Drilling Engineering Association - Forth Quarter

Coil Tubing Directional Drilling

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Content

- Why Coil Tubing Directional Drilling?
- Re-entry
- Grass roots
- Questions
Closed loop / Automated Drilling Systems

CoilTrak®

TruTrak®

Slim AutoTrak® RSS
What is Coiled Tubing Drilling?

- CT & Motor to drill, sidetrack, or deepen a well
  Efficiencies & economies compared with jt’d pipe

- Types of CTD
  Non-directional i.e. ~90% Canada shallow <$
  
  Directional Advanced BHA controlling well path

  Re-entry CTD accesses uneconomic reserves w/o tbg retrieval
Why consider Coil Tubing Directional Drilling?

- Reservoir access
- Production
- Recovery factor
- Life of Field
- Existing infrastructure
- Unit lifting costs
- Hostile environments
- Environmental impact
Typical reentry CTD sidetrack

Parent  - 4 ½” production tubing
         - 7” liner

Pre rig
• Set 4 ½” x 7” whipstock
• Squeeze cement to abandon perfs

CTD
• Mill window
• Drill  - 3 3/4” or 4 1/8” bicenter
         - 45° DLS common
         - Xanthan drilling fluid
• Run 3 3/16” x 2 7/8” liner & cmt
• Log CNL & Perforate

2.3/8” slimhole option increases candidates
Electronic Disconnect & Circulation (EDC)
Electro-Hydraulic Orienter (HOT)

Stroke length corresponds to 400° rotation of spiral thread
A case for Rib Steering
X-treme motor section

Near bit Inclination 12.2ft (3.73m) behind bit

Control Electronics

Hydraulic Power Unit

Bit RPM measurement

X-treme motor section

Steering Pads 1.3ft (0.4m) behind bit

3” CoilTrak RSM

- 4 Drilling Modes
- “ribs off”
- “steer” (direction steer force)
- “inclination hold” (target inclination + steer force)
- “backreaming” (steer mode with SF = 0%)
RSM extends lateral and saves 6 days/$ - Alaska

**Well Data**
- North Slope
- August 2008
- 3 ¾” Re-entry
- Sandstone

**Objectives**
- Extended lateral
- Decrease tortuosity and drag
- Meet AFE $/time
- Increase production

**Results – Answers While Drilling**
- AFE – 6 days
- Additional sidetrack drilled
- Minimize tortuosity + extend lateral
- Improved weight-to-bit transfer
- Improved bore-hole quality
- Increased production

**INTEQ Solution**
- 3” RSM and CoilTrak
- 3 ¾” Hughes Christensen Bit (HCM 304Z)
A case for Reservoir navigation

Shaley sand with poor markers. What if dip or faulting different than expected? Porpoise = lost pay and in some cases OH sdtk.
Multiple Propagation Resistivity

- Frequencies 400kHz & 2MHz
- Pilot fleet
TruTrak CTDD - DJ Basin
TruTrak Automated Directional Drilling

- Unmatched X-treme motor power
- Reliable VertiTrak hardware
- Superior AutoTrak steering concept

Steering Head

Pulser Sub
Control Sub
X-treme Power Section
Steering Head
MWD System
Adapter Sub
A Slide Only Experience

Commands:
– Maintain Verticality
– Kick-Off and Build to 30°
– Hold Inclination
– Drop back to Vertical
– Maintain Verticality

Downlink System
<table>
<thead>
<tr>
<th>Tool size</th>
<th>9-1/2&quot;</th>
<th>8&quot;</th>
<th>6-3/4&quot;</th>
<th>4-3/4&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Inclination</td>
<td>30°</td>
<td>30°</td>
<td>30°</td>
<td>90°</td>
</tr>
<tr>
<td>Max Build up rate</td>
<td>2° / 100 ft</td>
<td>2° / 100 ft</td>
<td>3° / 100 ft</td>
<td>5° / 100 ft</td>
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<tr>
<td>Possible to run on coil</td>
<td>no</td>
<td>no</td>
<td>Under certain conditions</td>
<td>yes</td>
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<tr>
<td>Commercial</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>Pilot phase</td>
</tr>
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</table>
TruTrak: New Well Profiles

a)

b)

c)
4.3/4 TruTrak on CT

Results

- 21 wells ~ 118,000ft (14 with 3.1/2” CT)
- Exceptional HS&E
  - fewer crew; less handling; automation
- Ave. 3 - 4 days drilling /well (8,000ft)
- 500 fph instantaneous / 200 fph average ROP
- Precise directional control “painting the line”
- Excellent bore-hole quality
- HD404z optimized bit / hydraulics
- Case histories awaiting approval
- Continue CTD with TruTrak 2nd rig
- Further optimize CTDD operation
TruTrak advantages

- **Precise well placement via automated control**
  - High-quality, vertical section
  - Smooth build/drops with minimal doglegs
  - Efficient tangent drilling in auto-inclination hold mode

- **Improved bore-hole quality**
  - Minimal doglegs
  - Reduced tortuosity

- **Lower torque and drag**
  - In-gauge hole
  - No spiraling
  - Time saving

- **Improve gross ROP vs. conventional motors**
  - No correction runs
  - Simple casing run and reduced wear
Questions?