



Total: Elgin/Franklin 1999–2015

Workover and suspension



2.19 g/cm³ (18.28 lb/gal) cesium formate brine has provided effective well control in over 20 HPHT workover and suspension operations in the Elgin/Franklin fields in the North Sea.

Development activities in Total's Elgin and Franklin fields in the UK North Sea started in 1997 and continue to this day. Seven production wells were initially drilled in Elgin to around 5,600 metres true vertical depth, with maximum deviations ranging from near vertical to 45°. A further six production wells have been drilled in the Franklin field to deeper horizons.

Initial reservoir pressures were around 110 MPa (15,954 psi) and maximum BHST was in the range 190–205°C (374–400°F). The 8½" reservoir intervals were drilled with synthetic oil-based mud (SBM) and completed with 7" liners before running production tubing. The wells were then temporarily suspended for eventual use as gas condensate producers. Design production rates for the combined fields were 14.6 million m³/day of gas and 170,000 bbl/day of condensate.

During preparations to bring the Elgin wells into production in the latter part of 1999 it was discovered that incorrect heat treatment procedures had been used during the production of the 10¾" casing-hangers. A remedial workover plan was prepared to re-enter the wells, recover production strings, replace hangers and re-run the production strings.

Two of the seven Elgin wells (G1 and G3) had already been perforated, making it imperative to kill them with high-density workover fluid before carrying out remedial work. Total first tried oil-based mud as the workover fluid for these live wells, but barite sag problems indicated that a solids-free high-density brine was required for safety reasons.

Choosing the right brine

Prior to 1999, the only solids-free brine available at this density was zinc bromide. This corrosive and hazardous product did not meet any of the performance criteria, other than being solids-free, and would have created a tangible HSE risk, in addition to possibly compromising well productivity and integrity. Alternatively, cesium formate brine – which had recently come on to the market – is benign with a good HSE rating, and is not aggressive towards the metals used in the construction of casing, production tubulars and packers.

Consequently, Total selected cesium formate as the HPHT workover fluid for Elgin/Franklin's well intervention campaign.

Well interventions

The Elgin G1 and G3 wells were displaced to 2.19 g/cm³ (18.28 lb/gal) cesium formate brine prior to running and setting the packer. The production tubings were then run without incident, followed by the tubing hangers. Following this, wells were displaced to inhibited drill water. In G1, a faulty packer had leaked, allowing the formation of hydrates. This well was killed again with cesium formate brine and the hydrate plug melted by circulating hot cesium formate brine into the annulus.

The remaining Elgin wells (G4–G8) requiring re-entry were not so demanding because they were not perforated and had been suspended with inhibited drill water. These re-entries involved simply displacing the wells to 2.19 g/cm³ (18.28 lb/gal) cesium formate brine, recovering completion strings, replacing casing-hangers, re-running completion strings and displacing the wells back to inhibited drill-water.

Conclusions

Cesium formate brine has provided the hydrostatic well-control required for safely carrying out essential remedial work on the casing hangers of seven offshore HPHT wells and in a number of further interventions and suspensions in Elgin, Franklin and Glenelg wells over a period of nine years. In deploying cesium formate brines in these fields, Total created new health, safety and environmental standards for completion and workover brines in the North Sea. Other oilfield operators followed suit, with the result that zinc bromide brine has not been used in Europe since 2004.

Literature

Brangetto, M. et al: Cesium formate brines used as workover and suspension fluids in HPHT field development, Drilling Contractor, p. 108–111, May/June 2007.