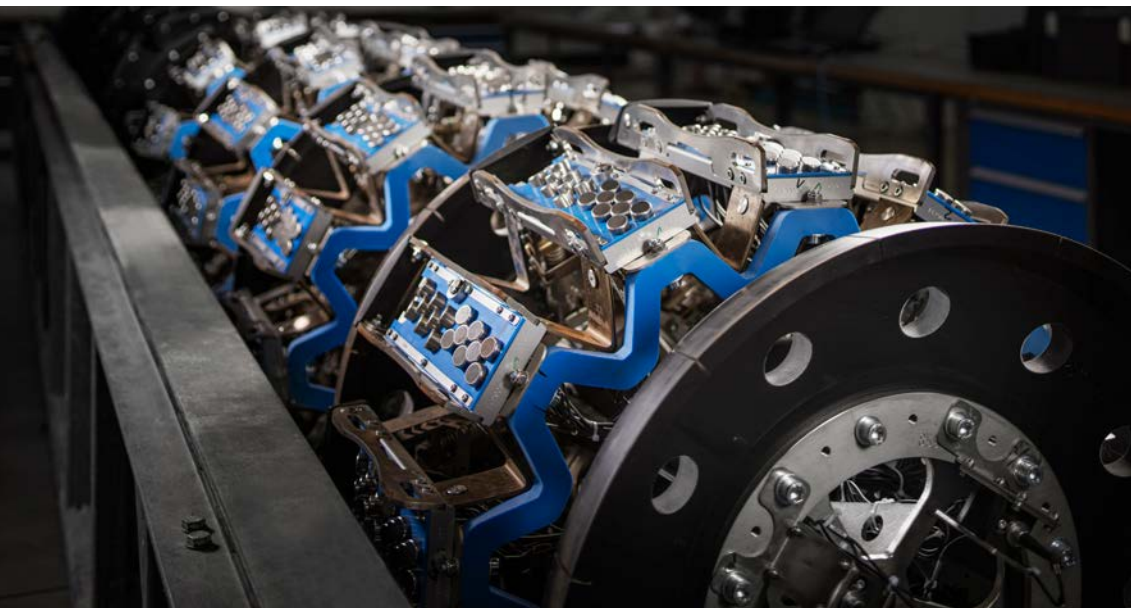
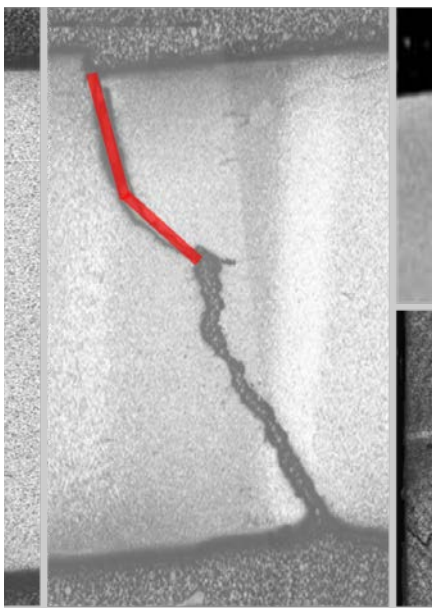
Case Study

Complex Cracking in LF-ERW Pipe

EVO Eclipse UCx Service





Challenge

Pipeline operators often employ various techniques to ensure the safety of their pipeline systems, including inline inspection (ILI) and non-destructive examination (NDE). However, detecting and characterizing complex cracks, such as hook cracks, in low-frequency electric resistance welded (LF-ERW) pipes pose significant challenges. These challenges are exacerbated by the limitations in the performance specifications of available ILI tools. This is particularly true for small diameter pipes, and the complexity of crack geometries. Hook cracks are difficult to detect and size accurately due to their non-radial orientation and the presence of impurities in vintage pipelines.

In December 2021, a high-resolution axial crack inspection was conducted on a 6" pipeline constructed before 1970. The inspection revealed numerous anomalies, including hook cracks, which standard ILI tools struggled to accurately size and characterize due to their complex geometries and the small diameter of the pipeline.

Solution

To address this challenge, NDT Global, in collaboration with Phillips 66, developed a novel approach to identifying and sizing hook cracks.

The project was structured in two steps:

Step 1: ILI Data Signal Pattern Analysis

- Analysis of ILI data patterns based on NDE results to identify and categorize complex cracking
- Implementation of pattern recognition techniques to differentiate between various types of crack geometries

Step 2: Field Verification and Methodology Validation

- Validation of the pattern recognition methodology through in-ditch NDE and field verification
- Application of advanced signal analysis to correlate ILI data with actual crack characteristics verified in the field

Axial Cracks

Circumferential Cracks

Metal Loss

Geometry Ovalities

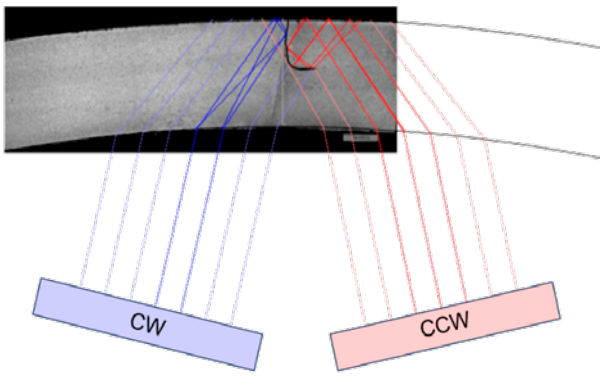
Mapping

Results

The innovative approach combined years of accumulated knowledge and advanced NDE techniques, including shear wave UT and phased array UT, to improve the accuracy of crack detection and sizing. This method also involved calibrating the approach using destructive testing during lab analysis.

- Enhanced crack detection: The new approach enabled the identification of patterns in ILI data that indicated the presence of hook cracks. This resulted in more accurate detection of complex crack geometries that traditional ILI tools would often miss or undersize
- Field validation: The validation process confirmed the reliability of the pattern recognition methodology, with a significant percentage of field-verified anomalies matching the identified patterns in the ILI data
- Informed integrity management: The systematic method developed from this research has been integrated into the Integrity Management Program (IMP), allowing for better prioritization and management of pipeline integrity threats

> **Collaboration with Phillips 66 yielded significant improvements in the detection and characterization of hook cracks**



Scheme of a hook crack detected by clockwise and counterclockwise sensors. Colour lines simulate the sound beam, and the stronger ones indicate reflections from the flaw back to the sensors.

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