



SPE 166170

Managed Pressure Drilling, Casing and Cementing Enables Success in Conventionally Undrillable Wells in the Harding Field

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This paper was prepared for presentation at the SPE Annual Technical Conference and Exhibition held in New Orleans, Louisiana, USA, 30 September–2 October 2013.

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Abstract

Managed Pressure Drilling (MPD) has been used around the world to help drill wells where there is a tight mud weight (MW) window, due to the ability of the technology to more accurately control annular bottom hole pressure (BHP) while drilling, tripping and during connections. This paper presents the case history of the Harding PNE2a well design and execution in 2012, with particular focus on the planning process, design methodology and execution particulars associated with the use of MPD as the enabling technology to drill, case and cement the well. The team also employed a novel Fluid Pressure Transmission Pill (FPTP)¹, composed of a cross-linked polymer, to maintain hydrostatic pressure while tripping BHAs and during deployment of the liner and sand control equipment.

Earlier attempts to drill Extended Reach Drilling (ERD) wells from the Harding platform to the PNE4 and PNE2 reservoir targets resulted in drilling issues including packoffs and severe lost circulation due to BHP departing from the tight window of useable mud weights between the pressures at which the formation is expected to collapse or fracture. Use of MPD on the PNE2a well directly contributed to achievement of the well's objectives, and the operation was able to provide good control of BHP throughout the well construction process, in both 12-1/4" and 8-1/2" sections. This led to the long unstable shale sections being maintained with no cavings being observed while drilling, a first for the field, and the cementation of the long 9-5/8" liner being performed without losses despite the tight operating window and the use of conventional cements.

Background and Drilling Challenges

The Harding Field is a mature North Sea platform development upon which an infill drilling project has been initiated to access the remaining oil. This tends to lie in more distant, hard to reach targets, including those in the far North of the field, and a new field located south of the platform. These would be accessed by ERD wells. A combination of reservoir depletion and weak interbedded sands and shales has resulted in a further reduction in the already narrow MW window between fracture and formation collapse pressures. The window had decreased from 2 ppg to 0.7 ppg, equivalent to a 200 psi BHP window. Extended reach drilling to access the oil accumulations most distant from the platform would generate equivalent circulating densities that are 50% greater than the available MW window, and are therefore not conventionally drillable.

It was thought that MPD may be a suitable technology for accessing these remaining reserves. The IC6 well was drilled in early 2010 and was the first to trial MPD for the Harding operator in the North Sea, although the technology was only used in drilling the reservoir section. IC6 was chosen as a test well for MPD as it was felt that there should be a good chance of success with conventional drilling. Thus if operational issues were experienced with the MPD system, a return to conventional drilling could be made without jeopardising the success of the well. The 8-1/2" x 9-7/8" reservoir section of IC6 was drilled MPD at inclinations of 80 – 90° within a downhole mud weight window of 11.8 – 12.8ppg, demonstrating that despite some operational issues, the use of MPD was appropriate for Harding.