JENTEK® Sensors Inc.
THE ONLY SOLUTION.

110-1 Clematis Avenue, Waltham, MA 02453-7013
Phone: 781-642-9666 • Fax: 781-642-7525
email: jentek@shore.net

DTRT57-09-C-10046 – "Digital Imaging of Pipeline Mechanical Damage and Residual Stress"

JENTEK Sensors Inc.
110-1 Clematis Ave
Waltham, MA 02453-7013
Point of Contact: Dr. David Jablonski

Introduction

Mechanical damage is the most frequent cause of DOT-reportable pipeline incidents, and results in many pipeline failures every year. (PRCI Roadmap) While some failures due to mechanical damage occur at the time of the damage, (delayed failures) occurring only after passage of time remain a critical concern. Mechanical damage, such as dents, gouges and wrinkles, can reduce wall thickness and burst pressure, create residual stresses that render the material susceptible to SCC and create stress concentrations that decrease fatigue life. All of these can increase the likelihood of a delayed failure.

Background

JENTEK will develop enhanced high resolution eddy current array imaging for characterization of mechanical damage in pipelines. JENTEK has conducted preliminary investigations that indicate that lift-off (proximity) maps can be used to develop 3-D quantitative representations of mechanical damage caused surface topology. These will provide an opportunity for automated analysis of both size and shape of damage and a permanent digital record that can be compared to future measurements.

Furthermore, magnetic permeability maps, generated from the same scan that produced the lift-off map, can be used to determine residual stress patterns around mechanical damage sites. Residual stress values and distributions can be combined with existing life-prediction models to produce enhanced life management tools for pipeline owners and operators. In future efforts, low frequency eddy current methods can be added to provide thickness images as well.

Work Plan

Task 1. Problem definition.
In this task, we will clarify the types of mechanical damage of interest to pipeline materials.
Task 2. Acquire materials for mechanical damage specimens.
In this task, we will acquire the material that will be needed for the mechanical damage specimens.
Task 3. Determine electromagnetic properties of selected pipeline steel.
In this task, we will acquire sample pipeline material of interest and fabricate tensile or bend specimens.
Task 4. Acquire or fabricate mechanical damage specimens.
In this task, we will pursue access to mechanical damage specimens from our contacts.
Task 5. Perform computer simulations to assess potential performance of candidate designs.
In this task, we will perform computer simulations to assess the anticipated performance of 1-D and 2-D MWM-Arrays.
Task 6. Perform laboratory testing to determine capabilities of candidate approaches.
In this task, we will conduct laboratory testing to evaluate capability to produce detailed lift-off and permeability images.
Task 7. Investigate feasibility of enhancing spatial resolution of mechanical damage geometry images.
In this task, we will investigate methods/designs to enhance spatial images of mechanical damage.
Task 8. Evaluate correlation of permeability measurements with residual stresses.
In this task, we will subject some mechanical damage specimens for which we have baseline data plus permeability maps of the induced damage, to a stress relief to access the residual stress at the mechanical damage site.
Task 9. Final report.