Case study: Gulf of Mexico, United States

FoamSet cementing system successfully isolated high geohazard zones, saving potential loss of well

An operator, drilling at a depth of 4,776 ft (1456 m) in the Gulf of Mexico, encountered a number of challenges involving both cement design issues and shallow water/gas flow, risking escalating production time and the ability to successfully maintain wellbore integrity.

The operator began by drilling a 10⅝ in. pilot hole to ensure well control against any possible worst-case scenarios, including unplanned discharges of either water or gas. Once the pilot hole was drilled to total depth, an unwanted shallow water flow was observed coming from the well. In an effort to stabilize the well pressure, the operator increased the weight of the pump and dump (PAD) mud. With little success in stabilizing the well pressure, the operator exhausted its supply of mud, pumping five separate times at density of 13-ppg to 15-ppg. At this time, the operator was forced to pull out to the casing shoe, risking the loss of the well. Frustrated with these efforts, the operator asked Baker Huges to analiyze the situation and provide a cementing solution that would provide rapid and reliable well stabilization.

Using its **CemFACTS™ cement design software**, Baker Huges engineers performed a well analysis to evaluate the well conditions. It was determined to that the problems were being caused by shallow water zones and gumbo-entrained gas present in the surrounding formation. These conditions were creating substantial risk of inter-zonal communication and even loss of well control, threatening the entire operation and driving up health, safety, and environmental risk.

A 26-in. hole opener operation was performed, and a 13-ppg PAD mud was pumped into the hole in an effort to shut off the flow. The operation proved ineffective, as minor gas flow was still observed coming from the well. Taking into consideration the changing well environment, the operation determined that their initial cement design using Type 1 cement would not be sufficient to overcome and control the current flow issues present in the well.

Challenges

- Narrow pore pressure and frac gradient margins, with high pore pressure
- Visual indication of shallow gas and water flow
- Two geological faults leading to mudline
- Wellbore breaching to seafloor on previous section
- Type I cement onboard, with parameter changes requiring Class H

Results

- Provided and implemented a solution within 24 hours
- Minimized unfoamed tail slurry
- No flow after cementing operation
- Stabilized the well and verified wellbore integrity through casing and formation integrity tests

Based on the CemFACTS modelling analysis of the well, Baker Hughes recommended the use of our **FoamSet™ foam cementing system** combined with a Class H cement, more suited to the present well conditions. This solution provided the wellbore integrity and zonal isolation needed to address the shallow water/gas flow challenges effecting the integrity of the wellbore. The versatile, all-liquid FoamSet system, enhanced with nitrogen bubbles, adjusts to the changing well pressure, compensating for volumetric losses as the cement sets. The system's improved coverage creates more tortuous paths for the influxing fluids to pass through, limiting invasion risks.

Baker Hughes pumped the FoamSet slurry into the wellbore, shutting of the shallow water/gas flow, completely filling the annulus. Formation integrity tests were performed and proved the integrity of the wellbore.

The successful combination of the Baker Hughes well simulation, cementing, and evaluation capabilities, and the quick 24-hour turnaround of the well analysis by the Baker Hughes engineering team, helped successfully address the issues affecting the integrity of the wellbore, quickly and effectively. This prevented the operator from incurring the time and costs associated with drilling a new well. The operator was pleased with the Baker Hughes solution.

Baker Hughes