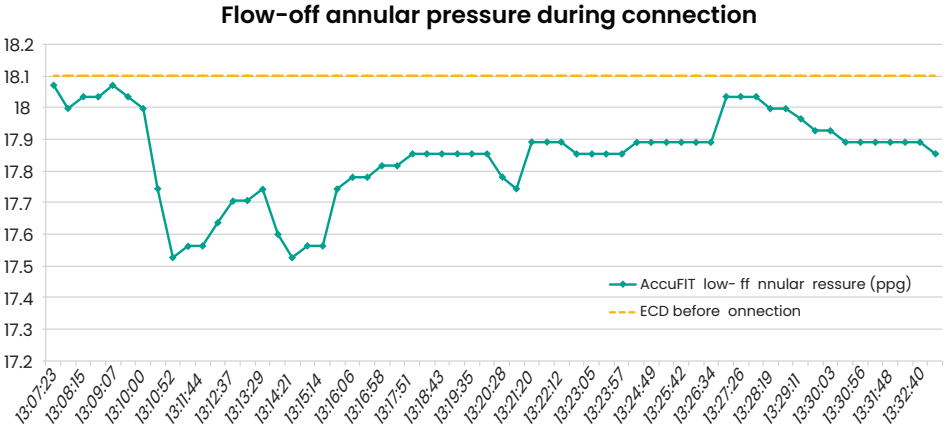
Case study: Onshore Nigeria

AccuFIT service delivered accurate pressure data in real time, enabling Shell to make pressure-related decisions during MPD operation

In Nigeria, Shell needed to drill a deep, deviated, high-pressure (HP) onshore well through a challenging TD hole section interval with a narrow margin between pore and fracture pressures. Accurate real-time monitoring of the flow-off pressure was desired to evaluate the necessary mud weight for well control purposes during a managed pressure drilling (MPD) operation. The operator's main objective was to safely drill the well with MPD system and obtain all required logging-while-drilling (LWD) and measurement-while-drilling (MWD) data in real time.

During the planning phase for the well, Baker Hughes recommended the **AccuFIT™ real-time flow-off annular pressure service,** integrated with the pressure sensors of the **OnTrak™ integrated MWD service**, to monitor the downhole annular pressure during connections. The AccuFIT service quickly and reliably transmitted high-resolution downhole flow-off pressure data to the surface in real time, enabling the operator to make bottomhole pressure-related decisions during the operation. Other Baker Hughes LWD services in the bottom-hole-assembly (BHA) included the **TesTrak™ LWD formation pressure testing service** to identify the reservoir fluids in real time with pressure gradient analysis.

The AccuFIT service obtained high-definition flow-off annular pressure profiles consisting of 60-point datasets delivered automatically after each connection once normal circulation resumed. Subsequent 60-point datasets were available on request with a downlink specifying specific timeframes with resolutions as low as 2 seconds for any subset of the flow-off interval. Each measured pressure point provided actual time and annular pressure information, as well as calculated depth, total



The real-time downhole flow-off annular pressure profile data that were acquired during a connection indicated a loss of back pressure during the MPD operation.

Challenges

- Drill deep, deviated HP well though an interval with a narrow pressure margin
- Drill well with MPD system and obtain all LWD data in real time
- Determine the correct mud weight and surface pressure from MPD operation to maintain well control and forestall formation breakdown
- Gather the ESD pressure profile in real time during connections with MPD system

Results

- Delivered accurate flow-off pressure profile in real time
- Monitored downhole annular pressure during connections to understand downhole flow-off pressure and improve reliability of pressure data for MPD operation
- Reduced risk of wrong downhole pressure interpretation compared to using just the minimum and maximum flow-off pressures

vertical depth (TVD), and equivalent static density (ESD) information. The advanced data compression telemetry, and automated logic to start sending at the base of the ramp-up in pressure, reduced the time to transmit the real-time measurements.

Initially, the operator expressed doubts in the AccuFIT service measurements, as a pressure drop was observed during connections despite the back-pressure that was applied by the MPD system to maintain the annular pressure. This pressure drop of up to 400 psi (0.6 ppg) was not measured on the surface by the MPD system and, if left untreated, could have created a pressure control hazard. After pulling the bottomhole assembly (BHA) out of the hole, it was observed that the float valve above the BHA had failed and was not holding backpressure through the bore of the tools. This confirmed the reason for the connection pressure drop as measured by the AccuFIT service.

The AccuFIT service enabled Shell to evaluate the downhole flow-off pressure profile in real time during MPD operations. Shell was very satisfied with the service and will be interested in this service for future operations.

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