Standardisation of Well Completion Designs for Statoil wells on the NCS

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Agenda

• -Why was this process started
• -Why is it important
• -What has transpired in the process
• -What has been defined as the standardized well designs
  • -Casing
  • -Upper completion
  • -Lower Completion
• -How has the implementation been executed
• -The service companies role
• -Where are we now and what do we strive to achieve
• -Q&A
Upper Completion Pre-standardisation snapshot – as was

• Statoil was building of huge inventory of completion equipment at the end of 2013
• Delivery times were long
• Low degree of interchangeability between licences
• Had a huge number of items in SAP per main Contractor and very high numbers for the smaller contractors
• A large number of different well completion designs were used
• Very low degree of standardisation in upper, lower nor middle completions across licences
• Unsufficient control of items used or ordered
• Learnings from failures were not always easily translatable for use across the licences - Hence learning curves were sub-optimal
What was done?

- The Contracts were re-tendered
- Made the back-up equipment the contractor responsibility to ensure alignment in the standardisation process
- Usable inventory has been and is being deployed in 2014 & 2015
- Introduced availability fee & installation fee
- Significantly improved lead times has been achieved
- The wireline insert valves, lock open manipulation tools, running and pulling tools will be retained and a model for maintenance is being set up
What is a completion?

• A simplified approach
Well Completion Concepts

Cement Liner

Oil

Courtesy of Baker Hughes
Well Completion Concepts

Perforate Liner

Oil

Courtesy of Baker Hughes
Well Completion Concepts

Install Wellhead

Run Upper Completion

Oil

Courtesy of Baker Hughes
Well Completion Concepts

Add DH P&T Monitoring
Well Completion Concepts

Add Annulus Safety Valve

Add SPMs for Gas Lift
Well Completion Concepts

Add Chemical Injection

Oil

Courtesy of Baker Hughes
Well Completion Concepts

Add gas cap gas lift

Courtesy of Baker Hughes.
Well Completion Concepts

Run Whipstock and Seal Bore Diverter

Oil

Oil

Courtesy of Baker Hughes
Well Completion Concepts

Run Whipstock and Seal Bore Diverter

Drill Lateral Wellbore
Well Completion Concepts

Install Wellhead

Install Upper Completion
Well concept standardisation

- GL3519 Cementing
- GL3513 Guidelines-Directional drilling
- GL2385 Well completion products and services
- TR3596 Standard well designs for NCS
- GL3509 Casing, liner and tie back design work
- GL3518 Drilling fluids, reservoir drill-in fluids and total fluid management
- GL3512 Down hole mechanical isolation
Simplification and Standardization
Recommended standard casing design

- 30”/36”
- 20”
- 13 3/8”
- 9 5/8”

Lower completion

- 30”/36”
- 20”
- 13 3/8”
- 9 5/8” x 10 ¼”

Lower completion

- 30”/36”
- 20”
- 9 5/8” (Alt 10 3/4”) tie-back
  - Tie-back anchor
- 13 3/8”
- 9 5/8”

Lower completion

Classifiction

2014-11-24
What is new with Casing/Tubing Standard list?

• The new standard list is mainly focused on
  - cost and time efficiency program initiated by STEP

• New standard list contains:
  • Low cost and high cost material
  • More standardized choice of intermediate and production casings

• Start design with low cost and weight materials
  • Business case will be needed for upgrading to high cost materials
How do we utilize Standard list?

- How can we be cost efficient with all regulations and requirements?
  - We need to focus on
    - Are we designing our wells based on realistic well life period?
    - Are all requirements applicable to my well?
    - Are casing wear simulations realistic?
    - Do we need all completion jewelries (7” GLV or Chemical injection valve)?
    - Design of wells vs verification of wells?
    - Over design wells? Pressure testing with higher MW?

- Result
  - Significant positive impact on financial cost for casing and tubing (stock turn over approximately 1.8 per year)
Lower & Middle Completion Standardisation

• Lower completions have been standardised by;
  − Use of standardised liner hanger selections
  − Standardising sand screen selections available (From 60 to 11)
  − Open hole screen solutions (with swell packers/ICDs/AICDs)
  − Expandable screen solution qualified and field implemented
  − Gravel packed screen solutions (with swell packers/ICDs/AICDs)
  − Cemented and perforated casing solutions

• Middle completions, work have commenced to try to negate these, by:
  − Investigating solutions which allows circulation whilst RIH and leaving a barrier plug intact in the lower completion – need sleeves & communication solutions
  − Use of disappearing barrier plugs – but ensure the well is cleaned out properly and avoid fill!
Completion snapshot – as is

• Now - New contracts
  • Standardised equipment lists per licence, only the needed 20-80 items per licence is available dependant on well designs used
  • Reduced cost for all
  • Stock turn-over is greatly increased
  • Only +/-200 items active in SAP for each of the main completion equipment providers
  • All licences have a standardised list of available equipment controlled through Contracts Team and Senior Vice President D&W approval of any change
CSD library have been created of the 9 standardised well designs
• The total alternatives are now 6 for the Statoil concept bare-bone approach
• The schematics was implemented in GL2385 issued 03.07.15
• The designs have been verified against intervention and revised casing designs
• Can be pre-viewed in computer program CSD under test fields on Statoil computers
### Upper Completion overview per field

<table>
<thead>
<tr>
<th>Standardisert brøndesign</th>
<th>P1</th>
<th>P2</th>
<th>P3</th>
<th>I1</th>
<th>I2</th>
<th>I3</th>
<th>H1</th>
<th>H2</th>
<th>H3</th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
<th>A4</th>
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<tbody>
<tr>
<td>Well design</td>
<td>7” in 10</td>
<td>5 1/2” in 9</td>
<td>7” in 9</td>
<td>5 1/2” in 9</td>
<td>7” in 9</td>
<td>5 1/2” in 9</td>
<td>7” in 10</td>
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<tr>
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<td>Prod</td>
<td>Prod</td>
<td>Inj</td>
<td>Inj</td>
<td>Inj</td>
<td>HPHT</td>
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<td>Advanced</td>
<td>Producer</td>
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<td>Grane</td>
<td>Oseberg B</td>
<td>Oseberg C</td>
<td>Oseberg Sør</td>
<td>Oseberg Øst</td>
<td>GSO</td>
<td>Gudrun</td>
<td>Valemon</td>
<td>Kvittebjørn</td>
<td>Morvin</td>
<td>Kristin</td>
<td>Fast Track</td>
<td>Snorre A</td>
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<td>Baker Hughes</td>
<td>Åsgaard</td>
<td>Tyrifjord</td>
<td>Visund</td>
<td>Snøhvit</td>
<td>Statfjord</td>
<td>Smørbukk/Sør/Midgard</td>
<td>Brage</td>
<td>Tordis</td>
<td>Vigidis</td>
<td>Gullfaks</td>
<td>Veslefrikk</td>
<td>Troll SS</td>
<td>Nome (incl Alve, Skuld)</td>
</tr>
</tbody>
</table>

- **Planned use**
- **Contingency 1**
Materials

• TR3596 which describes casing and material standards - challenge materials used, but
  - Completion equipment shall remain standardised on 13% chrome (producers) or high alloy (injectors/HPHT)
Defined exceptions to Standardisation

- Deep set TRSV for Aasta Hansteen
- WRSVs (wireline retrievable valves) for Statfjord
- Special TLP related equipment (Hang off devices, expansion joints, etc)
- ESP (Electrical submersible pump) wells
  - TRSV as production wells, all other equipment is specialised (packer, fluid loss valves, Y-tool, ESP system)
- IGLS (Inverted gas lift) is highly specialised at the wellhead and TRSV
Wrap up

• It is important to both the vendors and Statoil that all are loyal to the standardisation process
• Keep the targets in mind at all times
• Control purchases outside dedicated SAP lists
• Questions?