Drilling Safety:
Off-Rig BOP Monitoring

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Drilling Safety: Off-Rig BOP Monitoring Today’s Technology and Beyond


- Summarize some of our experience over the last three years – lessons learned, feedback from users, etc.

- What’s possible in the future.
Technology Overview

Remotely Monitor the BOP Anytime, Anywhere
Both Current and Historical Status

Collect raw BOP Data from pressure switches, solenoids, pressure transducers and flow meters

Satellite Link

Internet Connection

Turn raw BOP data into useful Information made available via the Internet

Onshore Web Server

May 2012
Preventive Maintenance
Tracking Usage - Cycles

Cycle report for all valves associated with Opening and Closing the Upper Annular

Max Cycles Currently no good data, using 5000 as a placeholder

<table>
<thead>
<tr>
<th>Valve (#)</th>
<th>Function</th>
<th>Location</th>
<th>Current Cycles</th>
<th>Max Cycles</th>
<th>Percent Max Cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solenoid 4W2P (1)</td>
<td>Open</td>
<td>HPU</td>
<td>333</td>
<td>5000</td>
<td>6.66</td>
</tr>
<tr>
<td>Solenoid 4W2P (2)</td>
<td>Close</td>
<td>HPU</td>
<td>334</td>
<td>5000</td>
<td>6.68</td>
</tr>
<tr>
<td>Manipulator 4W3P (3)</td>
<td>Open/Block/Close</td>
<td>HPU</td>
<td>333</td>
<td>5000</td>
<td>6.66</td>
</tr>
<tr>
<td>SPM 4W2P (4)</td>
<td>Open</td>
<td>Blue Pod</td>
<td>224</td>
<td>5000</td>
<td>4.48</td>
</tr>
<tr>
<td>SPM 4W2P (5)</td>
<td>Close</td>
<td>Blue Pod</td>
<td>225</td>
<td>5000</td>
<td>4.5</td>
</tr>
<tr>
<td>SPM 4W2P (6)</td>
<td>Open</td>
<td>Yellow Pod</td>
<td>112</td>
<td>5000</td>
<td>2.24</td>
</tr>
<tr>
<td>SPM 4W2P (7)</td>
<td>Close</td>
<td>Yellow Pod</td>
<td>112</td>
<td>5000</td>
<td>2.24</td>
</tr>
<tr>
<td>Shuttle (8)</td>
<td>Open</td>
<td>BOP</td>
<td>331</td>
<td>5000</td>
<td>6.62</td>
</tr>
<tr>
<td>Shuttle (9)</td>
<td>Close</td>
<td>BOP</td>
<td>332</td>
<td>5000</td>
<td>6.64</td>
</tr>
</tbody>
</table>
Monitoring Operations
Tracking Operations, Providing Guidance

Detailed 24-hour summary of all major BOP functions

Color Coded to Tool Pusher’s Panel

May 2012
Control History - Partial Day

Select Date

Select Time

Scale

Select Controls to View

Current Date/Time
Nov 16, 2009
3:34 PM

24-Hour Window

May 2012
Monitoring Hydraulic Pressure

1-hour Window
Annular and Ram Functions

1-hour Window
Manifold Read-back Pressure
What is the technology?

• A Black Box
  – Yes. A tool for doing forensics after-the-fact.
• But more importantly it is a tool
  – To review and monitor drilling and safety equipment on a regular basis. Identify equipment problems before they become critical.
  – To review operational procedures on a regular basis.
• The goal is to improve operations and increase safety (and hopefully reduce the need for a Black Box).
Objectives of BOP Monitoring

• Move from time-based maintenance to cycle-based maintenance:
  – Determine the useful life of BOP components.
• Develop metrics to identify potential equipment problems:
  – Pressure and flow versus time profiles (signature).
• Monitoring is a three part problem:
  – Raw data acquisition and storage.
  – Raw data analysis to create useful information.
  – Present information in a simple common format.
All Rigs – Common Presentation

--- Satellite Link ---

Jackup Rigs 350 ft Water Depth
Surface BOP

Semi-submersible Rigs
3K to 5K ft Water Depth
Hydraulic BOP Control System

Drill-ship 5K-10K ft Water Depth
MUX BOP Control System

--- Internet Connection ---

Raw Data

Database
All Rig Information in a Common Format

Partial Day
Real-time

Convert
Rig Information to a Common Visual Presentation for all Rigs

Full Day
Historical Information

May 2012
Something for everyone - Driller, Operator, Regulator

- One person should be able to easily monitor multiple rigs on a regular basis.
  - *Operating Companies*: Oversee drilling and safety operations.
  - *Regulators*: Efficient utilization of manpower to insure adherence to regulatory requirements.
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