

Efficient openhole logging of the horizontal wells

A paper by Tatweer Petroleum and Schlumberger shows how a new wireline tractor reduces time, cost and risk conveying downhole tools in openhole laterals.



Figure 1. UltraTRAC all-terrain tractor delivers more than twice the efficiency of conventional drill pipe conveyance methods in openhole laterals; the tandem configuration of the tractor allows negotiating abrupt changes in borehole geometry (Image courtesy of Schlumberger)

THE MARKED INCREASE in horizontal and deviated drilling, even in conventional formations, has enabled operators worldwide to maximise production by accessing a greater portion of the reservoir. Yet, safe and efficient data acquisition for reservoir characterisation and completion design in the openhole lateral section remains challenging, usually relying on methods that are costly, time-consuming and risky.

Loss of gravity assistance, especially when hole deviation exceeds 60°, requires that essential openhole logging tools be pushed downhole by mechanical force, typically using drill pipe. This conventional drill pipe conveyance method, or tough logging, is a labour intensive, time-consuming process that involves two crews working in synchronised fashion. The drilling crew pushes the tools with the heavy, rigid pipe, one stand at a time, while the wireline crew deploys the cable or wireline on a spool at a specific speed to facilitate communication between the surface and the downhole components.

The operation can take several days and often requires coordination of two or more companies, which is inefficient in terms of cost, time and risk exposure. The recovery cost of failure is very high, requiring multiple trips to pull out of the hole, change out the equipment and reenter to remove an obstruction or remediate other

problems. Casedhole conveyance tractors are not suited to open-hole environments, which have geometric anomalies, changing diameters, restrictions, rock debris and are not smooth.

A new wireline tractor to convey large payloads in challenging horizontal open holes and across high-angle extended-reach wells significantly reduces time and risk in conveying downhole tools, streamlining wireline operations for faster data acquisition and providing the capability to integrate conveyance, data-gathering and interpretation services from one provider. Tatweer Petroleum deployed the technology in the long-producing Bahrain Oilfield in the Middle East, saving considerable operational cost and time.

The Bahrain Field, the first discovery in the Gulf region, has been producing since 1933. The play is characterised by stacked tight carbonate and sandstone layers with 16 oil and gas reservoirs. Wells are shallow, and economics dictate that a maximum number of wells be drilled quickly. To improve production rates, an increasing number of wells in the field are being developed with horizontal drilling techniques. Thirty per cent of the wells drilled by Tatweer between 2010 and 2013 are horizontal; the company anticipates that percentage will increase to more than 60 per cent in 2014.

The need for efficient openhole logging of the lateral section was the impetus behind Tatweer's decision to use the new wireline conveyance method to deploy downhole tools in two key reservoirs of the Bahrain Field, where horizontal drilling has proved beneficial in targeting the pay zones to improve recovery.

“Tatweer Petroleum deployed the technology in the long-producing Bahrain Oilfield”

Tractor conveyed logging

The technology, the UltraTRAC* all-terrain wireline tractor, has more than twice the efficiency of conventional drill pipe conveyance methods in openhole laterals and cased holes (Figure 1). Placed on

top and near the front of the logging tool string, the continuous-drive system has wheels that apply axial force to push tools in highly deviated wells three to five times faster than pipe, facilitating horizontal conveyance on tractor. Deployment requires only a wireline crew for both the tractor conveyance and logging operations, reducing personnel and operational time. Conveyance in the cased-hole near vertical section is up to 10 times faster on gravity descent than with drill pipe. When pulling tools out of the hole, the tractor is closed and the wire is pulled back to surface with the winch.

The tractor has three fit-for-purpose design features that provide robust manoeuvrability. Traction control enables real-time adjustment of the radial force being applied by the tractor arms. Radial force can be adjusted to increase traction if slippage occurs, and reduced to minimize wear on wheels and drive components and conserve energy. Dynamic suspension enables constant radial force applied by the extended-reach arms that can increase the opening up to 15 in. (38 cm).

Bidirectional capability reduces operational risk by allowing the tractor to be retrieved if tools become stuck or in cases of high friction or borehole collapse. By putting the tractor in reverse at full power, the operator can free up tools, eliminating the need for high-cost fishing operations.

The modular design of the tractor enables it to be configured for load and well geometry. Drive sections, each with a motor and two wheels, can be stacked to provide greater push force. Multiple wheel diameters and designs can be used for different rock types and strength and well conditions. A tandem sub increases functionality by enabling independent surface control of the drives to help steer the tractor through washed out intervals.

Reducing time and risk

Characterised by hard formations with moderate unconfined compressive strength (UCS), the Bahrain Field reservoirs were deemed good candidates for applying the wireline tractor conveyance technology. Mauddud, the primary oil reservoir, is highly fractured and features a porosity system that often results in early water and gas breakthrough. UCS ranges from 1,500-3,000 psi. The two faces of the reservoir have a total thickness of 110 ft. (34 m), all considered net pay. The main oil zone has been on gas injection since production began and has developed a secondary gas cap. The primary recovery mechanism has been gravity drainage.

In recent years, the development of high-angle and horizontal wells in the primary oil zone has been successful in targeting production between high-permeable zones that promote rapid gas and water breakthrough. Horizontal sections are typically 1,000 ft. (305 m) in length.

The deep Arab D limestone reservoir is approximately 230 ft. (70 m) thick with a large gas cap and thin oil rim with a long water transition zone underlying the entire hydrocarbon accumulation. The formation has been developed both vertically and horizontally using crestal gas injection. Horizontal drilling has improved recovery by mitigating water and gas coning. Horizontal sections are about 600 ft. (183 m).

Prior to the tractor deployment, Tatweer and Schlumberger conducted pre-job modelling and planning using tractor tension modelling software to determine tractor accessibility, wireline tension modelling for the wireline weak point and size and tractor forces required for the operations. Formation pressures ranged from 1,400 to 3,000 psi.

Two 6,200-ft. (1,890-m) TD wells were drilled in three sections, 12 ¼ in., 8 ½ in. and a 6 1/8-in. openhole lateral section in the oil zone were approximately 3,200 ft. (975 m.) in length. In the Mauddud reservoir, the operational time to convey the downhole tool string using the wireline tractor was about 13 hours, compared to 30 hours using the conventional drill pipe conveyance method. In the Arab D well, the wireline tractor deployed the tool string in the eight hours, compared to 26 hours using the conventional method.

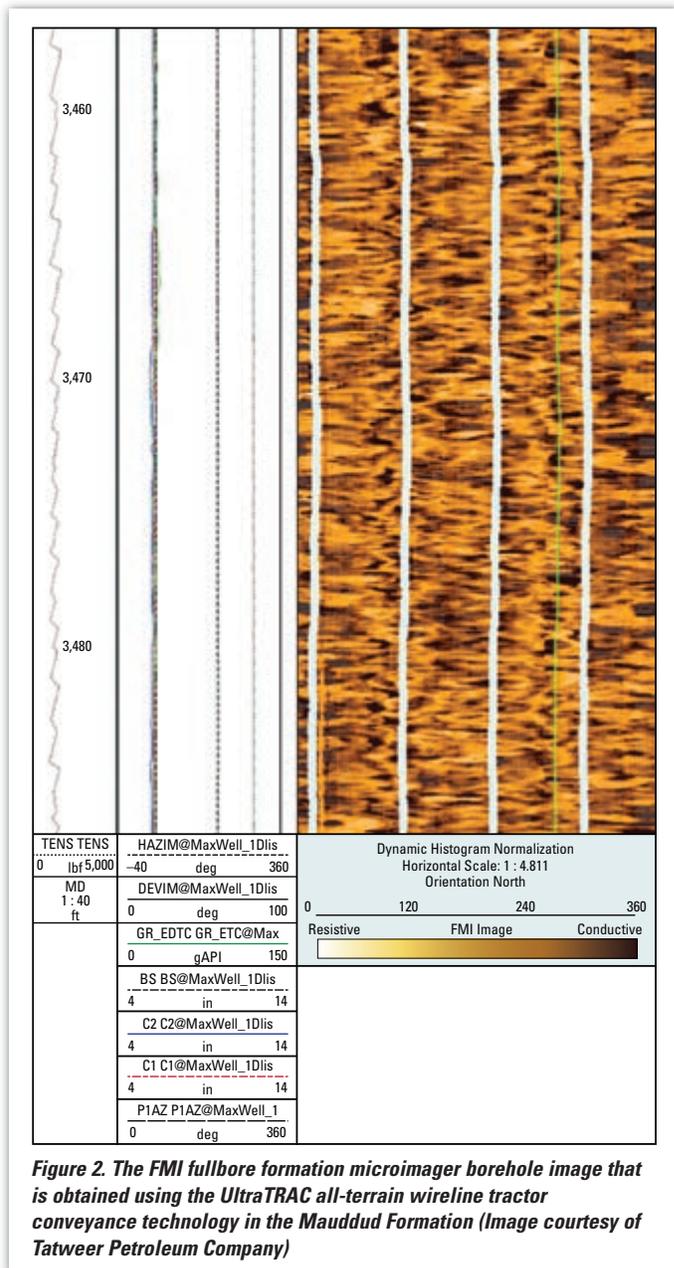


Figure 2. The FMI fullbore formation microimager borehole image that is obtained using the UltraTRAC all-terrain wireline tractor conveyance technology in the Mauddud Formation (Image courtesy of Tatweer Petroleum Company)

The wireline tractor was able to convey tool strings up to 2,400 ft. (732 m) per hour in both wells, enabling Tatweer to acquire necessary high-quality images for formation evaluation, while saving 60-70 per cent logging time (Figure 2). Rig cost savings were US\$40,000 per well. Since it was introduced in 2013, the wireline tractor has been deployed in wells worldwide.

As horizontal drilling continues to grow in all regions, wireline operations for reservoir understanding and completion design are essential in achieving economic hydrocarbon recovery. An integrated approach that streamlines efficient downhole tool conveyance, high-quality logging data-acquisition and interpretation enhances the value proposition for operators in challenging horizontal wells by significantly reducing cost, time and risk. ■

*Mark of Schlumberger

References

This article is based on the 172172-MS SPE Conference Paper *Efficient Open-Hole Logging of the Horizontal Wells Using Openhole Tractoring. Field Experiences from Tatweer Petroleum Company, Bahrain.* Authors: Bill Ofield, Michael Down, Lana Al-Hashimi, Tatweer Petroleum; Amir Hermes, Nicolas Murphy, Mohamed Hamdy, Moustafa Eissa, Enrico Annovi, Schlumberger.