LUKOIL-Nizhnevolzhskneft Achieves 82% NTG in 2.5-m-Thick Sweet Spot with PeriScope HD Service

Integrated drilling system achieves 3,694-m section in 9½-in horizontal section in one run, lands wellbore in thin target 6 days ahead of section AFE, Caspian Sea

CHALLENGE
Maximize reservoir exposure and ROP while placing long horizontal section of extended-reach well within thin reservoir.

SOLUTIONS
- Optimize drilling parameters and trajectory control using PowerDrive Xceed* RSS and TeleScope* high-speed telemetry-while-drilling services.
- Increase drilling efficiency using a PDC bit with ONYX II* premium PDC cutters matched to RSS using the IDEAS* integrated drillbit design platform and DBOS OnTime* real-time drillbit optimization system.
- Ensure smooth completion with a predrill wellbore stability study, MEGADRIL† oil-base drilling fluid system, and advanced petrophysics interpretation and geomechanics services.
- Maximize reservoir contact without crossing into the water zone by using PeriScope HD* multilayer bed boundary detection service and EcoScope‡ multi-function logging-while-drilling service.

RESULTS
- Drilled 3,694-m section in one run at average ROP of 48 m/h.
- Achieved overall 82% net-to-gross (NTG) ratio.

Place long horizontal section within thin reservoir
The 9½-in horizontal section of Well P-120, an offshore extended-reach well LUKOIL-Nizhnevolzhskneft was drilling in the Korchagina field of the Caspian Sea, had to be placed within a reservoir with a gross vertical thickness of 4 to 6 m — thinner than any reservoir targeted by previous extended-reach wells in the project. The upper part of the reservoir was interbedded with high-density laminated intervals, the lower part gradually transitioned from shale to sand, and the sweet zone within the reservoir was only 2–2.5 m thick.

In addition, the 3,694-m long section had to be kept 5 m above the oil/water contact, which was very close to this targeted interval in the reservoir; a lack of vertical offset data in the drilling direction created great uncertainty about formation properties and structural dip; collision with nearby wells had to be avoided; and maximum dogleg severity was limited by the need for smooth completion operations. All these steering constraints made it challenging to achieve LUKOIL-Nizhnevolzhskneft’s objective of maximizing both the NTG ratio and ROP.

Provide precise trajectory control
Schlumberger met the challenge by integrating many services and technologies to optimize drilling parameters and provide precise trajectory control. This successful placement was achieved using the PeriScope HD service with a PowerDrive Xceed RSS. The PeriScope HD service allowed proactive geosteering and provided valuable information about reservoir geometry and substructure to supplement real-time formation evaluation data acquired by the EcoScope service. Real-time measurements from the PeriScope HD and EcoScope services were transmitted to surface, where LUKOIL-Nizhnevolzhskneft and Schlumberger petrotechnical experts delivered real-time interpretation.

Schlumberger utilized integrated technologies, including the PeriScope HD service, to optimize drilling parameters and provide precise trajectory control. The custom drilling approach helped LUKOIL-Nizhnevolzhskneft reach TD of the horizontal section 6 days ahead of AFE.
The PowerDrive Xceed RSS was teamed with a Smith Bits MSi516 bit that included ONYX II cutters and was specially designed using the IDEAS integrated drillbit design platform. Real-time drillbit optimization system was used to maximize drilling efficiency and to improve overall performance based on statistical processing of offset drilling parameters and rock properties. It was the first commercial use of the DBOS OnTime real-time drillbit optimization system in Russia.

To address the need for smooth completions, a predrill wellbore stability study was conducted, and mud weight was defined. The M-1 SWACO MEGADRIL oil-base drilling fluid system was selected because of its inherent lubricity and shale inhibition compared with water-base mud. The fluid system lowered the friction coefficients. Additionally, the low-end rheology allowed the equivalent circulating density (ECD) to be lowered while wellbore stability was maintained and cuttings removal was facilitated in the long horizontal section. These systems and services enabled a trouble-free drilling and smooth completion run.

Drill horizontal section in one run
The entire 3,694-m horizontal section was drilled in one run—6 days ahead of section AFE. This set world records for the longest PeriScope HD service geosteering run in any size hole and the longest 9½-in section drilled in a single run by a PowerDrive Xceed RSS. ROP averaged 48 m/h, higher than any previous ROP in the Korchagina field project. Geosteering the wellbore using the PeriScope HD service achieved 86.7% reservoir exposure in the first 2,936 m of the run. At that point, the technical limit of the drillpipe made it necessary to discontinue geosteering for the final 800 m to keep torque levels under control. That lowered overall NTG to 82%, which still surpassed any previous NTG in the project.

The record-setting NTG and ROP were made possible by advanced joint engineering planned and the PeriScope HD service’s detection of bed boundaries in time to avoid penetrating high-density intervals. Drilling through those intervals would have strongly deflected the BHA, forcing the directional driller to reduce ROP to remain in the drilling tunnel. LUKOIL-Nizhnevolzhskneft chose to use PeriScope HD service in several more complicated future wells in the Korchagina field.

The BHA that included the PeriScope HD service allowed the operator to achieve a record overall NTG ratio of 82%.