OTC-27084-MS
Introducing a new Recommended Practice for Fit for Purpose Well Abandonment

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OUTLINE

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Introducing New DNV GL RP

• In May 2016, DNV GL are releasing a new Recommended Practice (RP)

Risk-Based Abandonment of Offshore Wells

• The document is currently available online at the following address: www.dnvgl.com

• The RP can be an alternative to current practices
Dealing with Complexity in Decommissioning

“Everything should be made as simple as possible, but no simpler.”

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Fit-for-Purpose Method

Current P&A Regulations Internationally
• There are prescriptive requirements as to the number and size of plugs required.
• The requirements are the same for all types of wells (one-size fits all).

Alternative ways
• The industry is looking to differentiate between P&A requirements on a well-by-well basis.

Fit-for-purpose
• The DNV GL RP adopts a fit-for-purpose method, where both the risk acceptance criteria is site-specific and the abandonment well design can be well-specific.
# Global P&A Barrier Length Requirements

<table>
<thead>
<tr>
<th>Regulator</th>
<th>No of Plugs</th>
<th>Minimum Length (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norway</td>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>UK</td>
<td>2</td>
<td>~30</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Germany</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>USA (BSEE)</td>
<td>2</td>
<td>~30</td>
</tr>
<tr>
<td>Canada</td>
<td>1</td>
<td>~8</td>
</tr>
<tr>
<td>Russia</td>
<td>1</td>
<td>~24</td>
</tr>
<tr>
<td>Australia</td>
<td>1</td>
<td>~30</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1</td>
<td>~30</td>
</tr>
</tbody>
</table>

Are all P&A Wells the Same?

- Primary barrier
- Secondary barrier
- Surface barrier

Moderate flow potential, hydrocarbon-bearing

HPHT reservoir, moderate flow potential

Limited flow potential, not hydrocarbon-bearing

Depleted reservoir, limited flow potential
Concept

Cost Saving - Comparison Prescriptive Requirements v. Risk Based

- Primary barrier
- Secondary barrier
- Surface barrier

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Approach - Well Abandonment Risk Assessment

- Based off ISO 31000:2009: Risk Management - Principles and Guidelines
- Can assess environmental and safety risk
- Can evaluate alternative well abandonment designs to assess their suitability
From Well Parameters to Environmental Risk Metrics

<table>
<thead>
<tr>
<th>Potential inflow of hydrocarbons from overburden formations</th>
<th>Micro-annulus or seepage pathway in outer cement sheath</th>
<th>Potential leakage rate with probabilistic modelling</th>
<th>Oil in water and accumulation of oil in sediment</th>
<th>Measurable impact on organisms?</th>
</tr>
</thead>
</table>

![Diagram of well parameters](image1)

![Diagram of micro-annulus](image2)

![Diagram of potential leakage rate](image3)

![Diagram of oil in water and sediment](image4)

![Diagram of measurable impact on organisms](image5)
Acceptance Criteria – an example

<table>
<thead>
<tr>
<th>THC concentration</th>
<th>5-20 %</th>
<th>20-50%</th>
<th>&gt;50 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5 ppb</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>5-20 ppb</td>
<td>1x10^{-2}</td>
<td>1x10^{-2}</td>
<td>1x10^{-3}</td>
</tr>
<tr>
<td>20-50 ppb</td>
<td>1x10^{-2}</td>
<td>1x10^{-3}</td>
<td>1x10^{-3}</td>
</tr>
</tbody>
</table>

• Based on DNV GL experience, long-term leakage that lasts more than 10 years should have an annual likelihood less than 1x10^{-3} if the environment is to be unaffected 99% of the time.
• However, this should be operator and site specific.
Case Study

- Fit-for-purpose solutions have been implemented in well P&A in Norway\(^2\)
- Risk assessing the proposed well abandonment designs strengthens the case for alternative solutions
- There is a large savings potential in well P&A (~$12 Million per well)


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Advantages to Using the Alternative

Advantages to this approach are that it has:
• Explicit criteria for environmental protection
• P&A spending focused on higher-risk zones
• Optimize P&A design
• Flexibility – can incorporate new technology
• Site specific considerations.

Summary

- The RP provides the framework for establishing and evaluating P&A wells individually using a risk perspective.
- Considerable savings can be achieved.
- DNV GL can evaluate well abandonment designs and help optimize them to be fit-for-purpose.
Acknowledgements / Thank You / Questions

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