Replacing 'pump and dump' with a RDG system

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AS THE EXPLORATION frontier for oil and gas progresses further offshore and into the deep and ultra-deepwater regions of the world, drilling becomes significantly more challenging. When drilling in deep water, a company must consider technical challenges unique to deep water, economic limitations and, most importantly, the health and safety of the crew and the environment.

Perhaps the portion of the wellbore that is depended on the most for success or failure is the wellbore's top-hole portion. If drilled and completed successfully, the top-hole portion offers a stable foothold for the drilling crew to continue operations. If compromised, it can slow or halt all further drilling operations.

Common shallow hazards – including methane hydrates, shallow gas flows and shallow water hazards – at the very least complicate the technical planning of a well and, at the worst, threaten the stability of the wellbore and the safety of the personnel on site.

RISERLESS DUAL GRADIENT

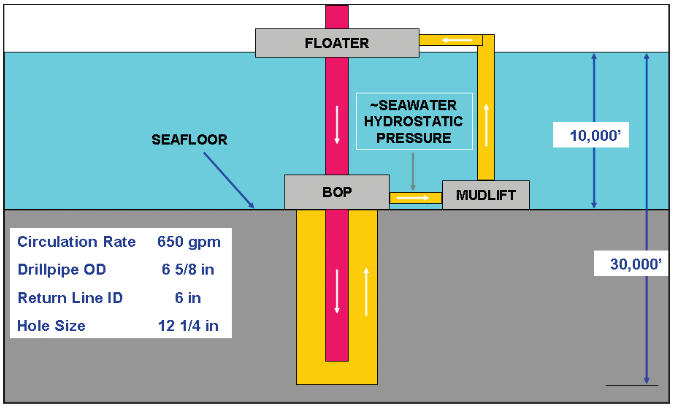
Riserless dual gradient (RDG) technology handles shallow hazards proactively. It has already shown promise in managing the narrowing pressure window in deepwater environments and ultimately reducing costs, improving wellbore integrity and increasing production capacity. Specifically, the application of this technology to the top-hole portion of the wellbore can lead to safer operations, reduced costs and a more technically stable wellbore by providing proactive control over shallow hazards.

The current industry standard used to drill the top-hole portion of the wellbore, "pump and dump," is not efficient enough to remain the standard response to these trying and uncertain shallow hazards. The "pump and dump" method is largely inadequate in supplying safe well control methods and depends heavily on accurate seismic data to avoid shallow hazards. The kick detection methods are slow and unreliable, resulting in a need for visual kick detection. Additionally, "pump and dump" does not offer dynamic methods of controlling kicks or the formation of methane hydrates when they do occur. There is also environmental impact, high mud costs and limited mud options.

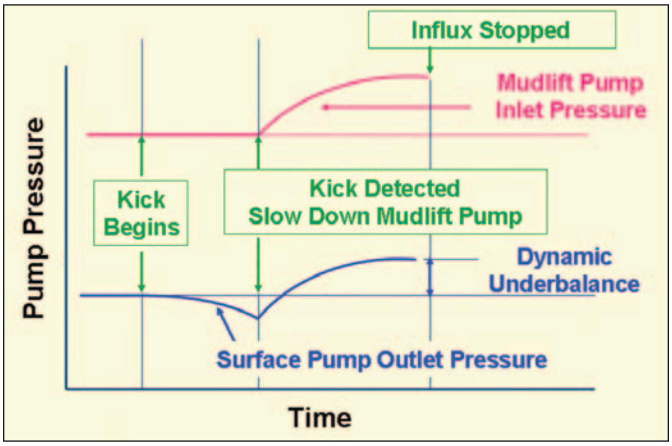
Now, the introduction of a better method of drilling the top-hole portion of the wellbore is on the industry's horizon.

In a RDG system, after the mud is pumped down the drill string and into the wellbore, it flows back up the annulus to the rotating diverter, which transfers the mud to the subsea mud pump. In typical drilling mode, this mud pump is set to operate at a constant inlet pressure. The mud is then pumped up the return line to the rig floor, where it is recycled and pumped back down the drill string to be used again.

There are inherent benefits to this system over "pump and dump" simply because this is a closed system. The amount of required mud is reduced, the variety of acceptable mud types is increased, and adding chemicals with specialized properties to the mud becomes an option.



Shown above is an illustration of a RDG system, which handles shallow hazards proactively. Below: An illustration of the Modified Driller's Method.



Accurate and faster kick indication: The RDG system offers faster and more accurate kick detection methods in addition to those that are used in "pump and dump." As the subsea pump, in standard drilling mode, is operated at a constant inlet pressure, when a kick enters the wellbore, the subsea pump inlet pressure increases. In order to maintain a constant inlet pressure, the subsea pump automatically increases its pumping rate to compensate for the additional inlet pressure created by the influx. This rate increase is the first kick indicator. As the subsea pump automatically increases its pumping rate, the subsea pump's outlet pressure increases, and the levels in the mud pit increase. These are the second and third kick indicators.

Finally, as a result, the surface pump pressure decreases, which gives the 4th indication that a kick is occurring. These 4 kick indicators provide warning to the driller that a kick is occurring much faster than the "pump and dump" method. When a kick is detected, the system then uses a modified driller's method to prevent further influx and circulate the kick out of hole.

Advanced & precise well control: The RGD system allows for the application of more conventional well control procedures that are not an option when using the standard "pump and dump." The modified driller's method maintains constant circulation, and the well is not shut in, as is the case in some other well control procedures. The subsea pump is slowed to the pre-kick rate, which is equal to the pump rate of the surface pump.

This causes a backpressure on the wellbore annulus, which increases annulus pressure until the kick influx is stopped. The driller then continues circulation and controls the subsea pump rate, like a more conventional choke valve, to maintain constant bottomhole pressure until the kick is circulated completely out of the wellbore. Then, kill weight mud is circulated to prevent further kick influx once drilling operations resume. This proactive method of well control allows the driller to drill through difficult shallow hazard zones while maintaining proper well control at all times. At no time is the well shut in, and the driller is always in control of the pressures within the RDG system.

Methane hydrate detection, control: The most common problem created by methane hydrates is when methane hydrates form within equipment. In the RDG system, the mud is recycled, not released onto the seafloor like in the "pump and dump" method. This means hydrate-inhibiting chemicals may be added to the mud to prevent the formation of methane hydrates. In the case of dissociating hydrates, there is the advantage of early detection and pressure control, to manage the increasing volume and migration of the methane gas in the annulus. The riserless dual gradient system allows for the application of more conventional well control procedures that are not an option when using the standard "pump and dump."

Managed pressure drilling options: When faced with shallow gas zones, often a company may choose to drill more complicated directional and horizontal wellbores in an effort to avoid overpressured shallow gas zones. With the RDG system, while this may still be a good policy, it is no longer the only option available. The pressure control granted to the driller by the use of a subsea mud pump allows proactive control over shallow gas flows. Additionally, the driller now has a system where variations of managed pressure drilling may be utilized; these were not options when using the "pump and dump" method.

Detecting shallow water flows and preventing erosion: Finally, in the situation of shallow water flows, the main hazard is erosion of the formation. In the "pump and dump" method, there is little or no indication when a water influx occurs. Also, when detected, these zones are often simply allowed to produce and de-water, which can result in severe formation erosion and ultimately the collapse of surface casing.However, as with a gas kick, shallow water flows can be quickly detected in a RDG system, and pressure control can prevent the need to de-water shallow zones and formation erosion.

RDG TECHNOLOGY ADVANTAGES

Riserless dual gradient technology offers a closed system compared with the current open system, which improves the drilling fluid system by removing the fluid property constraints. Also, this technology offers proactive well control over dissociating hydrates, shallow water flows and, most significantly, overpressured shallow gas zones. Summarily, RDG technology provides:

- Rapid and accurate kick detection;
- Safe well control procedures;
- Successful pore/fracture pressure window navigation;
- Control over pressured shallow gas zones;
- Control over shallow water flows;
- Control over dissociating methane hydrates;
- Improved casing seats and wellbore integrity;
- Reduced number of casing strings;
- Reduced overall costs;
- Prevention of methane hydrate formation;
- Reduced environmental impact.

There are many clear advantages for dual gradient technology, both economic and technical. In the case of top-hole drilling, the most significant advantage is the improved safety that results from better well control.

THE FUTURE OF RDG TECHNOLOGY

Riserless dual gradient technology has been successfully executed to drill the top-hole portion of a wellbore in offshore shallow water environments. A RDG system has been successfully field tested to drill the intermediate and deep well sections in offshore deepwater environments. The academic research has been completed to prove that a riserless dual gradient top hole drilling system is feasible and beneficial. All that remains is to take this technology, build and test the required equipment, and perform a field test on the top-hole portion of the wellbore in deepwater. RDG technology is the answer to the rising costs, technical challenges and safety hazards encountered when drilling in deepwater. The key is industry acceptance and implementation of riserless dual gradient systems.

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