Mix on the Fly System

Challenge
The hydrostatic pressure seawater exerts is not sufficient to prevent salt leaching and maintain wellbore stability in certain applications. Operators face existing concerns such as shallow water flows and shallow salt drilling, both of which require salt saturated fluid with densities above 10 ppg. Higher density fluids can help prevent a flow or ensure the hole remains stable. But with no marine riser, these fluids and cuttings will also be lost to the seafloor. Because of the pump rates required to efficiently clean the hole in these intervals, very high volumes of weighted drilling fluid may be required to drill relatively short intervals of a few hundred feet. This creates significant logistical challenges associated with riserless drilling. Up to 15,000 bbl of weighted drilling fluid may be required. Many rigs simply do not have the storage facilities for these types of volumes and significant numbers of supply boats may also be required. The high rates also mean that standard rig mixing systems will not be quick enough to keep up with the drilling fluid demand.

Overview
Halliburton Baroid’s Mix on the Fly system technology is used to combine different types of fluids into a single, homogenous fluid stream with specific properties to be used during the riserless drilling of deepwater wells. Our advanced technology is designed to allow real time adjustment of output properties like fluid weight, viscosity, cuttings carrying capacity and flow rate, so that only fluid with the programmed properties reaches the entire wellbore.

Benefits and Features
Baroid designed the Mix on the Fly system to provide a safe and efficient solution to customer challenges and bring added value to drilling operations:

Benefits:
• Smaller operational foot print
• Ability to be handled by fewer personnel and helps minimize the risk of injury
• Ability to fit in confined area contrary to previous generations of mixers
• Provides a regulated, homogeneous blend of fluids for drilling the riserless section of the well at a rate consistent with the conditions outlined in the drilling program
• Reduced weight and size, producing a modular, lightweight unit, having a minimal footprint, easily transported to and setup at the jobsite

Features:
• Ability to instantaneously change flow stream proportions and properties
• Monitors fluid volumes and percentages pumped during the drilling process
• Principal design parameters were to provide enhanced fluid combination in order to create a truly homogenous fluid blend
• Mix up to three discrete liquid streams into a homogenous blend with real time control of mix properties
• Incorporated metering system to provide real time readings of total fluid flow, fluid percentage of total flow, and fluid weight.

Applications
Baroid’s Mix on the Fly unit is highly effective and can add value to the following drilling operations:
• Deepwater
• Environmentally sensitive areas
• Small rig footprint required
• Operators with multi-rig drilling operations

The Mix on the Fly unit gives operators the ability to combine different types of fluids into a single, homogenous fluid stream.
When drilling offshore in deepwater, before the marine riser is used, seawater typically is used as a drilling fluid. The seawater is pumped down the drillstring, and the returns (fluid and drill cuttings) are discharged at the seafloor. This seawater is usually supplemented with high viscosity sweeps to clean out the hole. This drilling technique requires large volumes (as hole volumes are large and all returns are deposited at the sea floor), but as seawater is readily available offshore, this is not usually a problem and is also very economical. One solution to this challenge has been to ship smaller volumes of high density fluids (perhaps as high as 16 – 17 lb/gal) and mix with seawater on the fly to generate the required volumes of lower weight mud.

**Conclusion**

Baroid Surface Solutions™ service offers the simple-to-install Mix On The Fly system that can blend fluid and seawater at rates of up to 2000 gpm, yet provide consistent and even mixing and consistent fluid physical properties. The system is small, easy to install and simple to operate. In addition to the flow meter technology installed on all units to measure all input and output flow rates, the Baroid Mix On The Fly system also can be installed with online density measurement as well. The system is also adjustable, allowing the Baroid operators to get the exact blending required.

<table>
<thead>
<tr>
<th>Specifications</th>
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<tbody>
<tr>
<td>Length: 59 in.</td>
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<tr>
<td>Width: 37.5 in.</td>
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<tr>
<td>Height: 36 in.</td>
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<tr>
<td>Weight: 560 lbs.</td>
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<thead>
<tr>
<th>Flow Data</th>
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<tbody>
<tr>
<td>Inlet: 4in. Flowrate: &gt; 750 gpm @ 60 psi (ea)</td>
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<tr>
<td>Outlet: 6in. Flowrate: &gt; 2250 gpm @ 60 psi</td>
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