

# Autonomous Downhole Control System

Minimize surface interference and eliminate downlinks



**At-Bit Steerable Systems**



**Rotary Steerable Systems**



**Drilling Motors**

## Applications

- Reduces surface interference and eliminates downlinks for onshore and offshore wells.
- Increases ROP while improving borehole quality with less tortuosity.

## How it improves wells

Autonomous downhole control technology reduces control latency. Adjustments are made when and where tools encounter the data, which means following the plan more precisely for better verticals, steeper curves, less tortuous tangents, and way more accurate laterals. This all translates to consistent directional results well after well, reduced carbon, and overall better well economics and outcome.

## How it works

Conventional drilling with rotary steerable systems requires operating in manual mode, involving a command sequence applied repeatedly to control the trajectory from the vertical through the curve and into the tangent. And each sequence comprises multiple interventions and downlinks from the directional driller at the surface for steering force, toolface (TF) orientation, and measurements. Downlinks to the BHA and tool data fed back to the surface for adjustments in commands are called control-loop time, which can be as much as 20 minutes.

The autonomous downhole control system overcomes control-loop time and associated data-to-surface delays by minimizing surface interference and eliminating downlinks. Advanced BHA components can assess the data and react at the time and place needed, even when heading into the zone of exclusion (ZOE) or into rugged downhole conditions.

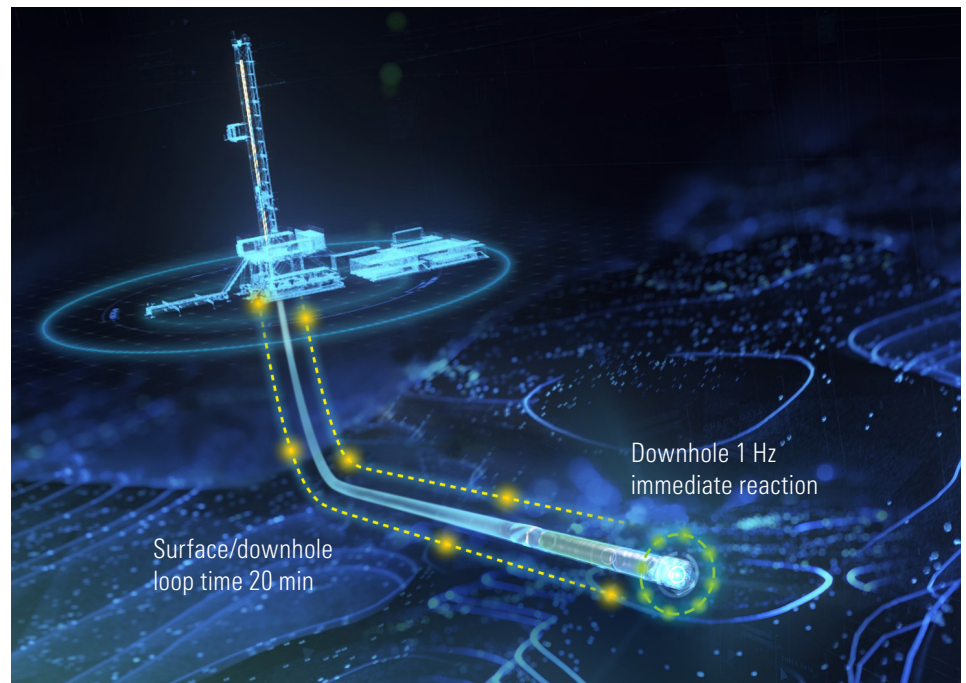
And we're talking auto-vertical, auto-tangent—and, now, auto-curve.

Specifically, the technology enables the auto-curve capability by bundling all the steps of manual mode into a single downhole autonomous process that begins with the directional driller downlinking the dogleg severity (DLS) and TF as required on the well plan. The ABSS or 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 azimuth using sensors close to the bit (3-axis inclinometers and triple 3-axis magnetometers). With the addition of downhole ROP data, the autonomous controls enable the tool to compute its resulting DLS and TF. Each second, the tool adjusts its steering parameters to meet the designated trajectory to stay on plan. The technology functions without the need for surface control, which means fewer downlinks and less time lost to the cycle. Tortuosity is reduced compared with the infrequent and violent surface control. And freed from trajectory concerns, the directional driller can focus on drilling efficiency.

## The takeaways

Decisions and adjustments are made when and where tools encounter the data, which means far better verticals, steeper curves, less tortuous tangents, and way more accurate laterals. This all translates to consistent directional results well after well and better well economics, reduced carbon, and an overall better outcome.



*The autonomous downhole control system enables the downhole tools to compute DLS and TF, making adjustments each second to steering parameters that keep on the trajectory plan. Corrections are made when and where needed, so placement is more accurate and borehole quality is smoother.*