RISK

Onboard Tools for Planning and Optimizing SIMOPS

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Overview of Presentation

• Background

• Onboard planning tool
  – Onboard SIMOPS simulation
  – Onboard simulator inputs
  – Operator interface

• Example application

• Conclusion
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Drilling Riser SIMOPS – Background

- High drilling rig day rates
  - Driving need to maximize efficiency
- Dual activity rigs:
  - Dual derrick
  - High-capacity subsea cranes & winches
- SIMultaneous OPerationS:
  - Subsea operations carried out with drilling riser deployed:
    - Running casing
    - Subsea equipment installation (X-mas trees, manifolds, etc.)
Onboard SIMOPS Planning

• Problem:
  – Feasibility of SIMOPS dependent on metocean conditions
  – Operations in high current areas
  – Planning essential to minimize risk

• Solution:
  – Advanced on-board software used to plan SIMOPS
  – Plan operations using *prevailing* or *forecast* data
  – Removes conservatism associated with assumed metocean conditions
SIMOPS Planning & Riser Management

Onshore

- Integrity Assurance: Analytical
  - Operability
    - Connected
    - Unconnected
  - Fatigue
    - Connected
    - Unconnected
- Integrity Assurance: Mechanical Qualification
  - Seal Tests
- Operations Planning
  - Operability Planning
  - Riser Response Prediction
  - Etc.
  - Installation Planning
    - Riser Running/Retrieval
    - Equip. Running/Retrieval

Offshore

- Real-Time Monitoring
  - ADCP
  - Riser Vibration
  - Riser Tension
  - Riser Angles
  - Slip Joint / Tensioner Stroke
- On-Board Simulation Software
  - Operations Planning
    - Measured Environment
    - Forecast Environment
  - Position Optimization

Onboard Riser Operations Planning & Management
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Onboard SIMOPS Simulation

- Intuitive, easy to use, simple to interpret
- Core analysis engine from MCS Flexcom/DeepRiser
- Models established onshore
- Operates in "online" or "offline" modes:
  - Online – data acquired from other vessel systems
  - Offline – all inputs specified by operator
Onboard Simulator Inputs

- Vessel data:
  - Position & heading

- Riser data:
  - State (connected/hung-off)
  - Top tension
  - Mud weight
  - No. of joints deployed

- Metocean data:
  - Ocean current profile

- SIMOPS operation details:
  - Nature of operation
  - No. of stages to be examined
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Example – Running Casing

- Installation of 36” casing
- Drilling riser deployed
- 10,000 ft water depth
- 10 installation stages examined
  - User specifies length of casing run for each stage
- At each stage:
  - Clearance between riser and casing examined
  - Recommended heading to maximize clearance calculated by tool
Casing Running Example – Overview

- Numerical (FE) model of riser & casing
- Range of casing running depths analyzed
  - Models for each configuration automatically generated
- Input data – combination of measured and operator specified data used
  - Current profile – ADCP
  - Riser profile – riser angle data
## Casing Running Example – Input Data

<table>
<thead>
<tr>
<th>Input</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vessel Data:</strong></td>
<td></td>
</tr>
<tr>
<td>Vessel Position &amp; Heading</td>
<td>DP System / DGPS &amp; Gyrocompass</td>
</tr>
<tr>
<td><strong>Riser Data:</strong></td>
<td></td>
</tr>
<tr>
<td>Top Tension</td>
<td>Tensioner System</td>
</tr>
<tr>
<td>Mud Weight</td>
<td>BOP Mux</td>
</tr>
<tr>
<td>Telescopic Joint Stroke</td>
<td>Tensioner System</td>
</tr>
<tr>
<td><strong>Casing Data:</strong></td>
<td></td>
</tr>
<tr>
<td>Casing Running Down Depths</td>
<td>Operator Input</td>
</tr>
<tr>
<td>Clearance Tolerance with Riser</td>
<td>Operator Input</td>
</tr>
<tr>
<td><strong>Environmental Data:</strong></td>
<td></td>
</tr>
<tr>
<td>Riser Angle Data</td>
<td>ERA System</td>
</tr>
<tr>
<td>Current Profile</td>
<td>ADCP</td>
</tr>
</tbody>
</table>
Casing Running Example – Procedure

1. Riser Model
2. Initial Static Analysis
3. Analysis with Current & Mean Ambient Loading
4. Vessel Heading Sensitivity Analyses
5. Recommended Heading Calculation
6. Clashing Data
7. Recommended Heading
**Recommended Headings at each Installation Stage**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Heading (deg)</th>
<th>Max Clearance (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>270.0</td>
<td>39.9</td>
</tr>
<tr>
<td>2</td>
<td>270.0</td>
<td>51.3</td>
</tr>
<tr>
<td>3</td>
<td>270.0</td>
<td>47.0</td>
</tr>
<tr>
<td>4</td>
<td>270.0</td>
<td>46.2</td>
</tr>
<tr>
<td>5</td>
<td>270.0</td>
<td>56.7</td>
</tr>
</tbody>
</table>

**Fig. 1: Equipment Clearance v Heading, Stage No. 1 - Stage No. 5**

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*True Vessel Heading = <50 deg*

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Stage No. 1, Depth = 1000.0 ft
Stage No. 2, Depth = 2000.0 ft
Stage No. 3, Depth = 3000.0 ft
Stage No. 4, Depth = 4000.0 ft
Stage No. 5, Depth = 5000.0 ft
Export for Visualization

DC-114 Clashes With:
Drilling Riser at E:260.444, N:9890596, D:572.82
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Conclusion

- **Onboard simulator** provides capability to plan SIMOPS in prevailing/forecast environment
- **Minimizes risk** of operations through planning
- **Maximizes operating window** – through use of actual metocean conditions
- **Deployed** on 6 vessels to date
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