

Offshore Well Tests Save Lukoil 4 Days' Rig Time, USD 1.6 Million

Reservoir potential proved with no nonproductive time, Caspian Sea

CHALLENGE

Conduct long-duration offshore well tests to

- prove reservoir potential and the viability of a future pressure-sustained pumping system in three zones (one water and two oil)
- estimate affects of future fracture operations on reservoir behavior and stability
- test both oil zones, one of which required testing both before and after fracture operations to anticipate future effects on the reservoir.

SOLUTION

Test water zone using an electrical submersible pump (ESP) with tubing-conveyed perforating (TCP) guns; test and achieve maximum flow rate in one oil zone; and test before and after fracturing in the second oil zone.

RESULTS

- Executed first successful water-zone test in the Russian Caspian Sea and proved reservoir potential.
- Achieved maximum flow rate of 2,969 bbl/d in first oil zone.
- Saved at least 4 days' rig time and an estimated USD 1.6 million by combining perforating, prefracture testing, fracturing, and postfracture testing in a single trip.



Test three zones for production potential and fracture effect while remaining compliant

Lukoil was conducting exploratory drilling operations in the Russian region of the Caspian Sea with its *Astra* jackup rig. To evaluate the reservoir potential and estimate the economic feasibility of a potential pressure-sustained pumping system, the company chose to conduct a long-duration test in the water zone (Zone 1). Lukoil required treated water to be completely void of hydrocarbons before being pumped to specialized tanks on the barge. Further, two oil zones (Zone 2 and Zone 3) were to be tested. Zone 3 required testing before and after fracturing to anticipate how the fracturing would affect reservoir production.

Ensuring that all test operations followed the strictest HSE standards with no accidents or NPT was mandatory.

Run multiple tests in one downhole trip

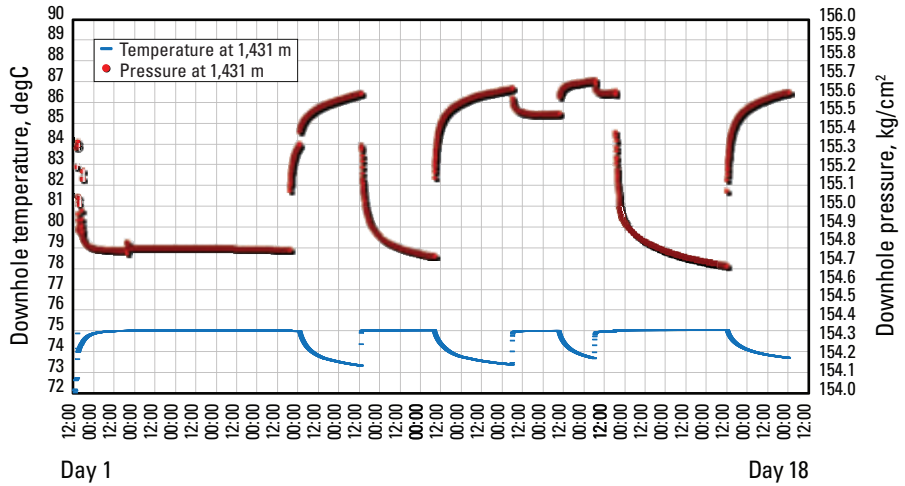
To better achieve its test objectives, Lukoil consulted with Schlumberger on this complex project. To expedite water-zone testing operations in Zone 1, an ESP was combined with TCP guns, a shock absorber, a production valve, and quartz gauges in the same string. A hydraulic-delay firing head initiated perforation, and the shock absorber protected the ESP from perforating shock. The well flowed for 16 days, reaching a maximum water rate of 9,350 bbl/d [1,115 m³/d]. Cumulative water produced in the operation totaled 85,541 bbl [10,200 m³]. To ensure that the stored water contained no hydrocarbons, Lukoil used the CleanPhase* well test separator to provide improved separation and reduce the risk of unseparated fluid disposal.

Oil Zones 2 and 3 were then tested. Zone 3 required perforating, then testing, then fracturing, and then another test operation to estimate how fracturing would affect the zones. Schlumberger proposed doing so in one run to save rig time and associated costs. First, the downhole test string with TCP guns and PowerJet* deep-penetrating shaped charges was run in hole, and the guns were fired. Immediately after firing, the guns were automatically dropped to the rathole by using the SXAR explosive automatic gun release system, which saved hours of rig time. The reservoir was then fractured through the downhole test string. After the fracturing operation, the well was tested through the string, which avoided pulling out of the hole, running back in the hole, and conducting one well-kill and one displacement operation.

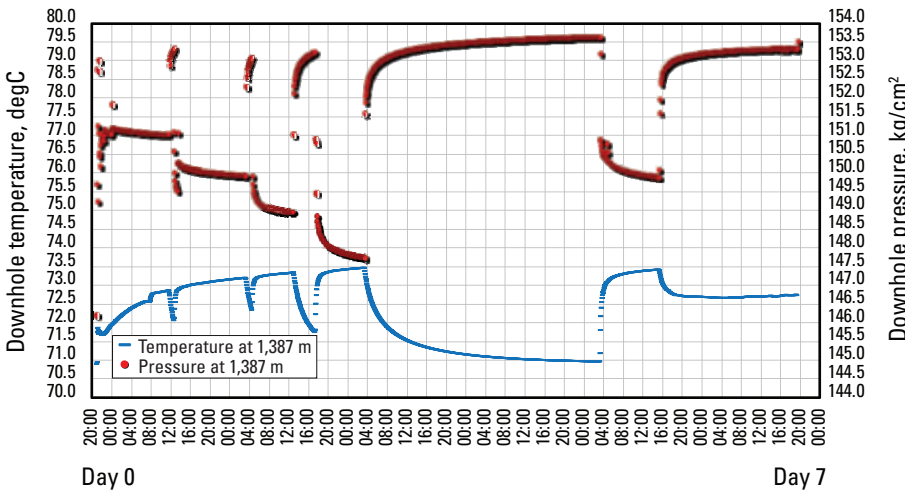
“Successful performance during this project helped achieve our objectives and will be considered in future development of this field. Professional services at the highest levels of quality and responsibility, meeting time frames, and resolving technical issues in the process confirm the Schlumberger specialists’ qualification.”

Dr. Sergey Deliya
Chief Geologist
Lukoil-NVN

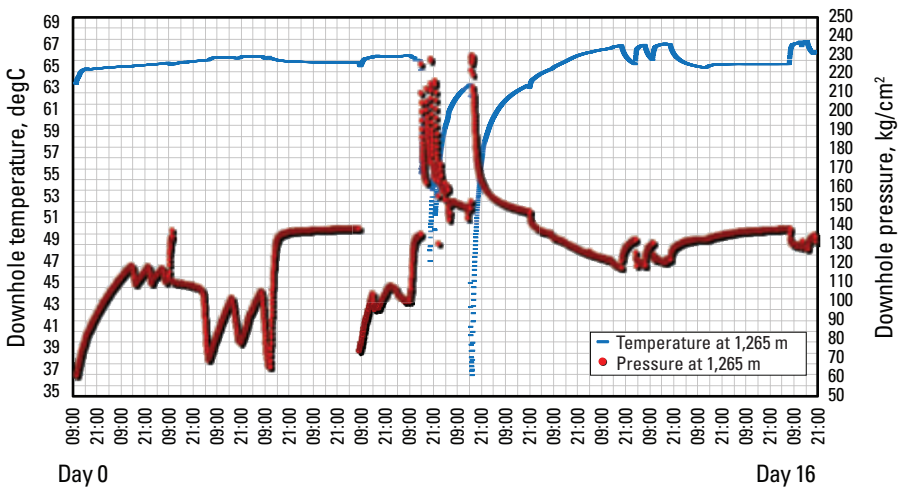
CASE STUDY: Complex water- and oil-zone tests prove reservoir potential, Caspian Sea



Downhole plot of Zone 1 (water zone).



Downhole plot of Zone 2 (first oil zone).



Downhole plot of Zone 3 (second oil zone).

Save rig time while ensuring effective, safe cleanup

This complex array of water- and oil-zone test operations was conducted in a timely, HSE-standards-compliant manner with no accidents or down time. Running the tests for Zone 3 in one trip saved Lukoil 4 rig days and a total of USD 1.6 million in associated costs. The results of these tests showed the fracture effect to increase production by 10 times. In addition, avoiding killing the well, pulling out of hole, running in hole, and displacement enabled faster, more efficient cleanup of the well and near-wellbore zone, further reducing rig time. Lukoil obtained high-quality test data that aided in estimating fracture effectiveness and ultimately helped determine future development plans for the field.



Surface well test equipment on the Lukoil Astra jackup exploration rig in the Caspian Sea.

www.slb.com/welltesting



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