Z-Torque

Reduce stick-slip with the latest Z-Torque technology interfaced into Alpha™

Stick-slip is when drilling stops and slips exhibiting a pattern caused by a discrepancy in imposed rotational speed and the actual speed of the bit below the surface resulting in axial and rotational vibrations which can cause:

- Premature side cutter bit wear and tear or damage (see Fig. 1)
- Drill pipe fatigue
- Twist-offs
- Downhole equipment failure
- Reduced Rate of Penetration (ROP)

Fig. 1
Z-Torque

BENEFITS

The Z-Torque Alpha application simulates a transformer matching the resistance of a power transmission line applied at multiple frequencies by controlling the top drive revolutions per minute to match the top drive impedance with the drill string. This reduces standing high-frequency electrical signals to help mitigate stick-slip vibrations.

Precision Drilling strives to achieve the highest quality drilling performance, and with Z-Torque we can mitigate multiple modes of stick-slip on our rigs.

Using the Alpha interface, drillers can adjust how intense Z-Torque performs, save settings for well plans, and more.

- Diminishes the amount of downhole stick-slip (as seen on Fig. 2)
- Mitigates drilling dysfunction allowing for increased rates of penetration (ROP)
- Downhole vibrations are decreased minimizing the risk of unplanned trips
- Reduces drill pipe fatigue increasing drill pipe life

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**Fig. 2**

- **Z-Torque ON**

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Z-Torque

AN IMPROVED APPROACH\textsuperscript{1} TO STICK-SLIP MITIGATION

Conventional stick-slip mitigation systems like the SECOND ORDER INERTIA-STIFFNESS SYSTEM, uses a drill string model. It utilizes a modelled resonance frequency to dampen the torsional energy produced by stick-slips.

Z-Torque, on the other hand, uses wave guide impedance matching to address the problem eliminating the need for the drill string model. This allows the driller to focus solely on the top drive and drill pipe interaction.

\textsuperscript{1} See Sicco Dwars (2015), MS SPE Conference Paper #173037, and, Sicco Dwars (2019) MS SPE Conference Paper #194108

<table>
<thead>
<tr>
<th>Z-Torque</th>
<th>CONVENTIONAL STRS</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>Mitigates 1st stick-slip vibration frequency mode</td>
</tr>
<tr>
<td>✓ ✓</td>
<td>Auto tuning</td>
</tr>
<tr>
<td>✓</td>
<td>Targets multiple stick-slip vibration modes</td>
</tr>
<tr>
<td>✓</td>
<td>Absorbs multiple stick-slip waves at the surface</td>
</tr>
<tr>
<td>✓</td>
<td>Matches drive impedance to drill pipe impedance</td>
</tr>
<tr>
<td>✓ ✓</td>
<td>Vibration frequency-independent</td>
</tr>
<tr>
<td>✓ ✓</td>
<td>Expanded efficient drilling window</td>
</tr>
</tbody>
</table>

\begin{center}
\begin{tikzpicture}
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    ylabel={Weight-On-Bit (lb),}
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    ytick={0,10,20,30,40,50},
    grid=major,
    legend style={at={(0.5,0.95)},anchor=north west}
]
\addplot[green,mark=x,mark options={red}] table [x expr=
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\addlegendentry{Efficient Drilling}
\addplot[blue,mark=x,mark options={red}] table [x expr=\thisrow{Rotary Speed (RPM)}, y expr=\thisrow{Whirl}]{data.csv};
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\addplot[black,mark=x,mark options={red}] table [x expr=\thisrow{Rotary Speed (RPM)}, y expr=\thisrow{Stick-Slip}]{data.csv};
\addlegendentry{Stick-Slip}
\addplot[black,mark=x,mark options={red}] table [x expr=\thisrow{Rotary Speed (RPM)}, y expr=\thisrow{STRS window}]{data.csv};
\addlegendentry{STRS window}
\addplot[black,mark=x,mark options={red}] table [x expr=\thisrow{Rotary Speed (RPM)}, y expr=\thisrow{Efficient Drilling}] {data.csv};
\addlegendentry{Efficient Drilling window}
\end{axis}
\end{tikzpicture}
\end{center}