

LOCATION: OMAN



MAX-BRIDGE bridging solution enabled drilling with water-based mud in challenging overbalanced well



In Oman's mature Saih Raw field, an operator had historically experienced sloughing shale, downhole losses, and incidents of differential sticking. Due to the low formation pressures found in fields such as this one, there is often only a narrow operating margin between the pore pressure and formation breakdown. The low pressure does not allow for increased drilling fluid density, therefore causing a dilemma over how to address the borehole stability requirements without inducing fractures.

Saih Rawl deviated production wells typically consist of surface and intermediate sections,

with kick-off points around 4040 m (13,255 ft), casing set around 4700 m (15,420 ft), and then drilled out at 80° through the four Barik formations. These formations are largely sandstone and shale layers and are depleted with formation pressures as low as 3,481 psi (4.1 ppg).

This section consequently experiences overbalanced pressures higher than 5,000 psi, which can cause differential sticking while high hydrostatic pressures are maintained to stabilize the transitional shales frequently leading to nonproductive time (NPT).

Results

- Successfully drilled the well to TD of 4570 m (14,990 ft) despite differentially pressured zones causing two offset failures
- Eliminated NPT by minimizing downhole losses and incidents of differential sticking

Challenges

- Changing pressure in highly depleted formations in 563 m- (1,847 ft-) section
- Achieving a buildup of 0° to 80° in reactive shale and depleted zones
- Extremely overbalanced conditions
- Sloughing shale
- Deviated wellbore

BHGE solution

- The BRIDGEWISE engineering software to design an optimized MAX-BRIDGE bridging system to strengthen the wellbore
- Maintained the system despite overbalance conditions up to 5,800 psi during the drilling operation

After two previous unsuccessful attempts at drilling this field, the operator approached Baker Hughes, a GE company (BHGE), for an alternative solution.

Analyzing data from offset wells in previous operations using the BHGE **BRIDGEWISE™ engineering software**, the BHGE team worked with the operator to develop a **MAX-BRIDGE™ solution** for this depleted well based around the **NANOSHIELD™ sealant** for extreme wellbore stability and **BRIDGEFORM™ wellbore strengthening** technologies.

The well was drilled successfully through the depleted Barik formations (Barik 1 through Barik 5) with the highest over balance pressures of 5,800 psi using mud weight up to 12 ppg.

The fluid density was increased sequentially from 11 to 12.1 ppg to combat increasing wellbore instability, which consequently increased the overbalance differential from 4,000 to 5,800 psi. As a result, the operator was able to log the well and cautiously reduce the fluid density while keeping the hole open.

The MAX-BRIDGE system was used to drill the 5 $\frac{7}{8}$ in. reservoir section to a measured depth of 5365 m (17,602 ft) and total vertical depth of 4570 m (14,990 ft) at an inclination of 80° with excellent results. The system increased wellbore stability by allowing higher density fluids to be used to maintain the wellbores stability. This also eliminated NPT by minimizing downhole losses and incidents of differential sticking.



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