

STATOIL: HULDRA 2001 – 2002

DRILLING AND COMPLETION



Six reservoir sections were drilled and completed with cesium/potassium formate brine in the HPHT Huldra field in the North Sea.

Huldra is a gas condensate field in the Norwegian sector of the North Sea operated by Statoil ASA. During drilling and completion of this field, high temperature and pressure conditions were encountered in the reservoir section (67.5 MPa/9,790 psi and 149°C/300°F). The difference between pore pressure and fracture pressure gradient was small in the reservoir. The Huldra gas stream contained 3 – 4% CO₂ and 9 – 14 ppm H₂S. The wells were drilled at 45° – 57° inclination through the reservoir and completed with 300-micron singlewire-wrapped screens.

Change of plan

The initial plan was to drill all the wells with barite-weighted oil-based mud and complete in cesium/potassium formate brine. When the first production well was drilled a severe well kick was experienced while running the sand screens. The main reason for the kick was a loss of drilling fluid density due to barite sag during the wiper trip. A 1.85 – 1.94 g/cm³/ 15.4 – 16.2 lb/gal cesium/potassium formate-based drill-in fluid was therefore selected for the following wells, primarily for well control. This was the first time worldwide that cesium formate had been chosen as a drilling fluid.

The Huldra drilling operations using formate brine were characterised by good hole stability, low ECD and good hole cleaning. The excellent rheology and thermal stability of the drilling fluid led to rig-time savings from faster tripping speeds, faster casing-running speed, less mud conditioning and fewer wiper trips. The ROP was also good. The drilling fluid was circulated over a combination of 250, 300 and 400-mesh shaker screens before the completion screens were run. After running the screens, the drilling fluid was replaced with filtered cesium/potassium formate completion brine.

Statoil has reported that the six Huldra wells drilled and completed with formate brines are each producing with excellent average productivity indices of around 1.9 million scf/day/psi. In fact, plateau production rates were achieved from the first three wells of the six-well project.

Conclusions

The most notable features of the Huldra drilling and completion operations using 1.85 – 1.94 g/cm³ / 15.4 – 16.2 lb/gal cesium/potassium formate brine were:

- Six reservoir intervals were successfully drilled and completed in a challenging HPHT environment with cesium/potassium formate fluids – all without a well control incident
- Unlike weighted oil-based mud, the formate fluids provide an extremely good well control environment, improving safety and reducing risk
- The use of formate fluids for both drilling and completion gave a very simple transition from the drill-in fluid to the completion fluid
- Statoil has reported that the six Huldra wells drilled and completed with formate brines are each producing with excellent average productivity indices of around 1.9 million scf/day/psi. In fact, plateau production rates were achieved from the first three wells of the six-well project

No alternative

The Huldra project manager says: "For the specific conditions of the Huldra field there is no realistic fluid alternative for successfully drilling and completing the wells."

Literature

Saasen, A. Jordal, O.H., Burkhead, D., Berg, P.C., Løklingsholm, G. Pedersen, E.S., Turner, J., Harris, M.J.: "Drilling HT/HP Wells Using a Cesium Formate Based Drilling Fluid", 2002, SPE 74541.

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