Overview

• Introduction to Petrofac Late Life Asset Management & Decommissioning Solutions

• Horne & Wren: Rig-less NUI Well P&A
  – Summary of Petrofac Well Engineering Work Scope for Horne & Wren Wells P&A
  – Review of Wells Project Performance and Recommendations
  – Well P&A Activities vs Approach: What did we do and how?
  – Who stole my derrick? Working without a derrick – what is different?
  – Would we change our approach in the future? – What are the drivers for vessel selection?

• Alternative approaches to Well P&A in other projects
New approaches

Mature basins require new service sets and approaches; as the project phase evolves, so too does the focus. Early engagement is key to optimising the planning and execution of decommissioning services.
Late Life Asset Management and decommissioning services

- STuDIES
- ENGINEERING
- WELL ENGINEERING
- OPTIMISATION
- DUTY HOLDER
- OPERATIONS AND MAINTENANCE
- LATE LIFE ASSET MANAGEMENT

- DECONSTRUCTION
- HLV MANAGEMENT
- VERIFICATION
- PROJECT MANAGEMENT
- SUPPLY CHAIN MANAGEMENT
- DISPOSAL MANAGEMENT
- PLUG AND ABANDONMENT
- DECOMMISSIONING
Track record

Currently providing:

• **Duty Holder in Decommissioning**, BP Miller (UKCS)

• **Asset management review**, Talisman Sinopec (UKCS)

• **Duty Holder** oversight, decommissioning, Tullow Horne and Wren (UKCS)

• **Late Life Asset Management (LLAM)**, ENI Hewett (UKCS)

• **Studies** – various (confidential)

Previous projects:

• **Well Plug and Abandon** campaign, Tullow Horne and Wren (UKCS)

• **Hutton TLP topsides separation** project, Conoco (UKCS)

• **AH001FPU decommissioning** project, Ithaca/Petrofac (UKCS)

• **Bacton Gas Terminal decommissioning**, ENI (Onshore, UK)

• **Decommissioning Cost Estimates**, multiple, confidential (Europe and Africa)
HORNE & WREN:
Rig-less NUI well P&A
THOUGHT MOMENT...
What seems simple from afar...
IS NOT SO SIMPLE UP CLOSE …

Challenges included:
• Multiple service requirement
• Congested decks
• No derrick

We addressed these challenges, met our objectives and delivered 58 incident-free days.
WELLS WORK SCOPE & PERFORMANCE
Petrofac well engineering work scope

Timeline

End 2015 Tender Process Started
End Feb 2016: PM Contract Award
March 2016: Start P&A Planning
June 2016: Commence P&A Operations
August 2016: Well P&A Completed
October 2016: End of Well Review Phase Completed

3 months of P&A planning, review and permitting
Readiness Review & Project Safety Day
68 days of operations
Using our project delivery tool, WellAtlas® we were able to drive project schedule and efficiencies through its ability to integrate 14 key project elements including:

- Plans
- Actions
- Risks
- Lessons learned
- Critical information
- Assurance reviews
- Approvals
How did we do?

<table>
<thead>
<tr>
<th>KPI</th>
<th>TARGET / ACTUAL</th>
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<tbody>
<tr>
<td>LTI’s</td>
<td>0 / 0</td>
</tr>
<tr>
<td>Recordable Incidents</td>
<td>0 / 0</td>
</tr>
<tr>
<td>Spills</td>
<td>0 / 0</td>
</tr>
<tr>
<td>Loss of primary containment</td>
<td>0 / 0</td>
</tr>
<tr>
<td>Fines</td>
<td>0 / 0</td>
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Accrued WOW 2%
Accrued NPT 26%
(SNS offsets)

WHAT TOOK LONGER THAN PLANNED?
- Waiting on Weather due to tall main crane boom height (100m weather) and drive on currents preventing PSV work
- Critical Path Scaffolding
- Interface activities between barge and platform and platform preparation
- First Well Activities: Deep Plugs 44% time improvement on Well 2

WELL P&A COST (GBP)

<table>
<thead>
<tr>
<th>WELL P&amp;A COST (GBP)</th>
<th>£3.0M – £7.0M</th>
</tr>
</thead>
<tbody>
<tr>
<td>OGUUK 2015* for SNS Platform Wells</td>
<td></td>
</tr>
<tr>
<td>Horne</td>
<td>£2.9M**</td>
</tr>
<tr>
<td>Wren</td>
<td>£3.5M**</td>
</tr>
</tbody>
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$2.5 M COST SAVED

<table>
<thead>
<tr>
<th>$2.5 M COST SAVED</th>
<th>after additional barge productive time included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barge vs Rig: $1.4M USD saved</td>
<td></td>
</tr>
<tr>
<td>Casing removal with barge vs HLV: $0.65M USD saved</td>
<td></td>
</tr>
<tr>
<td>Pre-RD&amp;D activities as a SIMOP: $0.40M USD</td>
<td></td>
</tr>
</tbody>
</table>

** Horne & Wren well costs are fully inclusive of all mob and demob and NPT for a two well campaign plus pre-RD&D activities

* Oil & Gas UK Decommissioning Insight Report 2015: Average to Upper Range of Platform Well P&A costs for all Southern North Sea and Irish Sea Platform Wells
Our performance

• EHS assurance role during the planning phase
• Good quality EHS and operations inductions for all personnel
• Good shared understanding of control of work tools and processes
• Prompt After Action Reviews and implementation of lessons and optimisations into the next wells activity
• Multi-discipline service company personnel
• Wellsite EHS Advisors: Positive energy reaching all crew members embedding the “one team” culture
  – Leading on hazard hunt activities – excellent initiative and a fresh perspective that focussed the crews and supported enhanced HazOb system participation
  – Leading on delivery of key EHS messages to the crew: Barrier policy, PPE, Platform POB management, Housekeeping
  – Daily EHS Report focussed discussion on key topics at regular meetings
  – Daily Permit Audits
• Leading & Lagging indicator tracking – Trend monitoring, provides focus to proactive efforts and able to identify key areas of EHS activity that are receiving less attention
• Regular visits by onshore management team to the location
WELL P&A ACTIVITIES VS APPROACH

How did we do it?
Horne Well

Fluids
- 5 ½” Tubing – Seawater
- A Ann – 9.5ppg Brine
- B Ann – 10 ppg OBM

Zones of Interest
- Leman Sandstone
  HC gas bearing normally pressured
- Bunter Sandstone & Cretaceous Chalk
  Water bearing normally pressured

Verification
Plug 2: Single Barrier
- Cement Plug Tagged (631ft MD barrier)
- Cement Plug Pressure Tested (500psi above FG)
- Bridge plug tagged and pressure tested
- Annulus cement verified during construction

Plug 1: Combination Barrier
- Cement Plug Tagged (860ft MD barrier)
- No losses during cementing
- Bridge plug tagged and pressure tested
- Annulus cement verified during construction
Wren Well

Zones of Interest
- **Leman Sandstone**
  - HC gas bearing normally pressured
- **Bunter Sandstone and Cretaceous Chalk**
  - Water bearing normally pressured

**Verification**

**Plug 2: Single Barrier**
- Cement Plug Tagged (731ft MD barrier)
- Cement Plug Pressure Tested (500psi above FG)
- Bridge plug tagged and pressure tested
- Annulus cement verified during construction

**Plug 1: Combination Barrier**
- Cement Plug Pressure Tested (1020ft MD barrier)
- No losses during cementing
- Bridge plug tagged NOT pressure tested
- Annulus cement verified during construction
# How did we do each well activity?

<table>
<thead>
<tr>
<th>WELL ACTIVITY</th>
<th>WELL SERVICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep Set Plug Setting</td>
<td>Slick-line suspension plug recovery, set bridge plug’s. Coiled Tubing cementing Surface Tank Farm Surface Venting Package</td>
</tr>
<tr>
<td>Tubing Severance</td>
<td>Slick-line, Jet cutter</td>
</tr>
<tr>
<td>Tubing Recovery</td>
<td>Tension table and starter jacks, Crane and side door elevators, Band saw, Laydown rack with kick over plate</td>
</tr>
<tr>
<td>Shallow Set Plug</td>
<td>Slick-line, 9 5/8” BP, perforation guns, Surface Tank Farm, Surface Venting Package, Coiled tubing cementing Slick-line tagging TOC</td>
</tr>
<tr>
<td>Multi-String Casing</td>
<td>Multi string (4) Abrasive cutter, Tension table and starter jacks, Drill and pin unit, Band saw, Crane and dedicated sling set (Limited platform load), Laydown bucket</td>
</tr>
</tbody>
</table>
WHO STOLE MY DERRICK?

Working without a derrick – what is different?
## Differences between Rig and Rig-less P&A?

<table>
<thead>
<tr>
<th>DIFFERENCE</th>
<th>LEARNING</th>
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<tbody>
<tr>
<td>Sea Fastening</td>
<td>Time consuming activity if welding is required: best avoided if the balance of risk recommends to do so e.g. heavy lifts, poor weather forecast</td>
</tr>
<tr>
<td>No rig floor</td>
<td>Extensive scaffolding required around the platform top deck which is time consuming</td>
</tr>
<tr>
<td>Manning Levels</td>
<td>Deck crew only, no drill crew to re-assign to assist services. Multi-skilled service crews are an important resource for barge operations.</td>
</tr>
<tr>
<td>Vertical to Horizontal</td>
<td>No V door, require kick over rack and swivel bucket to lay down recovered tubulars</td>
</tr>
<tr>
<td>Incidental Services</td>
<td>Ad Hoc welding, Drill floor tools, Dunnage</td>
</tr>
<tr>
<td>Tanks not pits</td>
<td>Less functionality for separating, recirculation, and supplying the on-board fluids</td>
</tr>
<tr>
<td>Deck Management – Multiple Services</td>
<td>JULB not as familiar with service change out. More used to load – sail – deploy – return</td>
</tr>
<tr>
<td>Approach to critical path</td>
<td>JULB less attuned to offline preparation</td>
</tr>
<tr>
<td>Primary Crane</td>
<td>Slow compared to draw-works</td>
</tr>
<tr>
<td>Crane Operators</td>
<td>Less familiar and less efficient with multiple loading and offloading of PSV</td>
</tr>
</tbody>
</table>
Would we change our approach in future?

What are the drivers for Barge vs Rig vessel selection?

<table>
<thead>
<tr>
<th>DRIVER</th>
<th>BARGE</th>
<th>RIG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rig Move Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A self propelled barge needs no tow vessel support. Lighter vessels have shorter pre-load and jacking times.</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>Operating Rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barges remain lower cost than jack-up rigs.</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>Crane Operations for Boat Work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High capacity cranes move more slowly and crew’s are less accustomed to high volume lifting activities.</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>Lots of Tubular Handling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A rig would provide more handling options for stands of pipe and contingencies, including torque capability.</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>Scaffolding Requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A rig would require fewer scaffolding towers to provide safe access to intervention equipment on the drill floor or top deck.</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>Rig-Up time per well</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Could be more efficient with the benefit of a drill floor.</td>
<td>–</td>
<td>+</td>
</tr>
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ALTERNATIVE APPROACHES TO WELL P&A:
Other projects
Alternative approaches to Well P&A: Other on-going projects

**UKCS**
- Abandonment of three subsea wells in the CNS with Petrofac Well Engineering as outsourced Well Operator

**Japan**
- Examining methods to abandon a problem well onshore Japan which has collapsed casing and annulus pressures

**Australia**
- Strategy for abandonment of two onshore wells in Western Australia to use coiled tubing to set the primary reservoir abandonment plug then a workover rig to cut and recover tubing and complete the abandonment operations. This will reduce cost as a rig can be mobilised for the drilling and abandonment phases at the same time

**New Zealand**
- Review of studies into the optimal method of decommissioning offshore subsea wells in New Zealand – recommendation is to use an intervention vessel rather than a rig
Alternative approaches to well P&A: Some interesting challenges

- Abandoning a well that was drilled in 1931 and therefore has no data
- Wells drilled and completed with fully un-cemented casing strings
- Wells that have been suspended with ‘wooden plugs’
- A well beside an airport runway – SIMOPS with Air Traffic Control!
- An old well that started leaking under a house
- An old abandoned well that is leaking and it is located in a warehouse basement
THANK YOU