

Case study: Colombia

# DELTA-DRILL fluid delivered complex, ERD well with narrow drilling window

A major international operator working in Colombia's Cosecha field required a synthetic drilling fluid on a challenging extended-reach drilling (ERD) application. The well plan called for almost 11,000 ft (3353 m) of horizontal displacement with a 76° inclination.

ERD wells are not very common in Colombia due to a variety of drilling challenges including high-instability formations. However, an ERD well was necessary due to environmental issues. With large swamp sanctuaries surrounding the Cosecha field and limiting the placement of potential rig sites, the only option for reaching many reservoir targets is with an ERD well.

The customer had attempted several ERD wells in this area using competitive mud systems and experienced significant drilling issues including wellbore instability and stuck pipe events. These led to the loss of directional drilling tools and significant non-productive time (NPT) for the wells. Due to the ongoing operational issues and the challenging wellbore design, the operator decided to suspend the project.

Following the suspension of drilling activities, the operator reached out to Baker Hughes to help analyze the offset wells and develop a solution that would allow the project to resume. Working closely with the operator, Baker Hughes recommended an intelligent fluids solution leveraging a low-toxicity oil-based mud (OBM) to reduce the risk of stuck pipe and specialized fluids additives for

improved wellbore stability. The intelligent fluids solution Baker Hughes proposed included a **DELTA-DRILL™ low-pressure-impact drilling fluid** enhanced with the **NANOSHIELD™ wellbore sealing polymer** and **LC-LUBE™ sized, synthetic graphite** for increased wellbore strengthening.

The operator approved the Baker Hughes recommendation and displaced the competitor's fluid to the DELTA-DRILL system. After drilling resumed, the next section of the well was drilled to 13,969 ft (4258 m) with an 8½-in. bit and enlarged to 9½-in. with an underreamer.

A managed pressure drilling (MPD) system was planned in order to keep a maximum equivalent circulating density (ECD) of 14.0 lbm/gal (1.68 SG) to control collapse pressure, prevent wellbore instability, and minimize the risk of cavings that were a major problem during trips in the offset wells. In addition to maintaining a minimum 14.0 lbm/gal (1.68 SG), it was critical that the ECD not exceed 15.0 lbm/gal (1.8 SG) as that could induce mud losses.

During a run-in-hole (RIH) trip, mud pressure accidentally reached 15.2 lbm/gal (1.82 SG) in one section which resulted in a loss of between 20 to 80 bbl/hr for a total loss of 1338 barrels of mud. Based on that, Baker Hughes and the operator decided to remove the back pressure from the MPD system and drill ahead with the 12.7 lbm/gal (1.52 SG) DELTA-DRILL system. This kept the

## Challenges

- Drilling challenging 16,000-ft (3353-m) ERD well with 11,000-ft (3353-m) horizontal displacement
  - 76° maximum inclination
  - 230°F (110°C) bottomhole temperature
- Manage wellbore instability in narrow (1 lbm/gal) drilling window
  - 14 lbm/gal collapse pressure
  - 15 lbm/gal fracture pressure
- Avoid multiple sidetracks required on offset wells
- Minimize downhole mud losses
- Manage complicated logistics in remote location

## Results

- Drilled well with zero drilling fluids-related NPT
- Avoided barite sagging during 120+ hours of static time
- Significantly reduced tripping times
- Minimized back-reaming and hole-conditioning requirements
- Saved approximately \$630,000 USD in estimated operating costs

maximum ECD at 13.2 lbm/gal (1.58 SG) for the section to avoid any further losses or fracture propagation in the section.

MPD services used in the well for the 8 ½- x 9 ½-in. section cost the operator approximately \$500,000 USD in service costs despite generating some associated issues like induced losses. The DELTA-DRILL fluid's performance served to maintain wellbore stability and allowed the operator to suspend the MPD service in the 6-in. hole section. The lower section was drilled to total depth (TD) at 16,888 ft (5147 m) with an adjusted 10.5 lbm/gal (1.26 SG) mud weight in order to minimize formation damage.

Removing the MPD system from these operations with potential savings of \$630,000 USD in 21 days of operation.

This first-time deployment of the DELTA-DRILL system in Colombia allowed the operator to drill the planned hole sections while effectively reducing operational risks and NPT in the challenging ERD well. Once the MPD system was removed, the DELTA-DRILL system's non-progressive gels permitted faster trip speeds without compromising wellbore stability. The system's unique viscosity profile ensured proper hole cleaning by keeping the ECD lower and stable while drilling and providing superior solids suspension (with no barite sagging)

in the 76° inclination hole. The system maintained a 12.5 lbm/gal (1.50 SG) value into the hole after more than 120 hours of static time associated with installing the 7-in. liner.

Finally, the NANOSHIELD and LC-LUBE additives improved wellbore stability while drilling the overburden and reservoir sections.

Despite drilling much of the well without the MPD system, the fluid system remained within the desired equivalent mud weight window and no fluid losses were recorded while drilling. A post-drilling evaluation of the reservoir section showed a minimal reduction in formation permeability.

Stage	Permeability (mD)	Return	Permeability reduction
Ko original	142.9	---	---
Ko after drilling fluid	136.6	95.6%	4.4%

Post-drilling analysis of the reservoir section indicated minimal invasion from the DELTA-DRILL fluid with the tests showing a 95.6% return permeability.



This graph shows that DELTA-DRILL fluid's LSRV remained constant, ensuring proper hole cleaning at high pressures and temperatures.

