



PHMSA's R&D Program and Leak Detection Research

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

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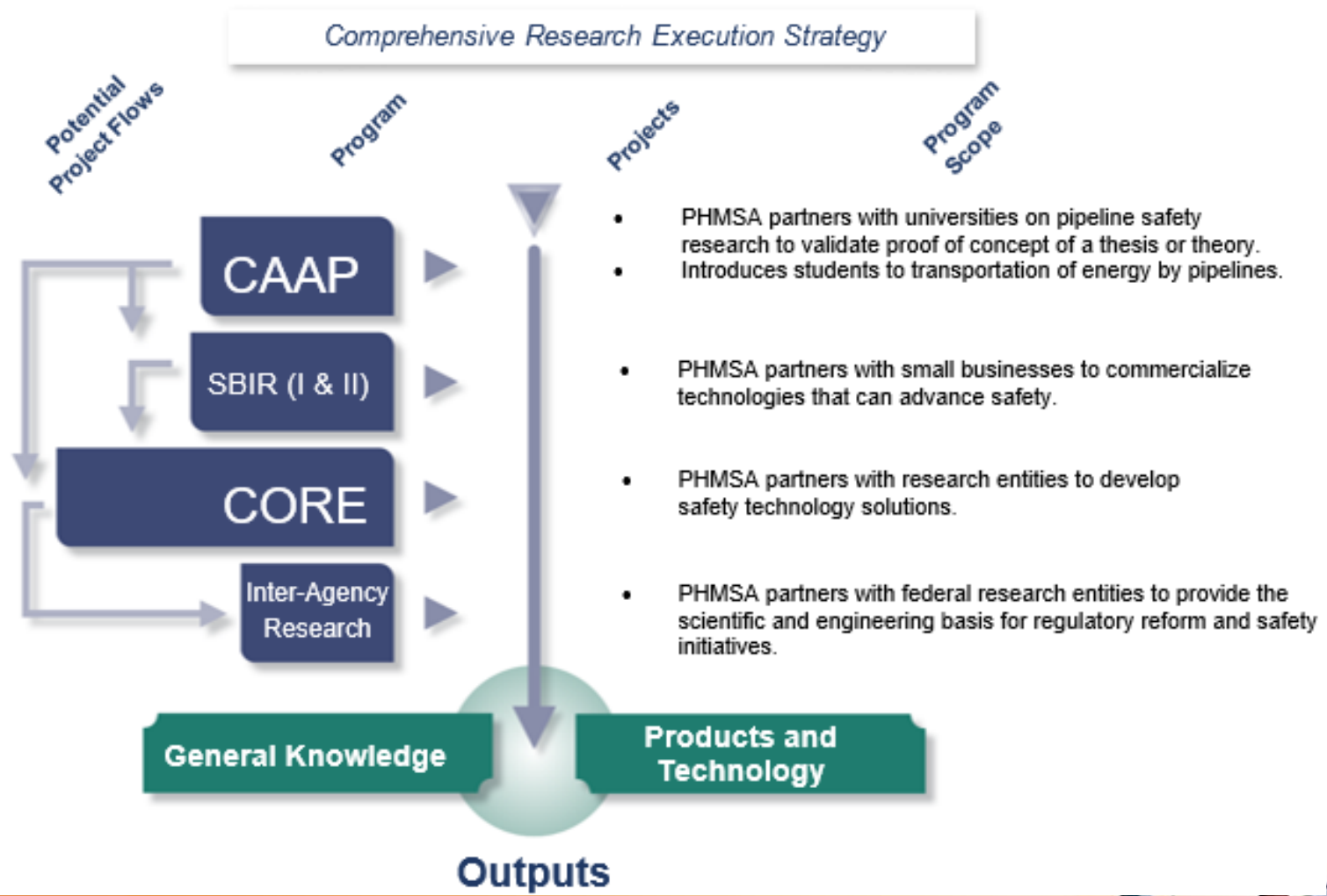


Pipeline Safety Research Program Mission

To sponsor research and development projects focused on providing near-term solutions for the Nation's pipeline transportation system that will improve safety, reduce environmental impact, and enhance reliability.



Research & Development Program



Program Performance

	Program Total	Leak Detection Total
Total R&D projects funded since 2002	361	29
Total R&D investment through PHMSA:	\$163 M	\$13.9 M
Technology projects funded:	112	15
Commercialized technologies:	33	6
Active R&D projects:	71	7
CAAP Student Involvement:	234	5

Data from:

<https://www.phmsa.dot.gov/research-and-development/pipeline/about-pipeline-research-development>
<https://primis.phmsa.dot.gov/matrix/>



Example Success Story

Technology/Knowledge Transfer



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Technology Transfer Project #1

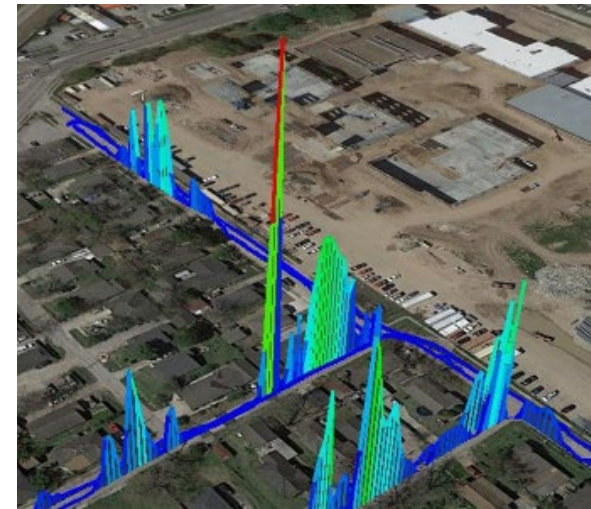
Natural Gas Pipeline Leak Rate Measurement System

Researcher: Physical Sciences, Inc.

PHMSA Costs: \$226,794

Main Objective: To develop survey technologies and methodologies to locate and quantify fluxes of non-hazardous natural gas leaks.

Net Improvement: Commercialized by Heath Consultants, Inc. in December 2018, the research improved the methane/ethane analyzer, and proprietary leak detection software presenting a real-time geospatial maps of multiple gas concentrations. MobileGuard is a laser-based sensor with sensitivity and precision more than 3,000 times greater than legacy methods. This enables identification of leaks several hundred feet away from the source.



Pictures courtesy of Heath Consultants, Inc.

<https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=650>



Technology Transfer Project #2

Rapid Aerial Small Methane Leak Survey

Researcher: Ball Aerospace & Technologies Corp.

PHMSA Costs: \$976,221

Main Objective: To develop a small methane leak rate quantification laser based sensor and algorithm supported by flight testing and test data analysis through collaboration with the University of Colorado.

Net Improvement: Commercialized by Ball Aerospace & Technologies Corp. in November 2018, the research supported technology development for rapid leak survey of natural gas transmission pipelines. Surveys are now low-cost, deployable from a single engine aircraft, with plume imagery to differentiate blow-over sources from off-system facilities. The wider-swath sensor validated by the field testing, and enables cost effective area mapping of methane emissions.



Pictures courtesy of Ball Aerospace & Technologies Corp.

<https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=651>



Knowledge Transfer Project #1

Emissions Quantification Validation Process

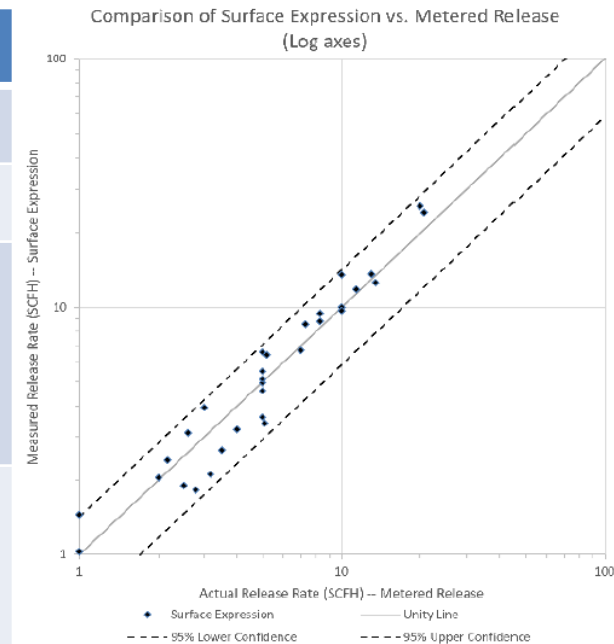
Researcher: Northeast Gas Association

PHMSA Costs: \$144,670

Main Objective: To identify, apply and test a methodology or methodologies that validate quantified methane emissions rate measurements in gas distribution systems.

Net Improvement: After project completion in March 2019, Northeast Gas Association pipeline operator member companies continue to use this successfully developed methodology. In 2020, Northeast Gas Association and the member companies are working with the American Society for Testing and Materials D.22 Committee to develop a nationally recognized standard methodology based on this research.

<https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=647>



Pictures courtesy of Northeast Gas Association.



Active Leak Detection Research



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Ongoing Leak Detection Research

- PHMSA is currently funding 7 active leak detection research projects at Universities and Research entities with \$2.5M in funding
- Projects are researching an array of topics such as:
 - Improved leak rate estimation models
 - Portable technology to measure the concentration of mercaptan in gas
 - Improving existing leak detection systems using machine learning



Leak Detection Research Projects

	Project Title	Researcher	PHMSA	Project Summary
1.	Unmanned Aerial Systems for Pipeline Inspection, Monitoring, and Landscape Analysis	West Virginia University	\$206,920	To develop a cost-effective combination of leak/Right of Way (ROW) monitoring sensors on Unmanned Aerial Systems (UAS) to evaluate pipeline conditions.
2.	An Autonomous Unmanned Aerial System Inspection Platform for High-Efficiency 3D Pipeline/Route Modeling/Change-Detection and Gas Leak Detection-Localization	University of Nebraska	\$249,964	To enhance the quality and efficiency of UAS pipeline and route inspections, and to evaluate and enhance the performance of pipeline leak detection-localization.
3.	Validation of Remote Sensing and Leak Detection Technologies Under Realistic and Differing Conditions	Operations Technology Development	\$500,000	Develop and implement a sensor validation framework focused on actual pipeline leaks verified through ground-truthing measurement and simulated integrity threats.
4.	Improving the Reliability, Detection, and Accuracy Capabilities of Existing Leak Detection Systems (CPMs) Using Machine Learning (ML)	Pipeline Research Council International	\$177,717	To develop a ML-based system capable of detecting hazardous liquid leaks shown in pipeline CPM data. Such a system will improve leak detection below the detection threshold of current CPM data assessment.

<https://primis.phmsa.dot.gov/matrix/>



Leak Detection Research Projects

	Project Title	Researcher	PHMSA	Project Summary
5.	Develop Remote Sensing and Leak Detection Platform that can Deploy Multiple Sensor Types	Pipeline Research Council International	\$307,881	To validate the performance of a complete end-to-end system, operating on a long-range, long-endurance unmanned aircraft that operates over hundreds of miles of pipeline ROW.
6.	Pre-Commercial Development and Field Testing of a Portable Mercaptan Sensing Device for Gas Industry Applications	Northeast Gas Association	\$427,052	To develop and validate portable technology that measures the concentration of mercaptans in gas industry field applications.
7.	Improve Pipeline Leak Rate Estimation	BMT Fleet Technology Limited	\$560,000	To improve existing leak rate estimation models by developing tools that can correlate through wall defect size and expected leak rates.



Future R&D



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Future Leak Detection R&D

- To support the Administration's agenda to address climate change, PHMSA is considering various relevant R&D areas
- PHMSA is currently exploring leak detection R&D projects related to:
 - Unmanned Aerial System (UAS) mounted systems
 - Satellite systems
 - Continuous leak detection systems (e.g. Distributed Fiber Optic Sensing)



Program Next Steps

- PHMSA's R&D program will continue to seek opportunities to advance leak detection technology
- PHMSA will be hosting a Climate Change and Alternative Fuel workshop in fall of 2021
- PHMSA will plan for an R&D forum – Spring 2022
- Research gaps can be submitted to PHMSA through our website
(<https://primis.phmsa.dot.gov/matrix/gapnew.rdm>)



Thank You

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