The world firsts – subsea compression at Åsgard

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Why subsea compression for Åsgard

**Compared to the Platform alternative:**

- Increased recovery
- Accelerated production
- Reduced CAPEX
- Reduced OPEX
- HSE benefits
- Benefits increase with water depth and step-out distance

- Project specific tech. qualification activities started in 2007
- DG2 concept select in 2010
- DG3 final investment decision - July 2011
- DG4 mid September 2015
Åsgard Subsea Compression

- 2 x 11.5 MW subsea compressors
- 40 km step out
- Water depth 270 meters
- Production 21 Mill Sm$^3$/d
- Secure production of 306 mboe
- Prolong lifetime of 15 years
Qualification focus: Subsea compression

- Compressor design – centrifugal compressor with upstream scrubber
- Robustness of seals, bearings and electrical insulation in contact with gas
- Liquid tolerance & flow smoothing
- Control systems (all-electric subsea control system)
- Condition monitoring
- Power systems and components (including connection systems)
- Endurance testing
- Cooling
Technology Qualification Program

Initiated 2007
Comprehensive Scope
Maturing Competitive Vendors

Cooler

All Electric Subsea Control System

Active Magnetic Bearing Control

Scrubber

Subsea Transformer

HV Connectors and Penetrators

Power Cable

Hot-Tap

Pump
Åsgard Marine scope

Significant marine operations and topside modifications at Åsgard

Work on-going from 2011-2015
Åsgard marine operations
Other critical installations

• Åsgard A swivel – HV power (2011)
• Remote hot tap tee (2012)
• Heavy lifts: topsides module Åsgard A, subsea compressor station template (2013)
• Subsea transformers, UTAs with power cables and power umbilicals (2014)
• Åsgard B fibre optic link (2014)
• Cassette base frames 1 & 2 (2014/2015)
• Subsea compression modules – moon pool and special handling system (2015)
Process flow diagram
Installed using the special handling system on NSG
Functional testing and system integration testing in 2014

• Compressors & compressor power system tested at K-lab
• Control system and liquid pumps at AkerSolutions (Aberdeen / Oslo area)
• System integration test at Aker Solutions Egersund (West Coast Norway)
Functional Unit Testing Åsgard Compressor Train 2014

Testing of Pilot and Delivery Compressors

- K-lab modification 2011-2013
  - Shallow water test pit
  - 11,5 MW compressor shaft power
  - 17 million Sm³/d flow rate hydrocarbon gas
  - Condensate and water/MEG injection

- Submerged test of pilot and delivery compressors 2014/2015
Åsgard subsea compression: Operation and intervention

- New “Vestbase” onshore facility for storage and maintenance
- Spare compression train onsite
- Intervention – with North Sea giant – will take ca 2-3 weeks
- Vessel has subsea process intervention system to manage flushing with MEG / nitrogen
- Condition monitoring system should provide early indications of issues
Summary

• Åsgard Subsea Compression project was initiated in 2006
• Comprehensive technology qualification testing carried out 2007-2014
• Pipeline, PLEM, and spool installation carried out 2013
• Subsea structures and topside module heavy lift installation 2013
• Testing and completion of subsea modules 2014
• Module installation 2015
• World's first subsea compressor started up September 2015
• Main Subsea Factory technology elements ready for deployment
• Large potential for reuse of technology and utility systems in new projects
The Way Forward

Subsea gas compression by 2015

Subsea factory tool box by 2020
The Statoil Subsea Factory™
Acknowledgements

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- Petoro AS (Åsgard only)
- ENI Norge AS
- Total E&P Norge AS
- ExxonMobil Exploration and Production Norway AS

Key suppliers
- Aker Solutions
  - Subsea compression station and Åsgard A&B topside modifications
- MAN Diesel & Turbo
  - Subsea compressor (sub-contract to the Aker Solutions contract)
- Reinertsen
  - Pipeline engineering
- Saipem
  - Heavy lift (topside power module and subsea structures)
- Nexans
  - Power cable and umbilical's
- Technip
  - Hot-tap Installation and marine operations
- Allseas
  - New flowlines and PLEMs

Operator Statoil

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