DEEP WATER

CASE STUDY

TOTAL S.A. Drills to Record Depths in HP/HT Well and Saves USD 5 Million

ENGINEERED MWD/LWD SOLUTION DELIVERS RELIABLE MEASUREMENTS IN EXTREME TEMPERATURE ENVIRONMENT

OFFSHORE NORWAY

CHALLENGE

To successfully drill and log an offshore vertical well in extreme HP/HT conditions

SOLUTION

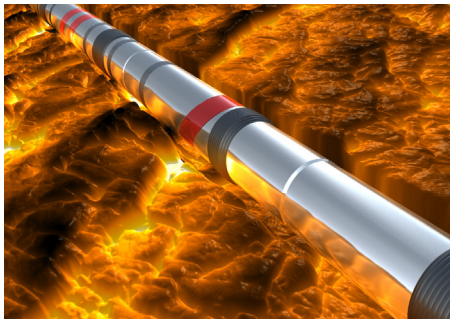
MWD/LWD engineered drilling solution for extreme-temperature applications, featuring:

- Quasar Pulse™ service for gamma, directional, and PWD measurements
- Quasar Trio® service for petrophysical measurements — multispacing resistivity, neutron porosity, and azimuthal density — and real-time, formation-evaluation data

RESULTS

- Successfully drilled and logged 147 meters (482 feet) in one of the deepest and hottest wells ever drilled on the Norwegian Continental Shelf
- Incurred no trips for failure in the reservoir sections
- Reduced well time by seven days, saving approximately USD 5 million

OVERVIEW



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In extreme-temperature environments, Quasar Trio® service can provide resistivity measurements and real-time logs of geological markers and fluid contacts.

When planning exploration activity on the Norwegian Continental Shelf, TOTAL S.A., a major energy operator, sought to drill and log a high-pressure/high-temperature (HP/HT) well with a static temperature around 200°C (392°F). It was to be one of the hottest and deepest wells ever drilled in this offshore location. The operator required real-time resistivity measurements while drilling (MWD) to provide enough information to demarcate the reservoir and identify the fluids that it contained. Pressure while drilling (PWD) was also required for continuous monitoring of downhole hydraulics and fluid performance to help optimize the downhole pressure. It took a highly engineered solution provided by Sperry Drilling experts to obtain reliable measurements and reach total depth (TD) in this harsh environment, without extra trips downhole. TOTAL S.A. increased its understanding of the reservoir and maximized its asset value by saving seven days of well time, equaling USD 5 million, compared to traditional methods.

ENHANCING RESERVOIR UNDERSTANDING IN EXTREME-TEMPERATURE WELL

Logging while drilling (LWD) in extreme-temperature wells can be challenging, as conventional MWD/LWD sensors are not able to withstand such conditions. Consequently, operators are often forced to drill "blind," thereby increasing the associated drilling risks and uncertainties of wellbore placement. With a targeted true vertical depth (TVD) of 6,096 meters (20,000 feet) in an 8½-inch hole, TOTAL S.A. had encountered temperatures above 175°C (347°F) and needed a solution that would enable the operator to drill to final TD, while maintaining visibility of the reservoir and control of the well.

ENGINEERING A SOLUTION TO REDUCE HP/HT RISKS

Sperry Drilling collaborated with TOTAL S.A. to understand the challenges and then to respond with a solution-based design that would best meet those challenges.

To reduce risks associated with drilling HP/HT wells, Sperry Drilling advised TOTAL S.A. to utilize the 6¾-inch Quasar Pulse™ extreme-temperature MWD/LWD service (providing gamma ray, drilling dynamics, directional, and PWD measurements), along with Quasar Trio® service for resistivity measurements and real-time logs of geological markers and fluid contacts. Designed to operate at up to 200°C (392°F) and rigorously tested to ensure operational reliability, the rugged Quasar Pulse and Quasar Trio services were ideal choices for this HP/HT application.

"Successful use of Sperry Drilling Quasar tools helped us drill the deepest well ever on the Norwegian Continental Shelf."

– Mats Skaug, Operations Geologist, TOTAL S.A.

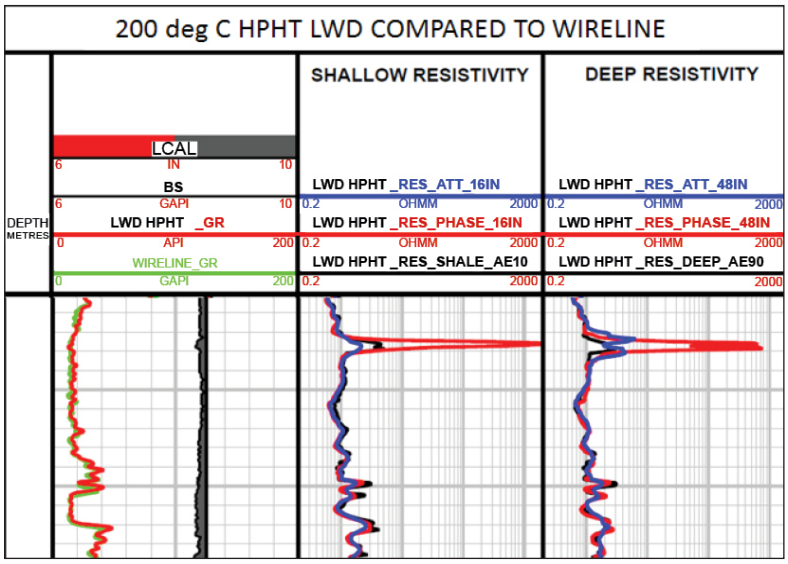
MAXIMIZING ASSET VALUE THROUGH COLLABORATION AND RESERVOIR INSIGHT

As the industry leader in HP/HT drilling expertise, Sperry Drilling made it possible for TOTAL S.A. to access reserves that were previously inaccessible with standard MWD/LWD tools, by deploying the 6¾-inch Quasar Pulse and Quasar Trio services. The collaboration between Sperry Drilling and TOTAL S.A. yielded the first successful 200°C (392°F) operation in Norway, and helped the operator maximize asset value.

In 344 total hours, of which 67 were actual drilling hours, TOTAL S.A. drilled the deepest well on the Norwegian Continental Shelf of 5,942 meters (19,494 feet) TVD, with zero nonproductive time (NPT). The reliability of the Quasar Pulse MWD/LWD service enabled the customer to acquire critical formation evaluation data while drilling in this extreme-temperature well, with a maximum static temperature of 198°C (388°F) and circulating temperature of 185°C (365°F). The following benefits were also delivered on this job:

- The HP/HT LWD technology survived high vibration levels and a mud weight of 17.69 ppg (2.12 SG) in addition to extreme temperature.
- The PWD sensor played an important role in several critical stages of the operation, including flow-rate management during displacement to heavier mud weights, and performance of the dynamic formation integrity test, which yielded an equivalent mud weight of 18.69 ppg (2.24 SG).
- The monitoring of trends in the bottomhole annular pressure enabled early detection of changes and fast operational adjustments to the surface backpressure on the managed pressure drilling (MPD) system to maintain wellbore integrity.

The combination of the Quasar Pulse and Quasar Trio services helped the operator enhance reservoir understanding through real-time formation evaluation measurements that closely correlated to those obtained by wireline methods in extreme-temperature wells, thus helping to maximize the value of the asset. This solution reduced well time by seven days, saving approximately USD 5 million.



The comparison between wireline and LWD data shows good correlation and gave the operator high confidence in the acquired data. The discrepancy between the resistivity responses in thin layers is an inherent characteristic of phase-shift resistivity measurements and highlights the excellent vertical resolution of the tool.

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