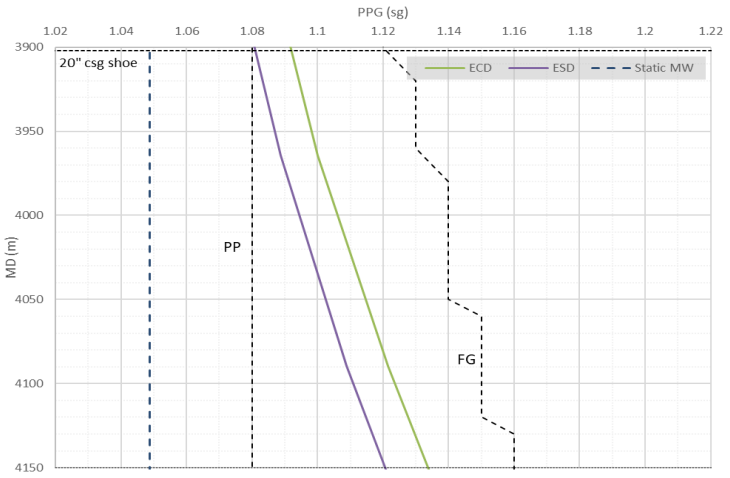
Managed Pressure Drilling, Cementing

Eliminated Intermediate Contingency Liner in Ultra-Deepwater Well, Saved 5 days, $3.5 Million USD



The chart illustrates the expected pressure profile of the operation with the lower limit (pore pressure, PP) and upper limits (fracture gradient, FG).

Objectives

- Manage pressure during the entire well program–including drilling, tripping, and running casing–through a narrow operating window, eliminating the use of a contingency liner.
- Run and cement a 13 3/8-in. casing with accurate pressure control to isolate the critical formations and avoid circulation losses, obtaining a good final strength to allow continue drilling next phase with a strong shoe.
- Drill further stages of the well to total depth (TD) safely.

Our Approach

- With the sea floor under 10,748 ft (3,276 m) of water, the conventional choice involved an excessive number of casing strings and an overbalanced mud weight.
- The customer could not conventionally cement a string of 13 3/8-in. casing to isolate the critical formation and safely continued further stages of the well.
- To address pore pressure uncertainty, pressure ramp increase, and a narrow pore pressure/fracture gradient (PP/FG) window, the customer decided to integrate a managed pressure drilling (MPD) system into the drilling program to provide the ability to adjust the bottomhole pressure instantaneously during the entire well program, including drilling, tripping, running casing, and cementing.

LOCATION
Gulf of Mexico (Mexico)

WELL TYPE
Exploratory

WELL DEVIATION
Vertical well

CASING SIZE
13-3/8 in.

TOTAL DEPTH
15,610 ft (4,758 m)

WATER DEPTH
10,748 ft (3,276 m)

PRODUCTS/SERVICES
- Managed Pressure Drilling
- Victus™ simulation and control software
- Remote MPD Engineering services

Weatherford®

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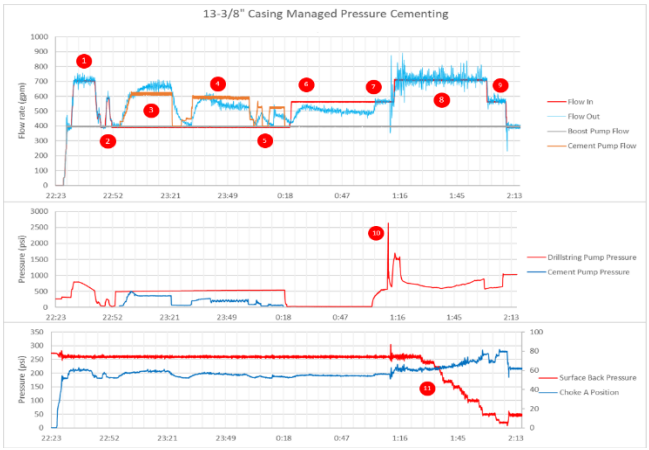
Our Approach (continued)

- A collaboration between the engineering teams of the operator, the cementing service provider, and Weatherford's MPD professionals resulted in a generated plan based on the maximum pore pressure encountered during the drilling of the 12 1/4-in. pilot, 1.08 SG (9.01 ppg), and then extended to the 16 1/2-in. hole.
- Using synthetic-based mud (SMB), a tail slurry of 15.86 ppg (1.90 SG) followed a 12.52 ppg (1.50 SG) lead gas-tight slurry. At a total depth (TD) of 13,622 ft (4,152 m), the combination kept the equivalent mud weight (EMW) at 9.18 ppg (1.10 SG) without exceeding 9.51 ppg limit at bottom (1.14 SG).
- At the previous casing shoe, located at 12,801 ft (3,902 m), the plan called for a 9.01 ppg (1.08 SG) EMW without exceeding 9.35 ppg (1.12 SG) limit at that depth.

Value to Customer

- Field personnel executed the operation flawlessly with zero health, safety and environmental (HSE) incidents.
- Full returns were observed throughout the entire cementing process and no influxes detected, verifying the MW window.
- The customer no longer needed to run a 16-in. intermediate contingency liner.
- The application of MPD techniques for drilling, tripping, running casing, and cementing operations saved five days, the equivalent of $3.5 million USD, observing no losses and obtaining a strong shoe to continue drilling deeper successfully to well TD.



List of Events

1. Pump Spacer with rig pumps.
2. Chase spacer with 10bbl SOBM to clear surface lines.
3. Begin pumping Lead Slurry with Cement pump.
4. Pump Tail Slurry with Cement pump.
5. Pump 20bbl of spacer with cement pump.
6. Begin displacement with rig pumps.
7. Flow out returns level to balance once SOBM has caught up to the falling cement in the drill pipe.
8. Final displacement with rig pumps.
9. Slow down rate to bump plug.
10. Dart hits top plug and shears at 2,600psi.
11. Reduce surface back pressure as per step down chart provided by Weatherford.

The chart shows the 13 3/8-in. casing Managed Pressure Cementing process.