ACTive Perf with ABRASIJET Jet Perforating Overcomes Severe Drilling Damage in Highly Deviated HPHT K-Gas Well

Production target achieved with thin-zone access and stimulation on coiled tubing

**Challenge**
Bypass drilling formation damage to enable stimulation and production of a 70° deviated HPHT gas well, where conventional perforation techniques had proved ineffective.

**Solution**
Use ABRASIJET* abrasive jet perforating enhanced with ACTive* downhole monitoring and depth correlation on coiled tubing (CT) in real time.

**Results**
Achieved production target with matrix stimulation enabled by abrasive jet perforating to provide formation access.

**Severe formation damage impedes production**
While drilling a gas well in the K-carbonates, an operator in the Middle East encountered high fluid losses. A special mud with different loss circulation material (LCM) was used to enable drilling the well to 12,600-ft MD, with maximum deviation of 70°.

However, this type of LCM causes severe damage to the near-wellbore formation, and has low solubility in acid. The K-wells drilled with this mud could not flow after being perforated using conventional techniques. Subsequent matrix stimulation is often not feasible because the short perforation tunnels cannot extend beyond the damaged zone to enable communication with the reservoir.

**Abrasive jet perforating penetrates damaged zone**
Creating large diameter, long cavities (notches) in the formation can potentially reduce the fracture initiation pressure and help extend the fracture deeper into the reservoir. ABRASIJET abrasive jet perforating was selected and optimized for the first time in the Middle East with ACTive pressure, temperature, casing collar locator (CCL), and gamma ray (GR) measurements in real time, all during the same trip.

The GR and CCL enabled accurate depth correlation for precise placement of the notches in every thin interval with high gas saturation. Forty perforations were made at the best reservoir depths for acid stimulation. By monitoring the pressure inside and outside the coiled tubing (CT) with the ACTive bottomhole pressure measurement, the abrasive-fluid pumping rate was adjusted to maintain a minimum of 2,500-psi differential pressure across the ABRASIJET nozzles for efficient perforation. The notch length was further optimized by nitrifying the abrasive sand slurry, increasing the pumping time and orienting the nozzles to the lower side of the highly deviated borehole to minimize standoff from the liner.
**Well exceeds expectations with production similar to offset wells**

Unlike wells perforated using conventional techniques, this well showed gas at surface—1,100-psi wellhead pressure (WHP)—after the first abrasive jet perforating run, demonstrating successful contact with the reservoir. Injectivity was confirmed and further improved with an acid wash through CT, while monitoring the distributed temperature sensing response across the perforated zones for smart fluid placement.

Temperature monitoring continued during subsequent acid fracturing operations, which were conducted at an average pump rate, and pressure similar to nondamaged K-carbonates offset gas wells. This brought production online quickly and efficiently to achieve the field’s highest post-perforating gas flow. The ability of the ACTive system to measure depth, pressure, and temperature in real time was critical to ensuring a successful intervention and increased operator confidence in the outcome.