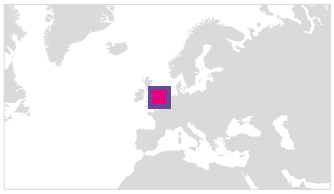
Decarbonise case study Multi Seal Integrity

Efficient seal failure diagnosis reduces water cut, prevents hydrogen sulphide release and helps lower emissions



Location: UK
Field: Scott
Well type: Gas-lift producer
Customer: Nexen (CNOOC)
Reference: SPE ICoTA European Well Intervention Conference 2019

Case benefits

— Applied through-barrier diagnostics to guide efficient workover programme and restore primary barrier integrity.
— Identified hydrogen sulphide (H_2S) source and helped with isolation planning.
— Optimised water shut-off to increase oil production and reduce water cut.
— Enabled rapid, low-impact remediation to minimise resource use and emissions.
— Characterised downhole failures that were not detected by conventional methods.

Challenge

The gas-lift producer in this case study had been shut-in due to sustained annulus pressure (200 bar) and excessive volumes of H2S that could not be handled by the production facilities. The operator wanted to assess primary barrier integrity and guide a workover programme. Traditional diagnostics methods, such as production logging tools (PLT) and temperature logs, were deemed inefficient because they could scan only the production tubing and were unable to confirm the integrity of the packer and production casing. Identifying and shutting off the source of the water with high H2S content would protect the environment and deliver a production gain of 2,050 barrels of oil per day (BPD). Eliminating the production of highly toxic H2S and ensuring its containment within the well system would also deliver important environmental and safety benefits.

Solution

TGT's True Integrity system with Chorus technology uses spectral acoustic methods to assess barrier sealing performance. The system offers a large scanning radius and the sensitivity to detect even small leaks. The ability to indicate failures in the tubing, in the casing behind the tubing, and in key completion components such as the production packer and gas-lift mandrels makes this technology highly effective at establishing the best approach for remediation when barrier failures occur.

High precision surveys across the reservoir zone characterised the flow and its content, thereby guiding operations for shutting off the water zone with high H2S content. Traditional PLT methods would not have been enough to make this identification as the water source may be above or below the perforated interval.

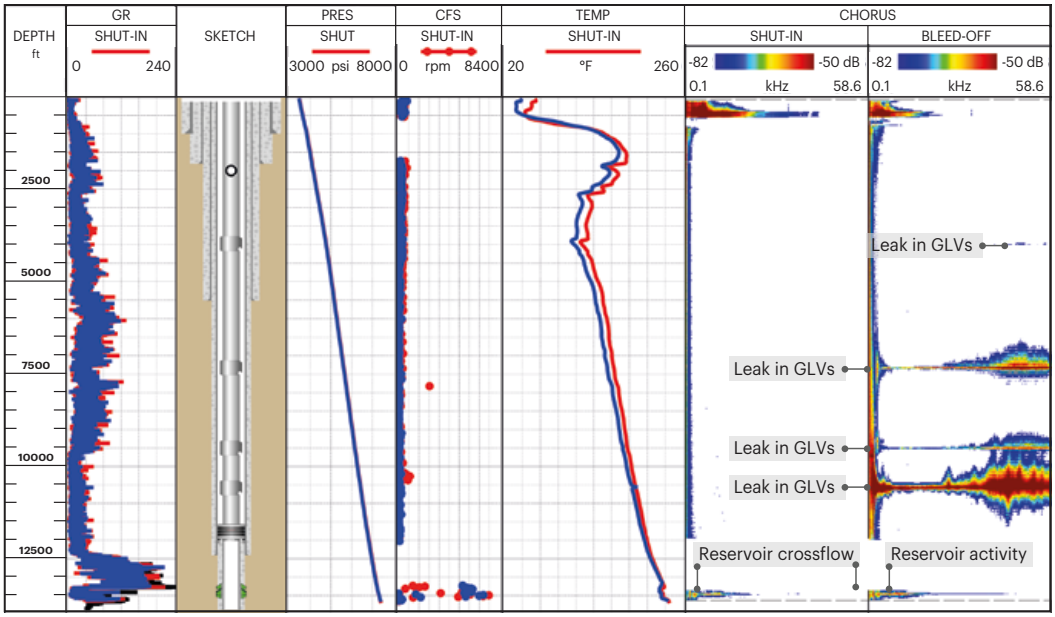


Figure 1
Failures in the gas-lift mandrels (or gas-lift valves) were indicated by Chorus spectral acoustic diagnostics. Conventional production logging tools failed to identify any of these leaks.

The diagnostics also revealed the effectiveness of cement sealing across the reservoir zones.

Result

The Multi Seal Integrity product with Chorus technology revealed leaks in all four of the well's gas-lift mandrels (Figure 1). Having confirmed that the failures were only in the mandrels, the operator changed them using the slickline, thereby eliminating the issue of sustained annulus pressure. Traditional sensors, such as spinner, resistivity and capacitance had not identified an issue in the mandrels, which indicates that the leaks were below their detection thresholds.

TGT's diagnostics solution also identified an active crossflow between the perforated intervals in this well (Figure 2). The direction and content of the crossflow were determined, indicating which zone had to be isolated. Verifying cement integrity behind the casing enabled the operator to select a cost-effective isolation programme that involved running straddle packers across the interval that was producing the water containing H_2S.

After the workover, the well returned to H_2S-free production with oil rate increased by 2,050 BPD and reduction in water cut from 96 to 80%. Increased oil production at a reduced water cut boosts recovery efficiency, enabling the operator to extract hydrocarbons in a shorter time period, and to reduce energy consumption and carbon-per-barrel over the life of field. In addition, having less water to manage and treat at surface reduces the energy requirement and emissions associated with these processes.

Figure 2
Reservoir crossflow under shut-in and bleed-off conditions. The zone at 13,440 ft shows flow upwards and downwards and charges the wellbore with water. This zone was isolated using a straddle packer.