North Cormorant sidetrack times are cut in half

Fraser Lawson, KCA Drilling Ltd

THE NORTH CORMORANT Drilling Team of **KCA Drilling Ltd** have been able to reduce sidetrack drilling and completion times by 50% through the application of Delivering the Limit (DTL) methodology.

DTL is a systematic approach to well delivery that involves rigorously analyzing and challenging every part of the well engineering process from conceptual design through to detailed execution. The aim is to get as close as possible to the theoretical "technical limit" time and cost for the well.

Since the formal adoption of the method some 12 months ago, North Cormorant sidetracks are regularly being drilled in 50% of the planned time and the trend is still improving. This includes the North Cormorant's fastest ever sidetrack CN-01S1 that was recently drilled and completed in 18 days.

METHODOLOGY

The DTL methodology takes place within an idealistic well delivery process that has been carefully documented. Onshore, two key milestone events take place within this process.

The DTL workshop 1 held 12 weeks before the well operation commences considers the conceptual design of the well. A petroleum engineering presence is essential here as the well objectives and priorities are sought to be understood and challenged by the execution team. Any new technology that will enhance the well design must also be identified at this stage.

The important deliverable here is the most cost effective conceptual design that will satisfy the well objectives.

The DTL workshop 2 follows and is an equally important process milestone usually referred to as the "DWOP" or drill the well on paper exercise. A slightly different mix of expertise including strong operational and wellsite links is required here to look in detail at the draft operations program and how to further optimize it.

The entire well program may be covered at this event or specific operations such as window milling or liner cementation may be analyzed in fine detail if deemed appropriate to the scope of operations. The workshop should be held 2 weeks before spud in order to adequately implement any actions or changes to plan arising from it.

Both workshops will typically require a half or whole day to cover the program adequately. The actions arising from them may be many and varied, requiring full commitment from the entire team to fully implement successfully.

Offshore, pre-phase meetings are held prior to commencing each operations phase. A critical element here is learning and a well-stocked lessons-learned database is meticulously trawled for ways of optimizing the upcoming job. Learning tools like this are recognized as an essential feature underpinning the DTL process.

Two additional positions within each rig team are required to effectively administer the DTL process.

Onshore a dedicated DTL drilling engineer is focused specifically on performance improvement including program reviews and optimization, performance analysis and DTL process facilitation. Offshore a DTL "coach" provides a complimentary role that also includes a strong reporting function and close liaison with drill crews during the execution phase. Various performance improvement projects are driven by these positions for which special training is provided.

IMPROVEMENTS

Some of the many specific areas targeted by DTL where improvements have been made are discussed below.

Although not a new concept, through-tree cemented abandonments have become a regular feature of DTL wells where as much work as possible is taken off the critical path. This technique is where cement slurry is bullheaded down the wellbore to isolate the production perforations before skidding over the well.

The key advantage here is that the work can be performed off line without the rig and saves valuable rig time when setting and testing deep isolation plugs. These operations can often become time consuming operations where plugs fail to test and must be reset.

Figure 1: Underbalanced drilling results in North Cormorant

Well No	Planned Days	Actual Days	Actual %
Pre CN18	100	116	116
CN18s3	84.87	103.06	121.4328
CN18s4	44.2	38.7	87.55656
CN22s1	54.3	47.86	88.13996
CN29s2	48.49	39.21	80.86203
CN33s2	35.62	27	75.80011
CN12	91.52	101	110.3584
CN07	81.21	91.78	113.0156
CN33s3	42.77	29.56	69.11386
CN19	44.76	47	105.0045
CN16s1	49.15	32.67	66.46999
CN23s1	45.85	35.71	77.88441
CN36s7	51.02	31.42	61.58369
CN32s3	48.68	24.75	50.84224
CN01s1	38.88	18.08	46.50206
CN26s1	48.64	24.67	50.71957
CN28s1	51.69	23.13	44.74753

Risks such as premature screen off and cement sheaths inside the tubing are inherent within this method. Again the DTL method compels us to document these risks and mitigate them with adequate contingency planning.

Drilling on and off bottom times have been recognized since the implementation of DTL as a valuable performance measure. It was seen that even on good performance drilling sections off bottom time could be as high as 50%.

This was recognized as a clear opportunity for further improvement. The potential was such that two specific DWOPs were largely devoted to first understanding in detail and then reducing these off bottom times.

With wellsite drillers and directional personnel present the mystique behind current reaming and circulating practices was gradually stripped away. This was replaced with a better understanding of how to practically use pressure while drilling and other information to optimize progress.

Also, surveying practices, especially repeat MWD surveys and check shots, were understood with relevance to achieving the specific well objectives in question. Importantly, these meetings permitted a full buy-in to the revised practices advocated complete with a shared acceptance of any additional risks inherent within them.

Cemented completions have also emerged as an important DTL initiative that has demonstrated savings of between 5 and 7 days over a standard completion method.

The cemented completion involves running the completion tubing directly into open hole and cementing back into the window. The cement is displaced directly with sea water and no wellbore clean up is performed prior to perforating. Three cemented completions have now been successfully performed on the North Cormorant platforms with important lessons learned during every job.

Onshore tubing preparation such as drifting, tallying and spiroliser installation provides an example of how activities can be moved even further away from the critical path.

Even activities like these which are normally performed on the pipe deck are transferred to the beach, reducing exposure to risk and allowing drill crews to focus more on forward planning rather than repetitive time consuming wellsite tasks. Onshore tubulars preparation is usually specified for use on DTL wells.

Traditional practices such as casing scraper runs prior to setting pack stocks are now reviewed on a job-by-job basis.

Clean wells with no completion debris downhole and low doglegs may be candidates for omitting this practice if care is observed. Frequently a junk basket/gauge cutter run on electric line may be performed in lieu of a full scraper run in a fraction of the time.

An incentive bonus scheme based on time savings against the plan allows offshore crews to benefit directly from the improvements made.

With this scheme each crew member is eligible for a £500 or £250 bonus if a particular well phase is completed within designated target times. Target times are defined as percentage of statistically derived planned times.

Although these targets are considered ambitious by historical standards, a bonus has been paid on 14 out of the 20 incentivised phases to date.

Repeatability of operation types must be considered particularly relevant at the DTL1 conceptual design phase. This should not be underestimated when striving to improve the efficiency of any well operation.

North Cormorant sidetracks typically comprise 8 ½-in. hole sections exiting out of 9 ⅝-in. packstock windows. Frequently, options such as 12 ¼-in./8 ½-in. hole sidetracks may be investigated. However unless the economics reflect a significantly attractive upside the repeatability of the 8 ½-in. packstock type sidetrack complete with an almost guaranteed execution efficiency is usually preferred.

After a few wells following the same sequence of events, all drill crews, service personnel and shorebase staff gain a close familiarity with these operations. By rigorously reviewing operations and trawling lessons learned each time, it is possible to see how the theoretical limit may be approached.

Such is the execution confidence in this particular type of 8½-in. sidetrack that it has already been performed in preference to a conventional tubing replacement workover on at least one occasion.

Numerous other smaller improvements have been implemented in the course of DTL wells.

Efficient dynamic limit test procedures have been developed to quickly confirm shoe strengths in known areas. Also, with guidance from internal deviation experts, survey error models have been relaxed where appropriate to eliminate gyro surveys. Each measure like this goes some way to shaving valuable hours or even minutes from the well operation.

RESULTS AND CONCLUSIONS

Results are effectively demonstrated by Figure 1 which shows planned against actual durations for North Cormorant sidetracks. In all cases the planned time is based upon a true historical norm of how long each operation will take.

It can be seen that a significant change has taken place in the process since the introduction of DTL, enabling sidetracks to be consistently delivered in 50% of the planned time.

Experience with the concept described here has led to the following conclusions:

- The Delivering The Limit concept is centered around achieving a theoretical technical limit time for every well operation. As predicted the technical limit has not yet been achieved although North Cormorant sidetracks are now consistently being delivered in 50% of the true planned time.
- Numerous technical improvements from major through to incidental may be expected by rigorous application of this method.
- Full involvement from the greater operations team including petroleum engineering and offshore personnel is important and will generate significant dividends.
- Crew incentivisation will further encourage offshore participation and allow the process improvements to be shared.
- Extra resources by way of dedicated onshore and offshore personnel are required to properly implement the process. ■