FluidHammer Performance Drilling Tool

The Challenge

- Poor Rate of Penetration (ROP) performance with roller cone and PDC drill bits
- Need solution for hard rock drilling outside of turbine or diamond impregnated bit
- Weight transfer to bit, toolface control
- Performance drilling without the extra cost of Rotary Steerable Systems
- Non-invasive system compatible with all drilling environments

The Solution

EDS Downhole’s FluidHammer performance drilling tool is the next step in drilling improvement with industry-leading performance-driven technology. This new technology utilizes the latest generation of performance elastomers in combination with a new energy distribution system to enhance the rock failing properties of the drill bit. This is accomplished through combined simultaneous axial and torsional loading of the drill bit.

The FluidHammer performance drilling tool increases ROP by combining the torque and rotation speed of a mud motor power section with a high frequency axial oscillation, which lifts the entire BHA with each pulse. This axial pulse is configurable to drill bit cutting styles (roller cone or PDC) to allow for application specific designs. Combining axial movement with the rotational drilling torque/speed increases the cutting efficiency of the bit by creating additional forces to overcome the rock’s compressive strength.

Features and Benefits

- Proven to increase ROP in both roller cone and PDC bits
- Reduces stick-slip
- Aids in weight transfer
- Tool activated by Weight on Bit (WOB) and disengages when off-bottom
- Oil sealed with 100% of mud flow going through the bit
- Compatible with most common power section configurations

Application Considerations

- Use in directional applications to reduce stick-slip, facilitate weight transfer, improve directional control and increase ROP
- Use in hard rock drilling with both PDC and roller cone drill bits to increase ROP through increased drilling efficiency
- Use in extended reach applications to aid in weight transfer, significantly increasing ROP and toolface control

FluidHammer Configurations

<table>
<thead>
<tr>
<th>Tool Size</th>
<th>Hole Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 ¾”</td>
<td>11 ¾” to 14”</td>
</tr>
<tr>
<td>7”</td>
<td>9 ½” to 12”</td>
</tr>
<tr>
<td>9”</td>
<td>11 ½” to 14”</td>
</tr>
</tbody>
</table>

FluidHammer Configurations

* Denotes future availability

Exceptional Performance

The 6¾” FluidHammer tool alongside 9½” DSH519M achieves 184% more interval drilled and 70% more ROP than the average offset records.

West China, CNPC, Q3 2013.

Objectives:

The FluidHammer tool was introduced in West China to improve the overall ROP performance and footage drilled in combination with a ReedHycalog™ DSH519M-C1 PDC bit, which was designed specifically for use with the FluidHammer tool in this area.

Summary:

The NOV FluidHammer tool combined with a DSH519M-C1 PDC bit were picked up to drill the vertical section of a West China well offset to several similar wells drilled with conventional mud motor and PDC bottom hole assemblies (BHA). The BHA drilled 959m in 177.65 hours with an average ROP of 5.4m/hr and a total of 240 circulating hours. The interval drilled consisted of mudstone, fine sandstone and siltstone formations.

The FluidHammer tool had normal wear and the bit dull grade was: 0-1-WT-N/S-X-I-NO-PR.

Results:

- 184% more footage
- 70% faster ROP

<table>
<thead>
<tr>
<th>No. Runs</th>
<th>Depth In</th>
<th>Depth Out</th>
<th>Interval</th>
<th>ROP</th>
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</thead>
<tbody>
<tr>
<td>Chinese Offset</td>
<td>16</td>
<td>3,820</td>
<td>4,268</td>
<td>448</td>
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<td>HC Offsets</td>
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<td>Other Offsets</td>
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<td>DSH519M-C1</td>
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<td>4,730</td>
<td>959</td>
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</table>

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