ISA Delhi Section

AREVA

Agenda

- Communication and its types
- Master slave and Client server architecture
- Protocols, types and Protocol converters
- IEC 61850 emergence
- Network Architectures
- Network Redundant protocols
- Conclusion

Communication

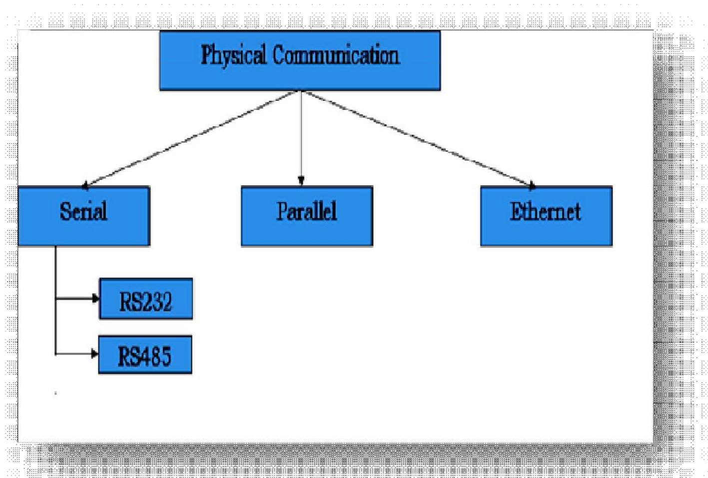
- What is communication?

  Imparting or interchanging of thoughts,opinions or informations by means of speech,signs etc.
- Types of Communication interfaces:

  Serial

  Parallel

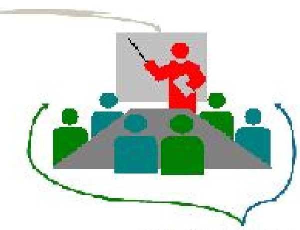
  Ethernet



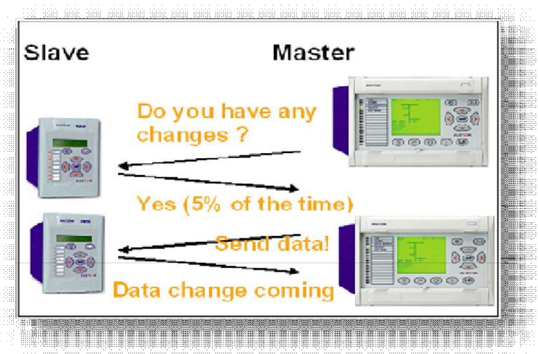
Master Slave and Client Server

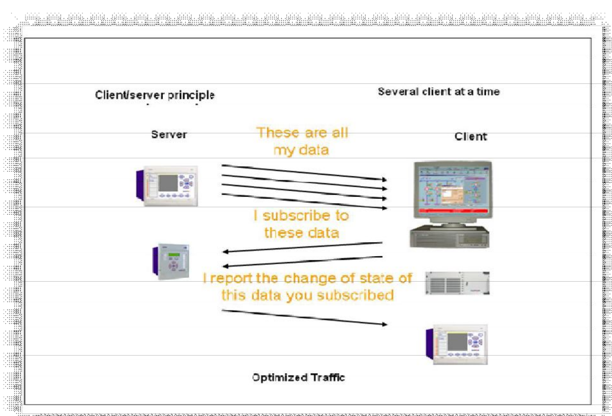
- Master Slave
- Client Server

The Master is requesting the data from its slave(s), and can also send orders (control) to the slave.



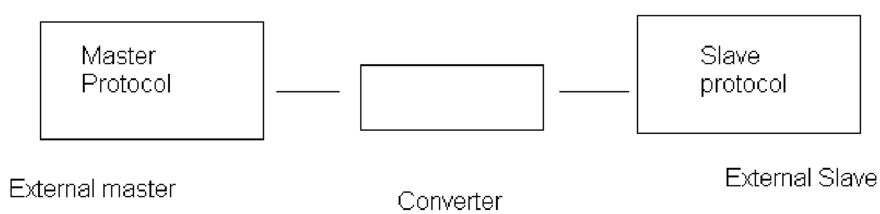
The slave replies to the Master only upon request, the Master can address him with specific address or by broadcasting.





PROTOCOLS

- What are protocols?
- Types of protocols used in the Power Industries
  Modbus
  IEC 60870-5-1
- Emergence of Protocol converters and its Application



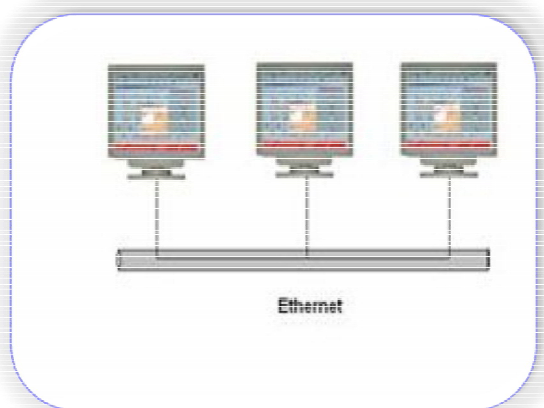
IEC 61850's Emergence

Advantages

- High speed communication
- Peer to Peer connection
- Interoperability
- Uniformity
- Simplified Engineering process
- Redundant system
- Conditional reporting
- Client Server architecture
- Standard Structure for naming Logical nodes

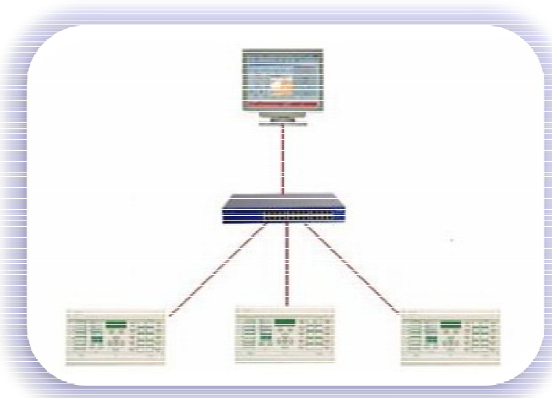
Network Topology – Bus Topology

- A bus topology connects each device to a communication line called the bus.
- Advantages and Disadvantages



Network Topology – Star Topology

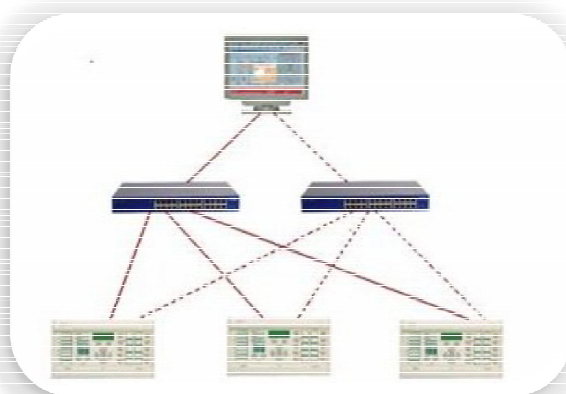
- There is a single connection i.e the hub or a switch
- Advantages and Disadvantages



Network Topology – Double Star Topology

- There are two hubs/switches in central connection point, hence redundancy is maintained

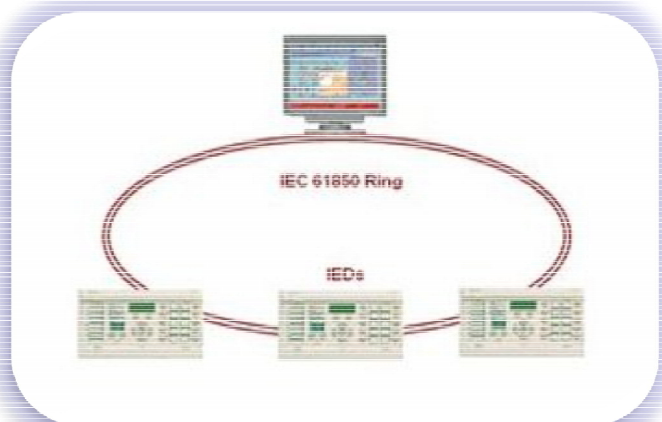
- Advantages and disadvantages



Network Topology – Ring Topology

- All IEDs are connected in a ring ,each node connected to other two devices forming a loop.

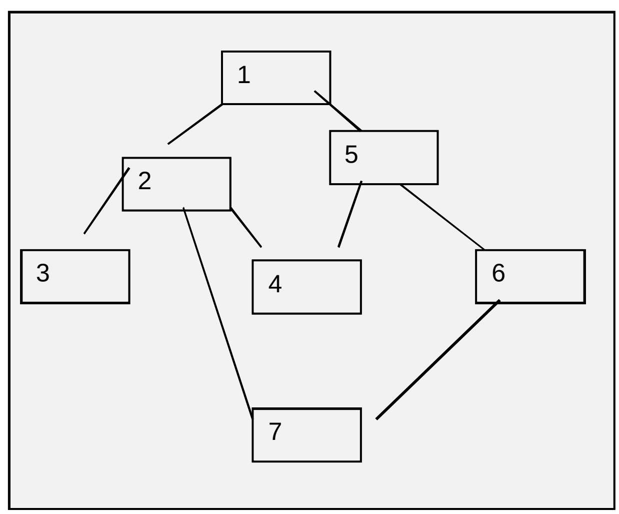
- Advantages and disadvantages



Network Redundancy protocols
- RSTP

1.RSTP

This is an algorithm used to quickly reconnect a network fault by finding an alternative path, allowing loop-free network topology.

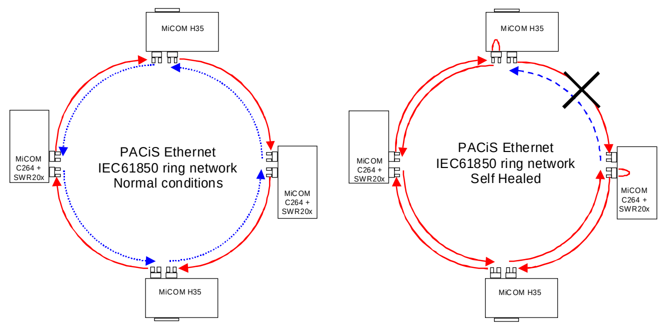


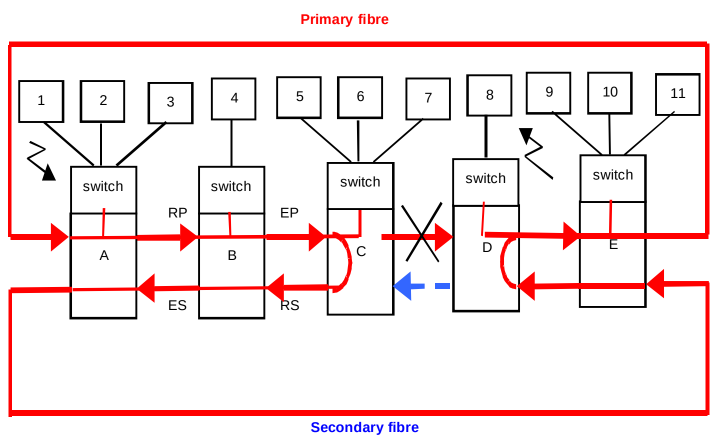
Network Redundancy Protocols

- SHP

2. SHP

Both rings are active when a message passes at the starting. Normally the Ethernet packets travel on the primary fiber in the same direction, and only a checking frame (4 octets) is sent every 5 µs on the secondary fiber in the opposite direction.

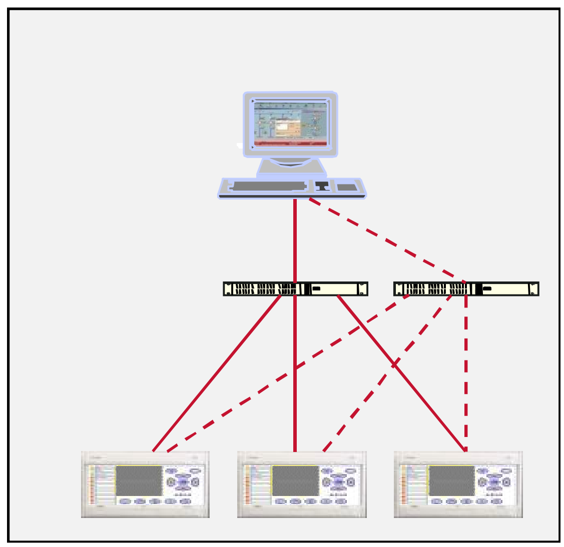




3. Dual Homing

Used in double star architecture.

Both main and backup active at starting.



Conclusion

- *In modern day Automation, communication systems has become an integral part.*
- *Ethernet network topologies helps in utilizing the advantages of protocols used in Ethernet such as IEC 61850 thus overcoming the limitation of serial protocols.*
- *Ethernet protocols such as IEC 61850 enables integration of different manufacturer relays on the same network allowing features such as Interoperability.*
- *Advanced features like Network redundancy has made the protection automation system more secure and reliable.*

ISA Delhi Section

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Thank You..

Fleet Generation Management System, Foundation Fieldbus System and Asset Management in Power Plants

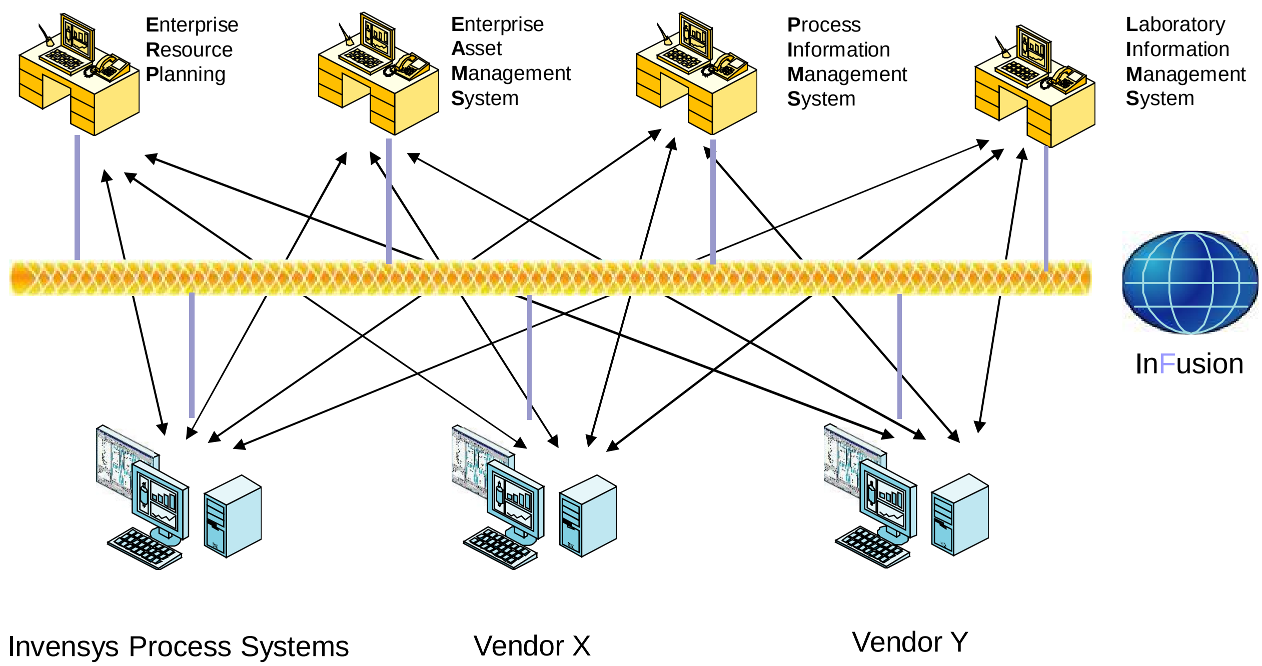
RAHUL NARGOTRA
Invensys Operations Management

- ISA (D) POWAT 2010 Mumbai, 28th and 29th May 2010

Generation Management Systems

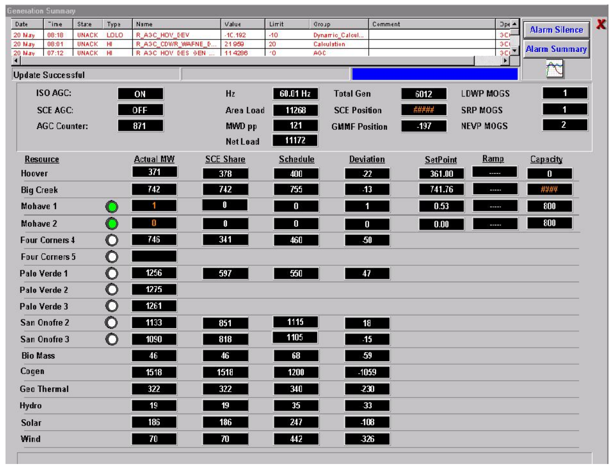
- Designed for the Generation Companies
  - Targeted towards better "Generation" management
  - Complementary to DCS + Power Vertical Solutions
- Requirements include:
  - Wide area Control of Generation Assets
  - Economic Dispatch
  - Operator Scheduling Interface
  - Access to in-house systems
  - Consolidation of public domain information required for generation operation
  - Integration with new business systems

Enterprise Unification



Functions

- Automatic Generation Control
- Energy Scheduling
- Economic Dispatch
- Report & Log Generation
- Online Trending
- Historical Data Storage and Retrieval
- Point Alarming
- Deviation Tracking
- Web Based Information Delivery



What are the Components of a Fleet GMS?

It is a [Power] Portal which provides an easy-to-use and easy-to-configure graphical Interface to access Information needed for daily activities.

- **Core functionalities**

1. Operations Monitor
2. Generation Monitor
3. KPI Monitor
4. Market Data Interface

ALL Core functionalities push the "6 Rights":

→ Right DATA
→ Right PERSON
→ Right TIME
→ Right CONTEXT

} cost, flexibility, capacity

← Resulting in the Right ACTION
← Producing the Right RESULTS

} Human Performance

Components

+

Management Dashboard

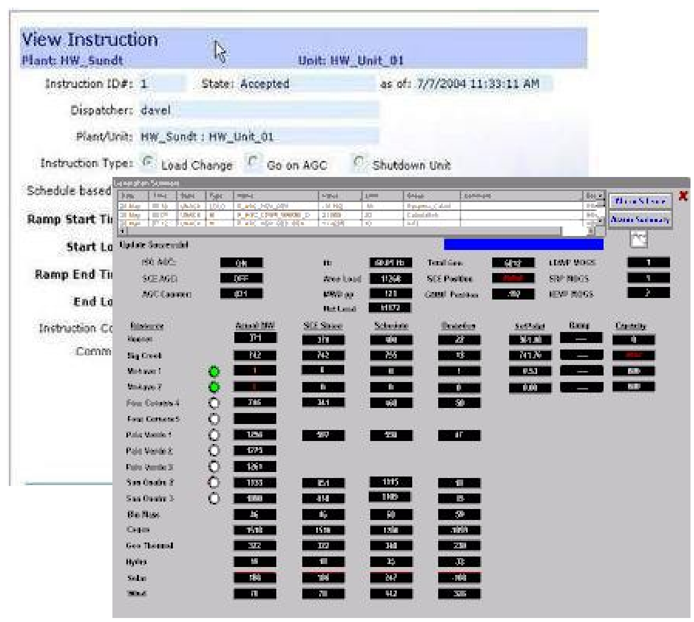
Core & Advanced Applications

Fleet GMS Core Functionalities

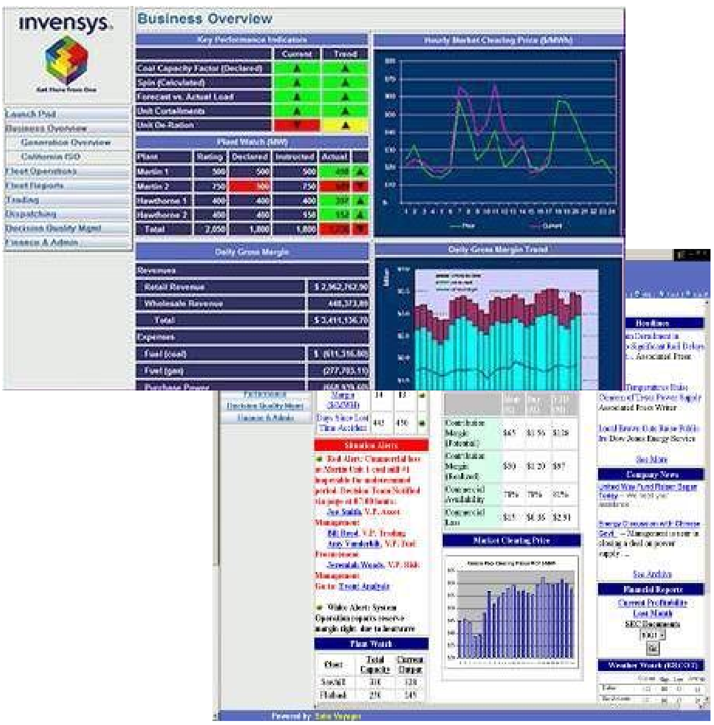
The Power Portal provides information in both operational and economic terms

Operation Monitor

- Real-time electronic capture of instructions sent to generation units
- Real-time capture of the units/plant capabilities/targets and limitations
- Plant Information Management
- Maintenance management strategy information



Fleet GMS Core Functionalities



Market Data Interface

- Interface for input of market pricing, fuel costs, and other market data to support calculations for the KPI Monitor
- Support for nodal and zonal pricing models
- Provides a foundation for connectivity to markets through a configurable market interface

Case Study – Williams Power Company

Williams Power

- The company manages 7900MW of Electricity and 2.8 Billion Cubic Feet of natural gas.
- Invensys Generation Management System provided to Williams Power in 2006
  - Enables William Power to monitor and control 12 Power Plants and 3 areas
    - California ISO
    - Midwest ISA
    - Pennsylvania/ NewJersey/ Maryland Interconnect

Case Study – Williams Power Company

Major Components of the GMS

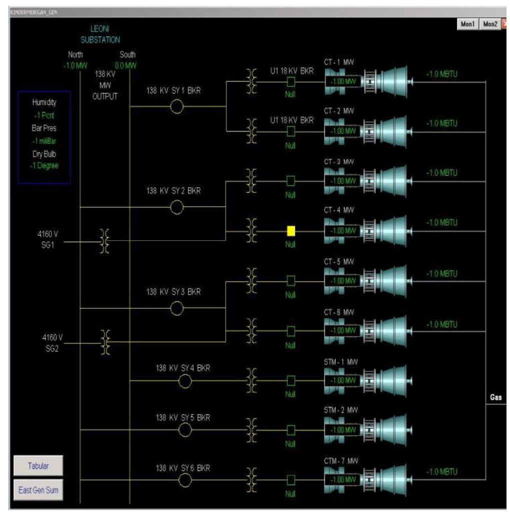
- 2 Redundant Main Servers acting as Infusion Primary and Secondary Servers
- High Availability Infusion Historian Database Server
- High Availability Web Portal Server Utilizing Infusion SuiteVoyager
- 8 Operator Stations
- An Engineering station for development using the InFusion Engineering services

Benefits to William Power by incorporating the GMS

- Automatic downloading of the AGC Set-points to generation plants
- Monitoring of operation of various plants versa actual set-points requested
- Historical Data collection for all the Units
- Maintained calculations of plant gas usage, total plant generation
- Interface to other Automation systems using DNP3, Modbus, PI etc
- Abnormal operation conditions are alarmed to operator for fast resolution

Project Execution

- Project Award March 2006
  - Factory Test May 2006
  - On Line June 2006
- Project Scope
  - Hardware + Software Licenses
  - Migration database + graphics + calculations
  - Multiple Business System Interfaces
  - Setpoint Control to (12) Power Plants
  - PI Historian Interface
  - Modbus + DNP3 + ICCP Protocol Interfaces



Case Study Eskom Plant Database System

The Current Eskom Power Generation Fleet

Type of Generation	Power Stations	Number of Units	Total Capacity (MW)
Coal fired Power Stations	13	93	37410
Open Cycle Gas Turbine	4	20	2414
Hydro	2	6	600
Pump Storage	2	6	1400
Nuclear	1	2	1930
Total Installed Capacity	22	127	43754

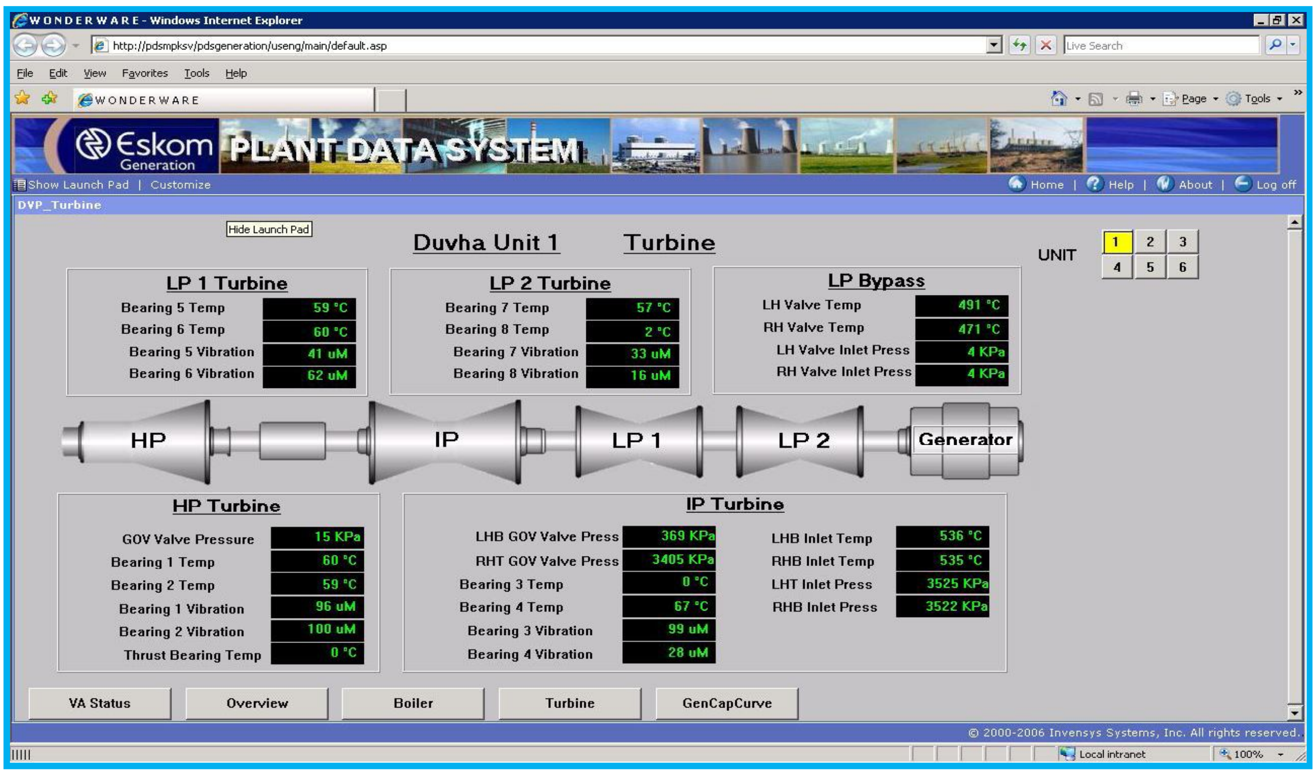
Productivity Excellence
Optimising energy demand and supply

Benefits / Goals Achieved

- Real-time plant data now a reality.
- Standardisation has been achieved.
- Definitely a cost effective approach.
- Has significantly raised the “visibility” of the benefits of open access to plant data.
- Closer relationship between Plant and IT
- Numerous applications now using the PDS data.

Using ArchestrA technology with Wonderware InTouch, Historian and Information Server, Eskom realized a full integration of all data across the power fleet and improved its asset lifecycle management resulting in a perfect match between energy demand and production.

PDS Screenshots



Eskom

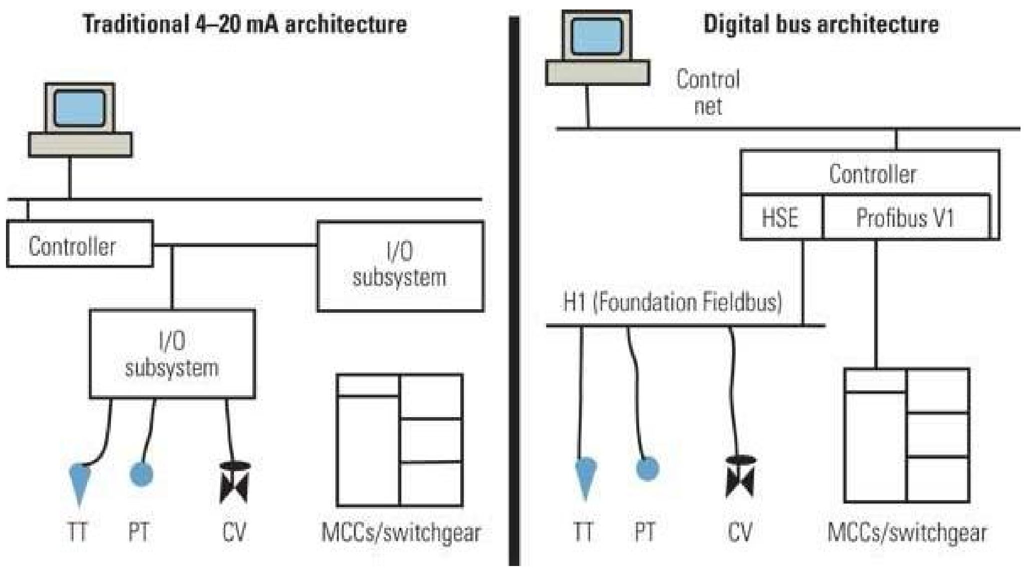
Foundation Fieldbus in Power Plants

- Digital Bus Technology utilizes the intelligence of Field devices to improve plant performance.
  - Foundation Fieldbus is an open architecture for information integration.
  - Foundation Fieldbus is an all-digital, serial, two-way communication bus system. The H1 bus interconnects intelligent field devices with host control system.
  - FF bus technology , when applied to the Power Industry, will revolutionize the power plant control industry.
  - The use of control in the field devices gives a new dimension to the control strategy by taking the control blocks to the field instruments.
- The debate over the benefits of using digital bus networks as the communications backbone of new power plants is all but settled.
  - The technology is maturing, and the reliability of digital hardware is superior to that of hardwired systems.

Newmont Gold Mining’s 200MW TS Power Plant

- Newmont Gold Mining’s 200-MW TS Power Plant is the power industry’s best example of how a plant-wide digital controls architecture can provide exceptional reliability and be significantly less costly to install.
- TSPP, located in Eureka Country, Nevada, gives new meaning to the words “remote I/O.”
- Fluor Power was selected as the engineering, procurement, construction, and commissioning (EPCC) contractor to complete TSPP in July 2004
- Digital Bus Networking Saves Time and Money

Foundation Fieldbus in Power Plants



Old and new. This diagram compares a traditional analog architecture with the new digital bus architecture for power plant controls. Source: Fluor

Case study from Invensys – TXU Martin Lake

- 3 Units 880 MW, CE Once-Thru Super Critical Boilers WH Steam Turbines
- I/A Series openness simplifies integration with other plant and corporate systems with
  - 28,000 I/O points,
  - 50+ Profibus Modules,
  - 20 Modbus Modules,
  - 100+ FF Modules (each can connect to 4 segments; average of 5 (or 6) devices each segment):
  - I/O distribution: 40% FF, 10% hard wired, 50% Profibus and Modbus
- I/A Series boiler control systems reduced fuel costs by allowing efficient operation over broader range of generating loads

Case study from Invensys – Enel Italy - Chivasso CCGT, 1140MW

- The project is a Thermal-CCGT, Gas fuelled, 1140 MW,
  - Includes 2 blocks of Combined Heat and Power (CHP) plants.

- DCS systems includes:

	I/O
Hardwired	6000
Foundation Fieldbus	900
Profibus redundant	9300
Ethernet (OPC – GE/GSM)	9000
Modbus	1000

Asset Management Solutions

- ❑ Invensys offers the products, services and domain expertise to meet your business requirements, from the production line to the bottom line.

- ❑ The advanced Enterprise Asset Management (EAM) solution enables your enterprise to do more than simply maintain assets. It is designed to meet the sophisticated maintenance and materials management requirements of today's asset-centric organizations.
  - ❑ It is fully and seamlessly integrated with distributed control systems on the plant floor;
  - ❑ It incorporates and responds to predictive condition monitoring processes;
  - ❑ It facilitates interface to the ERP and business network in a secure environment

Case Study I - Newfoundland Power

- Newfoundland Hydro is part of Nalcor Energy company
- Primary generator of electricity in Newfoundland and Labrador
- The company has an installed generating capacity of 1,635 megawatts
- Over 80% of the energy generated in 2008 was clean, hydroelectric generation
- Hydro sells its power to utility, industrial and 35,000 residential and commercial customers in over 200 communities across the province
- The company is committed to operational excellence while delivering safe, reliable, least-cost electricity

Newfoundland Power

- **Challenges;**
- Identified current/future maintenance needs are not kept in any one area.
- The Job Planning function for the most part not being performed.
- Work order scheduling of all work, based on work priority and asset criticality not being done. Weekly maintenance work plans not systematically created to include resource estimates and needs.
- Spare parts and stores supplies not being controlled

- **Today:**
  - Running Avantis at 23 plants
  - All plants have Avantis which they use to track Maintenance activities and costs
  - Doing more effective long term planning
  - Storerooms well managed and controlled
  - Widespread use of handhelds enables Mobile Maintenance
  - Increased safety reporting capability
    - They are also tracking personal safety equipment

Case Study II Vectren

- **VECTREN in Evansville, Indiana Utilizes Asset Management to attain Improvements in**
  - Maintenance
  - Planning
  - Cost Tracking
- Goals
  - Reduce and eliminate inefficiencies in scheduling maintenance
  - Track Completed Work
  - Reduce Operations, Maintenance and capital investments

Case Study II Vectren

- **Challenge**
- Streamline Maintenance work and Equipment processes
- Drive down the cost of unplanned work ; improve the ratio of planned to unplanned work
  - **Reasons for choosing Avantis**
- The Avantis solution allows the maintenance users to interface with other key programs
- The Windows look and feel
  - With the wide range of users – Janitors, mechanics, supervisors, little skills development was required.

- **Today**
- Continuous improvement of operations and services
- Better preventive maintenance and scheduling
- Planning work ahead – not driven by emergencies
- Tracking metrics such as:
  - Productivity of workforce,
  - Reasons for downtime
  - Reasons for delay
- Enables Reliability Centred Maintenance

Empowering 'Power' with Automation

ISA Delhi Section

TATA POWER

TMR BOARDS ON INTRA PLANT BUS IN TATA POWER

VIJAYANT RANJAN – TATA POWER COMPANY LTD
M.V.V.PHANINDRA - TATA POWER COMPANY LTD

- **ISA (D) POWAT 10 May 28-29, 2010, Mumbai**

TOPICS TO COVER

- FLASHBACK OF OUR LAST PRESENTATION IN ISA(D),2009.
- INTRODUCTION TO PROCONTROL SYSTEM.
- COMMUNICATION BETWEEN TMRs & WITH IPB.
- TRIGGER TO GO FOR IPB EXTENSION.
- HOW TO INTERFACE IPB WITH LOCAL BUS
- CHALLENGES & SOLUTION.
- COMMUNICATION OF TMR STATIONs AFTER IPB EXTENSION.
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Data Transmission:

The data transmission of PROCONTOL P13/42 is performed with simple, two level serial bus systems
- Local Bus – P13 Bus
- Intra-pant bus (IPB) – P42 Bus

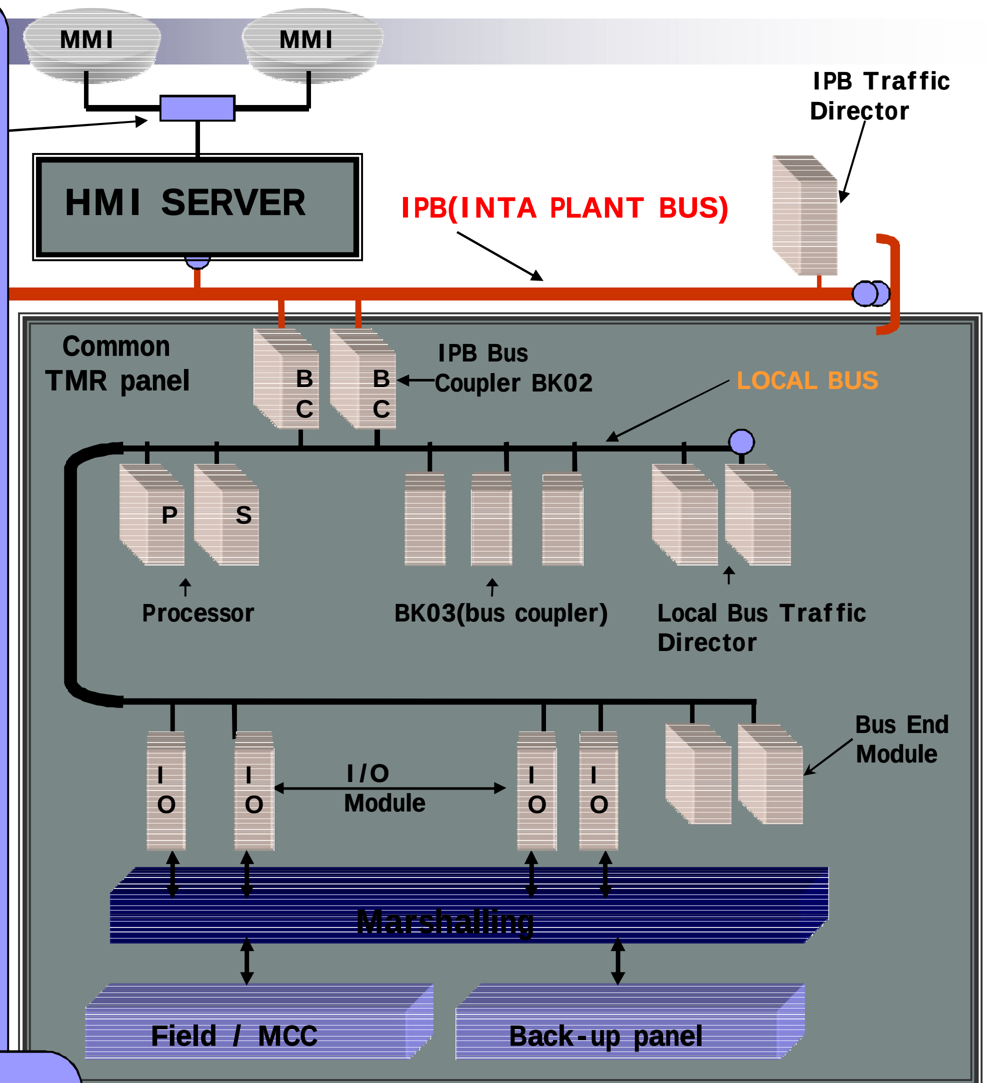
The **local bus** interconnects all input, output and processing electronic modules which are part of the station. Each individual local bus is self contained, working independently from any other local or intra-plant bus.

The **intra-plant bus** interconnects local buses via co-axial cables. This interconnection provides galvanic separation and dynamic data transfer. Each IPB have two lines (A&B) which are redundant.

IPB Bus traffic director (FV01) – Controls/directs the signal flow on IPB, Data which needs to float in IPB should be listed in FV01 .

Bus coupler (BK02) – Couples the Intra-plant bus and the local bus. It performs the bi-directional exchange of data between the two bus Systems based on Source/Sink Program written in EPROM.

Processor module (70PR05): It acts as a brain of the control station and executes the logics as programmed.



ISA Delhi Section TATA POWER

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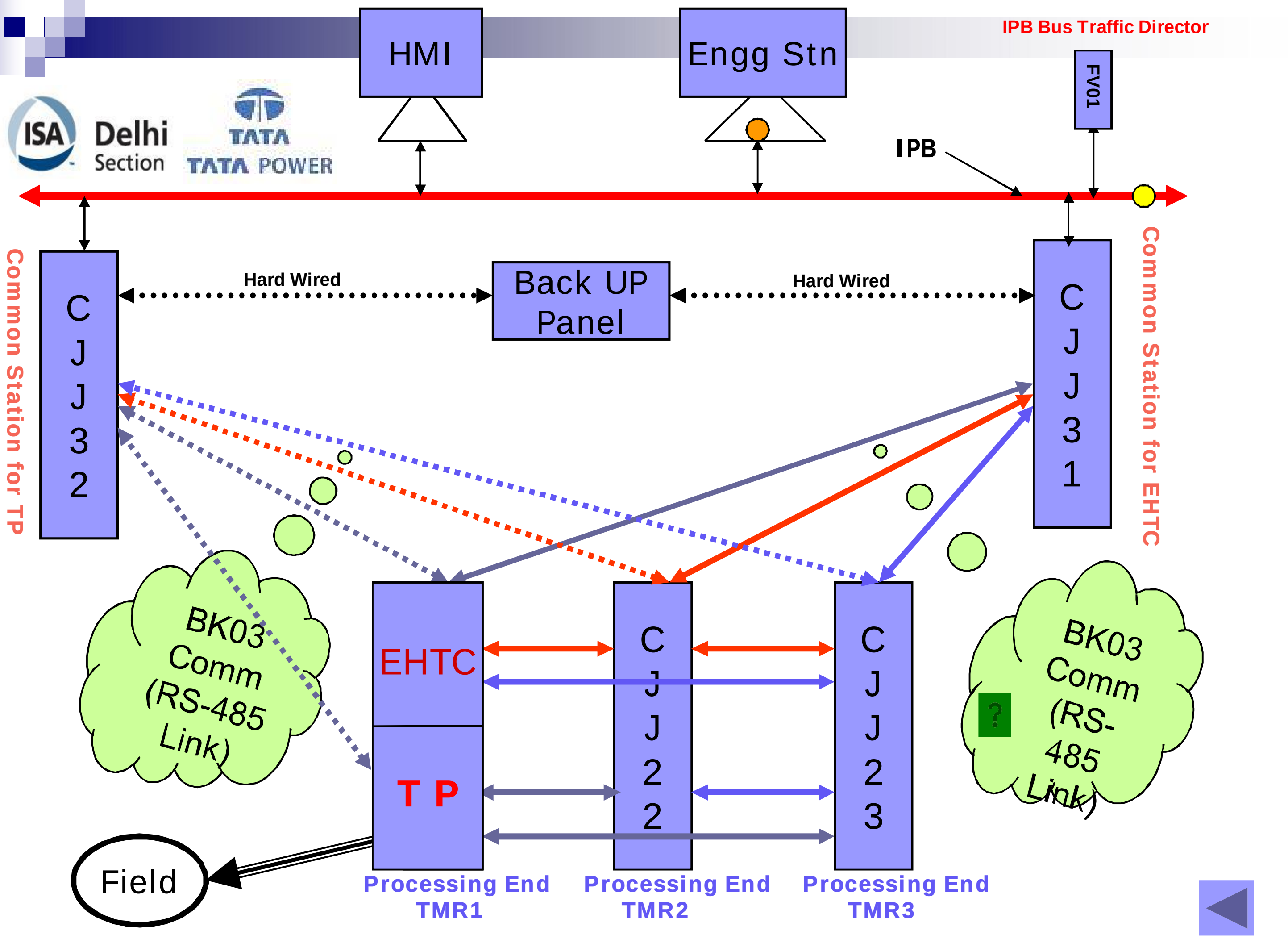
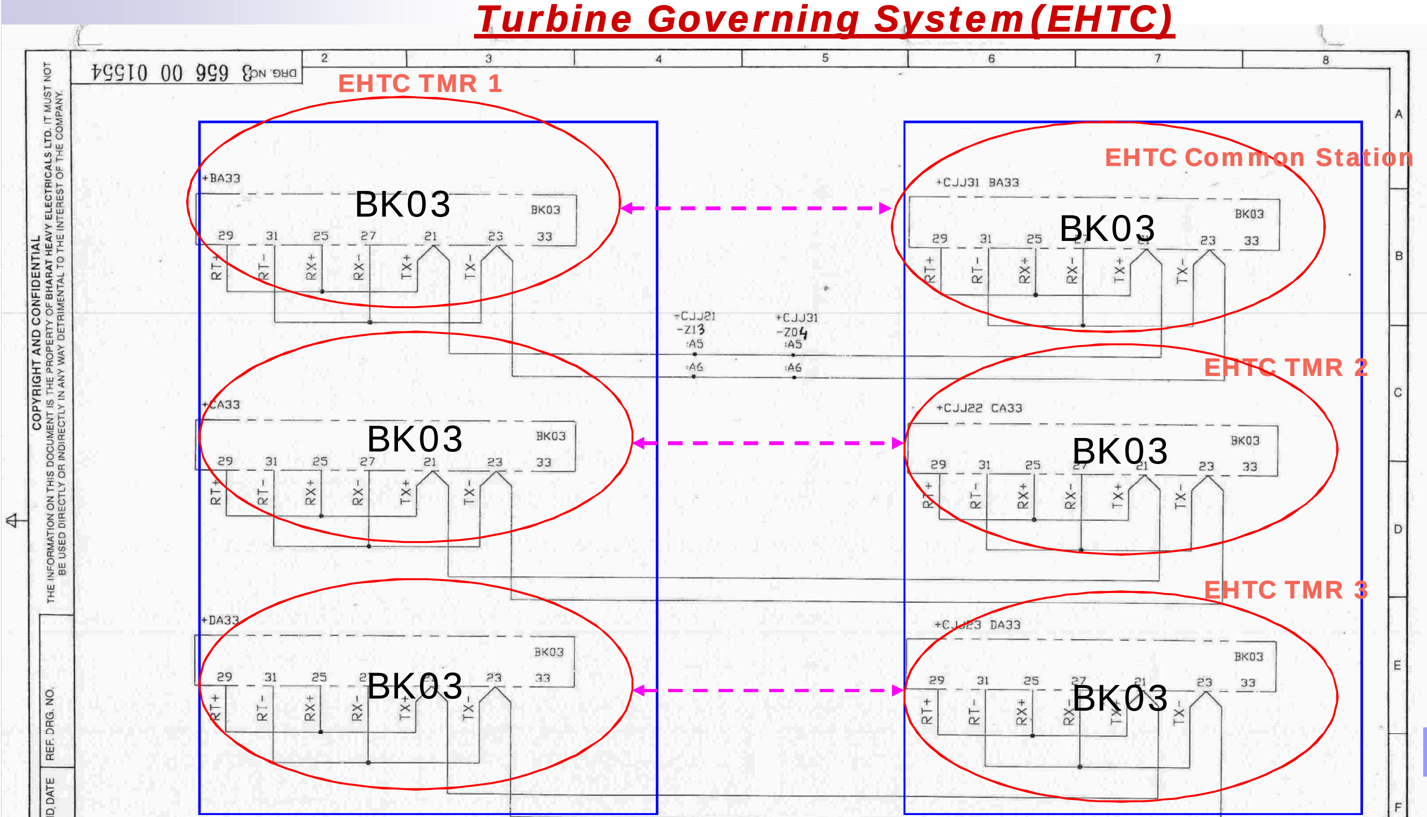

HMI
Engg Stn
IPB Bus Traffic Director
FV01
IPB
Hard Wired
Back UP Panel
Hard Wired
C J J 3 2
C J J 3 1
Common Station for TP
Common Station for EHTC
BK03 Comm (RS-485 Link)
EHTC
T P
C J J 2 2
C J J 2 3
BK03 Comm (RS-485 Link)
?
Field
Processing End TMR1
Processing End TMR2
Processing End TMR3

Single Line Diagram of BK03 for TMRs

Turbine Governing System(EHTC)



EHTC (TMR-1)	EHTC Common Station(1) EHTC TMR 2(2) EHTC TMR 3(3)

FORM No. A3 - 03 SIZE A3

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TRIGGER POINTS TO GO FOR IPB EXTENSION

- Online Uploading and Downloading of Logics in TMR panels were not possible. Look for Opportunity shutdown for even Minor logic modifications.
- TMRs Raw element signals are not available in HMI.
- Signal simulation in TMR panels not possible.
- Online Diagnosis was not possible.

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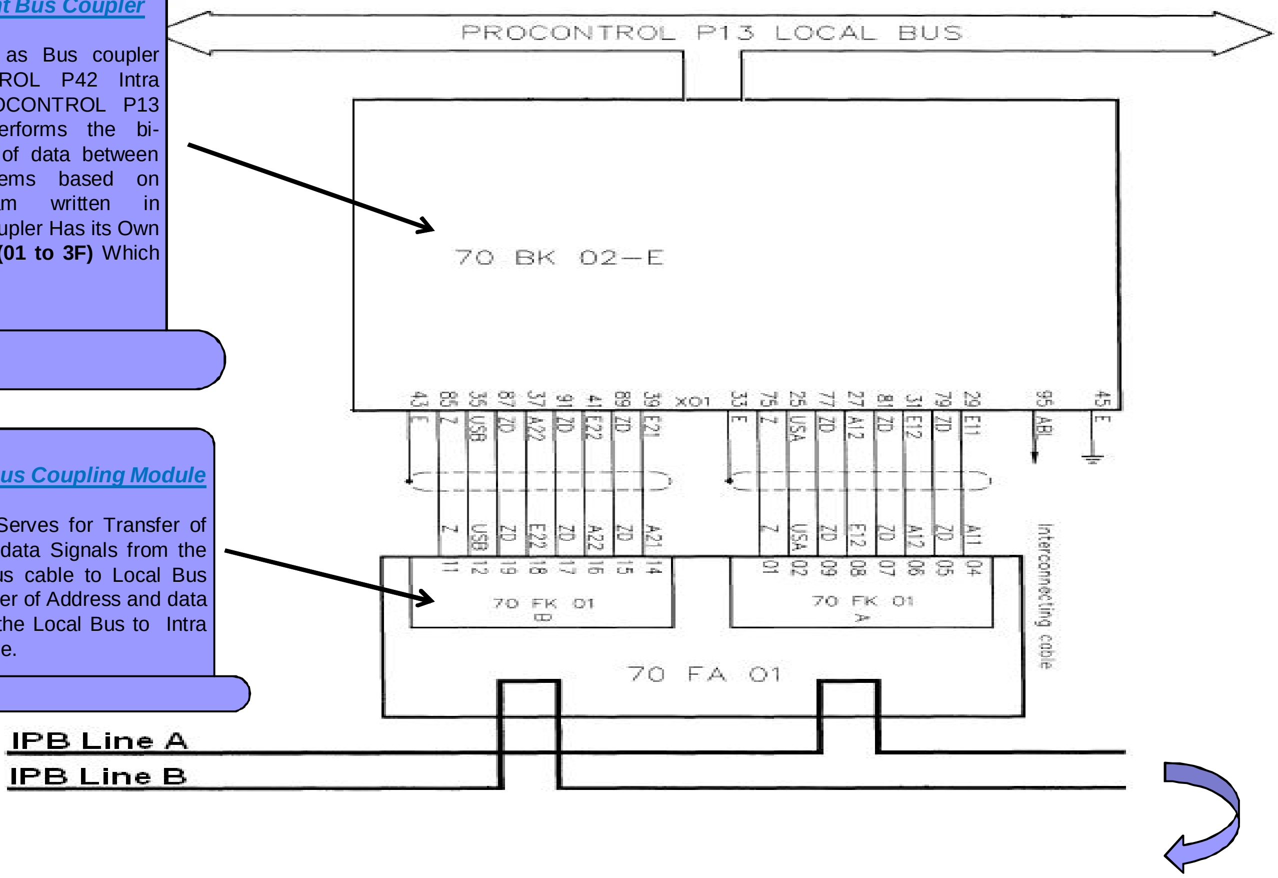
Local Bus/Intra plant Bus Coupler

The Module Serves as Bus coupler between PROCONTROL P42 Intra Plant Bus and PROCONTROL P13 Local Bus. . It performs the bi-directional exchange of data between the two bus Systems based on Source/Sink Program written in EPROM.Each Bus Coupler Has its Own Bus coupler address **(01 to 3F)** Which is adjustable.

Intra-Plant Bus Coupling Module

The Module Serves for Transfer of Address and data Signals from the Intra plant Bus cable to Local Bus and for Transfer of Address and data Signals from the Local Bus to Intra plant Bus cable.



INTRA PLANT BUS TO LOCAL BUS CONNECTION DIAGRAM

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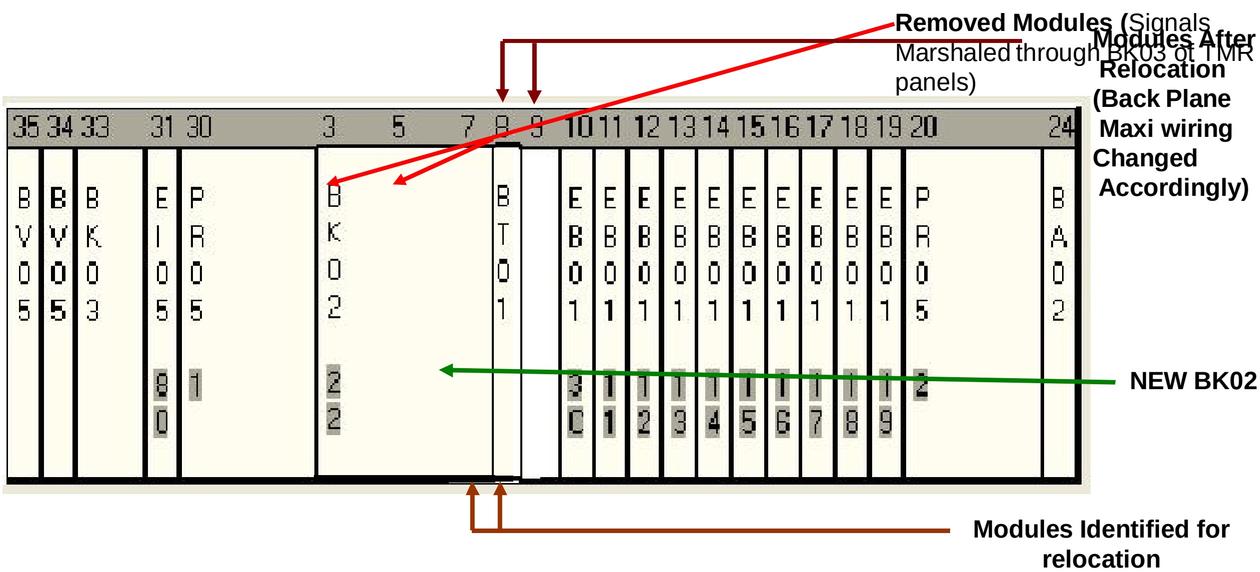
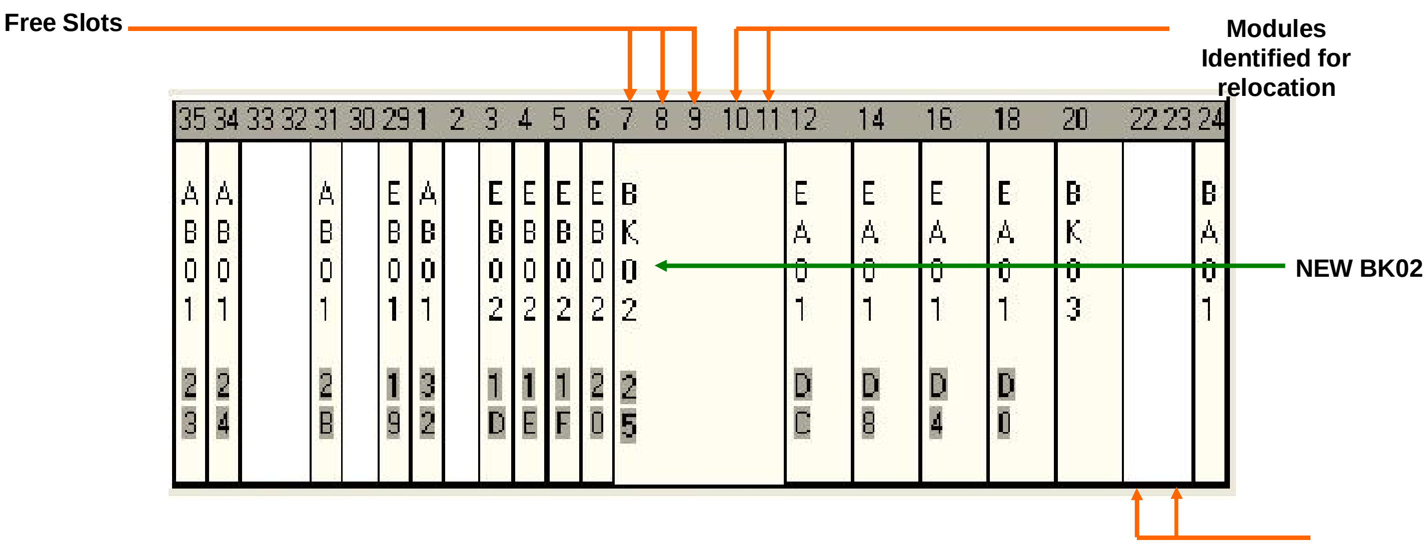
CHALLENGES

- To Install BK02 (Local Bus/Intra Plant Bus Coupler) in TMR station we needed 5 continuous free slots which was a real challenge as the original Hardware configuration we didn't have 5 free slots available.
- Loading on IPB.
- Mounting of FABOX in TMR panels.



EHTC TMR RACK CONFIG AFTER PB Extn
EHTC TMR RACK CONFIG BEFORE PB Extn



Modules after Relocation (Back Plane Maxi wiring Changed Accordingly)

TP TMR RACK CONFIG AFTER PB Extn

TP TMR RACK CONFIG BEFORE PB Extn

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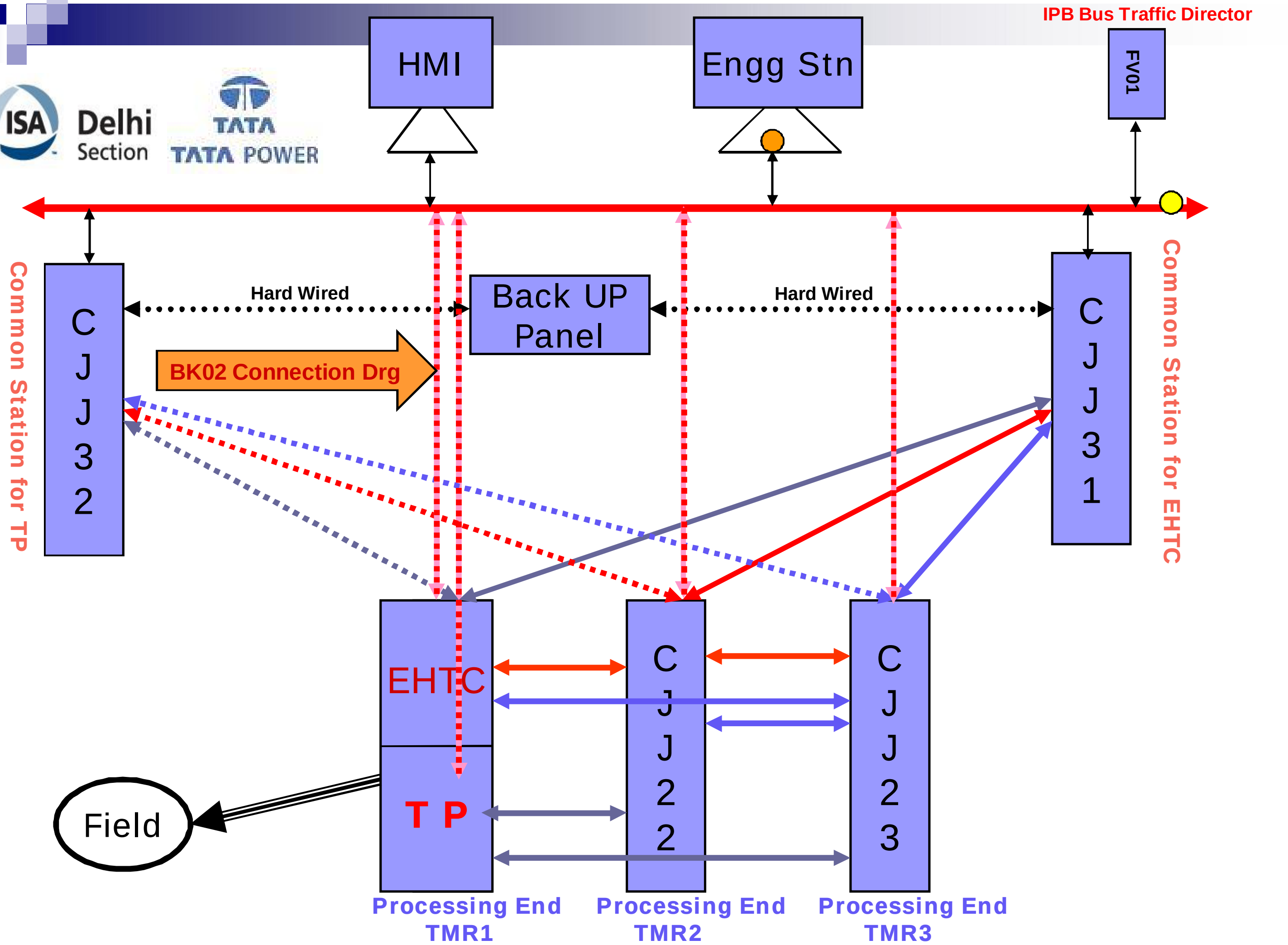

IPB Bus Traffic Director
HMI
Engg Stn
FV01
Common Station for TP
C J J 3 2
Hard Wired
Back UP Panel
Hard Wired
C J J 3 1
Common Station for EHTC
BK02 Connection Drg
EHTC
T P
C J J 2 2
C J J 2 3
Field
Processing End TMR1
Processing End TMR2
Processing End TMR3

ISA Delhi Section TATA POWER

PROPOSED SOLUTIONS

• Add one Sub rack and Extend Local Bus to that Rack – No Space Available in the TMR panels.

• Erection of one panel close to TMR panels & Extend Local Bus to New panel

– Which was not feasible ,Control Room Lay out Didn't Permit.

– Fixed cycle time of Annual Shutdown-21 days, System Up gradation Project was going on (New HMI and Engineering Station Commissioning) in Parallel .

•**Redistribute Signals** - In EHTC TMR stations identified some of the least priority signals, and mapped those signals in BK03 to ensure the availability of the same. Two Modules Relocated so that 5 Nos of Continuous free slots could be made available for BK02.

In TP TMR 3 Free slots Available , 2 Modules had to be Relocate so that 5 Nos of Continuous free slots could be made available for BK02.

TOPICS TO COVER

- FLASHBACK OF OUR LAST PRESENTATION IN ISA(D),2009.
- INTRODUCTION TO PROCONTROL SYSTEM.
- COMMUNICATION BETWEEN TMRs & WITH IPB.
- TRIGGER TO GO FOR IPB EXTENSION.
- HOW TO INTERFACE IPB WITH LOCAL BUS.
- CHALLENGES & SOLUTION.
- COMMUNICATION OF TMR STATIONs AFTER IPB EXTENSION.
- CONCLUSION.

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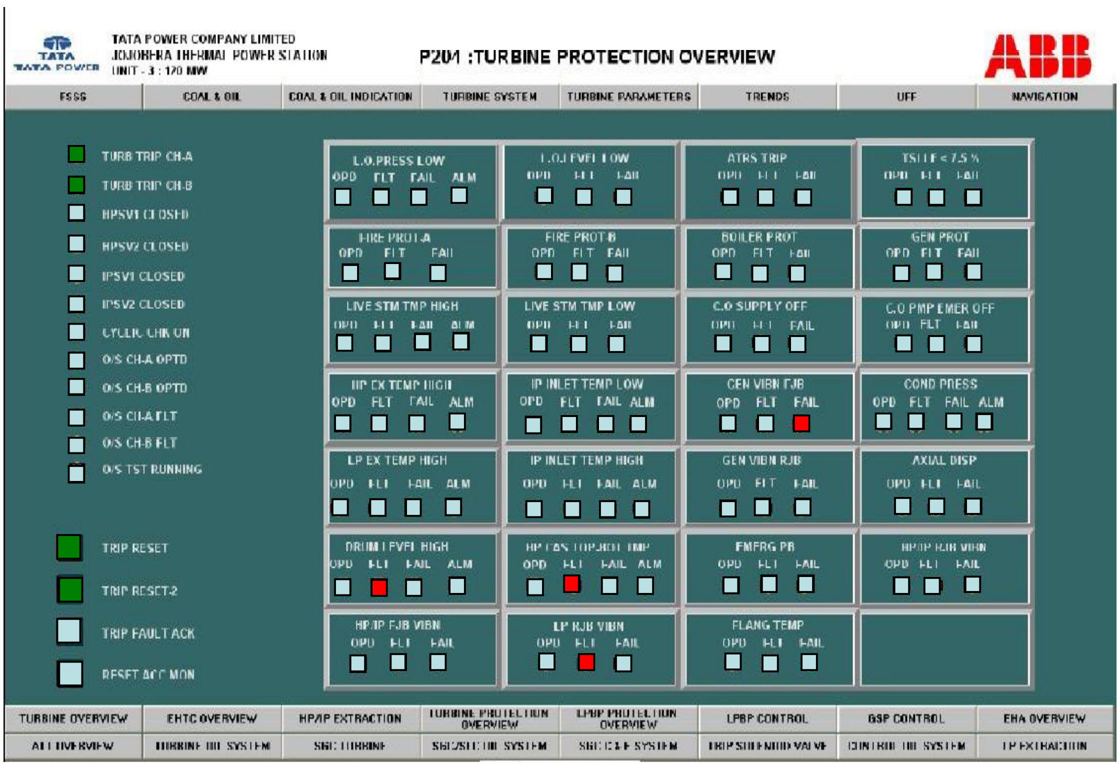

Common Turbine Protection Overview page Before IPB Extension Project

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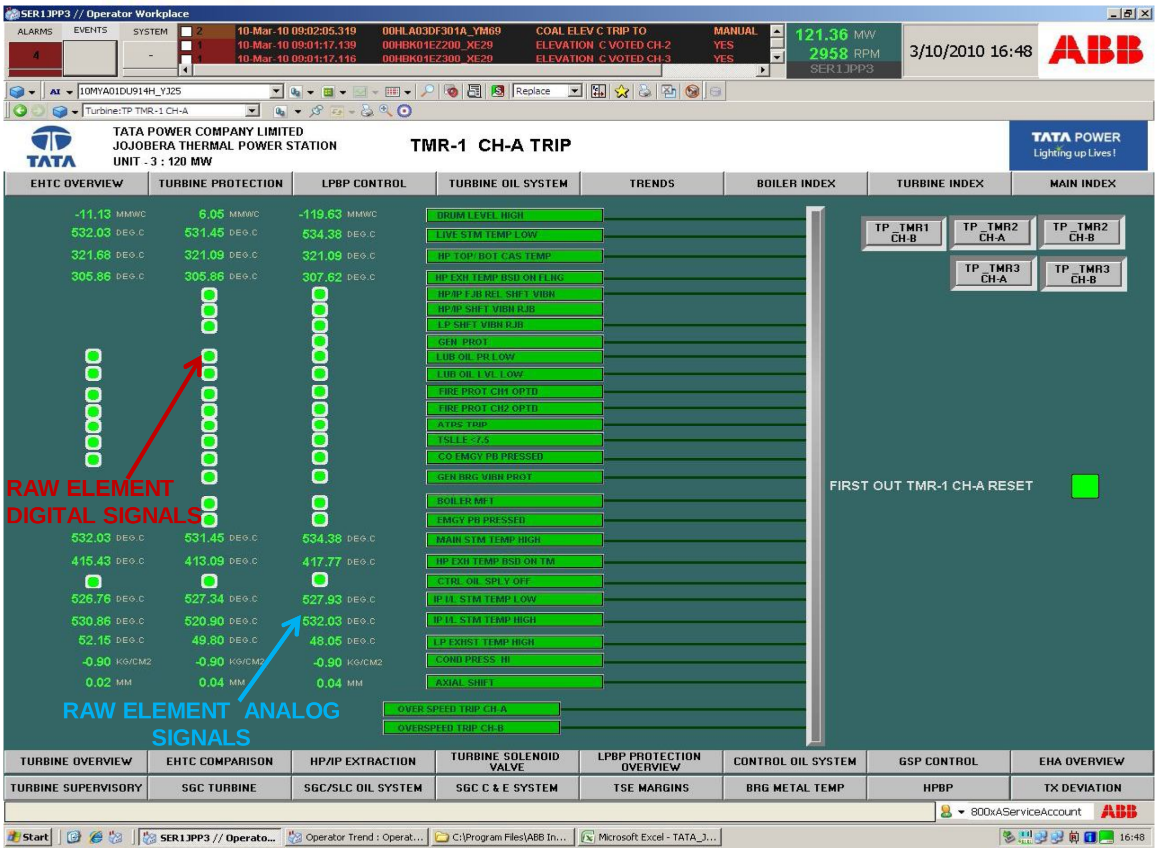
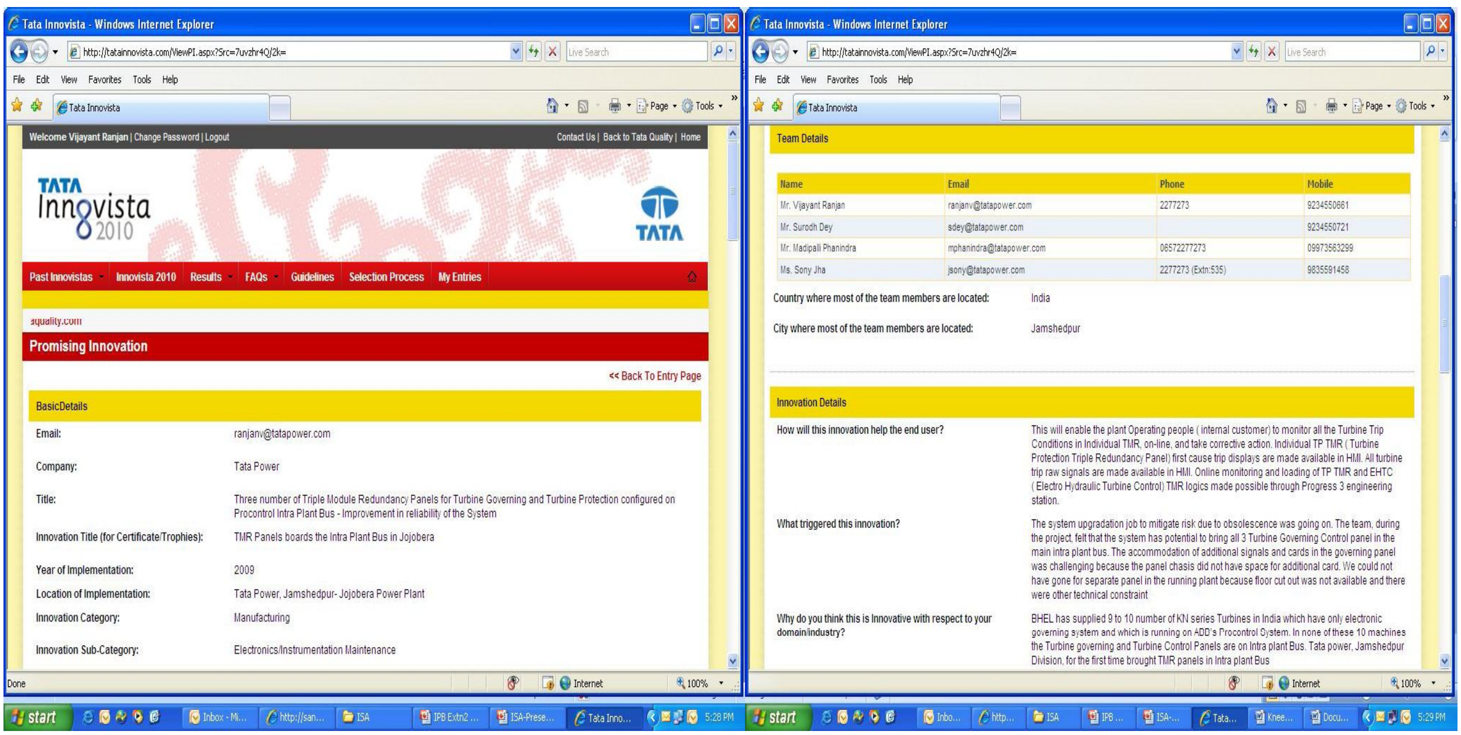


<u>First Cause of Turbine Trip TMR1 CH-A & Raw element Signals in HMI after IPB Extension</u>

Some of the benefits/outcomes of this project are

- ✓ TP TMR first cause trip displays are made available in HMI - which enabled us to quickly identify Root cause of Tripping/Disturbances & rectification of the same.
- ✓ Accessibility of TMR panels Controllers (Total 18 Nos) which enabled Online monitoring and loading of TP TMR and EHTC TMR logics made possible from centralized location, no need to wait for Opportunity Shutdown even for Minor logic modifications etc.
- ✓ All turbine trip raw signals are made available in HMI & Raw signals configured as alarm able - Better monitoring of Turbine Protection conditions and proactive action in case of any single Raw element fault. Increased reliability.
- ✓ Peripheral signal/Local Bus signal simulation is possible in TMR stations.



This Project has been Shortlisted for Final Round in TATA Innovista 2010, Conducted all over TATA Group of Companies.

THANK YOU

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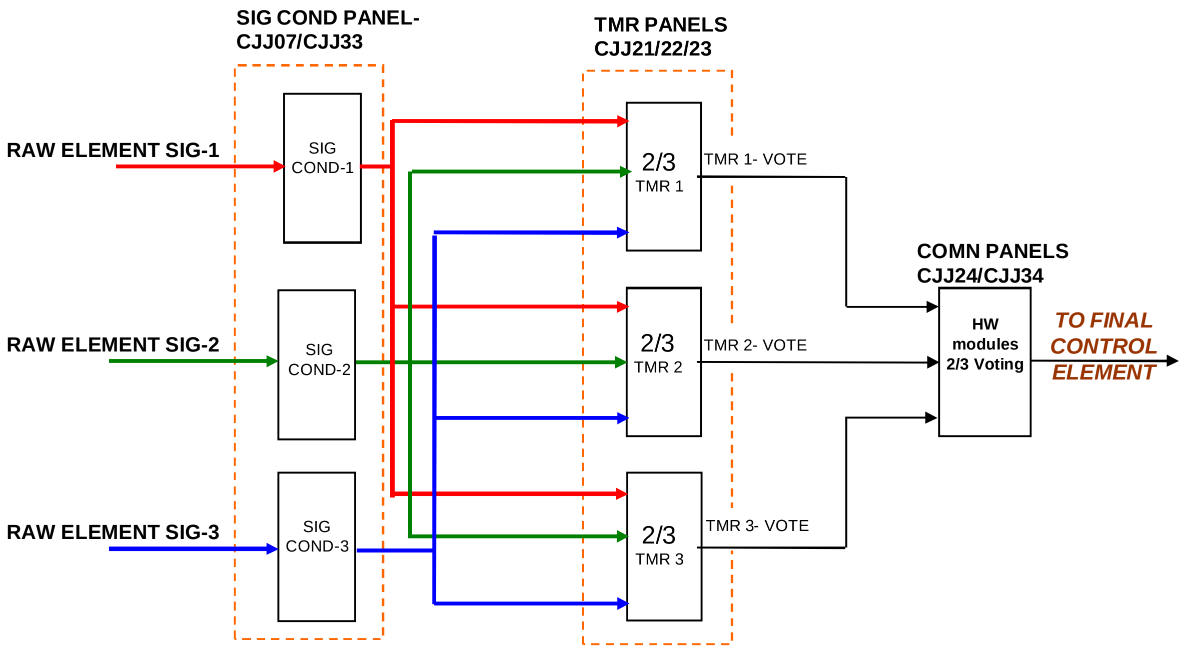
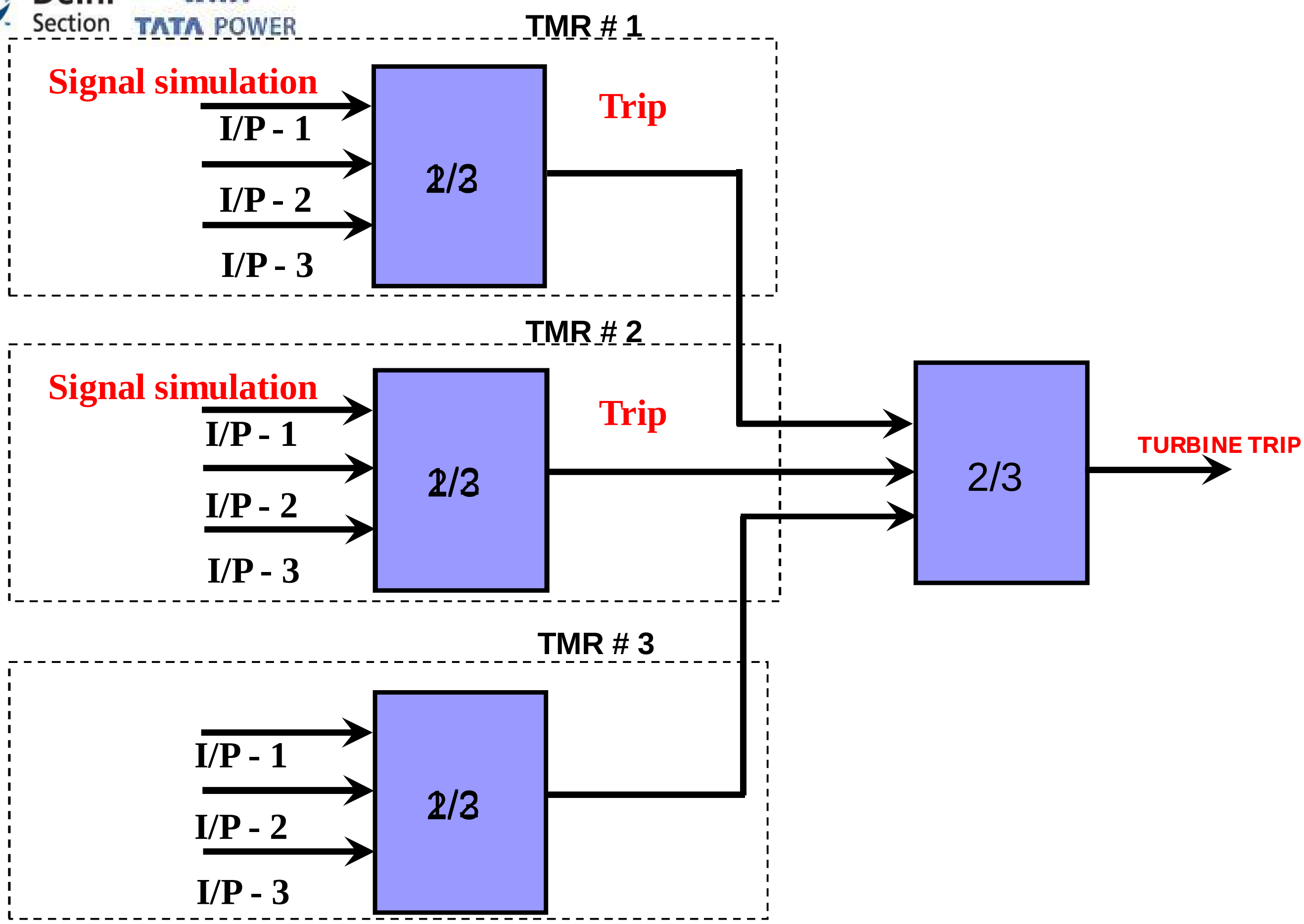
TURBINE TRIP CASE STUDY (120 MW)

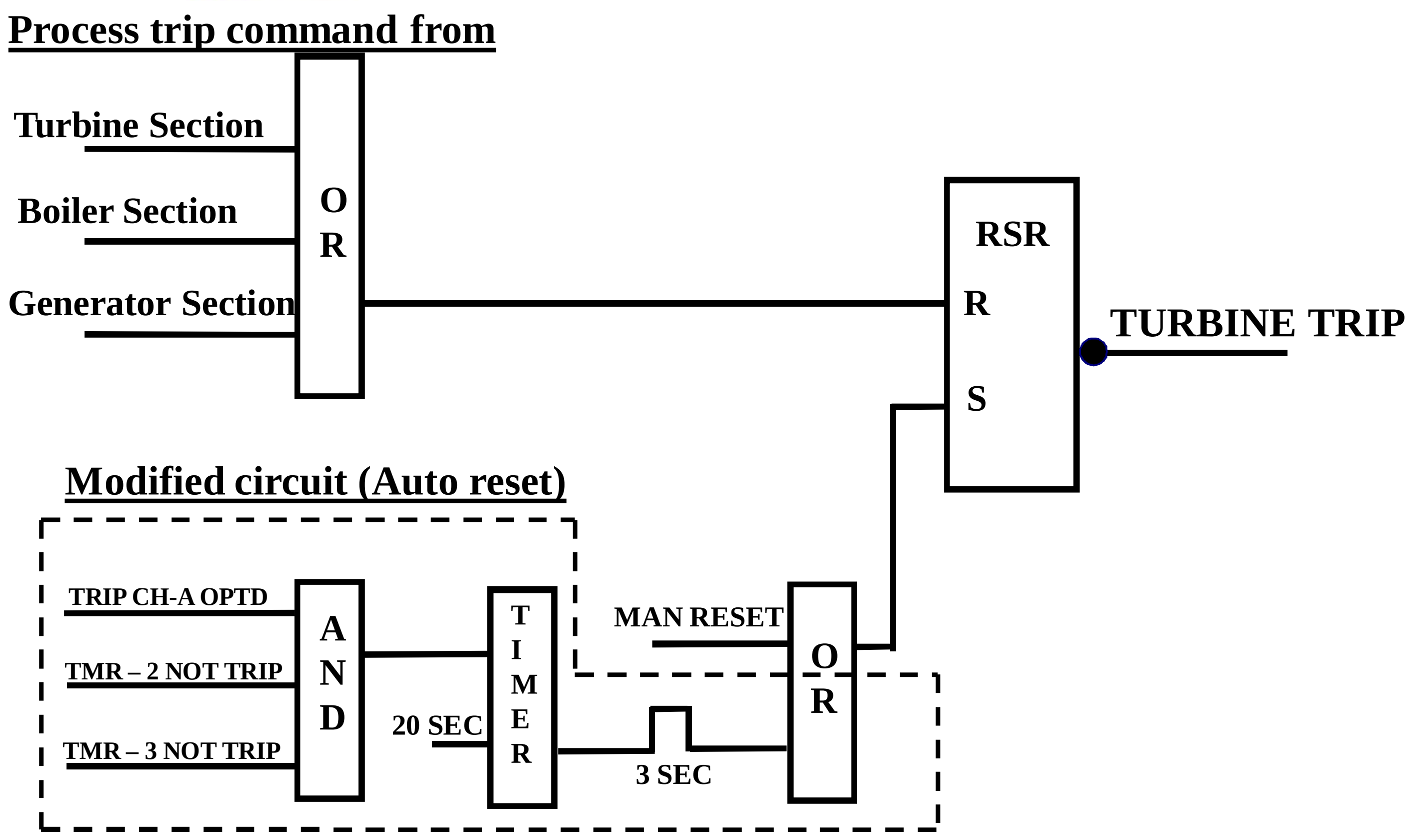
VIJAYANT RANJAN – TATA POWER COMPANY LTD
SONY JHA - TATA POWER COMPANY LTD

- **ISA (D) POWID INDIA 09**
  April 24-25, 2009, New Delhi



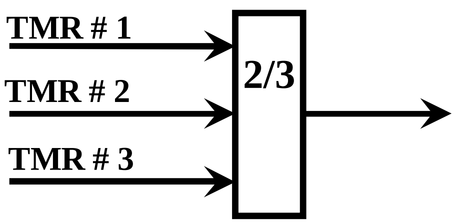
SIGNAL FLOW DIAGRAM OF TMR PANELS


TMR # 1
Signal simulation
I/P - 1
I/P - 2
I/P - 3
2/3
Trip
TMR # 2
Signal simulation
I/P - 1
I/P - 2
I/P - 3
2/3
Trip
TMR # 3
I/P - 1
I/P - 2
I/P - 3
2/3
2/3
TURBINE TRIP



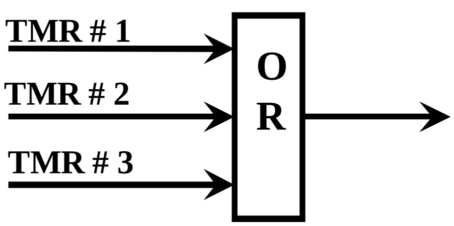
Turbine Trip Circuit (After Modification)

Process alarm from



Alarm Circuit (Before Modification)

Process alarm from



Alarm Circuit (After Modification)

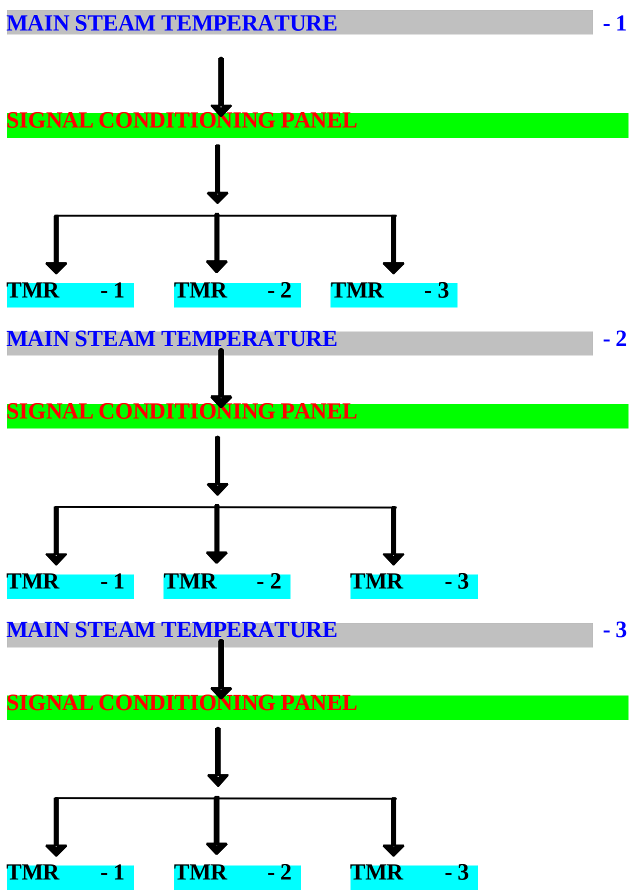
Contd..

CONCLUSION

Upon rectification of the problem, the team discussed about some of the similar trippings in past. However, **because of insufficient alarm configuration, root cause fault analysis could not be carried out correctly.**

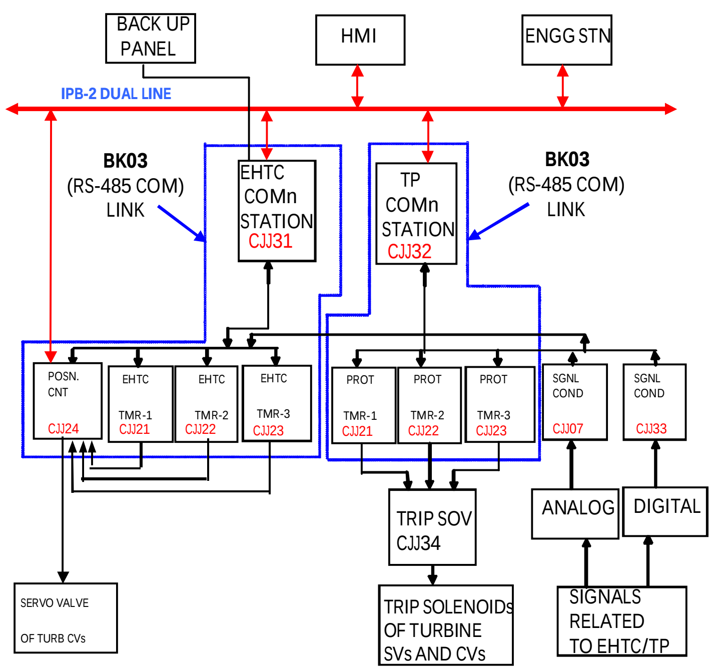
After the analysis, the root cause of the problem was identified to be spurious fault simulation by I/O cards. This was also confirmed later by BHEL that this is an inherent problem of the Pro-control I/O cards and therefore cannot be eliminated at site. Also, these cards are not intelligent enough for self diagnosis.

However, to improve the reliability of the units, the corrective actions were taken at logic level to eliminate the tripping because of fault simulation of cards. The same modifications shall be carried out in other units as and when opportunity comes.



MAIN STEAM TEMPERATURE - 1
SIGNAL CONDITIONING PANEL
TMR - 1
TMR - 2
TMR - 3
MAIN STEAM TEMPERATURE - 2
SIGNAL CONDITIONING PANEL
TMR - 1
TMR - 2
TMR - 3
MAIN STEAM TEMPERATURE - 3
SIGNAL CONDITIONING PANEL
TMR - 1
TMR - 2
TMR - 3

PANEL CONFIGURATION OF TURBINE CONTROL & PROT



DURAG INDIA Instrumentation Private Limited

ISA Delhi Section

Strategies and Solutions for monitoring of Pollutants in Flue Gas and Ambient Air monitoring solutions

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- ISA (D) POWAT-2010
May 28-29, 2009, Mumbai