Subsea Processing Solutions for Mature Fields with Large Water Cut

February, 2017
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Agenda

- Introduction
- Case description
- Design philosophy
- Subsea separation technology
- Subsea boosting technology
- Summary
Aker Solutions
Expertise
From subsea to surface and concept to decommissioning, our technical expertise and strong partnerships provide energy companies what they need to succeed
Front End Integrated Global Offering

- In-depth coverage of the entire spectrum of field development aspects
- Global presence in main oil and gas hubs

- Pulling together all the facets of Aker Solutions and its partners to provide an integrated solution
Case Study Introduction

Existing tie-in
- Water depth approx. 400 m
- 8 production wells
- Water production is increasing

FPSO
- Existing topside facility, also processing other fields
- Supplying power, lift gas
- Receiving produced water and hydrocarbons

Fluid
- API: 25

Topsides produced water handling capacity
- Rapidly increasing water cut
- Tie-in of new field ongoing, need to reduce water load from Template A and B down to ~2 000 m³/d

Subsea operating conditions
- 28 bar and 65°C
- ~10 years of remaining production
- Water cut ranging from 80 to 95%
Design Targets and Input

- Topside debottlenecking and subsea boosting are the main purposes of the subsea system
  - Water separation and hydrocarbon boosting
  - Need to polish and dispose of produced water
  - Utilize topside capabilities before adding complexity in subsea system
- Low solids production rate
  - Separator equipped for sand flushing
- System performance requirements, subsea vs. topside
  - What is a good balance between cost, complexity and robustness?
  - What is ‘good enough’ for the system subsea requirements?

- Is there any step change in subsea system capability that enables large overall savings?
  - Produced water injection or discharge
Reinjection into reservoir is a mature solution
- Numerous topside solutions

Achieving injection from subsea facility
- Potential to improve cost and reliability
- OiW target - case specific
- Online OiW monitoring

Potential produced water technologies
- Deoiling hydrocyclones
- Compact flotation unit
- Combination of compact and large subsea tanks for added robustness
High Level System Sketch

3-phase gravity separator → MPP → FPSO

CFU → WIP → Injection → Disposal
Separation System Design - Main Component Sizes
Subsea Separation Technology

- Primary stage: Three phase horizontal gravity separator
  - Proven, reliable, robust
  - Simple process control

- Produced water treatment: Compact Flotation Unit (CFU)
  - Topside proven, high turn-down capability, good performance, low dP, robust

- Vessel jetting system installed
  - Simple and cheap for fields with low sand production
  - Option to connect from ship to operate
Subsea Boosting Technology

- LiquidBooster™: Qualified & delivered
- HybridBooster™: Qualified in JIP
- MultiBooster™: Qualification on-going
- POWERJump™: Qualification on-going
## Technology Maturity Overview

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<tr>
<th>Component</th>
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<td>Separator</td>
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<tr>
<td>Vessel</td>
<td>7</td>
<td>Installed subsea</td>
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<tr>
<td>Internals</td>
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<td>Compact Flotation Unit</td>
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<td>Topside proven, new operating conditions subsea</td>
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<td>Water Injection Pump</td>
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<td>Installed subsea</td>
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<tr>
<td>Multi-phase Pump</td>
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<td>Qualification ongoing</td>
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![Component Images]
Overall System Performance

- Total subsea system water removal ~90%
Summary

- Subsea oil-water separation can extend life of mature fields with high water cut and debottleneck topside facilities.
- Subsea boosting can compensate for increased pressure drop due to increased water cut.
- Integrated evaluation of topside and subsea modifications is key for optimized and cost-effective solution.
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