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Office of Pipeline Safety Presentation on

Inspection-Repair-Leak Detection

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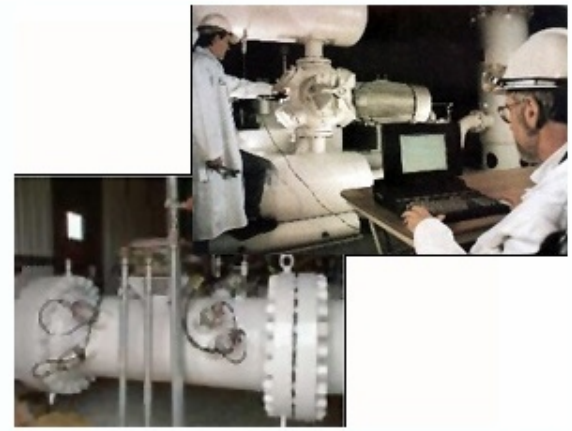
http://primis.rspa.dot.gov/rd/

Research & Development

Welcome to RSPA's Pipeline Safety Research and Development Website.



This site is dedicated to the coordination and dissemination of Research and Development information related to Pipeline Safety.

OPS conducts and supports research to support regulatory and enforcement activities and to provide the technical and analytical foundation necessary for planning, evaluating, and implementing the pipeline safety program. OPS is sponsoring research and development projects focused on providing near-term solutions that will increase the safety, cleanliness, and reliability of the Nation's pipeline system.

Recent R&D projects are focused on: leak detection; detection of mechanical damage; damage prevention; improved pipeline system controls, monitoring, and operations; and, improvements in pipeline materials. These projects are addressing technological solutions that can quickly be implemented to improve pipeline safety.

In 2003, a study by the General Accounting Office (GAO) found that OPS's R&D program is aligned with OPS's mission and pipeline safety goals.

Inspection-Repair-Leak Detection Research

Project Title	Researcher	OPS	Co-Share	(MO)	%
Piezo Structural Acoustic Pipeline Leak Detection System	Midé Technology Corp.	$100,000		24	100
Intrinsic Distributed Fiber Optic Leak Detection	Prime Research, LC	$99,706		24	100
NoPig Metal-Loss Detection System for Non-Piggable Pipelines	FINO AG	$387,818	$340,000	24	100
Assessment & Validation of TFI-Identified Anomalies Criteria for Repair and Available Repair Methods	CC Technologies	$70,000	$70,000	24	100
Enhancement of the Long-Range Ultrasonic method for the Detection of Degradation in Buried, Unpiggable Pipelines	PetroChem Inspection	$655,564	$633,325	27	100
Baseline Study of Alternative In-Line Inspection Vehicles	Southwest Research Institute	$40,000	$40,000	24	100
Feasibility of In-Line Stress Measurement by Continuous Barkhausen Method	Southwest Research Institute	$80,000	$80,000	36	100
Mechanical Damage Inspection Using MFL Technology	Battelle Corporation	$410,000	$380,000	36	100
High-power, Long-range, Guided-wave Inspection of Pipelines	Southwest Research Institute	$272,420	$352,600	18	98
Application of Remote-Field Eddy Current Testing to Inspection of Unpiggable Pipelines	Southwest Research Institute	$156,500	$87,500	36	83
Improved Inspection and Assessment Methods for Pipeline Girth Welds and Repair Welds	Edison Welding Institute	$349,900	$460,000	24	73
Advanced Welding Repair and Remediation Methods for In-service Pipelines	Edison Welding Institute	$409,673	$450,000	24	73
Hazardous Liquids Airborne Lidar Observation Study (HALOS)	ITT Industries LLC	$452,266	$455,267	12	37
Stage 2 Phased Array Wheel Probe for In-Line Inspection	R/D Tech	$160,000	$160,000	18	27
Design, Construction and testing of a segmented MFL sensor for use in the inspection of unpiggable pipelines	Northeast Gas Association	$500,000	$516,107	14	18
Design, construction and demonstration of a robotic platform for the inspection of unpiggable pipelines under live conditions	Northeast Gas Association	$499,998	$1,316,438	18	14
Validation and enhancement of long range guided wave ultrasonic testing	Northeast Gas Association	$499,629	$618,104	24	11

Inspection-Repair-Leak Detection Research

Portfolio Summary (14 Projects)

Total OPS Funding	$5,143,474
Total Industry Co-Funding	$5,959,341
Average Project Duration	25 months
Average % Complete	77 %

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OPS R&D Projects

Project Title: Piezo Structural Acoustic Pipeline Leak Detection System

Researcher: Midé Technology Corporation

Goal: This R&D program will offer a low-cost solution to early detect leaks and reduce environmental damage. Monitor data will be transmitted along the pipeline to a "central" station by sending the "status" of a monitor from monitor to monitor. Data will be retrieved from all monitors sequential or in a sequence prioritized by pipe sections that are known or considered to be high risk. This activated "upload" will occur at a predetermined time using a protocol that will be determined during the project.

Small Business Innovative Research

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OPS R&D Projects

Project Title: Intrinsic Distributed Fiber Optic Leak Detection

Researcher: Prime Research, LC

Goal: In addition to the protection of oil and gas pipelines, the proposed sensor network could be used to monitor leaks in water pipes for commercial or local civil infrastructure or used to detect leaks in chemical or manufacturing plants where potentially hazardous materials are transferred during normal processing operations.

Small Business Innovative Research
http://www.volpe.dot.gov/sbir/

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OPS R&D Projects

Project Title: NoPig Metal-Loss Detection System for Non-Piggable Pipelines

Researcher: FINO AG

Goal: The NoPig Pipeline Inspection System has been developed for above ground detection of metal loss anomalies on small diameter non-piggable pipelines. Objectives of the project are to:
- Confirm the NoPig System provides accurate pipeline metal-loss detection within present specifications.
- Improve the system to be able to discriminate between defects.
- Apply the technology to larger diameter pipelines.

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OPS R&D Projects

Project Title: Assessment & Validation of TFI-Identified Anomalies Criteria for Repair and Available Repair Methods

Researcher: CC Technologies Laboratories, Inc.

Goal: To develop a repair tool kit to assist pipeline operators in determining available repair methods while defining anomalies in seam welds. The objectives of this project are to (1) compile and evaluate the unique properties of early generation pipeline weld seams, (2) compile a catalog of defect types, and (3) develop methods for evaluating seam weld defects to determine whether pipeline integrity is compromised.

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OPS R&D Projects

Project Title: Enhancement of the Long-Range Ultrasonic method for the Detection of Degradation in Buried, Unpiggable Pipelines

Researcher: PetroChem Inspection Services

Goal: The purpose of this research is to develop better technologies for detecting degradation in buried, unpiggable, pipelines. The research will include the following tasks:

- Benchmark existing technology for metrics;
- Compare lamb waves vs. shear horizontal waves;
- Conduct finite-element modeling of ultrasonic guided wave responses from defects;
- Develop hardware and software for frequency tuning and time delay profiling;
- Develop simplified signal interpretation; and
- Improve instrumentation of sensors.

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OPS R&D Projects

Project Title: Baseline Study of Alternative In-Line Inspection Vehicles

Researcher: Southwest Research Institute

Goal: The purpose of this research is to conduct a baseline study of alternative ILI vehicles that might be able to negotiate unpiggable pipelines. The researchers will:

(1) document the status of unpiggable pipelines and mitigation options,
(2) document designs of ILI devices being used in other industries,
(3) identify options to inspect transmission and distribution lines,
(4) document current ILI systems in the U.S. and abroad, and
(5) summarize internal tool capability in other related industries (nuclear, water, plant production).

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OPS R&D Projects

Project Title: Feasibility of In-Line Stress Measurement by Continuous Barkhausen Method

Researcher: Southwest Research Institute

Goal: This project will demonstrate the use of modified MFL ILI tools to inspect mechanical damage, cracks, wrinkles and corrosion. Stress measurement will be tested using the continuous Barkhausen method. The purpose of this research is to determine optimum location and sensor design. This will be accomplished via lab/pull-rig tests as well as a full scale test in either a flow loop or an operating pipeline.

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OPS R&D Projects

Project Title: Mechanical Damage Inspection Using MFL Technology

Researcher: Battelle Memorial Institute

Goal: This research will address mechanical damage ILI through the use of smaller/simpler MFL tools. The project hypothesis is that this approach might work for inspection of currently unpiggable pipelines since the tools will be smaller. The approach for this project is as follows: a simplified multiple magnetization tool will be designed, a magnetizer and sensor will be developed, and ultimately the researches will collect and analyze pull rig and flow loop data.

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OPS R&D Projects

Project Title: High-power, Long-range, Guided-wave Inspection of Pipelines

Researcher: Southwest Research Institute

Goal: The proposed project is aimed at producing a high-aplitude guided wave that allows inspection of a significantly longer length of pipeline than is presently achievable, based on the magneto-strictive sensor (MsS) guided-wave technology.

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OPS R&D Projects

Project Title: Application of Remote-Field Eddy Current Testing to Inspection of Unpiggable Pipelines

Researcher: Southwest Research Institute

Goal: The project will conduct a technology assessment to determine the requirements for a new remote-field eddy current (RFEC) testing system. The purpose of the research is to determine if an ILI using RFEC testing is adequate to inspect currently unpiggable pipelines. The tool developed under this research is expected to be able to detect corrosion and mechanical damage. The researchers will design, fabricate and test a breadboard RFEC system using two excitation coil configurations (one smaller, one collapsible).

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OPS R&D Projects

Project Title: Improved Inspection and Assessment Methods for Pipeline Girth Welds and Repair Welds

Researcher: Edison Welding Institute

Goal: Determine limits of automated ultrasonic testing for cross-country gas transmission pipelines. There are uncertainties in defect detection and sizing using the current zonal discrimination.

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OPS R&D Projects

Project Title: Advanced Welding Repair and Remediation Methods for In-service Pipelines

Researcher: Edison Welding Institute

Goal: Develop low-hydrogen gas-metal arc-welding (GMAW) and flux-core arc-welding (FCAW) processes. Mechanize welding with multi-axis welding carriage and adaptive control/tracking for higher quality repair welds. This will allow in-service repair welding on future high strength/pressure pipelines where manual repair welding is not suitable.
The overall objectives of the research are as follows:

- Develop an automated welding system for use on in-service pipelines;
- Implement a real-time adaptive control system to ensure reliable welding conditions;
- Evaluate system performance by performing laboratory trials; and
- Validate the system and gain regulatory approval by qualification of procedures, complying with recognized industry standards, and performing field trials.

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OPS R&D Projects

Project Title: Hazardous Liquids Airborne Lidar Observation Study (HALOS)

Researcher: ITT Industries Space Systems, LLC

Goal: ITT is proposing to extend its ANGEL (Airborne Natural Gas Emission Lidar) technology to the detection of small hazardous liquid and refined product leaks. The ANGEL system is designed to remotely detect, quantify, and map small plumes of methane and ethane, the principle constituents of natural gas. In addition to the hardware and software systems, Kodak has developed expertise in the spectroscopy, modeling, and empirical/physical testing and validation of airborne dispersed hazardous vapors. These tests have yielded preliminary results that indicate the detection of vapors from hazardous liquids is possible with minimal changes to the existing ANGEL system.

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OPS R&D Projects

Project Title: Stage 2 Phased Array Wheel Probe for In-Line Inspection

Researcher: R/D Tech

Goal: To manufacture a Stage 2 phased array wheel probe for ILI detection of stress corrosion cracking (SCC). Specifically, to build a smaller wheel probe that can be utilized as-built for In-Line Inspections. This wheel probe uses ultrasonic phased arrays, which have high inspection speeds and considerable inspection flexibility. The advantage of the wheel probe technology is that it gives full coverage, while permitting inspection in gas pipelines without a liquid couplant. Specifically, this In-Line Inspection (ILI) device is targeted at detecting stress corrosion cracking (SCC), which can cause rapid failures in pipelines.

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OPS R&D Projects

Project Title: Design, Construction and testing of a segmented MFL sensor for use in the inspection of unpiggable pipelines

Researcher: Northeast Gas Association

Goal: The objective is to develop a segmented Magnetic Flux Leakage (MFL) sensor and respective module for integration in a robotic platform (TIGRE; being developed through a parallel project, which is part of this Consolidated Program) that will allow the inspection of presently unpiggable transmission pipelines. The sensor will cover only a portion of the pipe's internal surface but should be able to provide the same level of sensitivity and accuracy as a state of the art MFL sensor used in smart pigs. Through multiple passes of the pipe, or through rotation and translation of the sensor down the pipe, the entire surface of the pipe will be inspected.

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OPS R&D Projects

Project Title: Design, construction and demonstration of a robotic platform for the inspection of unpiggable pipelines under live conditions

Researcher: Northeast Gas Association

Goal: The objective is to develop a robotic platform (TIGRE) that will allow the inspection of presently unpiggable transmission pipelines. The platform, which is based on a locomotor developed for another robotic application in gas pipelines (Explorer; developed for visual inspection of distribution mains), will be able to propel itself independently of flow conditions, and will be able to negotiate all obstacles encountered in a pipeline, such as mitered bends and plug valves. The robot will be powered by batteries, which will have the capability of being recharged during operation by extracting energy from the gas flow. The operator will have live control of the robot using two-way through-the-pipe wireless communication, thus eliminating the need for any tether. The platform will be equipped with a segmented MFL sensor, also able to negotiate all pipeline obstacles, for NDE of the pipeline.

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OPS R&D Projects

Project Title: Validation and enhancement of long range guided wave ultrasonic testing

Researcher: Northeast Gas Association

Goal: The objective of the project is to further validate and develop a product that can be used as a screening tool to detect external and internal corrosion and coating defects in gas pipes (with diameters from 2" to 60"). It is particularly useful where traditional DA or inspection technologies cannot be used. Propagation distances are claimed to be on the order of 50 – 100’ in each direction from the transducer ring but distances vary based on pipe geometry, coating, content and presence of pipe appurtenances such as valves, tees, etc.

OPS R&D Program Contacts

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