Modus™ Managed Pressure Wells Solution

Optimizes Efficiency while Drilling in Hazardous Field, Saves $3.6 Million USD

Objectives

- Maintain the target equivalent mud weight at the landing point in an unpredictable formation with total loss and gas migration zones.
- Maintain constant bottomhole pressure (CBHP) during drilling and connection.
- Provide an early loss detection system while drilling in a known loss circulation zone.
- Use the pressurized mud cap drilling (PMCD) method to reach the target depth with expected total loss near total depth (TD).
- Secure the well while pulling the bottomhole assembly (BHA) out of the well and completions.

Our Approach

- Based on previous experiences in the field, the operator knew the well was undrillable without a managed pressure drilling (MPD) system. Drilling hard formation of basement requires few bit trips in the presence of loss circulation and gas migration. To optimize the ROP, the operator opted to put the mud weight near balance on circulation which resulted in a statically underbalance situation during connection.
- Prior to drilling the 8 1/2-in. hole section, Weatherford field personnel fully rigged up and pressure tested the Modus system, including the electric chokes and Coriolis real-time flowmeters. An in-casing test was performed prior to drilling out of the cement, and the data served as a benchmark when drilling the 8 1/2-in. section.
- Weatherford experts applied constant bottomhole pressure (CBHP)—as calculated by the Centro software—with the Modus system while drilling the 8 1/2-in. section at a measured depth (MD) of 7,611 ft (2,320 m) until partial losses were observed at 9,128.9 ft (2,782.5 m) MD.
- Per the operator's procedure, the well was displaced with water, and the resulting BHP was lower than before, caused by a fault in the reservoir zone. The gas reading during drilling was 200 units, while gas reading during connection with 300 psi of surface backpressure (SBP) was 800 units. Weatherford engineers applied 200 to 300 psi of SBP during drilling and 500 to 600 psi of SBP during the connection. With this value, it was proven that the gas reading was reduced, and the safety of the drilling operation improved.
- The electric chokes offered precise and efficient operation, regulating pressure with incompressible water as mud. During ramping up/down of the mud pump, the electric chokes quickly followed the set point of the SBP. The Modus chokes accurately and quickly matched the set point of the backpressure, with an average connection time of 13 to 15 minutes, 25% faster than the previous MPD system.

By providing visibility and control of downhole conditions, the Modus solution displays, captures, and transfers data in real time, enabling safe drilling in narrow, shifting, and unknown drilling windows by managing ECD.

LOCATION
Jambi, Indonesia

WELL TYPE
Horizontal

FORMATION
Batu Raja formation, basement

HOLE SIZE AND ANGLE
8-1/2 in., 40° angle

CASING SIZE AND TYPE
9-5/8 in. liner and tie back casing

LINER SIZE AND TYPE
9-5/8 in. liner hanger and tie back

TEMPERATURE
159°F (70.5°C) return flow

PRESSURE
8.8 ppg pore pressure prognosis

DEPTH
- MPD drilling from 7,611 to 9,514 ft (2,320 to 2,900 m)
- Partial loss with gas at 9,128.9 ft (2,782.5 m)
- Total loss circulation at 9,314 ft (2,839 m)

PRODUCTS/SERVICES
- Modus managed pressure wells solution
- SafeShield® Model 7100 RCD
- DDV® downhole deployment valve
- Centro® drilling optimization software platform

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As part of an overall well integrity system driven by our continued innovation and vision to push the industry forward, the Modus solution facilitates safe drilling in narrow, shifting, and unknown mud-weight windows by effectively managing ECDs and delivering a trusted approach to all your wells.

Our Approach

- At a MD of 9,315.9 ft (2,839.5 m), a total loss was observed, with the chokes fully closed while holding 500 psi of pressure on the surface. Drilling continued with the PMCD method, and the SBP was generated by a fully closed choke to ensure no gas nor cuttings returned to the surface. The initial method was continuous bullheading to ensure all cuttings and gas enter the fault. After all the parameters were stable, field personnel switched to intermittent bullheading.
- The operation reached TD at 9,514 ft (2,900 m) MD. Both the CBHP and PMCD methods was used to drill this last section. Continuously bullheading facilitated pulling the drillstring out of the wellbore until reaching the DDV at 3,100 ft (945 m) MD. After the DDV was closed without surface pressure, the rest of the drillstring was removed.
- Before removing the RCD bearing, a flow check revealed increased pressure due to gas in the wellbore. Field personnel used the Modus chokes to bleed off pressure safely and efficiently by rerouting flow to the rig mud gas separator and flaring system. After recycling the DDV and bleeding off pressure, no further gas migration was observed.

Value to Customer

- By using the Modus solution, the expenditure for the drilling fluid systems decreased by almost 40% compared to similar wells. A direct cost of around $3,600,000 USD would of have been incurred by the operator for fluid alone on conventional operations, from the time of the detection until the liner would have been run in hole.
- When the Modus solution accurately detected a flow out deviation, in under 2 minutes, the Modus operator knew a fracture had been encountered. This enabled a quick decision to switch to drilling ahead in PMCD mode with seawater, saving time and reducing volumes of lost drilling fluid and enhancing safety.
- Wellbore conditions were managed by the Modus system in all pumps-off scenarios. A lower mud weight could be used and, by performing CBHP connections, the pressure oscillations between pumps On and Off were significantly reduced. This feature led to minimal damage to the reservoir and the delivery of a good quality annulus for future operations.
- The hazard on the area is basement formation with a fault. Because the only option to drill the well efficiently and safely is by using MPD, the operator decided to deploy MPD technology in the first few wells of the field.

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