Liner hanger systems reduce drill-up times in Gulf of Mexico

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ALTHOUGH DEEPWATER drilling and production activity steadily is increasing worldwide, the Gulf of Mexico (GOM) continues to lead the pack with almost half of the total deepwater discoveries in 1999. Because these deepwater reservoirs are on the high end of the cost and time spectrum, the need for technologies and tools that help control these 2 factors remains a premium.

During the past 6 months, a major oilfield service company has introduced liner hanger systems technology into these GOM reservoirs that combine increased hanging capacity, retrievable pack-offs and other modifications that have reduced both remedial costs and drill-up times.

BACKGROUND

Weatherford International Inc's liner hanger technology, commonly known as the Nodeco product line, have been cutting their teeth on extended reach reservoirs in the North Sea for the past 20 years. In July 1999, for example, the liner hanger system helped an operator drill a world record extended reach of 11,278 m (37,000 ft) at Wytch Farm's M-site, the longest cemeted liner application recorded there.

Central to the system's success is a high strength running tool, which connects the drill pipe used to run the liner and the liner hanger assembly. More importantly, however, the tool allows operators to "get rough" with the liner by rotating and reciprocating it to get to the bottom without the fear of premature release. Once the liner has reached setting depth, it can be released from the running tool very easily.

A debris exclusion system, which completely seals the liner top and prevents the entry of drill cuttings, mud solids and cement into the liner, is another feature. Especially in extended reach wells, the entry of debris into the liner top can potentially prevent the release of running tools, which leads to expensive remedial actions.

Other differential tools include a ball-seat that is located in the run-in string, and a compact top drive plug dropping/cementing manifold with high torque, pressure and tensile ratings.

UNIQUE GOM CHALLENGES

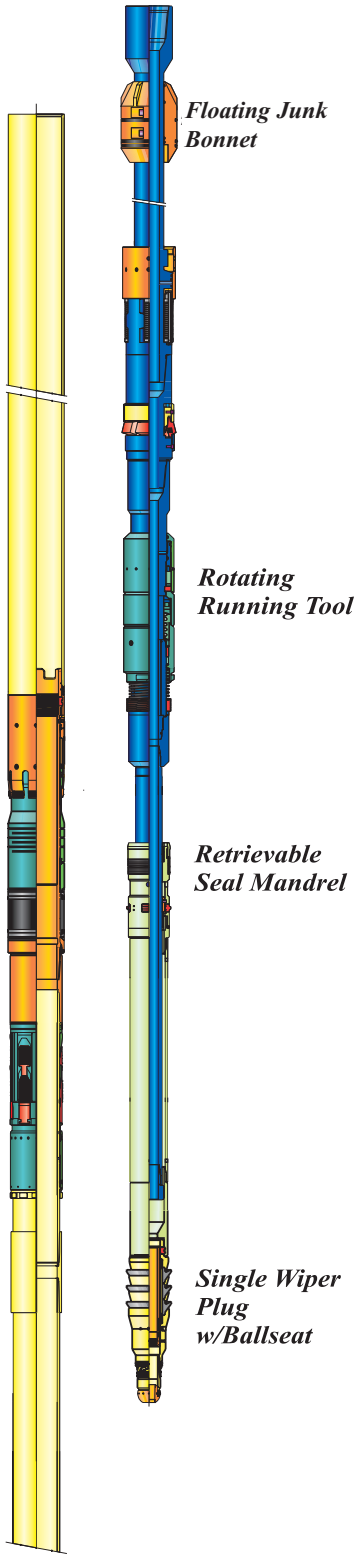
Gulf of Mexico reservoirs are commonly unconsolidated and are extremely sensitive to pressure surges. If a pressure surge is strong enough to cause a weak formation to "break down," then an adequate cement job is at risk, which could lead to future remedial work. Consequently, a key component of a successful liner job is to end up with a good cement bond across specific zones.

2 methods can improve the success rate of this bond. The first is to reduce pressure surges on the sensitive formations. During the running of a liner, several critical stages exist where the risk of a high-pressure surge is at its greatest. These include expending a ball-seat near the liner shoe following actuation of hydraulic tools. Incorporating an expendable ball-seat in the running tool string can reduce the associated risk.

The second method is moving the liner during cementing operations. This process is commonly accomplished in two ways—rotating and/or reciprocating. In many situations, rotating the liner will not work, due to load limitations of current bearing technology and torque limitations of commonly used threaded connections. Because of these constraints, reciprocating is the only option to maintain pipe movement in some cases.

However, designing a reciprocating system using a hydraulically activated hanger presents an engineering challenge because a second isolating pack-off is required in current liner systems. A solution for this specific application includes incorporating a retrievable seal mandrel (RSM) pack-off, along with a second, fully retrievable lower pack-off. (See retrievable pack-off for more detail.)

A second challenge posed by GOM reservoirs is one shared by all deepwa-



Retrievable packer: While retrievable cementing packers are not new, a recent new twist is use of a retrievable-seal mandrel as an upper cementing pack-off, with the lower isolating pack-off sealing the inside of the liner. No drillable pack-off below was necessary.

ter wells: maintaining control of increasing rig costs. There are many solutions; this article will focus on decreasing drill-out times with liner hanger systems that use wiper plugs made from materials other than aluminum.

RETRIEVABLE PACKOFFS

The issue of finding a better way to move the liner during cementing operations occurred when a major operator requested a liner system for a GOM reservoir that would allow reciprocation of a liner with the ability to set a hydraulically activated liner hanger following the cement job. The system also needed to employ a secondary method for hydraulically activating the liner hanger, in case the liner wiper plug failed to "bump" on calculated displacement.

With current liner hanger technology, this system would require 2 pack-offs: one to run above the setting mechanism on the liner hanger and one below the liner hanger. 2 pack-offs are necessary so that the hydraulic setting pressure can be isolated to the inside of the liner hanger. If no lower pack-off device exists to isolate the liner hanger, then hydraulic pressure for activating the liner hanger cannot be achieved, since the fluid would circulate out of the liner shoe.

This process has been done on a few occasions, but only with drillable pack-offs, which require the operator to spend money and time for drill-out. As its name implies, the drillable pack-off must be drilled out after the liner installation is complete. It was primarily designed to ensure that a cementing pack-off's seal—critical to a proper cement job—would not be compromised due to lifting forces caused by large piston areas and hydraulic pressure. If the seal is at risk, then the cement slurry could end up around the running tool and drill pipe string, causing the drill pipe to be cemented in place.

Weatherford's solution to this challenge was to incorporate 2 retrievable pack-offs in place of the drillable pack-offs. Granted, using retrievable cementing pack-offs is not new to the industry. Most liner hanger service companies have a retrievable cementing pack-off, which usually replaces the traditional drillable cementing pack-off and may be used on conventional liner hanger jobs. But their use in this type of application was new. It included using the RSM Pack-off as the upper cementing pack-off, while the lower isolating pack-off seals on the inside of any liner accessory or the inside of the liner itself. When the running tool was retrieved following the cement job, both pack-offs were withdrawn from the wellbore and the operator was free to drill ahead without having to spend time drilling out near the liner top.

Subsea release cementing plugs: A new approach to liner cementing is a subsea plug comprised mainly of polyurethane. Since it contains little aluminum, less of that element must be drilled. This has reduced drill-through times to less than 2 hours in several GOM wells.

Another advantage to using the retrievable cementing pack-off system was that no "extra" salable pieces were required for sealing the lower pack-off, which gave the operator the ability to use this system without increasing equipment costs. As a result, the RSM pack-off is now used exclusively in all of Weatherford's deepwater liner systems.

SUBSEA RELEASE PLUGS

Another challenge posed by GOM operators was the need to reduce rig time. One way to accomplish this was to decrease drill up times, specifically by reevaluating the technology used in liner cementing plugs.

The majority of these plugs are made primarily of aluminum, which ensure that they can be drilled. But they also, on average, can take up to six hours to drill up on a standard liner job. Consequently, time spent drilling out liner wiper plugs and landing collars seemed a logical place to make modifications.

Weatherford developed an alternative solution to the standard dual plug system—a subsea plug made primarily from polyurethane and containing very little aluminum. These plugs already had proven reliable in GOM reservoirs for another application: cementing casing strings. When combined with a cement landing collar, the plugs significantly decreased the volume of aluminum that must be drilled. They also greatly reduced drill-out times: 9 5/8-in. and 11 3/4-in. shoe tracks have been reported to be less than 2 hours.

For instance, drill-up time for one operator was less than 90 minutes and yielded cost savings in the range of $30,000 to $50,000. For another, cost savings were $60,000. The cost savings above are conservative for deepwater applications, because they assume that conventional liner wiper plugs and landing collars would be drilled in a single trip. Cost savings can vary greatly from job to job depending on rig costs, number of drill bits destroyed from drilling aluminum, and number of extra trips required.

CONCLUSION

The technologies used in for GOM operators were not new, from the standpoint that the products already existed. What is noteworthy is that they were used in new ways. Both the retrievable pack-off and the polyurethane subsea plug are helping GOM operators meet a key requirement: reduction of drill time. Additionally, because of their track record, these technologies are now being used in other deepwater applications around the world.

ABOUT THE AUTHOR

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