

Drilling and Running Open Hole Multistage Fracturing Completion Optimized with Managed Pressure Drilling in Unconventional Tight Gas in Saudi Arabia

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ABSTRACT

Managed pressure drilling (MPD) has improved horizontal drilling performance and running of an openhole multistage fracturing (OH MSF) completion in a tight and abrasive sandstone reservoir with a narrow mud weight window that could not be drilled and completed economically. Subsequent running of an OH MSF completion has tighter annular clearance compared to conventional cement plugs and perforate systems due to the presence of mechanical and swell packers. While running in hole (RIH) this clearance has a plunger effect and creates surge and swab pressure escalating the risk of lost circulation and well flow. While drilling a horizontal well in a reservoir with narrow window between pore and fracture gradient, the equivalent circulating density (ECD) can exceed the fracture pressure and induce lost circulation and subsequent well flow. The MPD method, also known as “walking the Line,” allows the operator to use a lower mud weight, which in addition to surface applied back pressure can hold the bottom-hole pressure (BHP) constant while drilling and making connections. This paper focuses on two horizontal wells in South Ghawar (Eastern Province of Saudi Arabia) that were successfully drilled and OH MSF completed with MPD. Initially, Well A (second horizontal in the field) was drilled with conventional overbalance mud weight and took a swab kick while pulling out of hole, requiring the high mud weight, which in turned induced lost circulation. Use of MPD allowed operator to drill horizontal well with lower mud weight without exceeding fracture gradient. A subsequent dummy run prior to running an OH MSF completion indicated that a lower MW is required to allow for better hole cleaning circulation while RIH with the completion. OH MSF mechanical and swell packers were successfully run to bottom with MPD. The completion was run with liner hanger and packer on drill pipe. OH MSF provided significant time and cost savings compared to a cemented liner with clean-out runs. Well B (third horizontal) was drilled with MPD. A dummy run with MPD simulated washing obstructions in lateral without lost circulation. As a result, MPD was not used and the well was displaced to an over-balanced mud weight prior to running the completion. OH MSF mechanical and swell packers were successfully run to bottom as an off-bottom cemented monobore completion with significant time and cost savings compared to running liner hanger and subsequent clean-out and filtration requirements.