U.S. Department of Transportation

FEASIBILITY OF IN-LINE STRESS MEASUREMENT BY CONTINUOUS BARKAUSEN METHOD

OPS ACCOMPLISHMENTS

Pipeline Safety Research and Development for Enhanced Operations, Controls, & Monitoring

Challenge

There is no commercially proven technology for measuring stress in a pipe wall using in-line inspection (ILI). Stress anomalies may represent a re-rounded dent or other mechanical damage defect. In addition, high-stress areas in pipe can result from pipe settlement or other displacement due to land movement. The challenge is to detect stress anomalies with a technique that is sensitive to pipe wall stress changes and easily adaptable to today's smart pigging systems.

Magnetic flux leakage (MFL) pigs have brush-coupled magnetizers which are adaptable to support addition of Barkhausen Noise sensors.

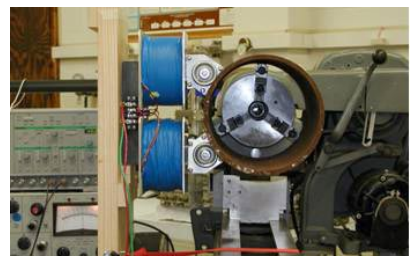
Technology Description

SwRI pioneered the Barkhausen effect for stress measurement in the 1960's. The method is still in use today. The standard Barkhausen technique requires an alternating magnetic excitation field and inductive sensor that responds to Barkhausen magnetic transitions. In contrast, the continuous Barkhausen noise concept doesn't require an alternating excitation field, relying instead on the field transition already present as a magnetic flux leakage (MFL) pig moves through the pipeline.

SwRI conducted experiments to validate the premise that Barkhausen noise was generated in the transition zone next to a magnetic exciter. Positive results give confidence that similar signals will be found next to the magnetizer poles in an MFL pig.

Accomplishments

The first two phases produced successful results. Finite element modeling was performed to guide in selecting optimum position for the Barkhausen sensor near the pig's magnetic poles. A laboratory apparatus was assembled to simulate the MFL pig magnetic structure and to detect Barkhausen noise from relative movement between magnetizer and pipe. A stress anomaly in the test pipe was repeatedly and reliably detected with the laboratory set-up.



Laboratory apparatus demonstrates the generation & detection of continuous Barkhausen signals from the surface of a rotating pipe.

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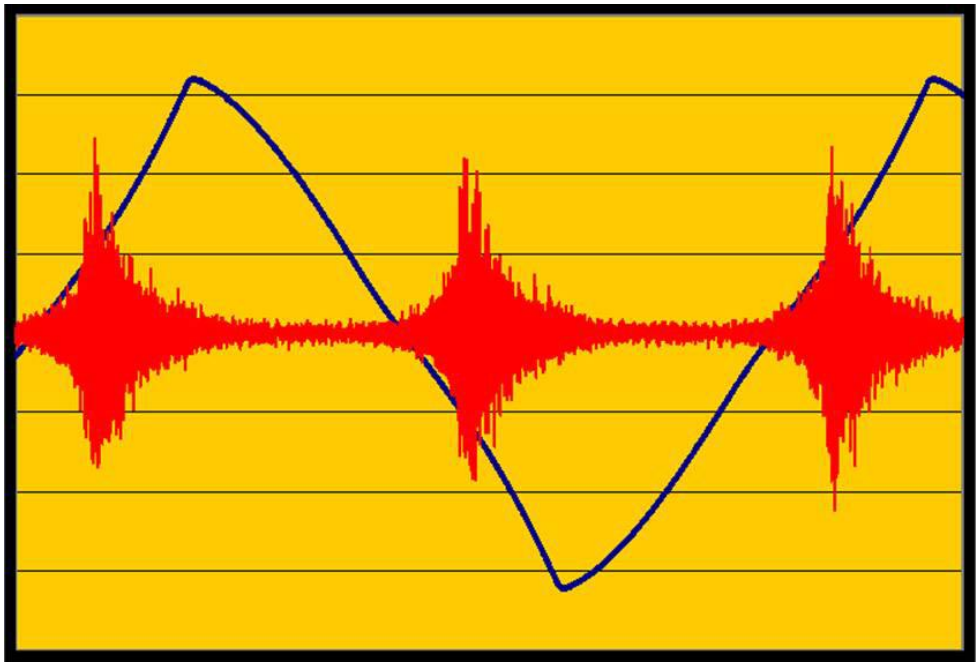

Waveforms of magnetizing current & Barkhausen noise showing that Barkhausen energy is released shortly past the zero crossing of the magnetizer current waveform in both positive-going & negative-going directions.

Benefits

Given success in this development project, SwRI's industrial partner, Rosen, is prepared to add the Barkhausen sensing technology to one or more of their MFL inspection pigs. This will be an immediate benefit to the pipeline industry as it would bring to the market a new capability, stress anomaly detection, which is not now available. The Barkhausen data, when combined with data from other sensors will enhance the quality of inspection results.

Future Activities

The technology will be carried forward for testing on a Rosen smart pig, first in a pull rig and then in pipeline operation. These are necessary steps before the commercializing company makes a commitment to full deployment in their product line.

Partners in Success

- Southwest Research Institute www.swri.org
- Rosen www.roseninspection.net

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