COIN Virtual Meeting # 17

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Presentations Offered for VM#17

- Talk 1
  - TLM UK Barrier Philosophy

- Talk 2
  - Tree & Wellhead Valve Testing Leak Rate Acceptance

- Talk 3
  - DHSV Control Line hydrocarbon Ingress measurement & acceptability
When acquiring Norwegian Assets TLMUK assessed well integrity processes for potential standardisation of TENAS & TLMUK – Norsok D010 Rev 3 August 2004 was not adopted due to inconsistencies with UK policies and procedures for SCE.

Some reasons why D010 not adopted:
- Premise in UK Regulations is to limit uncontrolled release – potential difference in concept / philosophy - containment not barriers
- D010 examples of Barriers and verification not practical for certain TLMUK scenarios
- Overly complicated definitions of barriers – well barrier, primary well barrier, secondary well barrier, common well barrier element, permanent well barrier, ultimate well barrier stage, well barrier element – Prefer more practical guidance on how to manage containment continually, but also particularly during interventions
- Concentrates on two barriers – need to be aware of all barriers (& barrier elements) in the well and often in attached systems
- Emphasis is on physical barriers – less on monitoring and assessment of pressure and continuing confirmation of containment (barriers)
- TLMUK already had Wellbore Schematics, Completion schematics and use Handover certificates to fully describe all barriers and their status – Well Barrier Schematics may not represent the whole story nor current status

Norwegian Petroleum Safety Authority - Well control and well integrity 29.01.2008

Well barriers are to prevent unintended influx (kick), cross-flow and outflow to the external environment.

The primary well barrier is the first obstacle against undesirable flow from the source. The secondary well barrier prevents further unwanted flow should the primary well barrier fail.
2. SINGLE BARRIER CONTAINMENT

During normal operation of a well a single physical barrier may be relied upon to provide fluid or pressure containment. A monitored fluid column, adaptor spool, Xmas Tree Body, Instrument Gauge or other single component may be the primary and only containment barrier. For significant periods of the well life-cycle, pressure containment may be reliant upon various single components.

The provision of double or multiple barriers or multiple redundant barriers may relate to concern over potential failure of certain types of single barrier. Reasons for having secondary barriers may include:

- Failure of a barrier in an emergency situation requiring either protection of the failed barrier or secondary containment.
- The need to achieve a leak-tight ‘combination barrier’ especially of valves for isolation purposes.
- Providing a second barrier for the purpose of confirming absence of leakage or verification testing of the primary barrier.
- Barrier designs where ongoing verification of the primary barrier / seals is not possible – secondary or tertiary barrier components being provided as insurance / back-up.

3. REQUIREMENTS FOR DOUBLE BARRIERS

The generally accepted oilfield practice is to provide as a minimum two-barrier isolation between the reservoir and all outlets from the Xmas tree / Wellhead and other formations through which the wellbore passes.

This practice is particularly important for non-routine well work or for valve repair work when the level of well isolation required must be clearly defined and carefully controlled.

Whilst it is generally accepted that a two-barrier system provides for safe operations, it is important to note that:

- This is not legally binding.
- It is based on the assumption that a well can sustain natural flow to surface.
- During normal operation of a well, surface containment of well fluids is reliant upon the Xmas tree body (and associated seals and spools) as a single barrier.
4. WELLS GROUP REQUIREMENTS FOR BARRIER INTEGRITY

4.1 Acceptance of a Single Barrier for Intervention Activities

5. TYPES OF BARRIER

5.1 Drilling, 5.2 Well Testing & DST, 5.3 Completion & Workover, 5.4 Well Operation, 5.5 Intervention Equipment, 5.7 Pumping Operations, 5.8 Suspension & Abandonment

6. CATEGORIES OF WELL RISK POTENTIAL

6.1 Risk Categories and Degree of Protection

6.2 Subsea Wells

7. CONFIRMATION OF BARRIER INTEGRITY

7.1 Barrier Integrity Test Procedures

7.2 Confirming Barrier Integrity

7.3 Test Failure

7.4 Barrier Leak Rate Acceptance Criteria

7.5 Inspection & Monitoring

7.6 Leakage from Subsea Wells

8. LOSS OF BARRIER INTEGRITY OF THE 5 SAFETY CRITICAL ELEMENTS

9. DISPENSATION FROM BARRIER PHILOSOPHY
Barrier Philosophy is part of Well Integrity Management Process which includes procedures on; Well Examination, Well Verification, Monitoring, Pressure Testing and procedures for the management of the five well Safety Critical Elements:

- Xmas tree Integrity
- Wellhead Integrity
- Annulus Integrity
- Down Hole Safety Valve Integrity
- Well Intervention Equipment Integrity

There is also an interface (potential conflict of concepts!) with installation procedures:

- Mechanical Isolation
- Breaking Containment
- Pressure Testing

And the ‘ Permit to Work’ ISSOW processes – which are open to varying interpretation by different asset teams / individuals!

Many ‘issues’ relating to operational well containment occur during interventions

Well Control is separate!
Talk 2 – Well Valve Leak Rate Acceptance Criteria

Potential for a standard for **Operational** Tree & wellhead valve testing / verification acceptance criterion? A field Proven Method.

- Talisman use 2cc per min per inch of valve leak criteria for verification testing of all Xmas Tree and Wellhead valves.
- Talisman has 12 years quantitative data using this acceptance criteria. This data allows direct comparison of;
  - Effectiveness of maintenance.
  - Reliability of equipment by component, position on well, manufacturer, Well conditions, comparison between assets.
- 40 times more stringent than API RP14B (ALARP)
- Once understood by maintenance & testing personnel, provides clarity of interpretation of a measured pressure change / leak rate
- Time testing a complete well can be shorter
- Talisman experience of 5000 valve tests per year indicates that valves tested to this criterion can usually be relied on to provide a leak-tight barrier when required for intervention purposes.
Talk 2 - API 14B for tree / wellhead valves?
Xmas Tree Valves Acceptance Criteria:

Table 6 gives the acceptance criteria for the maximum allowable pressure change for the XT valves. The values are the increase or decrease in pressure measured in psi over a ten minute period.

### Table 6: Pressure change Acceptance Criteria for XT Valves

<table>
<thead>
<tr>
<th></th>
<th>Gas</th>
<th>Oil</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>FWV (Inflow)</td>
<td>11 psi</td>
<td>11 psi</td>
<td>53 psi</td>
</tr>
<tr>
<td>FWV (Water inj. Inflow)</td>
<td>553 psi</td>
<td>550 psi</td>
<td>2658 psi</td>
</tr>
<tr>
<td>UMV</td>
<td>553 psi</td>
<td>550 psi</td>
<td>2658 psi</td>
</tr>
<tr>
<td>LMV</td>
<td>453 psi</td>
<td>451 psi</td>
<td>2103 psi</td>
</tr>
<tr>
<td>SV</td>
<td>1335 psi</td>
<td>1328 psi</td>
<td>6199 psi</td>
</tr>
<tr>
<td>KWV</td>
<td>3381 psi</td>
<td>3365 psi</td>
<td>15705 psi</td>
</tr>
</tbody>
</table>

Acceptable Pressure Build Up Calculation

Insert following data to calculate PBU

**Valve Bore**: 2.0625 inches

**Enclosed Volume**: 0.006 cubic feet

**Test Duration**: 10 minutes

### Maximum Acceptable Pressure Build Up

<table>
<thead>
<tr>
<th></th>
<th>Talisman Oil</th>
<th>Talisman Water</th>
<th>Talisman Gas</th>
<th>API 14b Oil</th>
<th>API 14b Water</th>
<th>API 14b Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure (psi)</td>
<td>17353</td>
<td>553</td>
<td>3381</td>
<td>1682667</td>
<td>7852375</td>
<td>3675000</td>
</tr>
<tr>
<td>Pressure (Bar)</td>
<td>1180.4</td>
<td>550.8</td>
<td>1185.9</td>
<td>5508.7</td>
<td>2658</td>
<td>534175.2</td>
</tr>
</tbody>
</table>

### Volume Conversions

- 1 m³ = 6.290 bbl = 35.315 cubic ft
- 0.001 bbl = 0.000 m³ = 0.006 cubic ft
- 1 cubic ft = 0.178 bbl = 0.028 m³
Talk 2 – TLMUK Valve Testing Findings

A total of 3729 valve are tests per year applying the Talisman criteria. The results of these tests can be reviewed by valve location, and shows both the ‘As Found’ and ‘Post Service’ failure rates. Applying the Talisman leak criteria, approximately 10% of all well valves failed the ‘As Found’ test, and 3% continued to fail ‘Post Service’.

![Graph showing total number of valves tested during 2008]
Talk 2 – TLMUK Valve Testing Findings

Xmas Valves tested during 2008

<table>
<thead>
<tr>
<th>Offshore Asset</th>
<th>Total Tested</th>
<th>Failed as found</th>
<th>Failed post service</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>140</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>B</td>
<td>145</td>
<td>28</td>
<td>6</td>
</tr>
<tr>
<td>C</td>
<td>350</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>D</td>
<td>130</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>E</td>
<td>190</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>F</td>
<td>194</td>
<td>38</td>
<td>14</td>
</tr>
<tr>
<td>G</td>
<td>401</td>
<td>1917</td>
<td>3</td>
</tr>
<tr>
<td>H</td>
<td>108</td>
<td>39</td>
<td>3</td>
</tr>
<tr>
<td>I</td>
<td>356</td>
<td>44</td>
<td>3</td>
</tr>
</tbody>
</table>
Apart from API RP 14B, which applies to DHSV, there is no standard leak rate criterion for tree and wellhead valves in operational service. API Standards relating to manufactured valve testing are not adopted for field testing of valves.

Talisman UK leak rate acceptance criteria of 2 cc/min/inch (0.35 scf/min/inch for gas) proven in use for all tree and wellhead integrity verification testing.

This criterion provides a consistent basis for testing a wide range of valve types / configurations under varying well conditions across all TLMUK assets.

TLMUK have a history of consistent testing which provides evidence for valve integrity issues (by site, service, manufacturer) and the efficacy of valve maintenance.

Operationally, the test criterion also ensures that the valves are maintained with a low leak rate – with the benefit of more easily
Talk 3 - DHSV Control Line Hydrocarbon Ingress

6 monthly PMR routines include verification of DHSV and control lines

25 wells have been shown to have hydrocarbon ingress into DHSV / ASV control lines

**Concerns** with Hydrocarbon Ingress:
- Contamination of the ESD system and potential gas release from open hydraulic fluid system
- Equalise the pressure in the DHSV control line and re-open the DHSV
- Early indication of potential operational failure of DHSV

**Response** - Dispensation with Platform standing instructions to shut wellhead Control Line Isolation valve during well shut down

**Remediation** – several options (Insert valve, install swellables, modify hydraulics, workover) but need to assess leak risk
The Leak Metering System is a portable and integrated system for high pressure leak metering in accordance with API RP 14B or similar criteria. The system provides:

- Origin of leaks (compositional analysis)
- Direct measurement of leak rates
- Depth of leaks and leak path (acoustic)
- Wireless wellhead monitoring (wireless)
Establish volumetric leak rate

Leak rates are measured by controlling the differential pressure across the leak point. The measurement is recorded for both the gas or liquid leaks allowing it to be quantified.

The unit is connected to the well via a ½” BSP hose. All internal lines within the unit are ½” bore. The outlet of the unit can be connected to closed drain on the rig or vented via other means.

- Wireless pressure measurements (up to 50 sensors)
- Direct measurement of the leak rate – Two flow paths
  - Small leaks from 0.1 to 30 SCF/min
  - Larger leaks from 3-300 SCF/min  
  Catchpot to measure liquid leak rate and fluid ‘quality’
- Measure flowing density, temperature and volumes.
- Accuracy ±/− 0.1%
- Operating limitations: 5000psi / 200°C
- Can also be used for conventional pressure buildup analysis
Talk 3 – DHSV CL Leak Measurement Plan

- LMS system will allow us to understand the leak rates and potential leak paths
- Provides quantitative data to determine severity of leak and potential deterioration with time?
- Field trial on Saltire (five DHSV & ASV) finished 21\textsuperscript{st} January 2011. Do not have leak measurement data, test durations and gas composition analysis yet. Preliminary indications are that leak rates are all low – much less than API 14B
- Will extend trial to cover all wells with DHSV Control Line ingress during 2011 PMR Campaigns
- On the basis of findings a plan of appropriate remediation for each well or control system will be developed