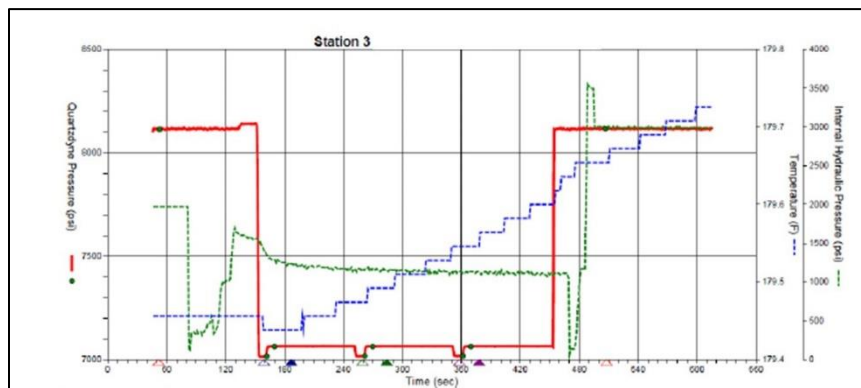


MPD and PressureWave™ Integrated Solution

Evaluate Formation in uHPHT Well in UK, Remove Wireline and Save \$963,000



The PressureWave formation tester acquires and records real-time pore-pressure data, which enhances reservoir modelling and drill plans.

Objectives

- Obtain, while drilling in an ultra-high-pressure and temperature (uHPHT) deviated well, a comprehensive set of downhole formation data that includes gamma ray, neutron porosity, density, caliper, photoelectric factor, bore and annular pressure, and resistivity logs.
- Test the formation pressure to understand the reservoir's pressure regime and mobility and optimize the mud weight.
- Improve the understanding of the fluid gradient, intra- and inter-fault block connectivity, and determine early the completion strategy and forecast the production capacity.
- Save rig time by removing the requirement for post-drill wireline data acquisition, significantly decreasing operational risk and maintaining the overall wellbore and quality of the reservoir.

Our Approach

- Weatherford customized a 6 3/4-in. bottomhole assembly (BHA) to drill the 8 1/2-in. section with a Magnus™ rotary steerable system (RSS), HEL MWD, AZD, TNP, MFR, BAP, and HAGR tools, and the PressureWave™ formation tester.
- In collaboration with the customer, Weatherford experts assessed the risk of running the PressureWave LWD formation tester potentially out of its technical specification of maximum 329°F (165°C) considering the bottomhole temperature was anticipated to be at 392°F (200°C). BHA functionality had been mapped out and a comprehensive decision tree was agreed by the customer to enable running in the same BHA in the attempt to drill and acquire critical formation evaluation data through the entire openhole section.

LOCATION

Offshore, UK Continental Shelf

WELL TYPE

uHPHT well
(17,650 psi formation pressure,
392°F static formation temperature)

FORMATION

Sandstone reservoir

HOLE SIZE AND ANGLE

8-1/2 in., 41°

TEMPERATURE

347°F (175°C)

TOTAL DEPTH

- 21,055 ft MD (19,025 ft TVD)
- 6,417 m MD (5,798 m TVD)

SECTION DEPTH

- 18,860 to 21,055 ft MD
(17,259 to 19,025 ft TVD)
- 5,748 to 6,417 m MD
(5,260 to 5,798 m TVD)

PRODUCTS/SERVICES

- Magnus 675 push-the-bit RSS
- MWD HEL-BAP-IDS
- LWD with azimuthal gamma ray (HAGR) tool
- Multi-frequency resistivity (MFR) tool
- Neutron-density (AZD-TNP) tool
- PressureWave formation tester
- Victus™ Intelligent MPD
- IES interpretation and evaluation services (IES)



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Our Approach

- Constant communication and information sharing between parties was paramount for the project and for the specific application of the formation tester. Dedicated meetings between the Weatherford product lines experts, at local and global level, were set to discuss operational plans and potential risks along with mitigation measures. These revolved mainly around the high temperatures expected and risks involved in sampling in an uHPHT environment. Simulations for both drilling services and managed pressure drilling (MPD) were cross checked to establish the best settings for the tool, running-in-hole procedures, MPD procedures, and acquisition plans to ensure capability to deliver successful formation pressure tests in the anticipated low permeability formations.
- During operations, the PressureWave tester facilitated performing pressure tests while the MPD Victus systems enabled, as designed, management of the bottomhole pressure to prevent stuck pipe and potential well-control challenges.
- The tests of the tools were transmitted in real time and monitored remotely from onshore offices by specialists from both the customer and Weatherford for quality check, data evaluation, and to adjust tool parameters for obtaining the best results.

Value to Customer

- By relying on Weatherford technology and expertise, the customer saved 2.5 days of rig time at \$385,000 per day.
- Although the temperature was above 329°F for most of the run, all Weatherford downhole equipment performed as intended and successfully reached TD facing a maximum circulating temperature of 347°F (175°C).
- The integrated approach by Weatherford—including drilling, MPD, ISP, and IES—demonstrated that drilling and obtaining formation sampling information simultaneously through the most challenging conditions of HPHT wells is no longer impossible. The solution was made possible by the cross expertise of the team and control of the risks using complementary procedures and Weatherford equipment.
- The PressureWave tester exceeded its temperature limits and still performed multiple pore-pressure tests in real time and provided a deeper insight of the reservoir, succeeding in unlocking the optimization of the entire field development strategy. At the same time, the success of the operations saved multiple rig days in an extremely challenging environment.
- A complete LWD data acquisition of formation evaluation in uHPHT conditions sets a new standard which can support operations done through similar harsh environment to obtain formation data while reducing costs.



The PressureWave formation tester takes fast, reliable formation pressure measurements with pumps either on or off. While testing with pumps on, data can be transmitted as fast as one pressure measurement every four seconds with 1/2-psi resolution. In memory mode, the tool records high-resolution 32-bit pressures at five samples per second.

