Offshore Malaysia: Overcoming a Challenging Narrow Operating Window and Successful Implementation of @balance Services Automated Managed Pressure Drilling (MPD) and Managed Pressure Cementing (MPC)

THE CHALLENGE

- Drill through kick/loss zone due to weak coal layers and high pore pressure sands
- Steep pressure ramp between sand pore pressure
- Keep the well at balance with very low overbalance margin for tripping and logging
- Run and cement the liner under the same tight environment

Revisit of an abandoned well

The original well was one of several over-pressured wells in the project. Although this well was drilled during the field development stage, it also carried the exploratory mission. It was also the first well to penetrate the over-pressured zones across the fault in the field. In the first attempt to reach well TD, the drilling team encountered a steep pressure ramp after drilling through the fault. The 7-in liner was set to isolate the fault. While drilling the subsequent 6-in hole section, a major coal layer was encountered after only 23 m of drilling. This coal layer lowered the fracture gradient from 19.0 ppg to 18.3 ppg and also caused a severe ballooning/supercharging effect. In addition, the formation pressure in the previous sand indicated a pressure of 16.72 ppg equivalent. Given the narrow pressure window of 1.58 ppg and indications of a pressure ramp, the decision was made to stop drilling and suspend the well until a suitable solution could be found.

THE SOLUTION

Automated MPD Strategy

Detailed data analysis and program planning were conducted by @balance Services based on the expected well behavior as learned from the original well. The plan was to re-drill the 6-in hole using static underbalanced mud weight with the application of MPD during drilling as well as during the liner running and cementing operations. Application of MPD allowed for better control of the bottomhole pressures given the very narrow pressure window by accurately controlling the amount of surface backpressure applied during dynamic as well as static conditions.

Biggest static underbalanced cementing job - MPC

In order to maintain the BHP within the operating window during the cementing job, it was necessary to displace the well to a mud weight that was 1.5 ppg below the pore pressure (600 psi) and apply a scheduled surface backpressure during the entire operation. The use of the @balance Services MPD system also made liner rotation feasible. The Operator was quite satisfied since this was the first time during the campaign that the plugs bumped and cement at the top of the liner was observed.

THE RESULTS

- The well was recovered and sands were explored after a year of suspension
- No major fluid losses were encountered during the drilling phase
- Overbalanced condition was maintained throughout the well construction process with no kick events
- The liner was run with an underbalanced mud weight
- For the first time in the campaign, bump cement plugs and cement on top of liner were observed
Plot 1: MPD drilling mud weight was designed to be 0.9 ppg statically underbalanced and 0.1 ppg dynamically overbalanced at the bottom of the section.

Plot 2: Light mud weight was displaced on four stages while running the liner in the well so not to exceed the fracture gradient.
Plot 3: Surface backpressure was applied during the cementing job to maintain the overbalanced condition at all times.