Challenging Inspections of Offshore Pipelines by Intelligent Pig

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Introduction

Shell UK have completed many pipeline inspections as part of their ongoing Pipeline Integrity Management System (PIMS).

A number of these can be considered routine, but many can be considered as falling into the category “Difficult to Pig”, the focus of this presentation.

- The “Pipeline Integrity Project (PIP)” was formed to bring together a team to execute a number of these pipelines that had Inspection Due Dates (IDD) falling in close succession, all of which needed an element of subsea intervention.
PIP Basis for Inspection

Shell use a Risk Based Inspection (RBI) process to generate an appropriate Inspection Due Date.

Over the span of the PIP, 10 individual pipelines have been considered with IDDs covering a few years. The final result was the inspection of 6 of these pipelines.

Givens:

- Quality inspection data delivered without harm to people or the environment.
- System to be left in the same condition as found ready for flawless start up by the Asset.
PIP Workscope

The pipelines that were inspected by the PIP were:

**Bittern, 2 x 10”, 1 x 8”, 22km.**
Subsea to Subsea

**Howe, 8”, PiP, 14km.**
Subsea to Subsea

**Penguins, to follow......**
Penguins to Brent C Field Layout

16" PIPELINE
10" PIPELINE

DC2
DC3
DC4
DC5
SSIV

Penguins Data

<table>
<thead>
<tr>
<th>Property</th>
<th>DC2-DC3</th>
<th>DC3-DC4</th>
<th>DC4-DC5</th>
<th>DC5-BRENT C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Diameter</td>
<td>10&quot;</td>
<td>16&quot;</td>
<td>16&quot;</td>
<td>16&quot;</td>
</tr>
<tr>
<td>Length</td>
<td>3.6</td>
<td>5.7</td>
<td>4.8</td>
<td>52.1</td>
</tr>
<tr>
<td>Service</td>
<td>Multiphase Oil</td>
<td></td>
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Inspection Philosophy

- Integrated Project with the Asset and Project Team.
- Utilise the previous vendors and USC team for continuity.
- Maximum Debris Assessment, Corrosion Products, sand & wax.
- Wax deposition modelling.
- Tool selection for best data.
- Progressive pigging.
- Re-start pre-commissioning.
- Incorporate previous lessons learned from Bittern and Howe.
- Wet store campaign in 2015 to assisting in the proposed winter pigging campaign w.r.t over boarding in swell limitations.
- Upfront testing of Brent C receiver for ops.
- Load receiving cassette.
- Execution delayed to align with TAR & reduce deferment.
Tool Technology Selection

- Quality data was the primary objective for the PIP.
- Evaluate all primary inspection technologies, UT, MFL, SIC, DMR.
- UT – Best Primary technology but requires high levels of cleanliness.
- MFL – Acceptable technology, influence by pipe in pipe, heavy wall thickness.
- SIC – only good for internal corrosion defects. Secondary technique.
- DMR – Secondary technology for internal wall information only.
- Shell Framework agreement options were: UT – MFL – SIC – Combo.
- UT-MFL combo selected to give the best chance of quality data in a single run.
Isolation and Construction

- Verified SSIV open and closing
- Isolate and test all 4 drill centres
- Significant topside package for debris handling
- Installation of spoolpieces
- Installation of signallers
  - Mechanical & magnetic
De-oiling and Cleaning

- De-oil 10” into 16” using 10” pathfinder pigs
- De-oil 16” to Brent C process using gel pigs
- Switch to temporary debris handling package
- Run debris pick up gel
- Load chemical soak train
- Clean 10” & Inspect 10”
- Run 16” pathfinders
- Clean 16” & Inspect 16”
De-watering & Restart

- 10” dewatering completed with MEG/Water mix supplied from the DSV.
- 16” dewatering completed with a pig train left in pipeline.
- Platform successfully re-started the Penguins Field following completion of the turnaround.
Inspection Results

Both 16” & 10” Pipelines in excellent conditions with no internal corrosion. There were a number of mill anomalies, weld anomalies and laminations.

Previous inspections from the PIP on the other pipelines had revealed both pipelines in pristine condition and those that were in a worse condition with many defects of differing corrosion types.

No pipeline was exactly in the condition predicted.

FIND WHAT YOU INSPECT NOT WHAT YOU EXPECT!
Lessons Learned - Examples

- Swapped out Flange connection to ROV destec connection on the 16” PLR, HSE and schedule advantages.
- Even the latest 4G communication system may have comms problems, back ups worked.
- Awareness of platform personnel operation roles (they have a day job as well).
- FAT/ SIT including loading/ unloading, pumping, signalling may prove very useful as much of this equipment is still not 100% reliable or compatible.
- Industrial action, weather, flight delays, cranes etc. can all trip you up.
- DSV held IRM work incase of platform based delays.
- Planning flexibility – worked with TAR, Flotel, Rig activation, P&L campaign.
- Use all steps to gain data on pipeline condition, visual, equipment gauges, historical databooks, the more knowledge you have, the better armed you are.
The Pipeline Integrity Project successfully completed 3 inspection campaigns, safely, on time and on budget.

Looking back over 5 years of work, we had an initial plan to do on a campaign style over two years, doing one pipeline after another. Even with the dedicated multi-discipline team the subsea aspects of the scope deemed this impossible without a significantly larger team. Never be afraid to take a step back and re-evaluate to ensure you deliver the promises you make.

The additional complexity of including a subsea launch or receive aspect should not be underestimated.

Need to be supported from the top down and bottom up, ONE TEAM.

Early heads up and engagement with any Partners is essential.

Although inspecting these pipelines is difficult and expensive, it was considerably cheaper than replacement.