CASE HISTORY

Ultra-Low Invasion Additive Counters Instability of Depleted Infill Reservoirs

United Kingdom North Sea

CHALLENGE:

- Highly depleted reservoir sections of the UK Continental Shelf
- Mechanical instability including differential sticking and induced losses
- Equivalent circulating densities (ECD) are always close to leak-off test (LOT) results

SOLUTION:

- FLC 2000 wellbore stabilizer in the 8 ½-in. reservoir section
- Incorporated the additive in a 11.3 lb/gal oil-based mud (OBM)

RESULT:

- The section was drilled in 15 days with the casing successfully run and cemented.
- FLC 2000 was approved for use in the reservoir section for subsequent wells by the operator

OVERVIEW

The severe lost circulation and wellbore instability of the mechanically weak and highly depleted reservoir sections of a well-known infill field illustrate drilling issues intrinsic to mature UK North Sea wells. In this depleted field, induced losses are experienced in the 8 1/2-in. sandstone reservoir section, and in the shale and sandstone sequences, equivalent circulating densities (ECD) are frequently close to leak-off test (LOT) results, typically resulting in borehole breakout and the inability to run liners to target depth, often requiring re-drills to access production targets.

SOLUTION

In a revised infill drilling program, FLC 2000, an ultra-low invasion additive which deposits a thin and impermeable filter cake or "shield", was incorporated in the oil-based mud (OBM) system used to drill the 12 1/4-in. intermediate and the 8 1/2-in. reservoir sections.

By laying down an impenetrable shield over pores and microfractures, the technology effectively restricts the transmission of destabilizing wellbore pressure to the pore fluid or insitu fractures and, in turn, reduces filtrate invasion into the matrix permeability and microfractures. This mechanism, in essence, raises the fracture initiation pressure by shielding or isolating the mud pressure in the wellbore from the geology, effectively inhibiting the fracture propagation process. Specifically, when a fracture begins to develop, a low permeability seal instantly forms over the fracture itself, preventing the continued invasion of fluid into the fracture and preventing continued fracture propagation.

RESULT

After displacing with 11.1 lb/gal OBM, pre-treated with 5 lb/bbl of FLC 2000, a milling BHA was run in hole (RIH) and a window milled from 8529-ft to 8549-ft and new formation drilled to 8,560 ft, at which point a LOT recorded an equivalent mud weight of 12.63 lb/gal. At 9,712-ft, 30 bbl of mud was lost, and with the density having steadily increased from 11.1 to 11.3 lb/gal, the ECD was very close to formation limit of 12.56 lb/gal. The flow rate was reduced from 550-500 gpm with base oil added to reduce the mud weight until the ECD was manageable. The mud weight was returned to its original 11.1 lb/gal and drilling continued with some losses, which were controlled with two lost circulation material (LCM) pills. After heavy losses at 11,669-ft had depleted the additive concentration beyond its usefulness, FLC 2000 was re-introduced to the active system at 5 lb/bbl at the top of the Kimmeridge, where drilling continued to the reservoir section with no additional losses or drilling issues. The section was drilled in 15 days with the casing successfully run and cemented.

The operator has since drilled a numerous re-entries and sidetracks, successfully intersecting highly-depleted reservoir sections at programmed depth, after which the liners have been run and installed with minimal to zero losses.