Installing Foundation Fieldbus in Hazardous Areas

Understanding your Options and How to Use Them
Typical Fieldbus Topology

CONTROL/RACK ROOM (by DCS Vendor)

- Fieldbus Host Interfaces
- Segment Power Conditioners
- Control System
- 24VDC Bulk Power Supply

FIELD (by EPC)

- Fieldbus-based Field Instruments
- Field Junction Box
- Spur Cables
- Fieldbus-based Field Instruments
- Trunk Cables
- Fieldbus-based Field Instruments
- Field Junction Box
- Fieldbus-based Field Instruments
Key Areas of Specification

• **Redundancy** required in Segment Power Conditioning?

• **Isolation** required between Segments within the same Fieldbus Host Interface?

• How many **Devices** do you desire per Fieldbus Segment?

• What **Wiring Practice** will be utilized between **Power Conditioners** in Rack Room and **Field Junction Boxes**?

• What **Wiring Practice** will be utilized between **Field Junction Box** and **Field Instruments**?

• What are the requirements for **Surge Protection**?
Options Available for Hazardous Areas

Zone 0/1 or Class 1 Division 1
Ex(i) Intrinsically Safe
Ex(d) Flame Proof (Explosion Proof)
Ex(e) Increased Safety (not allowed in C1D1)

Zone 2 or Class 1 Division 2
Ex(nC/nL) Non-Incendive (Energy Limited)
Ex(nA) Non-Sparking (Non-Arching)

Defining in Specification is Critical to Obtaining Accurate Costs
Non-Sparking/Non-Arching Trunk and Spurs

Power Conditioners Mountable in:
- a) Safe Areas,
- b) Zone 2 IIC T4 Haz Areas &
- c) Class 1, Div 2, Groups A-D Haz Areas

24Vdc

Ex(nA) Trunk NOT Live Workable

Junction Box: Ex(n) or Ex(e)

Megablock Certification Required: Ex(nA)

Ex(nA) Spurs NOT Live Workable

Zone 2 or Division 2

Ex(n) or Ex(d) Fieldbus Devices

Ex(nA) Power Conditioners

Control System

CONTROL ROOM

FIELD

Honeywell
Non-Sparking Trunk with Non-Incendive Spurs

Power Conditioners Mountable in:

- Safe Areas,
- Zone 2 IIC T4 Haz Areas &
- Class 1, Div 2, Groups A-D Haz Areas

Ex(nA) Trunk NOT Live Workable

Junction Box:
- Ex(n) or Ex(e)

Megablock Certification Required:
- Ex(nA) / Ex(nL)

Ex(nL) Spur NOT Live Workable

Spur short-circuit protection in wiring hub makes spurs Ex(nL)

Ex(nL) or Ex(i) Fieldbus Devices

Control System

Ex(nA) Power Conditioners

24Vdc

CONTROL ROOM

FIELD

Zone 2 or Division 2

Honeywell
Flame-Proof/Explosion-Proof Trunk and Spurs

Power Conditioners Mountable in:
- a) Safe Areas,
- b) Zone 2 IIC T4 Haz Areas &
- c) Class 1, Div 2, Groups A-D Haz Areas

Control System

24Vdc

Ex(nA) Power Conditioners

Ex(nA) Trunk NOT Live Workable

Junction Box:
- Ex(d)

Megablock
Certification Required:
- None

Ex(d) Cable Glands

Spurs NOT Live Workable

Ex(d) Fieldbus Devices

Zones 2 or Division 2

CONTROL ROOM

FIELD

Zone 2 or Division 2

FIELD

FIELD
Introducing **Fieldbus Non-Incendive Concept**

**FNICO is:**
- For Fieldbus in Zone 2 and Division 2 hazardous areas
- Live-workable throughout without gas clearance, just like Intrinsic Safety
- Based on FISCO, the Fieldbus Intrinsically Safe Concept
- Easy to install, easy to document, easy to maintain
- More field devices per segment than FISCO: lower cost

**FNICO brings the benefits of FISCO to Fieldbus installations in Zone 2 and Division 2 Hazardous Areas:**
- Simple safety assessment
  - The safety analysis is a list of devices
- No cable parameter calculations
  - When the cable complies with basic requirements
- Add new fieldbus devices without recalculating the safety analysis
- As proven by test, longer cables with higher capacitance are permitted
More Devices on a FNICO Trunk

• But FNICO has a key benefit, even compared with FISCO:
  - The reduced ‘factor of safety’ means more current is available to the fieldbus trunk
  - So more fieldbus devices can be supported!

Intrinsic Safety: I/1.5
Non-incendive: I/1.1
Typical Ex(n) Installation - FNICO

FNICO Power Conditioners Mountable in:
- a) Safe Areas,
- b) Zone 2 IIC T4 Haz Areas &
- c) Class 1, Div 2, Groups A-D Haz Areas

Control System

Ex(nC) FNICO Power Conditioners

24Vdc

Ex(nL) Trunk Live Workable !!!

Ex(nL) Spurs Live Workable !!!

Ex(nL) or Ex(i) Fieldbus Devices

Zone 2 or Division 2

FIELD

CONTROL ROOM
Typical Ex(i) Installation (Method #1 - Multibarrier)

Power Conditioners Mountable in:
- Safe Areas,
- Zone 2 IIC T4 Haz Areas &
- Class 1, Div 2, Groups A-D Haz Areas

**Ex(nA) Power Conditioners**

**24Vdc**

**Ex(nA) Trunk NOT Live Workable**

**FieldConnex Certification Required:** Ex(i)

**Ex(i) Fieldbus Devices (4 per FieldConnex)**

**Ex(i) Spurs Live Workable !!!**

**Zone 1 or Division 1**
Introducing **Fieldbus Intrinsically-Safe Concept**

- A new technical specification for Intrinsically Safe Fieldbus
  - takes advantage of recent experimental work on spark ignition
  - provides more current to IS trunk than earlier ‘Entity’ model, and hence more field instruments
  - first simplification of explosion protection techniques for many years!
The Benefits of FISCO

- Formerly IS installations were done using IEC/EN60079-14 (‘Entity’). This required:
  - calculation of cable parameters
  - comparison of safety descriptions
  - creation of descriptive system document
  - eliminates need to calculate cable parameters
  - reduces safety documentation to a list of devices
  - allows addition of devices without a review of safety documentation
  - as proven by test, allows longer cables with higher capacitance
Typical Ex(i) Installation (Method #2 - FISCO)

FISCO Power Conditioners Mountable in:
- a) Safe Areas,
- b) Zone 2 IIC T4 Haz Areas &
- c) Class 1, Div 2, Groups A-D Haz Areas

Control System

Ex(i) FISCO Power Conditioners

24Vdc

Ex(i) Trunk Live Workable !!!

Ex(i) Spurs Live Workable !!!

FISCO Fieldbus Devices

FIELD

CONTROL ROOM

Zone 1 or Division 1
## Comparison of Ex(i) Architectures

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>“Multibarrier” (P&amp;F)</th>
<th>FISCO (MTL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Design Rules</td>
<td>Non-standard voltage/current required at Trunk terminals of “multibarrier”</td>
<td>Same as safe area: minimum 9V @ Field Device</td>
</tr>
<tr>
<td>Efficiency</td>
<td>Up to 250mA @ 16V for 4 devices (30% efficiency)</td>
<td>Typically 84mA @ 9.4V for 4 devices (95% efficient)</td>
</tr>
<tr>
<td>Cost</td>
<td>One “multibarrier” per 4 devices, plus safe area power supply</td>
<td>One repeater-power supply for up to 12 field devices (9122-IS, IIB)</td>
</tr>
<tr>
<td>Ease of Maintenance</td>
<td>Complex, non-redundant electronics in field</td>
<td>Electronics in control room: easier to service; benign environment</td>
</tr>
<tr>
<td>Hazardous Area Considerations</td>
<td>Trunk current is incendive: different maintenance practice for Trunk and Spurs</td>
<td>Intrinsically safe throughout; live-workable Trunk and Spurs</td>
</tr>
<tr>
<td>Field Junction Box Material</td>
<td>No choice unless multiple variants (Ex(e) constraints)</td>
<td>Material may be chosen to suit environment (e.g. stainless steel for pharmaceuticals)</td>
</tr>
</tbody>
</table>
How Many Field Devices in Hazardous Area?

MTL5053 : Entity, IIC/IIB Gas Group (Class 1, Group A & B)
- 80mA available
- Typically 3 or 4 Devices

FISCO, IIC Gas Group (Class 1, Group A & B)
- 120mA available
- Typically 6 Devices

FISCO, IIB Gas Group (Class 1, Group C & D)
- 265mA available
- Typically 12 Devices

FNICO, IIC Gas Group (Class 1, Group A & B)
- 180mA available
- Typically 9 devices

FNICO, IIB Gas Group (Class 1, Group C & D)
- 320mA available
- Typically 16 devices

Assumes 20mA per field device
# Installation Summary

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>Ex(nA)</th>
<th>Ex(nC/nL) IIC</th>
<th>Ex(nC/nL) IIB</th>
<th>Ex(i)</th>
<th>Ex(i) IIC</th>
<th>Ex(i) IIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available Segment Power (mA)</td>
<td>350</td>
<td>180</td>
<td>320</td>
<td>80</td>
<td>120</td>
<td>265</td>
</tr>
<tr>
<td>Max. Number of Devices</td>
<td>17</td>
<td>9</td>
<td>16</td>
<td>4</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Hazardous Area Classification</td>
<td>Zone 2</td>
<td>Zone 2</td>
<td>Zone 2</td>
<td>Zone 1</td>
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<tr>
<td></td>
<td>Div 2</td>
<td>Div 2</td>
<td>Div 2</td>
<td>Div 1</td>
<td>Div 1</td>
<td>Div 1</td>
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<tr>
<td>Field Device Certification</td>
<td>Ex(n)</td>
<td>Ex(n)</td>
<td>Ex(n)</td>
<td>FISCO</td>
<td>FISCO</td>
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<tr>
<td></td>
<td>Ex(i)</td>
<td>Ex(i)</td>
<td>Ex(i)</td>
<td></td>
<td></td>
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<tr>
<td>Live Workable Trunk</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Live Workable Spurs</td>
<td>Yes (*)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Trunk Cable Length (No. Devices)</td>
<td>1,000m (1)</td>
<td>1,900m (1)</td>
<td>1,000m (1)</td>
<td>1,900m / 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>310m (9)</td>
<td>230m (16)</td>
<td>500m (6)</td>
<td>315m (12)</td>
<td></td>
<td></td>
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<tr>
<td>Max. Spur Cable Length</td>
<td>30m</td>
<td>30m</td>
<td>30m</td>
<td>30m</td>
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<td></td>
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<tr>
<td>Redundant Power Conditioners</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

Assumes 20mA per field device

\[
\text{Distance} = \frac{V_{PS\text{max}} - V_{DEV\text{min}} (9V)}{\# \text{Devices} \times 20mA / \Omega_{\text{Loop}} \text{km} (50\Omega)}
\]

Hazardous Area Design Critical to Successful Fieldbus Installation
Junction Box Terminations

- SpurGuardTM option:
  - visual indication of fault
  - short-circuit protection

- Power LED >9V
- Pluggable spur connectors
- 2, 4, 8 and 10-drop versions
- Field cabinet
  - suitable for environment
  - site standard
- Terminator
- Trunk
- Spur
One Last Point … Surge Protection

• Surge Protection is often taken for granted and not specified!

• Surge Protection provides additional benefits through reduced Operating Expenses (OPEX) of the Fieldbus installation through
  - Higher System Integrity
  - Increased Reliability
  - Reduced Downtime

• MTL will provide 10-year warranty of the complete solution (Experion PKS Servers/Stations, Controllers, I/O Modules, FIMs, Power Conditioners, Instruments, etc.) when Surge Protection is used on both the Control Room and Field Instruments!
  - Implemented at ChevronTexaco Richmond, CA
Surge Protection Warranty (MTL)

CONTROL/RACK ROOM (by DCS Vendor)

Fieldbus Host Interfaces

Segment Power Conditioners

Control System

24VDC Bulk Power Supply

Comms A/C Mains

FIELD (by EPC)

Field Junction Box

Surge Protection

Trunk Cables

Spur Cables

Fieldbus-based Field Instruments

Fieldbus-based Field Instruments

Fieldbus-based Field Instruments
Thank You