



एनटीपीसी NTPC
A Maharatna Company

CC EOC
Secunderabad

Advanced control & automation in power sector

-Raj Seth, DGM (Project Engineering-C&I)



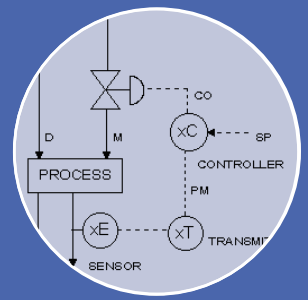


Role of Advanced control & automation

Advanced control & automation in NTPC

Flexible operation

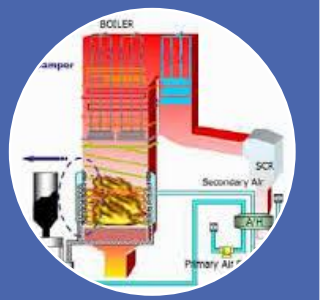
Grid security through improved frequency control



Improved plant O&M

Reducing lifecycle cost

Enhanced Safety & OT Cybersecurity posture



Improved Productivity

Advanced control & automation

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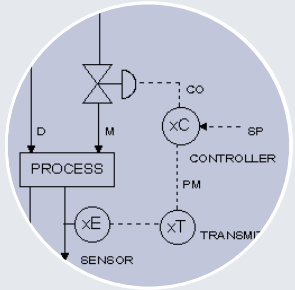

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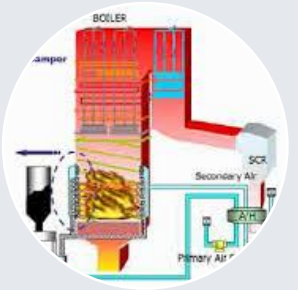


Improved Productivity

Advanced control & automation

Advance Process Control (APC)

Interfaced with existing DCS

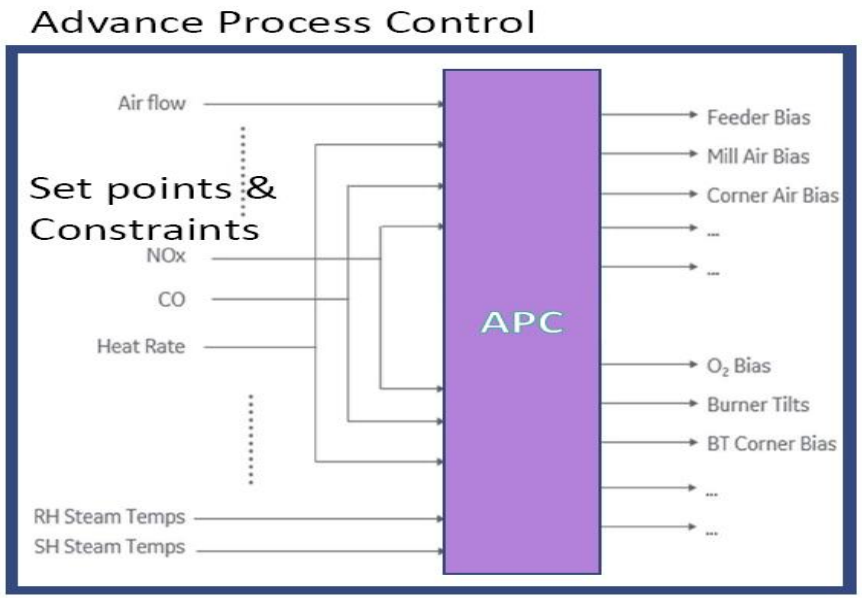
- SH/RH temperature control for excursion reduction in modified sliding pressure operation (STO)
- Unit control for faster ramp up/ramp down reducing throttle pressure deviations (URO)
- Closed loop combustion optimization to improve marginal contribution (CO)
- Optimum soot blowing based on heat transfer coefficients & self cleaning factor

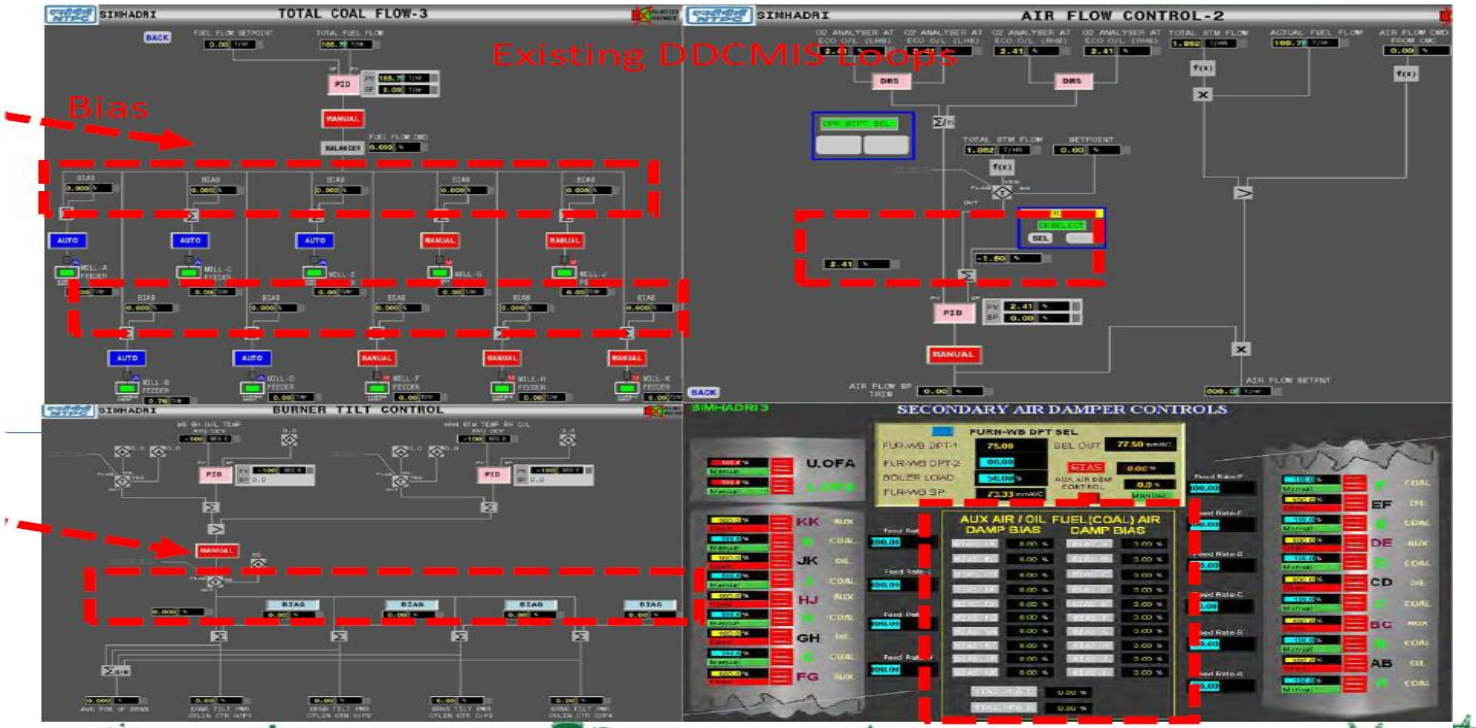
Tighter control of steam temp., pressure,
improved heat rate-
at Simhadri-II (2*500 MW)

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





TRANSFORM

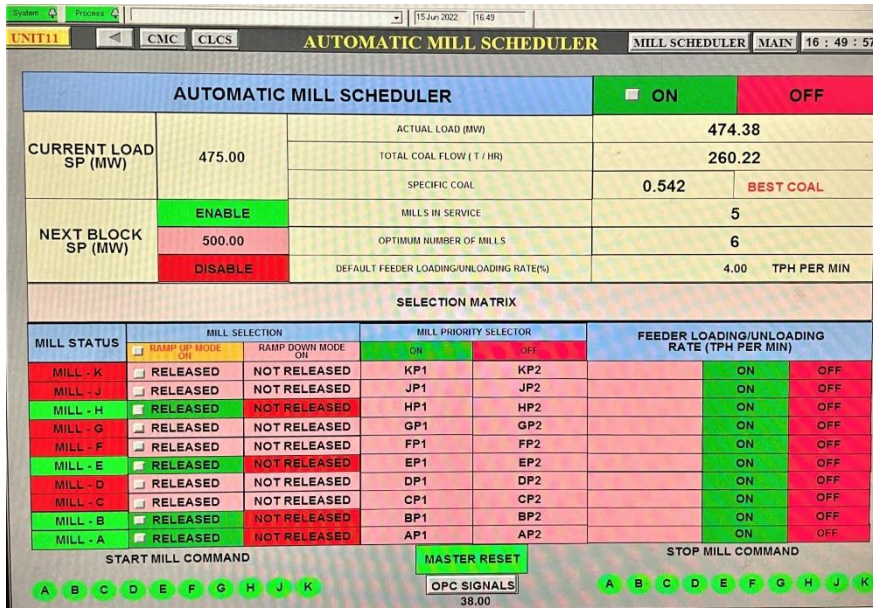
Thermal units **R**amping through **A**utomatio**N** and **S**cheduling of mills in **F**lexible **O**peration **R**egi**M**e (**TRANSFORM**)

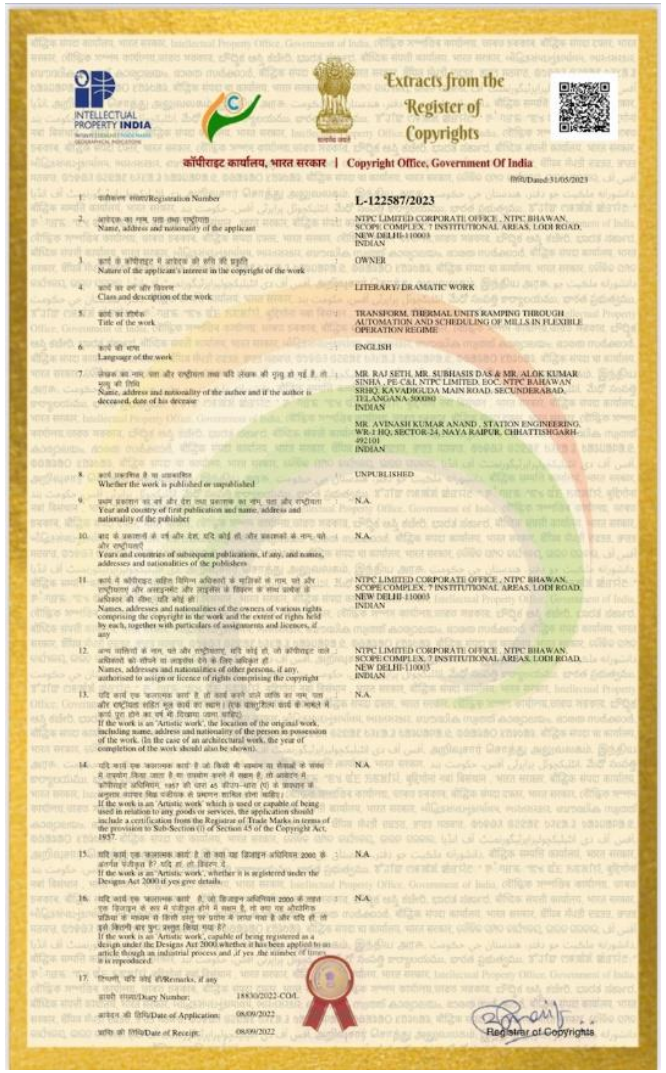
Objectives of TRANSFORM:

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:

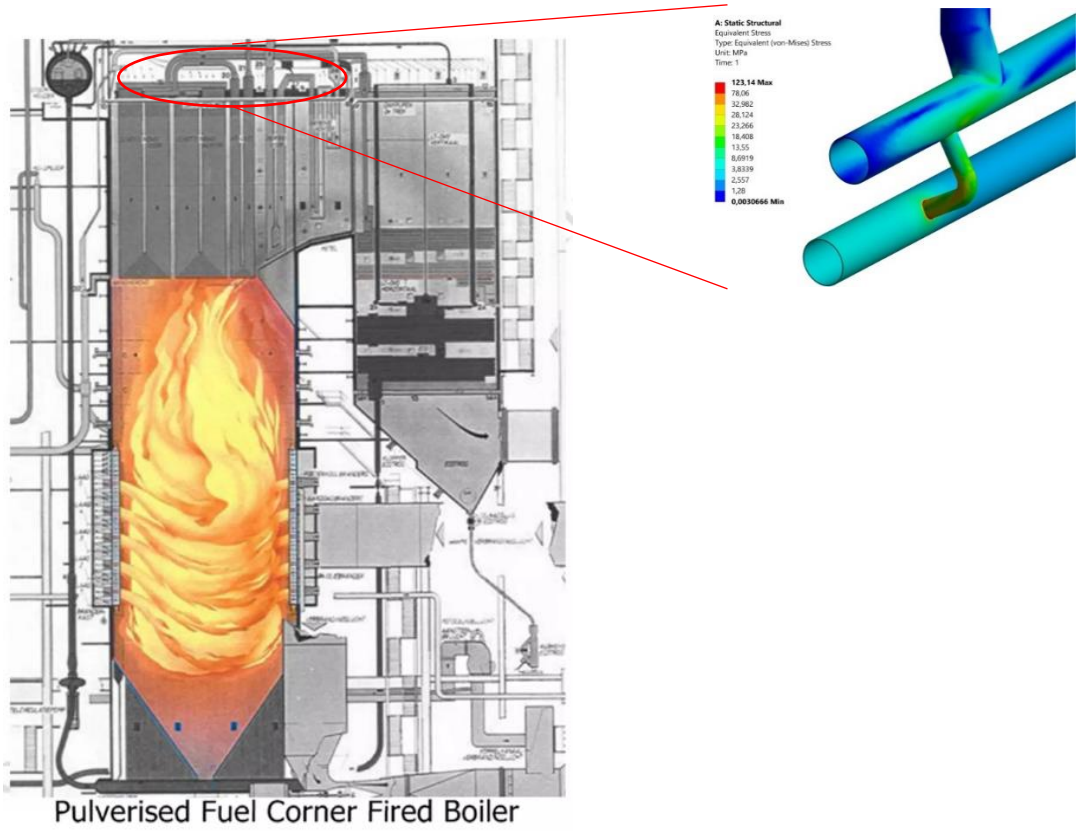
- ✓ Optimum no. of mills for different coal quality
- ✓ Timely cut-in/cut-out of mills.
- ✓ Imitates Best operator actions and intelligence.





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



Pulverised Fuel Corner Fired Boiler

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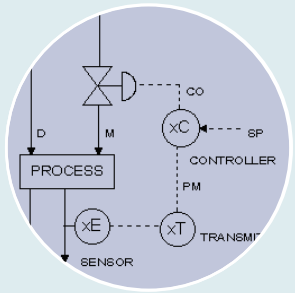

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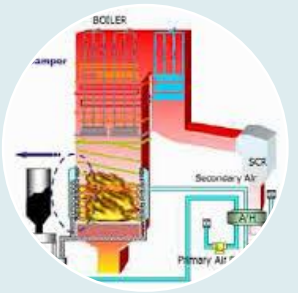


Improved Productivity

Advanced control & automation

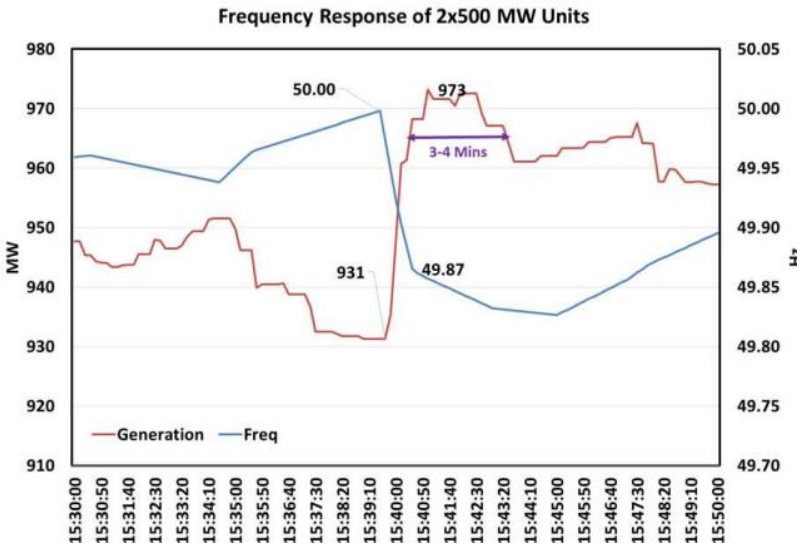
Ancillary services

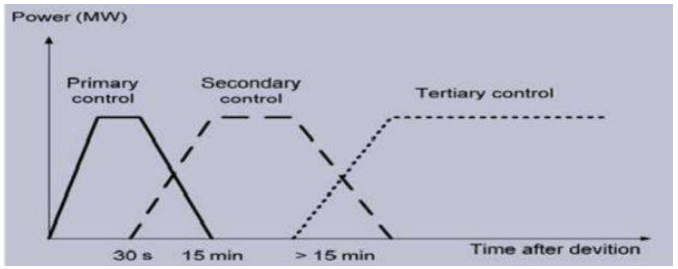
Primary Reserve Ancillary Services (PRAS)

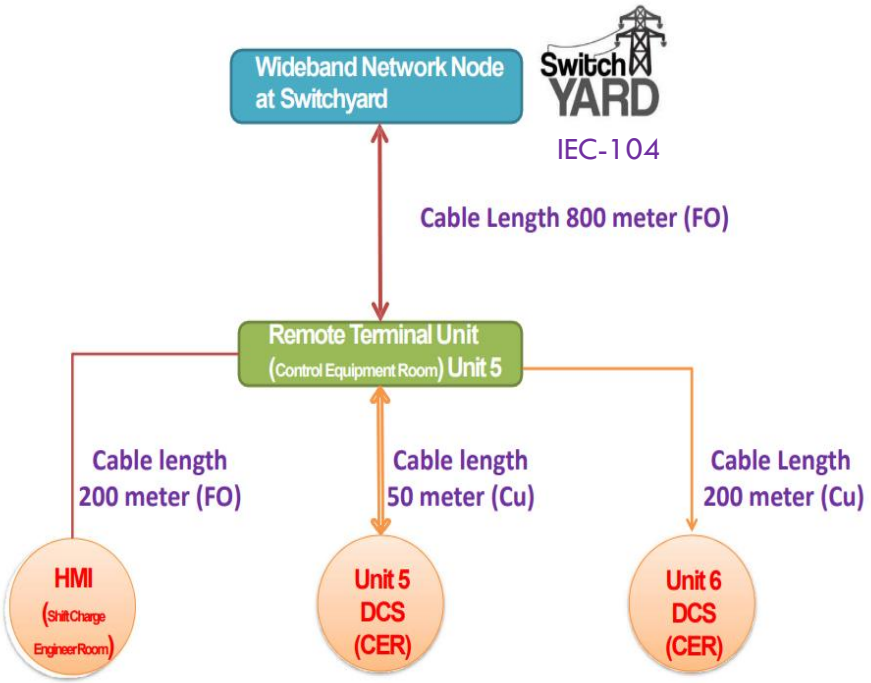
- Restricted Governing Mode of Operation (RGMO)
- Free Governing Mode of Operation (FGMO)

Secondary Reserve Ancillary Services (SRAS)

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







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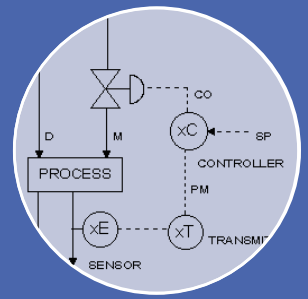

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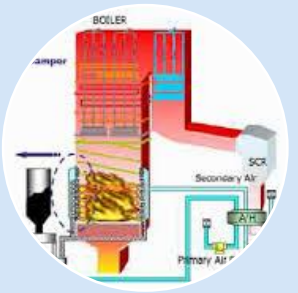
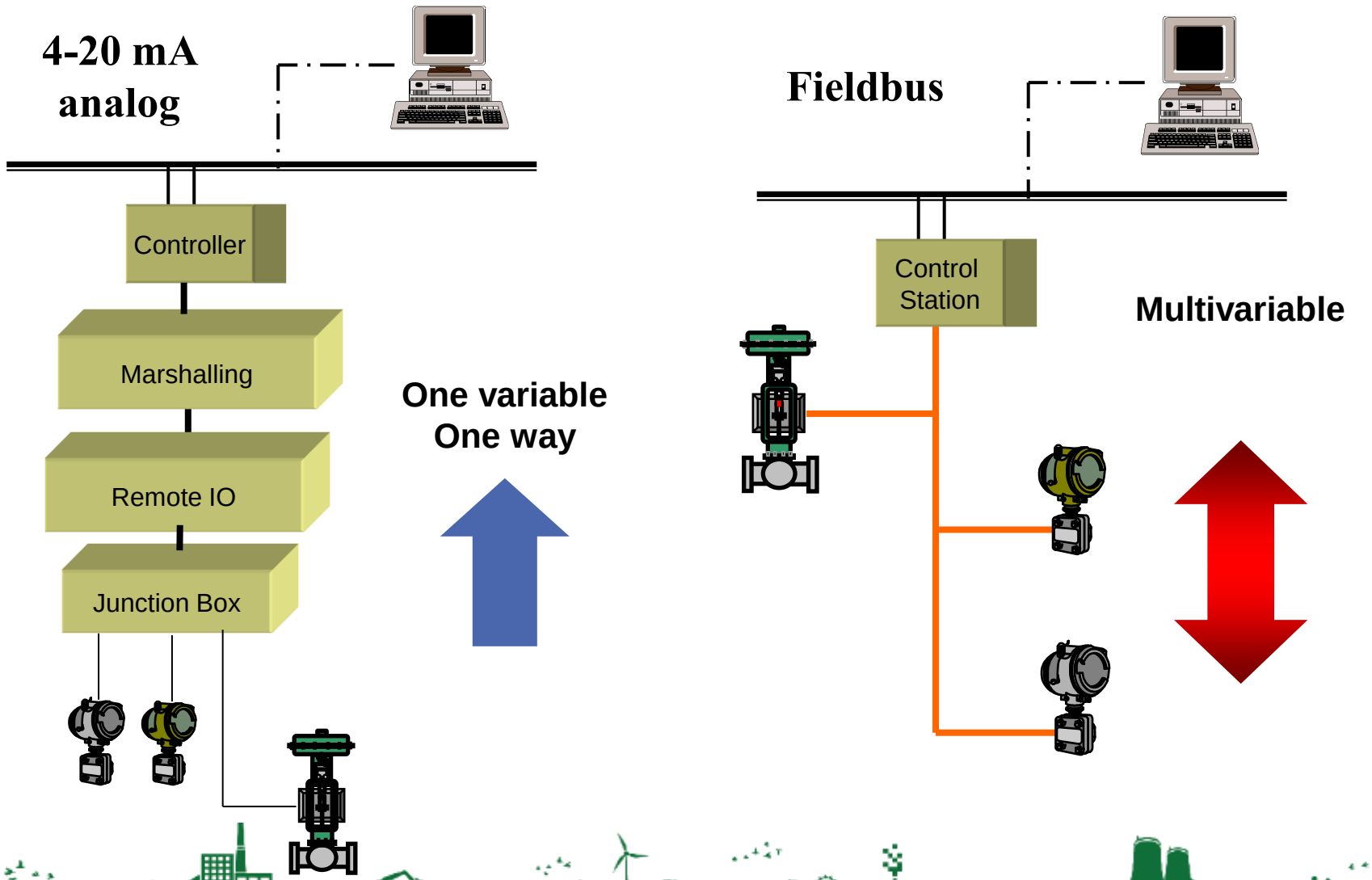


Improved Productivity

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.

Operations costs = Competitiveness

- Imperative to lower capital + lifecycle costs
- Pressure to increase profitability from operations

Systems are closed

- Costly to integrate new capabilities
- Data not readily accessible
- High operational costs for maintenance and upgrades

Security was an afterthought

- Security is often bolted on, not designed into architecture

OPAS

Improved Operations

- Easy migration and upgrade path
- Certified software and hardware component interfaces

Open Systems

- Multi-vendor interoperability
- Future proof

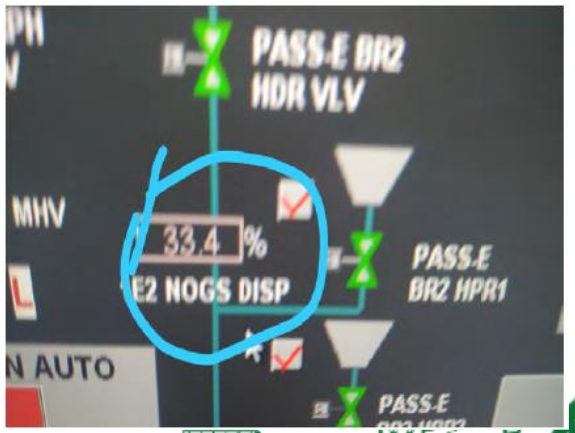
Pervasive Security

- Holistic security framework
- Designed and integrated from the beginning

Naturally Occurring Gamma Sensors (NOGS)

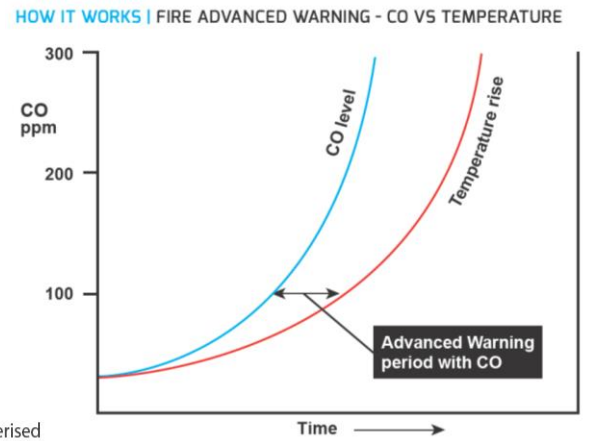
NOGS Sensors installed at Economizer hoppers for volumetric measurement of Ash quantity

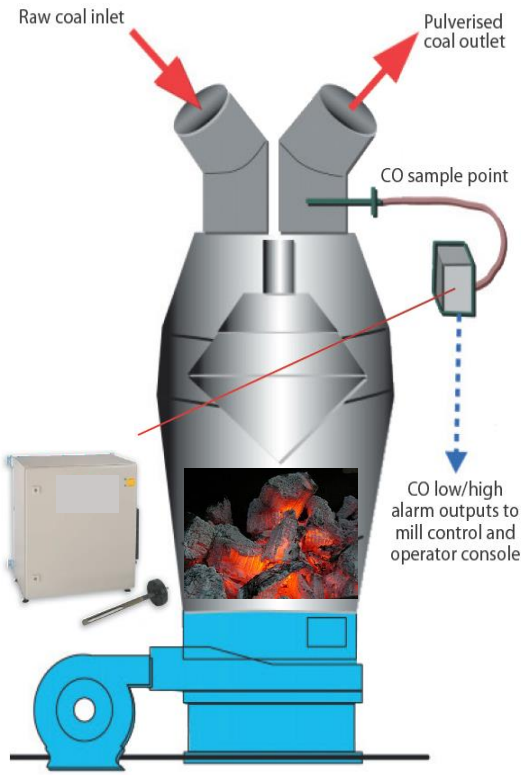
Quantity/ Level of Fly Ash	∝	Number of Gamma Ions
Number of Gamma Ions	∝	CPS on the NOGS Sensor
CPS on NOGS Sensor	∝	4-20mA output / Relay



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





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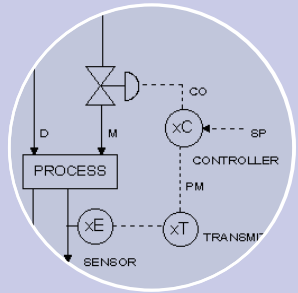

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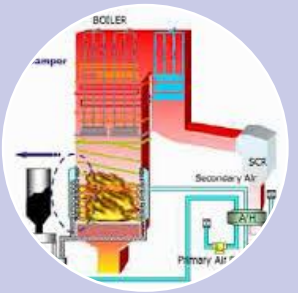
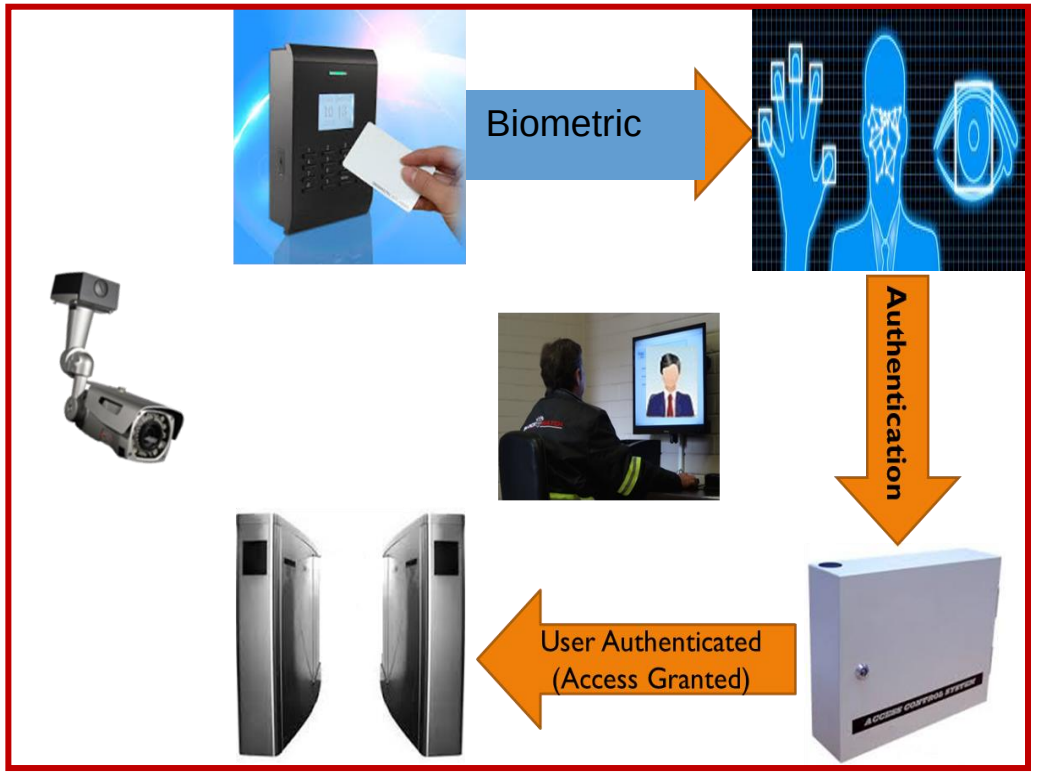


Improved Productivity

Advanced control & automation

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



Cybersecurity

- 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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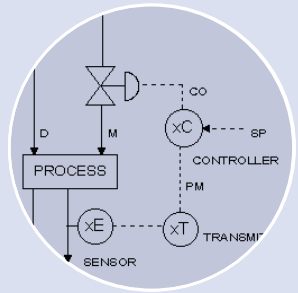

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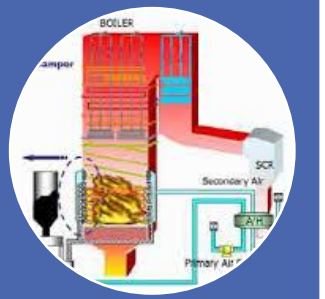

Improved Productivity

Advanced control & automation

IIOT based Predictive Maintenance Solution

IIOT Sensors (MEMS) installed on offsite area drives

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Triaxial vibrations, temperature information fed to cloud app

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Fault identification through spectral and trend analytics

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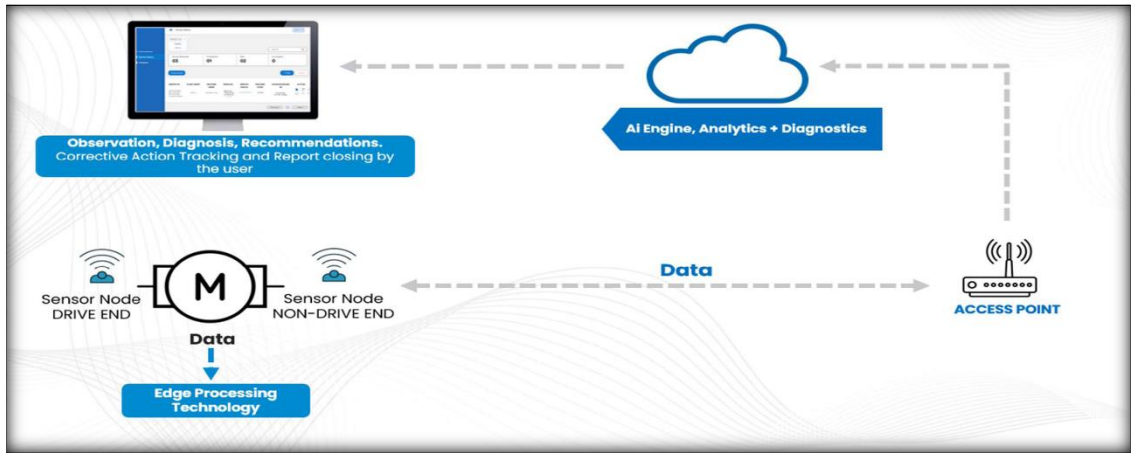
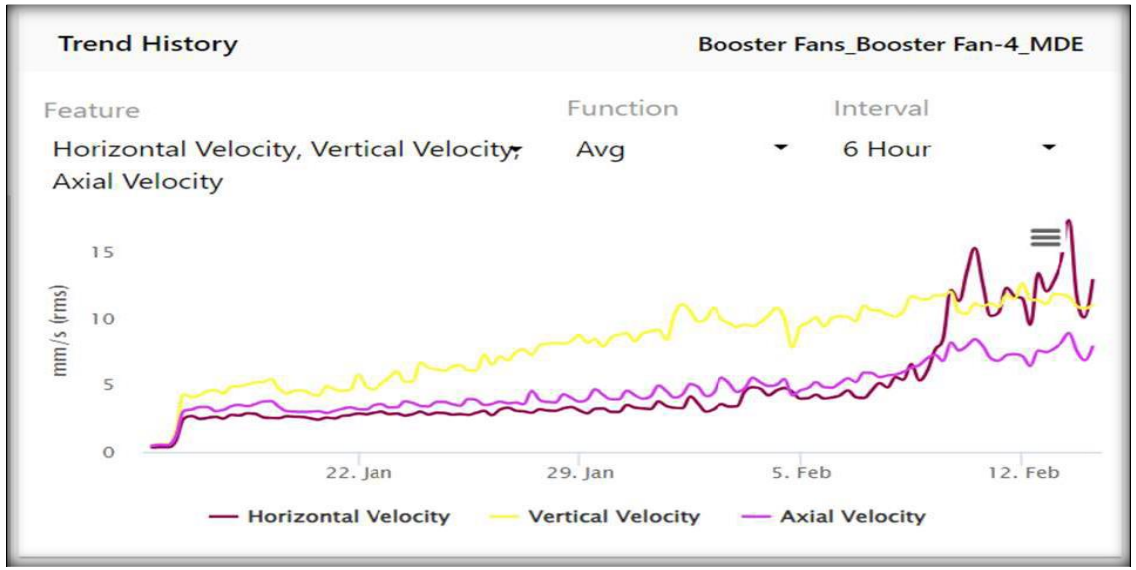
Alerts, report and recommendations

↓

Corrective action to mitigate alerts





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

Railway Siding

Automated Gate-Pass

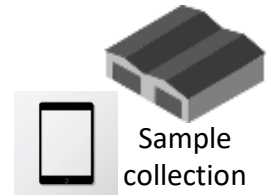
Vehicles enters the plant without human intervention.

Security check and exit

Plant Queue

PLANT

Man less weigh bridge

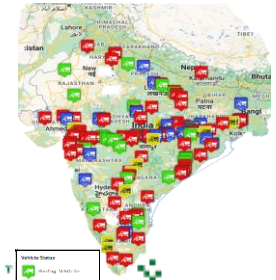


Sample collection

Controlled & Sequential Movement

Unloading Area

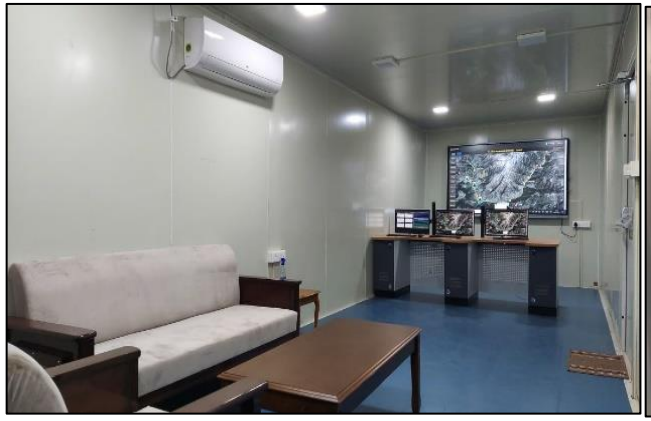
Man less Tare weight



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

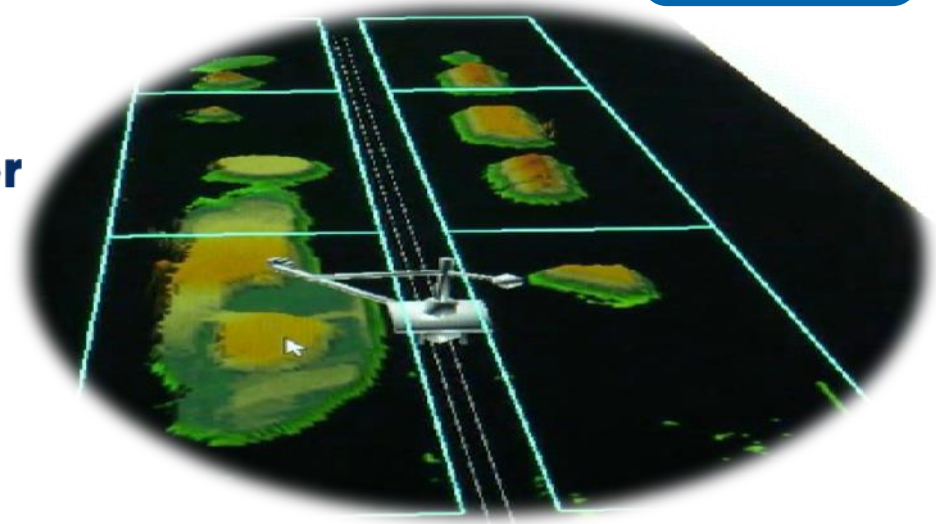
Flood Forecasting

Environmental Seismology

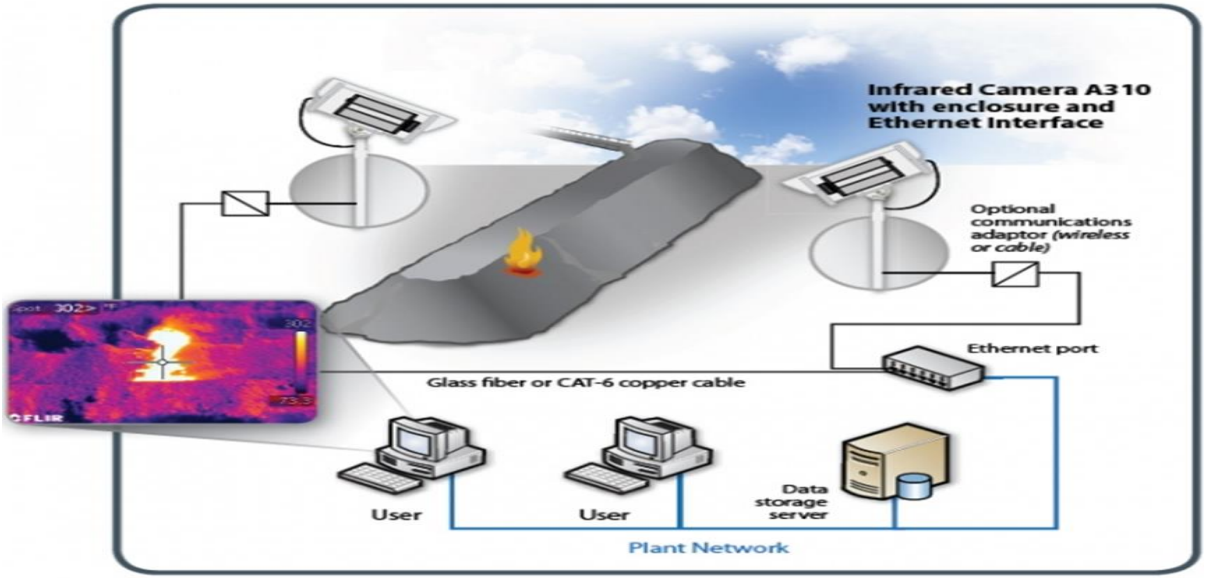
Advanced Monitoring of Stockyard (AMS)

❖ 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

3D Profiling	Quick Stock Reconciliation	Optimized Inventory Management	Optimized Stockyard Utilization
Hot spot Detection & Automatic Sprinkler Operation	Pin-pointing hotspot formation	Optimized Fire Water Usage	Minimizing GCV Loss
Man-less Operation of Stacker Reclaimer	Savings in operator Cost	Reduced Dozer Operations for pile dressing	Enhancing Safety for Machine and Operator

Thank You

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