Schlumberger

Integrated Drilling Approach Saves Shell USD 1.1 Million, Achieves Record 275-ft/h ROP Salt Drilling Performance

Data-driven BHA design delivers 52% ROP increase compared with best offset well, deepwater Gulf of Mexico

CHALLENGE

Maximize penetration rates while delivering maximum borehole quality in salt drilling operation in deepwater Gulf of Mexico.

SOLUTION

Work with Schlumberger drilling experts to identify, evaluate, and deploy the technologies, processes, and workflows that will achieve the operator's objectives.

RESULTS

- Reached section TD 1.4 days ahead of AFE, saving USD 1.1 million.
- Achieved an ROP of 275 ft/h [84 m/h], 52% faster than the best offset well.
- Drilled 4,230 ft [1,289 m] in one day compared with an average 2,000 ft [607 m] per day in the best offset well.

"[This job] sets the bar for future development—here and for our whole organization."

John Cook
Drilling Superintendent
Shell

Maximize drilling performance in deepwater salt section

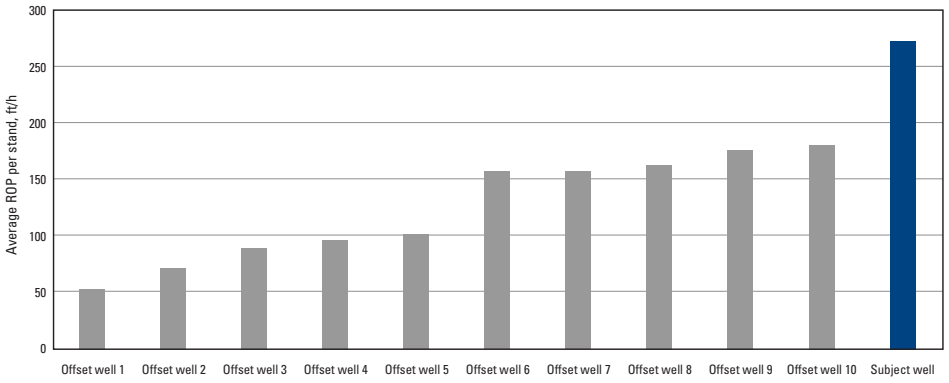
Shell was drilling in the Atwater Valley field of the deepwater Gulf of Mexico. The campaign's next well, Deep Sleep, would involve salt drilling. A similar well in a comparable field achieved an ROP of 180 ft/h [55 m/h] over 14,025 ft [4,275 m] that served as the performance benchmark to exceed. Shell challenged Schlumberger to deliver an integrated drilling solution that would achieve faster ROP, maintain a high-quality wellbore, and set new best practices for salt drilling in the area.

Implement engineered drilling approach to operate at high parameters

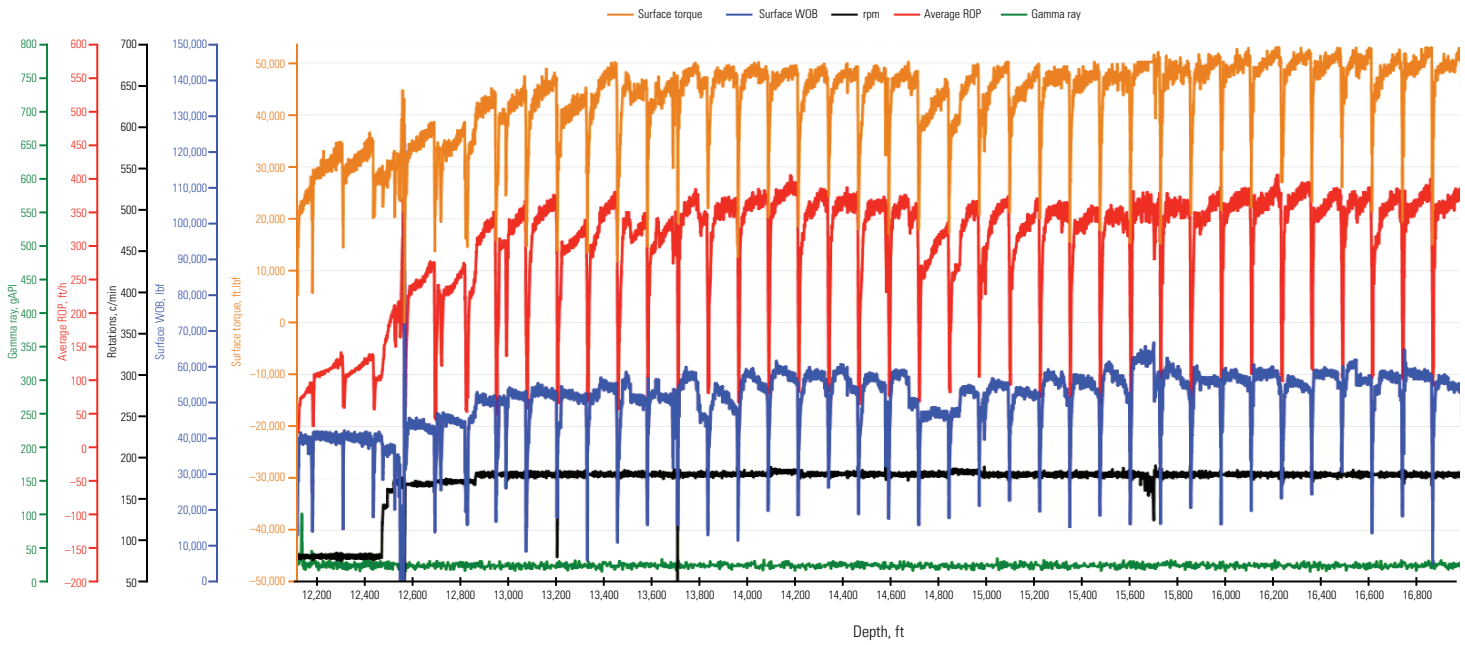
Shell collaborated with Schlumberger experts in Houston to investigate salt drilling KPIs across the Gulf of Mexico and to evaluate the drilling systems and workflows used in previous successes in the region. The highest-performance runs were drilled with 50,000- to 60,000-lbf [222,411- to 266,893-N] weight on bit (WOB) and 170–180 rpm, whereas previous wells in the Atwater Valley field had been drilled with about 30,000-lbf [133,447-N] available WOB and 150–160 rpm. Shell and Schlumberger agreed that increasing available weight and rpm was the key to maximizing performance.

A cross-discipline team of Schlumberger and Shell engineers investigated offset performances across the Gulf of Mexico to identify best practices and key BHA design features. With baseline performance determined, the IDEAS* integrated drillbit design platform was used to model and simulate all combinations of bits and BHAs. The modeling and simulation included dynamic finite-element analysis to help the team determine the optimal drilling system in terms of performance, stability, and directional control.

The results enabled the team to design a customized BHA that included a Smith Bits directional PDC bit (MDi716) for improved stability and enhanced torque response coupled with the PowerV* vertical drilling RSS for automatic well path verticality.



The integrated drilling solution helped Shell achieve an average ROP that was 52% higher than was achieved in the best offset well.



Using the drilling approach recommended by Schlumberger experts, Shell consistently drilled at 180 rpm and applied approximately 60,000-lbf WOB at surface. As a result, Shell achieved a record 275-ft/h average on-bottom ROP and 350- to 390-ft/h [107- to 119-m/h] instantaneous ROP.

The team ran the BHA using a drill-on-torque approach, which involves operating at the topdrive torque limit. The topdrive had a torque limit of 50,000 ft.lbf, dictating a maximum rpm of 180, WOB of 60,000 lbf, and flow rate of 1,100 galUS/min [4.17 m^3/min].

The makeup torque used to connect the 6⅝-in drillpipe was increased and some drilling tools were removed from the BHA to enable the most torque transfer to the bit. Certain hole-cleaning measures were eliminated because Schlumberger modeling determined that hole-cleaning issues in the vertical section were improbable.

Schlumberger also determined that surveys were necessary only at every fourth stand rather than at every stand. This decreased connection time from 20 minutes per stand experienced on offset wells to 14.3 minutes.

Set worldwide ROP record for salt drilling, saved USD 1.1 million

Before drilling began, Shell and Schlumberger held an onsite meeting to engage all stakeholders and reiterate the new mindset of drilling near the technical limit rather than in the middle of the safe zone. In addition, a drilling analyst was stationed at the rig to provide continuous monitoring and daily guidance during drilling to ensure high-quality hole conditions as well as maximized performance.

The teamwork fostered on the Deep Sleep operation increased technical collaboration, improved service support, and enabled superior results. Coupling this engagement with custom-engineered drilling technology and applied best practices, Shell drilled at an on-bottom ROP of 275 ft/h, a record for salt drilling. It also achieved an instantaneous ROP of between 350 and 390 ft/h—faster than any other performance in the area. Shell drilled 4,230 ft in a 24-hour period—more than twice the average footage drilled per day in offset wells. Shell reached section TD 1.4 days ahead of plan, reducing operational costs by USD 1.1 million. Compared with the best offset well, the vertical section of Deep Sleep was achieved at a 52% higher average on-bottom ROP.

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