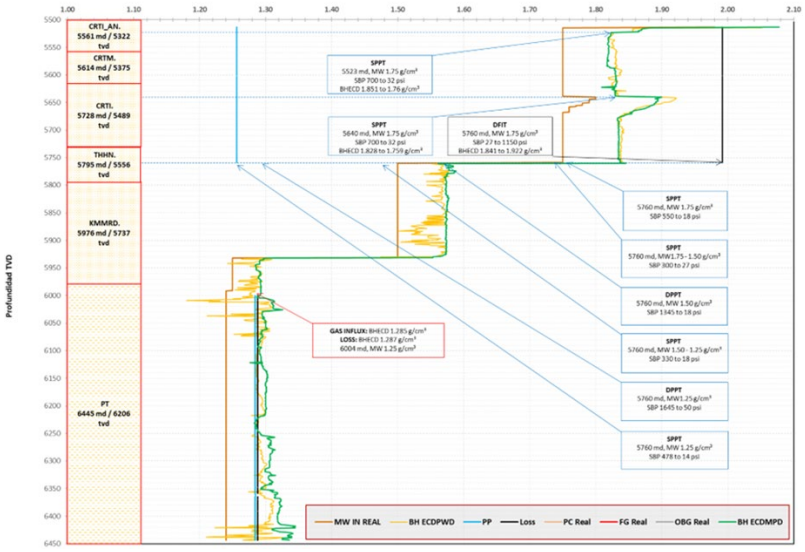
MPD Techniques, Victus™ System Thoroughly Characterized HPHT Reservoir, Eliminated Contingency Liner, Optimized Future Drilling



Section operating window and formation tests performed with MPD.

Objectives

- Apply managed pressure drilling (MPD) techniques to finish drilling operations with 1.25 g/cm³ drilling mud. According to offset wells, the Cretaceous had been drilled with 1.85 g/cm³ drilling mud, and the objective behind applying MPD was to test the upper Jurassic formation. The offset wells were drilled in five and six sections, but this well was designed for four, depending on the test results and use of MPD in the last section.
- Drill with an 8 1/2-in. bit through the Upper Cretaceous, Middle Cretaceous, Lower Cretaceous, and Upper Tithonian Jurassic reservoirs and reach the target via a tight narrow window in the Upper Tithonian Jurassic.

Our Approach

- Weatherford experts conducted an MPD engineering program and feasibility study with the customer to characterize the reservoir. Several simulations and risk analysis were performed, using the Victus simulation software, to determine the safest and most efficient way to perform the dynamic formation tests.
- Field personnel drilled out at 18,067 ft (5,507 m) with last section mud of 1.98 g/cm³ and an equivalent circulating density (ECD) of 2.08 g/cm³. After an additional 19.6 ft (6 m) were drilled, with well returns aligned to the Victus MPD system, the mud was displaced for 1.75 g/cm³ mud that was then used to drill from 18,087 ft (5,513 m) to the top of the Tithonian formation at 18,897 ft (5,760 m) with an ECD of 1.83 g/cm³.

LOCATION
Mexico

WELL TYPE
High-pressure, high- temperature (HPHT) development, onshore, type S

FORMATION
Jurassic

CASING SIZES
20 in., 13-3/8 in., and 9-5/8 in.

LINER SIZE
7 in.

TEMPERATURE
275°F (135°C)

PRESSURE
11,300 psi (77.9 MPa)

DEPTH
21,145 ft (6,445 m)

PRODUCTS/SERVICES
- Victus Intelligent MPD
- Rotating control device 7875

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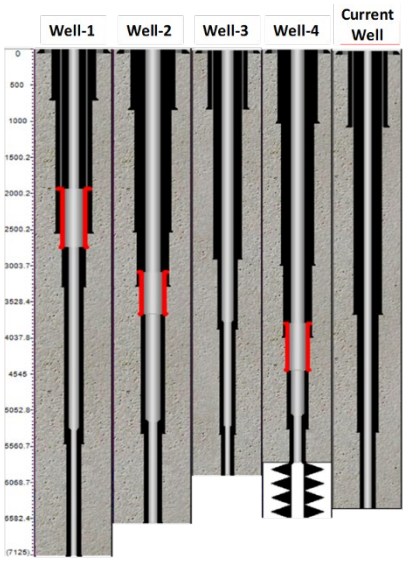

Comparison of number of stages between wells in the field.

Our Approach (continued)

- A static pore pressure test (SPPT) was performed at a depth of 18,120 ft (5,523 m) using the Victus MPD system from 1.85 to 1.75 g/cm³ equivalent static density (ESD).
- At 18,897 ft (5,760 m), a dynamic formation integrity test (DFIT) was carried out using the Victus system from 1.83 to 2.00 g/cm³, with the maximum surface backpressure (SBP) up to 1,150 psi (7.9 MPa). Another SPPT was conducted at this same depth from 1.83 g/cm³ to 1.75 g/cm³. The mud density was then reduced from 1.75 g/cm³ to 1.50 g/cm³, maintaining an ECD of 1.75 g/cm³ starting with 1,345 psi (9.2 MPa) SBP.
- A dynamic pore pressure test (DPPT) was performed with the Victus MPD system from an ECD of 1.75 to 1.57 g/cm³ followed by a SPPT from 1.57 to 1.50 g/cm³ ESD.
- After a flow check was successful with 1.50 g/cm³, the mud density was reduced to 1.25 g/cm³ to continue testing the well, maintaining a constant bottomhole pressure (CBHP) with an ECD of 1.50 g/cm³ and 1,345 psi (9.2 MPa) SBP.
- A DPPT was performed with the Victus MPD system from an ECD of 1.50 to 1.30 g/cm³. A SPPT was conducted with surface circulation from 1.30 to 1.25 g/cm³ ESD.
- The drilling fluid was displaced from 1.25 to 1.50 g/cm³ and drilling resumed until the top of the Jurassic formation where tests were run again displacing mud from 1.50 to 1.25 g/cm³.
- Drilling with the Victus system continued with 1.25 g/cm³ mud weight until a loss was observed at 19,698 ft (6,004 m), where density was further reduced to 1.24 g/cm³ to drill to TD. The very narrow window was observed from this point onwards (1.285 and 1.287 g/cm³).

Value to Customer

- By using Weatherford's MPD techniques implemented with the Victus system, the well was completed in 4 sections according to plan.
- The well was completed in record time: 25 days earlier than the previously recorded well and 100 days less than the first well drilled in this field.
- These tests using the Victus Intelligent MPD system enabled the customer to characterize all the MPD-drilled sections and optimize drilling operations in future wells.
- The new high-fatigue sealing elements were used during this operation and demonstrated an extended-life performance of 221 hours installed, rotating 170 hours over 4,002 ft (1,220 m) and 23.5 hours stripped at 18,280 ft (5,572 m) with up to 770 psi (5.3 MPa).

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