MPD can control pressures, annulus returns

MANAGED PRESSURE DRILLING (MPD) is not a new concept to the industry, although the term itself may be new to most people. The technology of drilling with a closed and pressurizeable mud return system that permits the rotating of pipe and tripping under pressure has evolved onshore since the mid-1990s.

One industry participant familiar with MPD states that about 75% of the working land rigs in the U.S are going to drill at least one section of any given well with a closed and pressurizeable mud return system for varying reasons.

While most of these MPD systems are not true underbalanced wells, the contractors and operators are finding that a closed pressured mud return system can affect more than precise pressure containment, management and diverting annular fluids under pressure.

Technology that is well developed onshore can usually be applied offshore, and MPD is no exception. MPD technology seems to be finding a ready audience with industry and regulatory agencies alike as evidenced by the number of offshore wells in progress since the concept was introduced 18 months ago.

A riser cap is installed on a well in Malaysia in preparation for drilling a well utilizing managed pressure drilling technology.

While MPD utilizes some of the same surface equipment used in underbalance drilling, MPD, particularly in offshore environments, is not intended to produce hydrocarbons while drilling but rather to more precisely manage wellbore pressure and annulus returns while drilling.

MPD VERSUS UBD

A rotating control device, a tool developed for the safe drilling of UBD wells, is required for most applications of MPD, onshore and offshore. An RCD and a dedicated choke manifold affect a closed and pressurizeable mud returns system while drilling ahead.

About 75% of the working rigs in the US and Canada use a rotating control head in each well's drilling program for one reason or another, according to **Don Hannegan**, PE, Functional Director for **Weatherford UBS**. He also noted that a larger number of RCDs are used onshore for MPD purposes other than underbalanced drilling.

Offshore variations of the rotating control head have been developed and proven for UBD and MPD operations offshore.

Additional specialized equipment that was initially developed for UBD operations that enable various MPD applications include wireline retrievable drill string float; downhole deployment valves; membrane nitrogen generation units; real-time pressure and temperature monitoring; closed system surface separation; drilling with casing; and drill-in liners.

It has been estimated that about half of the remaining offshore hydrocarbon resources (excluding gas hydrates) are uneconomical to drill with conventional drilling tools and methods. This percentage increases with water depth and will increase over time as pore pressure decreases.

Obstacles to economic drilling include lost circulation and differentially stuck pipe; low rate of penetration; narrow pore to fracture pressure margins that necessitate excessive casing programs; shallow geohazards when drilling top hole sections without risers; flat time spent circulating out gas, kicks, etc; and failure to reach the geological objective with large enough production tubing.

Weatherford UBS is taking some of the UBD technology and methods and using them to successfully drill managed pressure wells around the world.

"What were are doing is keeping managed pressure drilling separate in people's minds from underbalanced drilling," Mr Hannegan said, "because managed pressure drilling is not underbalanced drilling. MPD is as precise as UBD relative to pressure control and management.

"We are using tools and technology that might have been developed for underbalanced drilling but they are being used to benefit the industry in ways other than creating a drawdown across the formation and having to deal with produced hydrocarbons while drilling ahead."

MPD is not designed to increase well productivity or to minimize skin damage. The objective is to overcome some drilling problems such as low rates of penetration, lost circulation, differential sticking, eliminating a casing size and/or obtaining a deeper open hole.

MPD IS AN ENABLER

Managed pressure drilling is an enabler for other emerging technologies, according to Mr Hannegan. These include all

variations of dual gradient drilling, including true dual gradient drilling with a marine riser and subsurface BOP; light fluid injection into the riser; and riserless dual gradient with returns to the rig. Additional technologies are drilling with casing, slim riser, deepwater drilling with a surface BOP and dealing with riser gas while drilling ahead.

MPD BENEFITS

There are a number of arguments against UBD in marine environments, according to Mr Hannegan. Among these are the lack of space on the rig for the UBD surface equipment, or wellbore stability is often the operator's problem, or the operator doesn't want to or can't deal with produced hydrocarbons, or regulatory agencies won't permit UBD offshore.

Mr Hannegan points out that, unlike UBD, MPD is uniquely suitable for dealing with wellbore instability by imparting greater overbalance than drilling fluids and cuttings in the wellbore would otherwise impart. Additionally, no more hydrocarbons are produced to the surface than with conventional drilling. Also, a complete UBD kit is not required for MPD systems.

As to the regulatory agency argument, Mr Hannegan says that most regulatory agencies like the idea of a closed mud return system compared to an open system.

Managed pressure drilling equipment is being tested at Weatherford's facility prior to being used in the field.

The regulatory bodies indicated that with a proper safety case and justification particularly with early planning, the agencies intend to be a receptive audience. While on the topic of arguments, Mr Hannegan notes that many of the agencies argue that any new technology that has the potential to increase recoverable assets with positive HSE implications is welcomed.

Drilling decision makers also began to realize that with closed pressured mud return systems they have the ability to rotate the pipe and trip in and out. Additionally, they have the ability to lighten the mud in zones where lost circulation is expected. Alternatively, if the operator sees a mud pit gain or other indications of an influx he can close the choke and immediately increase bottom hole pressure.Operators also see an advantage with MPD when it comes to the narrow margins between pore pressure and fracture gradient to drill deeper wells while possibly eliminating a casing size.

Taking this a step further, if a well can be designed with a simpler casing program, the operator can drill with smaller semisubmersibles and drillships, further reducing costs.

MPD PROGRAMS

Several major operators have utilized MPD in their drilling programs around the world for various applications. For example, one operator in Southeast Asia is utilizing MPD in pressurized mud cap drilling from a floating rig. The program is on its third well.

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Another operator in Southeast Asia is using a low head MPD variation in its fourth well from a jackup offshore Vietnam. The operator will also use the same variation in a North Sea well in September. Weatherford is building the bell nipple insert for the rotating control head.

In the Gulf of Mexico, two operators will be utilizing variations of MPD in deep wells. One company will be practicing zero equivalent circulating density (ECD) in its MPD program set to begin this summer.

The other operator will be using the same variation on a prospect in the fall. Both programs call for wells drilled to about 25,000 ft with very narrow pore pressure and fracture gradient margins that demand more precise wellbore pressure.

“Many of those types of wells exceed AFE,” Mr Hannegan said. “One of the attractions of MPD is the operator has a better chance of drilling the well within the AFE.”

Additionally, an operator in South America will use a dual gradient variation of MPD in a deepwater well. A rig will be fitted with a nitrogen kit consisting of a nitrogen production membrane unit with an air compressor.

The operator will drill with conventional fluids the way they would typically drill. However, the company has frequently experienced lost circulation in a depleted pore pressure zone. The nitrogen unit installed on the rig will be hooked up to the rig’s booster pump line downstream of the pump itself.

If lost circulations occurs a pre-estimated amount of nitrogen will be injected into the booster pump line and achieve gas lift within the marine riser, reducing bottom hole pressure.

If lost circulation continues the injection rate will be increased and nitrogen will be injected until gas lift is increased to a point where the loss of mud into the depleted zone is halted. Once drilling past this zone the nitrogen injection will be stopped.

The rig booster line will run outside the riser to a point just above the subsea BOP. The nitrogen will be injected into the annulus.

As nitrogen is injected, the operator will achieve one depth gradient from the injection point and another gradient in the mud and cuttings below that point, resulting in dual gradient.

The net result is to decrease the bottom hole pressure since some of the hydrostatic head of the wellbore is reduced. ■