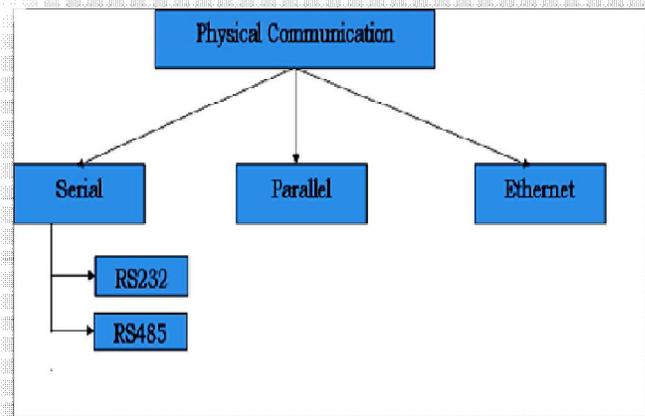




## **Agenda**

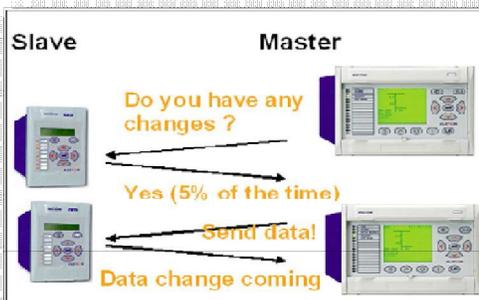
- Communication and its types
- Master slave and Client server architecture
- Protocols, types and Protocol converters
- IEC 61850 emergence
- Network Architectures
- Network Redundant protocols
- Conclusion

- 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

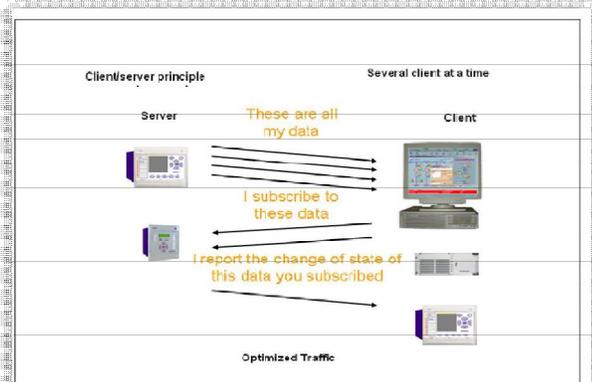
- Master Slave
- Client Server



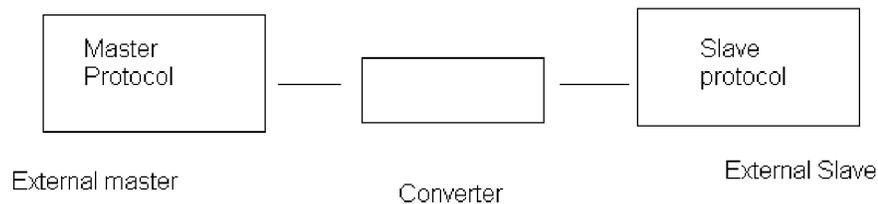
The Master is requesting the data from its slave(s), and can also send orders (control) to the slave.

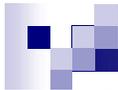


The slave replies to the Master only upon request, the Master can address him with specific address or by broadcasting.



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





**Delhi**  
Section



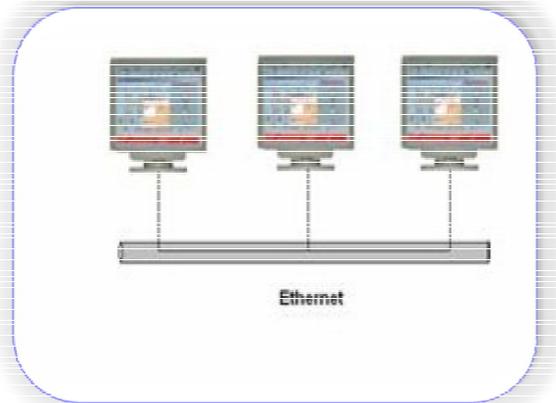
## ***IEC 61850's Emergence***

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### ***Advantages***

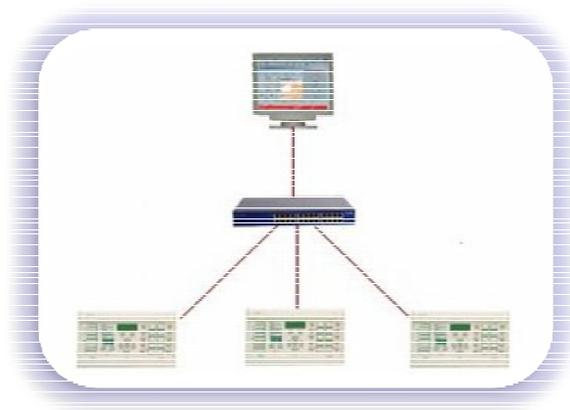
- High speed communication
- Peer to Peer connection
- Interoperability
- Uniformity
- Simplified Engineering process
- Redundant system
- Conditional reporting
- Client Server architecture
- Standard Structure for naming Logical nodes

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



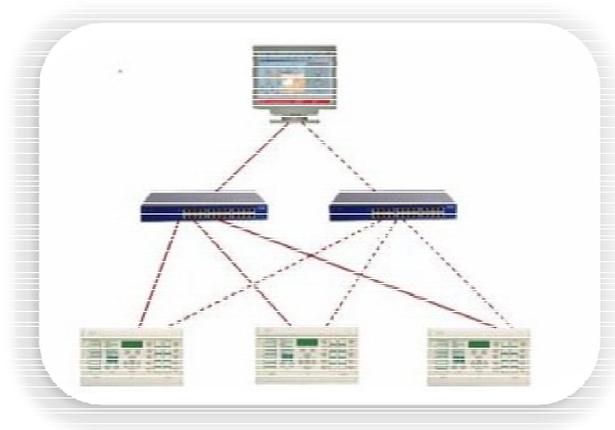
## ***Network Topology*** ***– Star Topology***

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



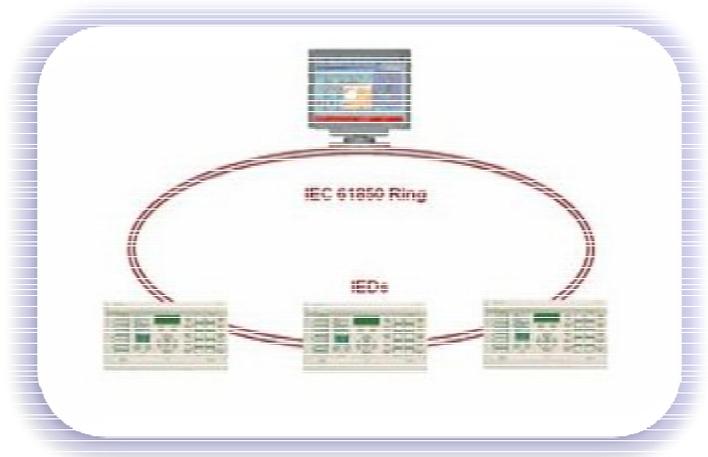
## Network Topology – *Double Star Topology*

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



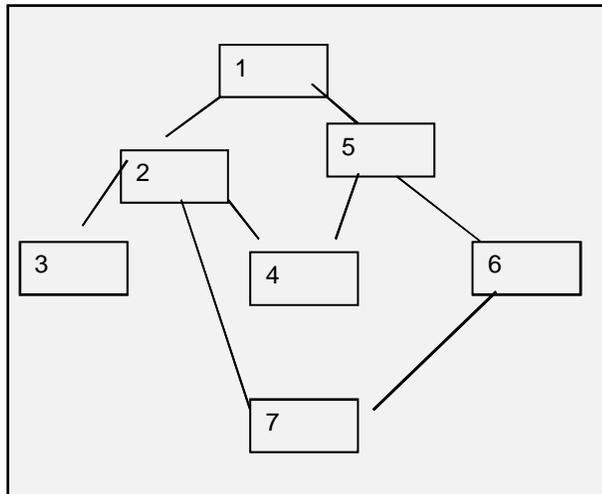
## ***Network Topology*** ***– Ring Topology***

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



## 1. RSTP

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

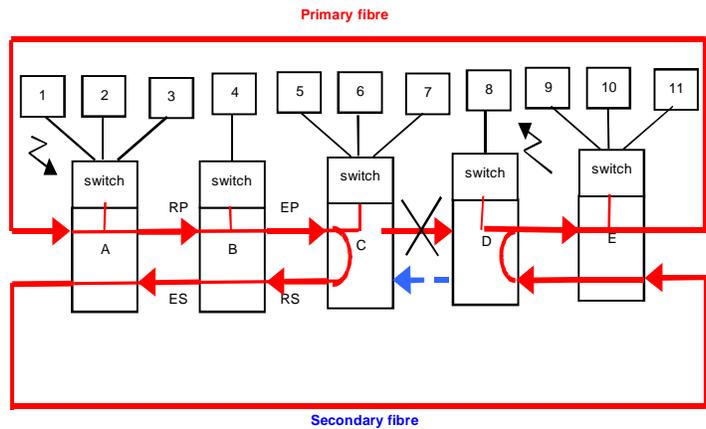
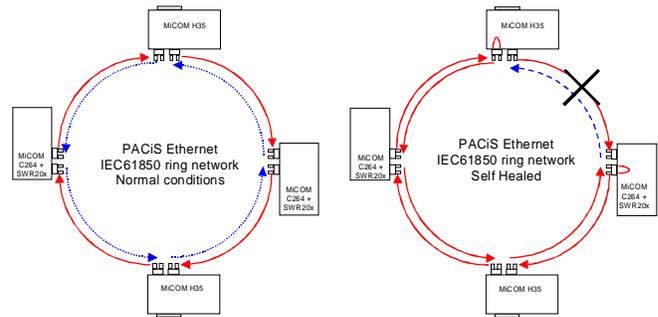


## Network Redundancy Protocols

### - SHP

#### 2. SHP

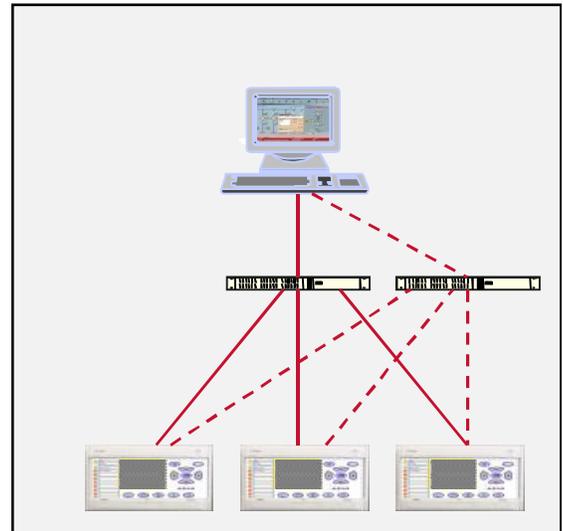
Both rings are active when a message passes at the starting. Normally the Ethernet packets travel on the primary fiber in the same direction, and only a checking frame (4 octets) is sent every 5 μs on the secondary fiber in the opposite direction.



3. Dual Homing

Used in double star architecture.

Both main and backup active at starting.



- *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.*



***Thank You..***



**invensys**  
Operations Management

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

**RAHUL NARGOTRA  
Invensys Operations Management**

- **ISA (D) POWAT 2010 Mumbai,  
28<sup>th</sup> and 29<sup>th</sup> May 2010**

**invensys**  
Operations Management



Delhi  
Section

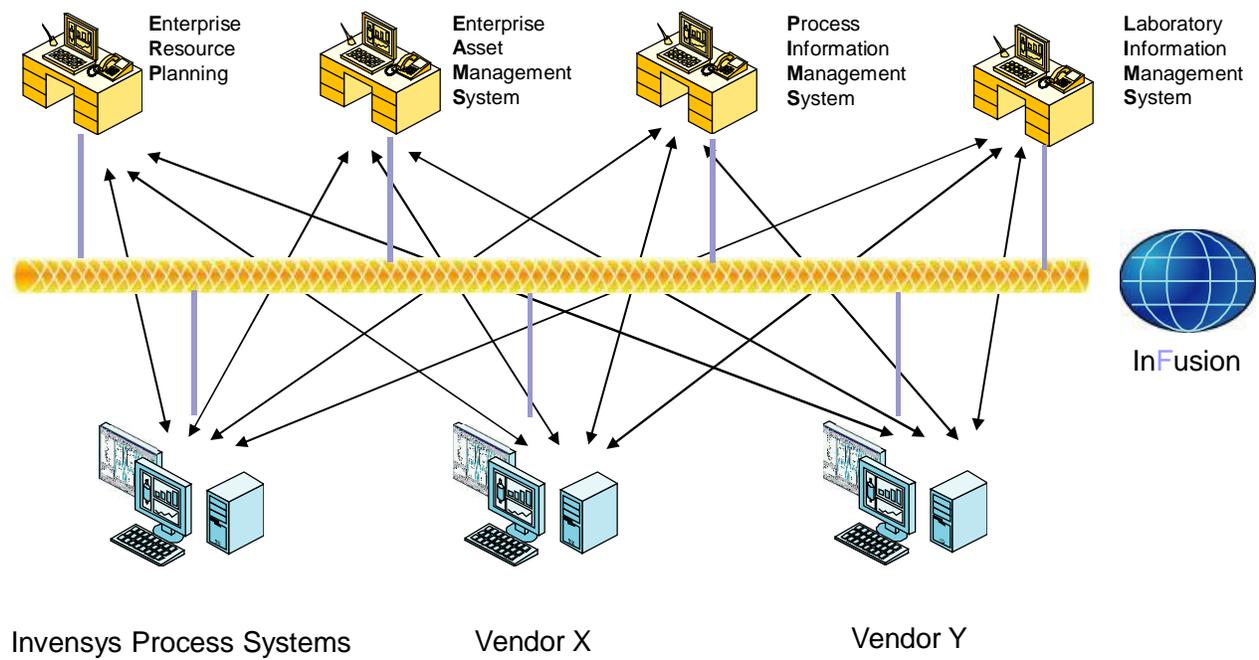
## Generation Management Systems

- 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

***Empowering 'Power' with Automation***

**INVENSYS**  
Operations Management

# 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

Date	Time	Status	Type	Name	Value	Limit	Group	Comment	Sp
20 May	10:10	UNACK	LOLO	R ASC HDV DEV	16.362	10	Dynamic Calor.		3CC
20 May	10:07	UNACK	W	R ASC CIVIL WORKING	11000	20	Generation		3CC
20 May	10:12	UNACK	W	R ASC HDV DEF 10N	114200	10	def		3CC

Resource	Actual MW	SCE Share	Schedule	Deviation	SetPoint	Ramp	Capacity
Hoover	371	378	400	22	351.40	.....	0
Big Creek	742	742	755	13	741.16	.....	2200
Mokave 1	1	0	0	1	0.53	.....	100
Mokave 2	0	0	0	0	0.00	.....	100
Four Corners 4	745	311	460	50			
Four Corners 5							
Palo Verde 1	126	597	500	47			
Palo Verde 2	1215						
Palo Verde 3	1261						
San Onofre 2	1133	851	1115	18			
San Onofre 3	950	818	1105	15			
Bio Mass	46	45	68	59			
Capean	1518	1518	1300	-189			
Geo Thermal	322	322	340	280			
Hydro	10	10	35	30			
Solar	185	185	247	1100			
Wind	70	70	412	326			



## 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

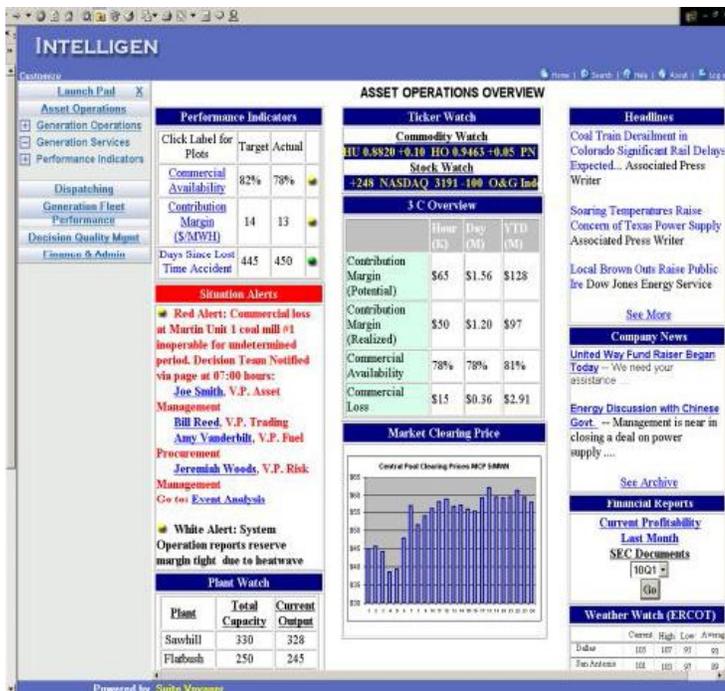
← Resulting in the Right ACTION

← Producing the Right RESULTS

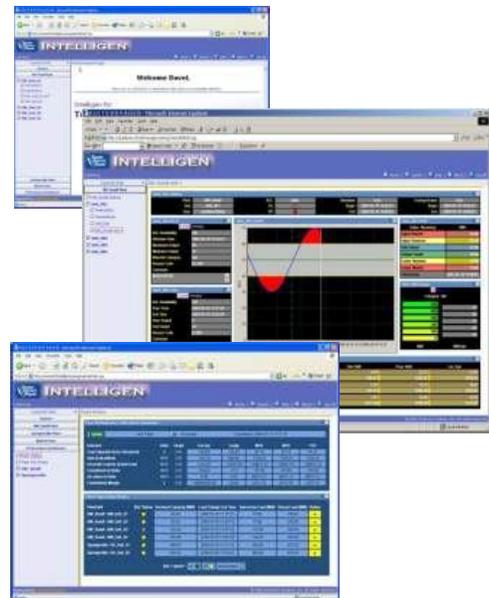
} cost  
flexibility  
capacity

} Human  
Performance

# Components



**Management Dashboard**



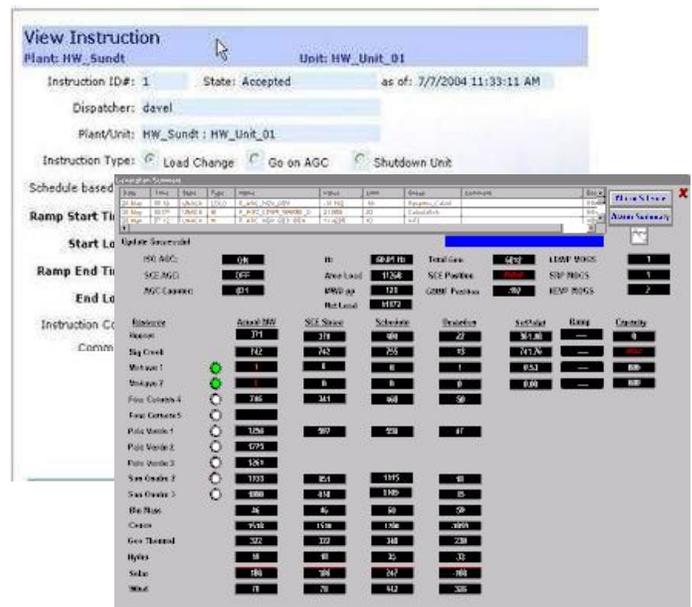
**Core & Advanced Applications**

# 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

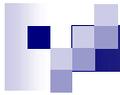


# Fleet GMS Core Functionalities



## 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**

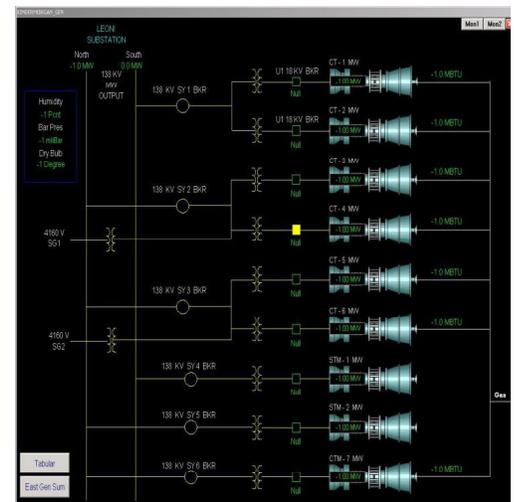
- 2 Redundant Main Servers acting as Infusion Primary and Secondary Servers
- High Availability Infusion Historian Database Server
- High Availability Web Portal Server Utilizing Infusion SuiteVoyager
- 8 Operator Stations
- An Engineering station for development using the InFusion Engineering services

## **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

**WONDERWARE - Windows Internet Explorer**  
 http://pdsmpkscv/pdsgeneration/useng/main/default.asp

**Eskom Generation PLANT DATA SYSTEM**

**DVP\_Turbine**

**Duvha Unit 1 Turbine**

**UNIT**

1	2	3
4	5	6

**LP 1 Turbine**

Bearing 5 Temp	59 °C
Bearing 6 Temp	60 °C
Bearing 5 Vibration	41 uM
Bearing 6 Vibration	62 uM

**LP 2 Turbine**

Bearing 7 Temp	57 °C
Bearing 8 Temp	2 °C
Bearing 7 Vibration	33 uM
Bearing 8 Vibration	16 uM

**LP Bypass**

LH Valve Temp	491 °C
RH Valve Temp	471 °C
LH Valve Inlet Press	4 KPa
RH Valve Inlet Press	4 KPa

**HP Turbine**

GOV Valve Pressure	15 KPa
Bearing 1 Temp	60 °C
Bearing 2 Temp	59 °C
Bearing 1 Vibration	96 uM
Bearing 2 Vibration	100 uM
Thrust Bearing Temp	0 °C

**IP Turbine**

LHB GOV Valve Press	369 KPa	LHB Inlet Temp	536 °C
RHT GOV Valve Press	3405 KPa	RHB Inlet Temp	535 °C
Bearing 3 Temp	0 °C	LHT Inlet Press	3525 KPa
Bearing 4 Temp	67 °C	RHB Inlet Press	3522 KPa
Bearing 3 Vibration	99 uM		
Bearing 4 Vibration	20 uM		

**VA Status** | **Overview** | **Boiler** | **Turbine** | **GenCapCurve**

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# 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.

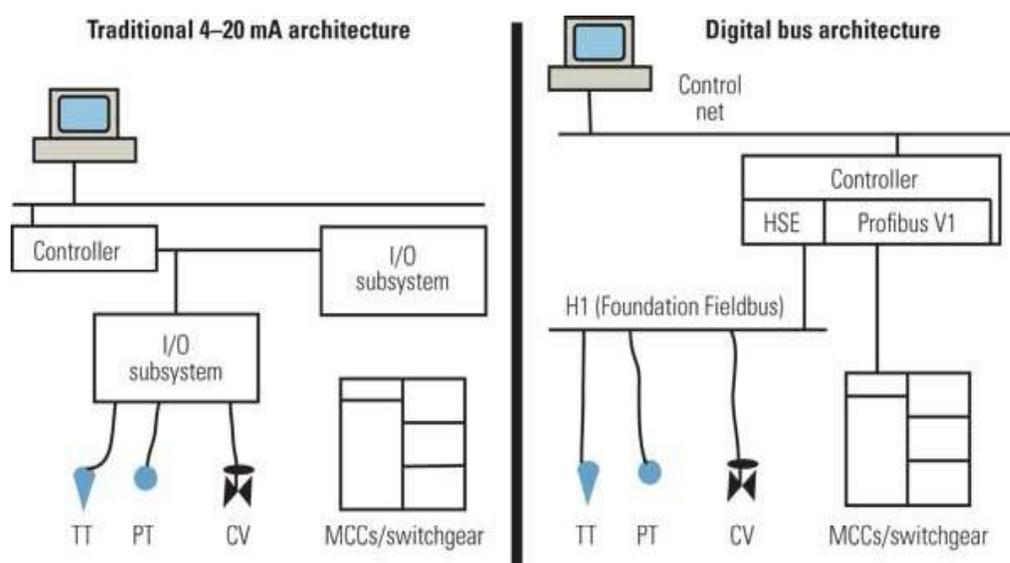
# Newmont Gold Mining's 200MW TS Power Plant



- ❑ 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*



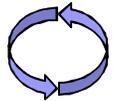
## TMR BOARDS ON INTRA PLANT BUS IN TATA POWER

**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.
- CONCLUSION.



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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-plant bus (IPB) – P42 Bus

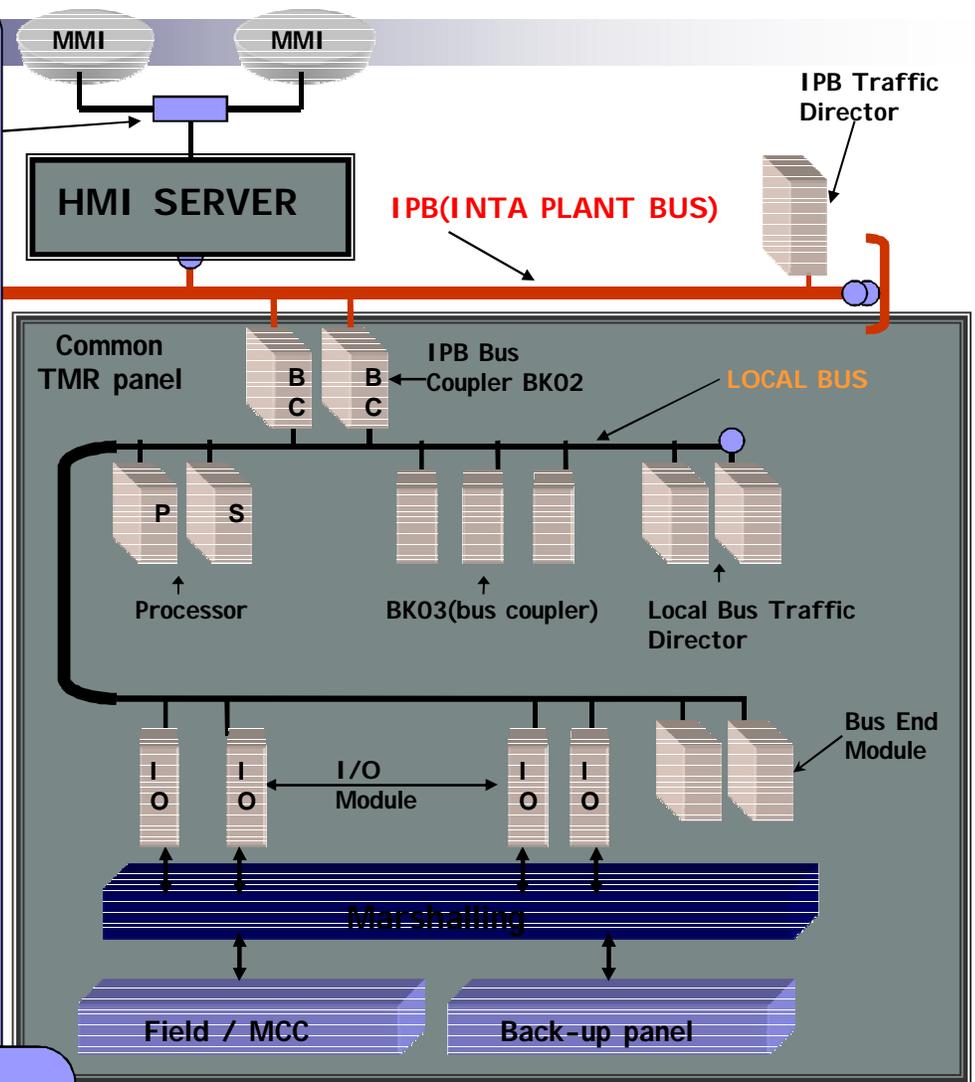
The **local bus** interconnects all input, output and processing electronic modules which are part of the station. Each individual local bus is self contained, working independently from any other local or intra-plant bus.

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 .

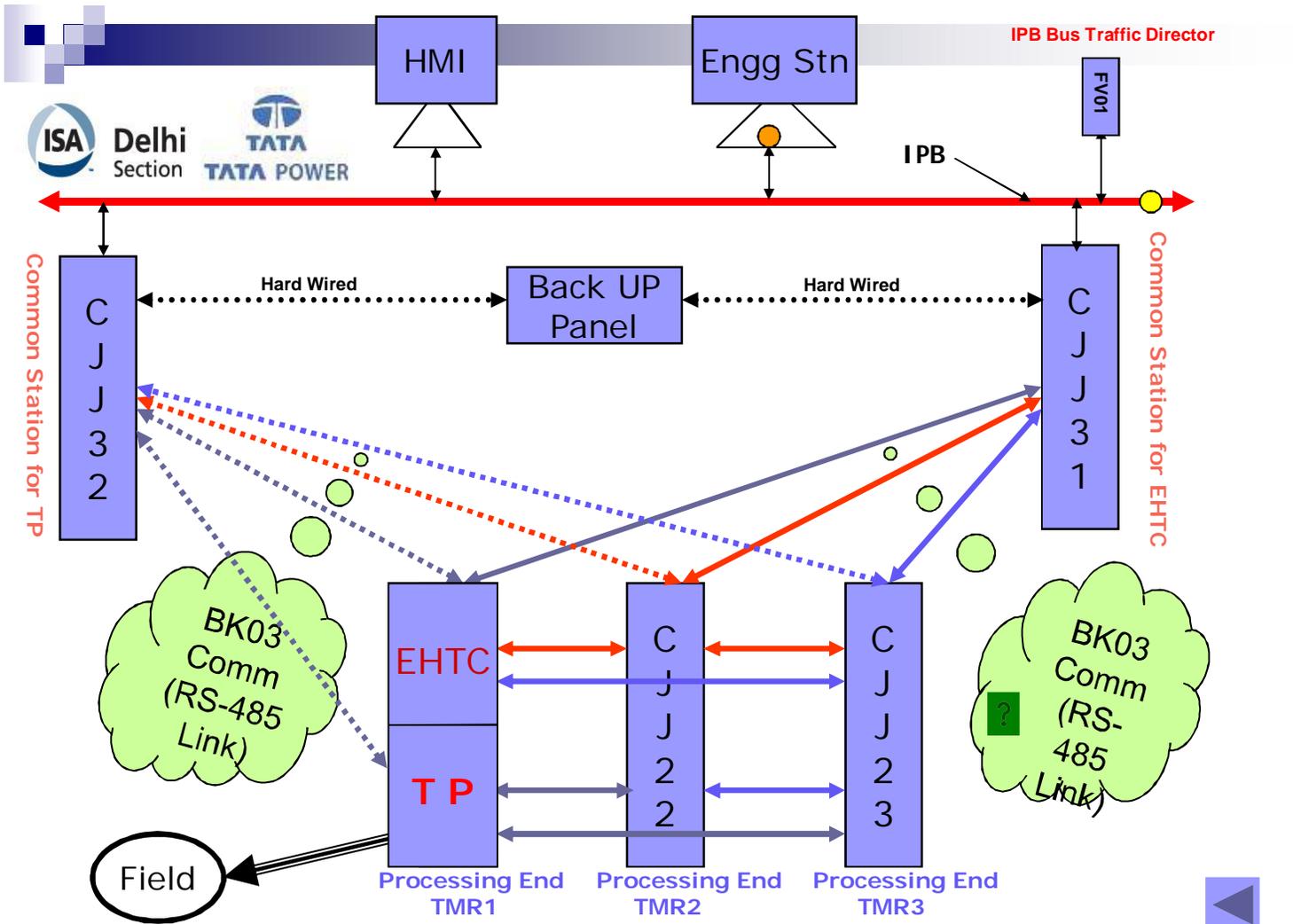
**Bus coupler (BK02)** – Couples the Intra-plant bus and the local bus. It performs the bi-directional exchange of data between the two bus Systems based on Source/Sink Program written in EPROM.

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



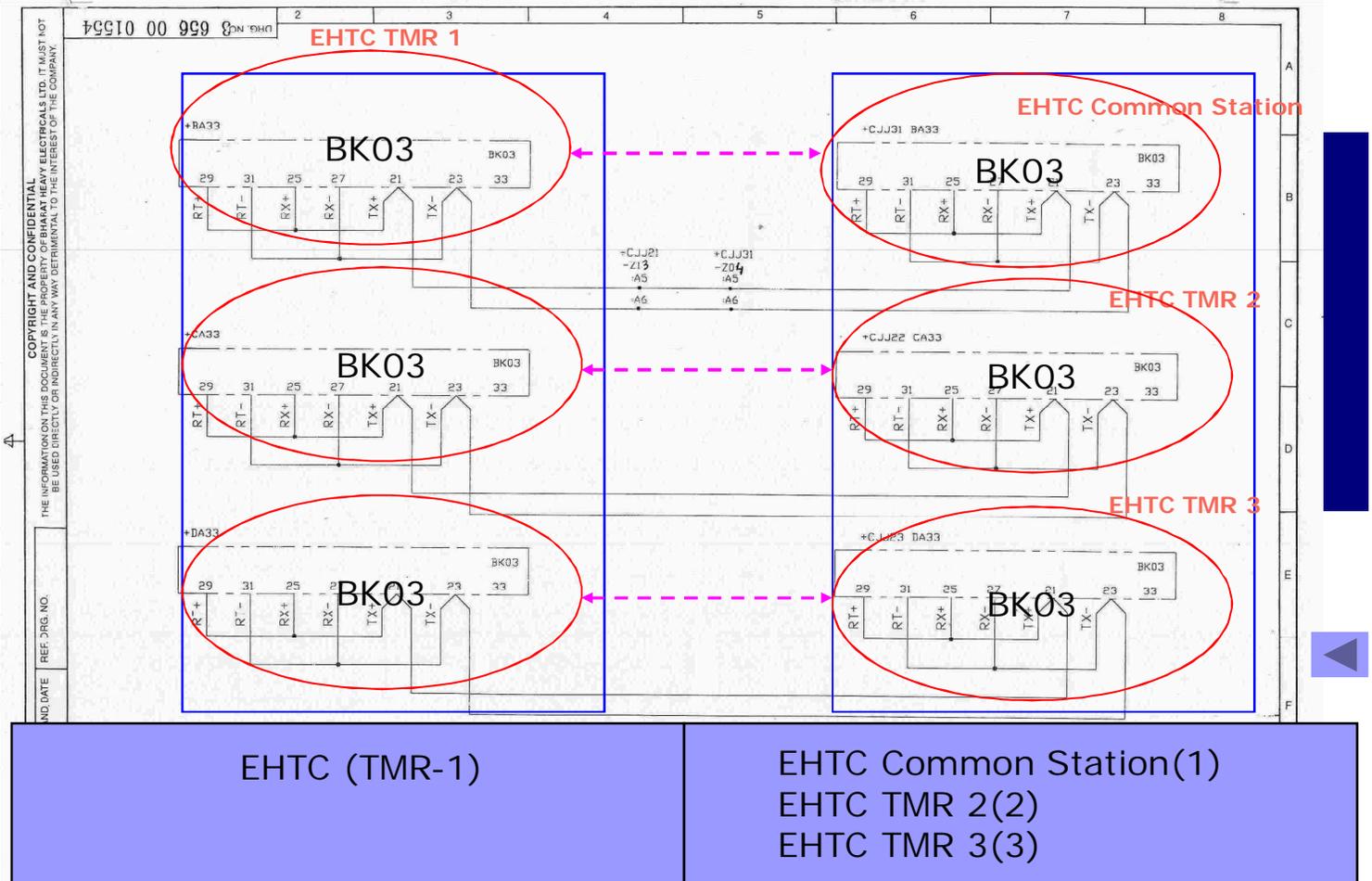
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## Single Line Diagram of BK03 for TMRs

### Turbine Governing System (EHTC)



## TOPICS TO COVER

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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.



## TOPICS TO COVER

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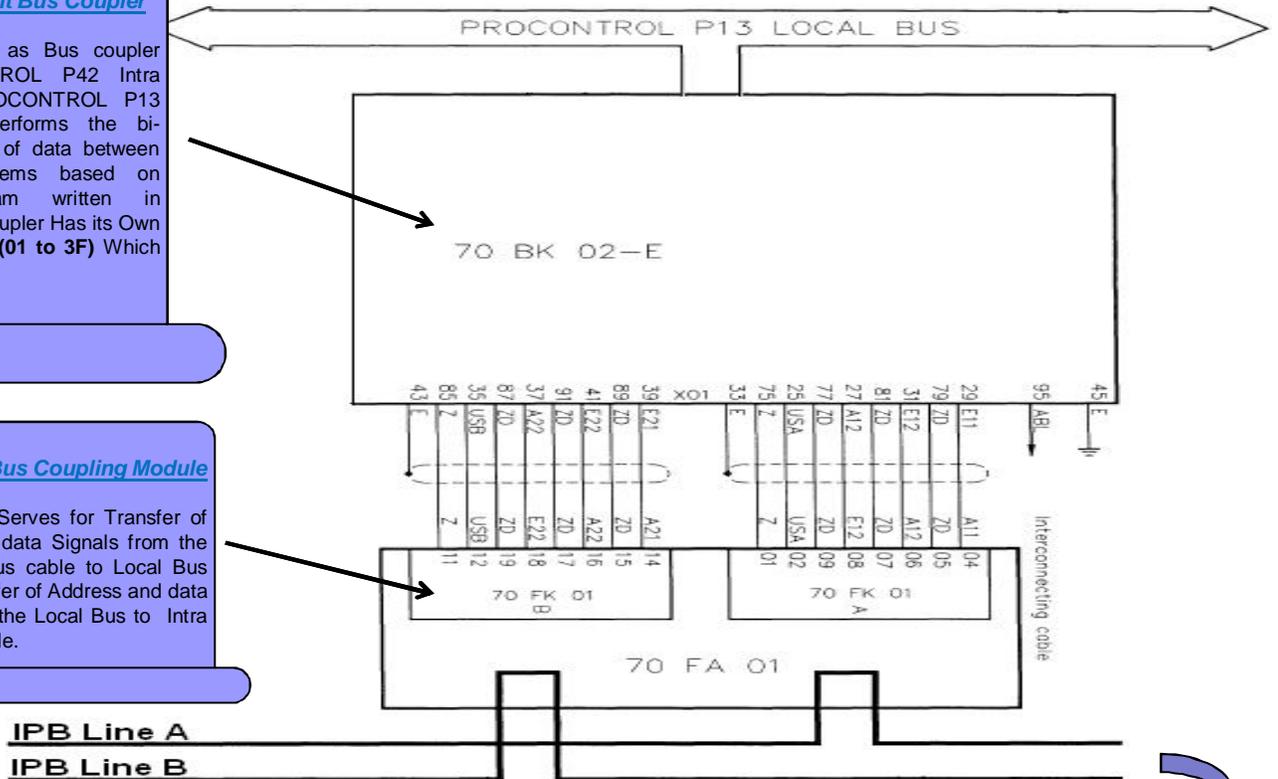
## Empowering 'Power' with Automation

### 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

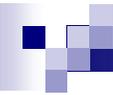
The Module Serves for Transfer of Address and data Signals from the Intra plant Bus cable to Local Bus and for Transfer of Address and data Signals from the Local Bus to Intra plant Bus cable.



**INTRA PLANT BUS TO LOCAL BUS CONNECTION DIAGRAM**

## TOPICS TO COVER

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*Empowering 'Power' with Automation*

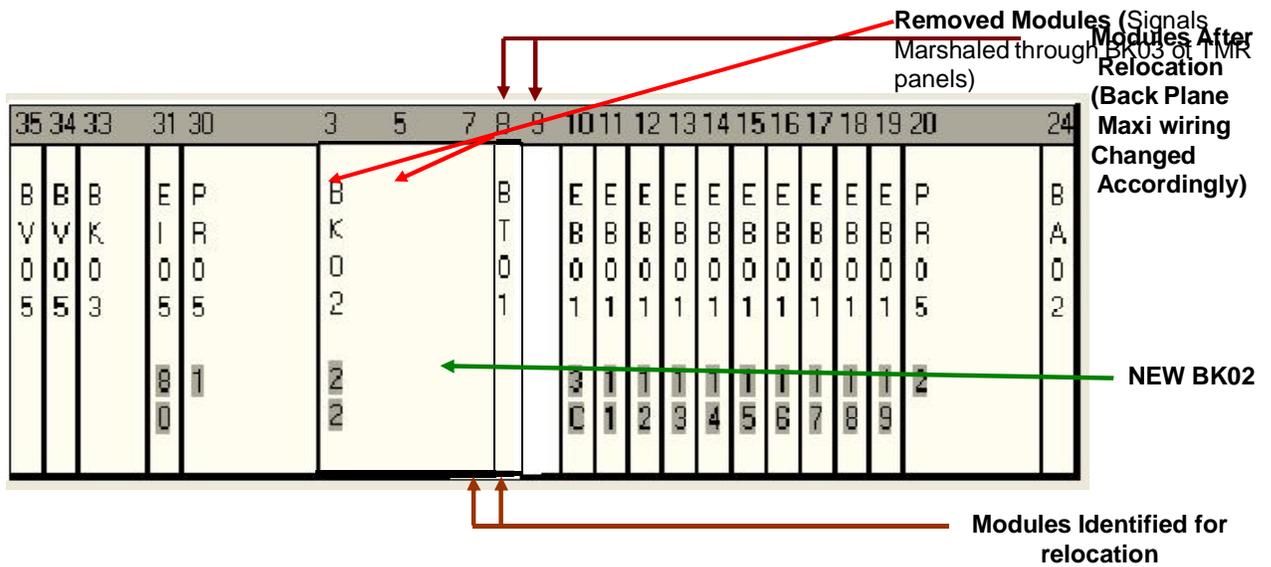


## CHALLENGES

- 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.



## Empowering 'Power' with Automation



**EHTC TMR RACK CONFIG BEFORE P/B Extn**

# Empowering 'Power' with Automation



Free Slots

Modules Identified for relocation

35	34	33	32	31	30	29	1	2	3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	23	24
A	A		A	E	A		E	E	E	E	B						E	E	E	E	B			B	
B	B		B	B	B		B	B	B	B	K						A	A	A	A	K			A	
0	0		0	0	0		0	0	0	0	0						0	0	0	0	0			0	
1	1		1	1	1		2	2	2	2	2						1	1	1	1	3			1	
2	2		2	1	3		1	1	1	2	2						D	D	D	D					
3	4		8	9	2		D	E	F	0	5						C	8	4	0					

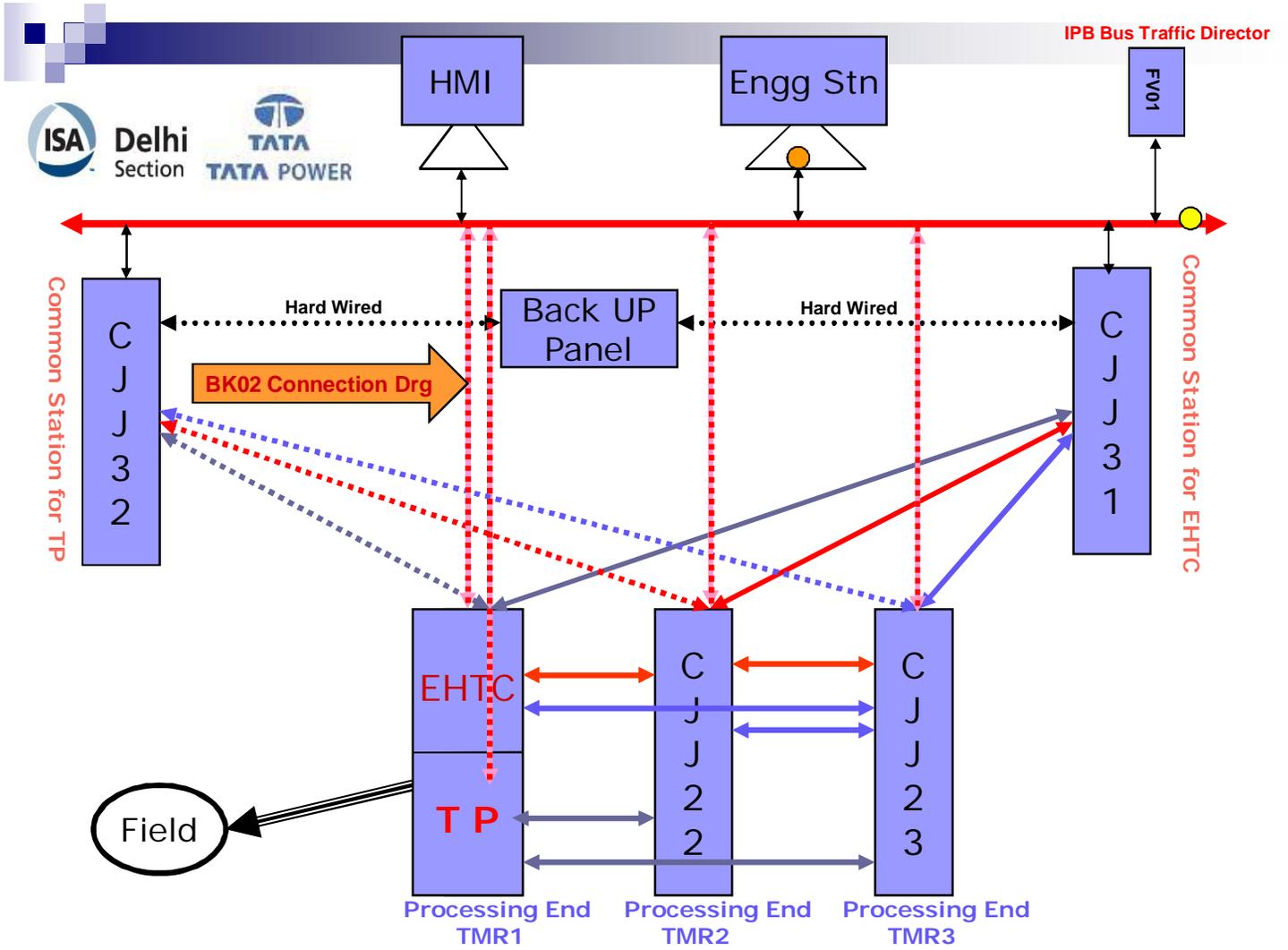
NEW BK02

Modules after Relocation  
(Back Plane Maxi wiring Changed Accordingly)

**TP TMR RACK CONFIG BEFORE RELOCATION**

## 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.



## PROPOSED SOLUTIONS

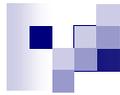
- **Add one Sub rack and Extend Local Bus to that Rack** – No Space Available in the TMR panels.
- **Erection of one panel close to TMR panels & Extend Local Bus to New panel**
  - Which was not feasible ,Control Room Lay out Didn't Permit.
  - Fixed cycle time of Annual Shutdown-21 days, System Up gradation 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.



## Empowering 'Power' with Automation

TATA POWER COMPANY LIMITED  
JODHPURA THERMAL POWER STATION  
UNIT - 3 : 120 MW

P201 : TURBINE PROTECTION OVERVIEW

ABB

ES&S	COAL & OIL	COAL & OIL INDICATION	TURBINE SYSTEM	TURBINE PARAMETERS	TRENDS	OFF	NAVIGATION																													
<input type="checkbox"/> TURB TRIP CH-A <input type="checkbox"/> TURB TRIP CH-B <input type="checkbox"/> HPSV1 CLOSED <input type="checkbox"/> HPSV2 CLOSED <input type="checkbox"/> I/PSV1 CLOSED <input type="checkbox"/> I/PSV2 CLOSED <input type="checkbox"/> CYCLIC VIB ON <input type="checkbox"/> O/S CH-A OPTD <input type="checkbox"/> O/S CH-B OPTD <input type="checkbox"/> O/S CH-A FLT <input type="checkbox"/> O/S CH-B FLT <input type="checkbox"/> O/S TST RUNNING  <input type="checkbox"/> TRIP RESET <input type="checkbox"/> TRIP RESET-2 <input type="checkbox"/> TRIP FAULT ACK <input type="checkbox"/> RESET ACC MON			<table border="1"><tr><td>L.O.PRESS LOW OPD FLT FAIL ALM <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></td><td>L.O.I VFI LOW OPD FLT FAIL <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></td><td>ATRS TRIP OPD FLT FAIL <input type="checkbox"/> <input type="checkbox"/> <input 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TURBINE OVERVIEW	EHTC OVERVIEW	HP/IP EXTRACTION	TURBINE PROTECTION OVERVIEW	LP/IP PROTECTION OVERVIEW	LPBP CONTROL	GSP CONTROL	EHA OVERVIEW																													
ALL LIVE REVIEW	TURBINE OUT SYSTEM	SINGLE TURBINE	SUBSYSTEM SYSTEM	SUBSYSTEM SYSTEM	TRIP STATUS AND VALUE	CONTROL OUT SYSTEM	LP EXTRACTION																													

Common Turbine Protection Overview page Before IPB Extension Project

# Empowering 'Power' with Automation



SER1JPP3 // Operator Workplace

ALARMS: 4

SYSTEM: 2

10-Mar-10 08:02:05.310 DDHL A03DF301A\_YM69 COAL ELEV C TRIP TO MANUAL 121.36 MW

10-Mar-10 09:01:17.139 DDH8K04E2200\_XE29 ELEVATION C VOTED CH-2 YES 2958 RPM

10-Mar-10 09:01:17.116 DDH8K04E2200\_XE29 ELEVATION C VOTED CH-3 YES SER1JPP3

3/10/2010 16:48 ABB

TURBINE: TD TMR-1 CH-A

TATA POWER COMPANY LIMITED  
JOJOBERA THERMAL POWER STATION  
UNIT - 3 : 120 MW

### TMR-1 CH-A TRIP

EHTC OVERVIEW	TURBINE PROTECTION	LPBP CONTROL	TURBINE OIL SYSTEM	TRENDS	BOILER INDEX	TURBINE INDEX	MAIN INDEX
-11.13 MMWC	6.05 MMWC	-119.63 MMWC	DRUM LEVEL HIGH				
532.03 DEO.C	531.45 DEO.C	534.38 DEO.C	LIVE STM TEMP LOW				
321.68 DEO.C	321.09 DEO.C	321.09 DEO.C	HP TOP BOT CAS TEMP				
305.86 DEO.C	305.86 DEO.C	307.62 DEO.C	HP EXH TEMP BSD ON FLNG				
			HPBP FJB REL SHFT VIB				
			HPBP SHFT VIB RJB				
			LP SHFT VIB RJB				
			GEN PROT				
			LUB OIL PR LOW				
			LUB OIL LVL LOW				
			FIRE PROT CH OPTD				
			FIRE PROT CH2 OPTD				
			ATRG TRIP				
			TSLLE <7.5				
			CO EMGY PB PRESSED				
			CFR PRG VIB PROT				
			BOILER MFI				
			EMGY PB PRESSED				
532.03 DEO.C	531.45 DEO.C	534.38 DEO.C	MAIN STM TEMP HIGH				
415.43 DEO.C	413.09 DEO.C	417.77 DEO.C	HP EXH TEMP BSD ON TM				
526.76 DEO.C	527.34 DEO.C	527.93 DEO.C	CTRL OIL SPLY OFF				
530.86 DEO.C	520.90 DEO.C	532.03 DEO.C	HP DL STM TEMP LOW				
62.16 DEO.C	49.80 DEO.C	48.05 DEO.C	HP DL STM TEMP HIGH				
-0.90 K9/CM2	-0.90 K9/CM2	-0.90 K9/CM2	LP EXIST TEMP HIGH				
0.02 MM	0.04 MM	0.04 MM	COND PRESS H				
			AXIAL SHIFT				
			OVER SPEED TRIP CH A				
			OVER SPEED TRIP CH B				

TP\_TMR1 CH-B TP\_TMR2 CH-A TP\_TMR2 CH-B  
TP\_TMR3 CH-A TP\_TMR3 CH-B

FIRST OUT TMR-1 CH-A RESET

RAW ELEMENT DIGITAL SIGNALS (Red arrow pointing to HP EXH TEMP BSD ON FLNG)

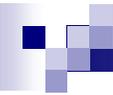
RAW ELEMENT ANALOG SIGNALS (Blue arrow pointing to 532.03 DEO.C)

TURBINE OVERVIEW EHTC COMPARISON HP/IP EXTRACTION TURBINE SOLENOID VALVE LPBP PROTECTION OVERVIEW CONTROL OIL SYSTEM GSP CONTROL EHA OVERVIEW

TURBINE SUPERVISORY SGC TURBINE SGC/SLC OIL SYSTEM SGC C & E SYSTEM TSE MARGINS BRG METAL TEMP HPBP TX DEVIATION

SER1JPP3 // Operato... Operator Trend : Operato... C:\Program Files\ABB In... Microsoft Excel - TATA\_J... 800xAServiceAccount ABB 16:48

**First Cause of Turbine Trip TMR1 CH-A & Raw element Signals in HMI after IPB Extension**



## ***Empowering 'Power' with Automation***



### 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.

## Empowering 'Power' with Automation



**Basic Details**

Email:	ranjanv@tatapower.com
Company:	Tata Power
Title:	Three number of Triple Module Redundancy Panels for Turbine Governing and Turbine Protection configured on Procontrol Intra Plant Bus - Improvement in reliability of the System
Innovation Title (for Certificate/Trophies):	TMR Panels boards the Intra Plant Bus in Jojobera
Year of Implementation:	2009
Location of Implementation:	Tata Power, Jamshedpur- Jojobera Power Plant
Innovation Category:	Manufacturing
Innovation Sub-Category:	Electronics/Instrumentation Maintenance

**Team Details**

Name	Email	Phone	Mobile
Mr. Vijayant Ranjan	ranjanv@tatapower.com	2277273	923450691
Mr. Surodh Dey	sdey@tatapower.com		923450721
Mr. Madipalli Phanindra	mphanindra@tatapower.com	9657227273	9997563299
Ms. Sony Jha	jsony@tatapower.com	2277273 (Extn 535)	9835591458

Country where most of the team members are located: India  
City where most of the team members are located: Jamshedpur

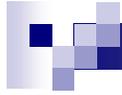
**Innovation Details**

**How will this innovation help the end user?**  
This will enable the plant Operating people ( Internal customer) to monitor all the Turbine Trip Conditions in Individual TMR, on-line, and take corrective action. Individual TP TMR ( Turbine Protection Triple Redundancy Panel) first cause trip displays are made available in HMI. All turbine trip raw signals are made available in HMI. Online monitoring and loading of TP TMR and EHTC ( Electro Hydraulic Turbine Control) TMR logics made possible through Progress 3 engineering station.

**What triggered this innovation?**  
The system upgradation job to mitigate risk due to obsolescence was going on. The team, during the project, felt that the system has potential to bring all 3 Turbine Governing Control panels in the main intra plant bus. The accommodation of additional signals and cards in the governing panel was challenging because the panel chassis did not have space for additional card. We could not have gone for separate panel in the running plant because floor cut out was not available and there were other technical constraint.

**Why do you think this is innovative with respect to your domain/industry?**  
GH&L has supplied 9 to 10 number of N1 series Turbines in India which have only electronic governing system and which is running on ADO's Procontrol System. In none of these 10 machines the Turbine governing and Turbine Control Panels are on Intra plant Bus. Tata power, Jamshedpur Division, for the first time brought TMR panels in Intra plant Bus.

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



*Empowering 'Power' with Automation*



THANK YOU



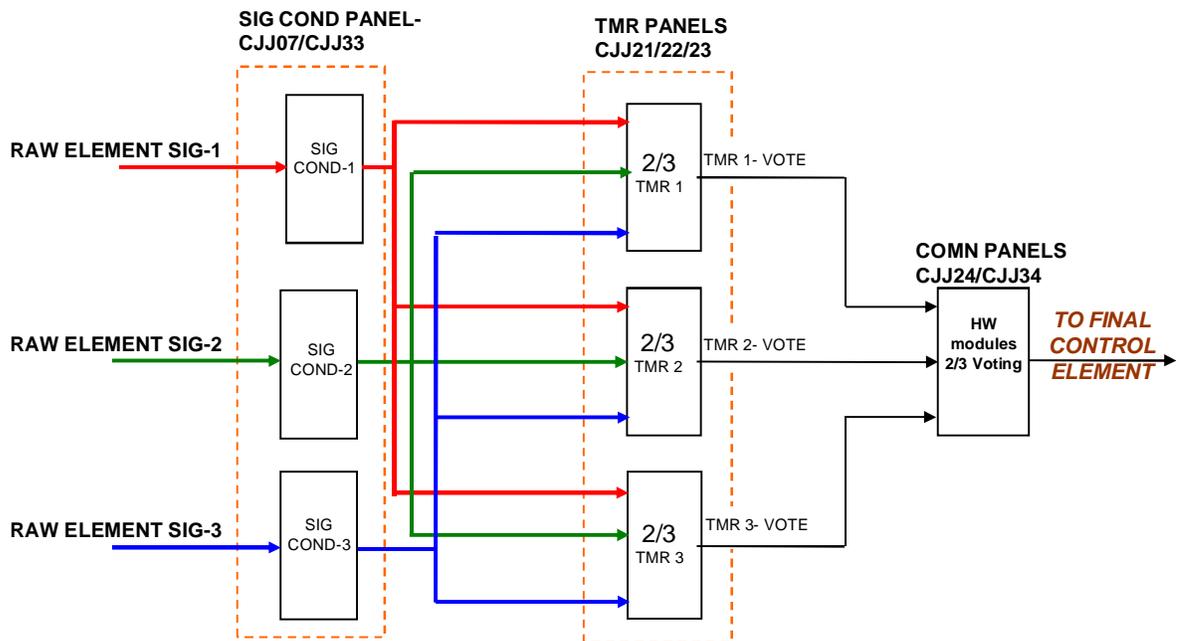
*Empowering 'Power' with Automation*



## TURBINE TRIP CASE STUDY (120 MW)

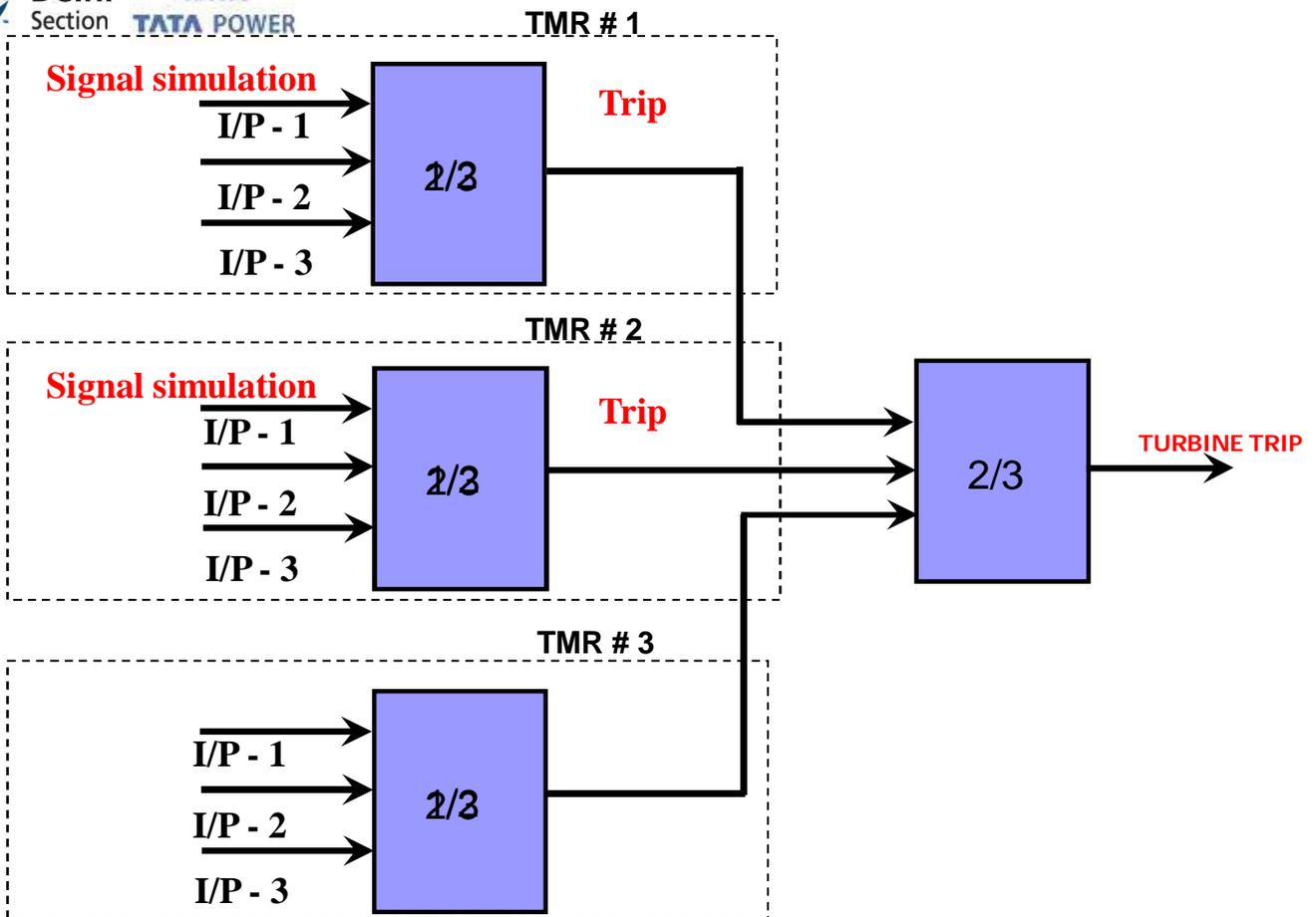
**VIJAYANT RANJAN - TATA POWER COMPANY LTD  
SONY JHA - TATA POWER COMPANY LTD**

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

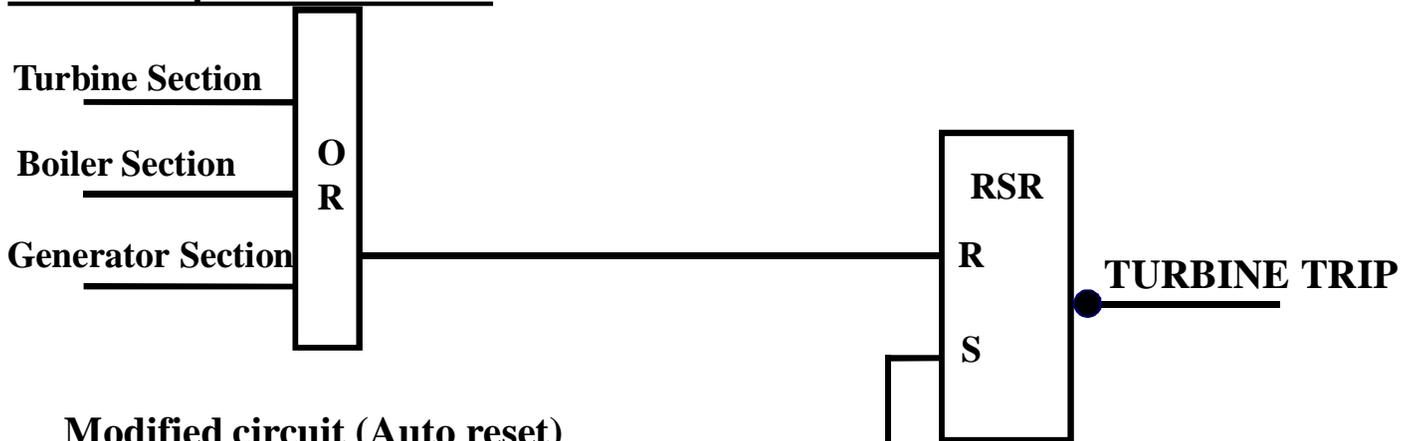


**SIGNAL FLOW DIAGRAM OF TMR PANELS**

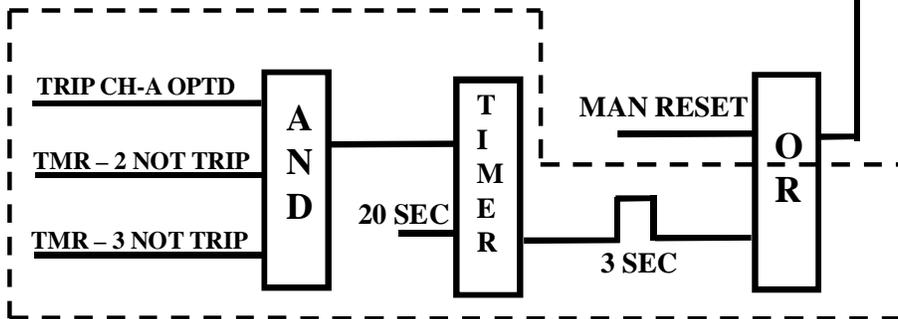
Empowering 'Power' with Automation



Process trip command from

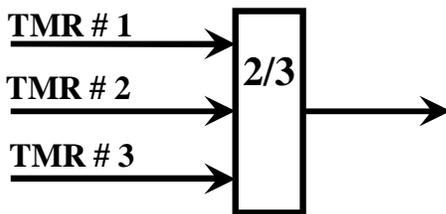


Modified circuit (Auto reset)



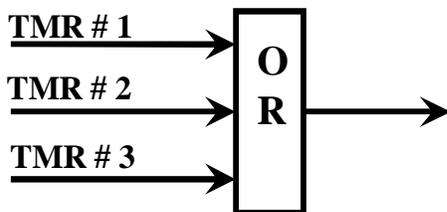
Turbine Trip Circuit (After Modification)

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.

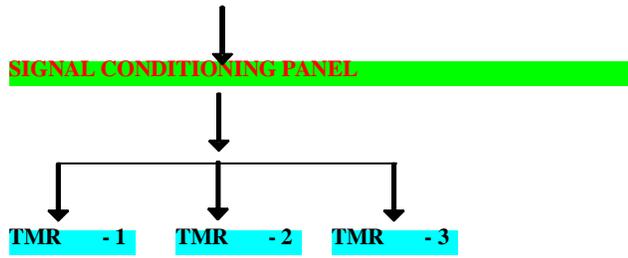
However, to improve the reliability of the units, the corrective actions were taken at logic level to eliminate the tripping because of fault simulation of cards. The same modifications shall be carried out in other units as and when opportunity comes.



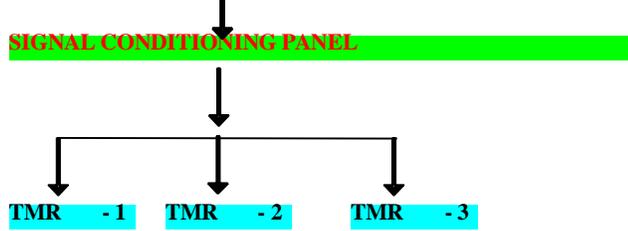
*Empowering 'Power' with Automation*



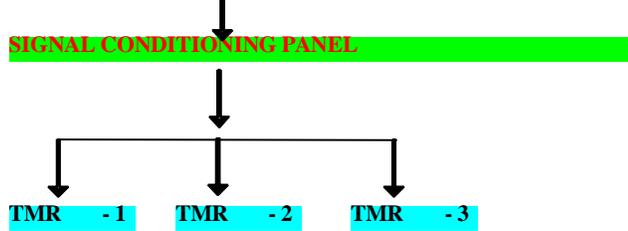
MAIN STEAM TEMPERATURE - 1



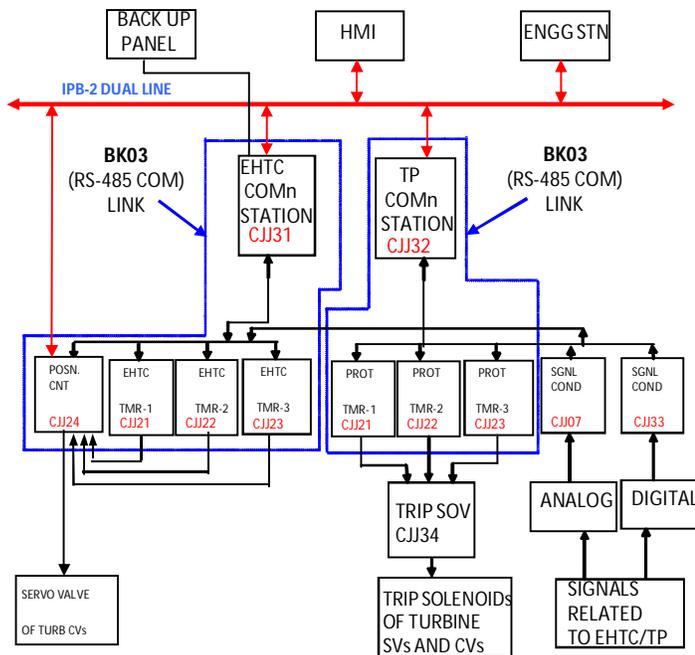
MAIN STEAM TEMPERATURE - 2



MAIN STEAM TEMPERATURE - 3



PANEL CONFIGURATION OF TURBINE CONTROL & PROT





**Delhi**  
Section

**DURAG INDIA Instrumentation Private Limited**

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

**Roland Zepeck**

**Managing Director**

**Durag process & systems technology gmbh**

**Kollastr. 105 , 22453 Hamburg , Germany**

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