Installation Considerations for Ultra Deep Water Risers

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Marine Construction
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Installation Considerations for Ultra Deep Water Risers

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AGENDA

• Steel Catenary Risers (SCR’s) Overview

• Design and Installation Considerations

• HPHT & Deepwater Applications

• Alternative Methods

• Summary

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STEEL CATENARY RISER (SCR)

KEY POINTS:

• Perceived to be a proven (mature) solution

• Outwardly appear simple and cost effective

• Design critical, inflexible in accommodating design changes, highly iterative

• Technical and commercial Success is INSTALLATION driven

• BEST solution for existing contracting mechanisms

10% SUBSEA COST….90% THE PROBLEM

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STEEL CATENARY RISER (SCR)

- Extensive use in GoM
- 6-24” diameter installed
- 1,000 – 7,000ft water depth
- All welded construction
- ‘Extension of flowline’
- Fatigue sensitive – weld quality
- Vessel interface options
  - Flex joint
  - Stress joint
- Payload impact on host facility
- Complex seabed layout
- **Installed by high spec vessels**
- Significant project specific issues

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## Applications – Current & Future

<table>
<thead>
<tr>
<th></th>
<th>Current</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installations</td>
<td>46</td>
<td>114 over next 5 years</td>
</tr>
<tr>
<td>Spars/TLP’s</td>
<td>85%</td>
<td>11%</td>
</tr>
<tr>
<td>FPSO’s</td>
<td>0%</td>
<td>41%</td>
</tr>
<tr>
<td>Semi</td>
<td>15%</td>
<td>48%</td>
</tr>
<tr>
<td>Export</td>
<td>70%</td>
<td>30%</td>
</tr>
<tr>
<td>Production</td>
<td>40%</td>
<td>60%</td>
</tr>
<tr>
<td>Gulf of Mexico</td>
<td>96%</td>
<td></td>
</tr>
<tr>
<td>West Africa</td>
<td></td>
<td>40%</td>
</tr>
</tbody>
</table>

This is a significant extension of ‘proven’ capability

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SCR Design Considerations

- Water Depth
- Vessel motions
- Currents and VIV
- Coatings and thermal management
- Corrosion and material loss
- Field layout
- Impact on host structure (payload)
- Fatigue (confidence levels)
- HP/HT and sour service
- Pipe quality
- Welding and inspection
- Inspection

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SCR Future Applications - Issues

- High Pressure, High Temperature and Deepwater leads to:
  - Thicker wall pipe (40mm limit)
  - Increases line pipe cost
  - Limited number of pipe manufacturers
  - Challenging offshore fabrication
  - Longer offshore installation times
  - Higher riser tensions during installation and service
  - Reduced flow area for production

BUT FITS WITH CONVENTION

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SCR Weld Criticality

- SCRs are dynamically loaded structures
- Constructed by welding
- All welds contain defects
- All welds have stress concentration
- Defects grow and eventually propagate
- Riser failure is UNACCEPTABLE
- Engineering intensive to achieve confidence

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SCR Installation Considerations

- Welded construction is the **default**
  - Large track record
  - High level of confidence
  - Industry preference to extrapolate shallow water technology
  - Contractor pre-investment in high spec installation vessels
  - No alternatives offered

- Installation strategy can be complex and yet is **critical**
  - Limited number of qualified contractors in busy market
  - Limited number of capable vessels
  - Many developments in remote locations (mob –demob)
  - Critical path activity – dependent upon weld qualification
  - Pre-installation an important commercial requirement

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SCR Suitability?

- What are the true drivers?
- Is the SCR really the best option?
- Are other riser options better suited?
Deepwater Considerations

• Develop Efficient Riser Designs
  – Reduce Weight / Payload / Buoyancy needs
  – Improve performance and reduce criticality
  – Facilitate future maintenance and upgrades (eg. pumping)

• Offshore Construction
  – Faster Installation
  – Lower Cost Installation

• Improve schedule flexibility
  – Improve contract arrangements
  – Availability of installation vessels
  – Pre-installation capability

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Free Standing Solutions

- Outwardly more complex
- Address deepwater issues
- Competitive installed cost
- Construction using T&C

Wellhead technology

NOT

Flowline technology

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THREADING & COUPLED CONNECTIONS

- Non Welded
- High strength steel
- Proven metal seal
- Fast make-up
- Good fatigue
- Testing shows ‘Better than weld’
- Low cost

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Threaded Construction Installation

- Option to use less expensive vessels
- Greater vessel availability
- MODU’s specifically designed for threaded pipe with large tension capacities
- Eliminates installation vessel mobilization
- Relaxes schedule constraints and allows pre-installation
- Facilitates future inspection, maintenance and upgrade

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Proven Wellhead Technology

- Top Tensioned Risers

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Weld vs Threaded Connections

- High strength steel 95-110 ksi
- 13% chrome steel (for CO₂ and H₂S)
- Example Comparison:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Welded X65</th>
<th>Threaded P110</th>
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<tbody>
<tr>
<td>Wall Thickness</td>
<td>1.0</td>
<td>0.55</td>
</tr>
<tr>
<td>Top tension</td>
<td>1.0</td>
<td>0.58</td>
</tr>
<tr>
<td>Flow area</td>
<td>1.0</td>
<td>1.28</td>
</tr>
<tr>
<td>Max Riser Stress (100yr)</td>
<td>1.0</td>
<td>0.86</td>
</tr>
<tr>
<td>Fatigue Life E- 1.25 vs B-3.0</td>
<td>1.0</td>
<td>2.00</td>
</tr>
</tbody>
</table>

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PREFERRED RISER SYSTEM?

• Most suitable is heavily dependent upon:
  – Project schedule
  – Schedule / development flexibility requirements
  – **Installation contract strategy**

• Most suitable riser is one that:
  – Meets functional requirements
  – Reliable performance
  – Fits with field layout scenario
  – Installed at lowest cost / risk (cost exposure)

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SUMMARY - SCR’s are:

- a cost effective riser solution for deepwater applications
- inherently complex with a multitude of interfaces
- not easy to accommodate changes – requires iterative design
- a riser solution that fits with existing contracting strategies
- heavily dependent upon success of welding operations and offshore installation capabilities
- response critical requiring monitoring for marginal designs

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Summary

• Alternative risers and construction methods are available
• “Best” option is dictated by installation consideration and contract strategy
• Optimum to minimize project risk and maximize flexibility
• Ability to accommodate inevitable changes
  – Technically
  – Commercially
  – Logistically

“Desire a contract strategy to CAP the exit wound”

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