Case Study:

Optimised Gas Cavern Storage Recompletion Using a Range of Interwell Technologies

Date: 2021
Region: England, UK

Product Capabilities

- HEX bridge plug design facilitated deployment and retrieval through narrow wellbore restrictions.
- IBV enabled setting of HEX bridge plugs in close proximity.
- BVS verified the upper HEX bridge plug's integrity real-time.
- All barrier equipment ISO 14310/API 11D1 V0 qualified (gas-tight).

Challenge

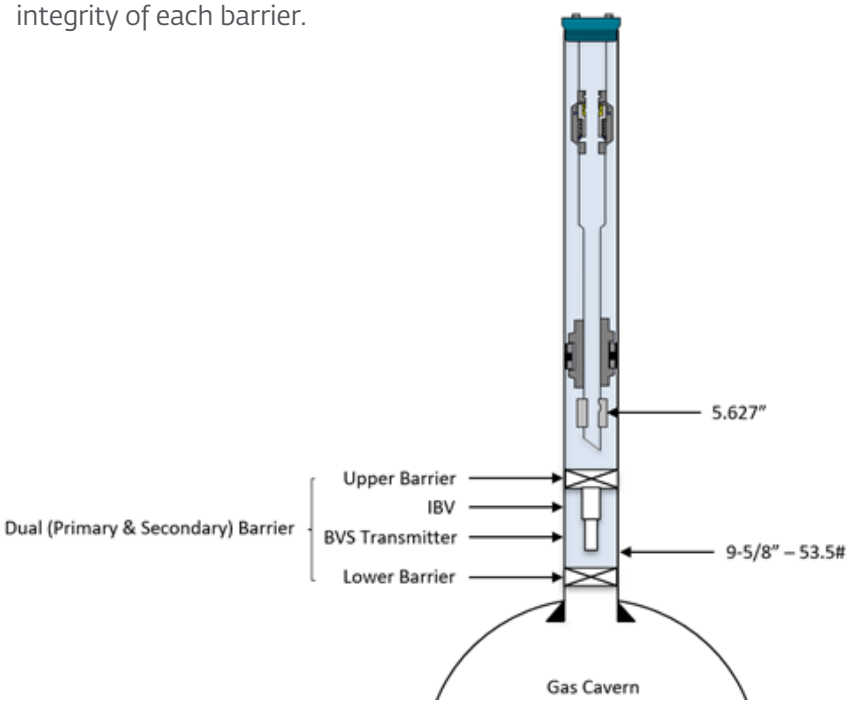
Two gas cavern storage wells were out of commission due to failed production packers. The decision was made to recomplete both wells to restore their integrity and return them to commercial service.

The recompletion of a gas cavern storage well is conventionally carried out using a "wet recompletion" method. This is where the cavern is rewatered by displacing the high-pressure gas with water, carrying out the recompletion and then debrining the cavern by displacing the now brine with high-pressure gas. This is because the caverns need to be maintained above a minimum pressure to minimise salt creep and prevent potential cavern collapse.

Where possible, a more favourable alternative to the conventional wet recompletion method is the "dry recompletion" method. For these applications, this would involve installing two gas-tight barriers in the liner below the upper completion. This would eliminate the need to rewater and debrine the cavern as the gas would be safely maintained at high pressure in the cavern throughout the recompletion. This would save significant time, along with associated reduction in cost and environmental impact when compared to the conventional wet completion method.

As the two barriers had to be gas-tight, there was a requirement for them to be ISO 14310/API 11D1 qualified to most stringent validation grade V0. The barriers had to be capable of being deployed and retrieved through a 5.627" restriction ID, set in a 9-5/8" – 53.5# liner (8.535" nominal ID) whilst withstanding a maximum differential pressure of 2,321psi (160bar) in a temperature range of 30-70°C.

Additionally, there was little distance between the bottom of the upper completion and the bottom of the liner where the two gas-tight barriers had to be installed. This meant it would be challenging to verify the integrity of the upper barrier due to the small volume that would exist between the two barriers, i.e. it would be difficult to volumetrically ascertain whether the upper or lower barrier was being tested during the pressure test and independently verify the integrity of each barrier.



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Key Achievements

- Dry recompletion method reduced cost, time and environmental impact.
- Restored two gas cavern storage wells back to commercial service.
- Believed to be the UK's first dry recompletion of gas cavern storage wells.

Solution

Interwell proposed to use their 520-963 High Expansion (HEX) for the two gas-tight barriers. The 520-963 HEX has a 5.20" OD for setting in 9-5/8" casing and has been ISO 14310/API 11D1 qualified to 4,000psi differential pressure in a temperature range of 4-100°C in 9-5/8" – 53.5# casing whilst being capable of being deployed and retrieved through a 5.325" restriction ID.

As it would be difficult to verify the integrity of the upper barrier due to the small volume that would exist between the two HEXs, Interwell proposed to use their Barrier Verification System (BVS). The BVS consists of a Transmitter that is hung below the barrier and a Receiver that is typically integrated into the Electronic Setting Tool (EST) generally used to set Interwell barriers on wireline. Upon setting, the EST remains in hole directly above the barrier whilst the pressure test is carried out. During the pressure test, the BVS Receiver is recording pressure and temperature data above the barrier whilst receiving pressure and temperature data from the BVS Transmitter below the barrier. The pressure and temperature data above and below the barrier allows the upper barrier's integrity to be independently verified. As the operation was planned to be carried out on e-line, the BVS's data was monitored real-time on surface.

After the lower 520-963 HEXs were installed and inflow tested against the gas caverns, the wells were lubricated and bled with fluid back to surface. A camera run was carried out to verify that no gas bubbles were present above the HEX to indicate leakage.

To prevent pressure build up between the upper and lower 520-963 HEX (as the upper HEX would be installed in close proximity to the lower HEX in an uncompressible fluid medium), Interwell proposed to use their Intelligent Barrier Valve (IBV) along with the BVS on the upper HEX. The IBV is a retrievable, intelligent valve that can be repeatedly opened and closed remotely. Deployed below a bridge plug or packer, the IBV can be used as an ISO 14310/API 11D1 validation grade Vo qualified downhole barrier or flow control device. The IBV was in the open position during the setting of the upper HEX to prevent any pressure build up between the barriers, and after setting, closed to reinstate the gas tight barrier.

Value Created

Interwell successfully installed two independently verified gas-tight barriers in each well to allow the recompletions to be carried out using the dry recompletion method. Once the recompletions had been carried out and integrity had been restored, all 520-963 HEXs were successfully retrieved to surface, returning the gas cavern storage wells back to commercial service with significant time, cost and environmental benefits for the operator.

These are believed to be the first dry recompletion of gas cavern storage wells in the UK. The reinstatement of these gas storage wells is believed to have increased the UK's gas storage capabilities and have contributed towards the UK's energy security.

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