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A new technique based on phased array ultrasound provides complete casing integrity verification and 3-dimensional imaging and measurement of the cavern neck immediately below the casing shoe in a single run in hole.

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Abstract

The integrity of a casing string is of paramount importance in the safe and economical operation of a well. Conventional methods of casing evaluation have relied on caliper tools with a number of fingers in physical contact with the casing wall. These tools have a high degree of radial accuracy, but suffer from a number of drawbacks. The number of fingers is limited, and consequently there is a gap in measurements between adjacent fingers. The fingers are also only capable of measuring the interior condition of the casing. An alternative approach is to use a focused beam of ultrasound to measure very accurately the internal diameter of the casing, and at the same time to detect the thickness of the metal wall remaining at that point. A circumferentially mounted array of transducer elements allows 288 individual measurements of ID and wall thickness around the casing, allowing high resolution analysis of the interior and exterior surfaces of the casing.

Multi-fingered calipers are unsuitable for measuring anything other than casing, so the neck of a well below the casing show has rarely, if ever, been evaluated. The phased array ultrasound tool is able to inspect the interior of the cavern neck without requiring any physical contact, and generate high resolution 3-dimensional images to fully understand the borehole properties immediately below the shoe. This paper intends to present the results of a recent trial where the phased array ultrasound tool was deployed into a solution mining well with a 13-3/8” (339.7mm) casing string installed. Inspection of the casing revealed many interesting features, such as areas of ovalisation, as well as evidence of exterior metal loss. With the tool switched to imaging mode, a number of passes were made to a depth of 5m below the casing shoe and the data used to generate 3 dimensional models of the borehole environment, which were then used for total volume calculations.

This new approach to well integrity analysis increases the resolution available for interior casing inspection, adds direct measurement of remaining wall thickness and allows comprehensive evaluation of the cavern neck immediately below the casing shoe.

Key words: Well Casing, Well Logging, corrosion, integrity, 3D imaging, cavern neck