

Case study: Middle East

# ControlSET FLEX-LOCK V liner hanger system deployed in extreme high-mud weight well

A gas field development in the Middle East had unusually high-pressure formations above the reservoir, which the operator needed to isolate in order to drill into the pay zone.

Challenging wellbore conditions, including S-shaped well geometry and water-based mud with a density up to 21 ppg with 49% solids content, coupled with potential total fluid losses during liner deployment, made activation and release of conventional liner hanger systems extremely difficult.

## The solution

Prejob planning and reviewing of best practices led completion engineers from Baker Hughes to suggest that a liner be deployed at controlled speed to minimize the pressure surge against the formation, which had resulted in earlier fluid losses.

The ability to rotate the liner through tight spots would be critical and it was also decided to frequently break circulation in order to monitor the complex mud rheology and to avoid fluid losses.

Baker Hughes proposed using a 7-in. x 9<sup>5</sup>/<sub>8</sub>-in. liner hanger system comprised of the **ControlSET™ FLEX-LOCK™ V hydraulic-set liner hanger** with a **ZXP™ liner top packer**, **HRD-E™ hydraulic liner setting tool**, extrudable ball seats, and the **Solo Plug™ wiper plug system**.

Conventional liner systems are typically restricted to 800 to 1,000 psi (55 to 69 bar) circulation pressures. The ControlSET FLEX-LOCK V liner hanger is a pressure-balanced system with mirrored hydraulic cylinders, which act in equal and opposite directions to prevent the hanger from prematurely setting while circulating at the high pressures required for running in hole.

The ControlSET liner hanger's simplified ball seat system incorporates extrudable ball seats, which yield at specific pressures, allowing activation of the liner hanger and release of the running tool.

The ControlSET FLEX-LOCK V liner hanger was set by applying pressure against the first setting ball landed on the lower extrudable ball seat. To release the HRD-E hydraulic liner setting tool, which made rotating the liner through tight spots possible, a second setting ball was dropped and then extruded through the upper ball seat.

The hydraulic-set liner hanger has a new slip and slip seat design that minimizes the chances of solids accumulation around the slips—a major concern in this fluid environment.

To improve the cement placement around the liner, a tapered roller bearing was utilized on the liner hanger to allow for rotation during the cement job.

## Challenges

- Drilling mud conditions (mud weight of 21 ppg and 49% solids content) made activation and release of conventional liner hanger systems extremely problematic
- Severe fluid losses, due to the delicate balance between ECD and pore pressure fracture gradient, encountered during prior liner deployments
- Displace extreme heavy weight slurries and rotate the liner during cement displacement

## Results

- Successfully set, released, and cemented liners in extreme high-mud weight environment using FLEX-LOCK V hanger slips design, which increases the resilience to solids packing off
- Significantly reduced fluid losses by thorough prejob planning, which included pressure surge modeling to optimize running speed and flow rate during the liner installation
- Saved customer three to five days of rig time

A Solo Plug liner wiper plug system was used to displace the 21.4 ppg cement slurry. The mechanical-lock Solo plug adapter, which is installed as part of the running tool assembly, prevents premature release of the liner wiper plug due to surge pressure of the extrudable ball seats.

The ZXP liner top packer was successfully set and the excess cement reversed out, saving further rig time as no cement needed to be drilled out.

## The results

By successfully deploying this advanced liner hanger system, the customer avoided the consequences of a failed deployment, which could have resulted in a stuck liner or having to pull the liner out of the hole. This would have incurred direct rig time costs for a minimum of five days, along with other costs such as standby equipment. In addition, there would have been the real risk of exposing the

open hole to a longer period with a complex mud rheology.

The ControlSET FLEX-LOCK V liner hanger system has enabled this major operator to successfully deploy cemented liners under extreme wellbore conditions where conventional liner hanger systems simply cannot venture.