DEEP WATER

CASE STUDY

GeoBalance® Service Helps Operator Save Big in Challenging Deepwater Environment

AUTOMATED MANAGED PRESSURE DRILLING SYSTEM SUCCESSFULLY DRILLS 'UNDRILLABLE' WELLS IN 2,000 METERS OF WATER

OFFSHORE BRAZIL

CHALLENGES

- Install first implementation of MPD surface control system on an MPD-ready drillship
- Maintain bottomhole pressure with a 50-psi window

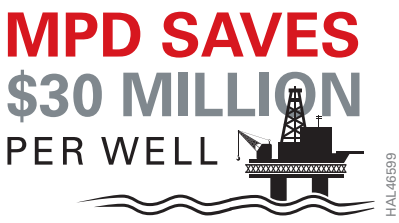
SOLUTIONS

- Install and utilize GeoBalance® automated MPD system, including DetectEv™ application
- Implement training for team to ensure successful operation

RESULTS

- MPD system was able to eliminate losses and avoid influxes within a 50-psi window
- Successfully drilled four sections for a total of 3,785 meters (12,418 feet) in 2,000 meters (6,562 feet) of water
- Successfully drilled what would have been "undrillable" wells, and left wells in stable condition upon completion
- Saved operator approximately USD 30 million per well

OVERVIEW



Ultra-deepwater pre-salt developments are considered to be among the most challenging projects for the industry today. With increasing costs in pre-salt well delivery, different technologies can be used to optimize rig time, reduce nonproductive time (NPT), and decrease risks to safety and the environment. Managed pressure drilling (MPD) is a technology that has a proven ability to help eliminate or mitigate NPT related to pressure incidents throughout the drilling process. MPD uses a closed-loop system that adds an increased level of environmental protection and allows for the use of an automated early kick detection system for increased safety. The Halliburton GeoBalance® automated MPD system was incorporated onto two MPD-ready, sixth-generation, ultra-deepwater drillships to provide the control, flexibility, and safety required to drill and mitigate these risks. This implementation allowed Halliburton to drill 3,785 meters (12,418 feet) in an extremely challenging zone in stable and safe conditions.

CHALLENGES

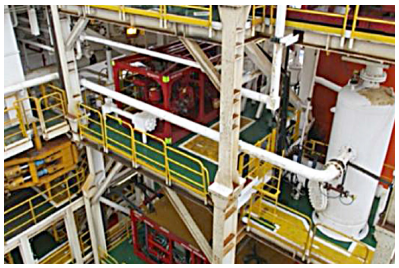
The pore pressure and frac gradient boundaries dictated that the bottomhole pressure needed to be maintained within a 50-psi window and that the drilling could be performed with either a pressurized or floating mud cap. These challenges associated with ultra-deepwater pre-salt developments led the operator to elect using the GeoBalance automated MPD service in conjunction with hydraulic modeling software for optimal adaptability and real-time pressure control. This project would also be the world's first implementation of an MPD surface control system on an MPD-ready drillship. The safe and successful implementation of the MPD system required using an engineered approach and working closely with the operator from the planning phase, through training exercises, and during the job execution.

Along with the installation of this equipment and hydraulic software, Halliburton developed a two-tiered comprehensive training program for all parties involved in these operations. The first exercise was designed as an MPD overview with the goal of exposing all operational personnel to the theory of MPD and to the equipment that would be utilized on this project. The second exercise was designed to expose critical personnel to the procedures and to help them develop a strong understanding of the contingency procedures in the event of kicks or losses.

SOLUTIONS

As this was the first-ever implementation of an MPD control system on an MPD-ready drillship, the operator decided to use MPD on the 16-inch hole salt section. This allowed all rig crews to become familiar with MPD operations on a live well in a non-hydrocarbon zone.

Training in the salt section provided the competencies to react with proper responses once in the reservoir. The uncertainty of the reservoir pressure created an extremely narrow drilling window that progressively got narrower due to a hydrocarbon gradient.



MPD surface equipment (in red) installed throughout the decks of the drillship

To keep the well within the available hydraulic window, the MPD system was designed to maintain pressure slightly above the highest pore pressure in the reservoir using a statically underbalanced drilling fluid. Running speeds were designed to control surge and swab pressures on trips, and the automation with the GeoBalance MPD system mitigated their effects in real time. Properly managing downhole pressure and staying within a safe "pressure window" required advanced event detection and the ability for the MPD system to react to these events. On the operator's wells, Halliburton utilized the DetectEv™ application, part of the hydraulic modeling software that uses well signature patterns for event identification and applies an appropriate response within the MPD system. On these wells, the two events of possible concern were incurring losses and experiencing kicks.

RESULTS

All the preparation and planning resulted in a flawless execution of four drilling sections for a total of 3,785 meters (12,418 feet) drilled using the GeoBalance MPD system at a water depth of 2,000 meters (6,562 feet). Manipulating the equivalent mud weight (EMW) at different target depths with the MPD system allowed drilling the salt in record time with no NPT. Precise and accurate pressure control eliminated the need for remedial work commonly seen in salt sections. For additional safety, both production sections were designed to use a static mud weight at or above pore pressure while in a hydrocarbon zone.

In both production sections, severe losses were encountered, and, with the precise control of the MPD system, these losses were mitigated rapidly, resulting in massive savings – estimated at USD 30 million per well. Multiple loss zones were encountered and, with each one, the DetectEv application quickly identified the event and the drilling team adjusted the bottomhole pressure accordingly. Due to mud weight, surface pressure losses, and the lower fracture pressure, the MPD system got to a point where it no longer had the ability to reduce EMW as chokes were fully open while circulating. At this point, because of the confidence that the operator and drilling contractor had in the Halliburton crew and the automated control system, the mud weight was reduced to a statically underbalanced fluid. By reducing the mud weight, the MPD system was able to eliminate losses and avoid influxes within a 50-psi window. Losses throughout both production sections were as high as 300 bbl/hour, but, by implementing proper bottomhole pressure management and reducing the mud weight, the team was able to finish drilling and leave the wells in a stable condition, eliminating continued losses. Without the GeoBalance MPD system, these wells would have been undrillable. Each loss event would have required immense amounts of rig time to solve; in the past, these events required the use of remedial cement plugs, which cost days of rig time in addition to the cost of suffering these large losses. The GeoBalance automated MPD system enabled the operator to avoid these issues and, thus, save a considerable amount of time and money.

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