

Integrated Planning and Execution Help Deliver Middle East Operator’s First High-Temperature ERD Gas Well

Drilling deep extended-reach well according to plan sets milestone

CHALLENGE

- Drill an onshore extended-reach well in a challenging high-temperature geological environment from a surface location adjacent to an urban area.

SOLUTION

- Perform rigorous prejob planning and risk assessment to design an application-specific drilling system that integrates drillbit design, directional drilling, LWD, drilling fluids, surface logging services, and hole-cleaning services while considering subsequent wireline logging and cementing operations.

RESULTS

- Drilled the long, HT extended-reach-drilling (ERD) well with bottomhole circulating temperatures reaching 315 degF [157 degC] according to plan with no HSE incidents.
- Set Schlumberger records for
 - deepest challenging logging conditions and wet latch runs in the Middle East
 - highest drilling and logging temperature in a Middle East ERD well.

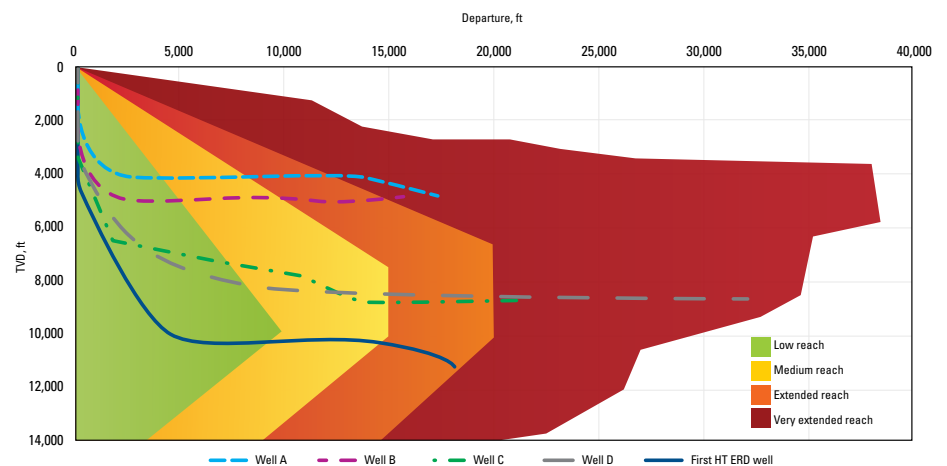


ERD well in a challenging geological environment

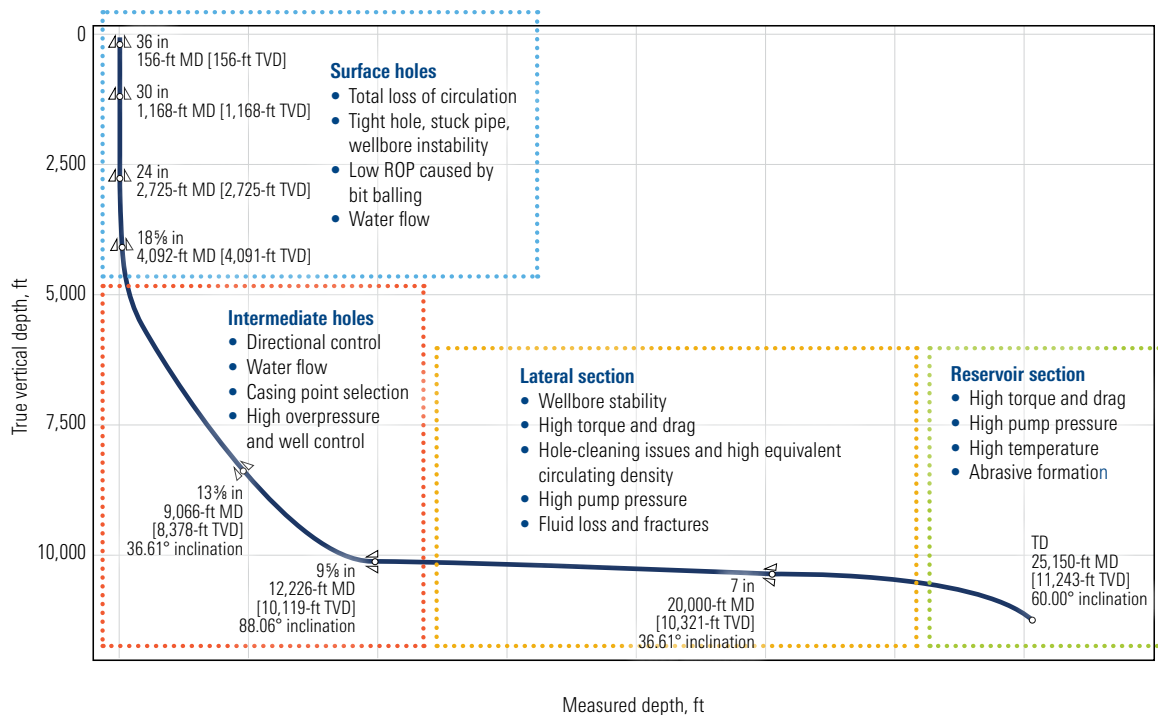
An operator in the Middle East was planning to drill an ERD well that would penetrate formations with temperatures that reached 315 degF. The ERD profile was dictated because the subsurface objective was under an urban area. When drilling ERD wells, operators typically face hole-cleaning challenges and the inherent difficulty of transferring weight on bit; the operator also faced additional challenges, including bit balling, wellbore instability, water flow, abrasive formations, and overpressured formations.

Integrated approach from planning to execution

To integrate all aspects of the project from planning and engineering to execution and drilling, Schlumberger used state-of-the-art software to engineer well profiles, BHAs, and fluid systems that maximize ROP and minimize risks. The process started with an in-depth offset well analysis and a geomechanics study to identify the safe mud-weight window. Drilling fluids were selected, and drilling loads and conditions were analyzed using torque and drag, hydraulics, and temperature models. Then, risks were identified by geological formation, and relevant prevention and mitigation measures were proposed.



The chart compares the first HT ERD well drilled with the operator’s other extended-reach wells. In addition to facing the typical hole-cleaning and weight-on-bit transfer challenges inherent to ERD wells, the operator also had to overcome the 315-degF temperature and difficult drilling conditions.



This pre-Khuff HT well was the deepest drilled by the operator, reaching 25,125-ft MD [11,243-ft TVD].

After the planning process, Schlumberger implemented ERD best practices and HT management through the technologies selected for this operation. Using the IDEAS* integrated dynamic design and analysis platform and i-DRILL* integrated dynamic system analysis service, Schlumberger compared different stabilization options to identify optimal drilling parameters that would increase ROP and minimize vibration to avoid premature BHA damage and failure. This was accomplished by combining a bit-rock cutting model based on extensive laboratory testing with a finite-element analysis of the bit and drillstring.

Although the well profile was designed to avoid possible H₂S-bearing formations, the SAFE-SCAV HS* brine-soluble hydrogen sulfide scavenger was incorporated in the drilling fluid as an added safety measure. Additionally, VIRTUAL HYDRAULICS* drilling fluid simulation software was used daily to simulate hole cleaning and to manage the equivalent circulating density.

PowerDrive vortex* powered rotary steerable system (RSS) was chosen to deliver high ROP in the harsh environment. PowerDrive Orbit* rotary steerable system, prepared for HT and abrasion resistance, was used to drill the deep, abrasive HT reservoir interval. The RSSs were paired with StingBlade* conical diamond element bits for superior performance in hard formations.

In addition, the following technologies were selected for surface logging services:

- CLEAR* hole cleaning and wellbore risk reduction service to evaluate hole condition and cuttings recovery in the highly deviated sections of the well
- PreVue* pore pressure analysis service for pore pressure evaluation
- FLAG* fluid loss and gain detection service for early detection of wellbore gains and losses
- FLAIR* real-time fluid logging and analysis service
- OptiWell* well construction performance service to integrate all wellsite data and provide recommendations to maximize ROP, minimize NPT, and reduce risks.

Record-setting pre-Khuff HT well

This well was the first and the deepest pre-Khuff HT well drilled by the operator. It was delivered in accordance with the planned subsurface targets with no HSE incidents and within the planned time. The operation set a new milestone in the operator's ERD track record and several Schlumberger records, including a Middle East record for the deepest challenging logging conditions and wet latch runs and the highest logging temperature in an ERD well.