Drillpipe & Riser Lifecycle Management

Ted Christiansen, P.E.
Director, New Technology Development
Product and Service Development Team
DEA Forum, Houston, September 29, 2011

http://www.nov.com/sension
Customer Value

- **Optimize** and document the use of drillpipe and riser over its life
- Accurate inventory of drillpipe fleet at all times
- Powerful data mining...charting and analysis of characteristics, i.e. diameter vs. age, etc.
How we will deliver this value

- Robust tag and mounting
- Rig system
  - Antenna
  - Control system
    - Operator screen
    - Data logger
    - Communications
- Central database and web interface
  - Fatigue calculation
  - Regression modeling for predictive capability
  - Pipe fleet management
Robust drillpipe tag/mounting

- Tag retention and package design by NOV
- Extensive FEA stress analysis performed to insure structural integrity of tooljoint

Ted Christiansen, P.E.
July 5, 2011

http://www.nov.com/sension
Level 1 & 2 – Tag ID, Electronically

Tag ID scan by handheld

Tag ID laser engraved on back of...
Level 3 – DPM, Scanner Read

1” diameter x 0.030” stainless steel coin

Press fit into bottom of drillpipe tag pocket

Used for tag/pipe pairing:

1. Initial tag install
2. Tag replacement due to failure
3. Tag re-install after hardbanding
4. Tag re-install after pipe id coating

http://www.nov.com/sension
Level 4 – Handstamped Serial#
## Rig System - Read Range

Commercially available technologies do not meet requirements

<table>
<thead>
<tr>
<th>kHz (Inductive)</th>
<th>MHz (Inductive)</th>
<th>MHz (Radio)</th>
<th>GHz (Radio)</th>
<th>GHz (Radio)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LF 125 kHz</td>
<td>HF 13.56 MHz</td>
<td>UHF 915 MHz</td>
<td>2.4 GHz</td>
<td>5.8 GHz</td>
</tr>
<tr>
<td>Insufficient read range</td>
<td>Insufficient read range</td>
<td>Operating frequency too low</td>
<td>No chip available</td>
<td></td>
</tr>
</tbody>
</table>

- **Read Range Too Short for Automatic Reading**
- **No chip available**

- **Antenna shrinks with increase in frequency**

<table>
<thead>
<tr>
<th>½ Wave Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>47232 inches</td>
</tr>
<tr>
<td>435 inches</td>
</tr>
<tr>
<td>6 inches</td>
</tr>
<tr>
<td>2.45</td>
</tr>
<tr>
<td>1 inch</td>
</tr>
</tbody>
</table>
Rig System - Antenna

Purged junction box

http://www.nov.com/sension
Rig System - Interface

One company ... unlimited solutions

http://www.nov.com/sension

Ted Christiansen, P.E.
July 5, 2011
Rig System - Detail

Pipe Selection

Pipe Detail

Ready For Use

Asset Id: 4E67B8C0E-709F-4784-8EB2-0914D0F8B181
Description: 5 Inch Drillpipe
Serial Number: A8004074
Manufacturer: Grant Pride Co
Date of Manufacture: 04/20/2002
Pipe Range: II
Tube Density: 0.283
Total Weight: 768
Nominal Weight: 25.6
Class: PREMIUM
Upset: IEU
Connection Type: NC50

Drill Pipe Life Cycle Manager

Config Pipe Detail Time Data Charts Resume

SensiOn SensiOn SensiOn Alarms

NATIONAL OILWELL VARCO

http://www.nov.com/senson
Handheld: Rig, Yard, Inspection

**One company ... unlimited solutions**

http://www.nov.com/sension

Ted Christiansen, P.E.
July 5, 2011
System Architecture

Internet (Secure)

NOV Datacenter

Rig Handheld

Rig Interface

Drill Floor Reader

http://www.nov.com/sension
Database & Web Interface

Hosted system >> no software for customer to install

http://www.nov.com/sension
Database & Web Interface

One company ... unlimited solutions

http://www.nov.com/sension

Ted Christiansen, P.E.
July 5, 2011
### Database & Web Interface

#### Drill Pipe Detail

<table>
<thead>
<tr>
<th>Tag Id</th>
<th>Data Matrix Code</th>
<th>Description</th>
<th>Location</th>
<th>Original Cost</th>
<th>Current Value</th>
<th>Serial #</th>
<th>Manufacturer</th>
<th>Date of Manufacture</th>
<th>Age</th>
<th>Length</th>
<th>Total Weight</th>
<th>Nominal Weight</th>
<th>Current Class</th>
<th>Grade Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>100110921003190410051472</td>
<td>DBA6AD6-4628-45A5-8E64-79068737A357</td>
<td>2-3/8 Drillpipe</td>
<td>Colorado</td>
<td>$1150.00</td>
<td>$1102.00</td>
<td>A0001000</td>
<td>GrantPrideCo</td>
<td>1/1/2004</td>
<td>2637</td>
<td>27.000</td>
<td>199.5</td>
<td>6.650</td>
<td>PREMIUM</td>
<td>E, II</td>
</tr>
</tbody>
</table>

#### Usage

<table>
<thead>
<tr>
<th>Other</th>
<th>String Name</th>
<th>Tube OD</th>
<th>Tube ID</th>
<th>Tube Density</th>
<th>Upset</th>
<th>Tooljoints</th>
<th>Connection Type</th>
<th>Year</th>
<th>OD (New)</th>
<th>ID (New)</th>
<th>TDG</th>
<th>Length (Trog)</th>
<th>Length (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008-PD-To</td>
<td>Test</td>
<td>2.375</td>
<td>1.815</td>
<td>0.281</td>
<td>EU</td>
<td>NC26</td>
<td>4/4/2006</td>
<td>3.38</td>
<td>1.75</td>
<td>8.00</td>
<td>4/4/2005</td>
<td>3.38</td>
<td>1.75</td>
</tr>
</tbody>
</table>

#### Mechanical Properties

<table>
<thead>
<tr>
<th>Make/Break Count</th>
<th>Hours Tripping</th>
<th>Hours Drilling (Rotating)</th>
<th>Hours Drilling (Sideling)</th>
<th>Depth Drilled</th>
<th>Relative Cumulative Fatigue Damage 0-100</th>
<th>Yield Strength (Trog)</th>
<th>Yield Strength (USD)</th>
<th>Tendon Strength</th>
<th>Hardness</th>
<th>Fracture Toughness</th>
<th>Lower Limit</th>
<th>Stress Concentrator</th>
<th>Co</th>
<th>Mean Gamma</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>16.2</td>
<td>192.0</td>
<td>2.2</td>
<td>13,997</td>
<td>0.0</td>
<td>75.00</td>
<td>75.00</td>
<td>75.00</td>
<td>60.00</td>
<td>145.00</td>
<td>2.50</td>
<td>1.14</td>
<td></td>
<td>0.00000000021524</td>
</tr>
</tbody>
</table>

#### Change History (Last 5)

<table>
<thead>
<tr>
<th>Date</th>
<th>Changed By</th>
<th>Old Value</th>
<th>New Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/20/2010 6:25:47 PM</td>
<td>Ted Christiansen</td>
<td>TotalLength</td>
<td>30</td>
</tr>
<tr>
<td>8/20/2010 6:38:14 PM</td>
<td>Ted Christiansen</td>
<td>TotalLength</td>
<td>37</td>
</tr>
</tbody>
</table>

#### Hardband History

- Applied By: Ted Christiansen
- Applied On: 11/24/2010
- Hardband Type: 5
- Width: 3
- Thickness: 1
- Flush: 0
- Smooth Edge: 0
- Location: 0
- Cost Per Joint: $0.00

#### Wall Data History

No records found
Database & Web Interface

One company ... unlimited solutions

http://www.nov.com/sension

Ted Christiansen, P.E.
July 5, 2011
Database & Web Interface

One company ... unlimited solutions

http://www.nov.com/sension

Ted Christiansen, P.E.
July 5, 2011
Database & Web Interface

One company…unlimited solutions

http://www.nov.com/sension

Ted Christiansen, P.E.
July 5, 2011
Database & Web Interface

Drillpipe fatigue calculation (offline), based on:

1. Well trajectory
2. Top drive torque, speed, weight on bit, rate of penetration (from drilling data taken by system)
Database & Web Interface

Drillpipe Inspection

Frequency Distribution Of PIN_OUTERDIAMETER

http://www.nov.com/sension