Operational issues:

People

Optimal Operation

Reliable Operation

Safe Operation

TECHNOLOGY

Operational issues:
- Displays
- History
- Trends
- Alarms
- Loop Tuning
- APC
- Plant Performance
- MCMS
- Analyser Mgmt System
- Online Analysis
- CCC
- Fiscal Metering
- Asset Management
- Emergency Management
- Alarm Management
- SIL, SIS, HAZOP
- Fire & Gas
- Atom Handling Analysis
- ASP
- Services
Operational Excellence is our Focus:

Human World

Project Director
Site President
Operational Manager

(KPI’s Cockpit)

Process Engineer
(Improve)

Process Operator
(RUN 24 / 7)

Reliability Engineer
(Maintain)

Automation World

Protecting Assets

SAFETY

DIAGNOSE

RUN

OPTIMISE

Making Better Product

Physical World

Installations:

Units
Mechanical Assets
Instruments
Valves
Foundation Fieldbus System:
Our considerations:

The future of Process Automation.
Life cycle stage

Proven Technology.
First FF systems delivered more than 5 years ago.

Openness.
Non Proprietary.
Continuity to evolve.
Adopt new technology.
Interoperability
Expectations of the FF Technology:

- Inter operatable products & Systems
- Elimination of proprietary Protocols
- Technology enables innovation by manufacturers
- Device Diagnostics
- Lower installation costs
- More information from the valves
- Multiple inputs from one device
- New instrumentation easier to add later
- Reduced wiring.
- Reduced terminations.
- Reduced commissioning time.
- Ability to implement control in the field.
- Reduced Control room space.
- Instrument Diagnosis.
Wiring Concept of FF System:

Most common Segment Design.
Chicken Foot Topology

H1 Interface

FF Power Supply

Trunk

Spur

FF Barrier

High Power Trunk

IS Spurs

Switchable terminator needs to be activated on this field barrier and deactivated on the first Field barrier

The FF barrier has the trunk side galvanically isolated from the spurs

Segment with more than one coupler.
Note the couplers can be mounted in junction boxes.
Marshalling Rack

Terminal Rail

5 PAIR CABLE TO FIELD JW-RUZ711-0001-FF-1

FIELDBUS JUNCTION BOX CONNECT UP TO 4 SPUR JUNCTION BOXES JB-RUZ711-01-FF

FIRST OFF JUNCTION BOX AND HOME RUN CABLE NUMBERED AS PER EXISTING INSTRUCTIONS IN 3PS-JP-001. SPUR JUNCTION BOXES. USE ALPHA SUFFIX TO MINIMIZE CHANGES, AVOID CLASHES, ASSIGN UNIQUE SEGMENT NUMBERS AND ASSOCIATE CONNECTED EQUIPMENT.

SURGE ARRESTORS FITTED ON HIGH LIGHTNING RISK INSTRUMENTS (TOP OF COLUMNS, TANK FARMS ETC) IN SPUR JB AND FOR ALL FF HOME RUNS IN PIB.

Wiring Concept of FF System:
FF Junction Box with 3 Field barriers:

- Isolator
- Surge protector
- Spur Terminals
- FF Junction Box
- Field Barrier
FF Power supply Arrangements:

- Surge Protector
- Power Supply
- Advance Diagnostic Module
- FF FBM
8 Way Base plate consists of;

8 redundant power supplies for 8 segments

1 Advance Diagnostic module (ADM) to monitor 8 segments

Physical properties.

Two redundant set of FBM 228

Two Alarm module for
hardwire alarm for segments connected.
Proven Technology:

- 900+ registered devices
- 10 registered hosts
- 6,000 control systems
- 1,000,000+ devices in service
ITK Device registration summary

ITK Profile 6 Specifications
- Initial Release: Sept 2009
- Mandatory for all new devices: Oct 2011

Test Tool Releases
- Initial release (6.0.0): Sept 2010
- Minor release (6.1.0): Jan 2013
# ITK 6 Test Coverage:

<table>
<thead>
<tr>
<th>Mandatory Features</th>
<th>Function Blocks</th>
<th>Transducer Blocks</th>
<th>Optional Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Resource Block</td>
<td>- Analog Input</td>
<td>- Pressure</td>
<td>- Common Software Download</td>
</tr>
<tr>
<td>- Alarms and Events Function Block Linking</td>
<td>- Analog Output</td>
<td>- Temperature</td>
<td>- Block Instantiation</td>
</tr>
<tr>
<td>- Trending</td>
<td>- Discrete Input</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Capability File</td>
<td>- Discrete Output</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Device</td>
<td>- Proportional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description v4</td>
<td>- Integral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Multi-Bit Alert Reporting</td>
<td>- Derivative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Field Diagnostics</td>
<td>- Arithmetic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Device</td>
<td>- Input Selector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description v5 (enhanced)</td>
<td>- Integrator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Enhanced downloading features</td>
<td>- Multiple AI</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Multiple AO</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Multiple DI</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Multiple DO</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Signal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Characterizer</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Totalizer</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Analog Alarm</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Output Splitter</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Control Selector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New for ITK 6.0</td>
<td>- Flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New for ITK 6.1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Host Profile Registration:

Class 61 – Integrated Host

Class 62 – Visitor Host

Class 63/64 – Bench Host

Operations

Engineering

Maintenance
Host Profile Registration Summary:

Host Profile B Specifications

- Initial Release: May 2007
- Mandatory for all new hosts: July 2010

Test Tool Releases

- Initial release (1.1.0): Mar 2009
- Major release (2.0.0): Dec 2009
- Maintenance release (2.0.1): June 2011
Host Profile Registration Summery:

Host Profile C Specifications

- Initial Release
  - Date: Nov 2013
- Mandatory for all new hosts
  - Date: Nov 2015

Test Tool Releases

- Maintenance release (2.1.0)
  - Date: 2Q 2014
New Features:

- Application Time Support (mandatory)
- Standard Dictionary Update (mandatory)
- Device Diagnostics Alarm Management (mandatory)
- DD Templates (optional)
- Like Device Replacement (optional)
What Is Usability?

- Effectiveness
- Satisfaction
- Efficiency

Could I accurately complete my task?

Good experience?

On time & budget?
Usability Project Approach

Identify Context of Use

Usability Requirements Specification

Design Proposals

Evaluate Proposal

Release Specifications

Iterate as necessary

-- ISO 9241-210:2010
Project Goal:

Make FOUNDATION fieldbus H1 easier than 4-20mA for process variables
Scalable Integration

Control Integration
- Control in the Field
- Advanced Applications

Asset Integration
- EDDs for setup and maintenance
- Automated Like Device Replacement
- Template-based Commissioning

Process Variable Integration
- No EDDs Required
- PV Device Interchangeability
- Unlike Device Replacement
Why Foundation Fieldbus?

• Extensive Block Model
• Common Data
• Common Time
• Deterministic Control
• Publish and Subscribe
• High availability
• Standards Based Control Network
• Network Management

FOUNDATION technology incorporates key aspects of what ARC calls the Collaborative Process Automation System.
Process Industry Challenges

Benchmark Results Indicate Room for Improvement

- 20-40% of control loops in manual control
- 80% of control loops demonstrate excessive process variability
- Many potential Advanced Process Control (APC) benefits are being missed
- Unplanned downtime is the largest single source of lost revenue
- 86% of maintenance is reactive (too late) or preventive (unnecessary)
- Best practice is 40% with predictive/proactive
- Most Petrochemical companies are not making returns greater than their cost of capital
Why Foundation Fieldbus

Opportunities

✓ Better measurements
✓ Accurate & stable control
✓ More capability at more levels
✓ More cost effective control system
✓ Higher availability
✓ Common interface for:
  ✓ Sequence control
  ✓ Continuous control
  ✓ Engineering
  ✓ Maintenance
  ✓ Reporting
Termination count

Field

Conventional analog termination

Fieldbus termination (also included in conventional termination count)

Marshalling done in Junction Box with Fieldbus so Marsh Cab is optional

Totals: 76 Analog

34 Fieldbus

76 Analog

34 Fieldbus
- Wiring & Rack
- Cable cost
- Junction box
- Cable Conduit
- Processing of cable
- Marshalling
- Barrier
Analogue:
Foundation Fieldbus:
Why Foundation Fieldbus?

Open Scalable Integration

- Foundation fieldbus was designed from the beginning for the process industry
- It is more than a Protocol, it is an Automation Infrastructure
- Standards Based
- Globally Accepted
- Tightly Integrated
- Easily Scalable
Why Foundation Fieldbus?

Process Integrity

• Robust design
• Redundant beyond any other technology
• Control in the Field (CIF)
• Safety Protocol FOUNDATION™ for SIF
Operations High Availability

Before FF-H1

Control in the DCS or PLC

After FF-H1

Control in the Field Provides Single Loop Integrity

Reduce Probability of Failure
- Fewer Devices and Connections
- Single Loop Integrity

Pressure

Flow

Multi-Sensing

Flow and Line Pressure

24V DC

Multi-Sensing

Level and Pressure

Before FF-H1

After FF-H1
## Impulse Line Plugging

### Conclusion;
- Dp Signal Fluctuation Diagnostics can detect only both Line Plugging.
- DP Signal and a Pressure Signal can detect 3 different types Plugging.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High Press. Line Signal</td>
<td><img src="image" alt="Signal" /></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Press. Line Signal</td>
<td><img src="image" alt="Signal" /></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Differential Press. Signal</td>
<td><img src="image" alt="Signal" /></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Why Foundation Fieldbus?

Business Intelligence

Extensive, Structured, Usable Diagnostics!!
Why Foundation Fieldbus

The global process industry loses $20 billion, or five percent of annual production, due to unscheduled downtime and poor quality.

ARC estimates that almost 80 percent of these losses are preventable, with 40 percent largely due to operator error.

Source ARC Insight June 10 2010
“Unneeded” Trips To The Field - Avoided Through Remote Diagnostics

63% of time is spent investigating “problems” that do not exist. Fieldbus will tell you this so it will no longer be necessary to check these reports.

Source: Dow Chemical Company
The Opportunity

- Improved plant stability and reliability
- Improved asset utilization
- Reduced operating and maintenance fixed cost
- Improved Variable Cost
Impact of Tighter Control loop:

- Control limit
- Digital
- Analogue
- Pneumatic
- Manual
Predictive Intelligence:

- Wear
- Installation
- Process variables
- Machine health
- Asset optimisation

*Process variables*
Collaboration with NAMUR

- Using the power of FOUNDATION Fieldbus, and considering NAMUR requirements, the new standard diagnostic profile aim to:
  - Standardize the integration of diagnostic information
  - Guarantee valuable information to the user
Role Based Diagnostics

Process Control Engineering Station

Asset Management Maintenance Station

HSE Control Network

H1 Process Network

Plant operators

Plant maintenance engineering
Diagnosis results must be reliable

Diagnosis results must always be viewed in the context of the application.

Internal diagnosis must be categorized into 4 standard “status signals”

Configuration must be free, as reactions will depend on the user's requirements

Detailed information can be read out by the device specialist
Namur - Diagnostic categories

**Maintenance Required**  The output from the device is valid but the wear reserve is nearly exhausted or function will be restricted due to operational conditions.

**Out of Specification**  Measurement uncertainty, or output position deviation, is greater than expected due to deviations in ambient or process conditions.

**Function Check**  Output invalid due to ongoing work on the device.

**Failure**  Output is invalid due to a malfunction in the field device.
Distribution of information

**OPERATOR**
- Maintenance Required: Output is valid
- Out of Specification: Measurement is uncertain
- Function Check: Ongoing work on the device, output invalid
- Failure: Output is invalid

**INSTRUMENT TECH**
- Wear reserve is exhausted due to deviations in ambient conditions.
- malfunction in the field device
<table>
<thead>
<tr>
<th>Maintenance Required</th>
<th>Output is valid</th>
<th>GOOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Out of Specification</td>
<td>Measurement is uncertain</td>
<td>UNCERTAIN</td>
</tr>
<tr>
<td>Function Check</td>
<td>Ongoing work on the device, output invalid</td>
<td>OUT OF SERVICE</td>
</tr>
<tr>
<td>Failure</td>
<td>Output is invalid</td>
<td>BAD</td>
</tr>
<tr>
<td></td>
<td>Wear reserve is exhausted</td>
<td>NEEDS MAINT SOON</td>
</tr>
<tr>
<td></td>
<td>due to deviations in ambient conditions.</td>
<td>NEEDS MAINT SOON</td>
</tr>
<tr>
<td></td>
<td>malfunction in the field device</td>
<td>NEEDS MAINT NOW</td>
</tr>
</tbody>
</table>
Example DTM – Device Needs Maintenance

ValCare™ Intelligent Positioner SRD991
Model: BQNS-BV...
Tag Number: IOM_FV1001

Parameterization
Online Diagnostics
- Overview
  - Trend View
  - Status List
  - Hardware
  - Process
  - Calibrations
  - Position Alarms
  - Service Manager
  - Position History
  - Response History
  - Load Factor

Start Up
- Report
- Advanced
- Calibration

Setpoint
- 49.9%
- N/A

Air Supply
- 14.8 psig

Air Output
- Y1: 11.0 psig
- Y2: N/A

Stem Setpoint
- 53.5%

Valve Position
- 57.9%
- 47.2 In.

Behaviour

Setpoint

Temperature
- 71.6 °F

Legend
- Good
- Alarm
- Out of Spec.
- Maintenance
Example: Air Supply Low – Maintenance is Required
Example – Measurement Value Uncertain (block put into manual)
Example – RTD sensor has failed
Example – Valve Taken Out for Maintenance Work
Intelligent Field Devices - A Rich Source of Diagnostics

- Travel Deviation
- Cycle Counter
- Valve Signature
- Step Response
- Dynamic Error Band
- Drive Signal
- Output Signal
- And More

- Electronics Failure
- Sensor Failure
- Process Condition
- Configuration Warning
- RTD Drift
- RTD Life Estimation
- And More

- Electronics Failure
- Sensor Failure
- Reverse Flow
- Empty Pipe
- Calibration Error
- Process Condition
- Configuration Warning
- And More

- Pump Cavitation
- Motor Overheating/Defects
- Severe Bearing Faults
- Rotational Faults
- Bearing Lubrication
- And More

- pH Electrode Aging
- Glass Electrode Failure
- Reference Electrode Failure
- Reference Electrode Coating
- Reference Electrode Poisoning
- And More
New Field Diagnostic Alarms

<table>
<thead>
<tr>
<th>Parameter Name (*)</th>
<th>NE107 Status Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD_FAIL_ALM</td>
<td>Failure</td>
</tr>
<tr>
<td>SD_OFFSPEC_ALM</td>
<td>Out of Specification</td>
</tr>
<tr>
<td>SD_MAINT_ALM</td>
<td>Maintenance Required</td>
</tr>
<tr>
<td>SD_CHECK_ALM</td>
<td>Function Check</td>
</tr>
</tbody>
</table>

- Additional supporting parameters
  - Enable/Disable of diagnostic detection
  - Enable/Disable Simulation
  - Configure Priority
  - Configure Alert Suppression (Detect, but not alert)
  - Recommended Actions

* Parameter names will have localized text labels. e.g. “Failure Alarm”
Fieldbus Life Cycle Benefits

- **Plan and Installation**
  - Reduction in cost for wiring, barrier, marshalling rack and Junction box
  - Reduction in cost for control system - I/O interface
  - Reduction in cost for power supply unit and number of cabinets
  - Reduction in control room size

- **Operation**
  - Increased information for better operation
  - Improved accuracy of measurement & control
  - Enhancement in control function and the performance
  - Fewer Process Upsets
  - Improved throughput

- **Maintenance and Improvement**
  - On-line diagnosis enables true preventive maintenance.
  - Reduction of instrument stock for maintenance
  - Increased Asset Intelligence Methods to Enhance Variable cost Management
Thank You