Subsea factory – cost efficient solutions?
Technology versus cost

Presented by: Torstein Vinterstø, Statoil ASA
Shaping the future of energy

Competitive at all times

Transforming the oil and gas industry

Providing energy for a low carbon future
Subsea Technology Steps

Multiphase Flow

1980
Start OLGA development

1986
Start Poseidon multiphase pump development

1987
Gullfaks
First subsea short oil wellstream transfer

1991
TOG!
Medium range gas condensate wellstream transfer

1995
Statfjord Sat
Medium range oil wellstream transfer

1987
Lufeng
Subsea pumps

1996
Gullfaks
First multiphase pumps (topsides, part of Framo commercialisation)

1996
Troll
Long range subsea to shore gas condensate transfer

1999
Asgard
Complex subsea development; advanced flowline concepts

2003
Mikkel
Long range subsea to subsea

2007
Ormen Lange / Snahvit
Long range subsea to shore in deep / in "arctic"

2007
Tordis
Subsea water removal & injection, oil & gas boosting

2009
Tyrihans
Subsea raw seawater injection (operation 2011)

2005
Troll
Pipe separator Qualifications Subsea water removal

2003
Norne
Technology program Subsea separation concept developments

Subsea Processing
Why subsea processing

**Compared to the Platform alternative:**
- Increased recovery
- Accelerated production
- Reduced CAPEX
- Reduced OPEX
- HSE benefits
- Energy efficiency – reduced CO2
- Benefits increase with water depth and step-out distance

**Optimal process conditions subsea**
- Stable temperature
- Well established flow assurance
- Possible to adapt process specification to individual reservoir parameters
- Improved separability at higher T/P
- Efficient cooling

**Maintenance**
- Ultimate unmanned solution
- Well established work procedures with ROV access from vessel
- Future installation might reduce cost by using pre-installed maintenance robots
- No need for personnel accessibility
- No EX requirements
- Reduced SIL requirements
- Less exposed for external impact
Åsgard Subsea Compression

- 2 x 13,5 MW subsea compressors
- 40 km step out
- Water depth 270 meters
- Production 21 MMB Sm3/d
- Secure production of 306 mboe
- Prolong lifetime of 15 years

Large scale test facility:
- Shallow water test pit
- 15.5 MW compressor, shaft power
- 17 million Sm3/l day flow rate, HC gas
- Condensate and water/MEG injection
- Large, high-voltage, high frequency power supply
- Experienced Statoil operating personnel

Åsgard SURF and Marine scope:
~1600 vessel days, 14 vessels
- 6 pipelines, total 53 km
- Hot tap on unprepared pipeline
- 12 PLEM’s, 18 spoons
- 135 tie-ins
- Decommission of pipelines

North Sea Giant:
- Accommodation 120 person
- Main Deck area 2900m²
- WAVV x2, Triton KX7 and L13
- SHS for large modules in fabrication
- Capacity 186 tons, 15*12*12 m, Hs 4.5m
- Mooring handling system 10 tons, 7.2x7.2m
- Subsea Process intervention system

Buildings and Utility:
- Workshop
- Office building
- Storage hall
- Workshop hall
- Test pit
Simplify
☑ Design-to-cost - always minimum solution as starting point
☑ Drive for significant efficiency improvements in all cost elements

Standardise on the simplified solution
☑ Standardise on cost effective design and limit variations
☑ Extensive effort to remove company’s specific requirements

Industrialise
☑ Systematically strive for re-use and repeatability
☑ Maximise use of industry standards and supplier solutions
Reduce SURF scope
• Prepare for late life phase at early stage
• Reduce complexity of process plant
  • Subsea process typically marinised version of topside/onshore plants
  • Additional requirements for subsea often developed for SPS
  • Subsea rotating equipment compact and robust
• Simplify control system topology
  • Utilise high speed fibre communication by moving functionality topside/onshore
  • Challenge need for redundancy
• Reduce Life Cycle documentation
**Standardise**

- Secure a coordinated approach to the supplier industry
- Reduce cost throughout the supply chain
- Open interfaces
  - Between and toward SURF system
  - Between modules
- IMR from sea fastening to subsea hook-up
- Establish international standards for technical requirements
- Define standard capacity categories and classes
Industrialise

- Reuse qualified and proven technology
  - First time implementation will normally be more costly than the next
- Realise synergies through projects and align execution
- Collaboration between operators
  - Establish common spare parts pool
  - Vessel availability
- Utilise existing vendor production lines and experiences

Significant potential cost savings for follower projects using existing technology, utilities, and experiences
The Statoil Subsea Factory™

Subsea gas compression by 2015

Subsea factory tool box by 2020

Sea water injection

Produced water injection pump

ROV intervention

Oil pump

Gas compression

Gas export

Oil export

Produced water injection template

Production template

Production template
Acknowledgements

Åsgard and Mikkel licence partners:
Thank you

Torstein Vinterstø
Vice President Project Management

www.statoil.com