Foundation Fieldbus Implementation in MRPL

End Users Perspective - MRPL

Suryanarayana
Senior Manager (Projects)
• Subsidiary of ONGC
• Schedule-B Public sector unit
• ‘MINIRATNA’ PSU
• Capacity - 15 MMTPA
• ISO 9001: 2008 and ISO 14001:2004 Certified Company
• US $ 10.0 B Turnover
• Subsidiary of ONGC State-of-the-art technology and flexibility to handle diverse crude mixes

• Capability to produce EURO III & EURO IV compliant fuels

• Dedicated infrastructure include port, SBM, tankage, pipeline and power

• Global Technology partners – UOP, Axens, Shaw Stone & Webster, Lummus, Novolen, Honeywell, Yokogawa, P&F, MTL, GE, BHEL, Emerson, ...
Major Units - PH1 & 2

CDU / VDU
Hydrocracker
CCR Platformer
GOHDS
Isomerization Unit
Mixed Xylene Unit
Major Units - PH3

- CDU / VDU
- Petro FCC
- Delayed Coker
- Cocker Hydrotreater
- DHDT
- Poly Propylene
- HGU, SRU, CPP & U
- Tankages
Phase 1 & 2 Control System
Phase 1 Control System

- Commissioned in 1995
- Honeywell TDC 3000 DCS for Refinery and CPP
- Upgraded to Experion
- Hybrid with conventional and Fieldbus
- Non Incendive Hazardous area Instrumentation
Phase 2 Control System

- Commissioned in 1998
- Yokogawa Centum CS DCS for Refinery
- Hima Emergency Shutdown PLC for Refinery
- Honeywell TDC 3000 DCS for CPP
- Fail Safe controller and Triconex for CPP
- Non Incendive Hazardous area Instrumentation
Light Naphtha Isomerisation Unit

- **Product**: EURO-3/EURO-4 grade Motor Spirit (MS)
- **Capacity**: 2100 TPD (125 M3/hr)
- **Technology Supplier**: M/s UOP
- **LSTK Contractor**: M/s Larsen & Toubro
- **100% FF instrumentation for control**
- **FINCO Hazardous area Instrumentation**

Plant Commissioned and dedicated to nation on 2nd Dec 2006
Isomerisation project provided the excellent opportunity to adopt the Fieldbus concept.

Stringent process control requirements (like single loop integrity) from M/s UOP, Process technology supplier.

In 2005, Global giants in Refineries and Petrochemicals like SHELL, CNPC... started adopting FF technology.

Technology of the future.
Instrumentation in Isomerisation unit

- Application of Fieldbus to control and monitor the Proprietary Process Technology supplied by M/s UOP, USA
- All the control and monitoring loops are on Foundation Fieldbus (FF) Protocol. Single loop integrity has been maintained by following “Good engineering practice”
Instrumentation in Isomerisation unit

- Extension of energy limited Non-Incendive concept. All the Foundation Fieldbus segments (126 segments) are powered by FNICO repeater/conditioner.
- Only limited no of 4-20 mA current loops (Variable Speed Drives, Analysers only).
- Extensive use of Control in Field facility. More than 50% PID function are located either in Positioner or Transmitter.
Instrumentation in Isomerisation unit

- All the control valves are with Foundation Fieldbus positioners
- All Trip and Interlock transmitters are with HART protocol
- All the shutdown valves are enabled with partial stroke testing (PST) facility
- Deployment of Asset Management facility to monitor Foundation Fieldbus and HART based devices
Instrumentation in Isomerisation unit

- Distributed Control System: CENTUM CS 3000 by M/s Yokogawa India Limited, Bangalore
- Shut Down system PLC: HIMA make PLC supplied by M/s Larsen & Toubro Limited, Mumbai
- Field Transmitters (Flow / Pressure / DP / temperature): M/s Yokogawa India Limited, Bangalore
Hybrid system with addition of FF instruments

Yokogawa DCS was upgraded to CS3000 from Centum CS

Enabled faster installation & Timely commissioning in March 2010

Controlled voltage Fieldbus Power supply fulfilling FISCO ic Concept

P&F HD2-FBPS.1.17.500 Power conditioners

47 segments

Over 100 FF devices with control in field

P&F HD2-DM-A Online segment diagnostic tool
CDU 1 Upgrade

- Hybrid system with addition of FF instruments
- Honeywell DCS was upgraded with C300 Controller
- Timely commissioning in October 2011
- Controlled voltage Fieldbus Power supply fulfilling FISCO ic Concept
- P&F HD2-FBPS.1.17.500 Power conditioners
- 47 segments
- Over 100 FF devices with control in field
- P&F HD2-DM-B Online segment diagnostic tool
Early Benefits

- Live working.
- Lesser no of Fieldbus segments due to FNICO adoption
- Less no of cables, less hardware, Less no of marshalling cabinets
- More devices per segment
- Easier selection of field bus devices
- Simpler design, configuration and documentation
- Simpler maintenance
- Faster commissioning
- **Launch pad for adoption on a larger scale**
Up gradation and Expansion project

MRPL Phase III

- Capacity Expansion to 15 MMTPA
- PMC - M/s Engineers India Ltd
- Estimated Cost - Rs 12400 Crores
- Process Sour/Heavy TAN crude
- Supplement secondary processing facilities
- Production of value added products like propylene etc
Up gradation and Expansion project

Objectives

• Expansion of Capacity to 15 MMTPA
• Up-gradation of low value products to high value products.
• To process cheaper crudes (Sour/ Heavy & High TAN crudes)
• Production of petrochemical feed stocks Viz. Propylene.
• Maximize distillate yield.
• Upgrading entire HSD into BS III/IV grade
New Units added

- CDU/ VDU - (3.0 MMTPA)
- High severity Petrochemical FCC (2.2 MMTPA)
- Delayed Coker (3.0 MMTPA)
- DHDT unit (3.7 MMTPA)
- Coker gas oil Hydro Treater unit (0.65 MMTPA)
- Associated Captive power plant, Utilities and Offsite facilities.
- Revamp of Hydrocracker units
Instrumentation in MRPL Phase III

- Common DCS network for the Entire Refinery along with CPP and utilities
- Foundation Fieldbus based DCS for all the Units
- Central Control Room for the entire Refinery
- Individual SRR for every unit
- SIL3 certified Emergency Shutdown system
- Maximized the use of control in the field facility
MRPL Phase III DCS

- Yokogawa Centum VP DCS
- Yokogawa Prosafe RS ESD system
- FISCO ic based Fieldbus network with Chicken Foot topology
- P&F HD2-FBPS.1.17.500 Power conditioners
- Field devices - Zone 2
- P&F HD2-DM-A Online segment diagnostic tool
- PRM Asset Management System
- Enhanced control system security measures
- Dedicated Blending Automation system
MRPL Phase III DCS

- Dedicated Surveillance system with over 45 CCTV cameras
- Large video screens for Central control room, CPP and TFMS
- Dedicated Data reconciliation system with Exa OPC server
- Integrated Alarm Management system with 1 msec time resolution
- Documenting Nodes for individual Units
- GPS based time synchronisation
MRPL Phase III DCS

- 3 Control rooms
- 8 Satellite Rack Rooms
- 11 Domains
- 86 Controllers
- 32 Emergency Shutdown systems
- 50 Dual tier operator Stations
- 10 ESD Operator stations
- Dedicated Engineering stations for every unit
- Over 50000 mts of FO cable for interconnection
MRPL Phase III DCS

- 2500 Segments
- 15000 Fieldbus devices
- 3500 conventional / HART instruments connected to DCS
- 6000 Digital signals
- 4000 conventional / HART instruments for safety system
- 14000 Digital signals connected to ESD System
- 100 modbus communication channels
MRPL Phase III DCS

- Emerson & Yokogawa Fieldbus transmitters
- Fisher, Metso & Dresser Positioners
- Fisher, Dresser, MIL & Koso control Valves
- Virgo, Koso, Neles & Tyco ESD Valves
- P & F, Emerson Multipoint temperature transmitters
MRPL Phase III FF design concept

- FISCO Topology for Zone 1
- FISCO ic Topology for Zone 2
- Only 1 closed loop per segment
- Field wiring block with max 12 spurs
- 500 mSec scan time for typical pressure & flow closed loops
- 250 msec Scan time for UOP & Novolen licensed units
- 1000 msec scan time for typical level & temperature closed loops and Open loops
MRPL Phase III FF design concept

- Scheduled communication less than 50% of segment macro cycle
- Type A FF trunk cable - 18 / 16 AWG
- Type A FF spur cable - 18 AWG
- Min 9.5 V at device end
- Short circuit protection @ 57 mA for each spur
- Max 60 mts of spur cable length
- Max 1900 mts of spur+trunk cable length for FISCO ic
- Max 1000 mts of Spur+Trunk Cable length for FISCO
- Max 12 devices / FISCOic segment
- Max 4 devices / FISCO segment
MRPL Phase III FF design concept

- PID controller in positioner for simple closed loop
- Primary PID in Transmitter and secondary PID in positioner for simple cascade loop (both in same segment)
- Primary PID in DCS and secondary PID in positioner for cascade loop (when devices in different segment)
- PID in DCS for complex loops
- 20% spares @ every segment
- Shields terminated at H1 card
- For a given process, energy input and energy removal related loops on different segments
- Backup LAS in redundant H1 card
MRPL Phase III FF Engineering Prerequisites

- Decide on the FF functionality requirements
- Basis for selection of Field instruments
- Grouping of devices
- Location of devices, loop criticality
- Critical Loops
- Macro cycle Execution Time
- Control Narratives (process control strategy)
- Power Consumption, Segment Length, Selection of cables
- Proper selection of FF components like PS, Segment protectors, megablocks, surge protectors, etc
- ITK guidelines
MRPL Phase III FF Diagnostics

• “Unneeded” Trips To The Field are Avoided Through Remote Diagnostics
• Better information improves technician productivity
• Less time outside carrying tools, climbing ladders etc.
• Focus on the real problems
• Stable process operation
• Higher accuracy of information
• Operations can plan more reliably
• Improved up-time of high profit advanced control
Transmitter Diagnostics

- Uses process “noise” to detect process problems like Fast “stick slip flow” of FCC catalyst before standpipe damage
- Plugged impulse line before reading sizes up, pressure or temperature sensor failure, electronics or memory failure, pressure or temperature reading degraded.. Etc
- Process temperature or cold-junction temperature sensor failure, sensor drift, hot backup warning, calibration error, process temperature or cold junction temperature reading degraded
- Electronics or memory failure, configuration error, and hardware/firmware incompatibility
Control Valves Diagnostics

• Performance Diagnostics like Actuator/tubing leakage, air supply availability, calibration shift, etc

• Common Diagnostics like Partial Stroke Testing (PST), travel histogram, step-response, valve signature, pressure sensor failure, abnormal drive current, travel deviation, low supply pressure, high supply pressure, position feedback sensor failure, etc.
FF Segment Diagnostics

- Creates baseline report, which represent a snapshot of physical layer
- Monitoring of physical layer health
- Ensures error free operation of the control system
- Notifies when deviation occur in the health of the physical layer
- Alarms for various parameters related to physical layer
- Helps to take advance action to avert any failure
- Part of Asset management systems
- Overall increase in availability of physical layer
Cost savings by

- Reduction in cable cost
- Faster completion of cable laying work
- Less number of terminations
- Faster completion of loop checking and validation
- Faster uptime of instruments
- Less number of cabinets required.
- Less space required for control room
Interoperability.

Easy access to device information

More information available for field devices

Re-ranging from DCS is easy and faster

Advance information, alarms on impending failure

Host of diagnostics tools available

Easy trouble shooting

Lesser time for replacement
MRPL Phase III FF in Pics
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MRPL Phase III CDU/VDU
MRPL Phase III HGU
MRPL Phase III SRU
MRPL Phase III FF Expectations

- Field proven FF-SIS
- Simple and easier parameter setting
- Lower power consumption instruments
- Higher segment performance - more devices on the segment
MRPL’s 6 years of experience proves that Foundation Fieldbus approach provides a cost effective yet efficient solution for process control.

In our 6-year experience there is not even one accident / upset attributable to Fieldbus technology.

Our opinion is that the Foundation Fieldbus is the technology to stay and benefit the manufacturing / process industry.
Thank You