All Electric System as a Key Enabler for Long Distance Tie-backs

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Agenda

• Subsea Technology Evolution
• Ultra-Deep Water and Long Tie-backs Challenges
• All Electric Technology Drivers
• Subsea Power Distribution Efficiency
• Subsea DC All Electric Milestones
• Subsea All Electric Technology Today
• All Electric Technology Future
• AES vs E+H Cost Analysis
• Closing Statements
Subsea Technology Evolution

Hydraulic System:
Cheap and low tech solution.

Electro-Hydraulic System:
More efficient approach since the 80’s.

Electric System:
Eliminates the need of hydraulic power, enabling ultra-deep water and long step out development.
Ultra-Deep Water and Long Tie-backs Challenges

- Distance from existing installation
- Water depth
- Recoverable volumes, reservoir size and complexity
- Tariffs for processing the produced fluids on an existing installation
- The potentially higher recovery rates from platform wells, due to easier access to well intervention and workovers...
All Electric Technology Drivers

Reliability
- Fewer parts, more standardized modules
- More reliable overall system

Operability
- Increased System Capabilities
- Enhanced diagnostic features
- Surveillance and health assessment

Maintainability
- Preventive Maintenance
- Reduced system downtime
- Pro-active intervention planning

CAPEX/OPEX
- Reduced umbilical diameter
- No hydraulic fluid consumption
- Reduced intervention time
- Simplified equipment

Game-Changing
- Better response time and rapid control
- Elimination of Deep Water/Long Step out limitations
- Environment-friendly
Power Distribution Efficiency – Where it all started
Subsea Power Distribution Efficiency

- All Electric offers a clear advantage over Electrohydraulic systems.
- DC delivers largest coverage of power vs offset compared to AC.
- CAPEX and OPEX savings when comparing All Electric vs Electrohydraulic systems.

“The results of the electrical analysis and economic evaluation indicate that the all electric solution could provide not only the most technically proficient solution but also the most cost effective in satisfying the requirement for longer tie-backs and higher power demands... In all cases, the total costs associated with an all-electric system operating over a 175km tie-back are lower than the traditional electrohydraulic equivalent. The same is true in the case of a 600km offset cluster, however at this tie-back distance further benefit can be achieved by the selection of DC over AC.”(*)

* Source: Viper Subsea, Power Delivery and Umbilical Cable Optimization for Long Offset Tiebacks
Subsea DC All Electric Milestones

- Customer Name: Total
- Project Name: K5F
- 3 off Mudline style Xmas Trees
- Water Depth: 44 m
- Step out 18 km
- Actuator reliability – 100% to date

1999
- Successful Pilot Trial
  - BP Magnus

2004
- Successful Start – World’s first All Electric Production System
  - (Total K5F)

2008
- Second Generation DC All Electric System

2012
- Rotary Valve Actuator Qualification
  - (1MM Movements)

2014
- Installation of ESCSSV in K5F3 project
Subsea All Electric Technology Today

- EPU / MCS
- EPCDU “A”
- EPCDU “B”
- eSCM
- Max. 32 Functions
- FO
- DSL
- RS485
Subsea All Electric Technology Today

- **eSCSSV**
  Electrical downhole safety valve.

- **Linear**
  Spring Return, Fail-safe electric actuators.

- **Choke**
  Absolute position indication and no-stepping.

- **Rotary**
  Drop-in-Place Fails as is electric actuators.
Subsea All Electric Technology Today

- **Electric Manifold:** Branch, Header and Chemical Injection Valves
- **Electric XT** eSCSSV Production, Annulus, and Chemical Injection Valves Choke
- **Electric Processing:** Isolation, Suction, Discharge, By-Pass and Chemical Injection Valves
- **Electric Controls:** Topside, Subsea Power and Communication Distribution
AES vs E+H Cost Analysis

<table>
<thead>
<tr>
<th>Scope of Supply Cost Comparison</th>
<th>Savings</th>
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<tbody>
<tr>
<td>AES Savings vs. Electro-hydraulic (not including umbilical)</td>
<td>11%</td>
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Cost Savings: 70%

Cost Savings: 30%
All Electric Technology Future

• Closing technology gaps:
  o Valve sizes
  o Subsea Chemical Injection
  o Battery management systems
  o Integration to existing Electro-Hydraulic Systems.

• Cost Reductions
Closing Statements

• For Ultra Deepwater and long tie-backs, All Electric Systems offer a more economical solutions than Electro-Hydraulic Systems.

• DC Power distribution has proved to be more efficient than AC power distribution.

• Subsea All Electric Technology is available today.

• Subsea All Electric technology can reach far longer distances than ever considered with Electro-Hydraulic Systems.

AE is the key enabler for long distance tie-backs!
Questions?

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