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Hybrid Coiled Tubing/Snubbing Drilling and Completion System
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SPE Members

Abstract

A drilling and completion system has been developed which will handle both continuous pipe (coiled tubing) and jointed pipe. The coiled tubing is handled using a conventional coiled tubing unit. The jointed pipe is handled using a set of snubbing jacks. This paper describes the design considerations and resulting system that was developed. A case history of the first use of this system is also presented.

Introduction

Since the experiments\textsuperscript{1,2} with coiled tubing (CT) drilling (CTD) in 1991, CTD has past from the experimental to the development stage. The number of CTD jobs is growing rapidly from less than 30 in 1993 to more than 140 forecasted for 1994. During the initial job designs it became clear that a system was needed which could handle both continuous pipe (CT) and jointed pipe. This system is needed for the following reasons:

- When using CTD to drill drainholes in an existing well, it is often necessary to pull and re-run the jointed production tubing.
- When wells or drainholes are drilled with CTD it is often necessary to run a jointed casing or liner.
- When wells or drainholes are drilled with CTD it is often necessary to run a jointed casing or liner.
- Another new service developing as part of the CT service industry involves running CT completions (CTC)\textsuperscript{3}. At least one project is underway and others are being considered in which old jointed pipe completions are being pulled and replaced with CTC. A hybrid system capable of pulling the old jointed completion and running the CTC is needed for these types of jobs.

Design Considerations

The following types of hybrid systems were considered in designing this system:

1. CT capability added to a rig - It would be possible to add CT capabilities to a conventional or slim hole drilling rig. The hydraulic power needed to run the CT equipment could be taken from the rig power. A CT control panel, injector head, reel and accumulator modules would need to be added to the rig.

2. Mast added to a CT unit - A mast capable of pulling jointed pipe would need to be added to
the CTD sub-structure. If jointed pipe rotation were needed a rotary table or top drive would also be needed.

3 Snubbing capability added to a CT unit - casing or snubbing jacks would be added to the CTD sub structure. Again, if jointed pipe rotation were needed a rotary table would also be needed.

Each of these types of hybrid systems have their advantages and disadvantages, shown in Table 1.

The ability of a hybrid snubbing and CT system to run jointed pipe underbalanced was one factor in favor of this approach. One of the advantages of CTD is that it can be used to drill underbalanced safely. If a producing section is drilled underbalanced it would be best for the formation to run the casing or liner underbalanced as well.

Another important factor in favor of this approach was that with this system the axial loads could be transmitted through the wellhead. This may become important when working offshore as the platform may not be able to support a load up to 170,000 lbs.

The final significant reason for choosing a hybrid snubbing and CT system was that the resulting system does not look like a rig! CT services have always been promoted as "rigless" operations. For marketing reasons it was desirable to maintain the distinction from a rig for CTD and CTC activities.

System Description

The hybrid drilling system shown in figure 1 is described with the following points:

- It has two 11 ft stroke snubbing jacks built into a substructure capable of pulling 170,000 lbs

- An injector head trolley supports the injector and hydraulically moves it off the wellhead to clear the injector from the wellhead for jointed pipe handling with the jacks.

- The jacks are used to lift the CT injector off of the trolley and hold the injector while CT is being run. The trolley is retracted away from the wellhead. If a telescoping lubricator is used between the injector and the BOP, small CT pipe movements can be performed with the jacks instead of the injector, avoiding some of the fatigue cycling while drilling.

- The control panel for the snubbing jacks is located on the drill floor giving the operator good visibility of the operation which is especially desirable for jointed pipe and BHA handling.

- The system can be run "free standing" with all of the loads carried by the structure (unlike conventional CT and snubbing where the string weight is carried by the wellhead).

- Alternatively the jacks are capable of being run so that the string loads are transmitted to the well head for offshore applications where the platform cannot support the load.

- The height of the "drilling floor" is adjustable in 6" increments from 14 ft to 18 ft above the ground to accommodate various BOP's and/or wellheads.

- The system is capable of running and pulling jointed pipe from 2 3/8" to 7 5/8" in diameter by changing the adapters in the HR340 slip bowls.

- The top slip bowl (traveler) is mounted on a passive rotary to allow manual pipe rotation. A powered rotary with a hydraulic motor drive could be provided.

- The system works with a conventional CT unit hydraulic power pack which supplies the power for both the CT mode and the snubbing mode. A crane is typically needed.
to work with the system for handling joints of pipe.

- There is a support pole for swing mounting pipe tongs or a winch for material handling. The arm swings on an 80 degree radius with 4,000 lbs capacity. It can be mounted in any of 4 mounts on each corner of the work floor. More than one support pole can be used to accomplish multiple tasks.

- A v-door was attached to one side of the substructure for jointed pipe handling.

- It is possible to switch from running jointed pipe to running CT quickly, using the trolley to move the CT injector on or off of the well. No switching of hydraulic hoses is required.

- The initial system does not have the slip bowls needed to snub jointed pipe against well pressure. These slip bowls may be added later.

Conclusions

The first hybrid CT/snubbing system has been developed and used in the field, although the first application did not utilize much of the system's potential. It did show that having the ability to rotate the casing is important. These types of systems fill an important need and are expected to become a major component in some CTD and CTC applications.

Acknowledgements

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References


Case History

This system was first used to drill a new shallow gas well. A water well rig had drilled the pilot hole and set 8 5/8" surface pipe to 140 ft. CTD was used to drill a 6.5" hole to 2,290 ft. Then 4.5" jointed casing was run.

The CT unit used on this job had a different injector head than the one the system was designed for. Instead of modifying the trolley for the injector, the trolley was removed and the crane was used to handle the injector.

Since the well was shallow, the crane was used to lower most of the casing using the lower stationary slip bowls to suspend the pipe. At one point a bridge was encountered. The traveling slips were installed into the jack and used to push the casing through the bridge. Then another bridge was encountered which the casing could not be pushed through. Finally a rig was used to ream the hole and set the casing. If the system had the ability to rotate the casing it would have been able to complete the well.
Table 1
Advantages and Disadvantages of Different Types of Hybrid Drilling Systems

<table>
<thead>
<tr>
<th>Type</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
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<tbody>
<tr>
<td>Rig + CTU</td>
<td>✷ Fast running/pulling of jointed pipe</td>
<td>✷ Expensive - Cost of full rig + CTU</td>
</tr>
<tr>
<td></td>
<td>✷ Full rig capabilities</td>
<td>✷ Large amount of equipment</td>
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<tr>
<td></td>
<td></td>
<td>✷ Large location size</td>
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<tr>
<td></td>
<td></td>
<td>✷ Large crew size needed</td>
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<tr>
<td></td>
<td></td>
<td>✷ Cannot run jointed pipe underbalanced</td>
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<tr>
<td></td>
<td></td>
<td>✷ Transmits load only through substructure</td>
</tr>
<tr>
<td>CTU + Mast</td>
<td>✷ Fast running/pulling of jointed pipe</td>
<td>✷ Cannot run jointed pipe underbalanced</td>
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<tr>
<td></td>
<td></td>
<td>✷ Large crew size</td>
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<tr>
<td></td>
<td></td>
<td>✷ Transmits load only through substructure</td>
</tr>
<tr>
<td>CT + Snubbing</td>
<td>✷ Can run jointed pipe underbalanced</td>
<td>✷ Slow running/pulling of jointed pipe</td>
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<tr>
<td></td>
<td>✷ Small crew size</td>
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<tr>
<td></td>
<td>✷ Less equipment</td>
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<tr>
<td></td>
<td>✷ Small location</td>
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</tr>
<tr>
<td></td>
<td>✷ Transmits load through either the substructure or the wellhead</td>
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Figure 1
Hybrid CT/Snubbing Drilling and Completion System