First NOV Voyager 15XT Deployed in a Tight HPHT Resevoir

Successful trial 15,000-psi open hole installation with major Middle East operator

Background

A major Middle East operator approached the NOV Completion Tools team with an opportunity to develop a true 15,000-psi open hole ball- drop system for their tight high-pressure, high-temperature (HPHT) conventional oil and gas operations.

To be technically accepted by the operator, they specified a series of rigorous tests. After technical acceptance, a field trial was commissioned with the following success criteria: Successful installation without mechanical failure, confirmation that the Flow Lock Sub was activated and closed during the installation, proper activation of the frac sleeves during the fracturing operation while applying up to 15,000-psi differential pressure, indication that there was successful zonal isolation, and successful milling of frac sleeves ball seats.

Solution

We developed the Voyager™ 15XT system using our industry-leading Voyager frac system as the starting point. Our experience deploying open hole ball-drop systems for various reservoir environments and customers proved crucial in designing and developing the 15XT system for this trial. The Voyager 15XT packer is a dual-element packer designed for 5.875- to 6.125-in. open-hole wells, and the operator required that it be fully qualified to API 19OH V1 to 15,000 psi at 350°F.

Case study facts

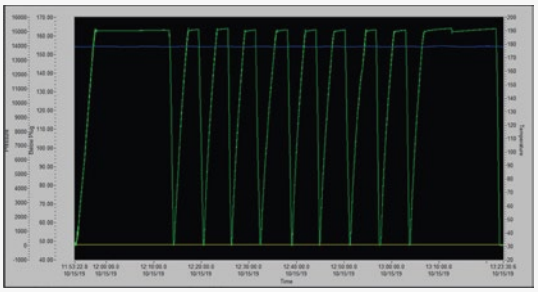
Location: Middle East

Products

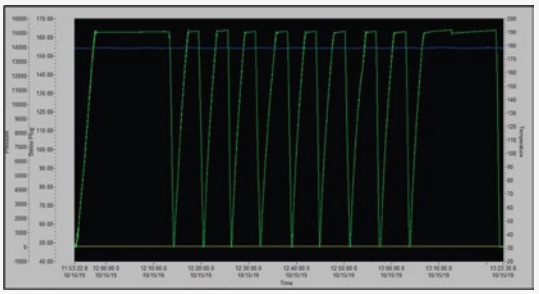
- Voyager 15XT packer
- I-Frac flex OH
- Flow Lock Sub
- GripR open hole anchor
- BPS

General well information

- Liner size: 4½ in. 15.1 ppf
- Open hole size: 5⅞ in.
- Well TVD: 14,991 ft (4,569 m)
- Well TD: 18,779 ft (5,723 m)
- Temperature: 306°F (152°C)
- Number of stages: seven stages, proppant frac
- Max. surtace treating pressure: 14,000 psi (96 MPa)
- Max. bottom hole pressure: 20,000 psi (138 MPa)

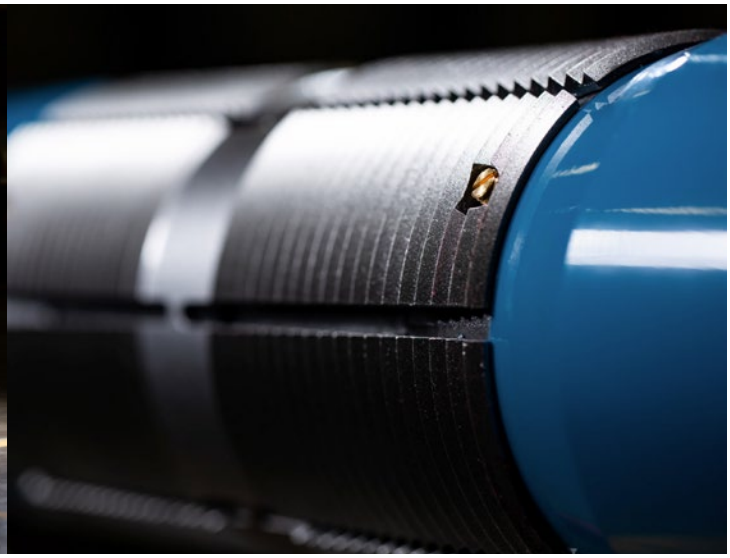


Cycle test, ten times at 350°F (176.7°C)



Cycle test, ten times at 150°F (66°C)

First NOV Voyager 15XT deployed in a tight HPHT reservoir



Additional pressure cycling testing was conducted to simulated worst-case stimulation pressures where the packer was subjected to ten cycles of 15,000 psi at 350°F and ten additional cycles at 150°F. All cycles were successfully completed, meeting the less than 1% leak off criteria.

The next component developed was the GripR™ open hole anchor. This anchor was required to be fully pressure tested to 15,000 psi and 350°F. A series of cyclic tests were performed like those required for the Voyager 15XT packer. Additionally, the GripR was set in a fixture with a 6.125-in. ID and subjected to tensile and compressive loads to confirm it would mechanically hold 350,000 lbf once set.

Stimulation can't be completed without a reliable trac sleeve, so we also tested the i-Frac flex sleeve at 15,000 psi for ten pressure cycles at 350°F, followed by 15,000-psi collapse testing from outside to inside. Then functionality testing was performed, including the opening of the frac sleeve to confirm sleeve opening/activation.

The Flow Lock Sub for this application was designed with the addition of a ball sump to hold multiple setting balls for the liner hanger system without impeding the Flow Lock Sub ball and seat's operation.

The BPS™ toe ports were selected as they are fully qualified for applications up to 400°F and can range in absolute activation pressures from 8,000 to 21,000 psi. The simplicity, robustness, and inherent redundancy of the BPS makes it the toe port of choice for many operators, especially in HPHT applications.

Once the testing was presented to the operator and all the system products were technically approved, the customer selected a trial well for deployment.

Results

In August 2020, a seven-stage proppant frac trial well was deployed successfully with no issues. The activation ball landed as intended and closed, and the packers and open hole anchor was set. A pressure test was performed, and the system successfully met the first trial criterion.

The fracturing stimulation was performed in October 2020. The multistage stimulation with a maximum rate of 40 BPM and bottom hole pressure of 20,000 psi was completed successfully. Each stage was stimulated, and the ISIPs pre- and post-fracturing indicated good isolation was achieved. This met all trial criteria.