

Case study: Middle East

Integrated Well Services performs record-setting UBD, CTD operations, triples average production rate

In 2009, an operator in the Middle East needed to develop a series of coiled tubing drilling (CTD) operations in a formation laced with highly deviated and horizontal laterals to achieve maximum reservoir contact (MRC).

When the project began in this formation with low porosity and permeability, the typical drilling pressure was around 3,000 psi (20.6 MPa). Downhole temperatures averaged 302°F (150°C) while the hydrogen sulfide (H₂S) content sat at 6%. With a thin net pay layer averaging <10 ft (3 m), any solution would have to account for all these factors.

Aligning the well plan

The operator contracted Baker Hughes for two years to provide CTD and underbalanced drilling (UBD) operations in the gas re-entry program. The scope called for Baker Hughes to drill nine wells per year per rig. The Baker Hughes Integrated Well Services (IWS) team studied the challenges presented by the operator's requirements and the limitations of the formation. Combining project management expertise, a comprehensive technology portfolio, and superior service delivery, IWS collaborated with the operator to optimize project performance and value.

Designing the solution

The complete package Baker Hughes delivered encompassed a broad range of services including directional

drilling, formation evaluation, wellsite supervision, and pressure pumping, but the core of the project deliverables was project management and well engineering. Through close collaboration with the operator, the IWS team ensured all aspects of the project aligned with the agreed upon objectives and selected the technologies for deployment.

The **CoilTrak™ CTD bottomhole assembly (BHA) system** would be used for the coiled tubing operations. This system increases recovery rates and improves well performance in slimhole directional CTD applications.

For the duration of the project, the IWS team recommended the Baker Hughes **Dynamus™ extended-life drill bits**. These bits reduced trips while preventing damage that shortens the life of sensitive BHA components by smoothing out lateral vibrations.

The **Delta™ exit system** enabled the operator to mill a window in a restricted wellbore environment using coiled tubing deployed mills and motors. The Delta exit system can be run and set in a live well environment without the necessity of removing the completion equipment, eliminating the requirement for a workover rig and negating the need for kill weight fluids.

Underbalanced coiled tubing drilling (UBCTD) was introduced as an enabling technology to accelerate and increase gas recovery at a rate greater than conventional technology can deliver.

Challenges

- Highly deviated horizontal laterals
- Thin net pay layer averaging <10 ft (3 m)
- Low permeability and porosity
- High-temperature sour well

Results

- Re-entered more than 200 wells (>600 lateral), exceeding 1.4 million ft (425 000 m)
- Improved production across three fields
 - Field 1: 403%
 - Field 2: 393%
 - Field 3: 269%
- Increased annual well delivery by 53%
- Reduced the average days per well from 38 to 26 days
- Decreased NPT each year to a total of a 77% reduction
- Went 8 years with zero LTI

Executing with predictable performance

Baker Hughes engineers and field personnel began implementing the two-year well plan in the second half of 2010 with a single underbalanced CTD package. Since that time, the project has expanded to multiple service providers, operating four coiled tubing drilling units for the operator.

By aligning all aspects of the operation, Baker Hughes and the operator re-entered and drilled more than 200 wells, surpassing 1.4 million ft drilled (425 000 m). The Baker Hughes IWS team consistently exceeded the operator's expectations and set significant record-breaking achievements including, in 2016, delivering wells 62% faster than conventional methods within the same field.

From the success of the project's initial stage, the operator now targets wells with higher temperatures—>350°F (>177°C)—with sour gas concentrations ranging from <1% to ± 10%.

Baker Hughes technology kept pace with the operator's objectives. At the operator's request, engineers developed the **CoilTrak™ HT CTD BHA system**. Specially designed for high-temperature (HT) re-entry drilling, the BHA delivered reliable drilling performance in this type of formation and in temperatures up to 347°F (175°C).

Additionally, Baker Hughes experts optimized the drill bit technology to meet new project objectives by introducing the **Dynamus™ extended-life drill bits**. These cutters are designed to prevent premature cracking and wear while offering a new, high-strength body engineered for extended life in extreme operations.

The target bottomhole circulating pressure has decreased over time, increasing the benefits to drill at lower pressures despite the thin pay zone.

UBCTD technology was expanded throughout the field, and has recently been deployed to drill a reservoir section in underground gas storage reservoirs.

The initial two-year contract included an option for a one-year extension, an option that kept being renewed for over a decade. The predictable performance of the Baker Hughes solution consistently exceeded the operator's expectations and, as of Quarter 2 of 2021, Baker Hughes remains the service provider of choice for the operator.