Passing the tipping point: Global acceptance of TCP in subsea applications

Martin van Onna
Contents

• Acceptance of new technology in a conservative market
• Why is TCP game changing for Risers & Flowlines
• Technology acceptance approach
• Piloting
• Full scale roll out
• Approaching fast: TCP Riser
Acceptance of new technology in a conservative market

• New technology in critical applications: building new basis of trust
• Strong fundamentals on key technology differentiators
• Understanding risks
• Building a new basis with small steps
• Shaping the regulatory environment
• Maintaining eye and focus on the goal
• Sponsors, champions, visionaries and partners
• Ambition & perseverance
• Dare to share
TCP is truly game changing

• In critical applications, simplicity is key:
  o One polymer / fibre combination per application

• Key fundamental benefits:
  o No corrosion
  o Superior fatigue performance

• Understanding the field application
  o Terminating pipe in the field
  o Installation know-how
  o Integrity management & service support

• Application based product development:
  o Final application drives material development
  o Current installation methods
  o No adjustments to installation vessels
Acceptance Approach

- Working with technology leaders
- Fit for purpose & risk-based technology qualification
- Pilots Pilots & Pilots
- Business case
- Knock on value:
  - Low OPEX
  - CO2 footprint
  - Impact on adjacent structures such as FPSO
Acceptance Approach

• Critical results:
  o No effect of CO2 & H2S on tensile strength
  o Stable & predictable reduction on shear strength
  o No degradation
  o Consistent: low variation

Status:
Dry qualification: 100%
Wet qualification: 80%
## Pilots unlock potential for operators

### Operator

<table>
<thead>
<tr>
<th>Strategic fit</th>
<th>Technology leader</th>
<th>Large brownfield potential</th>
<th>Good relationship with Petrobras</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrobras</td>
<td>Pragmatic qualification approach, open to new technology</td>
<td>Large brownfield potential</td>
<td></td>
</tr>
<tr>
<td>Shell</td>
<td>In need of solution to corrosion problem with flexibles</td>
<td>Large greenfield &amp; brownfield potential</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Severe corrosion problems</td>
<td>Huge brownfield potential</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Knowledgeable and independent</td>
<td>Powerful to implement when they believe in it</td>
<td></td>
</tr>
</tbody>
</table>

### Staircase

<table>
<thead>
<tr>
<th>Technology</th>
<th>Acid stim downline SNEPCO</th>
<th>TCP Jumper for WI, GOM</th>
<th>TCP Riser qualification</th>
</tr>
</thead>
</table>

### Chevron

<table>
<thead>
<tr>
<th>Technology</th>
<th>Chevron Alder</th>
<th>Pilot impact &amp; erosion testing</th>
<th>Nigeria &amp; Angola pilots</th>
</tr>
</thead>
</table>

### Riser concept development

<table>
<thead>
<tr>
<th>Technology</th>
<th>Riser concept development</th>
<th>Flowline qualification &amp; pilots</th>
<th>Riser qualification &amp; pilots</th>
</tr>
</thead>
</table>

### Qualification

<table>
<thead>
<tr>
<th>Technology</th>
<th>Qualification</th>
<th>Pilot</th>
</tr>
</thead>
</table>

### Jumper qualification

<table>
<thead>
<tr>
<th>Technology</th>
<th>Jumper qualification</th>
<th>Jumper pilot</th>
</tr>
</thead>
</table>

© Global Offshore Brazil Summit and Gulf Quest LLC
Pilots prove the Potential

- Hydrocarbons: Petronas, Chevron, Saudi Aramco
- Methanol injection: Chevron
- Water injection: Shell, Chevron
2019 marked the tipping point for Airborne & TCP

**Record project deliveries**

**Rapid km growth – SURF deliveries only**

<table>
<thead>
<tr>
<th>Year</th>
<th>Jumper</th>
<th>Flowline</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2017</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2018</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2019</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2020</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Record qualifications including Super Majors**

**Qualification testing completed**

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Short Term</th>
<th>Long Term</th>
<th>Fatigue</th>
<th>Combines</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Pressure</td>
<td>3049</td>
<td>390</td>
<td>29</td>
<td>121</td>
<td>3150</td>
</tr>
<tr>
<td>Collapse</td>
<td>2182</td>
<td>39</td>
<td>16</td>
<td>1001</td>
<td></td>
</tr>
<tr>
<td>Fatigue</td>
<td>421</td>
<td>39</td>
<td>27</td>
<td>27</td>
<td>123</td>
</tr>
<tr>
<td>Axial Compression</td>
<td>582</td>
<td>5</td>
<td>582</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thrusting</td>
<td>485</td>
<td>498</td>
<td>71</td>
<td>422</td>
<td></td>
</tr>
<tr>
<td>Torsion</td>
<td>20</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire Resistance</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMI</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>157</td>
<td>157</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

© Global Offshore Brazil Summit and Gulf Quest LLC
Coming to a field near you: TCP Riser

• TCP fundamentals inevitable for Riser applications:
  o Superior fatigue performance
  o No corrosion
  o Low weight
• Strong foundation with all pilots done and years & km’s of TCP accumulating life
• Dedicated qualification program moving forward as planned
• Strong partnership with Subsea 7 for installation and global analysis
• Strong partnerships with supply chain for material development
The TCP Riser is making tangible progress

- Full scale qualification testing in Brazil
- Manufacturing of prototypes
- Material qualification testing
- Full scale qualification testing in Brazil
And will Pilot to complete

TCP Riser

Riser & Flowline Pilot

TCP Flowline

Service Flowline; 2400m WD

Water Injection Flowline; 1000m WD

2017 2018 2019 2020 2021 2022

© Global Offshore Brazil Summit and Gulf Quest LLC
Conclusions

• TCP has passed the tipping point and is widely accepted – world wide
• The Key Fundamentals of No Corrosion & Fatigue make TCP Riser inevitable
• Qualification is progressing fast & as planned
• Pilots are key for operators to unlock and access the technology
Thank you