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Introduction

In-Line Inspection (ILI) is the dominant inspection method for buried pipelines. However, the cost and complexity of these tools has made frequent inspection impractical. The goal of this Phase II effort was "to encourage more repetitive ILI runs and wider use while ensuring safety of the hazardous liquid pipeline infrastructure." This goal has been aligned with a commercial opportunity for the delivery of next generation ILI products and services that can enable comprehensive inspection of pipeline infrastructure, thereby improving safety without adding costs and operational uncertainty.

Background

This Phase II SBIR addressed high priority needs such as cracking (ERW weld cracks, SCC, etc.) and corrosion and encompassed a fundamental shift in ILI technology away from MFL and ultrasonic solutions. The electromagnetic approach has the potential to provide the needed sensitivity to relevant defect types while providing the advanced analytical tools implementing JENTEK's Multivariate Inverse Methods.

The objectives of this program included substantial cost reduction for initial tool procurement, improved data analysis/decision support, and improved logistics (such as reduced requirements for launching and receiving). These factors enable more frequent inspections, which in turn enable trend mapping for enhanced damage detection and detection of short time constant damage mechanisms.

Summary of the Work Accomplished

Previously, the MWM-Arrays have been limited to either surface inspections at high speeds or through-wall inspections at low speeds. In this Phase II, JENTEK evaluated three different concepts that had the potential to produce an ILI tool that can break through these limitations and provide ID, mid-wall, and OD defect inspection (cracks and corrosion) under ILI operating conditions.

Advanced Data Processing. This concept used advanced data processing techniques to allow MWM-Arrays to operate at low frequencies while traveling at higher speeds. This advanced data processing greatly reduces sensitivity to the tool speed and increases the effective data resolution.

Low Frequency Eddy Current with Partial Saturating Field. This concept combines electromagnets with JENTEK's MWM-Array technology. The magnets lower the magnetic permeability of the pipe, which allows the MWM-Arrays to measure through the pipe wall while operating at higher frequencies and scan speeds.

DC Field Measurement Technique. This concept drives MWM-Arrays using a direct current (DC) and uses the resulting DC field as the primary wall thickness measurement technique. This technique overcame the skin depth limitation of conventional alternating current (AC) drives. An AC drive is also used (superimposed on the DC drive) to provide complimentary information about the position of the sensors relative to the pipe and the pipe's electromagnetic properties, while also proving higher resolution ID corrosion mapping and very sensitive internal crack detection and sizing.