U.S. Department
of Transportation
Pipeline and Hazardous Materials Safety Administration

Administrator

1200 New Jersey Ave., S.E.
Washington, DC 20590

May 21, 2020

The Honorable Roger Wicker
Chairman, Committee on Commerce,
Science, and Transportation
United States Senate
Washington, DC 20510

Dear Mr. Chairman:

Enclosed is the report prepared in response to Section 22 of the Pipeline Safety Improvement Act of 2016 (Pub. L. 114-183), which requires the Secretary of the Department of Transportation (DOT) to submit biennial reports updating Congress with a summary of each of PHMSA's awarded Research and Development projects carried out by Federal and non-Federal stakeholders and a review of how each project is designed to improve pipeline safety. The enclosed report is submitted in fulfillment of this mandate.

I have sent similar letters to the Ranking Member of the Senate Committee on Commerce, Science, and Transportation; the Chairman and the Ranking Member of the House Committee on Energy and Commerce; and the Chairman and the Ranking Member of the House Committee on Transportation and Infrastructure.

Sincerely,

Howard R. Elliott

Enclosure

U.S. Department
of Transportation
**Pipeline and Hazardous
Materials Safety
Administration**

Administrator

1200 New Jersey Ave., S.E.
Washington, DC 20590

May 21, 2020

The Honorable Maria Cantwell
Ranking Member, Committee on Commerce,
Science, and Transportation
United States Senate
Washington, DC 20510

Dear Senator Cantwell:

Enclosed is the report prepared in response to Section 22 of the Pipeline Safety Improvement Act of 2016 (Pub. L. 114-183), which requires the Secretary of the Department of Transportation (DOT) to submit biennial reports updating Congress with a summary of each of PHMSA's awarded Research and Development projects carried out by Federal and non-Federal stakeholders and a review of how each project is designed to improve pipeline safety. The enclosed report is submitted in fulfillment of this mandate.

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1200 New Jersey Ave., S.E.
Washington, DC 20590

May 21, 2020

The Honorable Peter A. DeFazio
Chairman, Committee on Transportation and Infrastructure
U.S. House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

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Howard R. Elliott

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**Pipeline and Hazardous
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Administrator

1200 New Jersey Ave., S.E.
Washington, DC 20590

May 21, 2020

The Honorable Sam Graves
Ranking Member, Committee on Transportation and Infrastructure
U.S. House of Representatives
Washington, DC 20515

Dear Congressman Graves:

Enclosed is the report prepared in response to Section 22 of the Pipeline Safety Improvement Act of 2016 (Pub. L. 114-183), which requires the Secretary of the Department of Transportation (DOT) to submit biennial reports updating Congress with a summary of each of PHMSA's awarded Research and Development projects carried out by Federal and non-Federal stakeholders and a review of how each project is designed to improve pipeline safety. The enclosed report is submitted in fulfillment of this mandate.

I have sent similar letters to the Chairman of the House Committee on Transportation and Infrastructure; the Chairman and the Ranking Member of the Senate Committee on Commerce, Science, and Transportation; and the Chairman and the Ranking Member of the House Committee on Energy and Commerce.

Sincerely,

Howard R. Elliott

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U.S. Department
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Pipeline and Hazardous Materials Safety Administration

Administrator

1200 New Jersey Ave., S.E.
Washington, DC 20590

May 21, 2020

The Honorable Frank Pallone, Jr.
Chairman, Committee on Energy and Commerce
U.S. House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

Enclosed is the report prepared in response to Section 22 of the Pipeline Safety Improvement Act of 2016 (Pub. L. 114-183), which requires the Secretary of the Department of Transportation (DOT) to submit biennial reports updating Congress with a summary of each of PHMSA's awarded Research and Development projects carried out by Federal and non-Federal stakeholders and a review of how each project is designed to improve pipeline safety. The enclosed report is submitted in fulfillment of this mandate.

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Sincerely,

Howard R. Elliott

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U.S. Department
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**Pipeline and Hazardous
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Administrator

1200 New Jersey Ave., S.E.
Washington, DC 20590

May 21, 2020

The Honorable Greg Walden
Ranking Member, Committee on Energy and Commerce
U.S. House of Representatives
Washington, DC 20515

Dear Congressman Walden:

Enclosed is the report prepared in response to Section 22 of the Pipeline Safety Improvement Act of 2016 (Pub. L. 114-183), which requires the Secretary of the Department of Transportation (DOT) to submit biennial reports updating Congress with a summary of each of PHMSA's awarded Research and Development projects carried out by Federal and non-Federal stakeholders and a review of how each project is designed to improve pipeline safety. The enclosed report is submitted in fulfillment of this mandate.

I have sent similar letters to the Chairman of the House Committee on Energy and Commerce; the Chairman and the Ranking Member of the Senate Committee on Commerce, Science, and Transportation; and the Chairman and the Ranking Member of the House Committee on Transportation and Infrastructure.

Sincerely,

Howard R. Elliott

Enclosure

Pipeline Safety Research and Development

Biennial Update Report

Fiscal Years
2017 & 2018

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Department of Transportation
Pipeline and Hazardous Materials Safety Administration
May 2020

Outline

Contents

Department of Transportation
Pipeline and Hazardous Materials Safety Administration
Pipeline Safety Research & Development
Biennial Update Report
Fiscal Years 2017 & 2018

Executive Summary

Safe and efficient transportation of energy and hazardous materials is critical to our economy and standard of living. Accordingly, research and development projects which enhance safety, reliability, and performance of our transportation system are essential. PHMSA funds research and development (R&D) that improves safety, ensures reliability of supply, boosts business and government productivity, and enhances the security of our infrastructure, our people, and our environment.

The Protecting our Infrastructure of Pipelines and Enhancing Safety Act of 2016, P.L. 114-183 (Section 22) amended 49 U.S.C. § 60124[1] by requiring the Secretary of the Department of Transportation to submit biennial reports updating Congress with a summary of each of PHMSA's research and development projects carried out by Federal and non-Federal stakeholders and a review of how each project is designed to improve pipeline safety.

Research Projects for Fiscal Years 2017 & 2018

PHMSA's R&D program identifies research priorities by sponsoring biennial R&D forums open to pipeline safety stakeholders. These forums with academia, departmental, and federal partners help identify pertinent technology and knowledge gaps. PHMSA organized an R&D forum in Cleveland, Ohio, on November 16-17, 2016, with 330 stakeholders in attendance. The forum held working group sessions in the following five subject-focused areas:

1. Threat/Damage Prevention
2. Leak Detection/Mitigation
3. Anomaly Detection/Characterization
4. Natural Gas Underground Storage
5. Liquefied Natural Gas (LNG)

These five working groups identified technical gaps and challenges for future research while considering existing research efforts, such that identified research topics would address the gaps effectively. Each group identified both short- and long-term research objectives for hazardous liquid/natural gas transmission and distribution pipelines, as well as for underground gas storage and LNG. The 2016 R&D forum set PHMSA's funding strategy for research projects for Fiscal Years 2017 and 2018 by identifying and prioritizing the research topics PHMSA should solicit.[2]

[1] 49 U.S.C. § 60124(a)(6)(c). All other reporting requirements in 49 U.S.C. § 60124 were terminated in the Federal Reports Elimination and Sunset Act of 1995, Pub. L. 104-66.
[2] No new research projects were awarded in Fiscal Year 2017. Awards for new research were initiated in FY 2018.

Table 1 includes a summary of each of PHMSA's R&D projects from the five subject-focused areas of threat prevention, anomaly detection, leak detection, LNG and underground natural gas storage. The table describes PHMSA's research projects for Fiscal Years 2017 and 2018 and provides a review of how each project is designed to improve pipeline safety by Federal and non-Federal entities.

Table 1: Fiscal Years 2017& 2018 Awarded Research Carried out by Federal or non-Federal Entities

Project Title		PHMSA Funding	Fiscal Year Start	Fiscal Year End
Project Awards via Core Program				
Topic Area: Threat/Damage Prevention				
1.	Modernize the Assessment of River Crossings	$386,204	2018	2021
Summary and Potential Research Impact on Safety This project will supplement guidance from American Petroleum Institute Recommended Practice 1133 (Managing Hydrotechnical Hazards for Pipelines located Onshore or with Coast Zone Areas), and to expand and improve the capabilities of existing engineering assessment tools, streamflow monitoring techniques, and risk tools used today for managing the integrity of pipelines crossing water bodies and planning the locations of new crossings. The developed guidance and risk screening tools will assist pipeline operators to predict scour, erosion, and avulsion and take actions to reduce the risks of pipeline failure at river crossings.				
2.	River Scour Monitoring System for Pipeline Threat Prevention	$400,000	2018	2021
Summary and Potential Research Impact on Safety This project will develop a "River Scour Monitoring System" for determining the degree of a scour in a river bed. The developed monitoring system will help pipeline operators to detect the depletion of the cover above the pipeline and take actions to prevent damage on the pipeline.				
3.	Tools for Predicting Gas Migration and Mitigating its Occurrence/ Consequence	$787,298	2018	2020
Summary and Potential Research Impact on Safety Underground pipeline leakage resulting in gas buildup and migration through soil and ultimately its release into the air or a substructure (e.g. basement) can be catastrophic. This project will develop an analytic method to predict the conditions needed for gas migration to occur and establish a recommended practice to improve response to gas migration incidents and improve the efficiency of finding and fixing natural gas leaks. The results from this project will be used in decision making on how to efficiently and safely respond to such leaks and prevent the occurrence of catastrophic gas migration incidents.				
4.	ORFEUS Obstacle Detection for Horizontal Directional Drilling	$993,970	2018	2021
Summary and Potential Research Impact on Safety ORFEUS (Optimized Radar to Find Every Utility in the Street) is an initiative aimed at developing a safe, cost effective "look ahead" obstacle detection system for Horizontal Directional Drilling (HDD) equipment. This project seeks to reduce third-party damage to underground utilities by completing the development of the ORFEUS tool as a viable technology for identifying obstacles in and around the path of a HDD drill rig.				

Project Title		PHMSA Funding	Fiscal Year Start	Fiscal Year End
5.	Improved Tools to Locate Buried Pipelines in a Congested Underground	$502,000	2018	2021
Summary and Potential Research Impact on Safety This project will improve the existing Geospatial's Smart Probe® technology to accurately map the location of live natural gas mains. The developed probe will be capable of mapping live underground pipes 3-dimensionally, and collecting and storing data using a cloud-based data collection system. Operators can use this tool to mitigate third-party pipeline damage and crossbores at the earliest stages.				
Topic Area: Leak Detection/Mitigation				
6.	Cost Benefit Analysis of Deploying or Retrofitting External Based Leak Detection Sensors	$349,396	2018	2020
Summary and Potential Research Impact on Safety This project will deliver new knowledge in the form of a document outlining a methodology for performing cost-benefit analysis on external leak detection systems intended for use on hazardous liquid and natural gas transmission pipelines. The methodology will enable decision makers to objectively weigh the safety, environmental protection, and public perception enhancements to be gained from system deployment against the associated installation, maintenance, and operating costs.				
7.	External Leak Detection Body of Knowledge	$399,821	2018	2021
Summary and Potential Research Impact on Safety This project will develop a recommended practice (RP) for external based leak detection on natural gas transmission lines. The RP will increase the safe operation of the U.S. natural gas transmission pipeline network by standardizing practices across operators and increasing the likelihood a leak is found before becoming a safety hazard.				
Topic Area: Anomaly Detection/Characterization				
8.	On-Board Power and Thrust Generation for the Explorer Family of Robots for the Inspection of Unpiggable Natural Gas Pipelines	$741,295	2018	2020
Summary and Potential Research Impact on Safety This project will develop an on-board electric power generation and thrust generation system to extend battery life and increase the inspection distance of robotic inspection tools. It will deliver a commercial prototype of the energy harvesting and thrust generating module for integration onto the robotic inspection tool for in-line/live inspection of unpiggable natural gas pipeline to enhance inspection results and mitigate risks.				
9.	Validating Non-Destructive Tools for Surface to Bulk Correlations of Yield Strength, Toughness, and Chemistry	$489,515	2018	2021
Summary and Potential Research Impact on Safety This project will facilitate the use of non-destructive surface testing technology for material property confirmation. Project results will be used to develop correlations between surface properties and bulk material properties, so that the non-destructive surface testing tools can be used to collect pipe material properties from the in-service pipelines. The results from this project will benefit pipeline operators to backfill their missing material property records for grandfathered pipeline segments improving risk assessment and mitigation.				
10.	Improvements to Pipeline Assessment Methods and Models to Reduce Variance	$1,619,065	2018	2021
Summary and Potential Research Impact on Safety This project will provide general knowledge, models, and methods pertaining to the assessment of overlapping defects in natural gas pipelines. The project deliverables will be directly applicable to fitness-for-service standards for more accurately predicting remaining service life.				

Project Title		PHMSA Funding	Fiscal Year Start	Fiscal Year End
Topic Area: Natural Gas Underground Storage				
11.	Reliability of Subsurface Safety Valves	$749,080	2018	2020
Summary and Potential Research Impact on Safety This project seeks to assess the role that subsurface safety valves (SSSVs) can have in improving storage safety. The results of the project will provide data and recommendations that can be used by regulators and operators to facilitate safer operations.				
12.	Tubing and Packers life-cycle analysis for UGS applications	$785,513	2018	2020
Summary and Potential Research Impact on Safety Tubing and packer (T&P) assemblies are one potential system that could mitigate against the accidental release of natural gas from underground storage wells (UGS). This project will develop a life-cycle analysis for T&P well-entry impacts and recommendations for improvements to T&P assemblies. The results of this study will allow UGS operators to better utilize T&P for safer well operation without creating further operational challenges.				
13.	Evaluation of Well Casing Integrity Management for Underground Storage Wells	$207,955	2018	2020
Summary and Potential Research Impact on Safety This project provides the industry a better understanding of the current state of the storage well logging tool technologies and their performance, factors affecting the tool response, and the suitability of available methods to calculate remaining casing strength. The results of this study will assist operators to evaluate storage well casing integrity with improved confidence and make decisions regarding well interventions and operating parameters to ensure safe operation of well casings.				
14.	Risk Assessment and Treatment of Wells	$394,396	2018	2020
Summary and Potential Research Impact on Safety This project will develop guidelines to perform relative, probabilistic, and Quantitative Risk Assessments (QRAs) of storage wells during well entry. The developed QRA model will allow operators and regulators to develop best practices for well completion types, entry procedures, and safety risk mitigation options.				
Topic Area: Liquefied Natural Gas				
15.	Consistency Review of Methodologies for Quantitative Risk Assessment	$858,587	2018	2020
Summary and Potential Research Impact on Safety This project will develop a methodology and guideline to establish consistency, guidance, background knowledge, and best practices to perform Quantitative Risk Assessments (QRAs) of LNG facilities. The developed QRA methodology will assist operators with conducting quantitative risk assessment on their LNG facilities to ensure safe operation and regulatory compliance.				
16.	Performance Gap Comparison of Process Safety Management Consensus Standards and Regulatory Requirements for LNG Facilities	$295,529	2018	2020
Summary and Potential Research Impact on Safety This project will evaluate consensus standards, best practices, and regulatory requirements for process safety management improvements to support PHMSA's strategy to update regulatory requirements for safety management systems of LNG facilities. The project will develop risk mitigation strategies to address key performance gaps that will improve safety management systems and reduce risk.				
17.	Review of Control System Testing Frequency	$149,966	2018	2019

Project Title		PHMSA Funding	Fiscal Year Start	Fiscal Year End
Summary and Potential Research Impact on Safety The objective of the project was to review the testing intervals prescribed for control systems in 49 CFR Part 193.2619 to consider risks associated with the impact of potential material and equipment degradation, impact of worker safety and human factors, and compare these issues to other relevant codes and standards. Project results would have included a recommendation to optimize testing frequency such that time intervals are sufficient for identified hazards. The project was cancelled since it was determined that the project objectives could no longer be achieved.				
Project Awards via CAAP				
Topic Area: Detecting, Mitigating, and/or Locating Internal Pipeline Corrosion				
18.	Smart Fluids for Detecting Internal Corrosion Locations in Oil and Gas Pipelines	$299,037	2018	2021
Summary and Potential Research Impact on Safety This project will develop a sensor concept to detect likely locations of internal corrosion in a natural gas pipeline and prevent the occurrence of internal corrosion incidents.				
19.	Development of Low-Power Wireless Sensor Network of Conductivity Probes for Detection of Corrosive Fluids Inside Pressure Vessels and Piping	$299,982	2018	2021
Summary and Potential Research Impact on Safety This project will utilize a low-power wireless sensor network to overcome challenges in power consumption and communications so that pipeline failures due to internal corrosion can be mitigated. The sensor will monitor the electrolyte accrual at critical locations where internal corrosion risk is high.				
20.	Development of an Electrochemical Approach to Detect Microbially Influenced Corrosion in Natural Gas Transmission Lines	$256,902	2018	2021
Summary and Potential Research Impact on Safety This project will identify specific electrochemical signatures of microbially influenced corrosion (MIC) that can be incorporated into innovative MIC monitoring approaches. Project results will be used to develop in situ MIC monitoring technology to prevent pipeline failure due to MIC in natural gas pipelines.				
21.	Internal Corrosion Monitoring in Pipelines by using Helical Ultrasonic Waves	$299,686	2018	2021
Summary and Potential Research Impact on Safety This project will design, implement, and validate Non-Destructive Evaluation technology for detecting, evaluating, and monitoring the progression of internal corrosion in pipelines. The developed technology would flag warnings of early deterioration for mitigation strategies.				
22.	Fluorescent Chemical Sensor Array for Detecting and Locating Pipeline Internal Corrosive Environment	$300,000	2018	2021
Summary and Potential Research Impact on Safety This project will develop passive fluorescent chemical sensor arrays, which are applicable in oil/water environments for locating and detecting corrosive water inside metallic pipelines. The developed sensor will monitor pipeline internal corrosive environment and predict corrosion rate for mitigating internal corrosion risk.				
23.	New Bio-Inspired 3D Printing Functionalized Lattice Composites for Actively Preventing and Mitigating Internal Corrosion	$300,000	2018	2021

	Project Title	PHMSA Funding	Fiscal Year Start	Fiscal Year End
Summary and Potential Research Impact on Safety This project will pioneer a novel proactive approach using new 3D printing bio-mimic functionally graded lattice composites to actively locate, capture, and mitigate the corrosive water and other contaminants in pipeline to effectively prevent early-age internal corrosion. The developed new composites will improve the safety of pipeline operation by preventing and mitigating early-age initiation of internal corrosion.				
24.	A Novel Structured Light Based Sensing and Probabilistic Diagnostic Technique for Pipe Internal Corrosion Detection and Localization	$300,000	2018	2020
Summary and Potential Research Impact on Safety This project will design and integrate an In-Line Inspection (ILI) tool based on novel structured light phase measuring profilometry to detect and characterize corroded surfaces in pipeline internal walls. The developed system will generate high-resolution reconstructed images to improve ILI detection accuracy and take mitigative actions to prevent pipeline failure by internal corrosion.				
25.	Magnet-Assisted Fiber Optic Sensing for Internal and External Corrosion-Induced Mass Losses of Metal Pipelines under Operation Conditions	$299,988	2018	2021
Summary and Potential Research Impact on Safety This project will develop a fiber optic sensing system to monitor internal and external corrosion growth in pipelines. This will allow for real-time actions taken by pipeline operators to mitigate such threats and safety potential incidents.				
26.	A Fast and Low-cost Method to Automate Detecting, Locating, and Mapping Internal Gas Pipeline Corrosion using Pig-mounted Thermal and Stereo Cameras	$299,980	2018	2021
Summary and Potential Research Impact on Safety This project will test and evaluate a new automatic multi-spectrum imaging fusion method in detecting and locating internal gas pipeline corrosion. The developed inline inspection device will monitor corrosion growth by comparing chronological corrosion inspection records and provide better prediction of corrosion rate and remaining service life for decision making.				
Topic Area: Engineering Improvements to Pipeline Computational Models to Reduce Variance				
27.	Low-Variance Deep Graph Learning for Predictive Pipeline Assessment with Interacting Threats	$300,000	2018	2020
Summary and Potential Research Impact on Safety This project will provide a fundamental understanding of interacting threats and develop models for predictive interacting threat assessment and variance reduction. This research can provide improved integrity management of the pipeline infrastructure, facilitating safe, reliable, secure, and environmentally responsible pipeline operations.				
28.	Brain-Inspired Learning Framework to Bridging Information, Uncertainty and Human-Machine Decision-Making for Decoding Variance in Pipeline Computational Models	$300,000	2018	2021
Summary and Potential Research Impact on Safety This project will develop and implement a new learning framework to bridge information, uncertainty, and human-machine decision making for pipeline systems. The developed framework will dramatically improve the prediction of potential damage/threat, support integrity management decisions, and enhance public information awareness to our pipeline health and safety.				
29.	Predicting Remaining Fatigue Life of a Dent with Corrosion Using Advanced Measurements and Modeling	$300,000	2018	2021

Project Title		PHMSA Funding	Fiscal Year Start	Fiscal Year End
Summary and Potential Research Impact on Safety This project will determine what affects the change/reduction in remaining fatigue life for mechanical damage, including a dent and/or gouge, combined with corrosion. Successful completion of this research will reduce variance of existing computational models for more accurate prediction of remaining life and prevent fatigue failure.				
Topic Area: Developing Advanced Knowledge Base Models from Root Cause Failure Analysis of Past Pipeline Incidents				
30.	Development of a Prediction Model for Pipeline Failure Probability Based on Learnings from Past Incidents and Pipeline Specific Data using Artificial Neural Network	$300,000	2018	2021
Summary and Potential Research Impact on Safety The project will develop a knowledge-based predictive model to assess pipeline failure. Root cause analysis of past incidents will be conducted to identify those factors having potential to contribute to failure. Machine learning will be utilized to predict the contributing factors behind pipeline failures. This will aid operators with monitoring current existing conditions to determine dynamic failure probability.				
Project Awards via SBIR Program				
Topic Area: Innovative Technologies for Nondestructive Determination of Fracture Toughness for Pipeline Steels in Transportation Infrastructure				
31.	A Multimodal Acoustic Tool for Inline Pipe Inspection	$149,926	2018	2019
Summary and Potential Research Impact on Safety The project developed a suitable nondestructive in-the-ditch measurement method for fracture toughness. The developed method may help the operators to determine the actual pressure rating of a pipeline and could prevent pipe rupture due to material embrittlement. The project was completed in March 2019.				
32.	Non-Destructive Coercimetry Fracture Toughness Assessment for Steel Pipelines	$149,832	2018	2019
Summary and Potential Research Impact on Safety This project developed the first coercimetry-based fracture toughness assessment solution. Project results demonstrated the technical and economic feasibility to apply this non-destructive testing solution, which could improve quality assurance of inline pipe material property testing and ensure pipeline safety. The project was completed in March 2019.				
33.	NDT of Fracture Toughness for Pipeline Steels	$149,908	2018	2019
Summary and Potential Research Impact on Safety This project determined through nondestructive methods the fracture toughness of pipeline steels. A major challenge facing pipeline operators is that many pipelines are vintage, making their structural integrity uncertain, and that material pedigree of the pipeline steel is unknown. Nondestructive technology to obtain fracture toughness may help the operators to dictate the critical crack size, and therefore control the flaw size that must be detected during inspections. The project was completed in March 2019.				
Topic Area: Dual Purpose Internal Integrity Assessment and Cleaning Tool for Hazardous Liquid Pipelines				
34.	Combined Cleaning and Guided Wave Inspection System for Hazardous Liquid Pipelines	$149,758	2018	2019

Project Title	PHMSA Funding	Fiscal Year Start	Fiscal Year End
Summary and Potential Research Impact on Safety This project investigated the feasibility of using Guided Wave Electro Magnetic Acoustic Transducer (EMAT) technology to provide a low-cost, small, and lightweight dual-purpose inspection and cleaning tool. The developed tool could reduce overall inspection costs, improve data collection, and ensure safety of hazardous liquid pipelines though inspection and data collection. The project was completed in March 2019.			

Program Website and Contacts

Program website: https://www.phmsa.dot.gov/research-and-development/pipeline/about-pipeline-research-development

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