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Intelligent Completions Increase Production in a Middle East Oil Field by 5% in One Year

Enhanced monitoring and control of fluid flow in heterogeneous carbonate reservoir provide access to additional reserves and reduce water cut

CHALLENGE

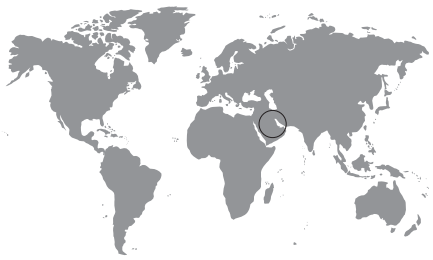
Improve understanding, monitoring, and management of a highly heterogeneous carbonate reservoir where locations of water-producing zones are uncertain and dual-ESP-equipped horizontal wells complicate production logging.

SOLUTION

Deploy Schlumberger tubing-retrievable flow control (TRFC) valves and REDA* Maximus* ESP systems equipped with Phoenix* artificial lift downhole monitoring systems throughout the field for zonal monitoring and control.

RESULTS

Increased oil production approximately 5% in one year and expanded accessible reserves while controlling water cut.



Heterogeneity and limited production data challenge reservoir management

An extremely heterogeneous, fractured, offshore carbonate reservoir in the Middle East consists of several thin layers with permeabilities ranging from 5 to 300 mD. Horizontal wells featuring long laterals and equipped with dual ESPs are used to maximize drainage.

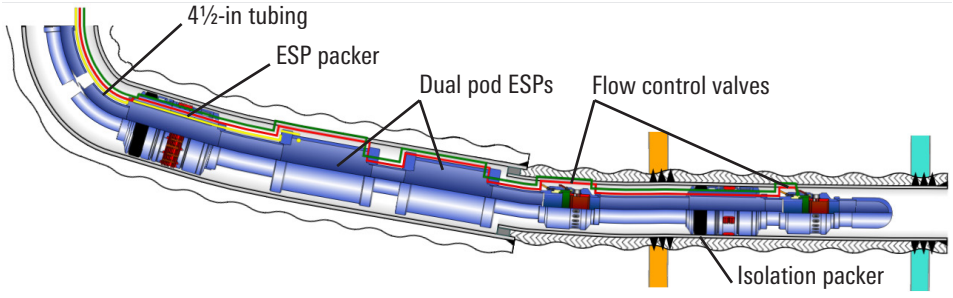
Reservoir management was challenging because production logging is complicated with this well design, and commingled flow from unequally depleted layers made pressure interpretation difficult. An underlying aquifer and uncertainty about both the water-production mechanism and the location of water-producing zones had resulted in a relatively rapid increase in water cut, from 10% to nearly 90% in less than 15 years. Since water-producing zones were often unknown, perforation strategies were conservative to avoid jeopardizing well performance, leading to bypassed reserves.

Downhole gauges and TRFC valves provide control

Intelligent completions incorporating Phoenix system downhole gauges and two or three Schlumberger flow control valves were installed in 22 wells—both new infill and workover wells—to improve

- understanding of the properties and dynamic behaviors of specific reservoir layers
- management of the differential pressure regimes of the completed layers
- recovery of oil
- control of water breakthrough.

Phoenix system gauges located at the bottom of each Maximus ESP system enable monitoring downhole pressures and temperatures. The multiposition and on-off TRFC valves are manually actuated from surface when needed, using portable hydraulic pumps. To enable control of individual zones, Schlumberger multiport packers isolate the zones while allowing feed through of hydraulic control lines for the valves. Use of multidrop modules for the valves has reduced the number of control lines required. The intelligent completion equipment is retrievable to facilitate ESP maintenance or replacement.



The illustration shows the typical configuration for an intelligent completion deployed in an oil producer in the subject oil field. Together with the pressure and temperature gauges at the bottom of each ESP system, the flow control valves have significantly increased production and ultimate recovery. The pod system is a specially designed capsule that encases and supports an ESP system in a sealed environment.

Operator increases oil production and recoverable reserves

Schlumberger TRFC valves have given the operator's reservoir engineers the ability to optimize production from each zone despite uneven depletion rates. Limiting gross liquid production is one of the priorities in this field because of low reservoir pressure and high water cut; intelligent completions have made it possible to improve oil recovery and choke or shut off a zone when water breaks through. Because flow control valves can mitigate the risk of water production, additional zones can now be investigated in existing wells and new laterals can be drilled in previously bypassed reservoir sections. The Year 1 program increased oil production by 2,300 bbl/d, and an additional 800 bbl/d was achieved during Year 2 operations.

Selective zonal management and control have also enabled monitoring of reservoir pressure in each zone and development of a field pressure map for each producing layer, a valuable aid to future development projects.

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