Schlumberger

Autonomous Downhole Control System Halves Downlinks, Increases ROP in Multiple Curves

PowerDrive Orbit G2 RSS with auto-curve and auto-lateral builds curve and lateral through ZOE

PowerDrive Orbit G2* RSS with auto-curve and auto-lateral capabilities drilled the curve and lateral sections for two sets of seven wells in the Permian Basin. Not only were downlinks to the RSS reduced by roughly half for all 14 curves, ROP also increased.

Build high-DLS curves in ZOE

Two sets of seven unconventional wells in the Permian Basin were planned with aggressive curves. The dogleg severity (DLS) demanded for these curves was a sharp 8° to 11°. Compounding the challenge was that these wells fall within the zone of exclusion (ZOE)—a narrow north–south window with azimuths between 160° to 200° (southerly) and 340° to 20° (northerly), which can further destabilize azimuthal headings already stressed by the formation's inherent shock and vibration characteristics.

Suffer lower ROP, lost time, and more tortuous curves

Drilling curves using rotary steerable systems previously required what is referred to as "manual mode," which involves a sequence applied repeatedly to control the curve trajectory. This sequence comprises multiple interventions and downlinks from the directional driller at the surface for steering force, toolface (TF) orientation, and measurements. Consequently, cycle times can be as long as 20 minutes and lead to loss of time, tortuous curves, and reduced ROP.

Replace manual mode drilling with autonomous systems

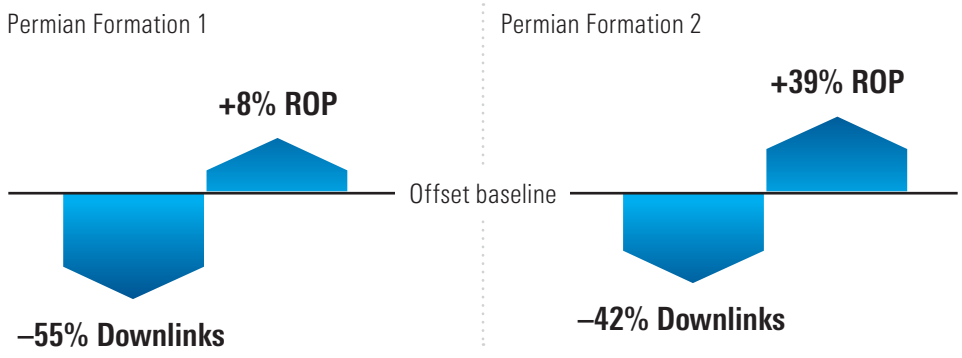
Schlumberger recommended deploying the PowerDrive Orbit G2 RSS and xBolt G2* accelerated drilling service with the autonomous downhole control system—in this specific instance, the auto-curve and auto-lateral components. These capabilities bundle all the steps of manual mode into a single downhole autonomous control process that begins with the directional driller downlinking the DLS and TF as required on the well plan. The RSS receives the command downhole and alone automatically adjusts its steering force and TF to match the demanded DLS and TF.

Additionally, the BHA tracks its continuous inclination and azimuthal using sensors close to the bit (3-axis inclinometers and triple 3-axis magnetometers). ROP data enables the RSS to compute its resulting DLS and TF. Each second, the tool adjusts its steering parameters to meet the designated trajectory, functioning without the need for surface control, which means fewer downlinks and less time lost to the cycle. The technology makes frequent and small adjustments, resulting in less tortuosity compared to the infrequent and violent surface control. Freed from trajectory concerns, this enables the directional driller to focus on drilling efficiency.

Autonomously drilled curve and lateral sections through ZOE while increasing ROP

The autonomous downhole control system drilled curves and laterals in 14 wells in their 6¾-in sections. Results observed across each well were compared to nearby offsets with curves drilled in manual mode. Downlinks to the PowerDrive Orbit G2 RSS were reduced as much as 55% in seven curves and 42% in the remaining seven curves.

ROP also increased in all the curves using the auto-curve component. Ten of the 14 wells were drilled in a "pure" north—south azimuthal window and despite severe shock and vibrations at very high rpm.



Auto-curve reduced downlinks to the RSS 42% and 55% in the curves of two different Permian Basin fields. The responsiveness of the autonomous downhole controls improved performance, including increased ROP in all 14 wells.