Qualifying new technologies for deepwater operation

Presented by
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Outline

• Background

• New Technology Qualification
  • Approval In Principle (AIP)
  • AIP to Full Approval

• Managed Pressure Drilling (MPD) Overview

• MPD System – Key Aspects and Risk Management
**Background**

**Novel Concept**
- Newly developed system or technology.
- Modification enabling use of established system or technology in new operating environment(s).

**Motivation**
- Harsh Environments
- Increased efficiency
- Automation
Background

Challenges

• Lack of or gaps in design codes/standards.
• Lack of system perspective – interfaces and integration.
• High complexity and uncertainty.
• Safety level determination.
• No prior experience.

Technology Qualification (TQ)

• Examining the system and providing evidence to demonstrate that the technology employed meets specified requirements for the intended use.
New Technology Qualification

*ABS refers to American Bureau of Shipping, an affiliated company of ABS Group.*
Approval In Principle (AIP) Process

1. Review goals, performance requirements (PR) & design basis
2. Identify novel aspects & related technology readiness level (TRL)
3. Conduct preliminary engineering evaluation, design verification and validation
4. Conduct preliminary risk assessment(s)
   - Show-stoppers?
     - Yes: Make necessary modifications
     - No: Determine qualification activities and acceptance criteria - TQ Plan

- Issue AIP along with Approval Road Map
AIP to Full Approval

Execute TQ Plan

Conduct detailed engineering evaluation, design verification and validation

Conduct detailed risk assessment(s)

Update TQ Plan

Issue Final Class Approval

Goals & PR met & adequate?

Make necessary modifications?

Add’l qualification activities?

Yes

No
New Technology Evolution

<table>
<thead>
<tr>
<th>Technology Readiness Level (TRL)</th>
<th>Engineering / Operation</th>
<th>Risk Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRL 0</td>
<td>Concept Idea / Design Basis</td>
<td>HAZID / Change Analysis</td>
</tr>
<tr>
<td>TRL 1 &amp; 2</td>
<td>Conceptual Design</td>
<td>Whatif</td>
</tr>
<tr>
<td>TRL 3</td>
<td>Engineering Prototype Development and Testing</td>
<td>HAZOP</td>
</tr>
<tr>
<td>TRL 4 &amp; 5</td>
<td>Detailed Design</td>
<td>FMEA</td>
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<tr>
<td>TRL 6 &amp; 7</td>
<td>Increasing understanding of system parameters and behavior</td>
<td>Fault Tree/ Event Tree</td>
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Required performance limits of system

*Risk Assessment services provided by ABSG Consulting Inc.

**ABS services provided by American Bureau of Shipping.
“Living” document maintained throughout the project lifecycle which details

- Type of risk assessment(s) to be carried out and its/their scheduling.
- Scope of each assessment.
- Risk metrics/criteria for acceptance, prioritization and re-validation.
- Risk mitigation responsibilities.
- Link to Risk Register.
- Link to TQ Plan.
Managed Pressure Drilling (MPD) Overview

Example MPD System
**MPD System Key Aspects**

- Closed-loop circulation system
  - Rotating Control Device (RCD)
  - Mechanical load-bearing components
  - Pressure-containing components
  - Pressure-controlling components
  - Pressure-retaining components
  - Control system
  - Ref. Standard(s): API 16RCD and API 16A

- Overpressure Protection
  - Pressure Relief Valve (PRV) system
  - Overarching philosophy
  - Arrangement
  - Sizing, capacity
  - Backpressure
  - Discharge location and routing
  - Control system

- Kick Detection and Surface Back Pressure (SBP) control
  - MPD Choke Control System
  - Single point failure criteria, control logic
  - Data acquisition systems
  - HPU design
  - HMI, Alarms, Interlocks, System Interfaces, Dependencies
  - Area Classification
**MPD System Risk Assessments**

<table>
<thead>
<tr>
<th>Scope</th>
<th>Studies</th>
<th>Objective(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preliminary Risk Assessment</strong>&lt;br&gt;Entire MPD System and its interfaces with existing rig drilling equipment</td>
<td>HAZID</td>
<td>(1) Identify at a high-level hazardous scenarios related to MPD system layout and operations.&lt;br&gt;(2) Mitigate risk as necessary by modifying design or operations.&lt;br&gt;(3) Develop qualification activities when necessary.</td>
</tr>
<tr>
<td><strong>Detailed Risk Assessments</strong>&lt;br&gt;Entire MPD System and its interfaces with existing rig drilling equipment</td>
<td>HAZOP</td>
<td>(1) Identify hazardous scenarios related to MPD system design and operations by evaluating deviations during all operational modes (normal and emergency events).&lt;br&gt;(2) Mitigate risk as necessary by modifying design or operations.&lt;br&gt;(3) Develop qualification activities when necessary.</td>
</tr>
<tr>
<td>Rotating Control Device (RCD) and its control system</td>
<td>FMEA</td>
<td>(1) Verify that no single failure can lead to an unsafe event (single point failure criterion).</td>
</tr>
<tr>
<td>Annular Isolation Device and its control system</td>
<td>FMEA</td>
<td>(2) Mitigate risk as necessary by modifying design or operations.</td>
</tr>
<tr>
<td>PRV Control System</td>
<td>FMEA</td>
<td>(3) Develop qualification activities when necessary.</td>
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Technology qualification

- Systematic approach to technology assessment.
- Reduced level of uncertainty and increased confidence.
- Pro-active risk management approach.
- Ability to set/confirm performance requirements and reliability goals.

Conclusion
Questions / Discussion

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