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IntelliZone Compact Multizonal Management System Enables Seplat to Meet Regulations for Back Allocation

Intelligent completion successfully manages joint production from multiple zones in marginal Nigerian field

CHALLENGE

Develop marginal field with fewer wells to reduce capex and opex and to meet local regulations requiring back allocation for individual reservoir zones.

SOLUTION

Use IntelliZone Compact* modular multizonal management system to maximize production monitoring and control.

RESULTS

Completed three-zone well faster, within budget, without incident or NPT, and with less HSE exposure; improved reservoir management; and met regulatory requirements for joint production and back allocation from multiple zones.

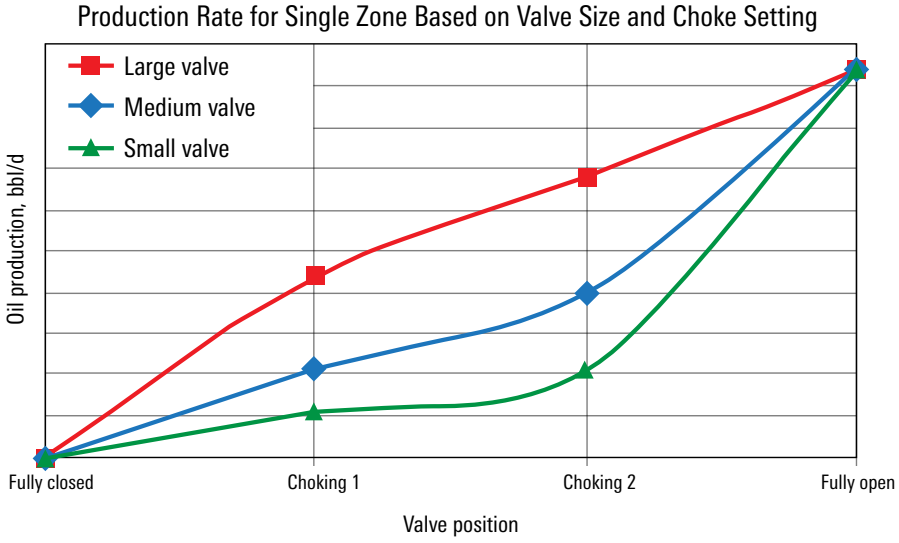
Develop marginal field economically and ensure back allocation of commingled production

Seplat Petroleum Development Company was developing a marginal onshore oil field in Nigeria's Niger Delta, where the reserves are distributed over 14 stacked reservoirs. The marginal reserves and the field's limited area made the project uneconomical unless the number of wells could be minimized. The goal, therefore, was to develop the field with fewer wells to reduce capex and opex. Due to the location's poor accessibility and increased HSE risks, remote zonal monitoring was a necessity. In addition, Seplat had to meet local regulations requiring that back allocation be reported for individual reservoir zones.

Use IntelliZone Compact system to monitor and simultaneously control multiple zones

Schlumberger and Seplat considered the reservoir parameters, sand control measures, production targets, and governmental regulations for back allocation of jointly produced zones before deciding on the final completion choice for the well: the IntelliZone Compact modular multizonal management system. This single unit enables operators to optimize production control and commingling through remote downhole monitoring and control. For each zone, the system integrates variable-choke flow control valves, an optional pressure and temperature monitoring system with valve position sensing, an optional multidrop module, and a packer. The module allows more flow control valves to be actuated on fewer hydraulic control lines than with traditional flow control completions and to be controlled from the surface in real time without intervention.

IntelliZone Compact system components are designed, assembled, and fully tested off site before shipment. Because Schlumberger stocks all the components, delivery time is reduced from an average of 8 to 10 months for traditional systems to only 8 to 10 weeks.



Nodal analysis was used to evaluate the optimal flow control valve sizing for three reservoir layers, with the objective of determining the zonal production rates as a function of specific tubing head pressure for three valve sizes and a range of choke settings. The figure shows the production rates in one zone based on three valve sizes and choke settings.

Design. In the first well, the production objective was to drain the three lower layers simultaneously. The single upper layer would be produced using a conventional sliding sleeve. To design the multizone completion, the Schlumberger domain support team compiled and studied PVT and nodal analysis data to determine the optimal size of the flow control valves. The system's valves are available in small, medium, large, and extra-large. Each size has four possible positions: fully open, two for choking, and fully closed. For this particular design, medium-sized flow control valves were selected for the three zones. Each zone was also equipped with tubing and annular pressure and temperature gauges, for a total of six gauges.

Planning. A full, offsite system integration test (SIT) was carried out simultaneously for the three IntelliZone Compact systems. The SIT was performed through 8,000 ft of electric and hydraulic reels, and flow control valve actuation and gauge monitoring were controlled via the WellWatcher UniConn* multiwell acquisition unit and hydraulic power unit. In addition to the SIT, Schlumberger held a planning meeting with Seplat to address preparedness, installation, contingencies, commissioning, and operational aspects for the wellsite. This detailed up-front planning resulted in an installation with zero NPT. This planning, along with function testing of the gauges and flow control valves during installation, maximized the probability of full operability when the string was landed.

Operation. During the startup period, a surface multiphase flowmeter and surface test separator were used to directly measure flow rates from individual and commingled zones. These rates, along with the downhole zonal pressure readings, allowed inflow performance relationship (IPR) curves to be created for the individual zones and the joint production. This analysis was also carried out for the various downhole choke settings. The presence of a flow control valve and annular pressure gauge in each zone allowed Seplat to monitor pressure buildup while the flow control valve was closed, enabling reservoir pressure, formation damage, and contributing permeability from each zone to be determined.

The IntelliZone Compact modular multizonal management system is designed, assembled, stocked, and tested at the manufacturing facility. It is delivered as a single, integrated unit that minimizes field connections and is ready to install out of the box.

The commingled testing results were used to evaluate the performance predicted by the original simulation model. No flow domination or crossflow was observed during static conditions. At the conclusion of the well test, a new calibrated simulation model was developed that was suitable for the new flow conditions. The difference between the measured and the estimated production was within 5%, confirming that the required daily production allocation could be performed from the updated simulation model. This model would remain valid as long as no significant changes occurred to fluid composition and gas/oil ratio.

The IntelliZone Compact system is delivered preconfigured and pretested, with electronics prewelded. This design accelerates final well commissioning at the wellsite and reduces rig time and related costs.

Improved reservoir management and met regulatory requirements

Use of the IntelliZone Compact system resulted in several significant benefits for Seplat. Because of the system's modularity, completion lead time was reduced and commissioning was accelerated. Installation in the three zones was completed within budget, without incident or NPT, and with less HSE exposure. The system's remote monitoring and control of zonal production greatly improved reservoir management. Finally, the real-time flow measurements showed that zonal production met the regulatory requirements for joint production and back allocation from multiple zones.

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