



Statoil: Kvitebjørn

2004–2007

Drilling and completion



Nine reservoir sections were drilled and seven completed with cesium/potassium formate brine in the North Sea's Kvitebjørn field from 2004 to 2007.

Kvitebjørn is a HPHT gas/condensate field under development in block 34/11, located in the south-eastern part of the Tampen Spur area in the North Sea. The field, which is east of Gullfaks and north of Huldra in block 30/2, is in 190 metres of water. The reservoir lies at approximately 4,000 metres depth and is classified as high temperature (155°C/311°F) and high pressure (81 MPa/11,700 psi).

By 2006, nine production wells were drilled and seven completed, all with inclinations varying from 20–45°. All drilling took place from the Kvitebjørn platform's fixed rig.

Of the seven completed wells, five were completed with openhole sand screens and two with cemented liners. Production started after drilling the first two wells, and the remaining part of the well construction programme took place in an environment of progressive reservoir pressure depletion. During drilling of the last well, 140–170 bar of depletion was encountered and losses were experienced. The remaining wells were drilled using managed pressure drilling (see separate case). In all these wells, the cesium formate brine system once again demonstrated clear performance benefits, such as very low equivalent circulating densities (ECDs), moderate to high rate of penetration (ROP), good hole cleaning, and excellent wellbore stability while drilling and logging. Quick, trouble-free, safe and robust completion operations were also accomplished. Furthermore, the wells that have been put on production show high production rates with low skin.

New logging interpretation technique pays dividends

Full openhole formation evaluation of the Kvitebjørn reservoir has been carried out with logging-while-drilling (LWD) tools. The evaluation has been aided by the development of an innovative logging interpretation solution for a LWD density tool, where the extremely high photoelectric effect of cesium-rich filtrate plays a vital role.

Conclusions

The most notable features of these operations were:

- All 8½" Kvitebjørn reservoir intervals were successfully drilled to total depth with inclinations ranging from 23–46°
- Drilling performance was generally very good with moderate to high ROPs, good hydraulics, no incidence of stuck pipe, low torque/drag and excellent hole cleaning
- One of the wells was completed in a record time of 12.7 days with an operation factor of 98.1%. According to the Rushmore database, this is the fastest HPHT well completion ever performed in the North Sea
- Use of cesium/potassium formate brine and stand-alone screen sandface completions in the Kvitebjørn wells has resulted in highly productive wells with low skin
- Full openhole formation evaluation of the Kvitebjørn reservoir has been carried out with LWD tools. The evaluation has been aided by the development of an innovative logging interpretation solution for a LWD density tool, which makes unique use of the extremely high photoelectric effect from cesium-rich filtrate

The Kvitebjørn operations add to Statoil's unique track record – 18 HPHT wells drilled and 22 completed using high-density formate brines with only one well control incident (losses incurred after drilling into a depleted reservoir, later rectified using managed pressure drilling).

Per Cato Berg, Lead Drilling Engineer for Kvitebjørn, says: *“Supported by our tests and data, we feel that cesium formate gives the best productivity for the wells. We have tested formation damage with water- and oil-based alternatives and cesium formate comes out best.”*

Literature

Berg, P. C. et al: Drilling, Completion, and Openhole Formation Evaluation of High-Angle Wells in High-Density Cesium Formate Brine: The Kvitebjørn Experience, 2004–2006, SPE 105733, February 2007.

Pedersen, B. K., Pedersen, E. S., Morris, S. and Constable, M. V.: Understanding the Effects of Cesium/Potassium Formate Fluid on Well Log Response – A Case Study of the Kristin and Kvitebjørn Fields, Offshore Norway, SPE 103067, September 2006.