Low Frequency Drill Bit Seismic While Drilling (SWD)

DEA Discussion Item

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Oxy Petroleum

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Objectives

• Achieve acoustic energy required for Drill Bit Seismic While Drilling at 15,000’ and deeper.

• Build and test prototype tools for laboratory and field demonstrations.

• Create seismic data for “look ahead of the bit” pore pressure analysis, geosteering, reservoir model verification; and bit location and near well bore diagnostics.

• Commercialize two advanced services
  • Drill Bit Seismic While Drilling
  • Wireline RVSP and Cross-Well Tomography
### Preface

#### 10 Technologies to Invest in This Decade

<table>
<thead>
<tr>
<th>Drilling</th>
<th>Completion</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotary Steerable</td>
<td>Stimulation</td>
<td>• ESP</td>
</tr>
<tr>
<td>Fixed Cutter Bits</td>
<td>Proppants</td>
<td></td>
</tr>
<tr>
<td>Shock &amp; Vibration</td>
<td>Well Tractors</td>
<td></td>
</tr>
<tr>
<td>Seismic At The Bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drilling With Casing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coiled Tubing Drilling</td>
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Richard Spears  
Spears & Associates, Inc.  
Tulsa, OK
Motivation

“The time is coming when we will not drill without looking ahead of the bit - anymore than we would drive at night without headlights occasionally shining a lamp to see what we hit.”

Mike Tweedy, Chevron
Drill Bit Seismic While Drilling and Cross Well Tomography

- **Drill Bit Seismic While Drilling**
  - Using drill-bit noise to create a velocity profile while drilling
  - Data Processing
    - Pore pressure ahead of the bit
    - Geosteering
    - Reservoir model verification

- **RSVP and Cross Well Tomography**
  - Wireline
  - Data Processing
Economic Benefits

- Health, safety, and environmental (HSE) risks will be decreased.
- Casing related costs and dependence on contingency casing strings will be reduced.
- Lower drilling costs by optimizing mud weights and assisting safe underbalanced drilling.
- Accurate pore pressure prediction will minimize non-productive time (NPT).
- Reservoir model verification
Historical Overview of Drill Bit SWD

- 1989: Roller Drill Bit SWD by Rector and Marion
- 1990: Roller Bit Source **SEISBIT™ & TOMEX™**
- 2002: GRI PDC Drill Bit SWD Feasibility Study
  - Identified Candidate Drill Bit Seismic Sources
- 2007: SPE/EAGE SWD Emerging Technology Workshops Held in both Dublin and Houston
- 2008: TII Discovered **SeismicPULSER™ Technologies**
  - Proved 2, 3, 4, 5, 6, and 7 Hz and greater peaks could be generated with an otherwise high frequency sparker in the laboratory
  - Successfully transmitted low frequencies from 4000 feet at RMOTC with capability to 15,000+
Laboratory Sparker Testing
Sparker Principle of Operation
Sparker Frequency Spectrum

Conventional Sparker
High Frequencies

SeismicPULSER™
5 Hz Peak Frequency
RMOTC Low Frequency SeismicPULSER™ Sparker
Seismic Survey at RMOTC

Background Rig Noise       SeismicPULSER™ at 3.3 Hz
Conclusions and Recommendations

• **Conclusions**
  
  Revolutionary SeismicPULSER™ technologies will provide low frequency acoustic augmentation needed for deep HPHT wells.

For more information
Contact Bob Radtke
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• **Recommendations**

  • Evolutionary advances will be discovered in:
    
    • *Test wells to generate seismic data*
    • *Field tests to verify performance in both wireline cased hole and drilling applications.*