Water dew-pointing with subsea gas dehydration to improve pipeline and flow assurance economics

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Agenda

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- Advanced Subsea Production Building Blocks
- Subsea Gas Processing Development Roadmap
- Subsea Dehydration Technology
  - Glycol Absorption
  - Membrane
  - Adsorption
- Application Scenario
Advanced Subsea Production Building Blocks
Typical Subsea Process Block Diagram

1) Gas Processing
   - Gas Treatment
   - Gas Liquid Separation

2) Oil-Water Processing
   - Oil Water Separation
   - Oil Treatment
   - Water Treatment

3) Boosting
   - Compressor
   - Pump

Host Facilities
Injection

Production
Subsea Gas Processing Development Roadmap

- **Concept**
  - 1985
    - Conceptual development
    - 1989-1993 Kværner Booster Station

- **Qualification**
  - 2001-2003 Demo 2000 GasBooster™ Qualification
  - 2004-2013 Ormen Lange Compression Pilot System Testing at Nyhamna

- **Project**
  - 2010-2015 Åsgard Subsea Compression system EPC

**Next steps:**
- Compression System Optimisation
- Active cooling
- Subsea Dehydration
- Gas Treatment - CO₂ removal

**Operating since Sept 2015**
Why Subsea Dehydration?

- Offshore development – deeper, longer, harsher environment
- Typical Issues on long distance multiphase transport:
  - Hydrate formation, corrosion
  - Liquid accumulation

- Subsea Dehydration – potential cost benefits area:
  - Pipeline – sizing and material
  - Chemicals – savings in MEG and CI, and associated hardware
  - Operations – reduced pressure drop, improve pipeline operability

Reduce uncertainties with multiphase transportation
Subsea Dehydration Application Scenario (1)

All-Subsea Development:
- Inherently safe solution – low personnel HSE risk
- OPEX savings – no offshore manning required
Subsea Dehydration Application Scenario (2)

Hybrid Subsea – Topsides Development:
- Greenfield – Hybrid Topsides & Subsea Development
- Brownfield – Process Debottlenecking

- Power generation
- Control
- Condensate handling and storage
- Chemical storage

- Subsea production system
- Dehydration and gas export
Dehydration Technology Overview

**Absorption**
- Water removal via **glycol absorption**
- Continuous process
- Low pressure drop
- Require continuous glycol supply

**Membrane**
- Water removal with **porous membrane**
- Continuous process
- No chemical required
- Low pressure drop

**Adsorption**
- Water removal using **beds of solid desiccants**
- Batch process
- No chemical required
- Require regenerations of the solid desiccants
Greenfield: Hybrid Subsea / Topsides Development

- **Subsea** - production and dehydration unit
- **Topsides** - Not-normally manned operation, provides utility (chemical, power)
- Dehydration using glycol absorption process:
  - Robust subsea unit
  - Overall simplicity of offshore setup
Subsea Dehydration Unit - Overview

Two Stages Dehydration Process
- Stage 1 – Water removal via condensation, with the aid of cooling
- Stage 2 – Water removal by glycol with inline contactor
- Both MEG or TEG is applicable, depending on application needs
Three main elements in the dehydration unit:
1. Active Cooler – cool down the fluid temperature, increase dehydration performance
2. Scrubber – recover the rich glycol for regeneration
3. Inline Contactor – facilitate the dehydration via absorption process
Conclusions

- **Subsea dehydration** offers advantages in pipeline operability, chemical consumptions, and pipeline material.

- The technology offers *alternative development options* for long subsea tieback developments, as well as for topsides debottlenecking.

- **NNM utility platform** with **subsea dehydration** offers potential CAPEX and OPEX savings for long distance step-out greenfield development.
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