

Case study: Intelligent production system, Sub-Saharan Africa

MultiNode delivers first nine-zone, all-electric intelligent completion, boosting production at lower costs

The operator faced significant challenges in selecting an intelligent completion system that could manage production from nine different zones (four gas producers and five oil producers) from a single well.

The operator wanted a more efficient solution to reduce the well-testing time and costs typically required by segmenting the nine zones with traditional mechanical sleeves. Also, some of the deeper oil zones had an appraisal element to them and uncertain associated volumes, which made it difficult to justify dedicated wells to access them.

The solution would also have to help gather production data over a minimum of one to two years from zones that had not been fully characterized previously. In addition, the operator required a completion solution that could be monitored and controlled remotely to avoid costly, time-consuming, and risky interventions.

Further complicating matters, the project had to be executed on a tight timeline in a remote region with limited local infrastructure and security concerns.

Selecting a smarter, all-electric solution
Baker Hughes proposed its **MultiNode™ all-electric intelligent well system**, a completion system designed to control and optimize production from multiple zones—remotely and without a well intervention. The MultiNode can control up to 27 electric flow control valves with a single tubing-encapsulated conductor

(TEC) cable to quickly and precisely alter flow paths in individual production zones. The operator selected the MultiNode all-electric system for its remote actuation and rapid shift speeds. Other completion solutions on the market, such as hydraulic inflow control valves and mechanical sleeves, require multiple control lines or add significant time, cost, and complexity to the life of the well. The MultiNode system's ability to customize choke positions would help the operator meet its specific production requirements in individual oil and gas zones.

Deploying the first nine-zone completion

While Baker Hughes previously executed an eight-zone electric completion of an oil-producing reservoir using a single TEC, this project marked the first nine-zone completion for a dual oil and gas reservoir. Planning and deploying the intelligent completion solution took three years and required the delivery and installation of more than 125 line items as part of the MultiNode technology.

The project also required precise coordination, meticulous execution, and local delivery of technologies and services from other Baker Hughes product lines, including Intelligent Production Systems, Upper Completions, Tubular Running Services, and Wellbore Clean-Up.

The operator's engineering team and various Baker Hughes product line representatives met multiple times, both in Houston and in the sub-Saharan Africa region, to collaborate on project design; execution planning; and CWOP (Complete Well On Paper), OWOP (Operate Well On Paper), and TWOP (Test Well On Paper) exercises.

Challenges

- Operate in a remote region with limited infrastructure and potential security concerns
- Manage production from nine different reservoirs (four gas and five oil) within a single well
- Avoid costly and risky interventions while adhering to a tight timeline and limited local resources

Results

- Deployed completion in 26 days from Wellbore re-entry to Well secure saving 3 days, which translates to \$800,000 USD savings
- Shortened well testing time to save \$750,000 USD
- Provided access to an incremental 29.7 Bscf of gas and 1.7 MMstb of oil through uncharacterized zones over the life of well potentially delivering \$272.6MM (\$.005 per scf and \$73 per bbl)

In addition to the MultiNode system, the full completion assembly included ten sets of downhole gauges, 18 flow control devices, and 39 timed connection couplings. It also included the deployment of 9 V3-rated 7 in., 1 V0-rated 9-5/8 in. Octopus production packers, and 1 wireline set 7 in. retainer sum packer.

Optimizing well production with lower costs and risks

The close collaboration and careful planning between the operator and all Baker Hughes product line teams helped ensure the successful execution of the intelligent well system to meet project objectives.

The full intelligent completion system was deployed in just 26 days from wellbore re-entry to well secure. Using a control line-set packer with burst disk on the 9 5/8-in. Eccentric Octopus production packer allowed setting pressures to be differentiated between the 7-in. vs. 9 5/8-in packers. As a result, packer fluid could be effectively displaced below the upper production packer without creating potential leak paths through the SSD.

Well testing was completed in a shorter timeframe, just 14 days, thanks to the elimination of mechanical wireline sleeve actuation.

The MultiNode system's rapid shifting time—just six minutes versus two hours for a mechanical sleeve—also contributed to significant cost savings for the well test. The single-line TEC minimized leak paths on feedthrough packers for tighter zone segmentation and control, which afforded greater insights into

the production behavior and pressure drawdown over the life of each zone in the reservoir.

The MultiNode system helped ensure real-time data acquisition of previously uncharacterized zones and then independently produce small tight zones to improve reservoir drainage efficiency. By boosting recovery from these smaller zones, the operator increased the well's full production expectation by 29.7 Bscf and 1.7MMstb which translates to estimated \$272.6MM USD additional revenue over the life of the well.

In total, the successful execution of the industry's first nine-zone, all-electric intelligent completion with V0-rated 9 5/8-in. Electric Octopus production packers saved the operator 3 days and \$800,000 USD.

The operator recognized that by unlocking marginal reservoirs, increasing recovery, speeding up well testing, and minimizing risk, the MultiNode system helped achieve groundbreaking performance improvements that can be replicated in other complex reservoirs.



Challenging remote region with limited infrastructure