PERFORMADRIL® Drilling Fluid Solution Facilitates Successful Sidetrack through Overpressured Shale

Location: UK North Sea

OPERATOR'S CHALLENGE – The operator was drilling in an area of very reactive clays, to depths such that the location and rig size constrained both the operational logistics of skip & ship. This, along with overall costs, precluded the use of oil-based drilling fluids. Previously, standard inhibited water-based drilling fluids had failed to cope with the challenges in this formation.

The operator was drilling the 17 ½-inch interval in the over-pressured Hordaland shale of this offshore UK North Sea well. After the decision was taken to sidetrack this section Baroid was challenged to maintain the performance of the system through the 1600 meter-long section of troublesome shale, without renewing the fluid system.

HALLIBURTON'S SOLUTION – For this well, Baroid’s engineers recommended the use of PERFORMADRIL® water-based fluid system, including PERFORMATROL® clay and shale inhibitor and encapsulator. As well, Baroid also utilized BARACARB® bridging agent to bond any developing micro-fractures, and enhance the overall fluid loss of the system to optimize and reduce pore pressure transmission.

Insufficient mud weight was suspected to have caused borehole failure in the original wellbore.

To maintain borehole stability through the Hordaland formation, initial mud weight in the sidetrack was increased from 1.30sg to 1.40sg. However, drilling the sidetrack would present additional challenges:

• Difficulty initiating the sidetrack due to soft cement, increased contamination, and exposure time of the PERFORMADRIL drilling fluid, as well as a trip required to change kick-off BHA.

• Slow penetration rates of less than 1m/hr produced very fine solids in the system. This led to a total of eight bit changes and further disrupting the unstable formation. As well, there was increasing clay content in the mud and the open hole was exposed for a total of 45 days before running casing.

• Low ROP also led to a high flow line temperature of 72°C, contributed to increased clay dispersion, as well as stressing the mud with a greater evaporation rate and water replacement requirement.

• Finally, coarse shaker screens used to maintain the BARACARB bridging agent content allowed more fine clays into the mud system, in effect depleting the key system component, PERFORMATROL.

All of these challenges contributed to increased requirements for treatment to an active system volume that exceeded 500m³ at TD. Nevertheless, the PERFORMADRIL™ system provided sufficient stability for the sidetrack to be drilled successfully, demonstrating high resistance to thermal stress, as well as to clay and cement contamination.
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**ECONOMIC VALUE CREATED** – Baroid’s customized PERFORMADRIL inhibitive fluid system exceeded performance expectations. The system withstood 45 days of open hole exposure; fluid contamination; and environmental and mechanical challenges, enabling this operator to successfully drill the sidetrack as planned.

The fluid system was used to drill out 83 meters of soft cement over a 24 hour period, with alkalinity rising to pH 13.9 despite addition of Citric Acid and SAPP with only minor polymer degradation was evident.

The system showed great resilience, with no significant sag or mud separation observed during circulation after the bit trip with the lowest mud weight of 1.38sg. With the cement drilled out, more Citric Acid was added to the system and the rheological properties increased again, showing not all polymers had burnt off.

Despite MBT values rising as high as 126kg/m³, the system drilled to TD without rheological properties causing excessive pump pressures. Even after static periods, the gels of the PERFORMADRIL system were easily broken due to their fragile nature.

As a result, the PERFORMADRIL water-based drilling fluid system enabled the Horda and Balder formations to be cased off successfully, and a 1592-meter sidetrack to be drilled from 1200m to 2792m as planned.