



Coiled Tubing Drilling – POLARIS™ Case Study

The POLARIS™ BHA was used in a five-well program in the Niobrara formation along the Colorado-Kansas border. The drilling program was completed in two phases in combination with a hybrid drilling rig. It demonstrated that the tool is suitable for drilling directional, S-curve, and horizontal wells in shallow reservoirs. The program was completed successfully with the plans for all 5 wells followed accurately, resulting in 5 producing wells. Mud was used for the build section of each of the wells, and air was used for the horizontal sections. No pads or access roads were prepared in accordance with the low margin nature of the wells in the particular field.

Description of the Wells

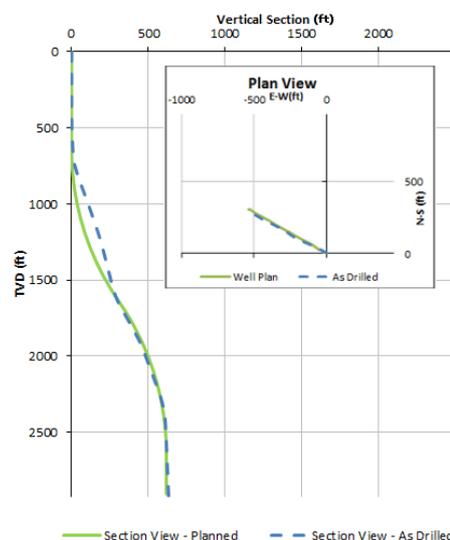
Well 1 (S-Curve) – This well trajectory was planned so that the rig could be sited beside a cornfield that was being harvested. This was important in order to prevent the inconvenience that would have been caused to the landowner by drilling a vertical well in the middle of his crop.

Wells 2 & 3 (Deviated) – The target reservoir for these wells was situated where the terrain, in this case dry river beds, made it difficult to site a rig for a vertical well. The deviated wellbore, therefore, prevented a compromise being made in terms of the reservoir exploitation.

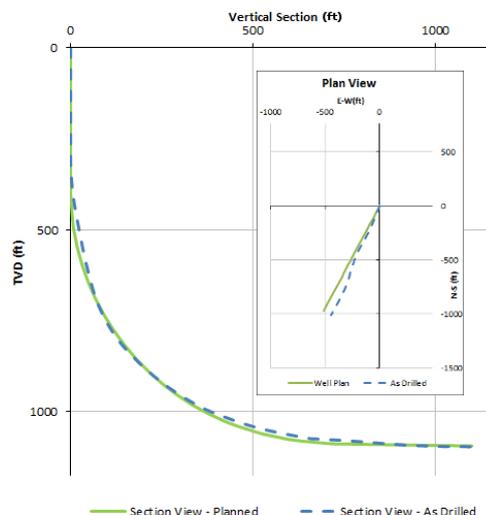
Wells 4 & 5 (Horizontal) – Both of these wells were planned with an intermediate section that was drilled with mud using 8-1/2" bit. The horizontal section was air drilled with a 6-1/4" bit. Air was used for these wells because of the inability of the formation to hold the pressure of a liquid column.

The POLARIS™ tool produces real-time readings of downhole vibration. When air drilling, or more accurately, with the bit off bottom, shock spikes of up to 250G were recorded by the accelerometers. The tool demonstrated it was able to withstand these types of forces and this data will be analysed with a view to modifying operational procedures and future tool qualification tests.

Well 1 - Drilling Profile



Well 5 - Drilling Profile



POLARIS™ Case Study – Well Details

| | Well 1 | Well 2 | Well 3 | Well 4 | Well 5 |
|------------------------------|--------|--------|--------|---|--------|
| Depth of Casing Shoe (ft) | 500 | 325 | 350 | 365 | 336 |
| Measured Depth (ft) | 3,030 | 1,800 | 1,467 | 2,270 | 1,884 |
| True Vertical Depth (ft) | 2,918 | 1,520 | 1,101 | 1,090 | 1,096 |
| Maximum Build Rate (°/100ft) | 13.5 | 19.6 | 15.3 | 15.8 | 15.9 |
| Hole Size (in) | 6.25 | 6.25 | 6.5 | 8.5 (intermediate) 6.25 (horizontal) | |
| Horizontal Offset (ft) | 633 | 785 | 727 | 1,452 | 1,103 |

Proven Capabilities

- **Accurate directional drilling** – Precise paths were drilled, hitting the pay zone and following specific well plans. Hole sizes ranged from 6.25” to 8.5”.
- **Optimised well paths** – The ability to kick off as soon as the bit exits the casing, but with the gyro MWD tool still within it, means that the build rates can be kept up to a minimum necessary to achieve the target, making it easier to run casing.
- **Pad drilling with CTD** – The program demonstrated the potential for multiple wells to be drilled from the same pad, safely and accurately, with the use of the gyro.
- **Underbalanced drilling** – Air drilling is known to be extremely punishing for downhole tools. At the same time, it is a necessity for wells where the reservoir pressure is very low and overbalanced drilling might damage the formation. POLARIS™ showed that it could effectively survive and function in its environment.
- **Economical drilling** – The drilling program is typical of the low-margin operations for which the POLARIS™ tool has been designed. With rapid mobilization and drilling, it is now possible to drill wells that were not previously considered to be financially viable.

AnTech’s Directional Drilling Services

For AnTech, the success of the POLARIS™ tool is a very important step forward in the development of its business. As a long-established provider of CTD and downhole technologies, the campaign signals the launch of the AnTech’s new directional drilling service division. With the confirmation of POLARIS™’ ability to drill accurately and withstand the punishing vibration of the drilling process, AnTech now offers two sizes of field-proven CTD BHA tools. The company’s COLT™ BHA tool (3.192” OD) also has an impressive track record, as illustrated by a successful drilling program carried out by AnTech. The combination of the two systems dramatically expands AnTech’s capabilities, making it a key player in the directional CTD market. The company aims to transform CTD by delivering solutions that not only improve existing operations, but also open up opportunities in new areas, new applications and new markets.