Drill a challenging offshore ERD well

While developing the Korchagina field from an ice-resistant stationary platform in the Caspian Sea, LUKOIL-Nizhnevolzhskneft wanted to drill a challenging horizontal ERD well. This well would be the longest in the project—a 5,555-m horizontal section at 9,000-m MD and 1,565-m TVD. The last 1,500 m of the horizontal section was expected to exit the seismic cube boundaries where geosteering would be the most challenging because of structural uncertainty.

Adding to the operation’s difficulty was the anticline structure’s several faulted zones, which could lead to significant mud loss and downtime caused by wellbore instability. Streaks of hard formation were expected inside the pay zone, and the drilling environment included several intervals with high shock and vibration as well as the risk of stick/slip, which could result in Schlumberger tool failure downhole. The operator also had to avoid colliding with existing production wells, maintain competitive NTG, and achieve planned production rates in the high-structural-uncertainty reservoir.

**CASE STUDY**

**LUKoil-Nizhnevolzhskneft Sets Record with Single-Run 4,895-m Horizontal Section, 88.5% Net to Gross**

Integrated drilling solution that included GeoSphere reservoir mapping-while-drilling service was engineered at local PTEC and met operator’s ERD objectives, Caspian Sea.
**CASE STUDY:** LUKOIL-Nizhnevolzhskneft drills world-record 4,895-m horizontal ERD section in one run, Caspian Sea

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**Develop a custom-engineered drilling solution**

Drilling the long horizontal section required thorough planning and collaboration between cross-domain teams of Schlumberger engineering experts at the regional PetroTechnical Engineering Center (PTEC). The PTEC teams performed a complete technical analysis that considered the complex environment, including faults, fluid contacts, and transition zones. GeoSphere reservoir mapping-while-drilling service and a number of other Schlumberger technologies and services were chosen to address LUKOIL-Nizhnevolzhskneft’s challenges. The GeoSphere service mapped formation boundaries that were located up to 24 m from the wellbore, helping to confirm the oil/water contact.

Real-time geomechanics surveillance and 3D modeling were used to assess wellbore instability risks. Using EcoScope* multifunction LWD service, safe limits within narrow mud weight windows were identified, which helped the PTEC experts develop appropriate measures to prevent and mitigate mud loss and downtime. In addition, advanced survey management techniques using geomagnetic referencing services (GRS) identified measures to reduce lateral position uncertainty and to ensure TVD. The DBOS OnTime* real-time drilling optimization system delivered drilling recommendations to the rig-floor display.

The PTEC used the IDEAS* integrated drillbit design platform and the i-DRILL* engineered drilling system design to identify solutions that would minimize vibrations and stick/slip during drilling operations as well as optimize BHA performance for the environment. A Smith Bits 9½-in SHARC* high-abrasion-resistance PDC drill bit fitted with a central Stinger* conical diamond element was chosen to increase PDC bit durability and ROP.

Schlumberger utilized a 3D geomechanical model that allowed identifying the safe mud-weight window and mitigating geomechanics-related risks in real time. While drilling, the team used the MEGADRIL† oil-base drilling fluid system from M-I SWACO and monitored equivalent static and circulation densities (ESD and ECD) to be within recommended limits.

The PowerDrive Xceed* ruggedized RSS was chosen for the BHA because its accurate point-the-bit directional control would enable controlling well trajectory and more effectively penetrate hard formation streaks.

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**Achieved drilling objective, set multiple records**

LUKOIL-Nizhnevolzhskneft drilled 4,895 m of the horizontal section in one run; based on the real-time reservoir mapping data obtained using the GeoSphere service, the operator decided not to drill further and called TD. The GeoSphere service allowed LUKOIL-Nizhnevolzhskneft to achieve a NTG of 88.5%, totaling 4,316 m. Five faults and their displacement magnitude were also identified. Using the EcoScope service and MEGADRIL drilling mud system, LUKOIL-Nizhnevolzhskneft was able to maintain wellbore stability with no downtime.

Because of i-DRILL system and IDEAS platform modeling, the drillstring and drill bit experienced almost no shock, vibration, or stick/slip. This reduced the load on the BHA and bit and allowed reaching TD without tool failure. Collision risks were also minimized because of the GRS service on this project.

Only five trajectory changes were required while geosteering compared with an average of 15–20 in offset wells. This led to less wellbore curvature and reduced drilling time due to fewer downlinks. LUKOIL-Nizhnevolzhskneft was later able to run liner without rotation down to 7,000 m.

Ultimately, LUKOIL-Nizhnevolzhskneft met its drilling objectives while also setting several records:

- Longest and most complex well on the project: 8,005 m
- Longest 9½-in section drilled in a single run, setting a run length record for Smith Bits: 4,895 m
- World record for single-run footage using GeoSphere service: 4,908 m
- Project record for footage drilled in 24 hours: 837 m.

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*Mark of Schlumberger.
†Mark of M-I L.L.C.

Japan Oil, Gas and Metals National Corporation (JOGMEC), formerly Japan National Oil Corporation (JNOC), and Schlumberger collaborated on a research project to develop LWD technology that reduces the need for traditional chemical sources. Designed around the pulsed neutron generator (PNG), EcoScope service uses technology that resulted from this collaboration. The PNG and the comprehensive suite of measurements in a single collar are key components of the EcoScope service that deliver game-changing LWD technology.