Subsea to beach using boosting and compression techniques

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Aker Solutions’ subsea business in brief

- Top-tier subsea production system provider
  - 4,000+ skilled and dedicated employees worldwide
  - Global manufacturing and service infrastructure in place
  - Project references and installed base in all major subsea regions

- Comprehensive subsea product portfolio

- Leading position on key subsea technologies

- Innovative service offering
Drivers of future field developments

- Deeper waters, complex reservoirs, harsh fluids
- Drive for increased oil recovery from existing fields
- Longer step-outs Subsea to beach / or distance to Platform
- Reduce costs to drive marginal developments
Subsea technologies key in solving these challenges

New subsea processing & boosting solutions

Deepwater subsea well intervention

High end subsea power transmission and data distribution

Reduced development cost through standardised and re-used solutions
Building local presence and competence where we operate

- Manufacturing and assembly
- Service bases
- Sales and engineering
The Arctic – the last oil and gas frontier

Oil and gas in the Arctic

Area north of the Arctic Circle has an estimated 90 billion barrels of undiscovered oil.

Probability of finding oil, gas

50-100%

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Source: U.S. Geological Survey
Graphic: Jutta Scheibe, Eeli Poll

Arctic accounts for 13% of undiscovered oil, 30% of undiscovered natural gas, 20% of undiscovered natural gas liquids
Russian offshore fields in Barents, Yamal, Kara and Sakhalin Areas suitable for Subsea to beach
Subsea to beach
Solution for harsh environment

Ormen Lange field development

- Production start-up: October 2007
- Production design rate: 60 MSm3/sd
- ~25% of the recoverable gas volumes is dependant on offshore compression from approx. 2016
Subsea gas compression: a technological leap

- Gas fields requiring boosting of the reservoir flow
- Subsea gas compression replaces the need for an offshore platform or onshore compression facility
  - Cost-effective development solution (CAPEX)
  - Reduced operational costs (OPEX)
- Advantageous to place the compressor close to the well
  - Increased and accelerated production
  - Reducing CO₂ emissions through lower energy consumption
  - No emissions or disposals to sea
- Safer due to unmanned operation
<table>
<thead>
<tr>
<th>Subsea control system</th>
<th>Separator module</th>
<th>Compressor module</th>
<th>Pump module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooler module</td>
<td>VSD module</td>
<td>Circuit breaker module</td>
<td>UPS modules</td>
</tr>
</tbody>
</table>

Main suppliers: Aker Solutions (Aberdeen, Tranby), Converteam, GE Oil&Gas, Aker Midsund, Poseidon, Ifokus, ConSepT, ABB, Deutsch, Tronic, Ifokus
Ormen Lange subsea compression pilot taking shape in Egersund
Ormen Lange offshore compression station

- LxWxH: 70x54x25 meters
- Total weight: 3500 Tons
- 4x15 MSm³/d of gas production
- 7 200 Sm³/d of condensate production
- 58 MW total electrical power
- 120 km power and control umbilical to shore

Option: 2012-2015
Subsea compression station

2006-2011(13)
Subsea compression pilot
Pilot testing in 2011 - 2012

- Pilot identical to one of the 4 trains for future compression station
- 12,5 MW compressor unit
- 400 kW pump unit

- Submerged testing 2011-12
- Test pit and test facilities at Nyhamna
- Testing with wet gas, slug and sand production
Åsgard subsea compression station

- **Scope includes:**
  - Subsea compressor manifold station (SCMS)
  - Subsea compressor station (SCSt) with three identical compressor trains
  - All electrical control systems
  - High voltage electrical power distribution system
  - Topside equipment

- **Aker Solutions has a unique delivery model to meet high quality standards**
  - Subsea: core subsea knowledge
  - Engineering: large project execution capability
  - MMO (Egersund): high quality yard and testing area

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“The development of gas compression on subsea installations creates some exciting opportunities for the industry and our choice of concept has been met with great interest by Norwegian and international suppliers”

“We are looking forward to working together with Aker Solutions in the Åsgard development. The company submitted the best bid, amid international competition”

Statoil press release, 1 Dec 2010
Åsgard animation
Sea water booster, Tyrihans Project

- 2x2.5 MW shaft power pumps
- 270 m water depth
- 31 km from platform

Water injection template (SRSWI system)
Tordis water injection
Fully equipped subsea boosting unit and topside platform module

2.5MW / 6.6kV Pump module
400A/12kV High voltage connectors
Pump cassette structure
Control module

4MVA 22/6.6kV Transformer Module

Delivery
Topside: Q2 2008
Subsea: May 2009

24kV Power umbilicals

Will be world's longest step-out in operation (commissioning Jan 2010)
Long track record of Arctic project execution

Sakhalin three concrete gravity based structures, Russia

Hibernia gravity based structure, Canada

Kashagan, Kazakhstan, Caspian Sea

LNG plant, Hammerfest, Norway

Varandey terminal, offloading system, Russia

Goliat, Norway, Barents Sea

FPSO Terra Nova, Canada

FPSO White Rose, Canada
Summary

- Top-tier subsea production systems provider
- Solid position in an attractive segment like the Arctic with high barriers to entry
- Skilled workforce, global manufacturing and service infrastructure in place
- Subsea boosting and processing technologies gaining acceptance - key in future harsh environment field developments
- Åsgard: world’s first commercial subsea gas compression station
- Aker Solutions well placed to capture new subsea growth era
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