**Case Study**

**Challenge**

Provide an alternative to drilling with positive displacement motors (PDM), which had yielded low ROP and short run lengths in abrasive, high-temperature Pre-Khuff sandstone.

**Solution**

Use 27⁄8-in Neyrfor T1/FBS Mk2 directional turbodrill with 35⁄8-in Smith Bits Kinetic* K705 diamond-impregnated bit.

**Results**

Increased average ROP from 4.35 to 8.9 ft/h, and average run length from 80 to 193.5 ft, with excellent turbodrill and bit durability.

**Abrasive formation challenges drilling performance**

The abrasive Pre-Khuff sandstones, combined with high downhole temperatures, present a uniquely hostile drilling environment that limits run durations and ROP. Encountered at depths between 13,000 and 17,000 ft, hardness, abrasiveness, toughness, and irregularity in size and orientation of the rock constituents, all contribute to high wear rates on bits and BHA components, creating a significant potential for premature equipment failures, limiting on-bottom rotating time, and necessitating long and frequent trips.

An operator initiated a horizontal drain in Pre-Khuff sandstone through a window cut in 4½-in production tubing in a land well in the Middle East. The initial buildup to horizontal was completed using 23⁄8-in coiled tubing with PDM technology. Thirteen runs were required to drill a total of 1,043 ft, with an average run length of 80 ft at 4.35 ft/h. Two different formations were encountered, with different compressive strengths. In the second formation, average run length was only 62 ft at 3.42 ft/h.

**Neyrfor turbodrills and Smith Bits Kinetic bits offer efficient solution**

2¼-in Neyrfor T1/FBS Mk2 directional turbodrill was chosen to replace the PDM drive system; it was run in combination with a 3¾-in Smith Bits Kinetic K705 diamond-impregnated bit. The turbodrill is normally configured with two integral body stabilizers as shown. On the initial turbodrill run in this well, however, the midbody stabilizer was replaced with a slick connecting sleeve because concerns were raised about the ability of the relatively stiff turbodrill assembly to pass through the casing window.

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*Schematic of 2½-in Neyrfor T1/FBS Mk2 directional turbodrill.*

**Interchangeable intermediate stabilizer**

**Interchangeable lower bearing stabilizer**
Initial ROP increases by nearly 500%; average run length more than doubles

An ROP of 16.6 ft/h was observed, compared with 2.8 ft/h on the previous run—an improvement of 490%. The first run was terminated prematurely because the absence of the midbody stabilizer resulted in an overaggressive directional build rate. Both bit and turbodrill were found to be in excellent condition and fit for rerun.

The second, third, and fourth turbodrill runs, configured with the inclusion of a 3½-in midbody stabilizer, displayed a predictable directional response. Initial ROP was 17.1 ft/h, gradually decreasing as the limits of WOB transmission for the coiled tubing were approached. Average run length more than doubled, increasing from 80 to 193.5 ft. 774 ft were drilled with minimal wear to turbodrill bearings and bit cutting structure. A total of 87 drilling hours were recorded on Neyrfor turbodrill BHAs with zero NPT.