

Case study: Offshore Brazil

DELTA-TEQ drilling fluid maintains well integrity in offshore pre-salt well, saving six days and \$3.75 million USD

The customer planned to drill an offshore pre-salt well at a 3,410 ft (1040 m) water depth in five sections. The well's narrow operating window required a managed pressure drilling (MPD) system to reach target depth (TD). But because no MPD system was available, the operator abandoned the well before drilling the 12¼-in. section.

As part of its ongoing service contract with the customer, Baker Hughes developed an alternative drilling solution that allowed drilling to safely continue through the salt. The solution also ensured wellbore stability while the operator characterized the fractured reservoir beyond the salt section.

The 12¼-in. section included two rubble zones, one on top of the 177 ft (54 m) salt section, and the other at the salt exit. The 16-in. section required drilling through two depleted reservoirs and shales with low collapse pressures. These conditions posed risks of mechanical destabilization and circulation losses in both sections.

After reviewing the well parameters, Baker Hughes recommended its DELTA-TEQ™ low-impact drilling fluid. DELTA-TEQ maintains high lubricity and minimal interaction with shales and other highly reactive formations. It is also proven to minimize pressure impacts while drilling in narrow operational windows. The operator agreed to trial the fluid's effectiveness at ensuring well integrity, maximizing rate of penetration (ROP), and reducing drilling days.

A low delta between equivalent circulating density (ECD) and equivalent static density (ESD) was crucial to ensuring the required hydraulics during drilling. The Baker Hughes drilling fluids team maintained close control on the DELTA-TEQ fluid properties and ROP to keep the ECD within the necessary range throughout the well.

In each section, DELTA-TEQ maintained low pressure impact during drilling, while minimizing risks and saving rig time.

In the 12¼-in. section, mud engineers kept DELTA-TEQ's mud weight within the 9.8 ppg to 10 ppg range. The drilling crew successfully drilled through the two rubble zones and salt section with no delays, fluid dilutions, or extra treatments required.

The fluid helped achieve an average ROP of up to 72 ft/hr (22 m/hr) in the 12¼-in. section and reduced drilling time from a planned 110 hrs down to only 48 hours. The operator saved an estimated \$1.25 million USD on this section.

In the 16-in. section, DELTA-TEQ stayed at the required 9.3 ppg to 9.4 ppg density range to safely drill through the depleted reservoir intervals, with no losses or wellbore collapses recorded.

The drilling team achieved an average maximum ROP of 256 ft/hr (78 m/hr), with an impressive ROP of 328 ft/hr (100 m/hr) recorded in one instance. The combination of high ROP and robust well integrity afforded by DELTA-TEQ reduced drilling days from

Challenges

- Offshore well at a water depth of 3410 ft (1040 m)
- Complex drilling environment including pre-salt and salt formations
- Narrow operating window
- Reactive shale formations in 12¼-in. section

Results

- Achieved constant ECD control while drilling through salt, depleted reservoirs, and shale intervals to maintain wellbore integrity
- Safely drilled 12¼-in. section 66% faster and 16-in. section 75% faster than plan
- Saved a total of six days of rig time and an estimated \$3.75 million USD in drilling two sections

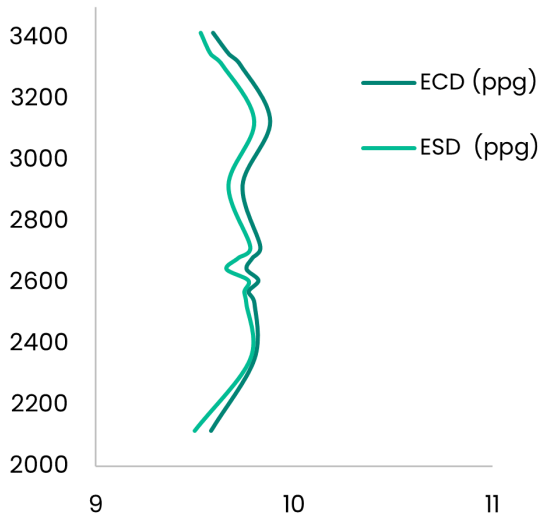
six to two, saving the operator an estimated \$2.5 million USD on the 16-in. section.

Baker Hughes was able to address the challenges combining DELTA-TEQ system with its Dynamus™ extended-life drill bit. The operator effectively

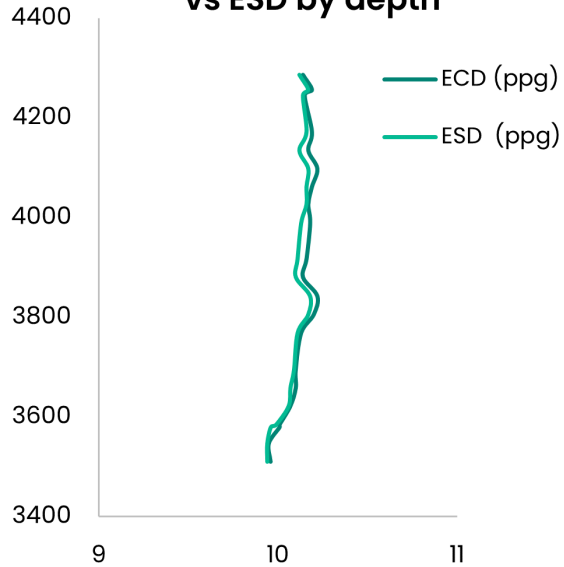
characterized the reservoir beyond the salt, with no well integrity or wellbore stability issues.

The customer was highly satisfied, both with the success of the job and the professionalism and dedication of the Baker Hughes well construction teams.

16-in. hole ECD vs ESD by depth



12 ¼-in. hole ECD vs ESD by depth



The DELTA-TEQ system reduced the delta between ECD and ESD to an average of 0.06 ppg in the 16-in. hole and 0.03 ppg in 12 ¼-in. hole sections.