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Challenges and Solutions for Advanced Through-Tubing Cement Evaluation

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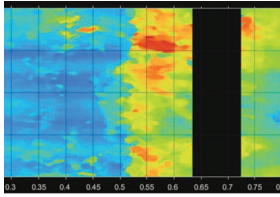
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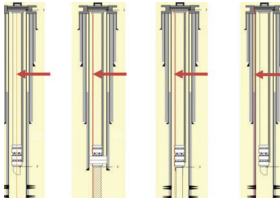
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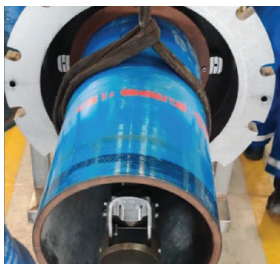
High-resolution acoustic imaging was deployed for the first time in the Middle East to assess well integrity and completion performance across multiple wells. Utilizing a solid-state array of up to 512 sensors, this tool delivers 3D visuals and measurements of corrosion, deformation, and connection damage in a single run. This paper presents real-world field results and demonstrates how this technology is applied for casedhole inspections.



Bazaid et al.

PAGES 555–564

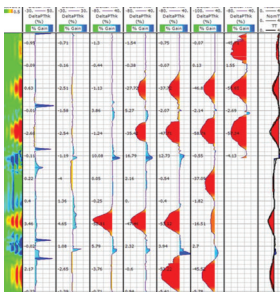
The paper demonstrates how distributed fiber-optic sensing delivers a step-change in well integrity diagnostics by enabling continuous, real-time monitoring with over an 85% reduction in diagnostic time. Through two complex field applications, the approach proved its potential to accurately localize anomalies, establishing a new benchmark in precision and efficiency for subsurface diagnostics.



Bazaid et al.

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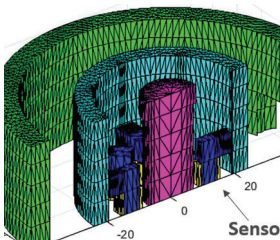
This study presents the successful validation of a novel flexural and ultrasonic tool for evaluating cement bond in fusion-bonded epoxy (FBE) coated casings, which pose significant challenges to conventional ultrasonic techniques. Controlled surface testing on both 7- and 9.625-in. coated casings demonstrated the accurate measurement of casing geometry and annular acoustic impedance, with results validated under both free pipe and cemented conditions. The tool has since been deployed in over 50 field wells, enabling improved integrity evaluation in coated casing environments.



Fouda et al.

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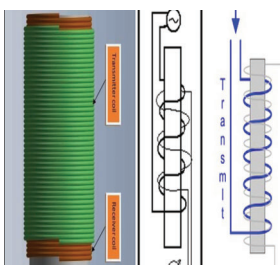
This paper presents the first successful demonstration of a multifrequency electromagnetic (EM) inspection tool capable of evaluating corrosion and wall thickness across seven concentric pipes in complex well completions. Operating in the frequency domain with multiple transmitter-receiver arrays and supported by a deep neural network, the tool accurately estimates individual pipe thicknesses—even in the presence of overlapping defects and eccentricities—with outer diameters ranging from 2.875 to 36 in. Validated by yard and field tests, this advancement enables high-resolution, non-invasive integrity assessments that reduce costs and support early corrosion detection.



Jawed et al.

PAGES 578–593

This paper presents the application of a sectorial electromagnetic scanning tool that enables azimuthal measurement of wall thickness in downhole pipes, offering superior detection of localized corrosion and deformation compared to conventional methods. Field and laboratory results confirm the tool's capability to quantify localized metal loss and geometry changes, including in chrome-alloy completions and gas-filled wells. These advancements improve early integrity diagnostics and support proactive well management.

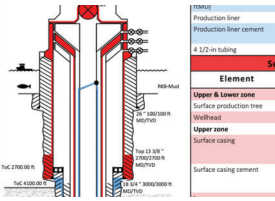


Jawed et al.

PAGES 631–646

The paper introduces an enhanced pulsed eddy current logging methodology that reliably identifies casing breaks through multiple concentric tubulars, eliminating the need for the removal of production tubing. It explains the underlying electromagnetic principles, describes the upgraded PEC-2 hardware and signal-processing workflow, and presents field results that validate the depth of investigation and diagnostic accuracy. Collectively, the findings position PEC-2 logging as a rapid, non-intrusive solution for comprehensive well integrity assurance in heavy oil and other complex completions.

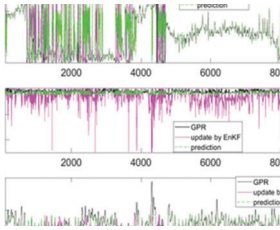
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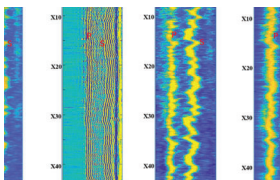
This methodology leverages generative artificial intelligence (AI) to enhance the plug and abandonment (P&A) process, delivering improved data accuracy, operational efficiency, and regulatory compliance. By optimizing workflows and mitigating environmental risks, it supports long-term well integrity and sustainability. The findings offer valuable methodologies for advancing well integrity management in the future.



Manh et al.

PAGES 662–675

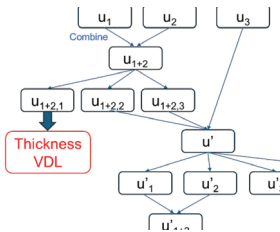
This paper introduces a novel method for inspecting through-tubing casing deformation using data-driven Koopman modeling and the ensemble Kalman filter. By treating the inspection as a dynamic system and integrating simulation-trained models, the approach accurately estimates deformation and eccentricity parameters, even under extreme conditions, without tubing removal. This enables more efficient and reliable well integrity assessments across diverse downhole environments.



Sun et al.

PAGES 689–697

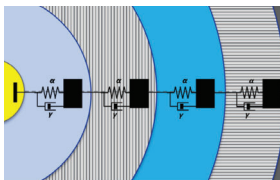
This manuscript presents a time- and cost-effective solution to address poor bonding effects and obtain reliable estimates of formation slowness, without the need for parameter tuning or human intervention. The work offers new insights into optimizing the use of borehole acoustics for well integrity evaluation and formation monitoring.



Wang et al.

PAGES 647–661

This paper presents an automated anomaly and collar detection method for wells with up to five layers of tubulars, using hierarchical multiresolution variational mode decomposition (HMVMD) in conjunction with physics-informed decision making. The method effectively separates collar and anomaly signals from complex logging data, achieving approximately 97% comprehensive detection accuracy for five-pipe scenarios. The approach saves 90% of manual analysis time while enhancing signal-to-noise ratio and interpretation efficiency for well integrity assessment.



Zeglache et al.

PAGES 677–688

This paper presents a novel application of selective non-harmonic resonance (SNHR) for through-tubing cement evaluation.