New approaches deliver safer, more reliable networks in hazardous areas

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Major Oil and Gas companies use or standardize on Foundation Fieldbus technology:

- BP
- Exxon Mobil
- Petronas
- Petrobras
- Qatar Petroleum
- Reliance
- Saudi Aramco
- Shell
- …
World’s largest Petrochemical plants use Foundation Fieldbus

- Shell Nanhai (China)
- BP Secco (China)
- Reliance JERP (Jamnagar Export Refinery Project) (India)
- Qatar Gas II (ME)
- Qatar Petroleum/Shell Gas to Liquid plant (ME)
- Saudi Aramco Khursaniyah, Hawiyah and Rabigh (ME)
Options for non-fieldbus systems

Ex i Intrinsic Safety
- Very safe, allows ‘hot’ working
- Need IS interfaces, design expertise
- Ex ic/Ex nL non-incendive for Zone 2 applications

Ex d Flameproof/Ex e Increased Safety
- Widely used, good experience, simple
- Only ‘cold’ working permits
- Ex nA non arcing for Zone 2 applications
Intrinsic Safety
- Retains live-working benefits common to all IS circuits
- FISCO addresses device limitations of ‘Entity’ solution
- Some limitations on cable length and number of devices in IIC
- Live work trunk and spurs
- FNICO/FISCO ic provides more power in Zone 2 applications

Flameproof
- No Ex limitation on number of devices per segment
- How to disconnect one device without de-powering segment?
- Not preferred for fieldbus – there are better options

Combination techniques
- Fieldbus Barrier (high energy trunk; IS spurs)
- Ex nA non arcing trunk Ex ic/Ex nL non incendive for Zone 2
- No live work on trunk
- Live work on spurs/devices
- Option of live connection/disconnection of fieldbus barrier module
### Topologies

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- **NI** = Non-incendive (Ex nA); **HET** = High Energy Trunk

**Note:**
- NI: Non-incendive
- HET: High Energy Trunk

**Instrument Protection method**
- **Non-Ex**
- **Ex nA**
- **Ex nL/ic**
- **FISCO or Ex nL/ic**
- **Ex d**
- **FISCO or Ex i**
- **FISCO or Ex i**

**Legend:**
- #: Grey Megablock either in Zone 2 or with Ex d box in Zone 1. Yellow Megablock in Ex e box in Zone 1.
- #: Grey Megablock either in Zone 2 or with Ex d box in Zone 1. Yellow Megablock in Ex e box in Zone 1.
- %: For live maintenance, ensure $U_i \geq U_o$.

- *: With Spur Connector.
- #: Grey Megablock either in Zone 2 or with Ex d box in Zone 1. Yellow Megablock in Ex e box in Zone 1.
- %: For live maintenance, ensure $U_i \geq U_o$.

- **= no live maintenance.**
- **= Live maintenance allowed.**
Topologies for IS fieldbus devices

High Energy Trunk

FISCO
Applications - High Energy Trunk
Applications - High Energy Trunk

- Solution for any Zone, any Gas Group
- Compatible with Entity and FISCO field devices
- Capable of long cable runs
- Trunk power can be redundant
- Multiple-unit enclosure options available

Examples: Reliance Jamnagar Export Refinery Project
- >13,000 FF instruments
- >3,600 segments
Applications - FISCO

- IEC 60079-27 FISCO standard
- Suits users who like fully Ex i systems
- Eliminates the need to calculate cable parameters (!)
- Reduces safety documentation to a list of devices
- Allows addition of devices without a review of safety documentation
- Cable runs limited
  - Typically fieldbus trunk 2/3 distance of Fieldbus Barrier
- Popular in medium size petrochemical plants, chemical plants, upstream oil and offshore.
  - E.g. Shell Bonny Island terminal
  - >5,000 FF instruments
‘Physical layer’ expectations

Users request:

- **Higher Reliability**
  - Redundancy
  - Simplification

- **Safety**
  - Removal of risks from inadvertent/unskilled maintenance
  - Use of intrinsic safe where possible in hazardous areas

- **Ease of use**
  - Flexible hardware solution

- **Maintainability**
  - ‘Pluggable’ modules
  - User-friendly, ergonomic construction
‘High Energy Trunk’ concept

Redundant FF power supply

High energy Ex e trunk

Control system

GAS

Zone 1
Division 2

ZONE 1
Zone 1/0
Division 1

FISCO or Entity fieldbus devices

FIELD

Zone 21

Live-workable Ex i spurs

DUST

ZONE 21/20

Zone 21/20

CONTROL ROOM

Fieldbus barriers
Live Ex de disconnect switches: allow replacement of a faulty fieldbus barrier
Ex e wiring block under plastic cover: allows opening compartment to access switches
Separate terminator: segment still terminated even if any of the fieldbus barriers removed
Surge protection: often required since built-in SP’s are only basic (for very small surges)
Wiring, ducting: clean wiring required to avoid wrong maintenance
Wiring blocks: Required for incoming field wiring as terminals on FBB are not replaceable
Number of terminals:
Spur: + / - / Shield of FBB to + / - / Shield of Surge Protector. There are 12 spurs = 72
Spur: + / - / Shield of Surge Protector to + / - / Shield of screw terminal. There are 12 spurs = 72
Trunk: + / - / Shield of FBB to + / - of Ex de switch. There are 3 Trunks = 15
Trunk: + / - of Ex de switch to + / - / Shield of Ex e terminals. There are 3 Trunks = 15
Total = 72 + 72 + 15 + 15 = 174 terminals = 174 Potential points of failure
New-Generation ‘High Energy Trunk’ architecture

- Pluggable trunk surge protector (optional)
- Pluggable Terminator
- Trunk terminals
- Trunk Terminal Assembly (TTA) housing
- Screw-secured, pluggable spur terminals
- “Live pluggable” Fieldbus Barrier modules
- Spur surge protector (optional)
Pluggable modules aid maintainability

Fieldbus Terminator and Trunk Surge protector modules plug into dedicated sockets in the ‘Trunk Terminal Assembly’

- May be removed and replaced while under power without ‘gas clearance’
Many details are still unconfirmed during FEED:
- Which fieldbus spurs require surge protection?
- How many spurs are required per field junction box?

Ability to retro-fit surge protection and barrier modules adds flexibility during the design and construction process.
“Honey, I shrunk the Fieldbus Barrier”

Smaller field enclosures lead to significant savings in infrastructure and installation costs
Every module and circuit within the shaded area is live-workable in the hazardous area.

Non-live workable circuits are confined within the Trunk Terminal compartment and protected by a cover.

Mixing circuits that can be live-disconnected in a hazardous area with those that can’t leads to unnecessary risks during field maintenance – which is why all circuits and modules in the main enclosure compartment are designed to be interruptible while powered.
- Compact, modular construction
- No interconnecting wiring inside main enclosure compartment
  - Eliminates complexity
  - Higher reliability
- Integrated, pluggable surge protection
  - Flexible to users’ needs
  - Suitable to retrofit
- All modules hot/live-pluggable
  - No additional isolating switches required
  - Reduces risk of explosion due to wrong operation
FISCO power supply

Control system

GAS
Zone 1 / Div1 Hazardous Area
Live-workable Ex i trunk

FISCO fieldbus devices

FISCO fieldbus devices

FIELD
Live-workable Ex i trunk

Live-workable Ex i spurs

GAS

区1 / Div1 危险区域

现场

现场

DUST
Zone 21 危险区域
Features of FISCO:
- Trunk and Spurs are intrinsically safe
- High reliability (typically higher than high energy trunk concept)
- Typically 12 instruments (typically limited by cycle time)
- Most economic concept for any number of instruments
- Verification of intrinsic safety documented by FISCO
- **No mix of protection methods – Safest technology of all**

Considerations:
- FISCO supply is single
- Cable distance shorter than with High Energy Trunk
  - Use thicker cable to compensate voltage drop
- Mainly used for FISCO instruments, not Entity
  - Study\(^1\) showed that 93% of instruments are FISCO certified
  - Use spur connector to connect to Entity instruments/Zone 0

Increasingly specified for critical process applications requiring high system availability

Recommended in Fieldbus Foundation Engineering Guide, AG181

“Fieldbus Power Supplies/Conditioners should be redundant…” (Clause 5.2.2)

Power supply redundancy significantly increases availability of the fieldbus segment, and hence of the overall control system
Redundant FISCO

Fieldbus control system (DCS)

Redundant FISCO power supply

Bulk power input 24Vdc

Intrinsically Safe trunk and spurs (1 segment of 4)

Intrinsically Safe Field wiring hub

Intrinsically safe FISCO Fieldbus devices

FIELD Zone 1

CONTROL ROOM
Redundant FISCO power supplies

- On power-up, output is defaulted to FISCO A.
- On detected failure of FISCO A or corresponding Supply Arbitration Module, FISCO B is selected.
- Failure notification is given (open-circuit alarm).
- LEDs indicators identify failed module, to allow replacement under power.

**SAM** = Supply Arbitration Module

**Hand-Shaking**

**IS H1** to Field
Redundant FISCO

- Change-over is bumpless
- FF-831 specifies behaviour of fieldbus network when power supply drops to 0V
- Fieldbus devices are required to survive the complete collapse of the bus for 500us
- If the change-over coincides with a data packet, data will simply be retransmitted (mechanism of Foundation fieldbus protocol)

- Fieldbus communication “as usual”
- No loss of control
- No loss of data
First application to use Redundant FISCO: BP Angola Block 31
With Advanced High Energy Trunk and Redundant FISCO, alternative concept continue to co-exist.

High Energy trunk becomes safer and more reliable.

FISCO remains the safest topology, and strengthens its position as the most reliable.
Thank you! Questions?

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