Casing Drilling proves effective drilling alternative

PILOT TESTING SHOWS that Casing Drilling technology significantly reduces drilling costs and speeds well completion by using conventional casing instead of drill pipe to drill the well, according to **Tesco Corporation**. Casing Drilling is safer, eliminating time consuming trips to change drill bits and set casing.

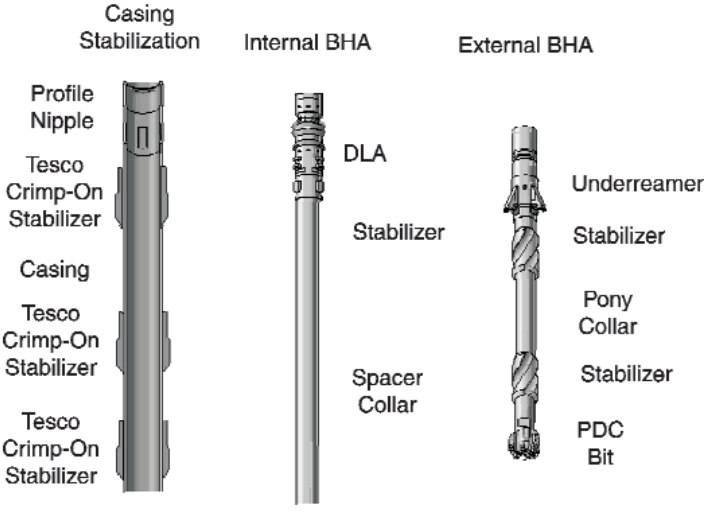
"Typically, wells drilled with Casing Drilling technology can be drilled up to 30% faster than conventional wells and represents a major advance in drilling technology," said **Bob Tessari**, Tesco President and CEO.

Following a series of wells in **Conoco**'s Lobos field in South Texas, Tesco and Conoco are constructing three innovative drilling rigs incorporating Tesco's proprietary Casing Drilling technology. The rigs will operate under an exclusive two-year contract with Conoco.

The first rig was expected to be operational by 1 Sept 2002 while the remaining two units will be ready for work before year-end.

LOBO FIELD TESTS

Conoco used Tesco's Casing Drilling system to drill 11 development wells in the Lobo field in South Texas. The intermediate and production sections of these wells are often trouble prone when drilled conventionally.



Time may be required for hole conditioning to deal with lost circulation through depleted zones, sloughing formations, gas influxes near the intermediate casing point and throughout the production section, potential stuck pipe conditions, and running the casing. The potential to reduce these flat times provides the incentive to use the Casing Drilling system.

The Casing Drilling system has significantly reduced these downhole problems on the sections drilled with it by casing the well as it is drilled.

This is accomplished by using the casing as the drill-pipe. Once the casing point is reached, a wireline retrievable drilling assembly is recovered to allow the casing to be cemented in place.

The potential for Casing Drilling to reduce drilling time and cost was sufficiently obvious after drilling the first few wells that Conoco entered into a two-year contract for three new Casing Drilling rigs to be delivered by the end of 2002. The full economic impact of Casing Drilling on Lobo drilling performance will not be realized until these rigs are in place.

CURRENT EFFICIENCY CYCLE

Tesco's Casing Drilling system was chosen for a five well pilot project to evaluate both the technology and its potential to impact the particular problems encountered at Lobo.

This Casing Drilling system is the only commercially available system for drilling with the casing that provides retrievable bottom hole assemblies that allow bit changes and directional work without tripping the casing.

Conoco significantly increased its holdings in the Lobo trend of South Texas in the mid-1990's and currently produces about 520 MMCFD from the trend. In 1997 Conoco embarked on an active field development program with the goal of drilling about 1,000 wells in seven years.

By 2001, ten rigs were being employed to drill about 160 wells per year, but the drilling efficiency stagnated. Even though there are slight differences in well depth, there was little indication of an improving efficiency. If anything, the wells were taking longer to drill rather than less time.

A specific goal was adopted to reduce drilling costs to make reservoirs smaller than 1.0 BCF economical. The ability to develop reservoirs this size would extend the development potential for several years because the untapped reservoir size is becoming smaller and smaller.

In examining the wells and drilling performance it was obvious that great strides had been made in increasing ROP, drilling each hole section with a single bit, and improving general rig operation efficiency. The most significant thing that still limited the ability to reduce days on each well was the time to prevent and recover from downhole problems.

Stuck pipe and lost circulation were the most consistent contributors to the trouble events for Lobo wells. These two items accounted for about 75% of the trouble time in 2000 and 2001 while well control and a failure to successfully run the 7-in. casing were also significant in 2001 and 2000.

Drilling with casing was identified as the item that potentially provided the greatest value toward continued reduction in drilling cost

Looking at the overall situation it became clear that any major reduction in drilling time had to address the flat time rather than the "making hole" times. The most significant flat times were associated with keeping and protecting the hole, averaging about 1.5 days per well, and casing running operations.

The flat time averaged about 45% for the Lobo wells compared to the typical value of 44-86% for all wells and 65% for onshore wells. This indicates that the conventional drilling performance on these wells was quite good.

Drilling with casing was deemed to have the most potential to impact the flat time because it eliminated the drill-string tripping and hole conditioning required before running casing, eliminated the casing running time, and reduced the risk of not getting casing to bottom.

The most significant unknown was how effective drilling with casing would be at mitigating thestuck pipe and lost circulation issues. Based on results while drilling with casing in less severe situations, it appeared that the overall borehole quality was improved so that both borehole stability and lost circulation were reduced.

In addition to the direct impact on drilling efficiency, the Casing Drilling system was also expected to improve overall well safety. Well control is improved since the casing remains in the hole at all times so there are fewer operations where the well cannot be circulated.

Reduced pipe handling and tripping also reduced the time spent on activities that have higher accident frequency rates.

CASING DRILLING PROCESS

The Casing Drilling system is composed of downhole and surface components that provide the ability to use normal oil field casing as the drill string so that the well is simultaneously drilled and cased.

The casing provides hydraulic and mechanical energy to a wireline retrievable drilling assembly suspended in a profile nipple located near the bottom of the casing. The casing is rotated from the surface and the drilling fluid is circulated down the casing ID and back up the annulus.

A drill lock assembly (DLA) in the top of the BHA provides mechanical (axial and torsional) coupling and hydraulic seals to the casing. The DLA has a locator mechanism, an axial lock, and torsional drive splines that mate with a profile nipple positioned at the top of the first joint of casing. It also provides a mechanism to facilitate insertion and retrieval.

The drilling assembly below the DLA terminates in a pilot bit, but may include other conventional drillstring components such as an underreamer, mud motor, coring or directional assembly.

In most Casing Drilling applications, an underreamer is used above the pilot bit to open the hole from the pilot bit diameter to the final wellbore diameter. The pilot bit is sized to pass through the casing and the underreamer opens the hole to the size that is normally drilled to run casing.

For example, a $6\frac{1}{4}$" pilot bit and $8\frac{1}{2}$" or $8\frac{7}{8}$" underreamer are used while drilling with 7-in. 23 ppf casing. In some situations it might be desirable to use a bi-center bit instead of an underreamer, but generally their ratio of drilled diameter to pass-through diameter is too small for Casing Drilling applications.

The Casing Drilling system utilizes a top drive to rotate the casing. Single joints of casing are picked up off the pipe rack and set in the mouse hole. The top drive, with extend feature, is connected to the top of the joint, which is then stabbed into the top of the casing string in the rotary table and drilled down in a conventional manner. The casing string is rotated for all operations except slide drilling with a motor and bent housing assembly for oriented directional work.

The casing string is attached to the top drive with a Casing Drive System (CDS) without screwing into the top casing connection. The CDS includes a slip assembly to grip the exterior of the pipe and an internal spear assembly to provide a fluid seal to the pipe.

It is operated with the hydraulic top drive control system. The use of the CDS speeds up the casing handling operation and prevents damage to the threads by eliminating one make/break cycle.

The rig being used for the Lobo drilling project is Drillers Tech 4, which is designed as a dual-purpose (drill pipe and Casing Dri1ling) rig. This rig is not optimal for the particular wellhead and muds used on the Lobo wells, but it provides the capability for Casing Drilling and allows a good evaluation of the Casing Drilling technology for these wells.

LOBO DRILLING PERFORMANCE

The Casing Drilling program was initiated with a five well pilot project to evaluate the technology and to determine how well it could deal with the specific issues encountered in drilling the Lobo wells. In general, wells were chosen that were relatively simple at first and progressively became more difficult.

A number of challenges were overcome during the five well pilot program were:

Crew Experience: The crews used on the first wells had no prior experience drilling Lobo wells.

Deviation Control: The first three wells experienced higher than desired deviation and two of them required corrective motor runs. Changes in the drilling assembly eliminated any further problem with deviation control.

Casing Wear: Excessive wear on the couplings was experienced on the first few wells. This was resolved by installing hard-faced wear bands on the casing below the couplings of the bottom joints of casing.

Equipment Reliability: A new style of drill lock was used on the first wells that caused problems retrieving the BHA before a design flaw was discovered and eliminated.

DLA seal failures: Seals on the DLA failed frequently in the early wells. This was quickly resolved for the intermediate hole section, but Casing Drilling of the production hole was suspended until the twelfth well while the seals were being redesigned.

By the time the five well pilot program was completed, the drilling performance had improved sufficiently to match that of conventional drilling. Sufficient progress had been made and potential demonstrated so that the program was extended for the remainder of 2001 and into 2002 and negotiations were begun to bring in three custom designed Casing Drilling rigs for Lobo operations.

POTENTIAL IMPACT OF CASING DRILLING

Data from the first few Casing Drilling wells was analyzed and compared to conventional drilling performance to access the potential value of Casing Drilling Lobo wells.

There is a significant incentive to further reduce the overall drilling time, but this has proven to be difficult to accomplish with the conventional drilling system.

The drilling performance has been optimized to the point where it is on the very flat portion of the learning curve and further improvement is difficult to achieve.

Totally eliminating all trouble time would reduce the average drilling time by only 8-9%. This indicates that the fundamental drilling system must be changed to provide a significant improvement in drilling performance.

An examination of the performance of Casing Drilled wells shows that certain normal activities take less time so that a Casing Drilled well with no lost time would be somewhat faster than a conventional well with no lost time.

For example, Well 5 was drilled in 16 days to a depth of 11,200 ft. This was faster than the median well even though it incurred 19% trouble time.

A reasonably conservative estimate of the time reduction for normal activities on a typical Lobo well is about 1.5 days (8%), based on performance to date.

The performance also shows that the in-hole trouble time is less with Casing Drilling. The exact reduction in trouble time is difficult to quantify because of the relative infancy of the Casing Drilling process in Lobo and the fact that the full process has not been implemented.

Sufficient data is available to support a reasonable expectation that the trouble time can be reduced 50% compared to conventional drilling.

Historical data was then used to generate probability curves for the time required to drill a well conventionally, including trouble time and excluding trouble time.

Variation in the drilling time of the fastest 50% of the conventional wells is mostly affected by normal variation in formation conditions and unidentified efficiency variations, while significant trouble time is identified for the slowest 50% of the wells.

Comparison of the drilling performance of the conventional wells to the Casing Drilled wells indicates that substantial savings can be achieved.

These results were used to justify expanding the Casing Drilling program by contracting for three custom designed rigs to be built and committing to a two-year Lobo drilling program.

REFERENCE

This article was adapted from “Casing Drilling Proves Successful in South Texas” presented at the IADC World Drilling 2002 in Madrid, Spain by **Kyle Fontenot**, Conoco, Inc, and **Tommy M Warren** and **Bruce Houtchens**, Tesco Corp.