CASE STUDY – MANAGED PRESSURE DRILLING

Managed Pressure Drilling (MPD) Solution Offshore West Africa

CHALLENGE

The well site is located offshore in Abidjan, Ivory Coast, in slot 7 of the field Marlin-Manta. The Manta B2 well is a gas producer well in the campaign, and it will be drilled by Foxtrot International using the Sapura Berani Tender Assisted Platform.

The Manta B2 well is a deviated well and it will be drilled in a water depth of 109.5m TVDSS. The 8 ½" hole section is planned to be drilled using the BEYOND ENERGY SERVICE & TECHNOLOGY (BEST) Managed Pressure Drilling (MPD) system with an Oil Based Mud (OBM).

The 8 ½" hole section is planned to be drilled from 4,510m (2,117m TVD) to 5,500m (2,318m TVD), resulting in a total length of 990m.

The primary MPD objectives are:

- Maintain the EMW on bottom hole within the drilling window. Maintain overbalance condition within the open hole during all drilling events such as drilling, connection (i.e., any pumps-off event), tripping, mud rollovers, casing or liner run, and cementing operations, when applicable.
- Early kick and loss of circulation detection. The Coriolis flow meter allows earlier detection of influxes and loss of circulation events compared to conventional systems.
- Rapid response to changes in the formation Pressure. Due to the uncertainties in the reservoir characteristics (virgin or depleted) and regarding the impact of the bathymetry change along the well trajectory in the drilling window, a clear definition of the mud weight window becomes challenging. The MPD system allows the BHP to be changed quickly by increasing or reducing the SBP as required to maintain the well in an overbalanced condition.
- Formation evaluation. The MPD system can be used to evaluate the formation at any time needed during the drilling operations. The following tests can be performed with the MPD system:
    - Dynamic Pore Pressure Test (DPPT)
    - Dynamic Leak-Off Test (DLOT)
    - Dynamic Formation Integrity Test (DFIT)

The main area challenges are:

- Narrow drilling window due to depleted reservoir conditions and changes in the bathymetry along with the well trajectory.
- The drilling window is unknown due to the uncertainties of the reservoir characteristics and the bathymetry change's impact along the well trajectory.

Under the "IADC Well Classification System for UBO and MPD" dated March 9, 2005, Manta B2 is classified as Risk Level 2, Category A, Fluid System 5 (2-A-5).

ENGINEERING SOLUTION

Figure 1 The graph below shows the EMW profiles for the 8 ½" hole section using a 1.27SG LTOBM. In this scenario, the mud weight utilized (1.27SG) is below the expected collapse EMW (P90). The following flow rates are graphed: 1,135lpm (300gpm), 1,515lpm (400gpm) and 1,892lpm (500gpm).

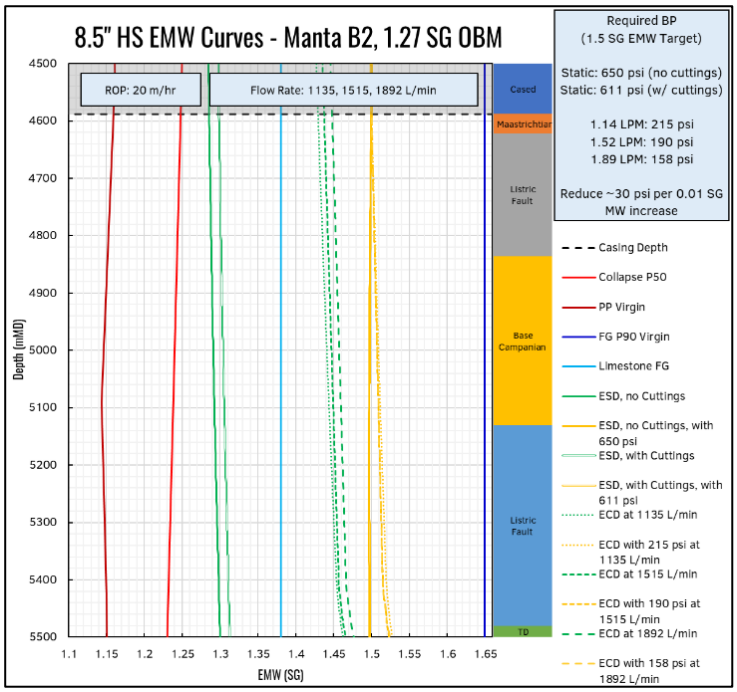
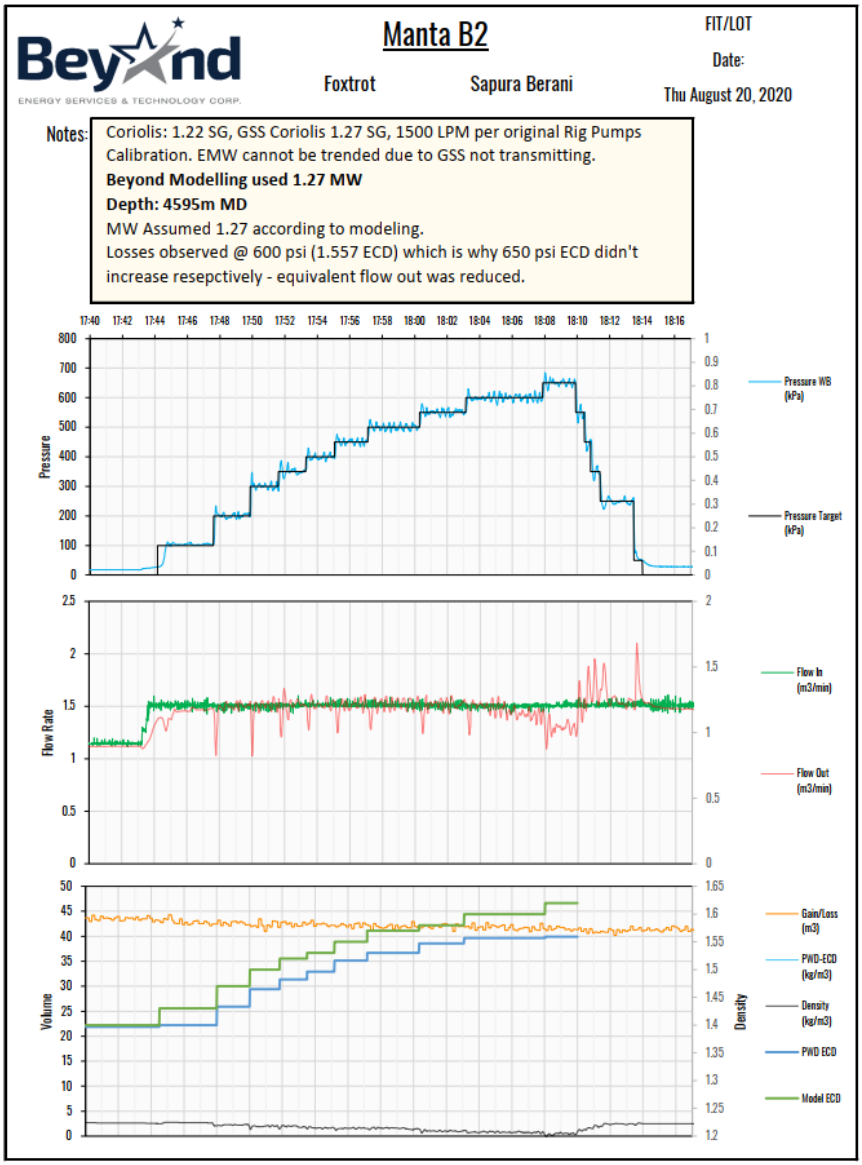


Figure 2 The graph below shows the LOT performed at 4,580m to 1.557SG.



A Dynamic LOT was performed with 1.27SG MW at 4,580m circulating at 1,500LPM with the MPD System to an EMW of 1.557 SG (520psi). The LOT was lower than expected, which provided valuable information to help drill the section successfully.

The well was successfully drilled utilizing MPD to maintain the wellbore stability with a 1.27SG MW.

Equipment Solution

The MPD Package utilized was composed of the following:

1. **TITAN 5 Rotating Control Device (RCD)**
2. **MPD Building**
   - **Dual Choke Manifold**
   - **Coriolis Flow Meter**
   - **MPD Control System**
3. **Interconnect Piping**