



Massive Salt Dome Drilled Riserless on Ultra-Deepwater Well Using Super-Saturated Water-Based Drilling Fluid in Eastern Mediterranean

Pump and Dump drilling on Deep-water operations requires a high degree of logistical planning to avoid expensive NPT. In this case, technical studies were performed to improve and overcome logistic limits.

CHALLENGE	SOLUTION	RESULT
<ul style="list-style-type: none"> • Ultra-DeepWater Well (7,600 ft) • Thick Salt Dome formation (9,800 ft) to be drilled with WBM in riserless – pump & dump • Large volume of Salt-Saturated WBM required (38,000 bbls) • Limited Mud Plant volume and access to supply vessels. 	<ul style="list-style-type: none"> • Designed a Super Salt Saturated WBM • Lab testing undertaken to evaluate polymer performance & dilution required (calculation based on fluid density) • Concentrated fluid system - reducing volume to be mobilized offshore (dilute at rigsite) • Reduced requirement for vessels needed to move the fluid offshore 	<ul style="list-style-type: none"> • Reduced mud volume mobilized by 47% using Super Salt Saturated WBM • Reduced CO₂ footprint thanks to less resources needed to be mobilized offshore • Diluted Super Salt Sat WBM to achieve saturation level • Drilled section successfully with no issues

CHALLENGE

Offshore Eastern Mediterranean Sea is one of the world's emerging ultra-deepwater basins, with water depth exceeding 7,600 ft. The challenges inherent to ultra-deepwater situations are exacerbated in exploratory wells. Furthermore, on this well, a shallow salt dome was to be drilled in the riserless top hole section using a salt saturated Water Based Mud (WBM) and 'pump and dump' technique, demanding focus on fluid management due to the large hole volume and high flow rates required. The major challenges around planning and successfully executing the drilling of this interval were around the logistics of the operation, in particular the limited number of supply vessels available and the maximum capacity of the Liquid Mud Plant (LMP). Initial calculations estimated that a total of nearly 38,000 bbls of WBM would be required to drill the 9,800 ft of salt dome, while the LMP capacity was limited to c. 6,000 bbls. In addition, while three supply vessels were available to support the operation, available storage capacity was limited due to a combination of space dedicated to other types of drilling fluid, and the demand for the same vessels to support other operations.

SOLUTION

A plan was developed to mix and store a Super Saturated mud system based on sodium chloride at the Liquid Mud Plant, which could then be transferred to the supply vessels when available and shipped to the rig. Once received at the drillship, the Super Saturated Brine Fluid would then only require dilution



with seawater down to normal salt saturation level to be used to drill.

Extensive laboratory testing was performed to evaluate the behaviour of the Super Saturated WBM at a density of 11.43 ppg - significantly above the normal salt saturation density of 10 ppg – specifically to evaluate the behaviour of the polymers in the fluid system at such elevated concentrations of salt and to ensure that no settling (sag) was observed over a minimum of 15 days under static conditions (when the fluid was being stored and transported). During these tests, it was noted that the density adjustment calculation for Super Saturated WBM should be based on the desired fluid salinity rather than density by mass balance. It was also observed that, as the undissolved salt goes into solution during dilution, the behaviour of the polymers can change as more free water becomes available.

RESULTS

The two surface intervals to were successfully drilled riser less using the designed Super Salt Saturated System and 'Pump and Dump' procedures as per planning. Supply of sufficient mud was maintained on the Drillship throughout the operation despite only two of the three proposed supply vessels being available during this operation. Excellent hole conditions were reported while running in casing and casing shoe integrity test results exceeded expectations. The risk of pitting corrosion was minimised by the addition of an Oxygen Scavenger to the fluid while drilling.

The design and implementation of a Supersaturated Salt drilling fluid for Pump and Dump operations greatly reduced the volume required to be mixed at the LMP, allowing the 6,000 bbl capacity plant to meet the demands of this operation, while also consequently reducing the overall CO₂ footprint of the operation.