Case Study

First successful application of open hole completion systems in Turkey

International, Selmo
StackFRAC HD System, QuickFRAC System

Background

Discovered in 1964, Şelmo is the second largest oil field in Turkey by historical cumulative production, with an estimated 600 MMbbl of oil in place. An operator planned to develop the Middle Sinan Dolomite (MSD) formation in the Şelmo field by leveraging technology used to exploit unconventional reservoirs in North America including 3D seismic, horizontal drilling and hydraulic stimulation.

They performed extensive work to remap and remodel the Şelmo field with 3D seismic to identify bypassed oil. A new 3D dynamic model encompassing updated substructure mapping with production and pressure histories identified specific areas of the field that would benefit from a horizontal drilling program.

Challenge

The operator planned to stimulate the MSD formation using matrix acidizing, which uses acid to react with the carbonate matrix creating conductive flow channels, or wormholes. Accurate acid placement is a major challenge because the acid tends to preferentially flow toward areas of higher permeability. This can result in overstimulation at these intervals leaving the lower permeability regions untreated. In some cases, increased water production results from preferential stimulation of high permeability sections associated with water.

Solution

The operator designed a pilot project including four horizontal wells in the Şelmo field: two were completed using the Packers Plus StackFRAC® HD open hole multistage completion system and two using the QuickFRAC® batch stimulated open hole multistage completion system.

In the StackFRAC system, there is only one injection port per stage (single entry) while in the QuickFRAC system, multiple injection jets are used (limited entry) (Fig. 1). In both systems, each stage is isolated using hydraulically set, mechanical RockSEAL® H2 packers. The FracPORT™ or QuickPORT™ V sleeves in each stage can be opened using successively larger actuation balls or coiled tubing activators.

Results

All four pilot wells were designed as 5-stage acid stimulation completions. Stimulated lateral lengths varied between 1,000 and 2,000 ft based on the structural position of the lateral. Packers were positioned based on the lateral placement within the reservoir, the presence of oil and gas shows and changes in mud loss experienced during drilling, as well as interpreted faults along the lateral, the presence of shale in the gamma ray measurement while drilling (MWD) and mud log data.

All stimulations used three concurrent sub-stages of 15% HCl slick acid, 15% HCl gelled acid, 15% HCl SDA (self-diverting acid), and 2% KCl spacers. The combined volumes of these sub-stages were successively increased throughout the job. Maximum treating pressures were calculated using an estimated formation breakdown gradient of 1.0 psi/ft, fluid hydrostatics calculated for stimulation fluids and estimated friction pressures.

Results of the pilot project indicate a successful stimulation and a significant increase in production from all four horizontal wells compared to offset vertical wells (Fig. 2). Overall, the implementation of open hole multi-stage systems resulted a marked increase in reserves per well as well as an associated drop in finding and development costs (F&D in capital invested for every BOE of reserves), indicating higher capital efficiency per reserve (Fig. 3).

With the success achieved from the first horizontal open hole multi-stage completion systems in Turkey’s Şelmo field, the operator continues to use these systems and to date has completed seven additional wells to exploit the MSD.