BaraECD® Allows Record-Breaking Well to be Drilled from Land Rig (14,600 m)

OPERATOR DRILLS LONGEST-EVER WELL IN SUB-ZERO TEMPERATURES USING SUPERIOR FRAGILE GEL FLUID

CHALLENGES

- Formulate ultra-low rheology non-aqueous fluid (NAF) that can be replicated in sub-zero temperatures and deliver equivalent circulating density (ECD) benefits, while minimizing any weight fluctuation risk
- Accurately model ECD at shallow TVD and extreme step out to provide confidence in NAF
- Prove NAF performance is repeatable and consistent enough to open up exploration in extreme areas of the field

SOLUTIONS

- Utilization of proven mixture of BDF™-919 and micronized ilmenite to produce a suitable BaraECD formulation for severe Arctic drilling conditions
- Use DFG™ drilling fluids graphics software to provide accurate modeling at shallow, extended reach depth (ERD)
- Employ BaraShear™ pump to enhance LMP mixing at 2,700 psi and 5.4 bpm throughput

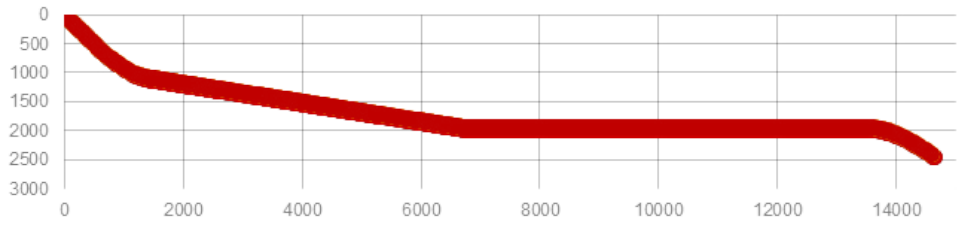
RESULTS

- Mixed 20,000 bbl of drill-ready fluid in sub-zero temperatures without the need for additional (rheology boosting) products
- Drilled well to record-breaking TD of 14,600 m and completed with no weight fluctuations observed
- Maintained ECD below fracture gradient at all times
- Stayed within DFG predicted 60 psi of observed annulus pressure loss in extremely shallow, ERD well

CHALLENGE

Extending the production life is critical to any operator's field development program. This is achieved by using a variety of sustainable Halliburton Baroid technologies and approaches to unlock the ability to reach new reserves, by drilling longer, more complex, extended reach, exploration wells.

The ability to drill longer wells can help increase the longevity of the field development program. Successfully proving that BaraECD can deliver the high-performance fluid required (in a prior Artic region well) was key to the operator attempting this record-breaking well. The previous campaign showed that 10,230 m could be reached while maintaining an equivalent circulating density (ECD) below a fracture gradient of 17.2 ppg, without loss of performance, or increase in risk. This well pushed that accomplishment to 14,600 m (47,900 ft), while maintaining an ECD below the fracture gradient of 17.5 ppg, at a flow rate > 500 gpm.



14,600 m (47,900 ft) is the longest oil well ever drilled from a land rig.

SOLUTION

Having successfully proven BaraECD drilling fluid on the previous well, albeit to a lesser depth and with less stringent requirements, the same base formulation, mixing procedures, and methodical approach to treating the fluid while drilling ahead were applied.

BaraECD components were mixed at the liquid mud plant (LMP) in sub-zero temperatures through a BaraShear™ high throughput shear pump at 2,700 psi and 5.4 bpm, and delivered to the rig with the same properties as the previous well (within 5% of laboratory specifications).

Despite running 325 mesh screens on all shakers, previous experience suggested the NAF would gain low gravity solids towards the end of the section, jeopardizing the gels and PV that allow the fluid to deliver such staggering ECD performance. In order to prevent excessive rises in these properties, weighted and unweighted low rheology versions of the base formulation (with an optimized concentration of 6 ppb BDF-919) were prepared

and utilized while drilling ahead. Due to limited mixing capacity when preparing for the completion phase, early preparation of premixed solutions was imperative. This ensured that the BDF-919 passed through the BaraShear pump and was fully dispersed.

To evaluate risk of weight fluctuations, all fluids were subject to ongoing daily VSST analysis (baseline comparison) and, at various stages, longer term static aging was performed to support the VSST data (LMP batch mixes, first footage drilled, at TD). All static age results showed excellent weight stability.

Drilling fluids graphics software (DFG™) was continually run, modeling current fluid specifications against actual geometric data, and comparing it directly to actual downhole pressure data from PWD (pressure-while drilling) sensors.

RESULTS

The BaraShear pump and BDF-919 formulation successfully:

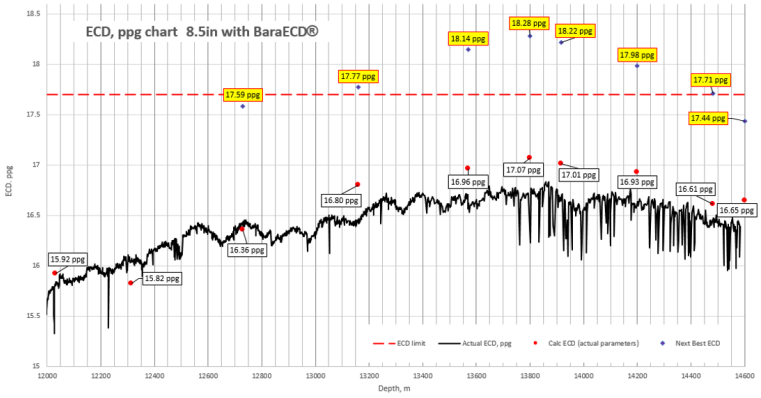
- Processed 20,000 bbl of "drill-ready" ultra-low rheology NAF in sub-zero temperatures
- Negated the need for additional rheology boosting products

The BaraECD NAF system surpassed the previous drilling performance, delivering:

- No weight fluctuations or hole cleaning issues
- PV of 20 cP or less maintained throughout the 8½-in. interval
- ECD maintained more than 1 ppg lower than FG at TD (16.5 ppg), at 14,600 m (2,406 m TVD and a step out of 13,649 m)

The DFG software delivered:

- Accurate modeling in the planning phase, allowing pinpoint rheological planning
- Accurate modeling while drilling, providing confidence in predicted ECD at TD via daily comparison with PWD data
- Post-well analysis of the PWD data, using DFG simulations, to validate the fluid for continued use in future wells



This chart highlights BaraECD performance by mapping the DFG modeled ECD (red dots) over the actual (PWD measured) ECD. The purple crosses are the modeled ECD expected from the next best NAF.

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