



MATURE FIELDS



UNCONVENTIONALS

Halliburton Introduces Vertical Stress-Oriented Perforating Solution in Large Middle East Gas Field

MIDDLE EAST

CHALLENGES

- » Improve percentage contribution from perforation tunnels
- » Reduce flow velocity through the perforations to limit formation sand production
- » Reduce flow velocity through the perforations to limit proppant flowback
- » Increase effectiveness of gravel pack completions
- » Ensure accuracy of perforation orientation

SOLUTION

- » Develop a custom solution combining tubing-conveyed perforating, gyro technology, and perforating
- » Use physically fixed reliable orientation point in well
- » Use gyro to find the orientation of the hardware relative to fixed reference
- » Ensure perforating gun is “locked into” the orientation device in the well when firing to eliminate orientation error

RESULTS

- » The well flowed back at 10 million SCFD, much higher than anticipated
- » Pressure post-job was 4,000 psi
- » Zero borehole solids and water were produced
- » Post-perforation caliper logged confirmed correct orientation of all perforations

OVERVIEW

Currently, customers are using an improved understanding of reservoir geomechanics and subsurface-stress profiles to develop solutions to complex problems. One such solution is to perforate and produce hydrocarbons from the direction of maximum horizontal stress in reservoirs that have brittle and unconsolidated sand. Doing so reduces sand production and enables higher production rates without incurring expensive well interventions. Perforating in the maximum stress direction has been demonstrated to reduce sand production significantly. The challenge of orienting a perforating gun in vertical wells is well known in the industry. Halliburton has introduced a customized solution that combines elements of different technologies, including tubing-conveyed perforating (TCP), gyro technology, and perforating, to achieve this objective.

CHALLENGES

A Middle East operator had a vertical natural completion and wanted to improve contribution percentage from each perforation tunnel. The formation had a 3° elevation, which did not provide enough gravitational forces to orient perforating. The operator had been using a competitor for over 10 years for their perforating services. Halliburton was approached to develop a simpler, more reliable solution.

Designs were to include large flow area to reduce flow velocity through the perforation, limiting formation sand production and minimizing proppant flowback. The customer also wanted to increase effectiveness of gravel pack completions. The vertical well would need to be perforated in the maximum stress direction with 0-180° phase. Because the earth’s magnetic field distorts inside metal casing, magnetic orientation is not possible. Near-vertical wells have no reference to the high side of the well rendering inclinometers ineffective. To facilitate accurate gun positioning an oriented gun hanger would need to be set using a gyro. Current industry gyros aren’t shockproof, and orientation measurement and perforating would need to be performed in different runs. The operator also needed to ensure accuracy of orientation despite not being able to measure orientation at the time of firing.

NEW
VERTICAL
STRESS-ORIENTED
PERFORATING
METHOD
OPTIMIZES
PRODUCTION

HAL54258

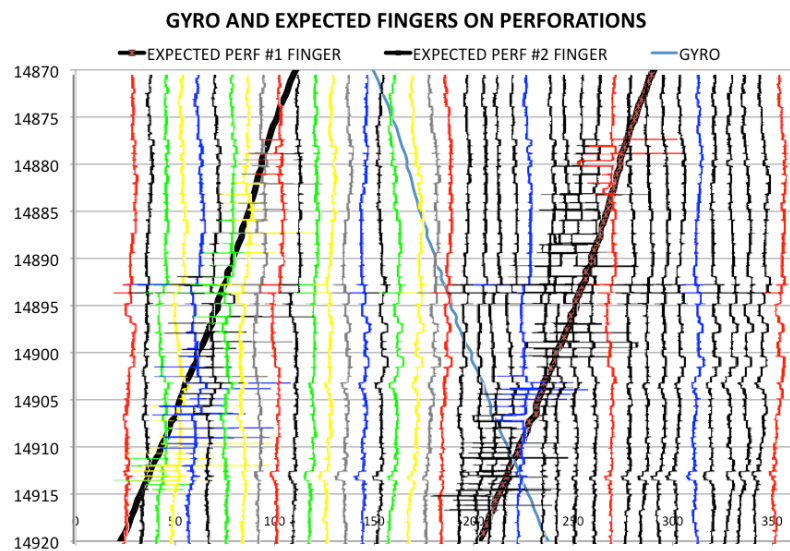
SOLUTIONS

Halliburton developed a unique vertical stress-oriented perforating (VSOP) methodology combining elements of different technologies, including TCP, gyro technology, and perforating, to solve the challenges of this well. Collaboration between the customer and Halliburton was crucial to customizing this new solution. A physically fixed reliable orientation point in the well was selected. A gyro would be used to find the orientation of the hardware relative to a fixed reference. The perforating gun would be “locked into” the orientation device in the well when firing to eliminate orientation error.

When orientating long gun systems in a vertical well without risking natural or intelligent completions, the Halliburton EZ Pass™ oriented gun hanger (OGH) delivers the assurance and peace of mind for achieving successful perforating in the right orientation. The EZ Pass OGH is designed to be run in monobore well applications with profiles and/or restrictions that would prevent the use of standard gun hangers and where perforating orientation is critical. The unique orientating system allows for precise positioning of guns in a vertical application, which was ideal for the customer. The slips are designed to stay retracted within the slip housing until the tool is set. Once actuated, hydrostatic pressure will keep the tool in the set position. Additional weight applied to the hanger further enhances the setting process.

RESULTS

The Halliburton VSOP service was successfully deployed in the operator’s well, and positive feedback was received from the customer. Post-job, the well performed much better than expected at 10 million standard cubic foot/day (SCFD) and 4,000 psi with zero borehole solids and water produced. Without this new solution, production was expected to be much less than what was achieved and would have included undesired formation sand. As this was the first time this solution was deployed, the customer decided to run a multiple-finger caliper log to confirm the orientation of the perforations, which indicated that the job was successfully performed.



First verification of vertical stress-oriented perforating.

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