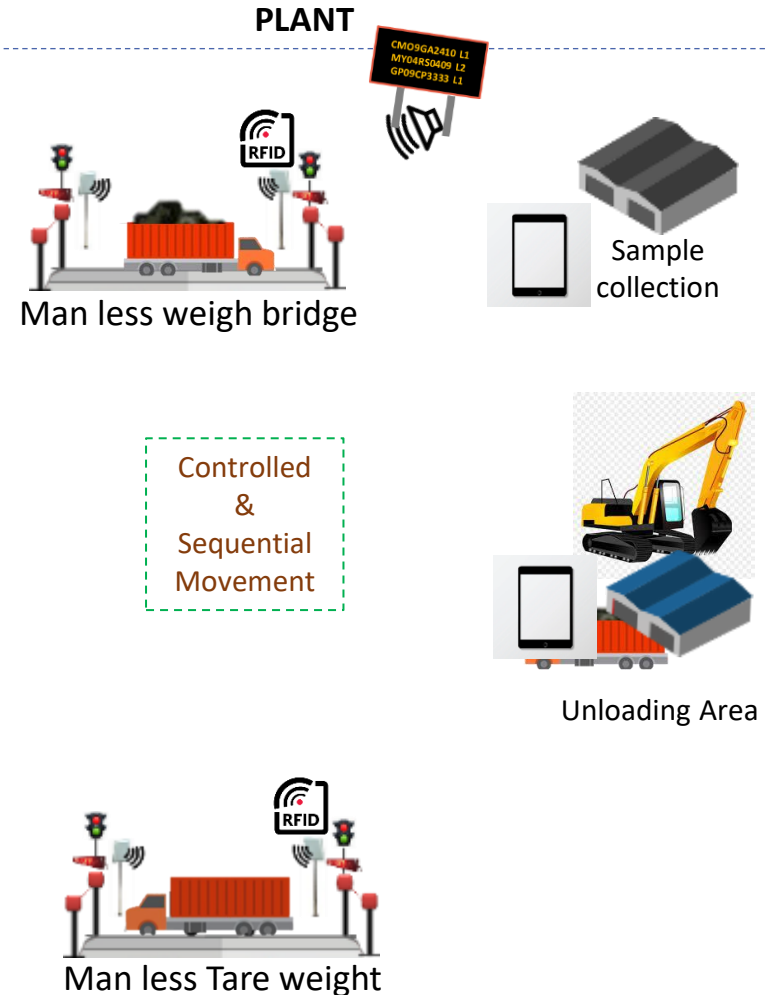
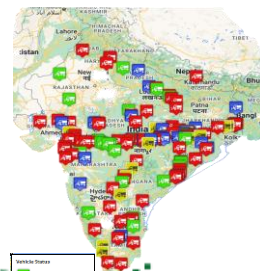
Unloading Area



Railway Siding



Command and control



Early Warning system for Hydro projects



Command & Control Center



Fully Automated Process

Data shared with Disaster Management CR on real time basis

High Reliability & Availability

- Sensors – 100% Redundancy
- VSAT & Cellular Communication
- Solar Power with Battery Backup

Multiple Warning Dissemination Modes

- Motorized Sirens & PA systems
- Automated Voice Calls, Messages & emails

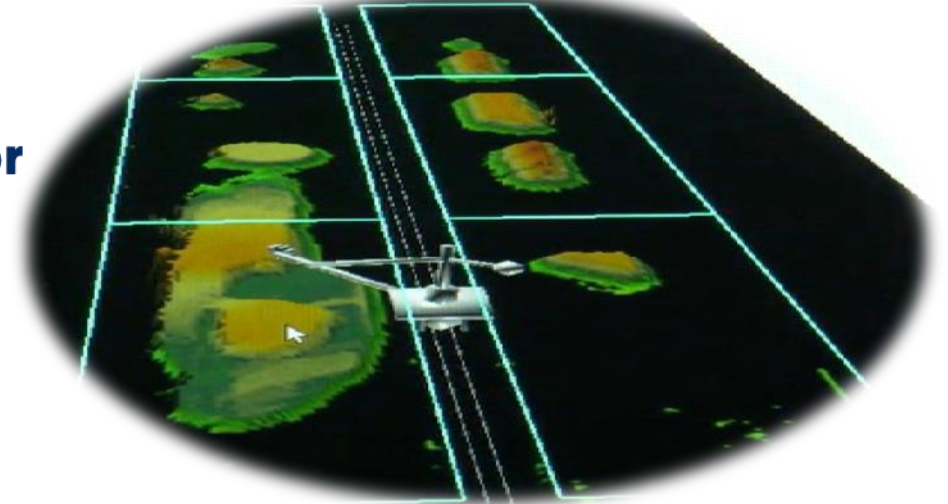
Future modules

Flood Forecasting
Environmental Seismology

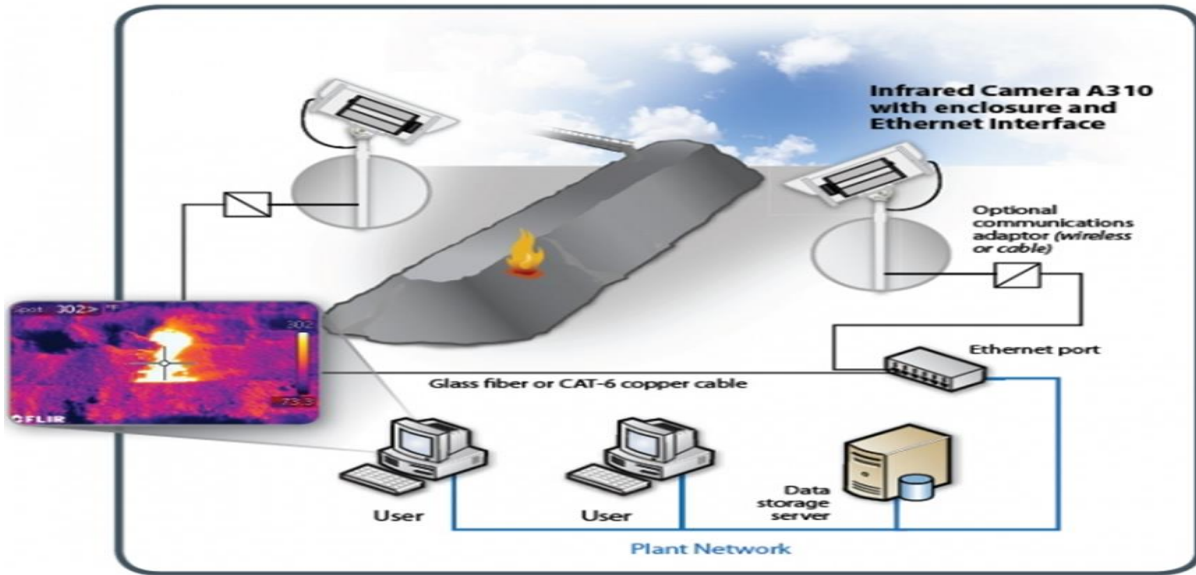


❖ Digital Solutions for Stockyards :

- 3D Profiling of Coal Stockyard for volumetric analysis



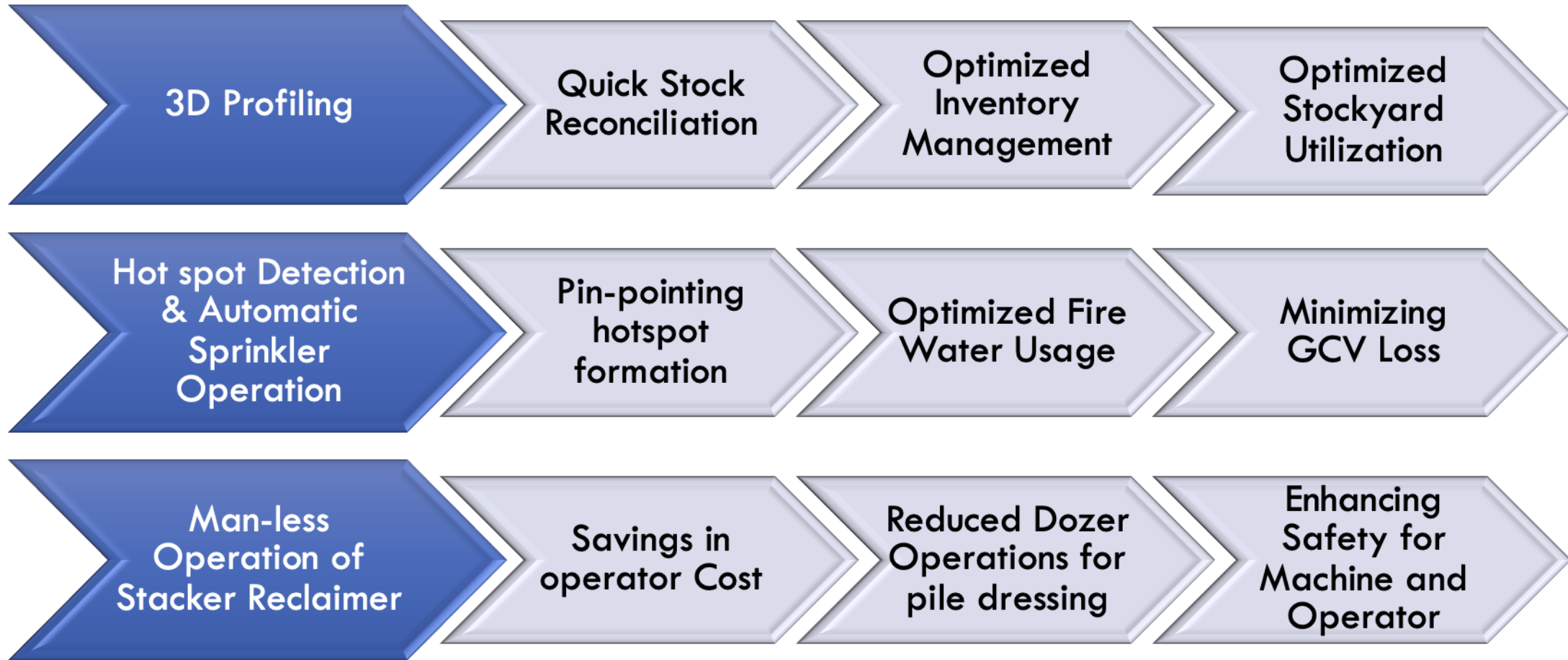
- Hotspot detection & Automatic Sprinkler Operation



- Unmanned operation of SR Machines



Advanced Monitoring of Stockyards Benefits





Thank You

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