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# High-Pressure, High-Temperature Consolidated Completion in the Continental Shelf Environment of the Gulf of Mexico: Case History

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## Abstract

Decades after the first completion in the Gulf of Mexico (GOM) continental shelf, the logical expansion of these mature assets has extended into reservoirs that are deeper, hotter, and higher-pressured than previously completed wells. The industry refers to wells in this category as high-pressure/high-temperature (HPHT) and these types of wells can cause extreme completion challenges. HPHT formations also tend to have low permeabilities, which is the opposite of most GOM reservoirs.

To make these low-permeability formations economical in an offshore environment, it is imperative that stimulation treatments be completely effective. Contrary to conventional GOM shelf completions, this well did not require the use of any sand face completion equipment because the formation is well consolidated. Due to the lack of screens, the engineers deemed it necessary to perform a hydraulic-fracturing treatment using a proppant coated with a surface modifying agent that inhibits flowback of proppant to the production facilities. This type of effective completion was instrumental in making the project economically successful and allowed the well to achieve post-hydraulic fracture production rates up to 35 MMscf/D. No further type of stimulation has been necessary and the well has continued to perform at a level above that of production rates before the fracturing treatment.

## Introduction

The West Cameron 62 (WC 62) field, located on the continental shelf just south of Louisiana at a water depth of 35 feet, saw its first well completed over 20 years ago. Since that time, more than 30 different intervals have been completed at depths ranging from a few thousand feet to over ten thousand feet. In recent years, it has become necessary to focus on

reservoirs that exist in the 18,000–20,000 ft true vertical depth (TVD) range. At these depths, the pressures and temperatures of the formation trend toward the extreme of what current technology allows when completion equipment and fluids are considered. The WC 62 A-2 well was completed at these depths in the Cris R formation.

As shown in **Fig. 1**, the Cris R sand is located between 17,843- and 18,021-ft TVD, which correlates to 19,789- and 19,976-ft measured depth (MD). **Table 1** shows the perforated intervals selected to target the cleaner, higher-resistivity zones and to help ensure against the production of fines from the shale intervals. The initial bottomhole pressure (BHP) for the Cris R formation was measured at 16,500 psi at mid-perf. The bottomhole temperature (BHT) at mid-perf was 356°F.

Table 1—Perforation Intervals

Top Shot MD, ft	Bottom Shot MD, ft	Top Shot TVD, ft	Bottom Shot TVD, ft
19,789	19,809	17,843	17,862
19,819	19,859	17,872	17,910
19,880	19,920	17,930	17,968
19,936	19,976	17,983	18,021

Also contrary to conventional GOM reservoirs, which typically have average permeabilities in excess of 50 md, the permeability of the Cris R sand averaged only 0.64 md. The porosity of 18% was also significantly lower than the well-sorted formations found at shallower depths. In fact, along with permeability and porosity, the rock mechanics fall more in line with typical south Texas “hard rock” reservoirs such as the Wilcox and Frio formations. The rock mechanics, as detailed in **Table 2**, show Young’s modulus in excess of 2.50E6 psi in the sand and 2.20E6 in the shale boundary layers.

Table 2—Rock Mechanics for Cris R Sand

	Stress Gradient	Young's Modulus	Poisson's Ratio	Permeability
Shale	0.94 psi/ft	2.20E+06 psi	0.3	0.00924 md
Sand	0.92 psi/ft	2.50E+06 psi	0.27	0.64 md