

Improving Surface Hole Foam Drilling Performance in Karstified Limestone in Papua New Guinea

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This paper describes operational efficiency and safety improvements made while foam drilling the Darai Limestone in the highlands of Papua New Guinea. Significant hole problems encountered on previous 17 ½-in. surface hole sections using foam drilling techniques often resulted in stuck pipe incidents, hence directional drilling was considered to be too risky. Foam drilling precluded the use of positive pulse measurement-while-drilling (MWD) telemetry, so gyro directional surveys were used. In drilling the Darai Limestone, there are three primary areas of concern.

First, because the foam injection was stopped during connections, the risk of stuck pipe events increased, as drilled solids dropped out and packed off around the bottomhole assembly. Also, significant time was required to bleed off drillstring pressure before each connection and to reestablish stable two-phase circulating conditions, which increased connection times. Consequently, a continuous circulation subs system was used to provide continuous hole cleaning and to maintain two-phase circulation and constant BHP during connections, which mitigated stuck pipe events and reduced connection times.

Second, because of the risk of stuck pipe associated with directional drilling on previous wells, the 17 ½-in. hole sections had to be drilled vertically. Nearby wells were shut in because of potential collisions with producing wells, with obvious cost implications. Gyro directional surveying also resulted in longer connection times. Consequently, a recent 17 ½-in. section was directionally drilled with a mud motor and an electro-magnetic MWD survey tool, which provided continuous directional tool faces and enabled surveys with negligible use of rig time, as compared to gyro single shots. Directional drilling managed the risk of collision with nearby wells, enabling continued hydrocarbon production from other wells during drilling.

Third, because the Darai has typically been drilled vertically, then drilled directionally in the lower, highly tectonically stressed formations, it was difficult to maintain directional control and manage the increased stuck pipe risk attributable to breakout in the lower formations. On a recent well, inclination was built in the Darai Limestone, enabling the lower formations to be

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drilled with a smaller inclination, reducing wellbore breakout.

Combining low risk directional drilling with continuous circulating systems improves drilling time and safety, mitigates stuck pipe conditions, and greatly improves the efficiency of foam drilling top hole sections in the Darai Limestone. The technology can be applied to wells in any areas, to enable more effective drilling in all hole section sizes, using mud or two phase fluids.