Riser Installation in Deep & Ultra Deep Water

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Outline

- Introduction
- Overview of current deepwater riser systems and installation methods
- Threaded connections
- Installation of riser systems based on threaded connections
- Contract strategies
- Conclusions

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Introduction

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Introduction

- Operators facing dual challenges of moving into deep and ultra-deep waters and reducing costs of components and activities relating to these developments.
- Riser system cost is sensitive to increase in water depth.
- Riser system installation cost is sensitive to increase in water depth.
- Majority of current deepwater riser systems based on welded construction, installed using high specification vessels.
- Alternative approach to welded construction is to use threaded connections.

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Overview of Current Deepwater Riser Systems and Installation Methods

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Flexible Catenary Risers

- Used for a number of years for both flowline and riser applications.
- Built up of independent spiral laid steel and thermo-plastic layers.
- Limited suppliers offer flexible pipe for riser systems.

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Flexible Catenary Risers

- Able to accommodate high curvature.
- Installed from a continuous reel.
- Installation may be limited by collapse resistance of pipe when installed air-filled in deep water.
- Care required to limit curvature and bending moment at TDP during installation.

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Steel Catenary Risers (SCR’s)

- Used in deepwater environments such as Gulf of Mexico, Brazil, West Africa.
- SCR is an ‘extension of the flowline’ consisting of steel pipe string free-hanging from vessel to form catenary shape.
- All welded construction – fatigue life driven by quality of welds.
- Good quality welds rely on pipe and weld material properties, joint dimensional tolerances, welding processes, welding procedure and inspection criteria.

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Steel Catenary Risers (SCR’s)

- High specification vessels are required to provide lay tension, these vessels command high day rates and mobilisation costs.
- Performing and ensuring integrity of weld takes time, increases with wall thickness.
- J-Lay is most common installation method. Riser stalks of up to 6 joints are pre-welded onshore. Stalks are welded offshore in tower to the riser string vertically.
- Vessel tensioner capacity may be limiting factor.

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Single Line Offset Risers (SLOR’s)

- SLOR’s are now operating in West African, Brazilian and Gulf of Mexico developments.
- SLOR’s employs a vertical steel riser section that is linked to the host vessel via a flexible pipe jumper.
- Key advantage of arrangement is that the vertical riser response is largely decoupled from the vessel motions.
- As such SLOR’s are suitable for deep and ultra-deep water applications.

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Single Line Offset Risers (SLOR’s)

- Installation of welded SLOR must be performed using a J-lay vessel.
- SLOR may be pre-installed before arrival of host vessel.
- Flexible jumper may be pre-installed and allowed to free hang; final pull-in after arrival of host vessel.
- Improved flexibility in project scheduling.

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Bundle Hybrid Risers

- Bundle hybrid risers made up of a number of small diameter steel pipe strings, buoyancy and steel core.
- Bundled strings kept free standing by a buoyancy can with flexible jumpers linking the pipe strings to the host vessel.

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Bundle Hybrid Risers

- Due to complexity of cross section on-shore fabrication must be used.
- This allows large quantity of local fabrication to be performed.
- After assembly riser is towed out before being upended and installed.

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Top Tensioned Risers

- Top Tension Risers commonly used with tension leg platforms and spars.
- Top tension riser connects directly from subsea wells to vessel deck.
- Tension applied by buoyancy cans or hydro-pneumatic tensioners.
Top Tensioned Risers

- Hydro-pneumatic tensioned risers are less complex and take less time to install.
- Conventional construction method is based on ‘weld-on’ threaded connectors.
- Recent top tension risers have been made up using integrally machined threaded and coupled (T&C) connections.

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Threaded & Coupled (T&C) Connections

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T&C Connections

- Alternative construction method based on premium mechanical connections in the form of non-welded threaded and coupled connectors.

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T&C Connections

• Benefits include:
  - Non welded
  - High strength steel
  - Corrosion resistant alloys
  - Proven metal seal
  - Faster make-up speeds
  - Improved fatigue performance

• TRF JIP

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Installation of Riser Systems based on T&C Connections

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Flexible catenary risers and bundle hybrid risers are proprietary riser systems often chosen because of contractual or functional requirements.

Large proportion of riser systems based on welding because it is ‘default’ method for flowlines and shallow water.

Continued into deeper water and installation contractors developed vessels and techniques to meet the demands.

Limited installation choice and often a high cost, complex riser solution.

As industry moves into deeper water, riser steel weight will increase and affect riser tensioning system and installation vessel payload.

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Installation using T&C Connections

- Key benefit of T&C connections is the ability to improve the installation procedure.
- Current lay vessels can be modified to make-up T&C connections within the J-lay tower.
- Connection integrity confirmed by computer controlled torque tongs with feed back control logic.

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Installation using T&C Connections

• Mobile Offshore Drilling Units (MODUs) are not generally used for installation of flowlines, facilities are well suited for J-lay mode;
  – Spiders and torque tongs tailored for use of threaded connections.
  – MODU motion characteristics generally superior to pipelay vessels.
  – MODU may be already in field drilling development wells, or on long term charter.

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Threaded SLOR Installation

- SLOR lends itself to installation by MODU.
- Riser joints passed vertically into derrick being connected at the drill floor.
- Buoyancy can most challenging aspect; achieved by keel hauling the buoyancy can underneath the MODU and running the riser through the can.

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Threaded SLOR Installation

- Riser string is landed on top of the buoyancy can.
- Riser system lowered on riser running string, riser base landed and locked into foundation pile using an ROV.
- Flexible jumper is then installed independently, at a later date if required.

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Threaded SCR Installation

- Vertical stinger fitted beneath drill floor to control catenary curvature and maintain vertical alignment at drill floor.
- SCR’s require a small top angle to ensure stability.
- For T&C connections make-up angles greater than a few degrees are not acceptable.
- Clearance with moonpool and pontoons must be maintained.

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Contract Strategies

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Contract Strategies

- Riser package is currently awarded within the subsea, umbilical, riser and flowline (SURF) package.
- Riser typically 15-20% of total SURF package cost, as such SURF package awarded to large pipeline installation contractors.
- Strategy suits Operators – responsibility and risk lies with installation contractors.
- Riser should be included as optional element in SURF package, and offered as stand alone package.
- Both T&C and welded solutions should be considered from initial development through front end engineering design.
- This approach will allow Operators to benefit from improved installation approach offered by T&C connections.

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Conclusions

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Conclusions

- Majority of deepwater riser systems based on welded approach.
- Performing quality offshore weld takes time.
- As industry moves into deeper water this approach may not be the best solution.
- Alternative solution is available based on T&C connections
- T&C connections may be used with adapted lay vessel and also with MODU.
- Benefits include:
  - Faster lay rates
  - Reduced tension requirements.
  - Improved vessel response.

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Conclusions

- Current contract strategy will lead to the flowline installation approach of a welded solution.

- Benefits of T&C connections can only be realised if process is Operator led with changes to contract method.

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