INNOVERT® oil-based fluid success on North Sea horizontal well for 16-in., 12 1/4-in., and 8 1/2-in. sections

**Location: North Sea**

**OPERATOR’S CHALLENGE** – The challenge was to drill an 18,000 ft (5,486 m) well into a chalk reservoir at a 90 degree inclination where high losses had been experienced on previous wells in the field. The well consisted of:

- a 16-inch section requiring 10.8 lb/gal mud weight building angle to 40 degrees
- a 12 1/4-inch section with an under-reamer opening the hole to 14 inches, requiring 14.0 lb/gal mud weight building angle to 65 degrees
- an 8 1/2-inch section requiring 10.7 to 12.0 lb/gal mud weight at 90 degrees

**HALLIBURTON’S SOLUTION** – Baroid proposed INNOVERT® high-performance organophilic clay-free oil-based fluid for these difficult angles given its proven track record. The goals were to decrease the risk of formation damage, achieve higher penetration rates, reduce the risk of barite sag, reduce pressure drops, provide improved zonal isolation, provide a higher solids tolerance, retain less oil retention on cuttings, and optimize hydraulics with minimal ECD.

The use of polymeric technology, as opposed to the traditional use of organophilic clays and lignites, allows the fluid to create a unique gel structure that improves suspension but can break easily, thus reducing pressure and reducing the risk of mud losses to the formation.

The INNOVERT system performed well in terms of hydraulics and pressure on this well.

- In the 16-inch section to TD at 4,250 ft (1,295 m), hole cleaning was excellent with a typical ECD of 11.2 lb/gal equivalent mud weight (EMW) with a 10.9 lb/gal mud weight and an average Tau 0 of 10 lb/100 ft².
  - The stand pipe pressure was 2,900 psi (20.0 MPa) with a flow rate of 1,200 gal/min at section TD.
- In the 12 1/4-inch section to TD at 13,135 ft (4,004 m), hole cleaning was excellent with a typical ECD of 14.4 lb/gal EMW with a 14.0 lb/gal mud weight and an average Tau 0 of 10 lb/100 ft².
  - The stand pipe pressure was 5,700 psi (39.3 MPa) with a flow rate of 950 gal/min at section TD.
- In the 8 1/2-inch section to a TD at 18,485 ft (5,634 m), hole cleaning was excellent with a typical ECD of 0.4 to 0.6 lb/gal over the active mud weight of 10.85 lb/gal and an average Tau 0 of 7 lb/100 ft².
  - The stand pipe pressure was 3,700 psi (25.5 MPa) with a flow rate of 500 gal/min at section TD.
- No barite sag was noted during the course of the well.

When compared to the average for the field, surface losses were reduced by 49 percent, and subsurface losses reduced by 60 percent in the 16-inch section, with surface losses reduced by 43 percent and subsurface losses reduced by 100 percent in the 8 1/2-inch section.

The following graphs show the surface (Figure 1) and subsurface (Figure 2) losses for this INNOVERT system well compared to the average losses on previous wells in the field using conventional oil-based mud.
ECONOMIC VALUE CREATED – Overall, 2,450 bbl of drilling fluid were saved (in terms of fluid lost to the formation and the reduced dilution/maintenance volume required) if the averages for losses and fluid built for previous wells in the field are applied to the INNOVERT system used in sections of this well. The savings in terms of the mud cost were about $210,000.

As there were no significant downhole losses while drilling the sections and no time was lost due to suspending drilling operations to cure losses, a further savings of between $380,460 and $760,920 in rig time can be extrapolated from the performance of the INNOVERT system on this well.

During the course of drilling the 12 1/4-inch and 8 1/2-inch sections using the INNOVERT™ system, 44 percent and 73 percent less base oil and chemicals, respectively, were required for maintenance treatments compared to the average for the field using conventional oil-based mud (Figure 3).