



## Drilling Fluids

# Well-planned pad mud operation helps maintain wellbore stability in deviated top hole riser less drilling, saving costs and eliminating casing string from well design

Location: Offshore Angola

### Overview

An operator was planning a 17.5” section to be drilled riserless with an inclination of up to 50°. The operator asked Baroid to provide a dynamic pad mud solution at 10.0 ppg to provide wellbore stability and help eliminate associated costs of setting four casing string. Offset information from Angola and Mozambique was reviewed to help prepare a solution customized to the operator’s requirements.

Building a sufficient volume of 10.0-ppg pad mud would require the addition of 16.0-ppg spike fluid to reach the target density efficiently. The decision was made to build the spike mud on the rig, rather than to supply it from the liquid mud plant. This was due to logistical constraints on boat availability at the time.

### Solution

Baroid’s laboratories undertook extensive testing on formulations based on the products available (see “Pad mud formation” table). The spike mud had to satisfy the following requirements:

- Minimize materials and mixing requirements at the rig
- Be environmentally acceptable for discharge at seabed
- Suspend barite for a period of time
- Remain pumpable
- Resist bacterial degradation
- Exhibit expected properties after dilution to 10.0 ppg

The final spike mud formulation was viscosified primarily with pre-hydrated bentonite, with BARAZAN® additive as the secondary viscosifier. The BARAZAN viscosifier was added after the barite to raise the low-end rheology and gels to ensure no barite settling in the finished fluid. PAC™-L filtration control agent was added after diluting the spike mud to 10.0 ppg. Further testing was then done to determine the treatments necessary after dilution, to restore the rheology to an acceptable range for drilling.

The success of this operation depended on effective planning, with early mobilization of sufficient personnel and materials to prepare the spike mud in advance. The 16.0-ppg spike mud was built during the rig move to location after a period of rig recertification.

CHALLENGE	SOLUTION	RESULT
Maintain wellbore stability while drilling deviated top holes.	Baroid personnel provided a fit-for-purpose pad mud formulation and managed the build and mixing operations at the rigsite.	Transport and barite costs were reduced by blending brine, seawater, and 16.0-ppg spike fluid for an on-the-fly supply of pad mud for the riserless operations.

The unit mixing rates were calibrated to ensure the correct blend of seawater, brine, and spike mud required for the 10.0-ppg pad mud.

The three-stream vortex mixing system at the rig allowed personnel to blend NaCl brine with seawater, and to dilute the spike mud to 10.0 ppg. The use of brine reduced the total barite requirement for the spike mud by 200 mt, significantly decreasing mixing time and associated logistical requirements (e.g., eliminating one boat run for barite). The use of brine also reduced costs, as the lower barite cost outweighed the added brine cost. An additional advantage was that neat brine (9.9 ppg) could be pumped as a contingency in case of equipment failure or excessive volume requirements.

Ultimately, all available surface pits were filled with 10.0-ppg pad mud to maximize the buffer volume available while drilling. This mud was retreated with BARAZAN viscosifier at the concentration established by lab testing.

The 17.5-in section was initially drilled as planned with seawater and sweeps, until the inclination reached 30°. At this point, the 10.0-ppg pad mud was pumped into place. The required volumes of pad mud were continually built by blending the 16.0-ppg spike mud, seawater, and NaCl brine. The well remained stable and was successfully drilled to TD with a 48.5° inclination using the 10.0 ppg pad mud application.

Material	Concentration
Drill water, v/v	0.239
Seawater, v/v	0.467
Caustic soda, ppb	0.25
Soda ash, ppb	0.25
Bentonite ppb	10.0
PACT™-L, ppb	3.0
Barite, ppb	408
BARAZAN®, ppb	0.5–0.75
STARCIDETM™, ppb	0.5

*Pad mud formation*

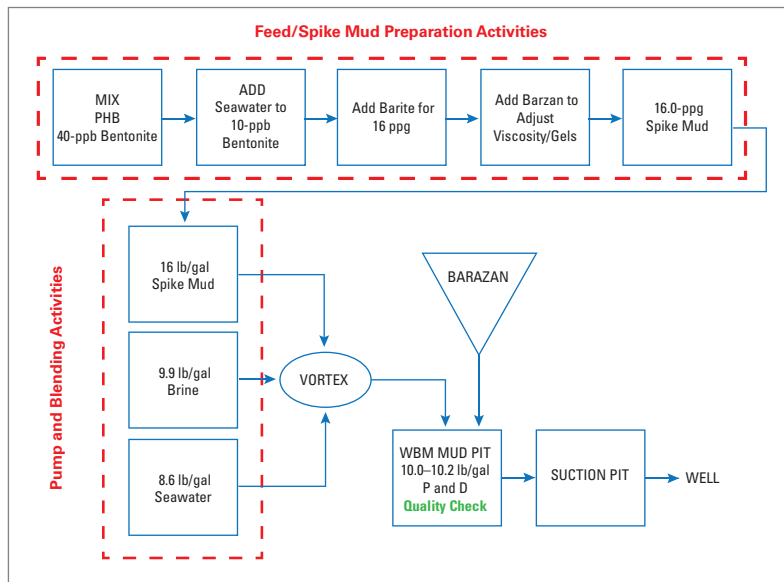
**Economic Value Created**

The spike mud formulation was more cost effective than other formulations considered, due to the use of pre-hydrated bentonite as the primary viscosifier.

Additions of BARAZAN viscosifier ensured that no sag or settling issues occurred, and that the spike mud remained pumpable.

Blending brine and seawater to cut back the spike mud to 10.0 ppg produced a net cost reduction. This was due to less volume of spike mud being required to build the 20,000 bbl of 10.0-ppg pad mud, resulting in lower barite requirements.

This also eased logistics by decreasing the total barite shipping and mixing requirement by 200 mt.



*Operational workflow for mixing spike fluid and 10.0-ppg pad mud*

The well design was for a three-string casing design, replacing the previous four-string designs. All four top holes were drilled successfully, validating the three-string design and eliminating the cost and time associated with the fourth casing string.