Rethinking Subsea Boosting for Optimized Subsea Field Development

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Outline

1. Introduction – Subsea Boosting
2. Boosting Technology - Pumps
3. Value Drivers
4. Re-thinking Subsea Boosting
Introduction – What is Subsea Boosting and its applications
What is Subsea Boosting

- The pumps will transfer fluids from low pressure areas
- Pumps transfer fluids from low elevations to higher elevations
- Pumps transfer fluids from local locations to distant locations

To add energy to fluids to move them against gravity and friction
Application of Subsea Boosting

- **Mudline Boosting**
  - Without Separation
  - with Separation

- **Produced Water Re-Injection**

- **Raw Seawater Injection**

- **Downhole Boosting (ESP)**

  - Single Phase Pump
  - Multiphase Pump
  - Wet Gas Compressor
  - Single Phase Pump
  - Multiphase Pump
  - Dry Gas Compressor
  - Single Phase Pump
  - Single Phase Pump
  - ESP Pump

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Why Re-thinking Subsea Boosting

To reduce subsea development cost

The opportunity for Subsea Boosting to become a standard in the industry is right now

- Subsea boosting have been in use for 20 years
- Played an important role in development of subsea processing projects
- Are playing an increasingly important role in the improvement of recovery rates and profitability.
- But in most cases the system is Big, Heavy and Costly
Boosting Technology - Pumps
Liquid and Multiphase Boosting

• Increase well-stream and/or export line pressure
  – Increase and accelerate production
  – Enable production from low pressure reservoirs

• Pump types
  – Single Phase
  – Multiphase
3 types of hydraulics available to select from:

- **Single phase**: Very high pressure boost for pure liquid phases
- **Hybrid**: Medium high pressure boost with relatively low GVF
- **Multiphase**: High pressure liquid and gas, relatively medium to high GVF

Achievable differential pressure is dependent on amount of gas in liquid
High Speed Motor – High Speed Pump

- High efficiency Synchronous motor performance, up to 4x 'air gap' and small diameter Permanent Magnet (PM) rotor
- Cable wound stator allows the use of a water-glycol barrier fluid.
- Enables the pump to rotate at across a large range of operating speeds up to a maximum of 6,000 rpm.
- A large range of operating speeds increases adaptability to production uncertainty.

Delivery in 2018 for:
- BC 10
- Block 15/06 West Hub

Allows for:
- High GVF
- High boost
- Deep water
- Long tie back
Subsea Boosting – Value Drivers
Economic Drivers – Maximize NPV

• Increase Oil Recovery
Main Drivers for Boosting

• Main drivers:
  – Low pressure reservoirs (Greenfield)
  – Declining reservoir pressure (Brownfield)
  – Increasing watercut (Brownfield)
  – Increase and accelerate production (Greenfield/Brownfield)

• System solution especially dependent of:
  – Power and differential pressure requirements (function of production rates)
  – Step-out; subsea/topside transformers and/or VSD’s, AC or DC transmission?
  – Injection reservoir characteristics (in case of injection pumps)
Rethinking Subsea Boosting System
Optimization by Integration of SPS and SSP equipment

The degree of integration depends on existing system or requirements for a new development.

- Greenfield – fully integrated
- Brownfield – partial integration

Case specific cost reduction (Brownfield)
- Re-use existing SPS infrastructure
- Reduced SURF scope
- Optimize existing pipeline infrastructure
Optimization by Integration of SPS and SSP equipment

**Green Field Case:**

Incorporate the MPP into the SPS Structure. This represents the arrangement with the largest cost reduction potential:

- Hardware cost reduction
- Reduced cost of gas lift gas due to boosting (where applicable)
- Reduced cost of SURF including power umbilical
- Combined control functions
Good Business Case by Integration

- Integrated Subsea boosting will give a positive contribution to the NPV and IRR.

The alternative configuration with a central manifold system and two off booster pumps is estimated to provide:

- 20 – 25% cost reduction
- Up to 50% size and weight reduction
Cost Reduction by Topside Simplifications

Most of the installed subsea boosting systems are as a standalone installation hooked up to new or existing infrastructure. Placing processing equipment on the seabed would release space and weight on topside design.

Cost can be saved if part of this topside scope of work can be simplified, eliminated or avoided entirely. Less equipment on topside will contribute to optimize the design or even enable development of marginal fields.

**Incentives and drivers:**

**Brownfield:**
- Very limited topside space available
- Big topside modifications required

**Greenfield:**
- Reduce floater size, weight, deck space and loads
- Reduce topside hook up - less construction work
- Simpler umbilical – lower cost
Increased Boosting after Separation

**Maximize Recovery**
- Gas/Liquid separation
- Liquid boosting at higher pressure

**Enable long distance transport**
- No local receiving facilities
  - opens for many new development options
Subsea Boosting – Other Optimization

• Reduce, optimize and Integrate with SURF scope
• Re-use and leverage exiting infrastructure, i.e. SPS Control Umbilical
• Simplify installation smaller modules – simpler, lighter and configurable
• Low cost driven design of all units – applying vendor based material and welding specifications, standard products and configurable system solution
Summary and Conclusions
Subsea Boosting

Summary

• Improves business cases and lowers break even cost
• Accelerates and/or increase production of existing fields
• Enables new field developments

Conclusions

• Re-thinking is necessary in the subsea industry as a response to new challenge of low oil prices
• Potential in exploiting existing or new subsea infrastructure to reuse or co-use functions, structural elements and topside installation
Thank You