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Reaming With Casing and Rotating While Cementing

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During Cementing operations, rotating and reciprocating methods plays major role in Casing system. Casing, once landed which cannot be moved prior to cementing, is a positive indication that something is wrong. The use of a single ball launcher and cement plug coupled with a modern casing-running tool allows the casing string to be run, washed, reamed, and cemented as part of a seamless operation. This adds the benefit of getting casing to bottom despite difficult formations, and the ability to transition immediately to cementing operations while retaining the ability to rotate and reciprocate. During Cementation, Pipe movement has recently become a simple operation for any operator to include in a drilling program: there is minimal cost and planning required. A cement plug is attached to the bottom of the proprietary Casing Drive system(CDS) and it is a trademark of TESCO Corporation. A side entry swivel sub is included between the CDS and the top drive. A ball launcher, also provided, is rigged up in line with the chicks an lines running from the cementing pump truck to the side entry swivel sub. The solution allows the operator to go directly to cementing after the casing has been run. It also enables the rotation and reciprocation of the pipe during cementation, which prevents channeling of cement and leads to a notably superior cement job as proven by cement bond logs. Using a hybrid cementing tool with a modern casing running system allows wells to be engineered more aggressively, thus the ensure casing can be run to bottom in difficult formations and guarantee an improved cement job. In turn, this provides greater production and returns for the operator.

Key words: Casing Driving System, Ball launcher, Cement head, Conventional casing elevators.

With drilling costs increasing, operator's attention is now focused on eliminating NPT (Non-Productive Time). Each year some operations that were considered productive and avoidable in the past are being considered NPT. The modern view of the industry reflects drilling as a continuous process, with much effort spent to reduce the wasted time at operational interfaces such as the one between running casing and cementing (1-5). Reducing obvious and hidden NPT, as well as increase cement job quality in a two-phase process:

1) During casing running, washing and reaming can occur, as well as simply circulating and conditioning the wellbore between casing running and cementing;
2) During cementing, it allows the casing to be rotated and reciprocated resulting in a superior cement bond with casing and formation face as demonstrated cement bond logs. This process will reduce the possibility of as gas migration, improve zonal isolation for fratconsiderations, mitigate the probability of remedial cement work, and prevent freshwater contamination.

Washing and Reaming while Running Casing

There are several reasons why wells are not drilled perfectly straight; tortuosity and hole

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spiraling are common even today. Moreover, after reaching TD and tripping out, wellbore stability and quality issues, such as tight hole, sloughing, mud cake thickening, break out , lost circulation, cuttings settlement, and mud gelatin, might happen and deteriote the condition of the wellbore. These hole problems necessitate washing and reaming casing to bottom in many cases.

Circulation and reciprocation were the only ways to clean the hole while casing running. If casing did not reach TD, it was often pulled out and drill pipe was then used to recondition the wellbore. A second attempt would then be made to run casing. With the introduction of reamer shoes and the CDS, it is possible to wash and ream to bottom while continuously circulating and conditioning the wellbore. This approach enables the casing to pass through tight spots and work through ledges. In some cases when casing is run conventionally, the casing becomes stuck and must be cemented in place before reaching TD. This could prevent a significant amount of already drilled hole that would otherwise be productive from being cased and the associated production is permanently lost. The modern casing running process using the CDS secures potential production by getting casing to bottom.

Tool Description

The Casing Drive System is installed directly into the rig's top drive drilling system after the drill pipe elevators, links and saver sub are removed. The CDR replaces power tangs, casing elevators, stabbing board, elevated for tong operations, and fill-up tool. The Casing Running and Reaming Tool (CRRT), helps get the casing to TD, despite compromising hole conditions such as bridges, ledges, doglegs, sloughing formations and deviated holes. The CRRT combines hydraulic and mechanical energy to break through down hole obstructions and features that cleans and circulates.

Table 1. Size chart

Model	Size Chart				
	Height	Diameter	Drill Pipe	Piston	Total
CD 140	40"	12"	4 ½"	140lbs.	750lbs.
CD 350	50"	15"	4 ½"	350lbs.	1300lbs.
CD550RC	46"	28"	9"	500lbs.	2800lbs.
CD1000RC	72"	28"	13"	1000lbs.	4800lbs.

Cement Quality Evaluation

The industry has long since known that pipe movement results in a superior cement job. Attached are cement bond logs from an operator that adopted this technology. There are logs of both vertical and horizontal wellbores. Offset wells are chosen such that the only variable was pipe movement as labeled accordingly. The cement bond was notably better on both vertical and horizontal hole sections in which the casing was reciprocated and rotated. Reciprocation improved the cemtn bond and rotation, combined with reciprocation, enhanced the results even further.

Table 2. Depth Diameter guide

Casing Diameter	Hole Depth	Cd Model
6"-10"	0"-400"	CD140
6"-14"	0"-800"	CD350
10"-20"	0"-500"	CD550
Over 20"	0"- Over 500"	CD1000

Rotating and Reciprocating the casing while Cementing

Poor bonding can cause failure at cement casing or cement-formation interface those afterwards lead to serious problems such as gas migration, cross-flow, and fresh water contamination. Rotating and reciprocating the casing while cementing has proven effective in improving the cement quality. As the casing is moved, it distributes the cement evenly, covering the entire circumference of the wellbore. This is especially important in directional and horizontal wells since the casing rests on the bottom side of the well, and if not moved, may result in casing directly contacting wellbore with no cement in

between.

Mud partially dehydrates during the cement hydration mud channels left in the annulus are preferential paths for gas migration[6]. The bond between the cement and the formation is what typically determines whether there will be gas or fluid migration. Casing rotation helps the circumferential flow and plasters the cement on the wellbore wall to prevent channeling and the formation of micro-annuli. It has also been scientifically proven that the increasing shear stress by pipe rotation in the annular gap greatly facilitates effective mud displacement[7]. Reciprocating the casing will help clean the gelled mud and rotation helps the initiation of the spacer flow in the annulus.

Another issue is casing off-center in the annulus: this creates a narrow and wide passage for the cement. More cement leads to flow through the wide side and if the casing is not rotated and reciprocated the cement tops will be different between the narrow side and the wide side[7].

Implementation

To implement this technology of running and reaming casing, the rig must have a top drive. The top drive can be of any make. In addition, there must be enough clear working height in the mast to accommodate the length of the CDS,approximately 10 feet. A power unit is rigged up and hydraulic lines are run through the service loop to power the CDS. Rig up typically takes less than an hour on most rigs. The rig up time can be as little at 30 minutes after rig crews are familiar with the tool. Figure 5 displays the CDS in further detail.

Standard slips can be used, but air or hydraulic power slips can increase operational efficiency. The CDS is made up directly to the top drive, which allows for the rotation, reciprocation, and ability to circulate through the casing. Withthe casing now rotating and experiencing torque, special attention must be paid to the casing connections. In extreme cases, torque can near drilling levels. Typically, it is not recommended to rotate long thread and coupling (LT&C)casing, because the fatigue induced by rotation can be greater than the connection can support. Often buttress connections will be sufficient, but if not, a premium connection can be used. Similarly, centralizers must also be able to withstand the rigors of rotation.

The CDS also reduces the amount of personnel required to run casing. Since casing is made up using the top drive, in most cases, no tongs are needed; thus eliminating the need for personnel on an elevated platform to operate power tongs. Typically the tool can be run with just two people. Also, since the tool has link tilts that operate hydraulically, no stabber is needed in the derrick. This greatly enhances safety by keeping people out of harm's way.

Working

The drill pipe elevators, links and saver sub are removed, and the Casing Drive System is installed directly onto the rig's top drive. Tesco's system is designed to operate with Tesco's top drives, but can be interfaced with most other top drive models. Through the CDS, the top drive provides the rotation and torque to make-up the casing connections. The controls on the top drive allow it to be preset to deliver a fixed maximum speed and makeup torque. Because of the high horsepower of the top drive, the casing is made-up in one smooth motion, rather than stopping to change gears as the joint approaches final make-up. This significantly decreases the risk of galling the threads, and subsequent connection failure.

A description of one operating cycle of the casing running process best illustrates how the Casing Drive System operates on the rig. The casing string is set in the slips and the CDS is at floor level :

The driller extends the CDS single joint links and elevators over the casing joint in the V-door, lowers them and the floor men latch the single joint elevators on the casing. (Remotely operated hydraulic elevators are under development). The driller raises the blocks, the casing swings over well center, and the floor men position the casing single over hole center. No stabber is required in the derrick. The driller lowers the blocks and Casing Drive System. The stabbing guide on the CDS centers the tool in the casing as the single joint elevators slide down the casing body. The driller hydraulically sets the trip and torque grapple of the CDS inside the casing (or outside on smaller sizes).The driller engages the top drive to make-up the casing to the preset torque. Torque and rotation can be monitored and recorded from the top drive. The slips are released and the joint lowered into

the well. The rig pumps can be engaged to fill the casing, and if desired to circulate while the joint is being run. As the joint reaches the floor, the single joint elevators are released and the links extended hydraulically to receive the next joint of casing. At floor level, the slips are set and the CDS released. A safety feature prevents release with weight on the grapple.

Specifications

Hoisting Capacity	350 Ton External	500 Ton Internal	750 Ton Internal
Casing Sizes	3 ½ in. - 8 5/8in.	4 ½ in. - 20 in.	9 5/(8) in. - 20 in.
Length	10ft	10ft	19ft
Maximum Torque	40,000 ft/lbs	40,000 ft/lbs	80,000 ft/lbs
Maximum Drilling Fluid Pressure	5,000 psi	5,000 psi	5,000 psi
Maximum Operating Speed	200 rpm	200 rpm	100 rpm
Maximum Push Down Capacity	25,000 lbs	25,000 lbs	25,000 lbs

Features and Benefits

i. Is quickly installed on virtually any Top Drive system, electric or hydraulic, with typically no modifications to any existing drilling equipment.
ii. Greatly reduces the amount of equipment and personnel required to run casing, provides a high level of mechanization keeping personnel out of the line of fire and places the Casing Running operation under the control of the Driller.
iii. Assures the ability to get casing to bottom through ability to simultaneously lower casing, while rotating and circulating.
iv. Reduces personnel on the rig floor during operations, as the ball may be launched from the dog house using an air-control panel.
v. Allows casing string to rotate and reciprocate while cementing, resulting in a superior cement job
vi. Reduces non-productive time between casing and cementing operations
vii. High fluid velocity

Safety Alternatives

The CDS eliminates cumbersome primary and backup conventional casing running equipment such as large casing elevators, power tongs, elevated work platforms and casing fill-up tools. It eliminates the stabber in the derrick, a high-risk position, and conventional casing running equipment with moving parts, pinch points and high-tension cables. Temporary work platforms on the rig floor for power tong crews are eliminated. It allows for a cleaner rig floor with hands actually handling the casing. Overall, fewer workers are around the rig floor, and none are in the derrick, reducing overall exposure to potential accidents. Additionally, automation using complementary tools can eliminate all personnel contact with casing.

Floor safety is enhanced due to the CDS' internal or external gripping systems with a valve in all mandrels. The valve prevents mud in the top drive and the Kelly hose from falling onto the rig floor during casing-running operations;this provides a safer work environment by preventing mud from dropping to the rig floor and onto operations personnel. While running casing with CDS won't completely eliminate accidents on a drilling rig, it can eliminate the potential for accidents in the two accident-prone areas where most injuries and fatalities occur- the derrick and the rig floor.

RESULTS AND DISCUSSIONS

The Casing Driving System works with a top drive to easily attain smooth make up with no tending load and with precise control on final torque. Once the connection is made up, circulation can be initiated, and the CDS may manipulate the entire string of casing. When used with a slip/ spider assembly, the CDS interlock eliminates the chance of dropping the string in the wellbore by preventing the CDS from releasing the pipe until the slips are set. Reduce risks normally associated with casing running by adding our CDS and ensure that your casing gets bottom safety and efficiently.

Calculations

1. The outer surface area of casing covered with cement is equal to circumference of casing multiplied by length of cement covering casing.

Area = Π × D × L

Where,

Area in square inch.

Π (called pi) = 22/7

D is diameter in inch.

L is length of cement in inch.

Area = Π x 9.625 x (2600 x 12)

Area = 943,420 square inch.

2. Casing weight = (weight in ppf) x (total length of casing)

Casing weight = 40 x 3200 = 128,000 lb

3. Shear force is required to support whole weight of casing

Shear strength (lb/in^2) = Casing weight + Area of casing covered by cement

Shear strength (psi) = 128,000 ÷ 943,420 = 0.136 psi

We can estimate the compressive strength of cement based on 1 ½ figure

Shear Strength ÷ Compressive Strength = 1/12

Compressive strength = 12 x 0.136 = 1.63 psi.

CONCLUSIONS

Using the CDS gets casing to TD with a significantly higher rate of success than conventional casing running tools in difficult well bores. When combined with the ball launcher and cement plug, NPT is further reduced by making the transition from casing running to cementing much more efficient. When the cementing tools are employed, casing can be rotated and reciprocated, resulting in a superior cement bond as demonstrated by the cement bond logs. Finally, safety is enhanced by reducing personnel on the rig and eliminating conventional casing running methods, which are inherently dangerous. CRRT gets your casing to total depth despite compromising hole conditions such as bridges, ledges, doglegs, sloughing formations, and/or deviated holes. The CRRT is ideally suited for use Casing Running System and a Top Drive. Design features provide the ability to combine hydraulic and mechanical energy to break through down hole obstructions.

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