Case History

Newpark's Expertise and Customized Water-Based Drilling Fluids Program Enables the Successful Drilling of Two Ultra-Deepwater Exploration wells, Offshore Cyprus

"I am writing to you to express my gratitude for your exceptional effort during both well activities…The ultra-deep explorative wells were successfully drilled despite various unplanned technical difficulties we faced"

Operator's Drilling Fluids & Cement Supervisor

CHALLENGE	SOLUTION	RESULT
• 2-well wildcat well campaign in ultra-deepwater frontier area • Challenging carbonate reservoir and salt-dome • Avoid reservoir formation damage, and obtain optimal logging results	• DeepDrill™ high-performance water-based drilling fluid (HPWBM) • Customized salt-saturated water-based CleanDrill™ Reservoir Drill-In Fluid (RDF) program to avoid formation damage • ClearTrack™ hydraulic simulation and modelling software	• Newpark fluids specialists' experience and expertise ensured a trouble-free campaign • All operational objectives were safely achieved in accordance with the project plan • Zero fluids related NPT recorded • Clear well logs obtained

OVERVIEW

An Operator planned a 2-well wildcat campaign in the Mediterranean Sea off Cyprus, which is one of the world's emerging ultra-deepwater basins. The objective of the campaign was to characterize the extreme north side of the 'Thor' reservoir.

CHALLENGE

The challenges of drilling in ultra-deepwater are exacerbated in exploratory wells, with additional focus placed on the reduction of risks associated with Equivalent Circulating Density (ECD) management, downhole losses, and wellbore instability. As this region is a relatively new drilling frontier, the lack of dedicated facilities to support large-scale deepwater projects presented an additional challenge.

Well #1 would be drilled in a water depth of 2,100m (6,890ft) and Well #2 in a water depth of 2,300m (7,546ft).

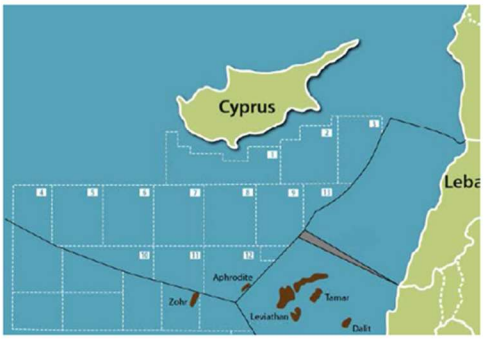
Both planned wells presented similar geologies, characterized by a carbonate reservoir sealed on top by a salt dome.

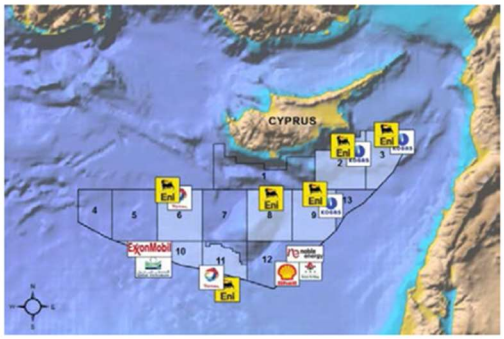
Newpark's experts concluded that the first well could be drilled with a combination of salt-saturated brine and high-viscosity sweeps, with the fluid density adjusted accordingly.

While the first well was drilled with no fluid related issues, on the second well, the Newpark fluids

specialists applied experience from the first well in selecting the DeepDrill™ high-performance water-based drilling fluid system due to the presence of a shale interval above the reservoir.

The Operator's original drilling fluids program called for the use of barite as a weighting agent in the carbonate reservoir but, due to the low fluid density required to drill the formation, Newpark instead proposed the CleanDrill™ reservoir drill-in fluid (RDF) weighted up as required with calcium carbonate to reduce the potential skin factor impact.





SOLUTION

In consultation with the Operator, Newpark designed a customized drilling fluid program featuring water-based systems (WBM) for both wells. Using WBM facilitates better logging quality especially the image logs needed for exploratory wells.

The first well was drilled utilizing Managed Pressure Drilling (MPD) with a fluids program comprising sea water, salt-saturated brine and high viscosity sweeps. Despite unexpected losses occurring which can be typical of exploratory wells, and a stuck pipe event which necessitated a side-track in the lower salt dome section to reach TD at 5,200m (17,060ft) MD, the well was tested and successfully plugged & abandoned.

The second well was designed with a vertical trajectory and a total depth planned of 4981.5m (16,344ft) MD/TVD (Measured Depth/Total Vertical Depth), targeting the tertiary-cretaceous carbonate which was expected to be gas bearing.

The first riserless sections were drilled utilizing sea water and guar-gum viscous sweeps then, on encountering the salt dome formation, the drilling fluid was switched to a salt-saturated sodium chloride-based brine at 1.20SG with salt saturated viscous pills. Once the section Total Depth (TD) was reached, the well was displaced to a PAD mud at 1.45SG to maintain hydrostatic pressure and avoid borehole instability issues while running the casing.

At this stage the blow-out preventer (BOP) and riser were installed and drilling continued with a 17½" interval enlarged to 18½" hole diameter to isolate the salt sequence, prior to enter the upper Miocene formation. This interval was also drilled utilizing a salt saturated polymer mud at 1.25SG (weighted up to 1.32SG with barite).

The 12¼" hole section was drilled with Newpark's highly inhibitive DeepDrill high-performance water-based mud (HPWBM) system, to 4924.6m (16,157ft) TVD. MPD techniques were employed because of the narrow window between pore and fracture gradients, and due to some uncertainty on gradients estimation.

The DeepDrill fluid system was pre-mixed at Newpark Fluids Systems' liquid mud plant (LMP) in Limassol. During drilling, as dictated by downhole conditions, the DeepDrill system was weighted up to 1.25 SG first, and then to the final mud weight of 1.31SG needed to get to section TD, set just above the carbonate platform.

Case History

The 8½" reservoir section interval was drilled with same MPD technique used in the previous interval, reaching almost 5,300m (17,388ft) MD/TVD with a combination of CleanDrill™ RDF and rollover/coring fluid, solid-free in the range 1.10 - 1.20SG.

The operator decided to drill a geologic side track of the 8½" reservoir interval over 5,000m (16,404ft) into the limestone formation utilizing a salt-saturated brine fluid with bio-polymer viscosifiers, fluid-loss reducer and corrosion inhibitor. A slotted 7" Liner was run and installed before the well was displaced with a sodium chloride-based completion fluid, The well was tested and then plugged & abandoned in accordance with the drilling program.

Initially, the drilling program for the reservoir section called for barite as the weighting agent in the drilling fluid. Newpark fluids specialists determined that the required density of 1.20SG could be achieved with just sodium chloride brine. This would have the advantage of not adversely affecting well-testing of the reservoir. This solids free RDF designed by the Newpark team avoided contamination of core sample permeability, and therefore improved the reservoir characterization results.

The fluid was designed using Newpark's proprietary ClearTrack™ hydraulic simulation and modelling software to meet drilling and logging objectives while balancing factors like corrosion potential and polymer degradation. ClearTrack simulation accommodates various MPD techniques for deepwater projects and provides data with very high levels of accuracy.

MUD PARAMETERS (real values on rig site)	**U.M.**	**Section 8**
Bit diameter	in	8 ½" ST
Hole Interval (MD/TVD rkb)	From (m)	4887
	To (m)	5003
Footage	m	116
Liner	in	7
Type of fluid	-	**WBM Solids Free**
Density	Kg/lt	1.20
Marsh Viscosity	sec/l	58
PV	cP	15
Yield Point	lb/100ft²	25
Gel (10")	lb/100ft²	9
Gel (10')	lb/100ft²	12
6 RPM	-	11
pH	-	9 – 9.5
API Filtrate	ml/30 min.	6.3
Chlorides	mg/lt	175 000

Fluid parameters

RESULTS

All operational objectives were safely achieved in accordance with the project plan, and fluid properties were maintained within specifications throughout drilling, logging, well testing, plugging and abandonment of these two wells.

A careful approach facilitated delivery of operational objectives without incidents of fluids-related non-productive time (NPT). All logistical and operational objectives were achieved in a safe and environmentally compliant manner.

Clear well logs were obtained by avoiding the use of barite in the CleanDrill monovalent brine based RDF.

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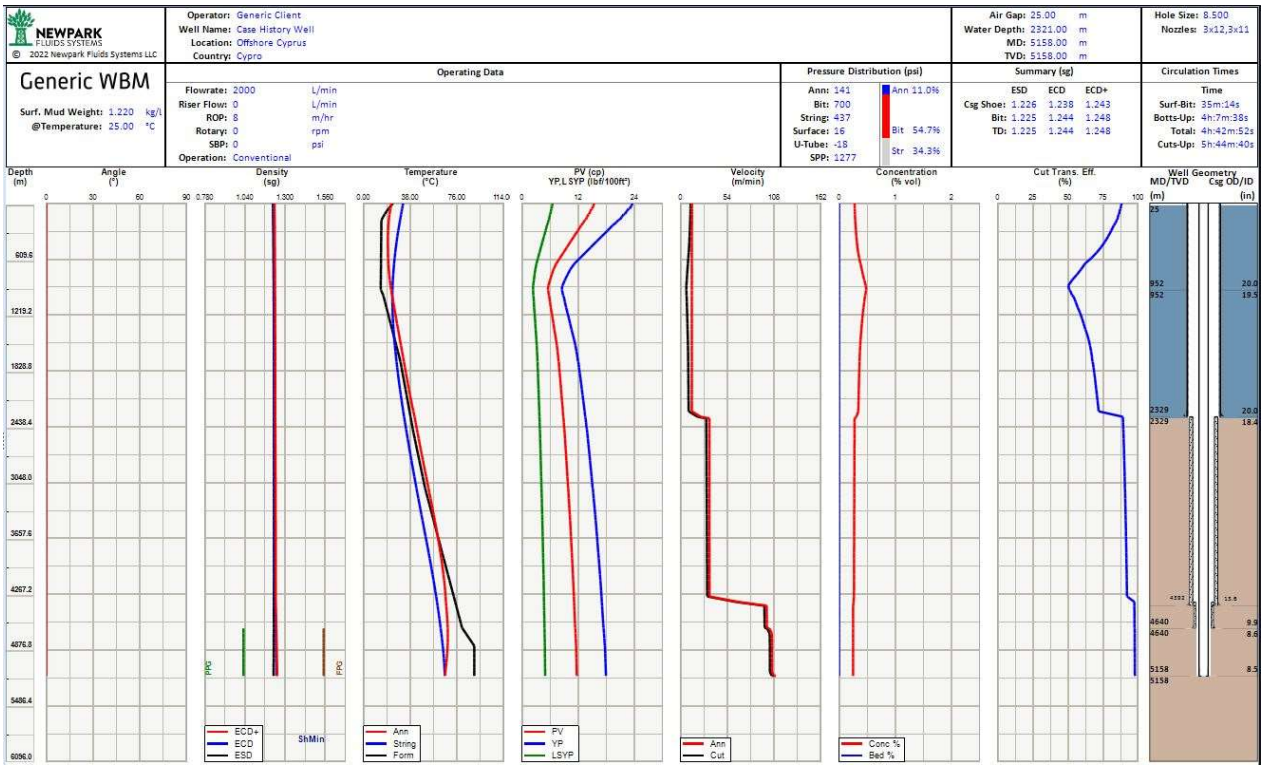
Case History



Newpark's ClearTrack hydraulic simulation and modelling software

Newpark Liquid Mud Plant (LMP) mobilized specifically to support this deepwater campaign

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