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Case study: Middle East

Continuous proportional steering reduced well tortuosity by 4 times

Tortuosity and deviations in well path cost time, increase potential problems while running the completion, and can negatively impact short- and long-term production. A large Middle East operator quantitatively compared available rotary steerable system (RSS) technologies utilizing high resolution wireline surveys to better understand their effect on wellbore tortuosity.

This study—published by the Society for Petroleum Engineers (SPE-189408 Effect of Rotary Steerable System Steering Mechanism on Wellbore Tortuosity in Horizontal Wells)—analyzed over 700 wells in the same field with similar geologies, trajectories, and bottomhole assemblies (BHAs). With like conditions, the study effectively isolated the RSS mechanism as the primary variable, enabling a like-for-like comparison between steering technologies. All survey data were gathered from areas of mature directional drilling operations, ensuring the elimination of the learning curve of the RSS BHA design experienced during the early phases of field development.

The RSS mechanisms known as push-the-bit and point-the-bit systems work using on-off steering cycles. They go from "steer" to "not steer," which is very similar to a conventional steerable motor. The only advantage these systems have versus a motor is that they are rotating all the time.

Push-the-bit systems rely on forces applied through mounted pads against the borehole wall to achieve bit deflections, usually with just one pad working at a time. Point-the-bit systems rely on internal deflections that tilt the bit into the desired well path during the "steer" cycle. Both systems share a deactivation of pads or tilt until a certain inclination threshold is crossed, after which the system re-activates to build and correct.

Continuous proportional steering—the underlying technology in the Baker Hughes **AutoTrak™ RSS**—continuously controls the pressure applied by three independent pads mounted on a slow rotating sleeve, with no switch-off cycle. This continuous proportional steering ensures more precise and consistent directional control that delivers a smoother, in-gauge hole, precise well placement, and faster, more reliable drilling performance.

The AutoTrak system uses internal hydraulics to power the independent steering pads. Steering control is not affected, or artificially restricted, by drilling dynamics like bit pressures, flow rates, and drilling fluid properties as it is in most competing systems. This flexibility enabled the operator to match the drill bit design to the formation challenges—improving rig and overall drilling efficiencies.

The high-resolution wireline surveys took survey measurements in 3-in. intervals throughout horizontal sections of the wells. This provided highly accurate insights into hole quality that cannot be observed with measurement while drilling (MWD) surveys. Longer survey intervals in MWD systems simply do not offer an accurate representation of wellbore hole quality with respect to tortuosity. Longer survey intervals give the impression that all RSS steering mechanisms deliver good

Challenges

- Quantify tortuosity and deviations in well path that increase potential problems while drilling, setting casing, running completions, and producing the reservoir
- Improve short- and long-term production potential, and decrease overall field development costs

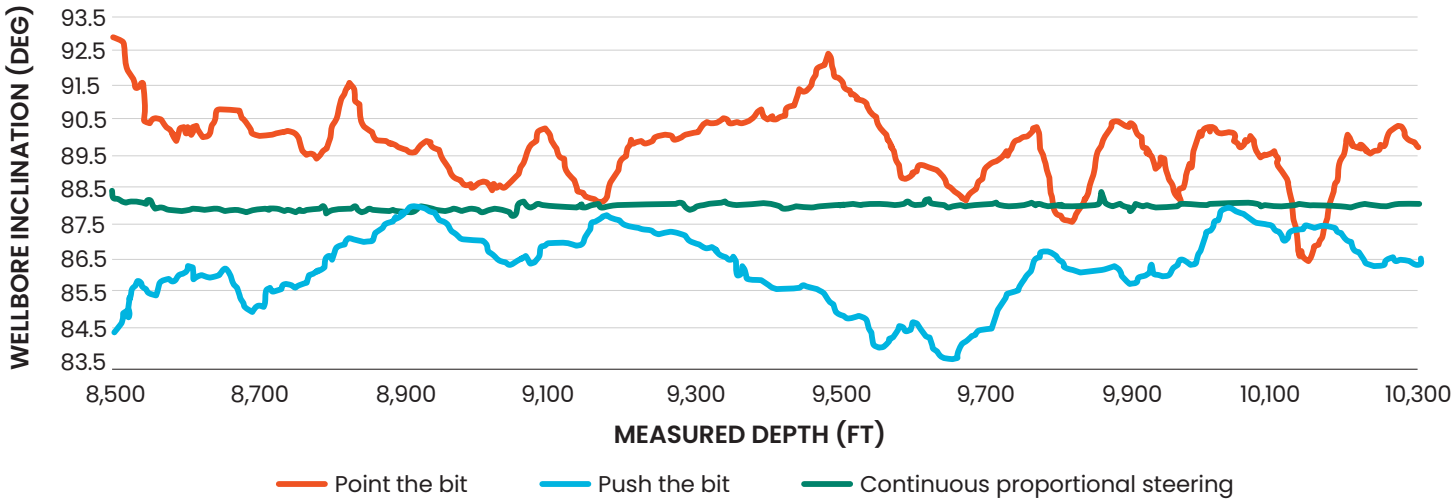
Results

- High-resolution wireline surveys provided tortuosity insight previously unknown
- The data effectively compared the degree of tortuosity achieved by three RSS technologies
- The study concluded that AutoTrak continuous proportional steering reduced tortuosity by 4 to 6 times compared push-the-bit and point-the-bit systems

wellbores. When examining the high-resolution wireline data, it became clear that the push-the-bit and point-the-bit RSS tools significantly increase wellbore tortuosity. The study concludes that the underlying on-off steering mechanics used by these systems are simply not capable of drilling a horizontal wellbore without a significant level of tortuosity. Increased tortuosity during drilling has immediate cost and efficiency consequences, requiring reaming, backreaming, and clean-up cycles.

As these consequences are multiplied across wells, tortuous wellbores can have a significant cumulative effect on field development, production, and profitability.

Results from the study overwhelmingly concluded that using AutoTrak continuous proportional steering reduced tortuosity by 4 to 6 times when compared to push-the-bit and point-the-bit methods, and consistently delivered better hole quality in horizontal drilling. Utilizing AutoTrak continuous proportional steering leaves a clear path that improves efficiency and reduces costs throughout the life of the well—not just while drilling, but also while running casing, installing completions, producing, conducting workovers, and performing abandonment operations.



Comparison of well tortuosity from the study using high-resolution wireline surveys from three offset wells. The difference is unmistakable when comparing wells drilled with push-the-bit (blue), point-the-bit (red), and continuous proportional steering (green) technologies. The AutoTrak RSS clearly delivers substantially superior hole quality.

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