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ACTive Plug & Perf System Saves 36 Hours for ENI by Combining Plug Setting and Perforating

New technology sets Copperhead plugs and fires perforating guns with just one coiled tubing run, saving USD 600,000 in rig time, Congo

CHALLENGE

Improve time and fluid efficiency in multistage plug-and-perf completions.

SOLUTION

Combine Copperhead* drillable bridge and frac plugs with perforating guns on a single bottomhole assembly, and selectively activate each device using the ACTive Plug & Perf* CT real-time plug setting and perforating system.

RESULTS

- Eliminated two coiled tubing runs into the well, saving 36 hours and USD 600,000 of rig time.
- Immediately verified plug setting and perforation detonation, expediting stimulation operations.
- Reduced operation costs, logistics, and time by eliminating 23.8 m³ [150 bbl] of brine to pump down the plugs.
- Achieved production target of approximately 476.9 m³/d [3,000 bbl/d].

Offshore multistage stimulation needs an efficiency boost

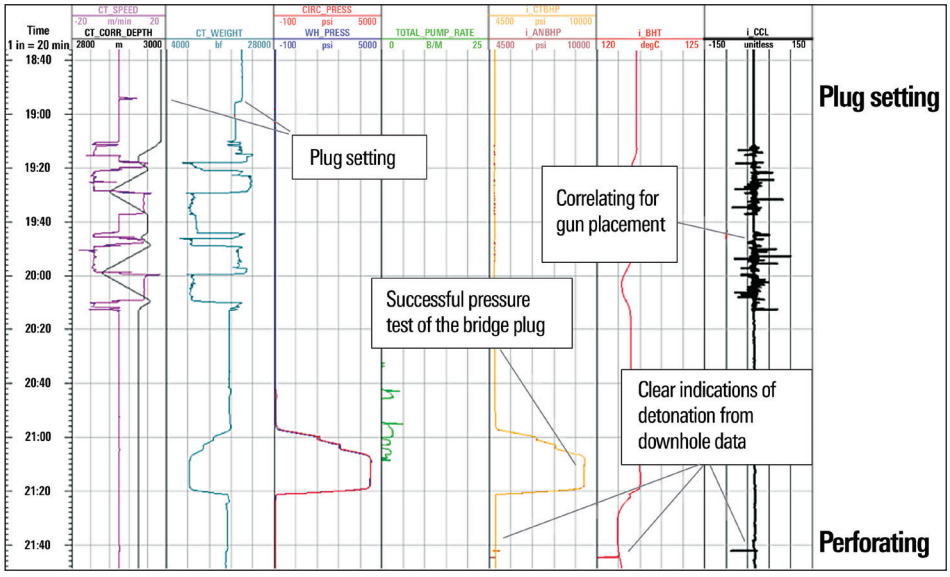
The Nene Marine field is a shallow-water sandstone development about 20 km [12 miles] off the coast of Pointe-Noire, Congo. ENI initially developed the field in 2016 by running plugs, perforating guns, fracturing operations, and cleaning out the well in sequential operations through a fracturing string before running the permanent completions.

In the first horizontal well, a Schlumberger team ran Copperhead plugs on coiled tubing (CT) and set each plug by dropping a ball and pumping fluid to achieve the setting pressure. The team then perforated the stage using the ACTive OptiFIRE* CT real-time selective perforating and activation system, which enabled the crew to run the perforating guns into the horizontal well, detonate the guns without pumping, and immediately confirm detonation. The team then pumped the fracture stimulation designed for the tight sand formation. Finally, CT removed sand and debris to prepare the well for the next plug. Although the ACTive OptiFIRE system improved perforating efficiency, the operation still required three CT runs for each stimulation stage.

To simplify, expedite, and optimize the completion operation, ENI asked for a way to combine more operations.

Downhole tools modified to add capabilities

The ACTive OptiFIRE system can perforate up to 10 zones in a single run and provide real-time downhole detonation confirmation. Because the ENI well design did not need the full 10-zone capability, Schlumberger instead used the ACTive Plug & Perf system, which enabled the system to set the versatile Copperhead plugs electrically using a conventional wireline plug setting tool.



The ACTive Plug & Perf system was used to set Copperhead plugs and then fire the perforating charges and immediately verify detonation. Completing both functions in one run per zone saved 36 hours for the three-zone well.

Plug set and perforations fired in one run

For the first zone, the ACTive OptiFIRE system was used alone (without a plug) to perforate the zone. After that zone was stimulated, the ACTive Plug & Perf system was run into the well with an 18-m [59-ft] bottomhole assembly comprising the Copperhead plug and setting tool, optimized 3⅛-in perforating guns, and a casing collar locator.

Upon reaching the plug depth, the system set the plug, gave immediate surface confirmation of successful setting, and automatically disengaged from the plug.

The CT was then pulled uphole, and the crew used the casing collar locator to precisely place the perforating guns. Before the guns were fired, the crew used the system's real-time pressure monitoring capabilities during the pressure test to verify the plug's zonal integrity. The guns were then fired and immediately verified detonation so the CT could be pulled out of the well for the fracture stimulation operations.

The process was then repeated as designed for one more zone. This efficient process eliminated two coiled tubing runs into the well, saving 36 hours and USD 600,000 of rig time.

The well met production targets with approximately 476.9 m^3/d [3,000 bbl/d]. Subsequent production logging determined that all zones were contributing to production, demonstrating the success of the completion and stimulation project.

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