A Combined Future

Colby Champagne and Katie Poché, Frank's International, USA, explore recent developments in casing and drilling technology.

The confluence of a currently troubled market and the growing trend of offshore reservoirs becoming deeper, some reaching 30 000 ft, has precipitated significant adaptations in the offshore drilling sector. In search of solutions, deepwater operators have had to reconcile the necessity of more complex (and expensive) well designs within the framework of strict budgetary constraints. To that end, operators are seeking technological innovations to improve traditional drilling and completions techniques and yield more efficient and safer operations.

Reviews of current practices indicate that certain procedures within a drilling operation are inefficient and dangerous, thereby warranting reconceptualisation. The transition from casing to drill pipe equipment, for example, is fraught with time-consuming, high-risk activities. Specifically, the techniques employed to land casing strings necessitate switching bails and swapping casing handling equipment for drill pipe

Figure 1. *VERSAFLO tool in casing configuration.*

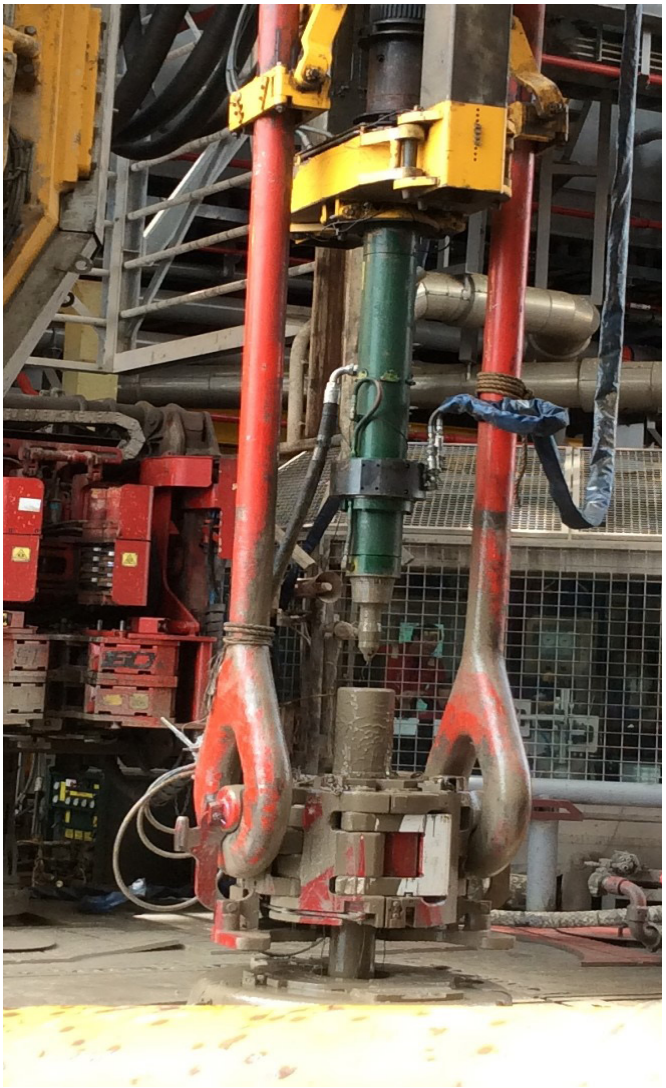


Figure 2. *VERSAFLO tool in drill pipe configuration.*

handling equipment. Additionally, the casing fluid management tool must be rigged down, and a drill pipe fluid management tool must be rigged up in its stead.

Traditionally, the bail and tool change out requires at least 1 - 4 hrs to complete. On average, an hour of non-productive time (NPT) costs deepwater operators US$42 000. Over the life of a well, at this rate, landing several casing strings with their associated NPT adds up to a substantial cost.

Another time-related issue pertains to how long the wellbore is left open during the casing-to-drill pipe transition period. Ideally, once the rig crew has begun running casing, advancing the string to the bottom of the wellbore is achieved as quickly as possible to minimise open-hole exposure. While swapping tools, the wellbore is frequently left open for longer than an hour. The longer a wellbore is left open, the more susceptible it becomes to such mishaps as well degradation, wall damage, and filter cake build-up. Such a setback could prove critical in that it may cause the string to become lodged downhole or prevent the casing from reaching the bottom of the well. Without casing to support the hole, the risk of wellbore collapse greatly increases, along with a potential cost to the operator in the millions of dollars.

In addition to exorbitant cost, the casing-to-drill pipe transition period as currently executed carries a high degree of safety risk. The rig-up/rig-down process regarding bails and tools is one of the most dangerous tasks performed during a deepwater drilling operation, due to the excessive manual handling of equipment and the extended personnel exposure within the red zone. The fact that four to six rig-hands are required to execute this task – as opposed to only one or two for connection make-up/break-out – compounds the risk factor. In the Gulf of Mexico (GoM) region alone, from 2014 to 2016, an average of 4.6 incidents occurred per year specifically during the rig-up/rig-down process. Furthermore, 16% of all field incidents in the GoM region take place during the casing-to-drill pipe transition period.

Meeting the challenge

Recent developments in casing and drill pipe fill-up/circulation/flowback technology have yielded a new technology that can reduce the costs and risks outlined above. Frank's International's VERSAFLO™ Casing and Drill Pipe Flowback and Circulation Tool offers improved functionality. Traditionally, fluid management tools are either casing-specific or drill pipe-specific, which necessitates the time-consuming and dangerous tool swap-out when attempting to land casing strings. In contrast, the VERSAFLO tool accommodates both casing and drill pipe fill-up/circulation/flowback with only minor adjustments. Aside from its ability to save rig time by completing applications more efficiently, the tool can also be used to pump out bottom hole assemblies (BHAs) to prevent swabbing. It is also designed to remove the need for the rig to make tedious connections with the top drive for every stand.

Intended primarily to work with drilling rigs equipped with top-drive systems, the tool can be operated while running casing or landing out drill pipe, with no shutdown required. The complete system is comprised of an upper portion that serves as a drill pipe module and a lower portion that functions as a casing module, the two halves of the tool joined by a special crossover sub. Furthermore, the tool's compact design allows the use of 16 ft bails, and wireless controls permit operations from outside the red zone, reducing risk to personnel by removing them from the vicinity of pressurised lines and valves.

Additional design features mean the tool is not only able to manage fluids or reduce surge pressure at the rig floor, but is also easy to set up, with streamlined operation, broad versatility, improved safety, and reduced ecological footprint. A hydraulic swivel, for example, allows the top drive to rotate downhole assemblies without tangling umbilical lines, providing better efficiency during rotating operations by negating the need to disconnect hydraulic/mud lines from the tool. The ability to perform fill-up/circulation/flowback without having to stop to rig up hoses or other accessories also saves further rig time.

The casing module is equipped with a packer-cup assembly capable of sealing up to 5000 psi that can be outfitted to stab into a range of casing sizes from 8 ⅝ in. to 18 ⅝ in. The fact that the packer cup seals on the ID of tubulars prevents contact with the top and/or OD of premium connections. And an automatically-operated internal valve – complete with an auxiliary mud drain line – assures no overflow of drilling fluid on the rig floor.

When transitioning from casing to drill pipe, rather than completely rigging down one set of equipment and rigging up another, the tool casing module can be detached from the system, which remains positioned above the main elevator. Utilising a breakout plate equipped with arms to provide backup against the rig bails, the top drive can break out the casing module and crossover sub. The assembly is then landed out on the casing stump and removed from well-centre via a lift cap.

With the addition of a special packer cup capable of creating an effective seal on a range of drill pipe IDs, the drill pipe module is now ready to stab into the landing string via a hydraulically-operated piston. The telescoping device and universal packer cup together mitigate several operational risks, such as the inability to effectively control circulation and pressure, a critical preventive measure when tripping in/out of drilled holes. Moreover, without any need to disconnect or remove the piston or packer cup from the ID of the drill string, the tool drill pipe module can be screwed directly into an API 6 ⅝ in. full-hole drill pipe connection, support up to 2 600 000 lb string weight (i.e. tensile capacity), and withstand as much as 70 000 ft-lb of torque. Like its casing counterpart, the drill pipe module also features an internal mud-saver valve whose actuation does not require any axial movement in order to protect against unwanted fluid circulation from the Kelly Hose pressure head.

Case studies

Over the span of only three months, this tool has successfully completed 13 jobs for two major deepwater operators. On average, the tool saved each operator a total of six hours per job. It took approximately 15 minutes to crossover from casing to landing string, saving an average of one hour compared to the conventional way of rigging down and rigging up two separate tools. The tool saved an average of 5 - 7 minutes per stand, which can accumulate to 4 hrs per run depending on the landing depth. Additional projected savings could result if the tool was coupled with complementary dual-capacity equipment, such as the Frank's Combination Drill Pipe/Casing Spider and Elevator.

When conducting a side by side comparison (Table 1) between tubular running operations using conventional tools and procedures versus the VERSAFLO tool, the following was determined based on collected data: rig up/rig down steps were reduced from 10 to 9. Run in hole (RIH) using conventional tools ranged from 17 - 19 minutes per stand of landing string. RIH using the tool was found to take 10 - 13 minutes per stand of landing string. According to this data, in one example taken from a job in the Gulf of Mexico, the tool ran 50 stands of 6 ⅝ ft FH connection landing string/drill pipe followed by 74 stands of the TT-585 connection size landing string/drill pipe without the need to make a cup change between the tapered string. In this case, the tool's combined efficiency improvements resulted in a total RIH landing string/drill pipe time savings of between 12 and 14 hrs.

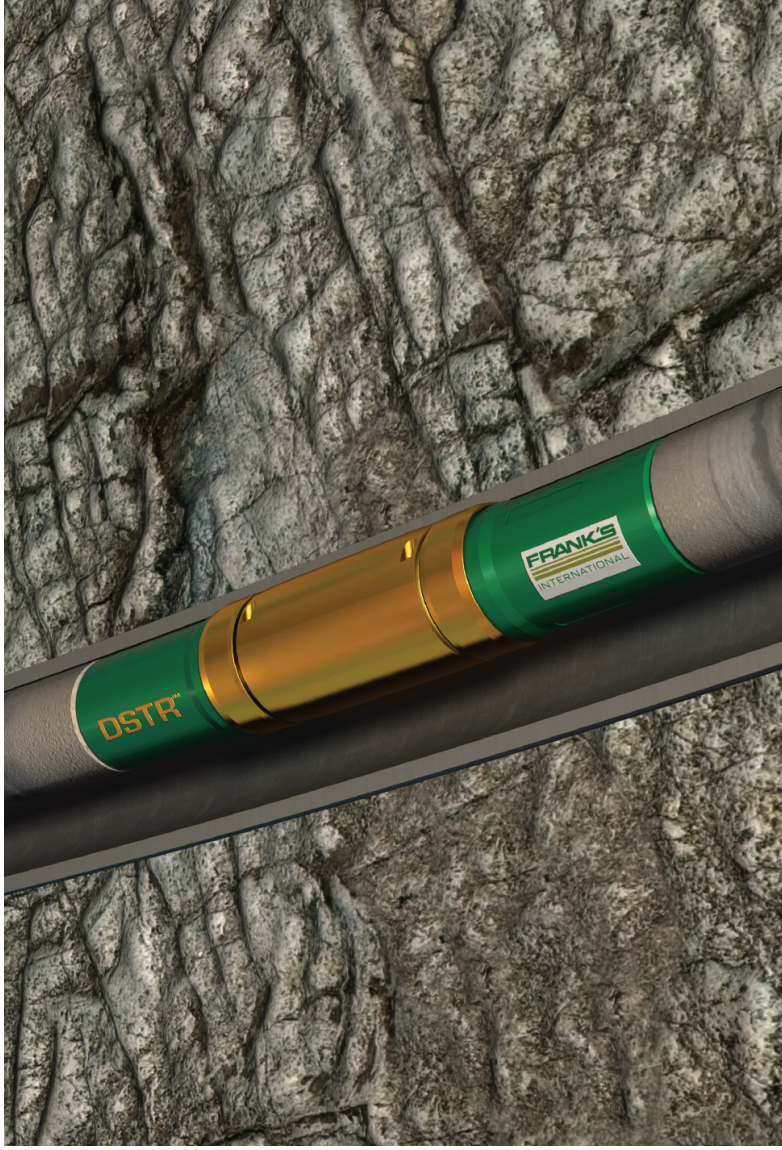
Table 1. Comparison chart of conventional methods versus using the VERSAFLO tool.

Conventional	Using the VERSAFLO tool
Data collected from standard rig tubular running service operations by conventional means using conventional casing fill-up and flow back equipment and drill pipe casing fill-up and flow back equipment. ↘ Rig up casing flow back tool and other casing handling equipment. ↘ Run casing. ↘ Rig down casing elevators – 30 minutes. ↘ Rig down casing flow back tool – 20 minutes. ↘ Rig up drill pipe flowback tool – 30 minutes. ↘ Rig up drill pipe elevators – 20 minutes. ↘ Pick up and make up hangar. ↘ Rig down casing spider. ↘ Rig up drill pipe spider. ↘ Run landing string. When using conventional methods, RIH was found to take 17 - 19 minutes per stand of landing string.	Data collected from rig operations utilising the VERSAFLO casing and drill pipe flowback and circulation tool ↘ Rig up VERSAFLO tool and other casing handling equipment. ↘ Run casing. ↘ Rig down casing elevators – 30 minutes. ↘ Remove casing adapter from VERSAFLO tool – 20 minutes. ↘ Rig up drill pipe elevators. ↘ Pick up and make up hangar. ↘ Rig down casing spider. ↘ Rig up drill pipe spider. ↘ Run landing string. RIH was found to take 10 - 13 minutes per stand of landing string.
Break down: ↘ Lift stand over stump and make up with iron roughneck. ↘ Make stand up to the top drive. ↘ RIH. ↘ Set slips. ↘ Break off top drive from stand. ↘ Repeat. ↘ Change connection size of drill pipe. ↘ Total time required to change over saver subs due to dismantle of the bell guides, gripper housing, reassembly and testing: 1 - 3 hrs.	**Break down:** ↘ Lift stand over stump and make up with iron roughneck. ↘ Extend VERSAFLO tool shaft with extended range packer cup seal into stand. ↘ RIH. ↘ Set slips. ↘ Bleed off and retract VERSAFLO tool shaft. ↘ Repeat. ↘ Rig down – 20 minutes. ↘ Remove packer cup assembly for drill pipe ID – 2 minutes.

Conclusion

During this market downturn, and following the eventual recovery, operators will benefit from new and advanced tools that offer improved functionality, efficiency and safety while reducing costs.

VERSAFLO™ Casing and Drill Pipe Flowback and Circulation Tool



DSTR™ Drill String Torque Reducer Sub

Drilling Technologies to Meet Complex Challenges

Today's operating environment requires responsive, innovative solutions that reduce drilling time, preserve wellbore integrity, and save operators time and money. With our line of proprietary drilling technologies, Frank's International helps operators meet complex drilling challenges throughout the world's major oil and gas producing regions, including land, shelf and deepwater applications.

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