RFID Optibarrier™ Ball Valve Demonstrated Superior Debris Tolerance in Extreme Deepwater Well Environment in Brazil

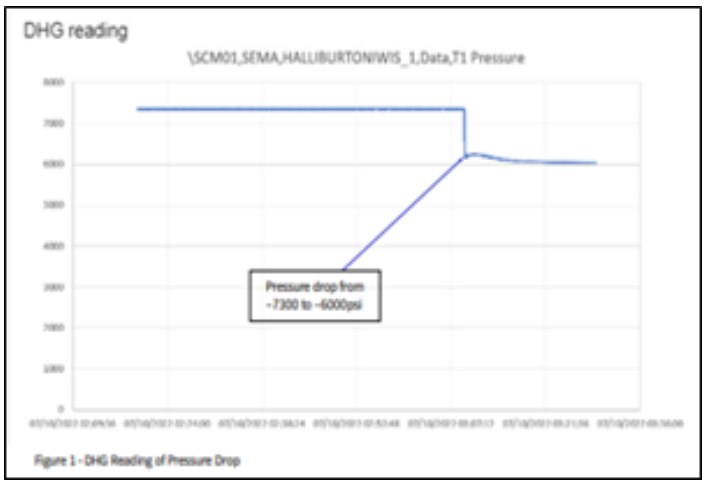

Figure 1 - DHG Reading of Pressure Drop

The downhole and Christmas tree gauge readings confirmed that the observed pressure drop and corresponding weight gain was proof the ball in the Optibarrier ball valve was open all along, even before intervention operations started.

Objectives

- Install the upper and lower completion while providing a qualified and testable barrier to allow topside operations to commence. In any deepwater well environment, one of the most critical completion components ensuring well integrity prior to suspension is the reservoir isolation (ball type) valve. Ultimately the deepset barrier had to be remotely opened via a pressure signature delivered from the remote operating vehicle (ROV).

Our Approach

- Prior to the project commencing and given the operational constraints of the ROV in relation to conventional pressure signature requirements, Weatherford designed a novel pressure pulse algorithm that was suited to the hydraulic functionality of the ROV. This approach not only addressed the operational concerns related to triggering the radio-frequency-identification (RFID)-enabled Optibarrier ball valve but would also see the valve activation in a timely manner when compared to other types of barrier valves.
- Following the successful installation of the lower completion and subsequent reservoir stimulation, the Optibarrier valve was closed with the wash pipe and tested to allow the upper completion to be installed. The ROV was then deployed to commission the well and open the deepset Optibarrier valve.

LOCATION
Santos Basin, offshore Brazil

WELL TYPE
Deepwater oil producer

FORMATION
Carbonate

HOLE SIZE AND ANGLE
14-3/4 in. diameter to 18,511 ft (5,642 m)
8-1/2 in. diameter to 19,350 ft (5,898 m)

MAXIMUM INCLINATION
42.5°

CASING SIZES
10-3/4 in., 85.3 lb/ft
10-3/4 in., 109 lb/ft

TEMPERATURE
158 to 176°F (70 to 80°C)

MAXIMUM PRESSURE
6,640 psi (45.78 MPa)

PRODUCTS/SERVICES
- Tubing hanger splice and hanging sub
- OptiValve™ hydraulic tubing isolation valve
- Optimax™ ultra deep-set safety valve
- SBRO™ series gas-lift mandrel
- SBRO-CI chemical-injection mandrels
- OptiPkr™ production packer
- Shearable no-go centralizer with self-aligning mule shoe
- WFX0™ seal bore packer
- RFID Optibarrier ball valve
- Inverted seal subs

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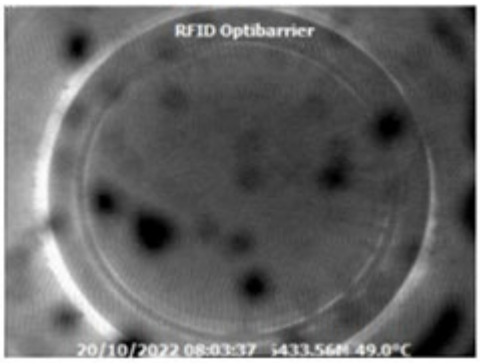

A camera confirmed that the ball was fully and not partially open.

Our Approach (continued)

- After a successful pressure pulse application, field personnel expected to see a positive indication at the surface that the RFID Optibarrier valve was open, enabling communication to the reservoir. This indication was not evident, so a further pressure pulse was applied at higher pressure as a contingency mechanism.
- Again, the desired results were not immediately evident so, given the availability of wireline on the rig, an intervention was possible to investigate further. Wireline was deployed in combination with a shifting tool to mechanically shift the Optibarrier valve in the event that it remained closed.
- It was immediately apparent during the intervention that there appeared to be a 32.8-ft (10-m) difference in holdup depth between where the ball mechanism was positioned and where the wireline toolstring was held up. The immediate thought was the ball remained closed and debris had accumulated above. Due to limitations in debris extraction capabilities offshore, the decision was made to suspend the well and return approximately 6 months later to investigate further.
- The subsequent intervention operation was conducted by deploying a tapered mill toolstring to the Optibarrier valve depth. Circulation was established to power the mill, and, after cleaning 9.8 ft (3 m), a pressure drop and corresponding weight gain was observed. This indicated that the ball valve had been open all along. This was confirmed by the downhole and Christmas tree gauge readings settling out to a reservoir pressure of approximately 6,000 psi (41.3 MPa).
- To further confirm that the ball was fully and not partially open, field personnel deployed a camera into the well and several pictures taken of the exact ball depth.
- Additional proof that the ball was open all along was provided by the operation time to clean out the debris plug and achieve reservoir pressure. Milling an Inconel 718 120 ksi material ball on coiled tubing downhole can take around 6 hours. From the point of starting to mill out the debris plug above the valve to the point of the pressure drop normalizing to reservoir pressure took only 30 minutes.

Value to Customer

- This operation demonstrated that, given the RFID Optibarrier valve's wide range of functionality and combined with a consistently achievable downhole opening force, a fully debris-tolerant barrier valve is now a reality in a key technology space that many have failed in before and continue to do so.
- This result gave the customer in this case valuable peace of mind that a barrier valve can now be discounted as the weak link in the well commissioning process.
- Taking this into consideration, it has also re-enforced the extreme importance of an effective wellbore cleanup process. This operation has shown that, although the Optibarrier valve successfully managed to function in a highly debris laden environment, a debris plug in the well can still hold a significant pressure differential, in this case 1,300 psi (8.9 MPa).
- This philosophy could also be applied in a proactive manner so deepwater operators can have the necessary intervention capabilities available to address any significant debris fill.

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