POWER for System Integrators

- STATIC Reserve
- Dynamic Reserve

Dynamic Reserve

Quick triggering of power circuit-breakers

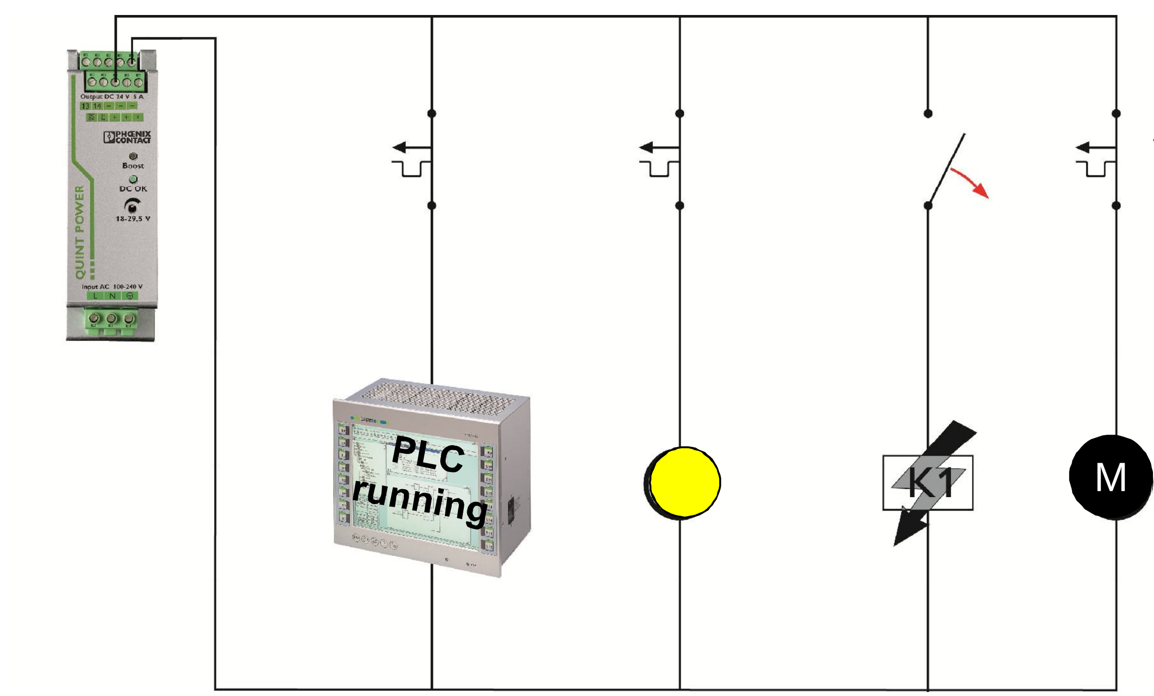
Maximum system availability due to dynamic power reserve SFB-Technology with six times the nominal current for 12 ms

→ Reliable releasing of standard circuit breakers

→ Optimal supply of loads with high peak currents

POWER

Quick triggering of power circuit-breakers

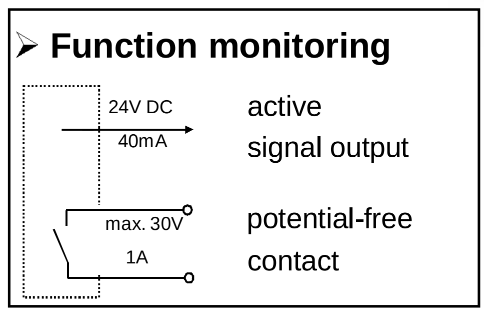


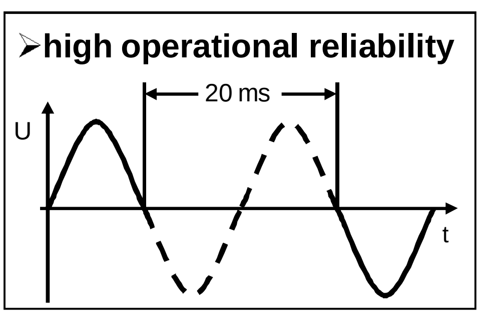
→ Short circuit at the contactor coil K1

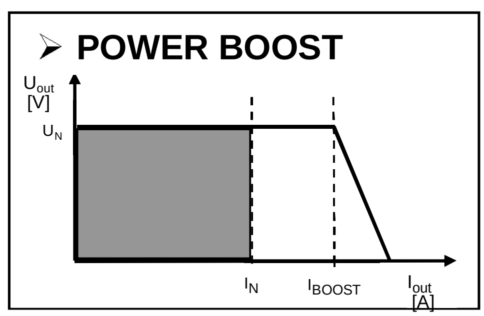
→ Corresponding power circuit breaker triggers immediately

→ The control system as well as all other loads continue their operation without interruption!

POWER
... for universal use

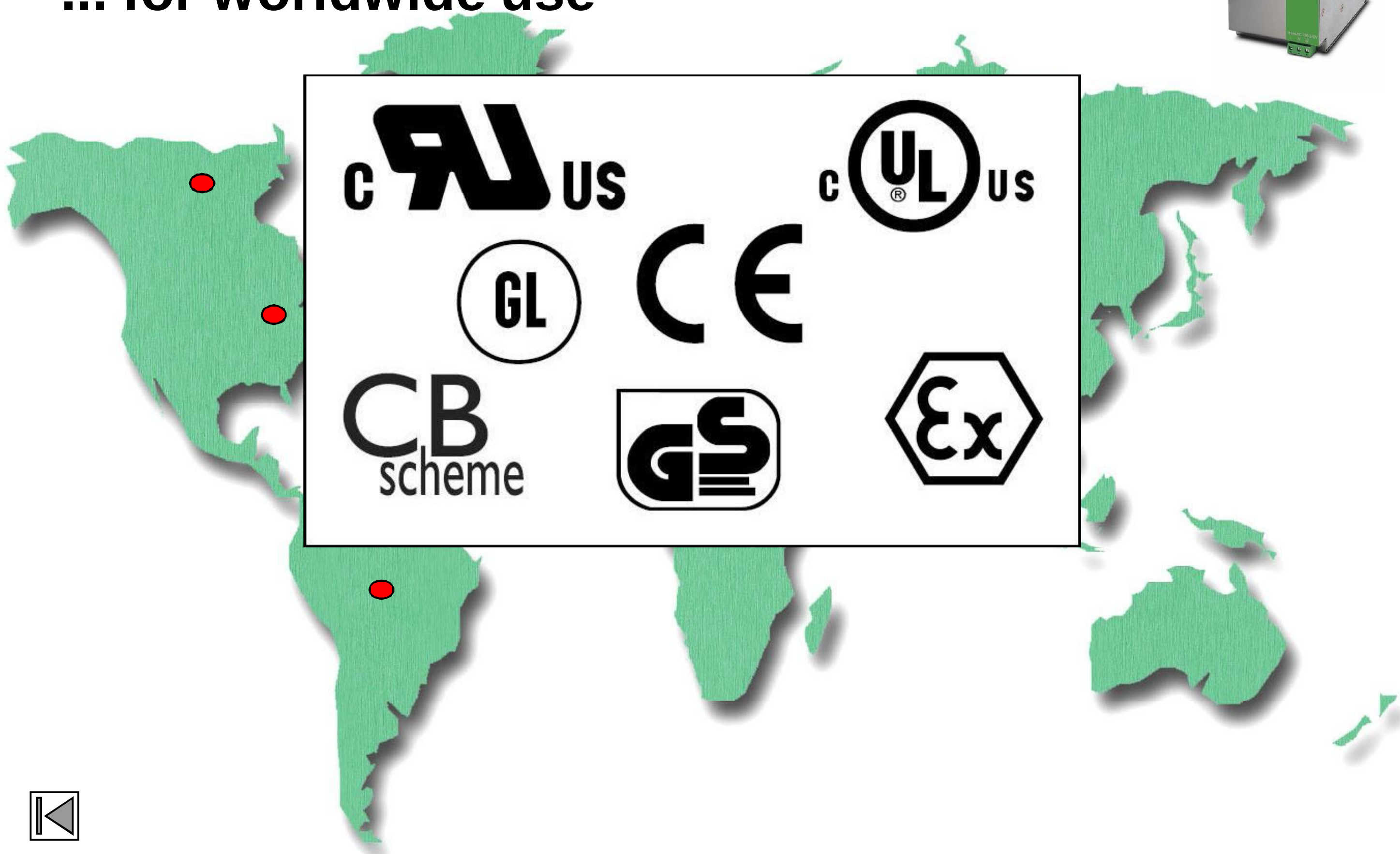






QUINT POWER

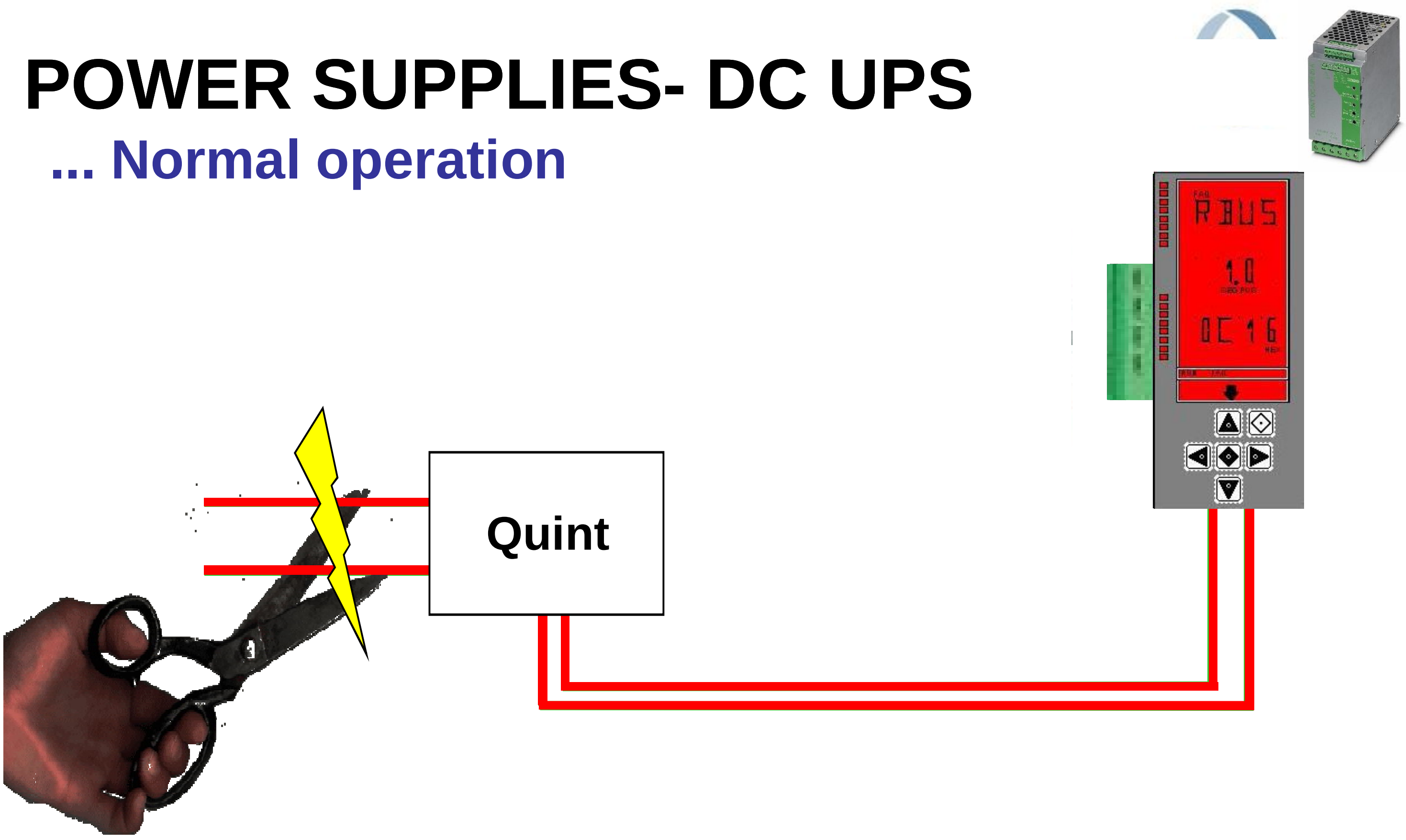
... for worldwide use



Innovating for Evolving Challenges !
DC-UPS

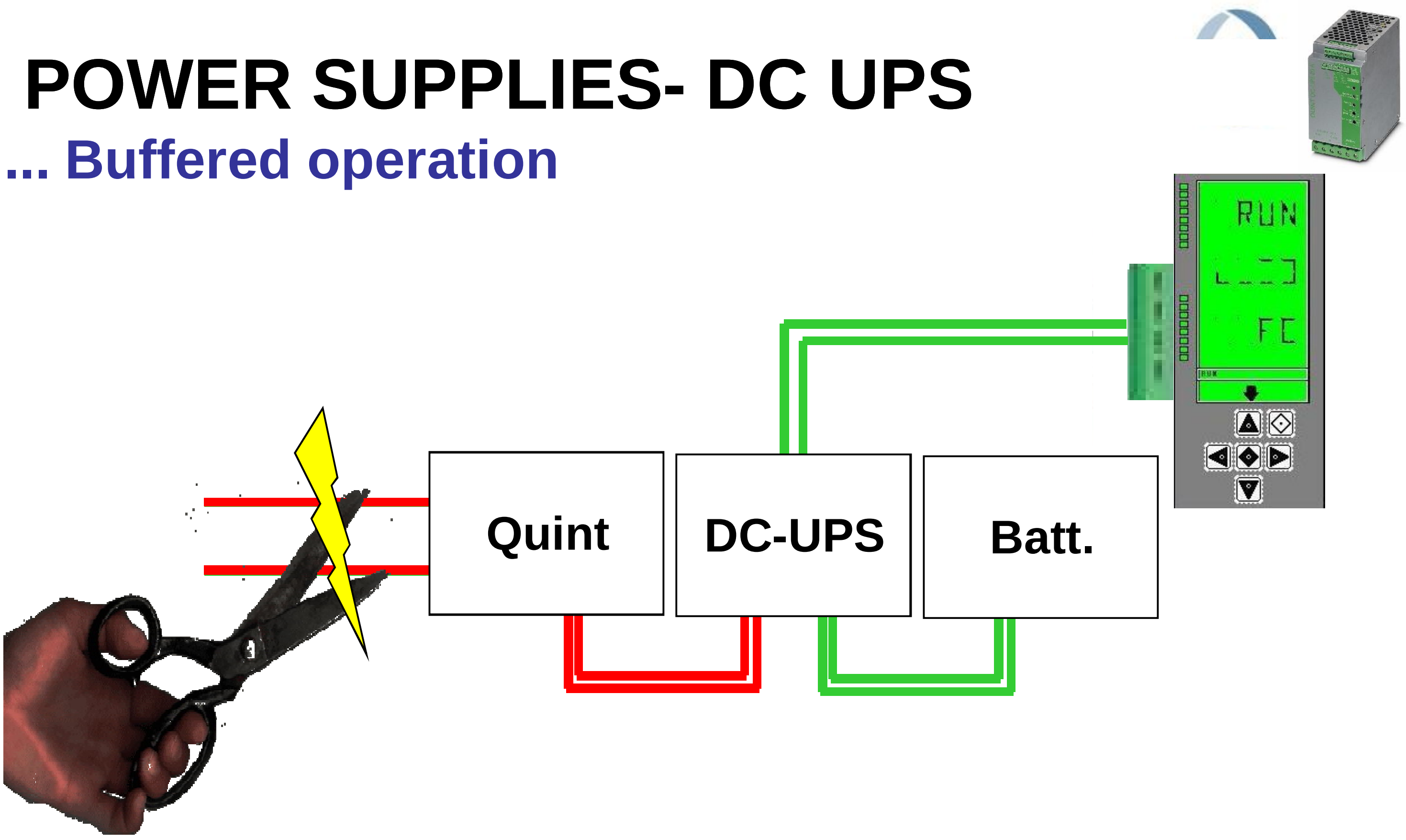
POWER SUPPLIES- DC UPS

... Normal operation



POWER SUPPLIES- DC UPS

... Buffered operation



POWER UPS

QUINT UPS IQ

Intelligent Battery control

Automatic Battery detection

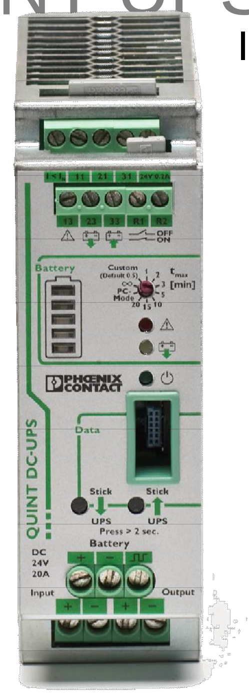
Continuously adapts the charging characteristics depending on the ambient conditions

Intelligent Charging

High charging current adapted to the power supply

Data Port

Monitor and configuration via PC or memory stick



Intelligent Battery Management

SoC (State of Charge)

Reports residual buffer time and charge of battery

SoH (State of Health)

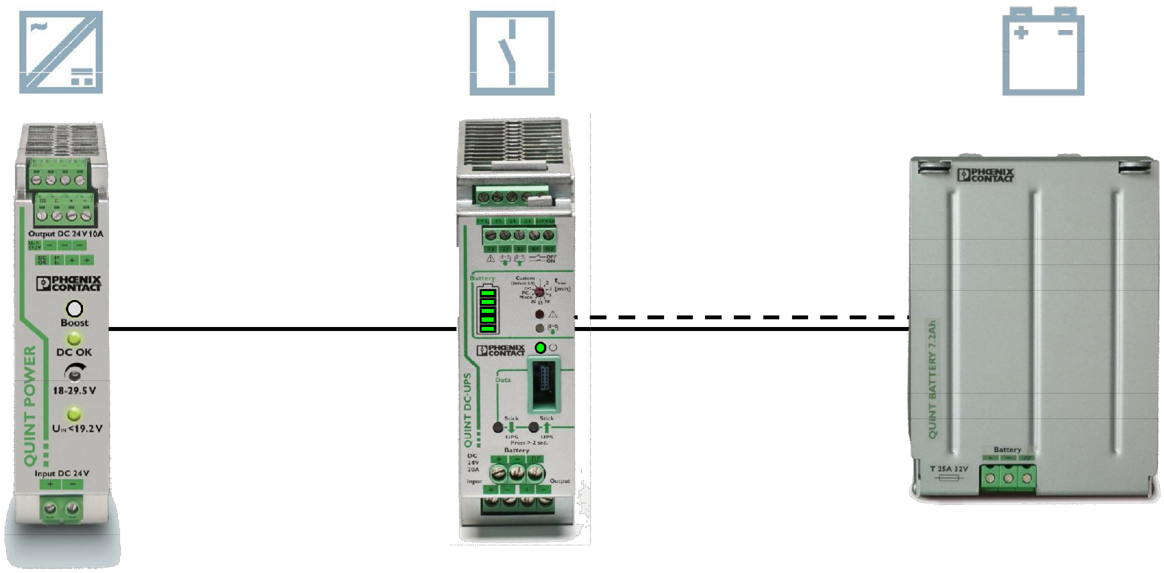
Informs about residual lifetime

SoF (State of Function)

Reports about battery performance

UPS IQ

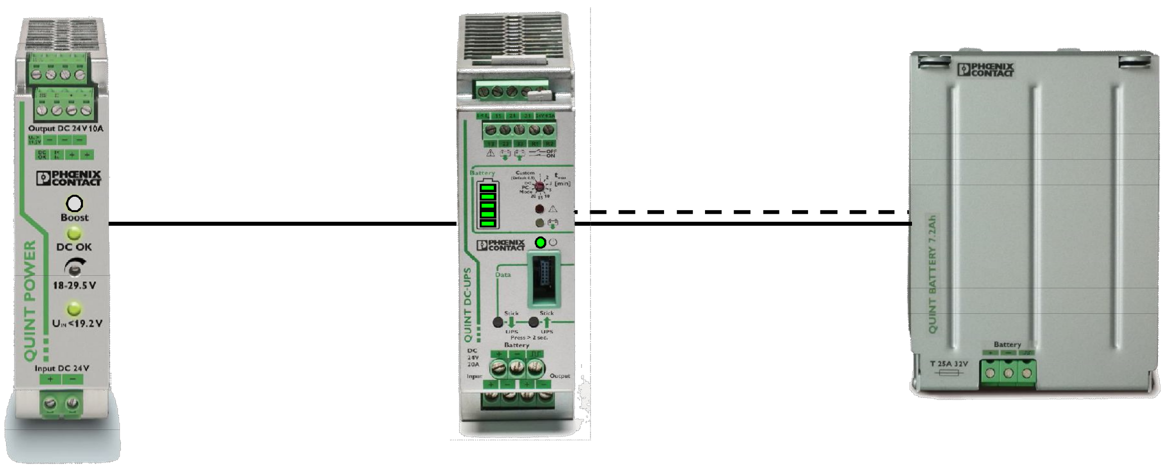
Intelligent Battery Detection



INSPIRING INNOVATIONS

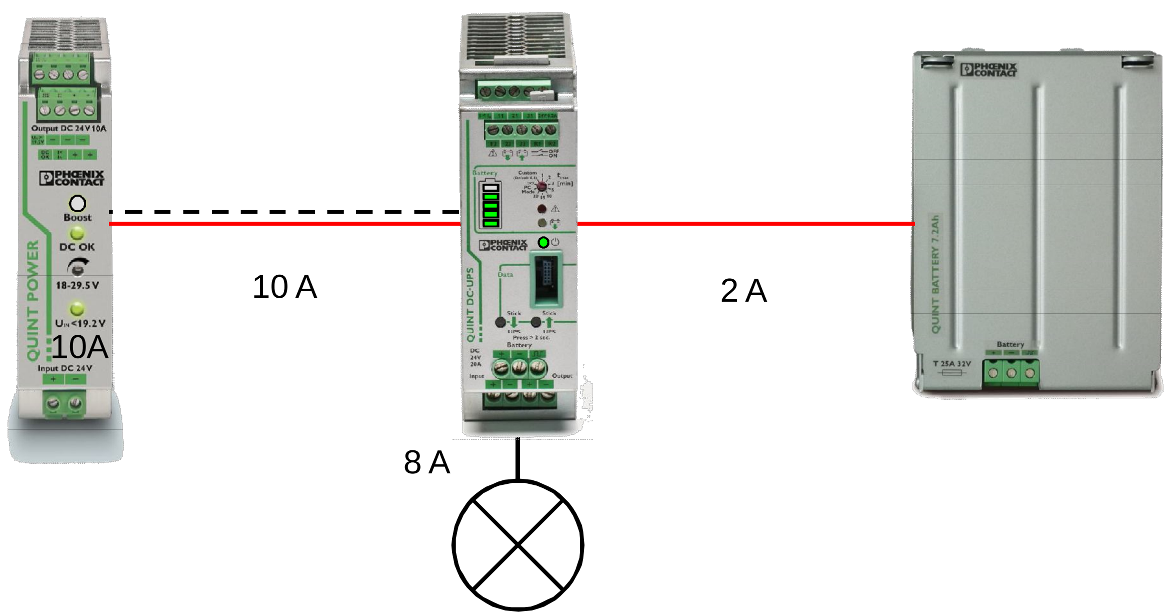
UPS IQ

Intelligent Battery Control



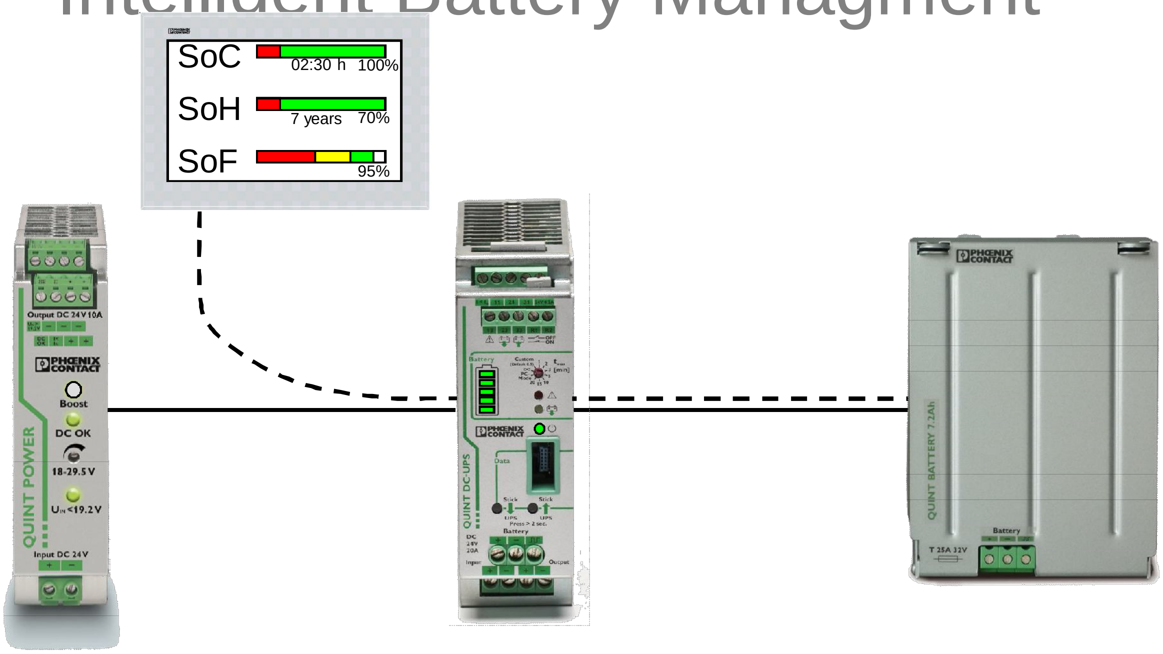
UPS IQ

Intelligent Charging Control



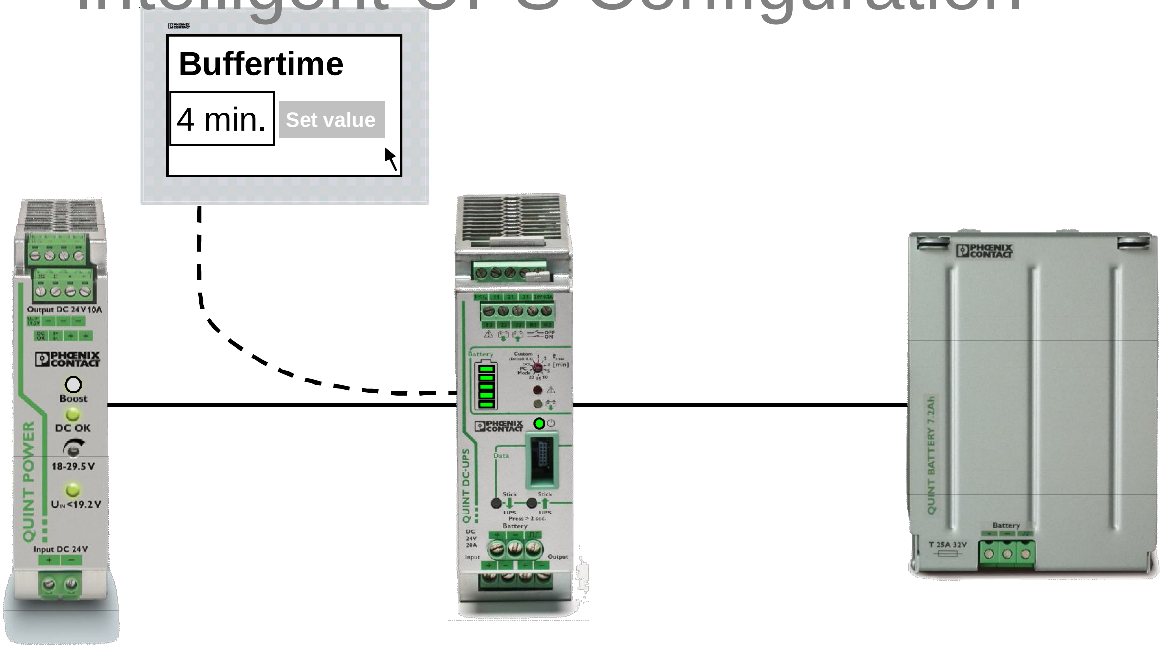
UPS IQ

Intelligent Battery Managment



UPS IQ

Intelligent UPS Configuration



POWER Solutions
DC-DC converter

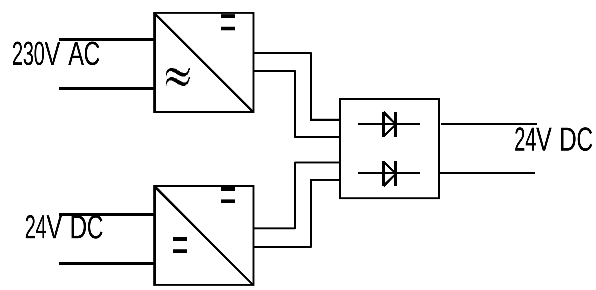
To transform 18-32 V DC to an adjustable and controlled output voltage of 22,5-28,5 V DC

Applications:

Unregulated transformer,

Battery supplied units or

Galvanic isolation of two DC mains



POWER DC/DC

Quick triggering of thermal-magnetic circuit-breakers

Dynamic power reserve
SFB Technology with up to six times the nominal current for 12 ms

Reliable starting of heavy loads

Static power reserve
POWER BOOST has the ability to continuously provides up to 125% the nominal output current

Refreshing the output voltage

on long lines due to wide input range

Setting up independent supply systems

by galvanic isolation

Preventive function monitoring

Reports all critical operating conditions before an error occurs by continuously monitoring the input voltage, output voltage and output current

POWER REDUNDANCY

QUINT ORING

Up to double lifetime

by equal load sharing with **ACB Tecnology**

Preventive Function Monitoring

Reports all critical operating conditions before an error occurs by continuously monitoring the input voltage, output current and decoupling path

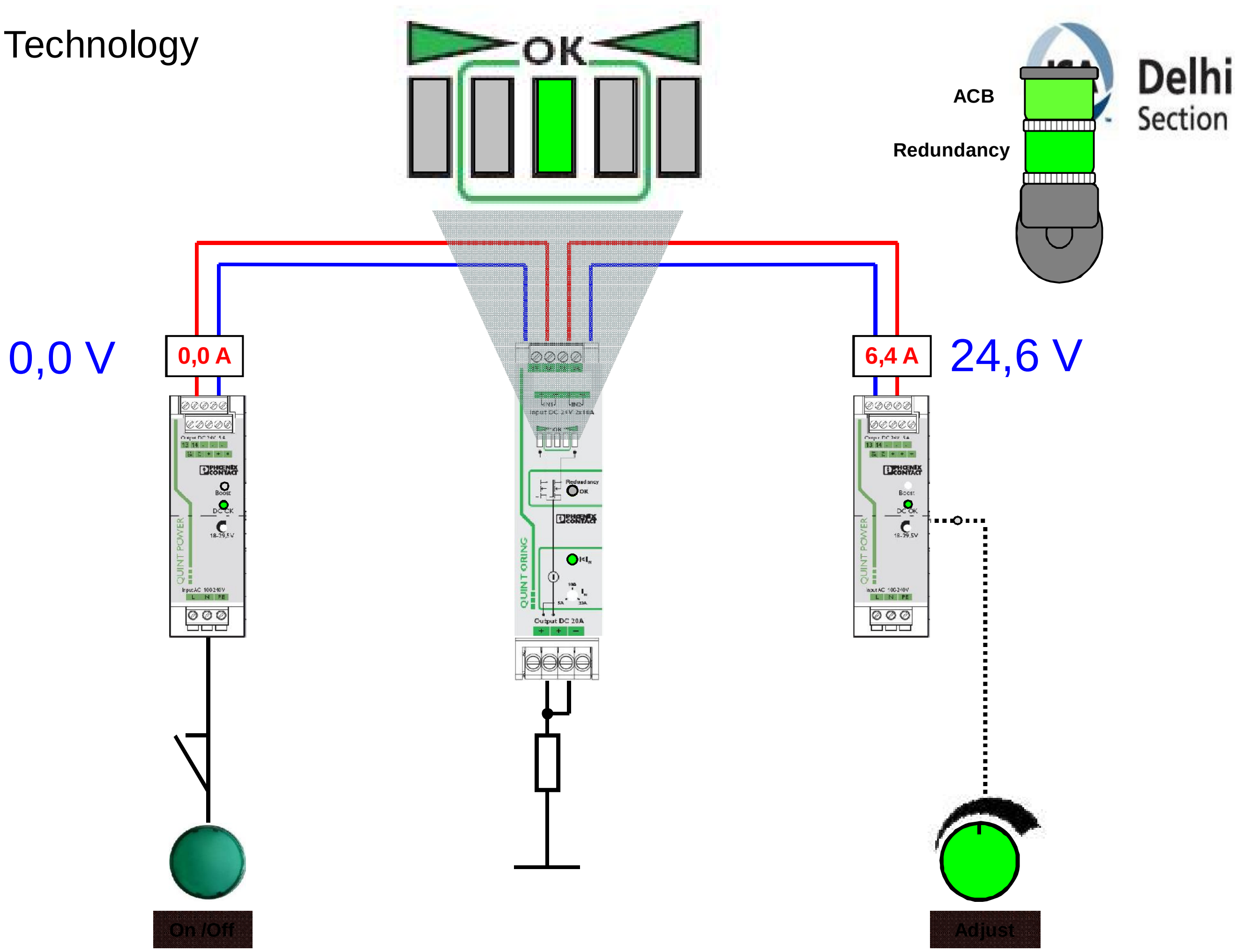
Up to 70% energy saving

with low-loss MOSFETs

Redundant wiring up to the load

with double output terminal block

ACB Technology



Conclusion…

- The reliability of a Power solution is the most important factor that crucially influences availability in complex Control systems.

- Power Solutions meeting the selection criteria at all the level shall ensure the highest availability and reliability of a Control system.


THANK YOU FOR YOUR TIME
PHŒNIX CONTACT
INSPIRING INNOVATIONS

Presentation on Implementation of BOP PLC Standardization and BOP Network at Rosa Power Plant

Viswanathan Kumar

Reliance Infrastructure Limited , Noida

ISA(D) POWAT-INDIA 2012, New Delhi January 13th -14th, 2012

Flow of Presentation

- Rosa Power Plant Overview
- Control / Automation Philosophy implemented at Rosa.
- DCS Architecture Overview
- BOP PLC Network Architecture
- Package PLC configuration examples
- Advantages of BOP PLC Network
- BOP PLCs and Network Vendor selection and implementation Methodology.
- Path Ahead.

Flow of Presentation

RELIANCE

- **Rosa Power Plant Overview**
- Control / Automation Philosophy implemented at Rosa.
- DCS Architecture Overview
- BOP PLC Network Architecture
- Package PLC configuration examples
- Advantages of BOP PLC Network
- BOP PLCs and Network Vendor selection and implementation Methodology.
- Path Ahead.

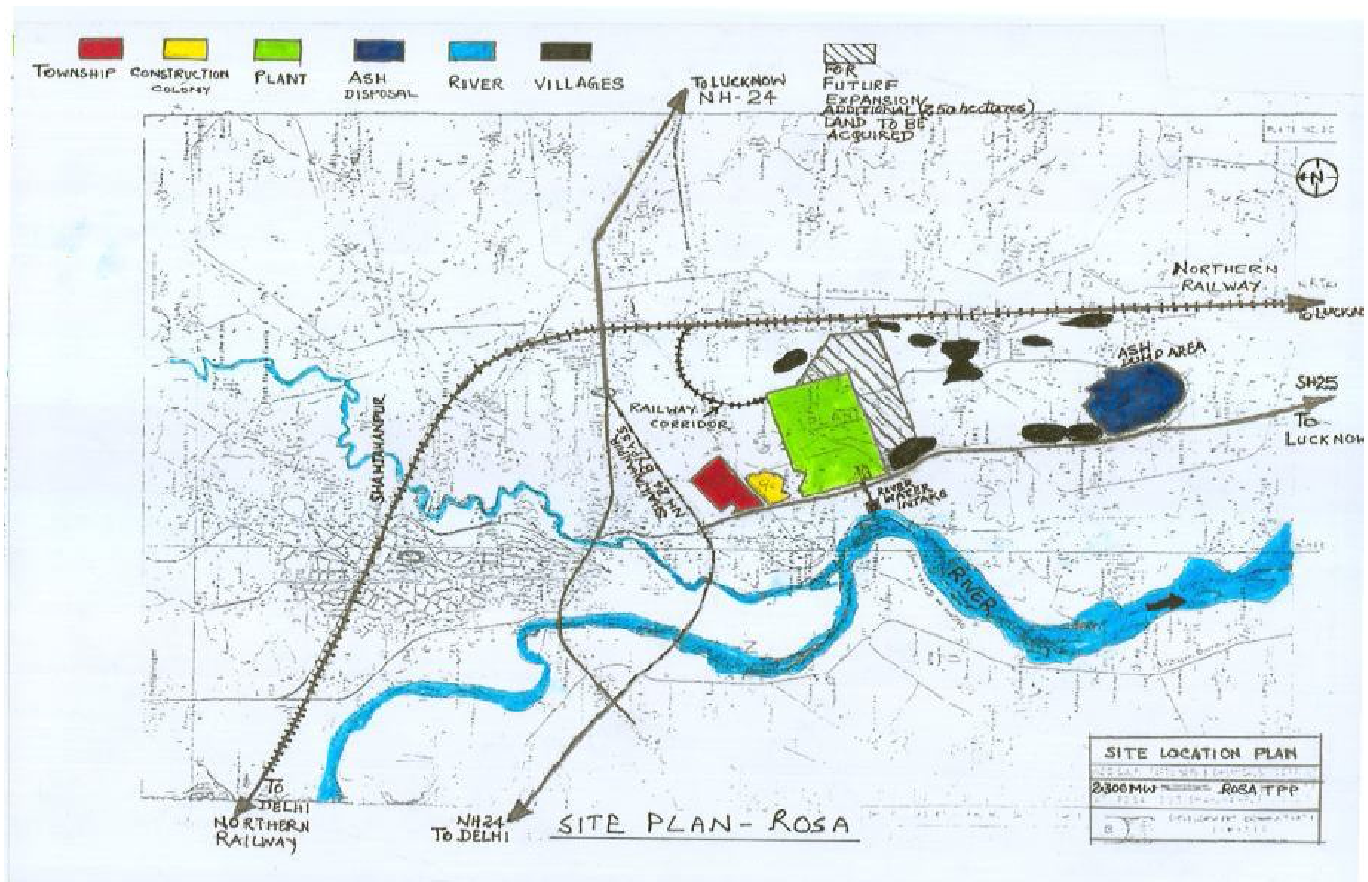
Rosa TPP: Stage – I & II : Salient Features

- Project Developer: Rosa Power Supply Company Limited (subsidiary of Reliance Power)
- Capacity: 2 x 300 MW (Stage-I) and 2 x 300 MW (Stage-II)
- Location: Rosa Village, Shahjahanpur District, Uttar Pradesh
- Nearest Railhead: Rosa Station
- Nearest Airport: Lucknow (170 km)
- Nearest Port: Kolkata
- Total Land: 610 Ha (Main Plant, Township, Ash Dyke & Corridor, Intake Pump house)
- Site Meteorological Data:
  - Temperature: Max. 44.4°C & Min. 5.5°C
  - Rainfall: 1072 mm annual
  - Humidity: 60% (RH)
  - Seismic Zone: Zone-III as per IS: 1893

Rosa TPP: Stage – I & II : Salient Features

- Availability of Resources
  - Coal: Sourced from North Karanpura Mines of Ashoka Block, CCL
  - Water: From Garrah River
  - HFO/LDO: From IOC Mathura Refinery
- Power Evacuation & Beneficiaries
  - 900 MW to UP State Electricity Company
  - 300 MW as Merchant

Rosa Thermal Power Project – Vicinity Map



Flow of Presentation

- Rosa Power Plant Overview
- **Control / Automation Philosophy implemented at Rosa.**
- DCS Architecture Overview
- BOP PLC Network Architecture
- Package PLC configuration examples
- Advantages of BOP PLC Network
- BOP PLCs and Network Vendor selection and implementation Methodology.
- Path Ahead.

Control Philosophy Overview of Rosa Plant

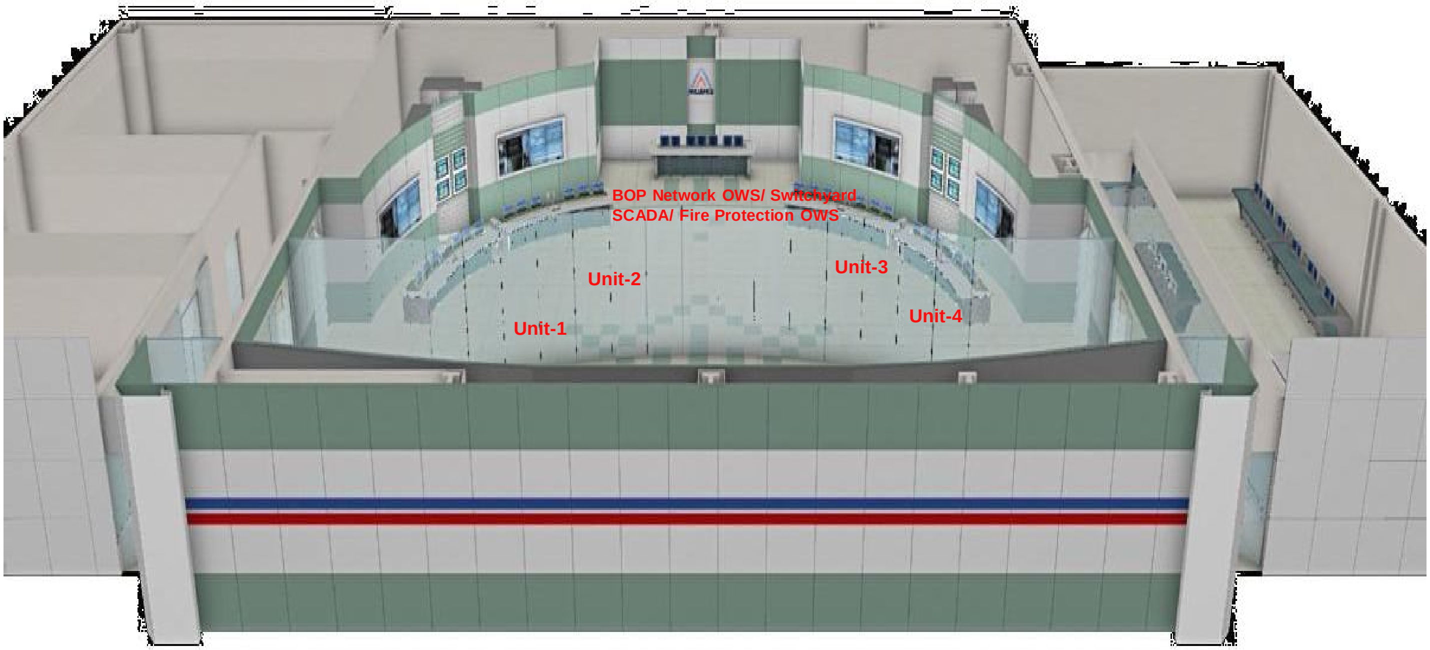
RELIANCE

- Main Plant Equipments Controlled And Monitored by DCS
  - Boiler & Auxiliaries
  - Turbine & Auxiliaries
  - Generator Auxiliaries
  - Cooling Water & Cooling Tower System
  - Makeup Water System
  - Fuel Forwarding System
- Turbine Control and Protection by Digital Electro Hydraulic (DEH) System & Emergency Trip System (ETS)
- Main Plant Auxiliaries Controlled And Monitored By PLCs .
  - ESP
  - Chemical Dosing System
  - Condenser Tube Cleaning System
  - APH Infrared Hot Spot and Gap Adjust Control System
  - Hydrogen Dryer System

The above systems are supplied by BTG vendor (SEC , China)

- Control Systems for BOP are procured from India through package OEMs.

Rosa Central Control Room

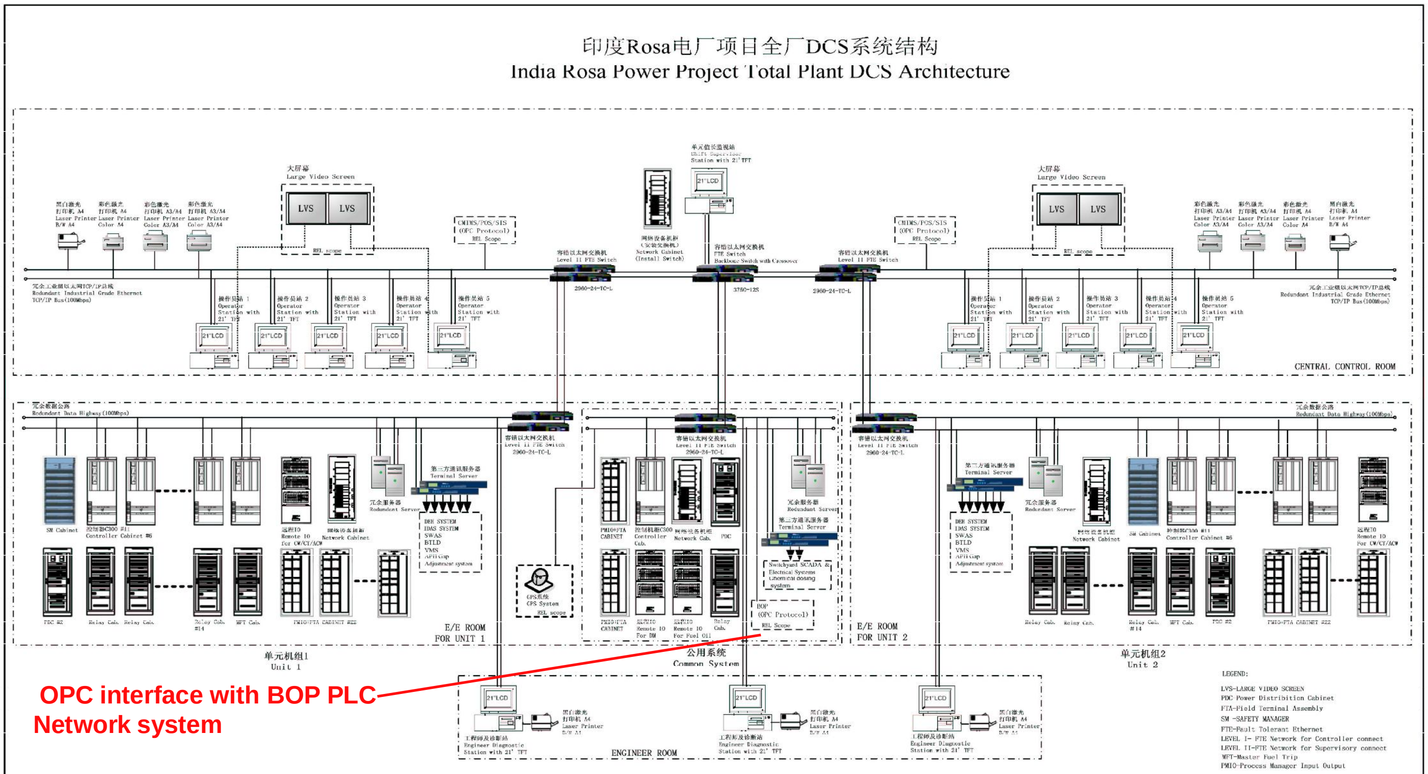


Flow of Presentation

RELIANCE

- Rosa Power Plant Overview
- Control / Automation Philosophy implemented at Rosa.
- **DCS Architecture Overview**
- BOP PLC Network Architecture
- Package PLC configuration examples
- Advantages of BOP PLC Network
- BOP PLCs and Network Vendor selection and implementation Methodology.
- Path Ahead.

Rosa DCS Architecture



Name	Quantity	Name	Quantity	Name	Quantity	Name	Quantity	Name	Quantity	Note:
Server	6	C300 Cabinet	13	MFT Cabinet	2	Terminal Server	6	A4 B/W Laser Printer	5	
Operator Station	10	PMIO+FTA Cabinet	46	Remote PMIO+FTA Cab.	4	FTE Switch	12			
Engineer Station	3	SM Cabinet	2	PDB Cabinet	5	A3 Color Laser Printer	4			
Shift Station	1	Relay Cabinet	29	Network Cabinet	4	A4 Color Laser Printer	2			

Honeywell Honeywell Process Solution	DOC. TITLE: Total Plant DCS Architecture				
PROJECT NAME: India ROSA Power Project (2×300MW)	DOC. NO: 41805650-A-GEN-011	REV	3	PAGE 1/1	CONT'D

Flow of Presentation

RELIANCE

- Rosa Power Plant Overview
- Control / Automation Philosophy implemented at Rosa.
- DCS Architecture Overview
- **BOP PLC Network Architecture**
- Package PLC configuration examples
- Advantages of BOP PLC Network
- BOP PLCs and Network Vendor selection and implementation Methodology.
- Path Ahead.

Packages Controlled From BOP Network System

RELIANCE

- Coal Handling Plant
- Ash Handling Plant
- Mill Reject Handling System
- Compressed Air System
- Fuel Oil Unloading
- Fire Water Supply System
- DM Plant
- Raw Water Pre-treatment Plant
- Effluent Treatment Plant
- Miscellaneous Pumps – Raw water Intake, Raw water, Rain water, Service water, Potable Water , CT Make up, DM feed, Boiler Fill

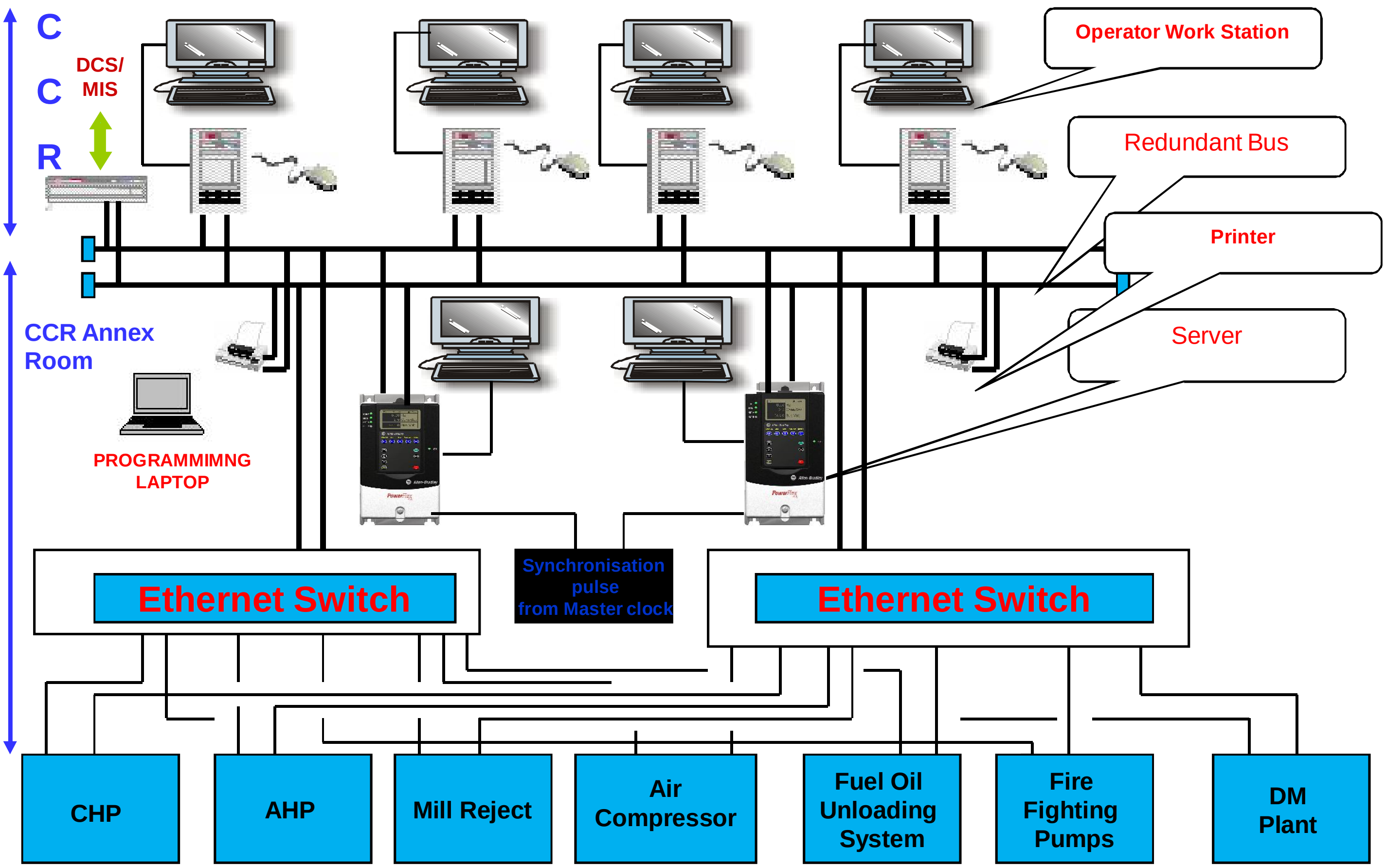
PLCs

- All PLCs are of
  - Same make (Rockwell)
  - Same family
- Larger packages are of Rockwell Control Logix family- with Redundant Processors.
- Smaller packages are of Rockwell Flex Logix family-with non-Redundant Processors.

BOP Network

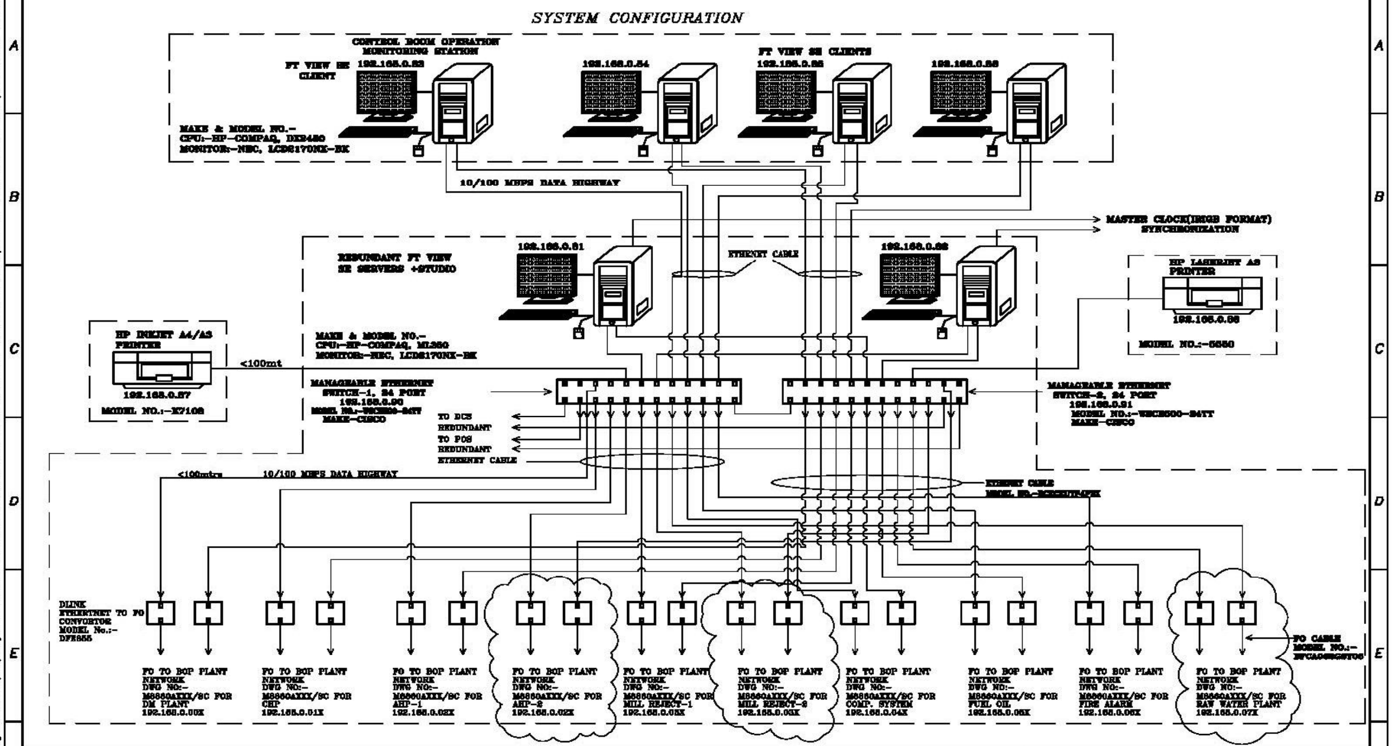
- 4 No. Monitors for operation in CCR
- Redundancy in
  - Servers
  - Network components like Ethernet switches, Cabling & Interface Modules
  - Time synchronisation with Master clock system.
  - Connectivity with DCS through OPC.

BOP Network Configuration



BOP Network Configuration - Details

RELIANCE



05.				
04.				
03.				
02.	AS DISPATCHED	21/03/11	SHANKAR	
01.	REVISION-1 FOR PHASE-2	13/01/11	AVARADEEP	
00.	ORIGINAL ISSUE OF UNIT -2	01/12/10	AVARADEEP	
No.	REVISIONS	DATE	SIGN.	

CLIENT:-	M/s UTILITY ENERGYTECH & ENGINEER PVT. LTD.
PROJECT	4X300 MW ROSA PROJECT
APPLICATION	BOP NETWORK SYSTEM

Rockwell Automation
Manufacturing Process Solutions

TITLE:-	SYSTEM COFIGURATION		
DWG NO.	UEEPL-RTPP-NVI-416-J-7001/SC	SCALE	N.T.S.
REF. DWG.NO.	------	SHEET	01 OF 06
PROJECT ID	M8860B003/M8860AD61		
DRAWN BY:	VINOD 01/12/10	CHECKED BY:	AVARDEEP 01/12/10
	02-SC-02		

This drawing and design is the property of ROCKWELL AUTOMATION INDIA PVT. LTD. and must not be copied or lent without their permission in writing.

BOP Network Components – Details

- Details of equipment of Network system -

- Server – 2 nos.
  - Make – HP- Compaq, ML 350
  - Configuration - Processor – Intel XEON 3 GHz., RAM – 4 GB, HDD – 320 GB with RAID level 10 mirroring.
  - Softwares –
    - ✓ RS Logix 5000 STD, RS Networkx Bundle
    - ✓ RS View SE server Unlimited Display
    - ✓ RS View Studio for RS View Enterprise (Contain Panel View software also.)
    - ✓ RS Linkx Classic Gateway
    - ✓ Windows 2003 Std. server, Service Pack-2

- Client – 4 nos.
  - Make – HP- Compaq, DX 2480
  - Configuration - Processor – Pentium 2.8 GHz., RAM – 1 GB, HDD – 80 GB.
  - Softwares –
    - ✓ RS View SE client

BOP Network Components – Details

RELIANCE

- ➢ Ethernet Switch – 2 nos.
- • Make – CISCO , WSCE 500 – 24TT
- • Type – Manageable, 24 port

- ➢ FO to Ethernet convertor – 20 nos.
- • Make – D link, DFE 855

- ➢ Printer – 2 nos.
- • 01 no. A3 size Inkjet colour , 2800
- • 01 no. A3 size Laser colour, 5550
- • Make – HP

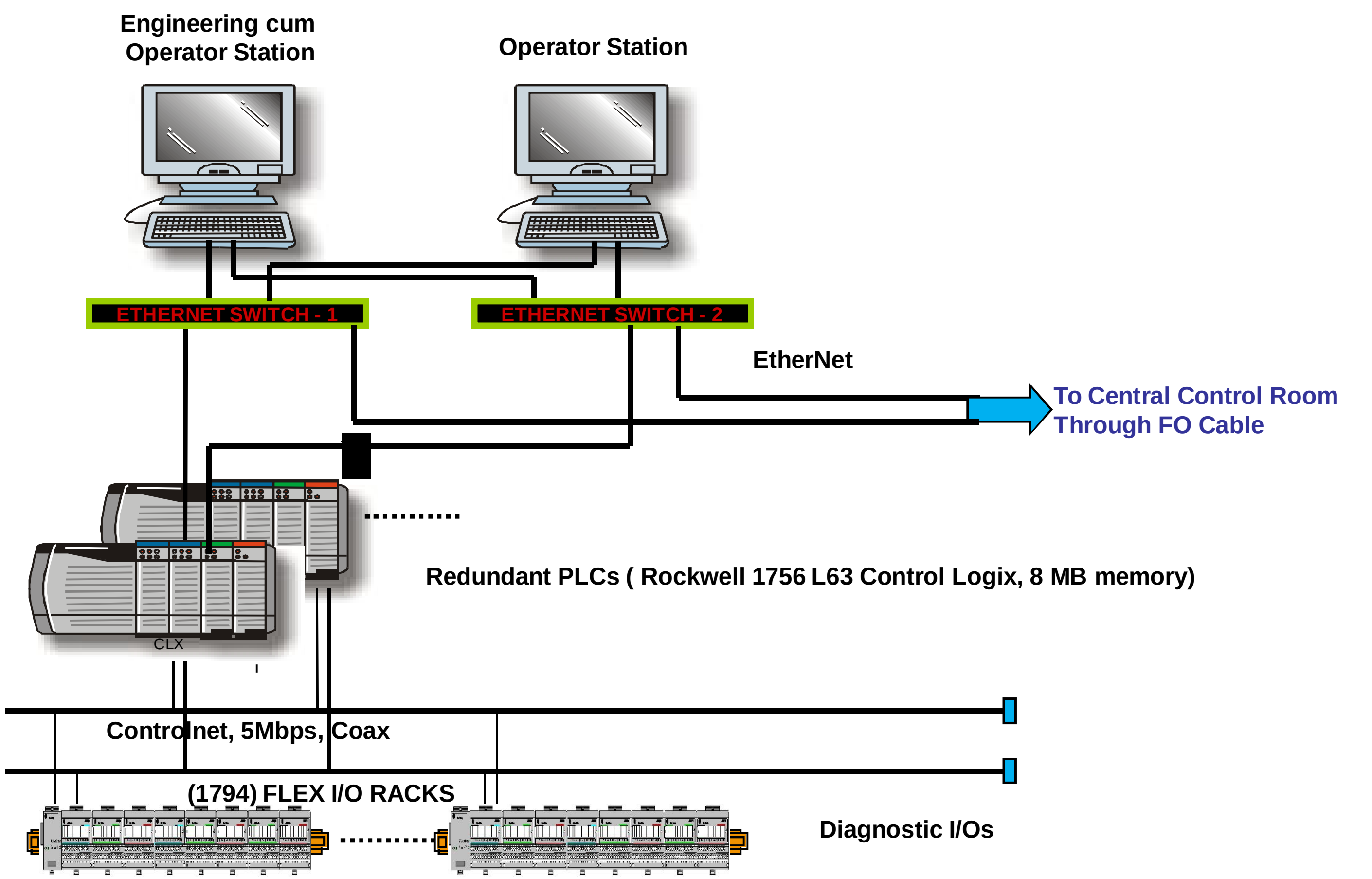
Input and Output Details

RELIANCE

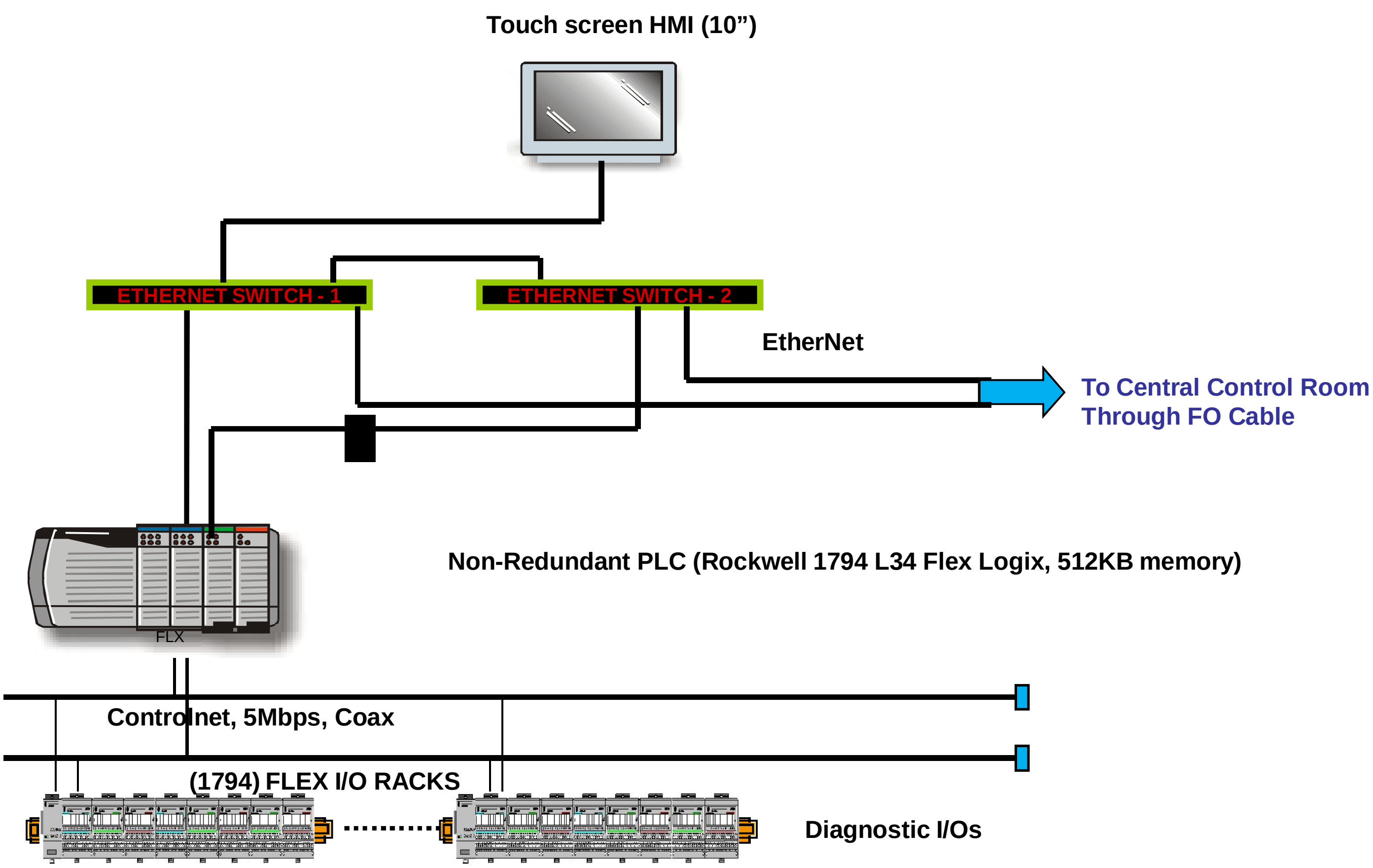
Package Name	Stage - I/ Stage - II	Digital Input	Digital Output	Analogue Input	Analogue Output	RTD Input	Total I/Os
DM Plant (including ETP/PT/ Intake/ Rain Water RI/Os)	Common for Both Stages	1264	592	228	24	0	2108
Fuel Oil System	Common for Both Stages	80	64	24	12	0	180
Mill Reject Handling System	Stage - I	432	192	0	0	0	624
	Stage - II	720	368	12	12	0	1112
Compressed Air System	Common for Both Stages	48	0	24	0	0	72
Ash Handling Plant	Stage - I	1216	1232	180	0	72	2700
	Stage - II	1152	1200	156	0	72	2580
Fire Protection System	Common for Both Stages	112	96	12	0	0	220
Coal Handling Plant	Common for Both Stages	928	384	156	36	160	1664
Raw Water System	Stage - II	32	32	12	0	0	76

Total I/O counts – 11336 nos.

Typical PLC Configuration For Large Packages



Typical PLC Configuration For Small Packages

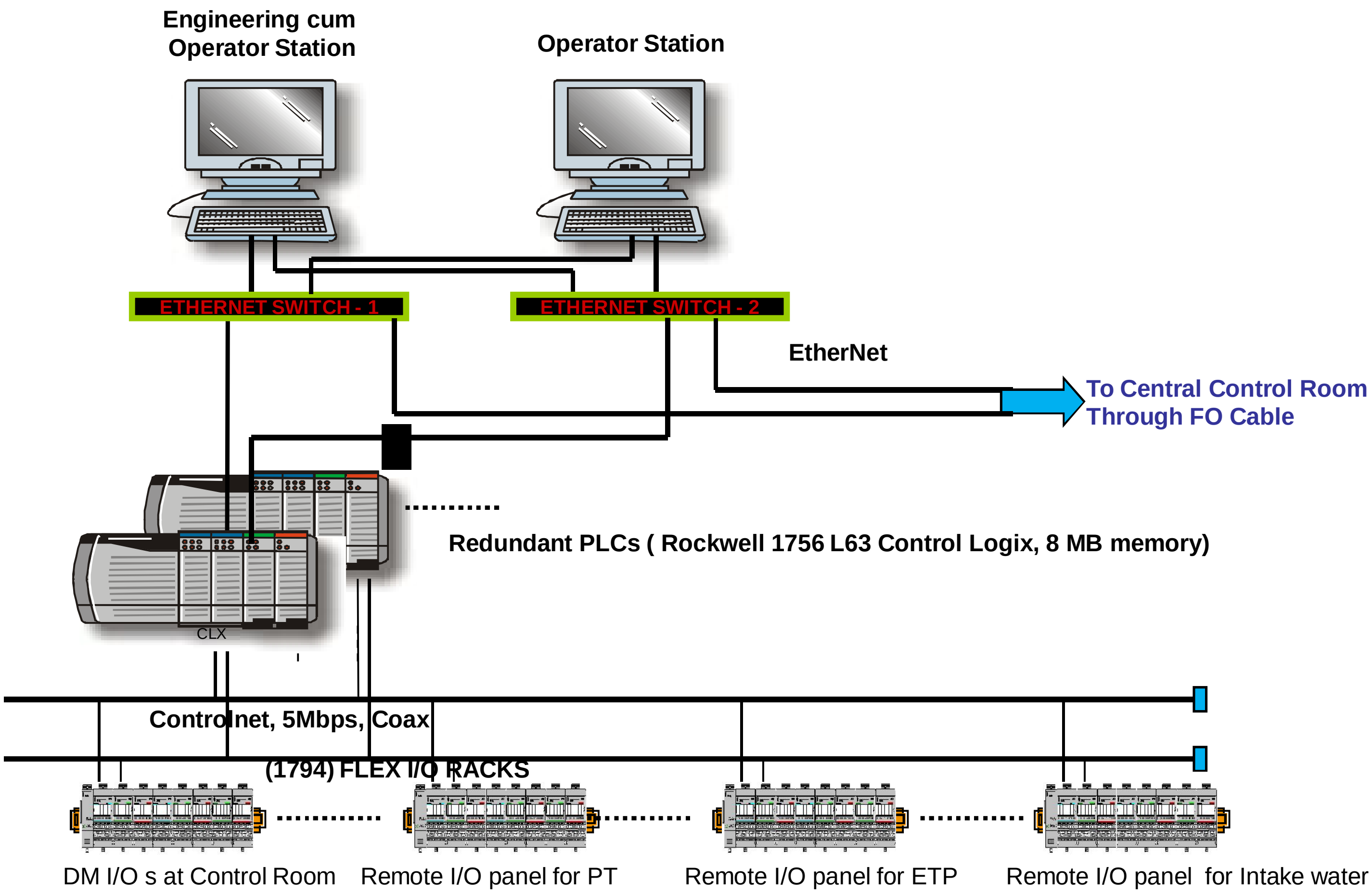


Flow of Presentation

RELIANCE

- Rosa Power Plant Overview
- Control / Automation Philosophy implemented at Rosa.
- DCS Architecture Overview
- BOP PLC Network Architecture
- **Package PLC configuration examples**
- Advantages of BOP PLC Network
- BOP PLCs and Network Vendor selection and implementation Methodology.
- Path Ahead.

DM Plant PLC



Engineering cum
Operator Station
Operator Station
ETHERNET SWITCH - 1
ETHERNET SWITCH - 2
EtherNet
To Central Control Room
Through FO Cable
Redundant PLCs (Rockwell 1756 L63 Control Logix, 8 MB memory)
CLX
Controlnet, 5Mbps, Coax
(1794) FLEX I/O RACKS
DM I/O s at Control Room
Remote I/O panel for PT
Remote I/O panel for ETP
Remote I/O panel for Intake water

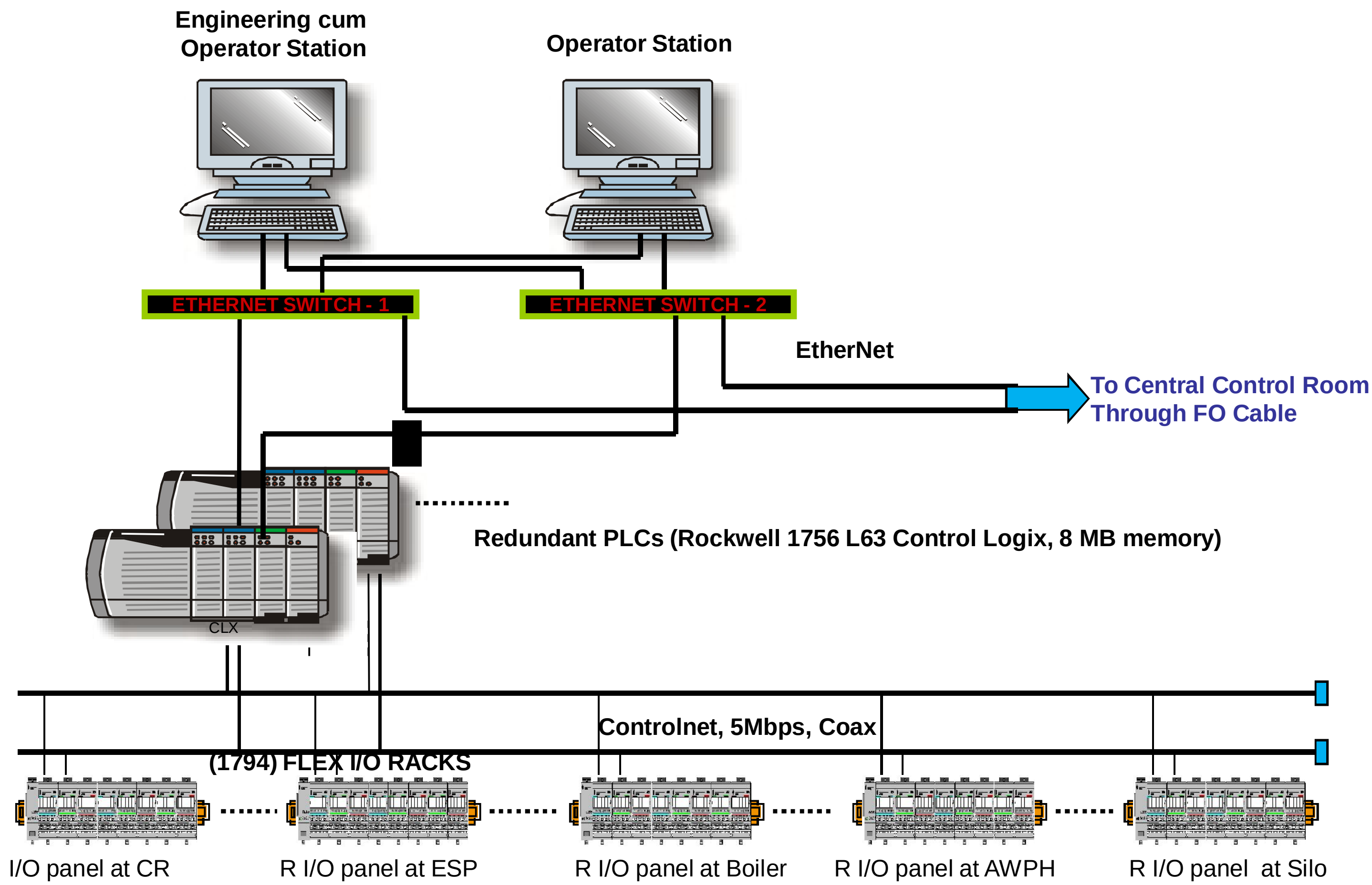
DM Plant PLC – Remote I/O Panels

RELIANCE

- Total 06 nos. remote I/O panels of DM PLC are geographically distributed in the plant and all these panels are connected to main DM PLC through fibre optic cables.
  - PT Plant – One no. remote I/O panel located at PT plant electrical room.
  - ETP – Total 3 nos. panel. One no. located at Fuel oil control room, one no. at CMB electrical room, one no. at MRHS control room.
  - Intake water – One no. remote I/O panel at intake water electrical room.
  - Rain Water – One no. remote I/O panel at rain water electrical room.

- Other pumps are directly wired to DMPLC for their control and monitoring. These pumps are as follows –
  - Raw Water Pumps
  - CT Makeup Pumps
  - Portable Water Pumps
  - Service Water Pumps
  - DM Feed Pumps

AHP PLC

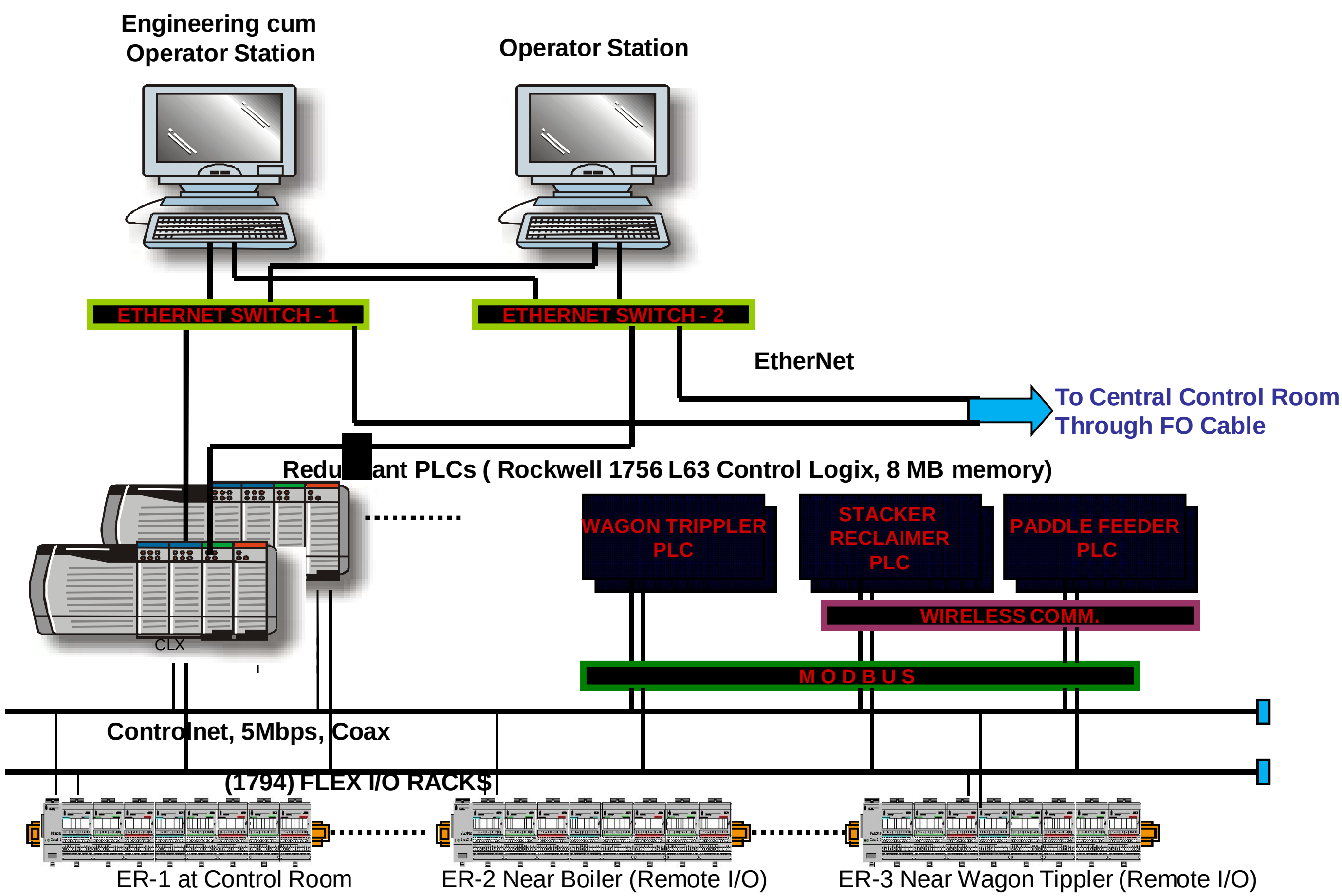

Engineering cum
Operator Station
Operator Station
ETHERNET SWITCH - 1
ETHERNET SWITCH - 2
EtherNet
To Central Control Room
Through FO Cable
Redundant PLCs (Rockwell 1756 L63 Control Logix, 8 MB memory)
CLX
Controlnet, 5Mbps, Coax
(1794) FLEX I/O RACKS
I/O panel at CR
R I/O panel at ESP
R I/O panel at Boiler
R I/O panel at AWPH
R I/O panel at Silo

AHP PLC – Remote I/O Panel Details

RELIANCE

- Total 09 nos. remote I/O panels of AHP PLC are geographically distributed in the plant and all these panels are connected to main AHP PLC through control net cable
  - Ash Water – One no. R I/O panel common for unit-1 and uni-2 located at Ash water electrical room.
  - ESP – 3 nos. R I/O for unit-1 and 2 nos. R I/O for unit-2 are located at ESP electrical building.
  - BACP – One no. each R I/O for unit-1 and unit-2
  - Silo - One no. R I/O common for unit-1 and unit-2

CHP PLC



Engineering cum Operator Station
Operator Station
ETHERNET SWITCH - 1
ETHERNET SWITCH - 2
EtherNet
To Central Control Room Through FO Cable
Redu ant PLCs (Rockwell 1756 L63 Control Logix, 8 MB memory)
CLX
WAGON TRIPPLER PLC
STACKER RECLAIMER PLC
PADDLE FEEDER PLC
WIRELESS COMM.
M O D B U S
Controlnet, 5Mbps, Coax
(1794) FLEX I/O RACKS
ER-1 at Control Room
ER-2 Near Boiler (Remote I/O)
ER-3 Near Wagon Tippler (Remote I/O)

CHP PLC Configuration – Technical Details

RELIANCE

- STACKER RECLAIMER – Being connected to CHP main PLC through Modbus via Wireless communication.
  - PLC Processor – Rockwell Compact Logix (1769 - L35CR) , 1.5 MB Memory
  - I/Os – 1734 Family also called as Point I/Os

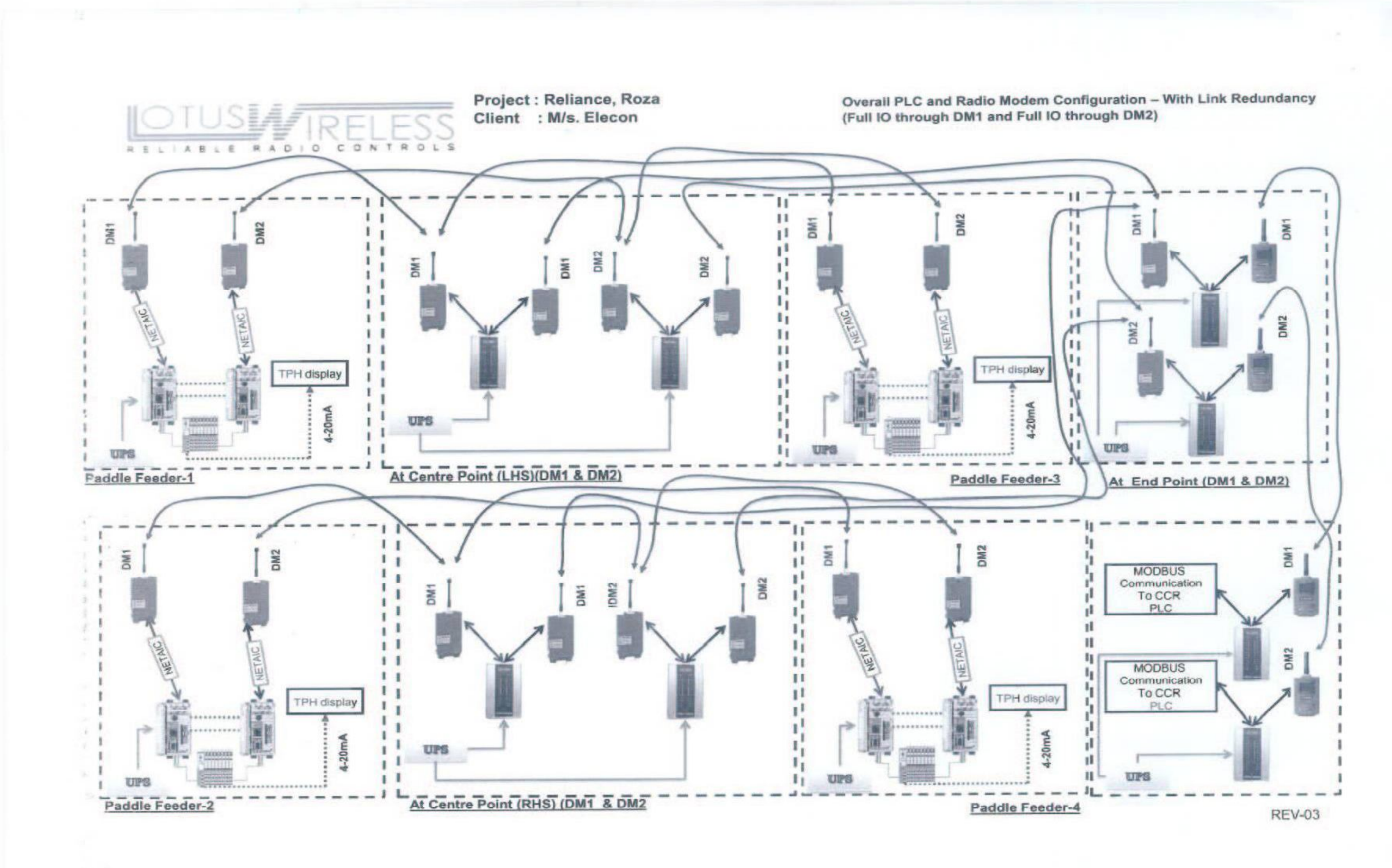
- WAGON TIPPLER – Being connected to CHP main PLC through Modbus
  - PLC Processor – Rockwell Compact Logix (1769 - L35CR) , 1.5 MB Memory
  - I/Os – 1734 Family also called as Point I/Os

- PADDLE FEEDER – Being connected to CHP main PLC through Modbus via Wireless communication.

  PLC Processor – Rockwell Compact Logix (1769 - L35CR) , 1.5 MB Memory
  - I/Os – 1734 Family also called as Point I/Os

- Wireless Communication –
  - Make – Lotus
  - Radio Modem – Satel 1870
  - RTU – 1400 D

Wireless Communication between CHP PLC and Paddle Feeder PLC



Flow of Presentation

RELIANCE

- Rosa Power Plant Overview
- Control / Automation Philosophy implemented at Rosa.
- DCS Architecture Overview
- BOP PLC Network Architecture
- Package PLC configuration examples
- **Advantages of BOP PLC Network**
- BOP PLCs and Network Vendor selection and implementation Methodology.
- Path Ahead.

Advantages of BOP PLC Network System

- Control & Monitoring of all BOP Packages from Centralized Location (CCR)
- Operational Flexibility- Operation can be done either from CCR or Local Control Room as per Operational requirement
- Operation of any of the BOP package from any Client station in CCR
- Operator Familiarization & Training is easy as all BOP packages have similar type of HMI screens (Look & Feel)
- Operation can be done with reduced man power.
- Engineering / Maintenance/Troubleshooting can be done from Engineer's room for all packages.
- Maintenance, Familiarization & Training is easy as all are same type of PLCs.
- Maintenance can be done with reduced man power.
- Spares Inventory minimized.

Advantages of BOP PLC Network System

RELIANCE

- Time synchronisation of BOP PLCs with Master clock system at one point so that individual PLC time synchronisation is not required.
- Connectivity of BOP PLCs with DCS/ MIS at one point through OPC so that individual PLC is not required to be connected with DCS.

Flow of Presentation

RELIANCE

- Rosa Power Plant Overview
- Control / Automation Philosophy implemented at Rosa.
- DCS Architecture Overview
- BOP PLC Network Architecture
- Package PLC configuration examples
- Advantages of BOP PLC Network
- **BOP PLCs and Network Vendor selection and implementation Methodology.**
- Path Ahead.

PLC Vendor Selection Methodology

RELIANCE

- Prepare technical specifications and functional requirement / concept note of PLCs and Network system.
- Freeze architecture of individual PLC including interface with BOP Network System.
- Estimate I/O counts package wise
- Mandatory spares included in the specification
- Invite bids from PLC Vendors
- Bidders to offer one consolidated quote with Package wise price break up
- Bidders to quote unit rates as well for modules (Processor, I/O cards, Communication controller etc)
- Reliance evaluate and decide the PLC supplier.
- MOM signed with PLC supplier for package wise price and unit rates.

➢ In case of Rosa , Rockwell was selected through the above methodology for supply of PLCs and BOP Network

PLC Procurement and Implementation Methodology

RELIANCE

- **For PLC**
  - Sourcing of PLC through Mechanical Package OEMS.
  - While evaluating Mechanical package OEMs , Reliance communicate their intent of PLC standardization
  - OEM place order on Reliance selected PLC supplier
  - PLC Supplier takes complete responsibility of supply, commissioning and warranty of PLC system (to OEM)
  - OEM has overall commitment of warranty (to Reliance directly)
- **For BOP Network System**
  - BOP Network system ordered directly on PLC supplier
  - PLC Supplier takes complete responsibility of supply, commissioning and warranty of PLC system (to Reliance directly)

Flow of Presentation

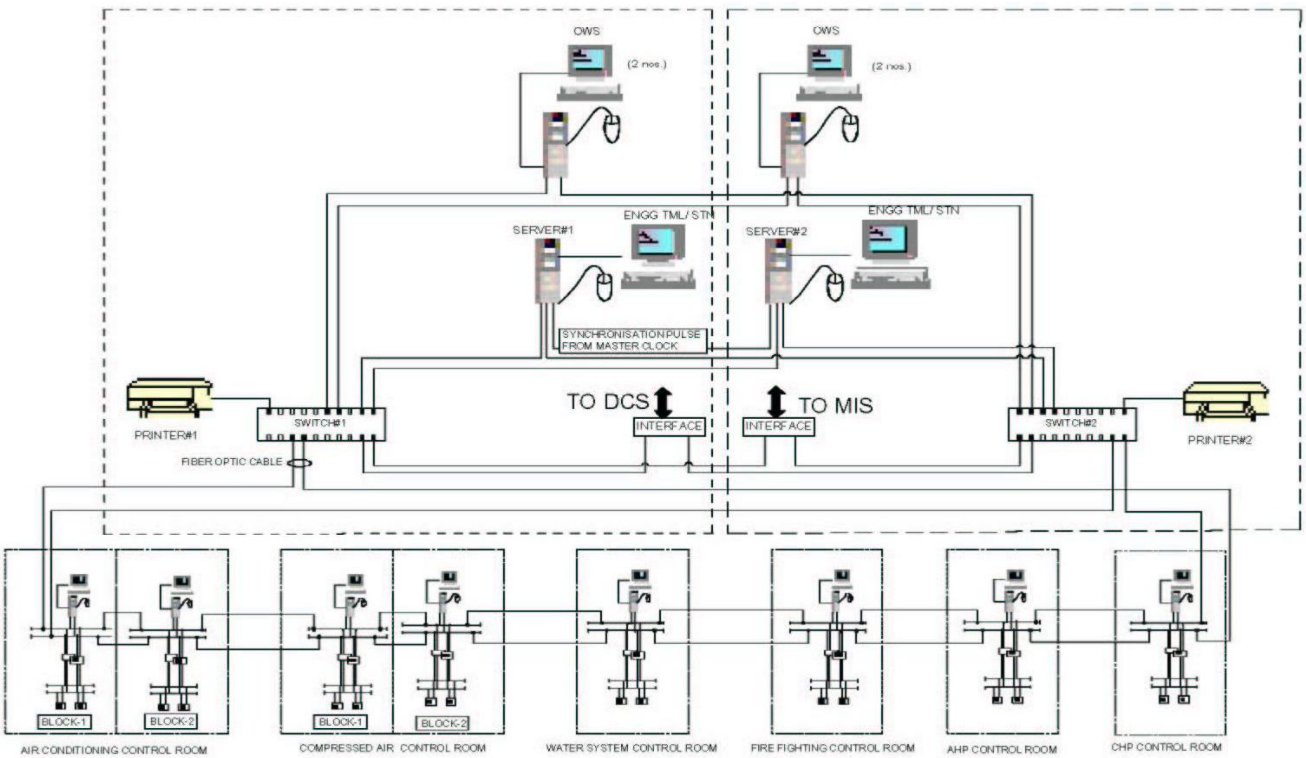
- Rosa Power Plant Overview
- Control / Automation Philosophy implemented at Rosa.
- DCS Architecture Overview
- BOP PLC Network Architecture
- Package PLC configuration examples
- Advantages of BOP PLC Network
- BOP PLCs and Network Vendor selection and implementation Methodology.
- **Path Ahead.**

BOP PLC Network System in Other Reliance Projects

- BOP PLC Network system concept is also being implemented in our other Reliance Power projects –

- Butibori – 2X300 MW Coal Based Power Plant
- Samalkot – 2400 MW Combined Cycle Power Plant
- Sasan – 4000 MW Coal Based Ultra Mega Power Project

BOP PLC Network with Ring Topology



Thank you for Participating

Smart grid and Its Challenges

By
SH. Y.K.Sehgal

Smartgrid

- **"Smart Grid" shall facilitate efficient and reliable end-to-end Intelligent two way delivery system from Source to Sink through Smart Generation including Renewable energy, Smart transmission & Distribution System**

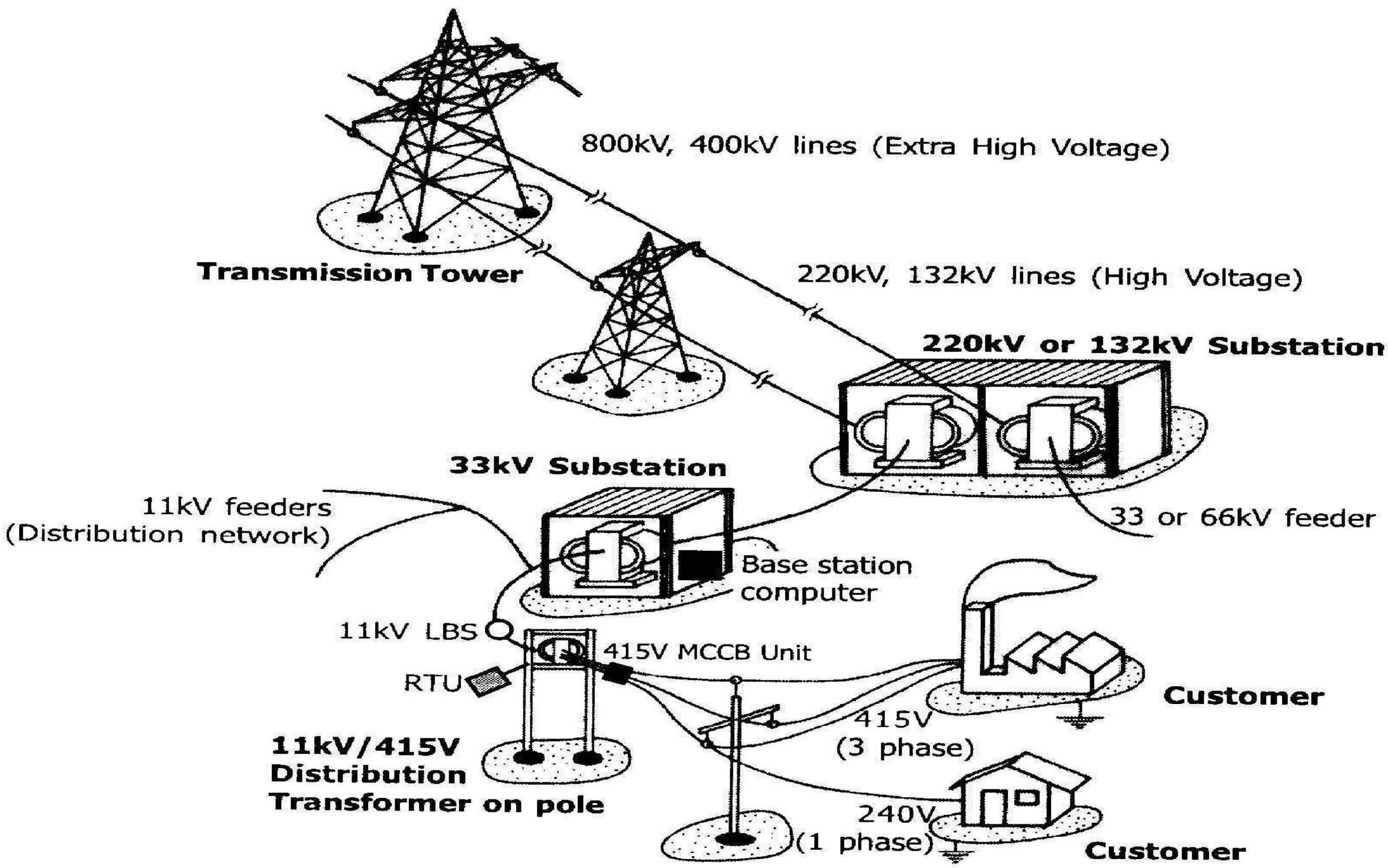
The difference

Conventional

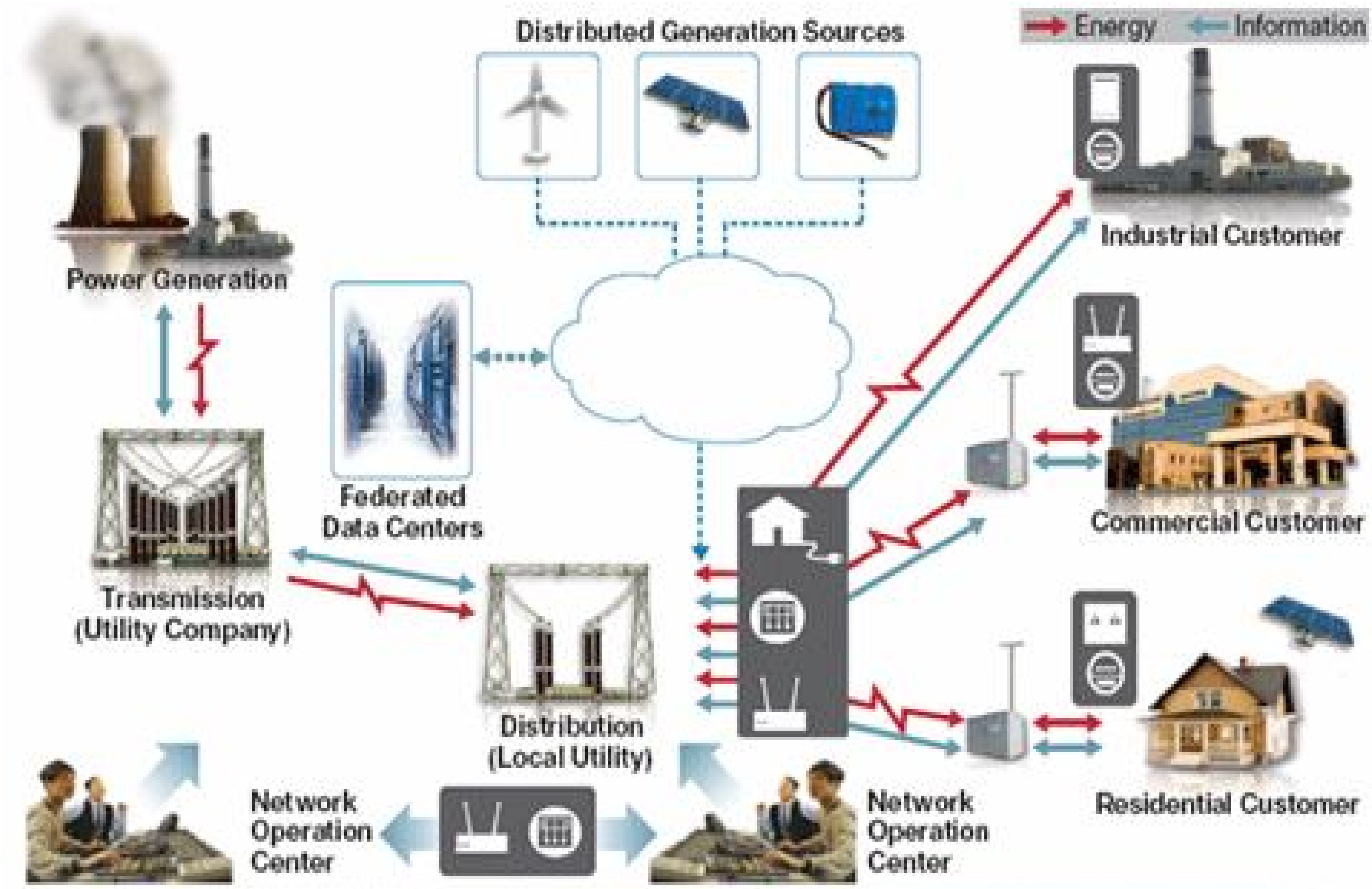
- Generation Follows the Load
- Generation is controlled
- Top down approach

Smart

- Load and Generation both move for Balance
- Both Generation and load are controllable
- Two way approach



Present Transmission & Distribution



The Smart Way

The Smart way needs changes in the way business is done mainly at Distribution level

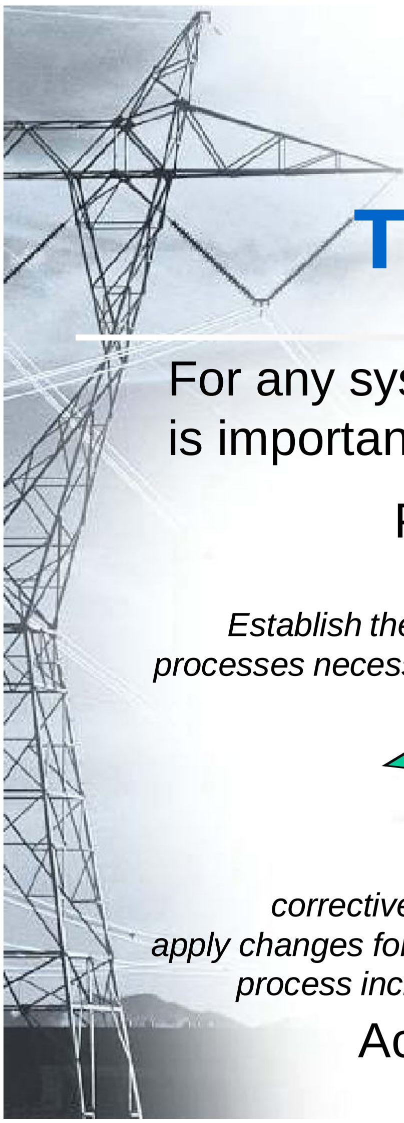
Automation in Distribution

The Smart Way out

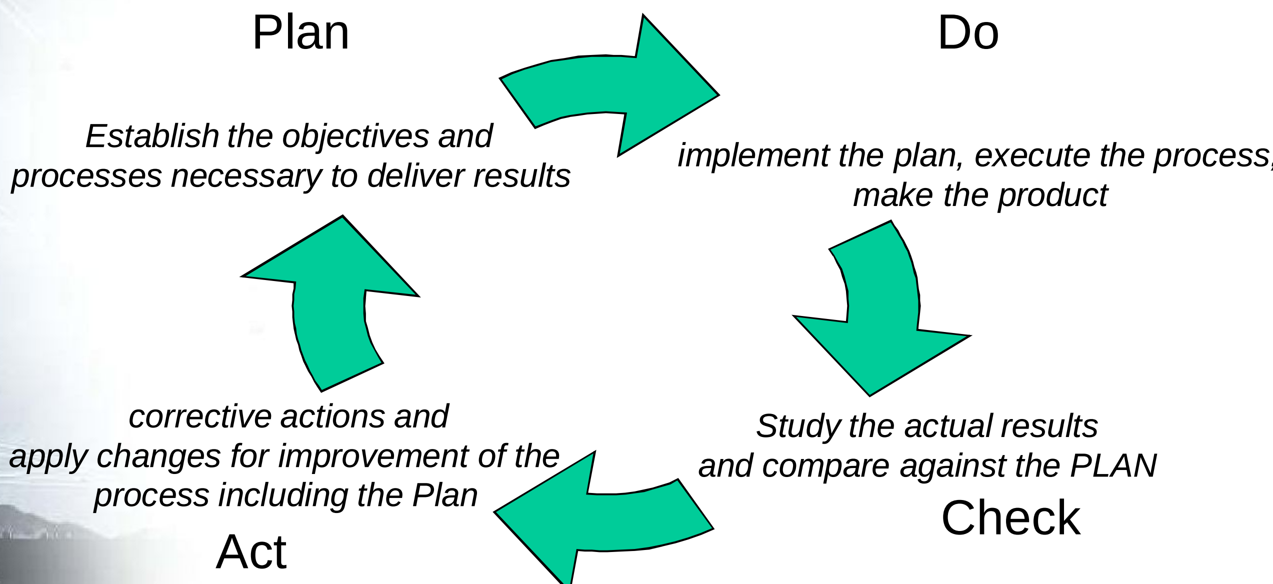
Current Status of Distribution

- Distribution is characterized by
  - High AT&C losses (National Avg~33%)
  - Low economic viability and
  - Poorly maintained infrastructure (mostly installed and no maintenance)
- India's Generation and Transmission have healthy infusion of Automation but distribution is lacking way behind.

The efficient system

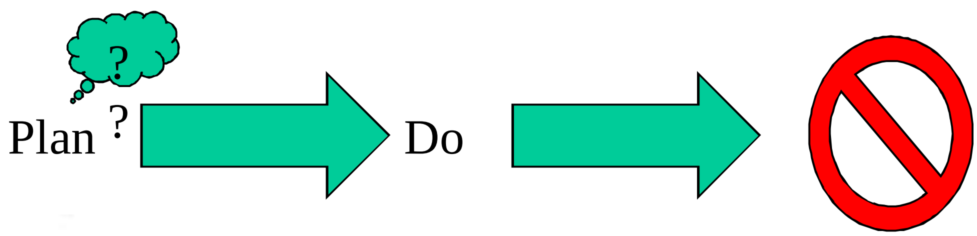


For any system to be more Efficient the **feedback loop** is important



Present Process in Distribution system

- Present System End the process at Planning and doing .
- There is no feedback loop to analyze and improve the system



- ➢ **<u>No Checks</u>**
- ➢ **<u>No Preventive action only breakdown and corrective</u>**

Necessity of Automation

You cannot control What you don’t Know

To know one need to

– Measure

– Compare then only control is feasible

<u>Lack of Intelligent Equipment</u>

<u>Situation</u>

– The present system only has circuit breaker which curtail the load on the down stream network completely in the event of a fault.

<u>Repercussions</u>

– Blackouts a large section of distribution causing inconvenience to the consumer and loss of revenue

Necessity of Automation

Lack of Data and Information about the system

Situation

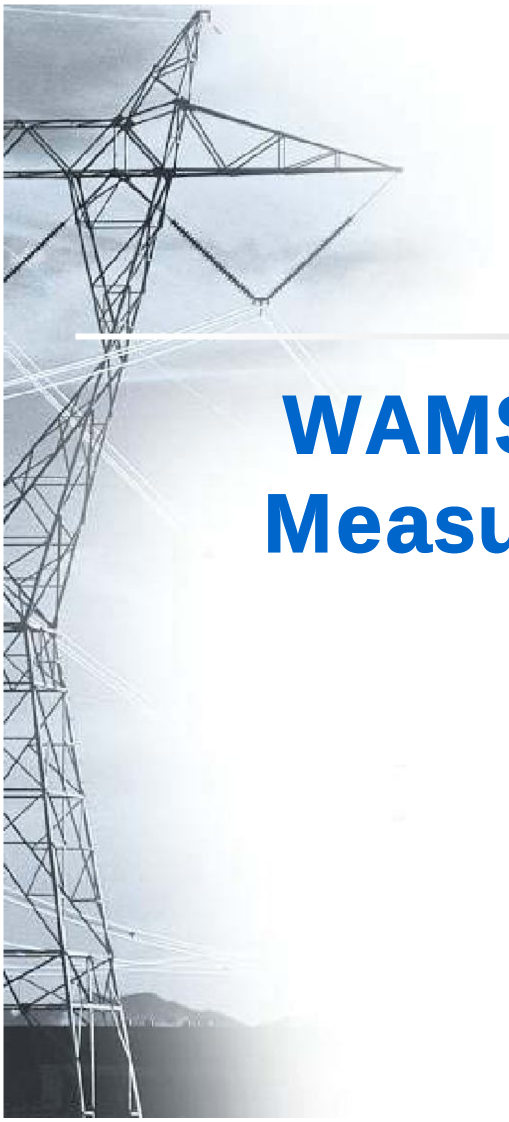
- Measurement of Energy, the basic parameter (means of quality delivery) in Power delivery system is not proper in most of the utilities
- The information about system is a far from reality

Repercussions

- Increased losses **Unaccounted energy** flow
- Lack of information on **Loads** leads to overloading and poor voltage at Customer end as well as unplanned outages
- Lack of information on **health of Transformer** leads to higher failures- upto 20% fail in India compared to achievable <8% (One Utility has <2%)

Challenges towards Automation

- People
  - Utility people are most important for improving the power sector but are the mostly unskilled
- Lack of experience and awareness of **Automation** & **data analysis** across Power Distribution Sector
- Need for Regulatory enablement for pricing and performance related compensation/reward payment structure
  - The current system is Asset related
- Changing Operational practices
- Culture



WAMS/Synchrophasor Measurement for a grid

Power Transmission System

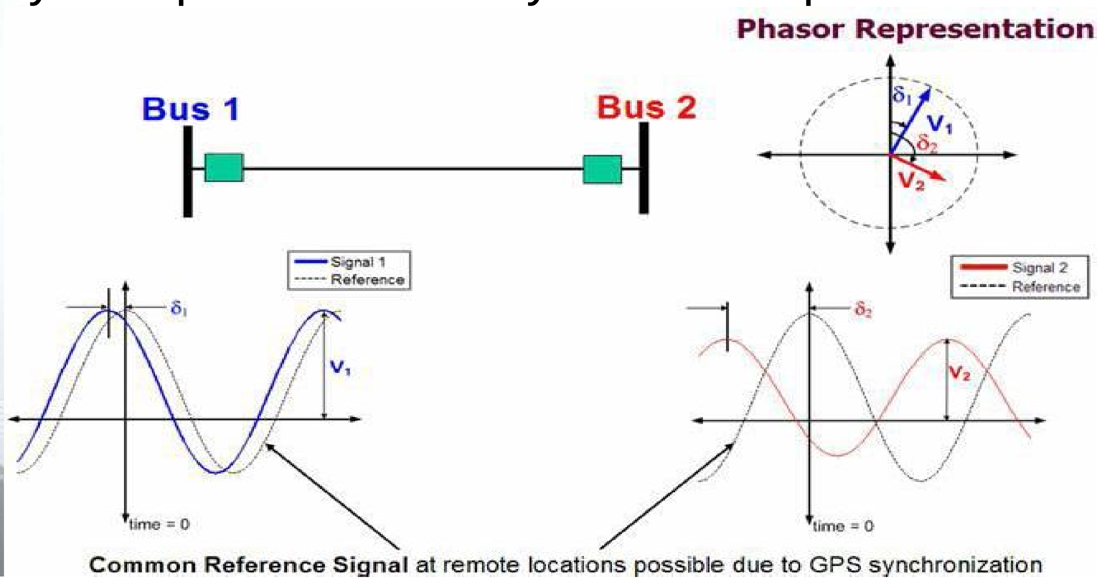
- Explosive growth of power system- Resource inadequacy – Generation / Transmission / Distribution
- Transmission
  - Haulage of power over long distances
- A statutorily permitted floating frequency band
- Integration of large power systems
  - NEW & SR Grids
  - Renewable Integration

Need for Smartgrid

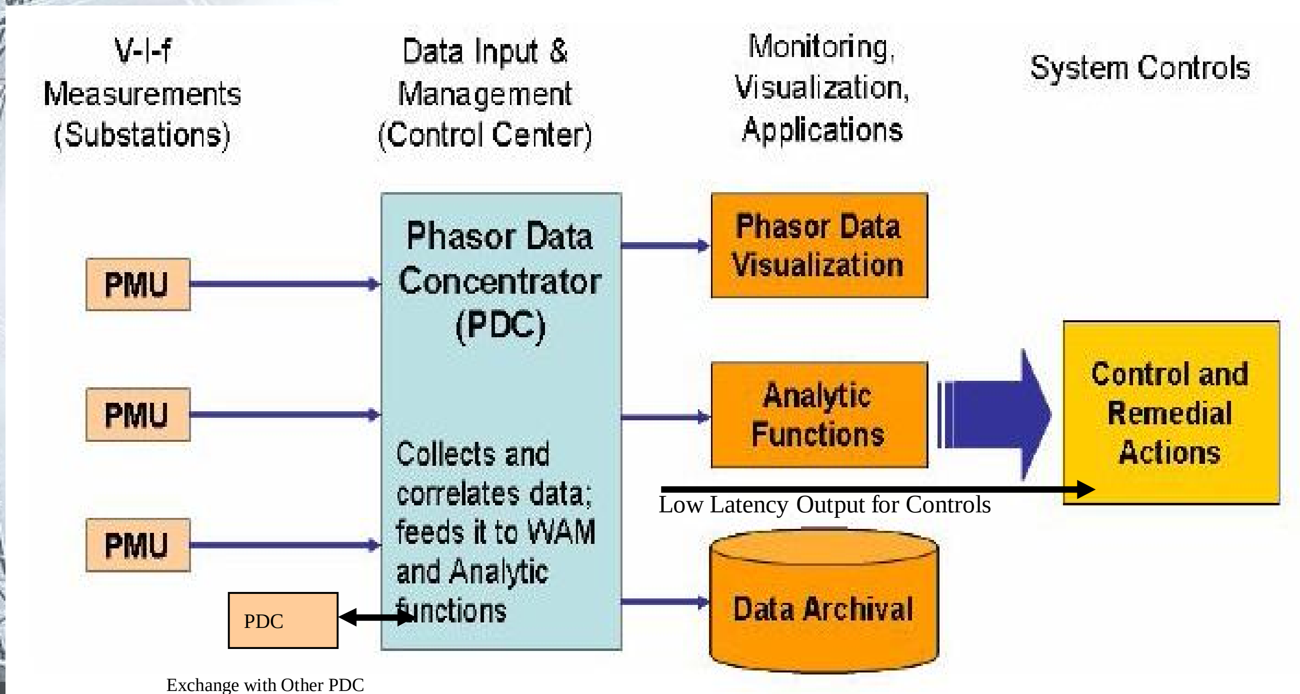
- Existing SCADA/EMS facility provides only Steady State view of the Grid
- To address issues like Safety, Security and Reliability amid complexity of the grid, real time/dynamic behavior of the system is to be monitored
- To facilitate optimal utilization of resources through real time assessment of transmission capability
- Smart Grids through WAMS/Synchro-Phasor Technology provides Real time dynamic state of the system which shall improve visualization & situational awareness of grid events

Synchrophasor Technology

- Phasor: An electrical quantity with magnitude and phase (angle)
- Synchrophasors: Time-synchronized phasors



WAMS Architecture



Smartgrid Promise

- WAMS/Synchro-Phasor Technology provides **Real time dynamic state of the system**
- Situational Awareness on a sub-second basis over wide area
- Instantaneous measure of power system stress between wide area locations
- Instantaneous measure of power system dynamics at given location
- PMU data is well suited to activate automated controls

Potential Applications

Real Time Applications

– Wide Area Situational Awarness

– Monitoring of Oscillations

– Alarming and setting system operational limit

– Dynamic line rating and congestion management

Off Line Applications

– Model Validation (Calibrate & fine-tune simulation models by comparing simulation results with synchrophasor data)

– Grid incident analysis

– Voltage Stability Performance

– Development of wide area protection scheme

Renewable Integration

CONVENTIONAL

RENEWABLE

Comparison

#	Parameter	Conventional Energy	Renewable Energy Recourses
1	Controllability	Power output of Conventional can be controlled to manage system study & parameters	Uncontrolled power output (Must Run)
2	Predictability	Scheduling is possible even few days before.	Specially in case of wind forecasting accuracy is low • 15 min – 95% (approx) • 4hrs – 80-85% • Day ahead - < 40%
3	Compactness	Land requirement/ MW is low. For Typical 5x800MW Thermal Power plant land requirement is ~ 11.5 sq-KM.	land requirement is quite large (Specially in case of wind power 460sq-KM for 4000MW)
4	Dependabilty	Conventional source supply a fixed portion of load - reliable, permanent, dependable	Low Reliability and distributed generation all along the area Not suitable for critical and essential loads. Back up is required
5	Generation Phenomenon	No sudden and unanticipated change to power output	Variability and intermittency in generation (3MW-2000MW in few minutes)

Comparison

#.	Parameter	Conventional Energy	Renewable Energy Recourses
6	Requirement of VAR compensation	Conventional generator can generate as well as absorb VAR to support grid	Wind Induction generator need VAR support from Grid.
7	Grid Connectivity issues	Single point injection at higher voltage level with proper scheduling. Planning is replicable for new generator.	Lots of connectivity issues ; Distributed generation at low voltage level which is further intermittent & variable depend upon weather. (Wind speed and solar intensity) – Conventional grid planning rules difficult to apply
8	Power Quality	Quality of power is controllable and reliable	Power Quality Problems (Voltage fluctuations, Harmonic distortion, DC injection, VAR support)
9	Control techniques	Mature Control techniques readily available	An adaptable advanced control system like STATCOM, SVCs, is under development.
10	Storage	There is no need of bulk storage as production can be planned	Energy Storage requirement as production is at mercy of natural phenomenon (pressurized air, electro mechanical storage, underground seasonal storage, batteries)

Need for Integration

- Rapid and large deployment of Renewable Energy Source in future
- Variability & Intermittency in RE Resources
- Sudden and Unanticipated changes to Power Output
- Power Quality Problems (Voltage fluctuations, Harmonic distortion, DC injection)
- Need of accurate forecasting of wind speed and solar intensity

Challenges in integrating

- Use of Smart Control devices of suitable rating like STATCOM
- Phasor Measurment unit/ Communication System at distribution end.
- Energy Storage such as pressurized air, electro mechanical storage, underground seasonal storage, batteries with Power electronic & control systems
- Information exchange with energy dispatch centre helps the utility to deal with these RES.

Challenges in integrating

- It platform should be developed to forecast both the load and the renewable power available.
- Development of an adaptable advanced control system is necessary to achieve optimal utilization of different kinds of renewable energy sources and to maintain a high degree of reliability and security.

Thank you

DEVELOPMENT
OF
AUTOMATION MECHANISM
FOR
INSPECTION OF POWER PLANT COMPONENTS
IN
CRITICAL AREAS

Kishore Aggarwal
Badri Vishal Gupta
Rakesh Kumar Chakraborty
Sensor & Robotics Lab, NETRA
NTPC Limited, Greater Noida

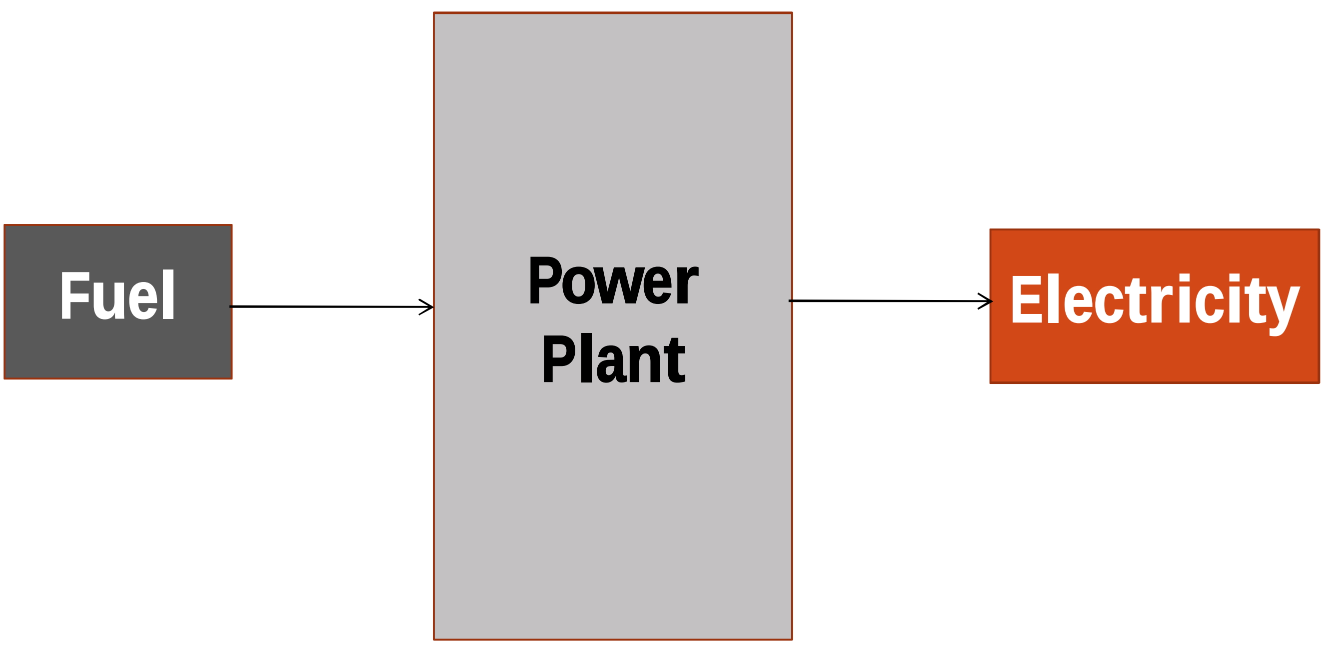
ISA(D) POWAT-INDIA 2012, New Delhi January 13th -14th, 2012

Overview

- Introduction
- Boiler Inspection in NTPC
- Geometrical Complexities of Boiler
- Generator Inspection
- Geometrical Complexities of Generator
- Projects
- Conclusion

Introduction

Thermal Power Plant



ISA Delhi Section

Introduction

A Maharatna Company

Power Plant Equipments

- Turbine
- Generator
- Condenser
- Piping
- Valves
- Fans
- Compressors
- Pumps
- Storage tanks
- Mills
- Transformers
- Transmission lines
- Others Auxiliaries

Introduction

How to ensure plant Availability

- Preventive maintenance
- Condition based Monitoring
- Good quality of Maintenance
- Adopting Advanced NDT techniques
- Faster and reliable Inspection

Introduction

Robotics

A robot is a reprogrammable, multifunctional machine designed for performing various useful tasks.

Robotics is related to the sciences of electronics, mechanics, mechatronics, and software engineering.

Today, robotics serve various practical purposes, whether domestically, commercially, or militarily.

Introduction

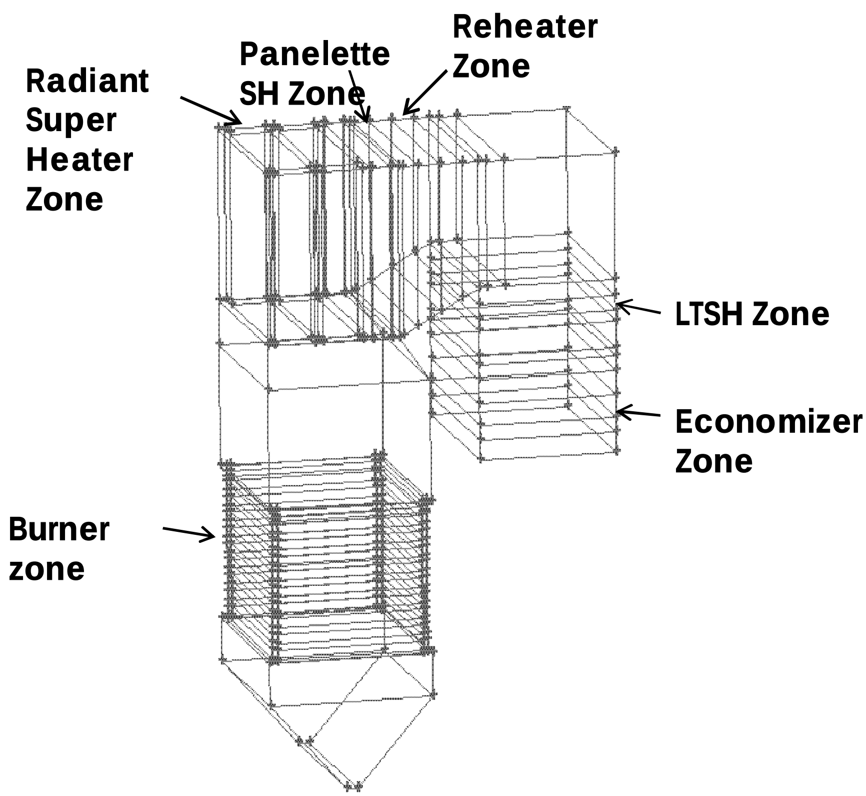
Why need Robotics in Power Plant?

- Faster Inspection
- Accessibility in critical areas
- Reliable Inspection
- Reduced downtime

ISA Delhi Section

एनटीपीसी NTPC
A Maharatna Company

Boiler Schematic



ISA Delhi Section

एनटीपीसी NTPC
A Maharatna Company

Tube Arrangement data

ARRANGEMENT DATA

Quantities indicated are per boiler. Heating surface are gas touched unless spec

Section	No. Assy.	No. Elem.	No. Loops	Spacing-mm		Tube OD mm	Heatin
				S_T	S_L		Length m
SH PANELETTE	48	432	1	3048	54.0	44.5	14818
SH PLATEN	25	400	1	762	60.3	51.0	13576
RH PLATEN	74	888	1	254	63.5	54.0	27883
RH SPACED(Final)	74	888	1	254	90.0	54.0	22712
LTSH Terminal	124	744	$\frac{1}{2}$	304.8	95.0	44.5	9070
LTSH Horizontal	124	744	2	152.4	95.0	44.5	33977
ECONOMISER	184	552	$10\frac{3}{4}$	103.0	76.2	38.1	152060

Boiler Inspection in NTPC

Activities involved in Boiler inspection:

- Cooling of the boiler after shutting down (min 24 hours)
- Washing of the heat transfer surfaces (24 hours)
- Erecting a scaffolding (96-100 Hours)
- Thickness survey of tubes
- Replacement/Repair of damaged tubes

Tube thickness survey done in two phases:-

Phase 1: Furnace zone inspection takes 60-72 hours

Phase 2: Second pass-economizer, LTSH and extending up to re-heater takes120 hours.

Issues in Boiler Inspection

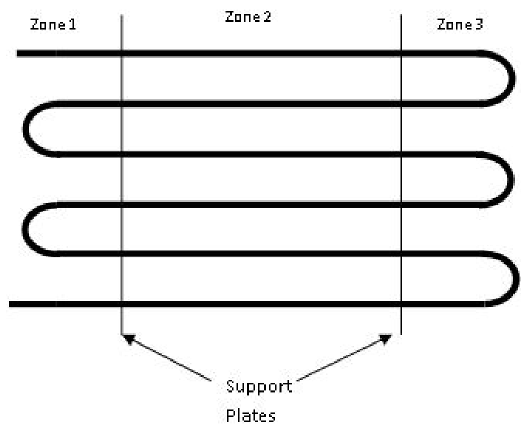
- Highly complex and labor intensive
- Manual intervention and supervision
- Historical Inspection data not used.
- Many areas are not accessible.
- Inspection is not continuous.
- 100 % inspection is not possible.

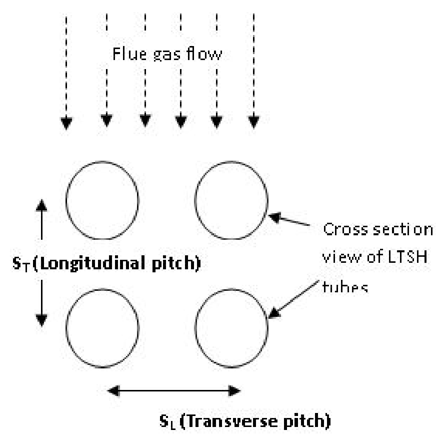
The entire operations of boiler tube inspection spread over 12 to 15 days

ISA Delhi Section

A Maharatna Company

Coiled Tube Layout



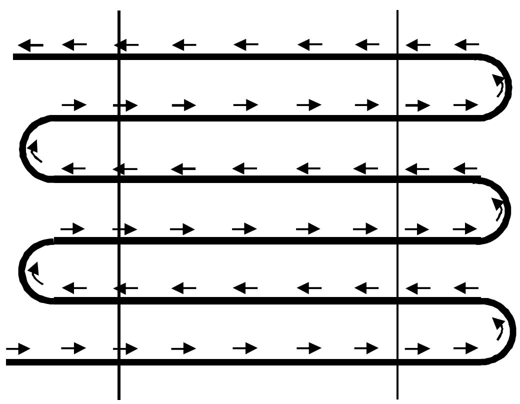


ISA Delhi Section

A Maharatna Company

Inspection Methodology

Option 1: Inspection of tube across the length



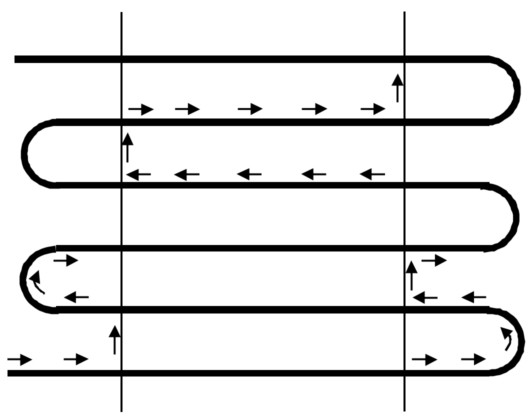
For this movement, the size of the robot along with the sensing and tube thickness detection mechanism should be small enough so as to pass through the support plates gap, which is approximately 20 mm wide.

ISA Delhi Section

A Maharatna Company

Inspection Methodology

Option 2: Inspection in different zones



The actual gap between the panels are much less and non-uniform due to misalignment so that robot movement in between the tubes is very difficult.

Either Micro-bots or In-pipe robots can be the appropriate solution for meeting such requirements.

ISA Delhi Section

एनटीपीसी NTPC
A Maharatna Company

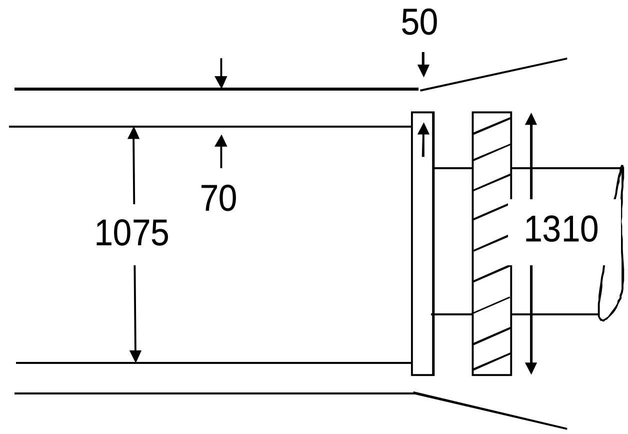
Generator Inspection

Activities involved in Generator inspection:

- **Opening of end shields**
- **Rotor Thread out**
- **Inspection like visual, ELCID, Wedge tightness, etc.**
- **Rotor Thread in**
- **Boxing up of generator**

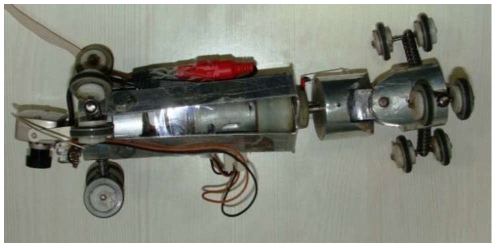
Generator Geometry

- **200 MW Generator schematic**
- **70 mm gap between stator and rotor**
- **50 mm air gap at entry**
- **10 m length**

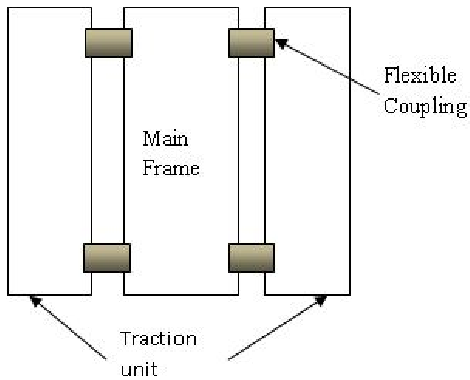


Projects

In-Pipe Robot development



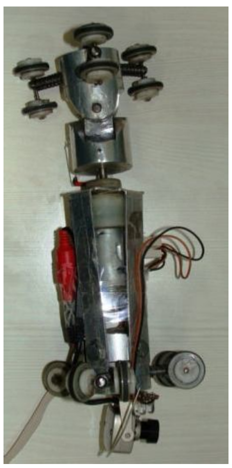
Generator Inspection system



ISA Delhi Section

A Maharatna Company

In-pipe robot



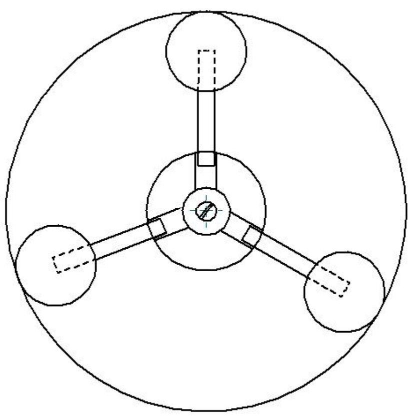
Salient Features:

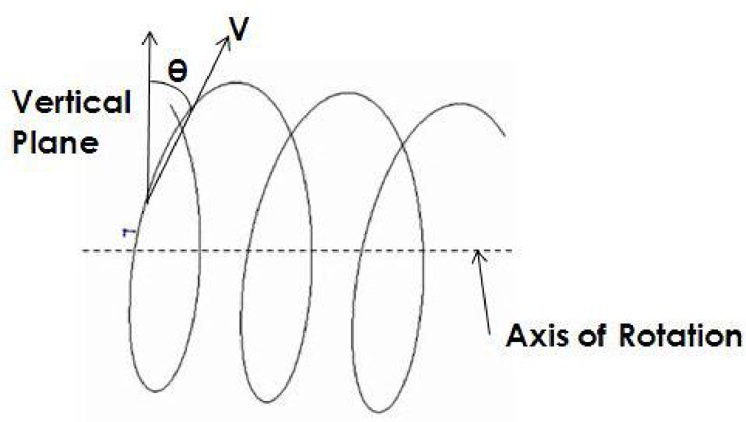
- **Prototype designed for 100 mm diameter pipe.**
- **Traction is provided by the helical motion**
- **Universal joint for bend**
- **Spring loaded wheels for uneven pipe.**
- **10 W DC geared motor**
- **Wireless camera mounted on robot**
- **LED light for camera**

In-pipe robot

Motion

- **Traction is provided by the helical motion of rotor wheels**
- **Helix angle plays a critical role between motor torque and speed of crawler**
- **Helix angle is optimized at 10 degree.**





In-pipe robot

Motion in Curved Pipe

- **Universal joint is provided between the rotor and motor**
- **It helps in transmission of torque during bends in pipe.**

ISA Delhi Section

A Maharatna Company

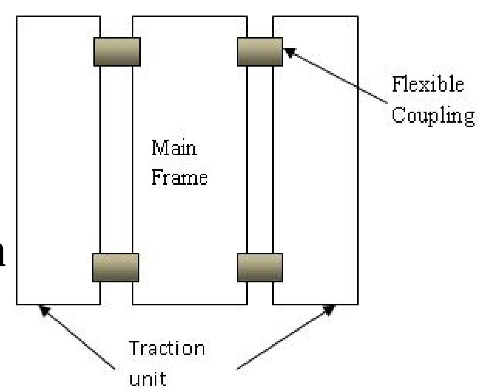
In-pipe robot

Application

- **Visual inspection over pipe length.**
- **Pipe internal inspection.**
- **Accessible to underground headers.**
- **Motor current signature can be used as sensor.**

Generator Inspection crawler

- Designed for air gap between stator and rotor.
- Belt drive for better traction
- Magnetic Gripping
- Flexible links to take care of curvature of stator.
- High resolution camera mounted on robot
- Crawler traction by DC motor.
- Two traction unit helps in turning on to the surface
- Other sensors and camera can be mounted on main frame.



ISA Delhi Section

A Maharatna Company

Generator Inspection crawler

Advantages

- **Faster and Reliable Inspection**
- **Reduce downtime.**
- **Inspection possible during Minor overhauls.**
- **Different sensors can be attached**

ISA Delhi Section

एनटीपीसी NTPC
A Maharatna Company

Conclusions

- **Internal inspection of inaccessible pipes is possible with in-pipe robot**
- **Wireless robots with on-board power source helps in inspection over long pipe length.**
- **Advanced robot can be useful in detecting and repairing the defect.**
- **In-situ Generator inspection is possible with Generator Inspection system**
- **Critical activity of rotor movement can be saved and saves a lot of precious time.**
- **Automated inspection mechanism for different critical areas needs to be developed to ensure reliability of the equipments.**

ISA Delhi Section

एनटीपीसी NTPC
A Maharatna Company

Thank you

OSIsoft

ISA Delhi Section

Fleet Management through Realtime Enterprise Integration

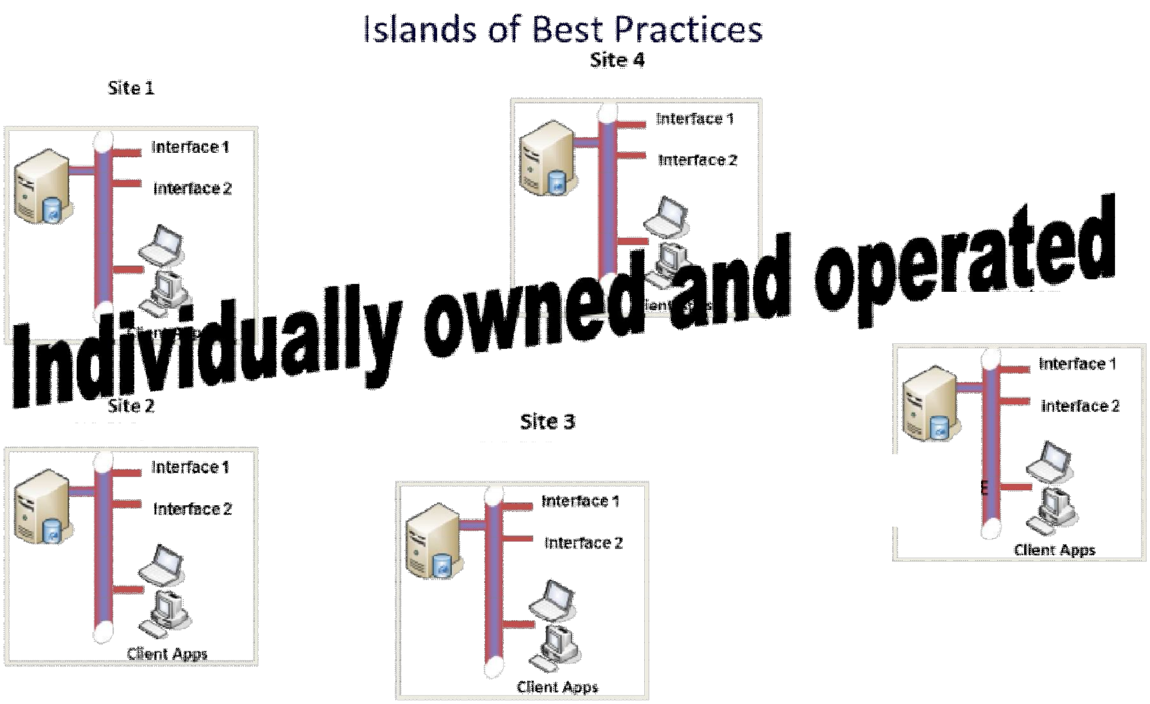
Shekhar Kamath, OSIsoft

ISA(D) POWAT-INDIA 2012, New Delhi, 13-14 Jan 2012

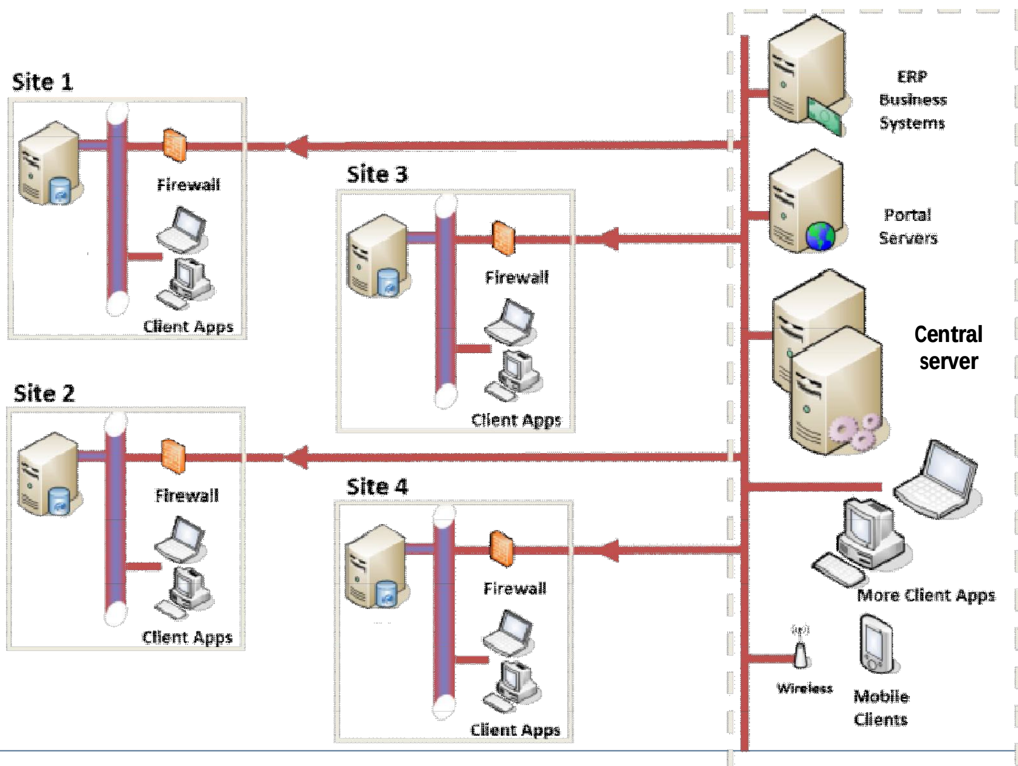
Value now. Value over time.

POWER & UTILITIES

Typical situation – No Integration



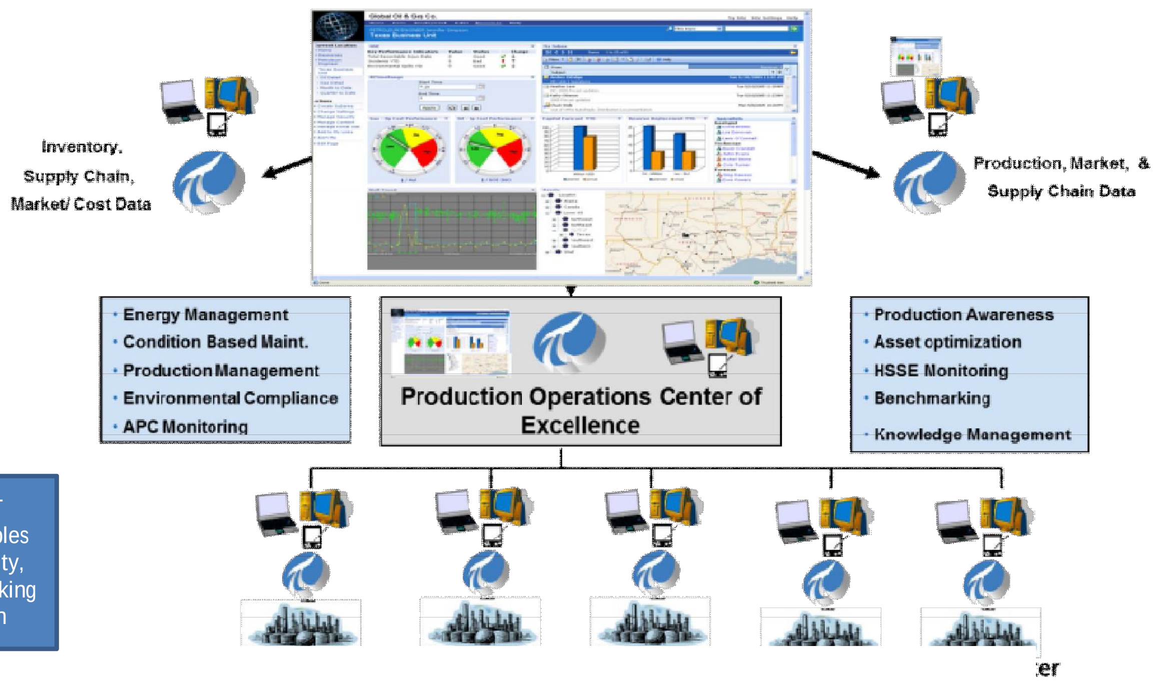
Strategy: Enterprise Driven Standards



Presented at POWAT-2012; http://www.isa.org

POWER & UTILITIES

Real Time Enterprise Competence Center



An Enterprise IT platform that enables value chain visibility, enabling benchmarking and optimization

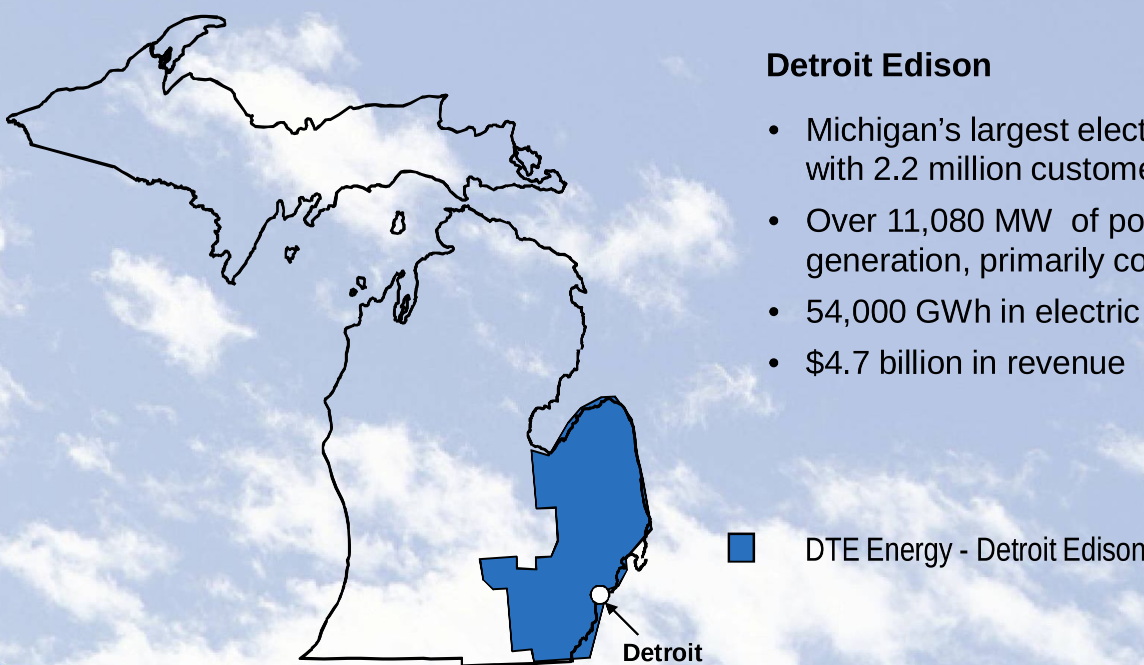
Presented at POWAT-2012; http://www.isa.org

POWER & UTILITIES

The Value of Enterprise Integration

Presented at POWAT-2012; http://www.isa.org

DTE Energy - Detroit Edison



Detroit Edison

- Michigan's largest electric utility with 2.2 million customers
- Over 11,080 MW of power generation, primarily coal fired
- 54,000 GWh in electric sales
- $4.7 billion in revenue

OSIsoft

VALUE NOW, VALUE OVER TIME

Plants & Performance Center

Monroe – 3,135 mw

Belle River – 1,260 mw

Trenton Channel - 730 mw

Performance Center – 11,588 mw

River Rouge - 527 mw

Greenwood – 785 mw

Generating Unit	Capacity Unit	Capacity Plant
Belle River 1	625	
Belle River 2	635	
Belle River		**1260**
Conners Creek 15	135	
Conners Creek 16	100	
Conners Creek		**235**
Fermi 2	**1110**	**1110**
Greenwood 1	**785**	**785**
Harbor Beach 1	**103**	**103**
Monroe 1	770	
Monroe 2	795	
Monroe 3	795	
Monroe 4	775	
Monroe		**3135**
River Rouge 2	247	
River Rouge 3	280	
River Rouge		**527**
St Clair 1	150	
St Clair 2	162	
St Clair 3	168	
St Clair 4	158	
St Clair 6	321	
St Clair 7	450	
St Clair		**1409**
Trenton Channel 7A	124	
Trenton Channel 8	122	
Trenton Channel 9	520	
Trenton Channel		**766**
Peakers	**1224**	**1224**
Totals:	**10554**	**10554**

Fleet Performance Center

Performance Center – Mission

Equipment Performance Optimization of the Fossil Generation Portfolio through continuous "real time and **predictive** asset **condition monitoring**" to maximize the asset **market value**.

Performance Center – Vision

Fossil Generation's Fleet-wide "**Mission Control Center**" for continuous monitoring and optimization of plant equipment performance

- Located in Ann Arbor Michigan
- 7x24 hour operation (February 2006).
- Plant interface with Merchant Operation Center.
- Oversight of Outage and de-rate coordination.

OSIsoft

VALUE NOW, VALUE OVER TIME