

Intelligent Completion System Boosts Oil Production by 41% in High-GOR Field

Integrated system maintains inflow balance across zones in each lateral to optimize hydrocarbon production for LUKOIL-Nizhnevolzhskneft, Caspian Sea

CHALLENGE

Improve oil production and increase recovery from extended-reach wells suffering poor toe cleanup, and early gas and water breakthrough.

SOLUTION

Dynamically balance inflows between laterals using intelligent completion technology including TRFC-HD surface-controlled multiposition hydraulic flow-control valves (FCVs), WellWatcher Quartz* premium high-temperature, high-resolution PT gauges, and WellWatcher Advisor* intelligent completion software for real-time production monitoring and control.

RESULTS

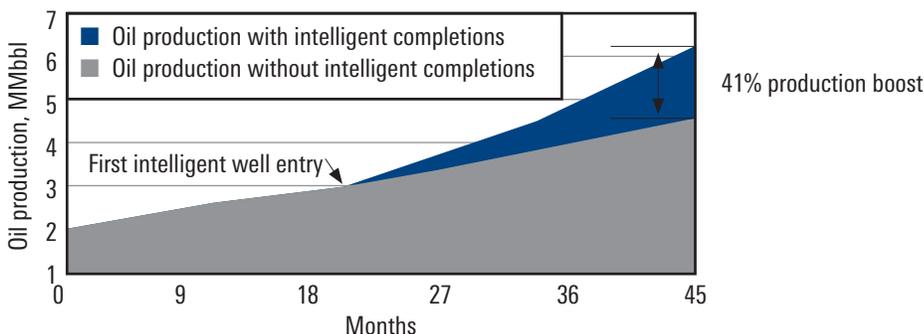
- Boosted production in the Tithonian reservoir by 41%.
- Improved performance in four wells to account for 30% of the 23-well field's production.
- Produced 3.5 MMbbl [0.56 MMm³] of incremental oil over 2 years.



Gas breakthrough drops oil production

Located on the shelf of the North Caspian Sea, the expansive Yury Korchagin field features a thin oil rim of 10 to 15 m [33 to 49 ft] with an anticline trap, or dome, of impermeable rock overlying permeable reservoir rock. The oil pay is positioned beneath a significant gas cap and above an aquifer. In 2010, LUKOIL-Nizhnevolzhskneft began developing the complex field with a horizontal extended-reach drilling campaign of 23 wells from a single platform.

Starting with the first well, however, a number of issues indicated the project faced steep economic challenges. Early gas breakthrough led to high gas/oil ratio (GOR), resulting in a sharp decline in oil production. The operator tried to balance flow along the laterals in some initial wells with inflow-control devices (ICDs) and drawdown pressure alterations based on time-consuming engineering studies of occasional fluid measurements at the wellhead. Still, production lagged; recovery was 17% below initial estimates from the least-performing formation. Additionally, a limited number of slots on the platform were available to drill additional wells, leaving no options for mitigating the losses. A more comprehensive, automated solution was required.



Introducing intelligent completions in the Tithonian reservoir increased calculated cumulative production by 41%.

Dynamic control balances the flow

LUKOIL-Nizhnevolzhskneft and Schlumberger devised a multidisciplinary approach to improve recovery in the field. Two new wells and two sidetracks were designed with intelligent multizone completion technology, including pressure and temperature gauges for each zone. The sensor data eliminate the need for production logging and extended surface well testing of individual zones, and the related time and risk associated with those functions. Each of the zones in the new completions also included TRFC-HD dual-line, multiposition FCVs, which (unlike ICDs) can be remotely and rapidly adjusted to suit variable and inconsistent downhole conditions.

To manage data and respond more rapidly to reservoir dynamics, the operator chose the WellWatcher Advisor software, which combines the pressure and temperature data from gauges with the flow-control valve position information to assess flow contribution and productivity indices by lateral in real time. This allows the operator to optimize the settings on the flow-control valves for maximum production and reservoir sweep efficiency. The software provides almost-real-time pressure transient or nodal analysis rather than weeks of manual engineering time, enabling unprecedented awareness and control of reservoir variations.

Intelligent wells lead field production

The first intelligent completion in the project became one of the best producers in the Korchagin field.

Production in the first multilateral well, which consisted of the motherbore and one side track connected by a junction, was achieved with much lower drawdowns than for a single-lateral well. GOR and water cut improved when compared to offset wells where gas and water breakthrough had been observed.

In the second multilateral well, also a motherbore with one side track connected by a junction, the intelligent completion redistributed the drawdown between and along the laterals. This resulted in a 75% reduction in GOR while the oil production rate more than tripled compared with previous wells without side tracks.

The fourth intelligent completion was installed in one of the oldest wells in the Korchagin field. A new horizontal wellbore was drilled as a side track and split into three intervals isolated by packers after the motherbore was abandoned. FCVs and pressure and temperature gauges were installed in each zone to control inflow. The first zone intersected a fracture so GOR and water cut were high — but completely controlled by the FCV. In the second interval, a highly productive oil zone, overall production was good. The operator determined that without the use of the intelligent completion strategy, the well would have been choked back at surface because of uncontrolled gas breakthrough from the fracture resulting in a reduction in well productivity.

Overall, in 2 years the intelligent completions boosted recovery for the Tithonian reservoir by 41% and increased oil production by 3.5 MMbbl [0.56 MMm³]. Of the 23 ERD wells in the Korchagin field, the four intelligent wells account for 30% of the total produced oil. Expanding on the success of these initial intelligent multilateral completions, LUKOIL-Nizhnevolzhskneft has adopted the approach for development of new Caspian fields.