INTEQ magnetic resonance LWD tool successfully measures T2 for the first time

By Jerry Greenberg, contributing editor

BAKER HUGHES INTEQ'S MagTrak LWD tool provides a comprehensive range of magnetic resonance data for the operator, including formation porosity, bound and volume, free fluid volume, permeability, hydrocarbon detection and T1 and T2 distribution spectrums. Because the tool is based on magnetic resonance technology, it does not require a radioactive source. Porosity measurement is not dependent on formation lithology.

The tool, the first to measure T2 successfully, according to the company, is capable of delivering real-time T2 distributions. Measuring T2 results in significantly more measurements, higher resolution and more accurate information for interpretation. That aids decision-making to optimize wellsite efficiency, safety and hydrocarbon recovery. The real-time applications and benefits include identifying potential borehole problems by clay typing, earlier input to improve perforation programs based on a permeability index, identifying missed pay in low-resistivity formations, geosteering into high-production zones and obtaining high-quality data in high-risk wells.

Development steps leading to this capability include a near-zero gradient field, a mechanical stabilization of the BHA and a short inter-echo spacing.

The service is available as a standard 6 ¾-in. collar-based tool that is fully combinable with rotary steerable systems such as INTEQ's AutoTrak. It can be used in borehole diameters from 8 ⅜-in. to 9 ⅞-in. and is rated for up to 150°C (307°F) and in pressures up to 25,000 psi. MagTrak received one of this year's Spotlight on Technology awards presented by the Offshore Technology Conference (OTC).

Baker Hughes INTEQ engineers prepare the MagTrak LWD tool for deployment in a well in Malaysia. The MagTrak LWD is the first to measure T2 successfully, INTEQ said, and is capable of delivering real-time T2 distributions. Measuring T2 allows for more measurements, higher resolution and more accurate information for interpretation.

DEVELOPMENT CHALLENGES

Asbjorn Kroken, product line manager, LWD magnetic resonance, for INTEQ, noted several challenges that had to be overcome during the development of the MagTrak, and drilling vibration was the first. BHA vibration prevented the direct measurement of T2 during drilling in many cases, often requiring a separate sliding pass for data acquisition. This accounted in part for the slow acceptance of magnetic resonance by the industry.

By optimizing the sensor array and measurement method, a new LWD magnetic resonance tool was designed that is tolerant of vibration and capable of acquiring T2 measurements under normal drilling conditions. The key to the new design is a static field that is nearly flat over a relatively broad zone of investigation.

BHA vibration is a major challenge in LWD, and both lateral and axial vibrations are present even in average drilling conditions. The company's new tool design has taken a three-pronged approach to reducing vibration while making T2 measurements. First, the static magnetic field was shaped to result in a near-zero gradient within the zone of investigation. Also, special electronic circuitry was developed to keep inter-echo spacing to a value of 0.6 milliseconds. Finally, special stabilizers were designed to eliminate any whirl caused by friction of the BHA against the borehole wall.

Vibration has been reduced by about 50%, Mr Kroken noted, but it varies from well to well depending on the BHA and the type of bit used. "The stabilizers are specific for a drilling environment," he explained. "It will eliminate a lot of the vibration or the lateral movement that can destroy measurements."

Mr Kroken likens the tool to a small MRI found in hospitals, but with the measurements taken outside the machine instead of the middle. "With this tool, you are not testing what is in the middle of the machine, you are testing what is around the machine, so another challenge was the tool's design."

Still another challenge was the time element involved in taking measurements downhole. MRI measurements in a hospital can take a long time, a luxury that can't be afforded downhole. Previously, if the rig is drilling ahead quickly, an operator typically wouldn't receive good-quality data from a typical LWD tool. A problem since the 1950s is that the electronics were not fast or powerful enough. "However, that is also one of the challenges that MagTrak has overcome," Mr Kroken said.

"Previous LWD tools were a copy of standard wireline tools, which didn't always work well in a drilling environment," he continued, "so the design was changed and the industry went to the Jackson Principle" to help in the development of magnetic resonance LWD.

The fundamental concept of MagTrak was originally devised for wireline logging by **Jasper Jackson** of Los Alamos National Laboratories. An array of permanent magnets and coil antenna is mounted symmetrically in a drill collar. The static magnetic field is generated by two opposing magnets that define a relatively large zone where the DC magnetic field is uniform in all directions. The radio frequency field is generated by a coil antenna wound around the collar.

MAGTRAK MARKETS

A magnetic resonance LWD tool initially was a tough sell. The MagTrak wasn't any different, mainly because magnetic resonance tools and services that came before it were complicated to set up. But the MagTrak is easier to set up and the data easier to interpret, Mr Kroken said. "We had the advantage of starting later," he explained. "We could take the faster components and better electronics.

"It is now moving out of a niche market because the measurements are more reliable and it is more reliable while drilling."

Initially, the tool is being primarily aimed at the offshore market and already has been deployed in the North Sea, Gulf of Mexico, West Africa and Latin America. It also has been utilized in onshore wells in Europe and Alaska. The tool has been run in specific applications where other measurements cannot distinguish what is water and what can be produced or not produced, according to Mr Kroken. So far, the tool has been used in about 60 wells.