The Viability of Rigless ESP Technology for Subsea Applications

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Subsea ESP Status Quo

• First deployment In Brazil – 1994 - (RJS-221) operated for 32 months without failure (Mendonça, et al., 1999)

• Heavy intervention cost > $ 12 Million

• In well and mud line installations
Why Rigless ESP in a Subsea environment?

- Reduce risk
- GHGE reduction
- Ready for Subsea
- Reduce OPEX
- Proven in dry tree applications
- Production strategy optimized
- Increase recovery factor
Rigless ESP Options Reduce Risk

Cable or CT deployed systems

- Cable exposed to produced fluids
- Wellhead must accommodate cable
- Reduced Manpower

Tubing deployed systems

- Rigless ESP with port fixed to tubing
- Cable in annulus
- Reduced Manpower
Rigless ESP Systems Allow Production Optimization

Permanent Completion Assembly

Seals/Protectors

Permanent Magnet Motor

Sensor

Plug Arm

Pump

Pack-off

Check Valve

Tubing Stop

Retrievable Assembly

Annular Connection Port

Packer
Rigless ESP Systems Proven in Dry Trees

Permanent Completion Reliability
✓ 70 Permanent completions delivered
✓ 40 Permanent completions installed
✓ 82.7 years of cumulative operational experience

Retrievable Assembly Reliability
✓ 90 Retrievable Assemblies delivered
✓ 67 Retrievable Assemblies (ESPs) deployed
✓ 29 rigless interventions (pull & replace)
  10 were replacements of the ESP pump only
  19 complete retrievable assembly swaps
  21 on slickline, 7 on coil and 1 on a tractor
The analysis assumes two ESP failures over 10 years.

180 days wait time for heavy intervention unit.

45 days wait time for RLWI unit.

Heavy intervention cost $12 Million.

Light well intervention cost $3.5 Million.

$23.5 Million of cost savings over 10 years.
Rigless ESP Reduce GHGE Emissions

- Akchiche et al. SPE-200607-MS - Exergoeconomic Optimization of Oil and Gas Production Systems
- Examined both economics and CO2 impact of lift systems
- Akchiche, et al., 2020 concluded “…ESPs are the least energy-consuming method …”
- Economically are affected by failures due to high WO cost and deferred production.
- Rigless ESP can address this issue

Source: Akchiche, et al., 2020

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Rigless ESP - Operational Readiness with Light Well Intervention

• For ESP changeout
  • Light well intervention (LWI) system for exist for interventions
    • Rigless compatible with wireline/slickline lubricator

• Rigless ESP system types and retrieval
  • Slickline - four runs with a maximum length designed for lubricator system

• Growth in subsea wells = growth in rigless intervention equipment

• Geography can dictate availability
# Rigless ESP Ready for subsea - there are few gaps

<table>
<thead>
<tr>
<th>ESP/Completion</th>
<th>Subsea Tree</th>
<th>Workover Ops</th>
<th>Interface Management</th>
<th>Subsea Power Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigless ESP System commercially available now</td>
<td>Existing subsea ESP tree designs apply</td>
<td>Location specific for operator and existing Slickline/wireline contract</td>
<td>UpCable connection to Subsea connector at tubing hanger</td>
<td>Existing systems from tree to power supply do not change</td>
</tr>
<tr>
<td>&gt;40 Dry tree installations</td>
<td>Lead time similar for conventional Subsea ESP</td>
<td></td>
<td>Specific Light well intervention vessel compatibility with tree vendor</td>
<td>Umbilical and tree orientation do not change</td>
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<tr>
<td>Any supplier pumps</td>
<td>Proven Permanent magnet motor</td>
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<td></td>
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<td></td>
<td>Engineering Required</td>
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**NO NEW DEVELOPMENT**
Conclusion

• Track record of Rigless ESP Systems demonstrates high reliability required for subsea deployment

• The technology exists and is proven for subsea deployment, only the specific interfaces within the tree need to be engineered

• Recent developments in ESP power cable, connectors, completion assemblies and associated completion components are qualified to deliver long-life expectancy
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References


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