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## Combining Latest Technologies Enables Successful Completion of ERD Exploration Project Off the Coast of Tierra del Fuego: Best Practices From a Case Study

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### Abstract

To help satisfy the demands for petroleum products, operators are being forced to drill in increasingly challenging environments. Combining cold winters, some of the strongest winds in the world, and a very remote location in the waters off the coast of Tierra del Fuego certainly could be considered challenging. In this case study, the operator successfully constructed extended reach wells through low fracture gradients under the previously described harsh environment. Many best practices were either established or re-enforced during the process.

Attempting to circulate long columns of cement slurry during construction of extended reach drilling (ERD) wells under these conditions stretches the limits of current technology. Nowhere else in the world has success required more preplanning and implementation of the latest technologies. Failure to achieve a seal could have a great impact on the cost of drilling these wells and the operator's ability to effectively produce the new field. In addition to the cost of the required remedial work, which is easy to quantify, additional costs can be accrued from delays in production delivery, which are harder to quantify.

This paper presents best practices learned from wells drilled offshore Tierra del Fuego using the latest cementing technologies as required to make this exploration project a success.

### Background

A six-well development package has been drilled in the offshore waters of Tierra del Fuego. Tierra del Fuego is at the very southern tip of South America. The base for this project was located in Punta Quilla, an 8-hour drive from the closest permanent oilfield base, Comodoro Rivadavia, which is 2,000 miles south of Buenos Aires. As if the remoteness of this location was not complication enough, the weather is even

more severe. The wind blows at 70 knots and the yearly average temperature is only 46 °F. The high winds generate an equally troublesome tide, which often reaches 40 ft. The currents associated with these tides limit boat loading and offloading to a short period each day.

To minimize the impact of this harsh environment, an ERD drilling plan was selected to develop this reservoir. With ERD, fewer wells could generate the required production. ERD wells typically have true vertical depths much less than measured depth or drilled length. This is illustrated by the well path from Aries-PH2 (**Fig. 1**). Effective cementation is always a concern with ERD wells. The primary concerns are: (1) whether cement can be effectively circulated across the entire openhole section without losses, and (2) if placed, whether it can efficiently displace the mud to form a successful annular seal.

To further complicate the cementing of these long horizontal sections was the fracture gradient, which was expected to be in the 13.7 lb/gal range, requiring lightweight cement. Current state-of-the-art provides for three different methodologies for reducing the density of cement slurries.<sup>1-4</sup> The original method called for the addition of bentonite to the slurry. With a specific gravity (SG) of 2.65, bentonite by itself will actually increase the density of most cement slurries. The high surface area and water-swelling properties allow substantially more than the standard volumes of water to be added. It is actually this extra water that provides the density reduction associated with bentonite cement slurries.

Over the past 60 years, many other "water-extending" additives have been introduced to the market. The primary advantage of this class of materials is economics. Typically only a small amount of these water-extending materials are required to tie up large amounts of water. Thus, the real benefit of these systems is the increase in the water-to-cement ratio, which also increases the slurry yield per sack. As more water is added, less cement (and associated additives) needs to be purchased.

Unfortunately, degradation in set cement is also associated with this increase in water-to-cement ratio. When a simple, lightweight filler cement is required, these economical water-extended slurries normally are the best choice. However, if much extra water is added, this category of slurry will often not be capable of performing satisfactorily in critical cementing applications. Eventually, the dilution of the cement will become so severe (as the density decreases or the water ratio increases) that the cement will not gain enough