Multifunctional Pipeline Systems

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A Schlumberger Company

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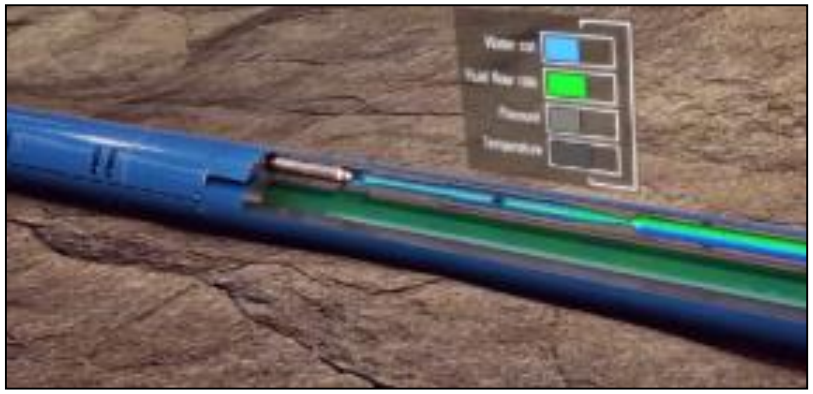
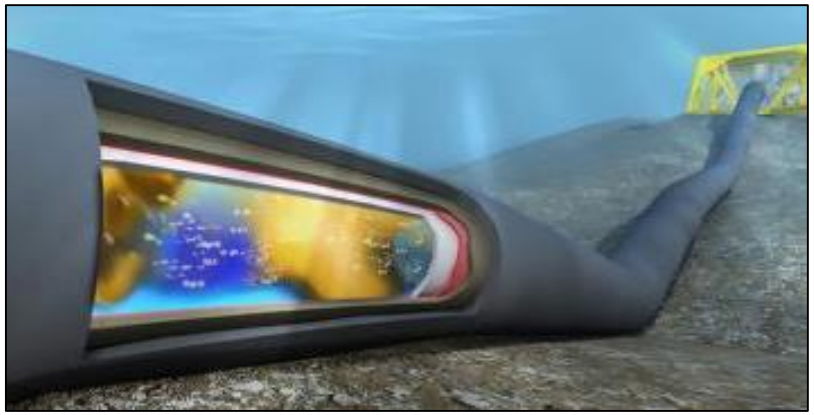
DEEPWATER DEVELOPMENT

Agenda

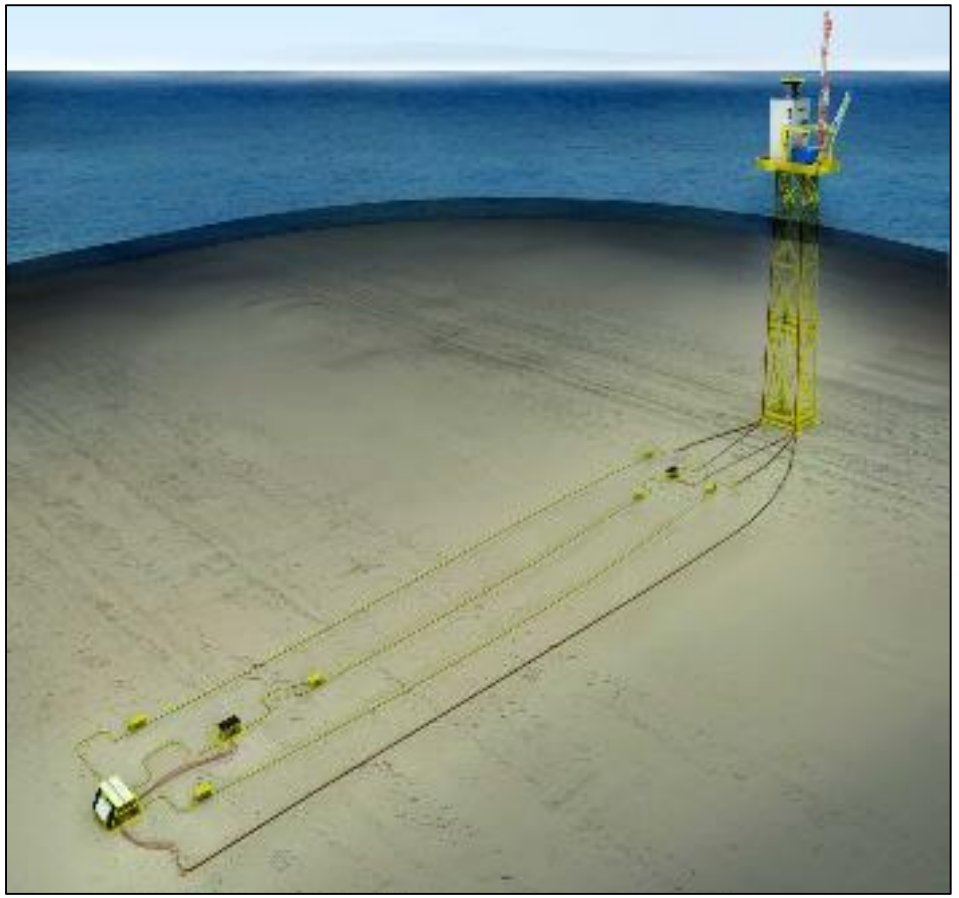
- Introduction
- Multifunctional Pipeline System (MFPS) Overview
- Concepts and Operational Scenarios
  - Water Injection
  - Gas Injection
- Flow Assurance
- Conclusion





Introduction: Problem Statement

- The tieback of new fields to existing facilities can be used to develop offshore fields that are often too small for economical development.
- Long tiebacks specifically come with inherent challenges, despite existing technologies in place to accommodate these scenarios.
- Challenges include
  - turndown
  - shutdown
  - active heating
  - depressurization
  - cost



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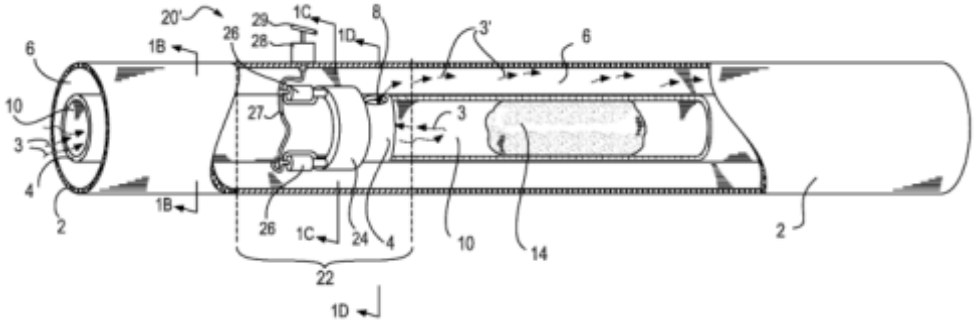
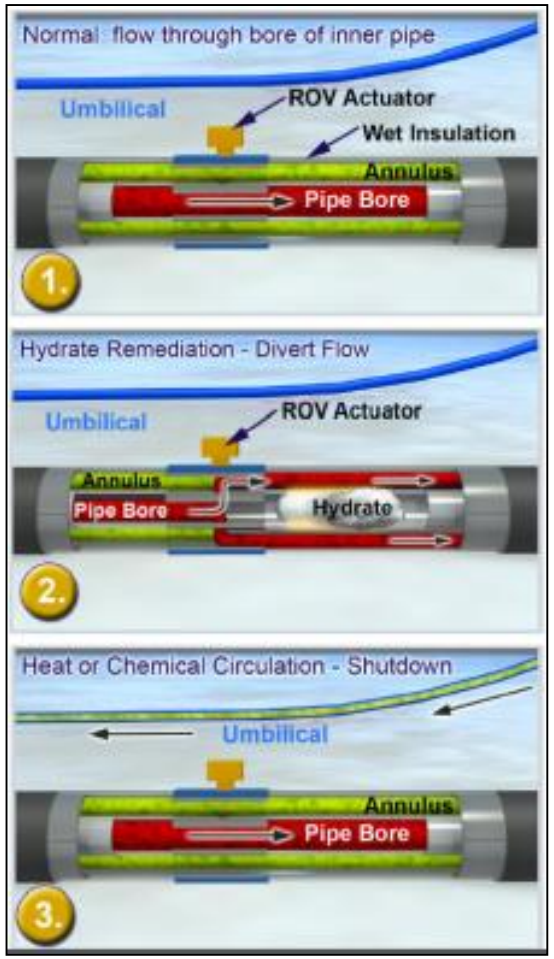
Proposed Solution: MFPS

- **Multifunctional pipeline system**
- Stations along pipe-in-pipe pipeline
  - Enable communication between the bore and annulus
  - Simplify subsea architecture
  - Provide operational flexibility to address flow assurance problems
  - US Patent No. US 8,950,499 B2





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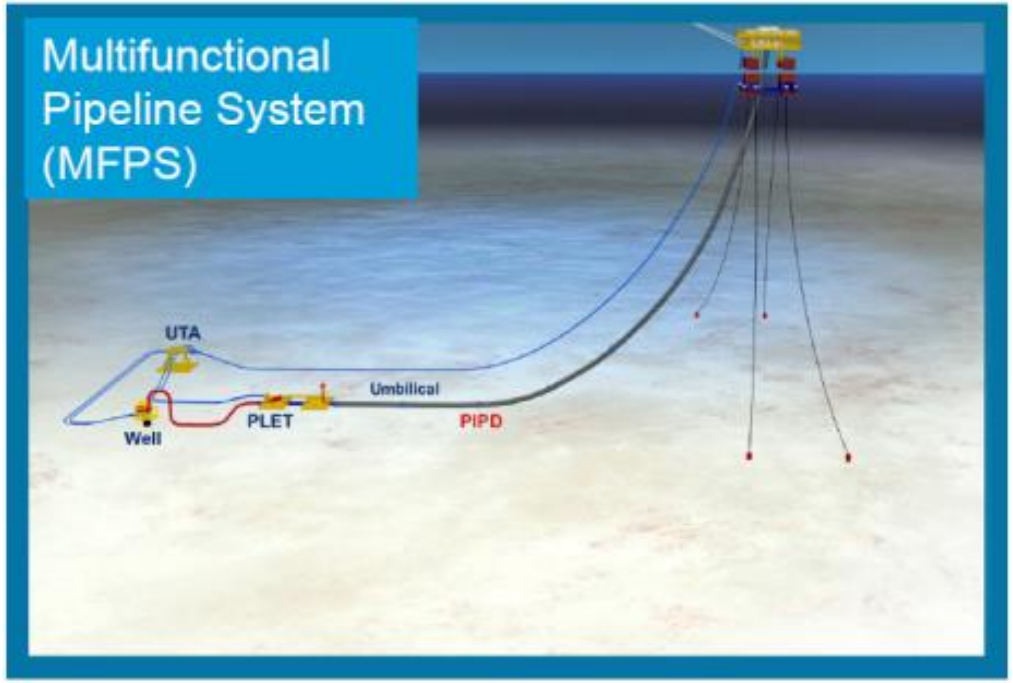
MFPS Overview

- **Key functionalities**
- Localized hydrate remediation
- Localized gas lift without additional flowline
- Chemical injection without umbilical
- Fluid sampling
- Well testing capabilities without dedicated test line
- Ability to circulate hot oil without looped flowline



Pipe in Pipe system with multiple communicating stations along pipeline

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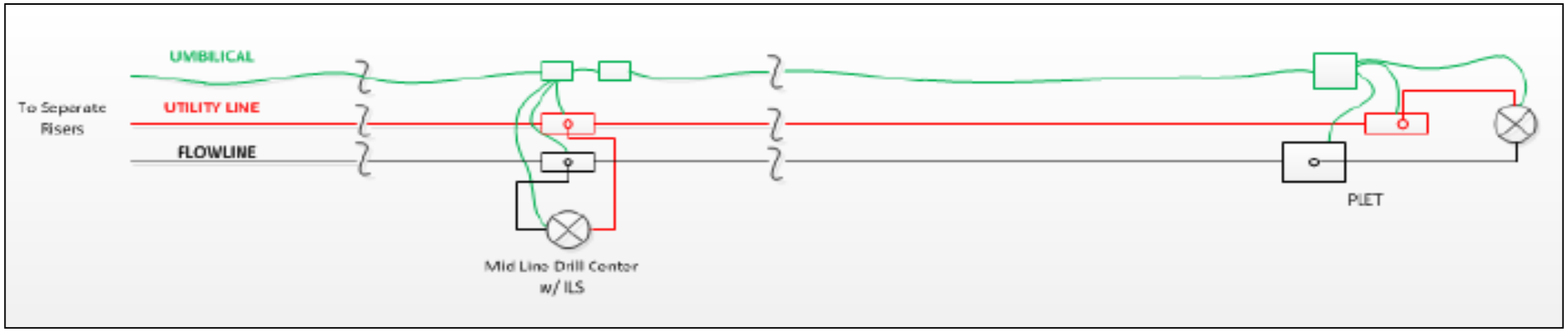
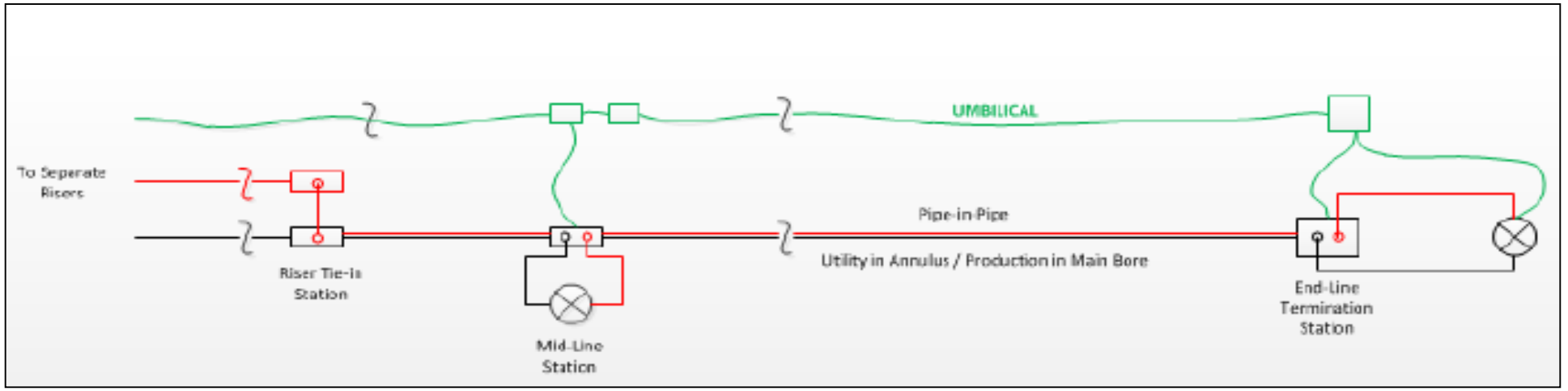
MFPS Case Study: Gas Lift System



Traditional Layout



MFPS Layout

Operational Scenario: Parameters

Water injection

- Production Fluid in Bore
- Water Injection in Annulus
- No Bore to Annulus Communication
- Intermittent Chemical Injection

Gas injection functional requirements

- Production Fluid in Bore
- Gas Injection in Annulus
- Bore to Annulus Communication Required
- Intermittent Chemical Injection

Design criteria

- Pressure: 6,000 psi (bore and annulus)
- Depth: 7,000 ft
- Design life: 10 years
- Temperature: –20 to 250 deg F
- Dimensions:
  - 16-in-OD × 1.219-in-wall-thickness outer pipe
  - 10-in-OD × 0.844-in-wall-thickness inner pipe
- Tieback distance: 12.5 mi [20 km]

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Operational Scenario: Field Layout

To host facility

Station 5

End station at riser

Station 4

Inline intervention station, ~10,500 m from drill center (optional)

Station 3

Inline intervention station, ~7,500 m from drill center

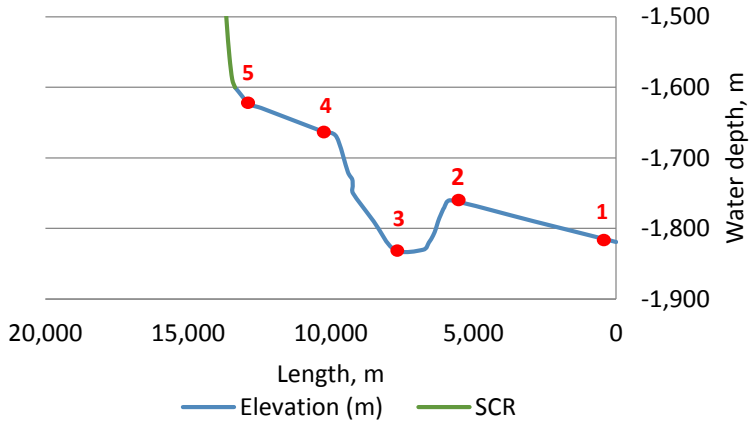
Station 2

Inline intervention station, ~5,500 m from drill center (optional)

Station 1

End station, at drill center

To drill center



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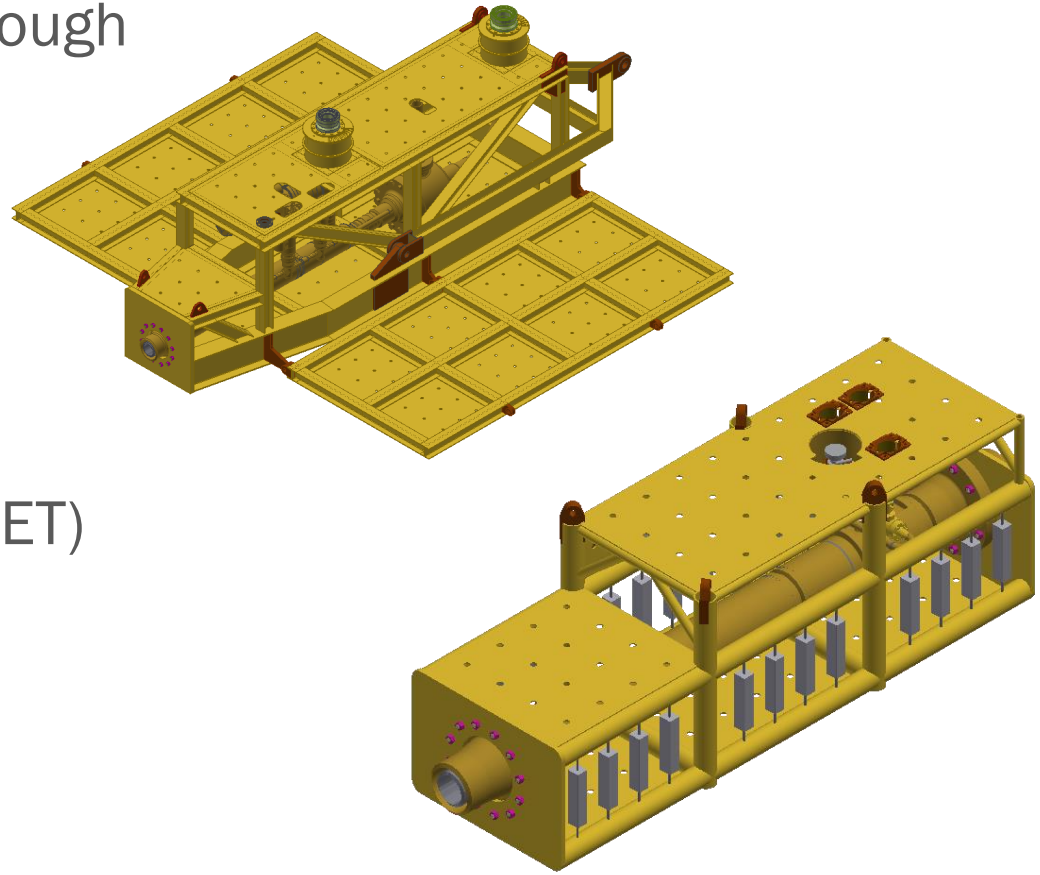
Station Concept Development

- **Station functionalities**
- Production fluid through bore; injection fluid through annulus
- Chemical injection into annulus and bore
- Annulus to bore communication
  - Traditional valve configuration
  - Flow control valve implementation
- In-line sled (ILS) or pipeline end termination (PLET) configuration and installation methodology
  - Welded to pipeline
  - Diverless connection points
- Manual, hydraulic, or electric operation



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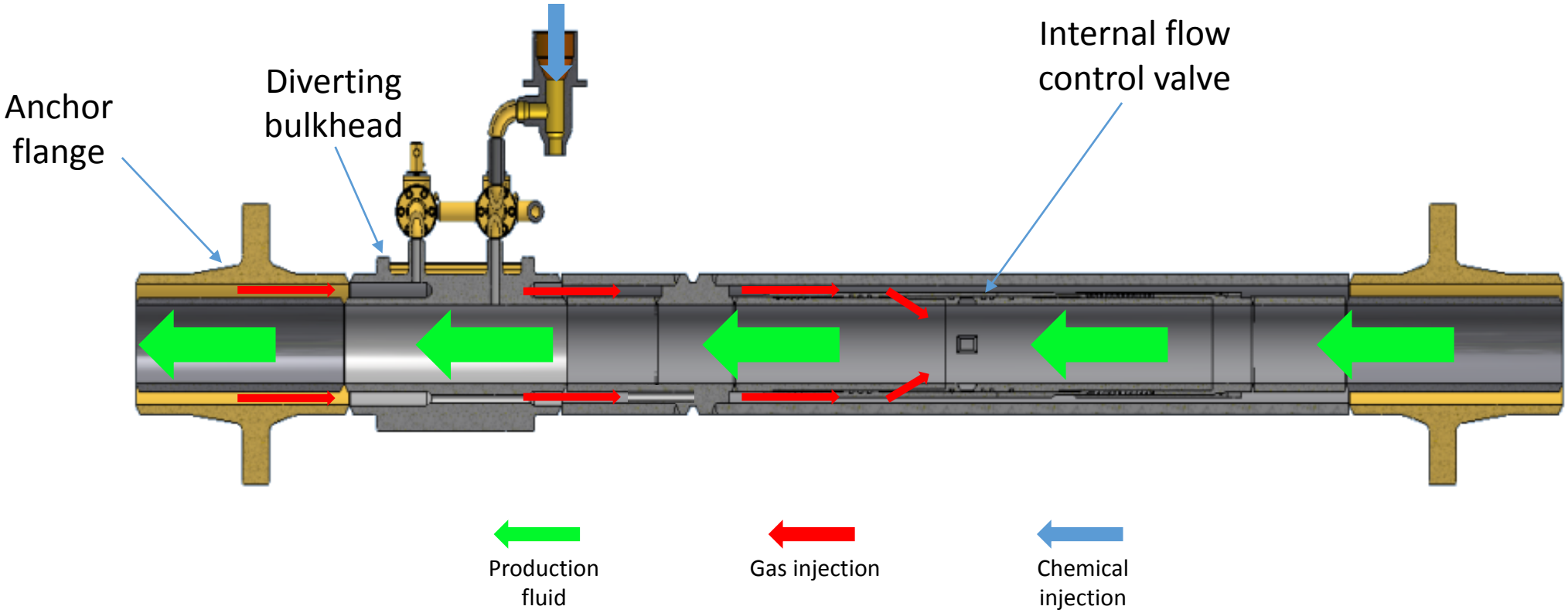
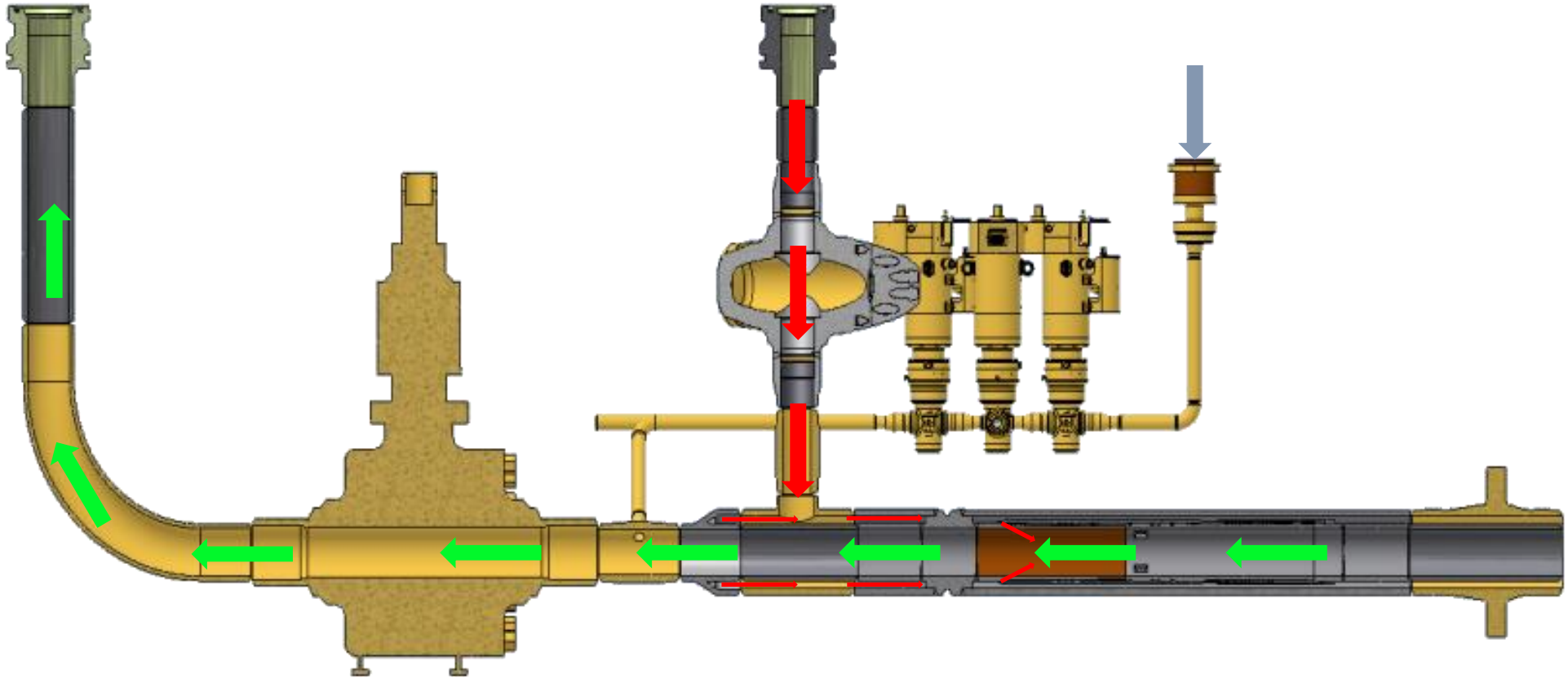
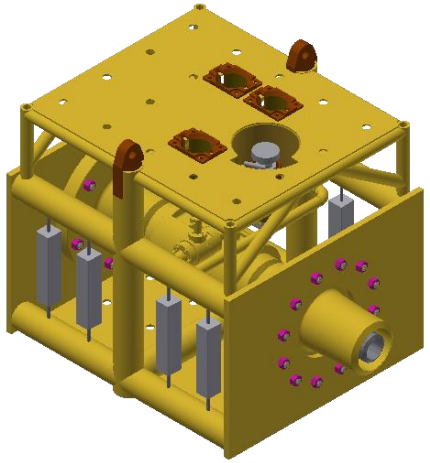
Station Concepts: Functional Overview



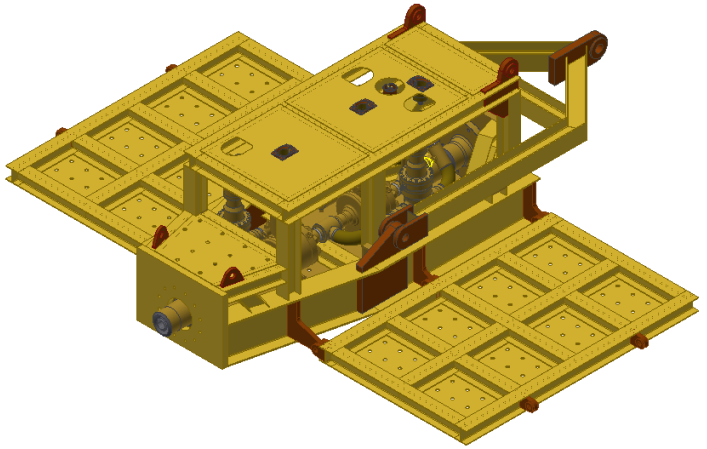
Station Concepts: Functional Overview



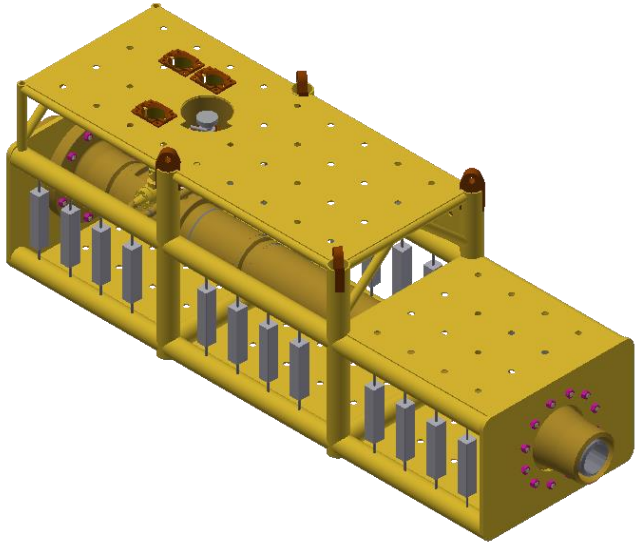
Station Summary



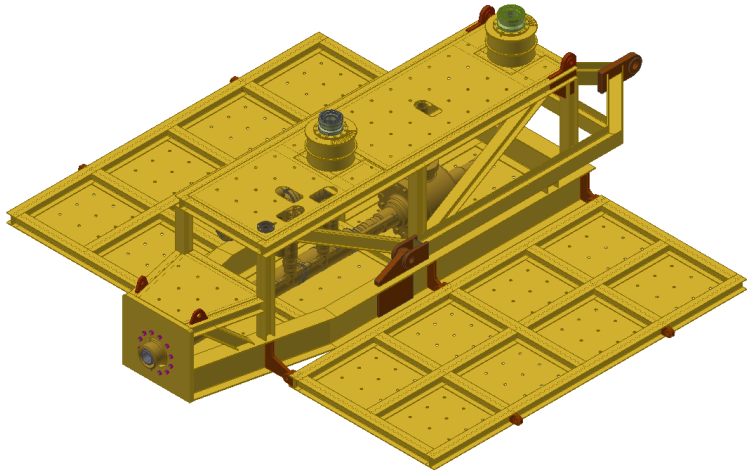
Inline intervention station



Inline flow control station



Inline flow control valve station



End station

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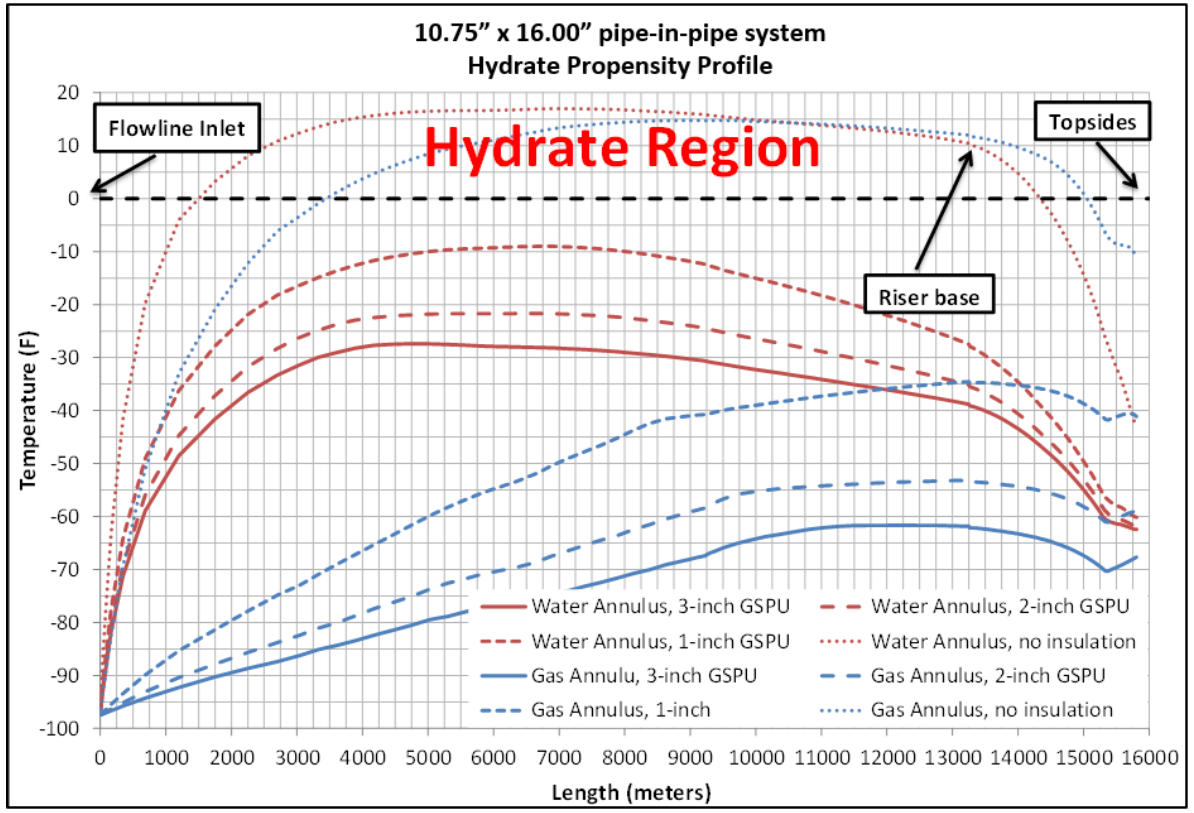
Flow Assurance

- Screening performed to determine vulnerability to hydrate formation
- Thermal performance analyzed using dynamic multiphase flow simulator based on historical Gulf of Mexico data
- Only passive insulation considered, although system could benefit from active insulation from hot fluid in annulus
- Results
  - Fluid in the bore operated within hydrate region based on reservoir characteristics
  - Mitigations include passive insulation, direct electrical heating, continuous chemical inhibition, and hot fluid circulation in annulus



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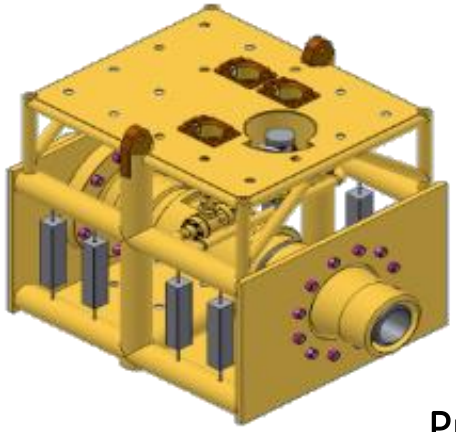
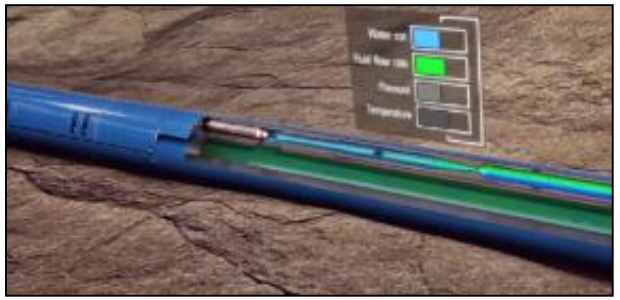
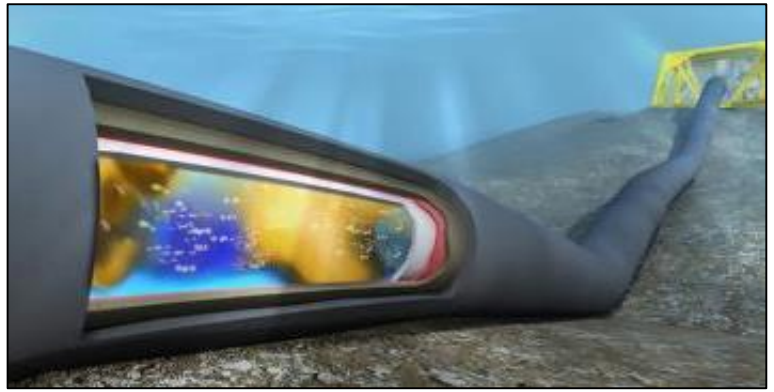
Conclusion





Product design expertise



Flow assurance

Installation

Thank you

Acknowledgements

Chevron

Antonio Critsinelis
Sid Mebarkia
Kale Lundeen

OneSubsea
A Schlumberger Company

Akshay Kalia
Tyler Skowronek
Eoghan O'Neill
Hosam Abu Zeid