ANADARKO PETROLEUM CORPORATION

2014-15 P&A PROGRAM
LESSONS LEARNED
DEEPWATER GOM

May 25, 2016
Agenda

- P&A Program Summary
- NPT (Non-Productive Time) Analysis
- Lessons Learned Analysis
- Conclusions
P&A Program Summary

- “Idle Iron Initiative” – 27 Deepwater GoM wells Plugged and Abandoned in 2014-15
- Over $650MM Gross Spend
- Varying Well Types, Well Conditions, Plugging Requirements and Vessels
  - Platform wells, Subsea wells, Exploration wells
  - Depleted Reserves, Expired Leases, Equipment Failures, Additional Work to Previously P&A’ed Wells
  - Platform Rigs, Intervention Vessels, Drillships (MODUs)
What Comprises a Deepwater P&A?

30 CFR 250.1715

1. Remove production tubing & accessories
2. Isolate producing intervals
   - Up to three intervals per well
   - Cement squeeze
3. Isolate annuli that are open to the mudline
   - Annular cement squeeze or cut and pull casing and cement plug
   - Up to Three annuli to be isolated, depending on well construction
4. Set surface cement plug
5. Remove subsea tree/ riser (dry tree wells)
2014-15 P&A Program

- **Types of P&As**
  - **Platform-Based Dry Tree** – Platform rig decompletion/ abandonment
  - **Subsea “Drive-By”** – Exploration wells requiring annular isolation and/or surface plugs to re-classify
  - **Subsea Full Decompletion/ Abandonment** – Removal of completion equipment, isolation of producing zones, annuli and surface plugs

- **Vessel Types**
  - Platform Rigs
  - Intervention Vessels
  - MODU
  - “Hybrid” – Intervention Vessel (Lower Abandonment) + MODU (Upper Abandonment)

- **Areas**
  - Independence Hub
  - Constitution
  - Neptune
  - Gunnison
  - Marco Polo (K2)
  - Nansen
  - Exploration Areas
P&A Summary – By Op/ Rig Type

P&A Breakdown by Type
- 4, 15%
- 8, 30%
- 15, 55%

Drive-by, Full, Platform

P&A Breakdown by Rig
- 4, 15%
- 5, 18%
- 7, 26%
- 11, 41%

Hybrid, Intervention Vessel, MODU, Platform

Average Duration, 2014-15 P&A Program

<table>
<thead>
<tr>
<th>Rig Type</th>
<th>Days</th>
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<tbody>
<tr>
<td>Hybrid</td>
<td>53.5</td>
</tr>
<tr>
<td>MODU</td>
<td>39.0</td>
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<tr>
<td>Platform (Full)</td>
<td>35.5</td>
</tr>
<tr>
<td>Intervention Vessel (Drive-by)</td>
<td>1.5</td>
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<tr>
<td>Intervention Vessel (Full)</td>
<td>41.6</td>
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NPT Data Collection

Why look at NPT?
- NPT is the result of an operation going “off-track,” whether for equipment failure, well issues, weather, or operational changes.
- Reducing NPT is key to reducing costs and becoming more efficient.
- Utilization of Time Codes – Z (Third Party,) X (Well-Related,) S (Unplanned,) W (Weather)

How Do We Track NPT?
- OpenWells primary source of NPT data, BUT phase codes and responsible parties are inconsistent and difficult to sum, lump into events, and summarize.
- Current Process for all completed jobs is for engineers to compile Post Job Reports where NPT events are summarized.
# NPT Summary

<table>
<thead>
<tr>
<th></th>
<th>Planned (P)</th>
<th>3rd Party Trouble (Z)</th>
<th>Well-Related Trouble (X)</th>
<th>Unplanned (S)</th>
<th>Weather (W)</th>
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<tbody>
<tr>
<td>Overall Completion Ops</td>
<td>69%</td>
<td>18%</td>
<td>8%</td>
<td>3%</td>
<td>2%</td>
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<tr>
<td>Overall P&amp;A</td>
<td>70%</td>
<td>19%</td>
<td>8%</td>
<td>2%</td>
<td>2%</td>
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<tr>
<td>Drive-By</td>
<td>78%</td>
<td>19%</td>
<td>3%</td>
<td>0%</td>
<td>0%</td>
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<tr>
<td>Full P&amp;A</td>
<td>64%</td>
<td>22%</td>
<td>12%</td>
<td>1%</td>
<td>1%</td>
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<tr>
<td>Platform</td>
<td>78%</td>
<td>6%</td>
<td>1%</td>
<td>9%</td>
<td>6%</td>
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<tr>
<td>Intervention Vessel</td>
<td>73%</td>
<td>17%</td>
<td>7%</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Hybrid</td>
<td>65%</td>
<td>25%</td>
<td>9%</td>
<td>0%</td>
<td>1%</td>
</tr>
<tr>
<td>MODU</td>
<td>69%</td>
<td>20%</td>
<td>9%</td>
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<tr>
<td>Platform</td>
<td>78%</td>
<td>6%</td>
<td>1%</td>
<td>9%</td>
<td>6%</td>
</tr>
</tbody>
</table>

**Compared against all operational average 2014-15**

1% reduction in NPT = Capex to D&C 1 Onshore Well at APC!
Relating NPT Events to Lessons Learned

- NPT events only identify problems that cost money or time
- What about identification of how to improve the next job?
- Post Job Reports also identify Lessons Learned
  - May or may not relate to an NPT event
  - Usually translate to a “Preferred Practice” or a refinement of a current “Preferred Practice”
- Identified need to relate each individual Post Job Report to the larger operation and compile into one database!
- 183 NPT events, 113 Lessons Learned compiled from 27 operations over 2 years
- All compiled data loaded into Spotfire as analysis tool
## Compiling Lessons Learned

### RESULT: Lessons Learned are now searchable across P&A operations!

<table>
<thead>
<tr>
<th>Observation</th>
<th>Description</th>
<th>Category</th>
<th>Major Equipment</th>
<th>Major Vendor</th>
<th>Short Summary</th>
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</thead>
<tbody>
<tr>
<td>1. Use of Heiks in P&amp;A operations</td>
<td>Lessons Learned are now searchable across P&amp;A operations!</td>
<td>P&amp;A Full Hybrid</td>
<td>HP Lab</td>
<td>QA, CO</td>
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**Frequency vs Impact Matrix**

- **Useda matrix to identify high value NPT/ LL**
  - Frequency – how often could the event happen?
  - Impact – what is the time/ cost severity of the event?
  - Modelled on Risk Management Matrices

- **Overall Factor = Frequency + Impact**
  - All events are ranked according to Overall Factor to identify critical events
  - Ex: Event happens once per year (3) + Impact of ~$4MM (4) = Overall Factor (7)

- **Events can also be positive**
  - Ex: Identified a safe way to test plugs while POOH, saving critical path time on every operation going forward

<table>
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<tr>
<th>Impact Factor</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>Frequency Factor</td>
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<td>3</td>
<td>4</td>
<td>5</td>
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<td>9</td>
<td>10</td>
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Ex: Event happens once per year (3) + Impact of ~$4MM (4) = Overall Factor (7)

Events can also be positive

Ex: Identified a safe way to test plugs while POOH, saving critical path time on every operation going forward
Top 10 Lessons Learned

1. “Bundling” P&As into a program yields many operational efficiencies.
2. Provide mechanical base for cement plugs when applicable (CIBP, HEC pill, etc.)
3. Lock out surface valves when running CT to prevent inadvertent cut of CT
4. Pump adequate cement to ensure all isolation requirements are met
5. Validate max circulating rates/pressures of setting tools
6. Optimize CT testing procedures to minimize critical path testing time
7. Reverse circulate cement out immediately above setting depth to prevent stray cement upheole
8. Ensure clear/known fluid weights when running TTICR (Through-Tubing Inflatable Cement Retainer)
9. Rig-related NPT drives overall NPT – well maintained rig and equipment is key
10. Ensure proper charge selection for annular squeezes, plan for contingency options
Next Steps – How to Improve?

- **Standardization of Post Job Reports**
  - Categorization of LL events w/ vendor, equipment
  - Separation of specific LL in PJR documents
  - Correlation to NPT event time/cost to track impact

- **OpenWells Tracking**
  - Improved consistency of operations coding
  - Implementation of P&A Phase Codes (similar to completion phase codes)
  - Utilization of Lessons Learned tracking tool in OW

- **Equipment/ Vendor Analyses**
  - Identify service trends/equipment limitations

- **Expand Analyses to Completion Operations**
THANK YOU!