



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

1200 New Jersey Avenue, S.E.
Washington, D.C. 20590

April 22, 2026

The Honorable Ted Cruz
Chairman
Committee on Commerce, Science, and Transportation
United States Senate
Washington, D.C. 20510

Dear Chairman Cruz:

Enclosed please find the "Pipeline Safety Testing Enhancement Study (Report)," which the Pipeline and Hazardous Materials Safety Administration (PHMSA) prepared per the requirements in section 105 of Pub. L. No. 116-260 directing the Secretary of Transportation to submit a report to Congress addressing issues related to PHMSA's Pipeline Safety Research and Development (R&D) Program and the establishment of an independent pipeline safety testing facility.

The Report contains PHMSA's analysis, findings, and conclusions with respect to each of the issues identified in section 105 of Pub. L. No. 116-260. In summary, while a pipeline safety independent testing facility could be established under the U.S. Department of Transportation, it would be costly and is not critical to the work of PHMSA. PHMSA also received valuable input from stakeholders, many of whom felt industry has adequate research facilities and is in the best position to pursue more comprehensive R&D.

A similar letter has been sent to the Ranking Member of the Senate Committee on Commerce, Science, and Transportation; the Chair and Vice Chair of the Senate Committee on Appropriations; the Chairman and Ranking Member of the House Committee on Transportation and Infrastructure; the Chairman and Ranking Member of the House Committee on Energy and Commerce; and the Chairman and Ranking Member of the House Committee on Appropriations.

Sincerely,

A handwritten signature in blue ink that reads "Paul J. Roberti". The signature is fluid and cursive, with a long, sweeping underline that extends to the right.

Paul J. Roberti
Administrator

Enclosure



U.S. Department
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1200 New Jersey Avenue, S.E.
Washington, D.C. 20590

April 22, 2026

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

Dear Ranking Member Cantwell:

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The Honorable Susan Collins
Chair
Committee on Appropriations
United States Senate
Washington, D.C. 20510

Dear Chair Collins:

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The Honorable Patty Murray
Vice Chair
Committee on Appropriations
United States Senate
Washington, D.C. 20510

Dear Vice Chair Murray:

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The Honorable Sam Graves
Chairman
Committee on Transportation and Infrastructure
U.S. House of Representatives
Washington, D.C. 20515

Dear Chairman Graves:

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April 22, 2026

The Honorable Rick Larsen
Ranking Member
Committee on Transportation and Infrastructure
U.S. House of Representatives
Washington, D.C. 20515

Dear Ranking Member Larsen:

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April 22, 2026

The Honorable Brett Guthrie
Chairman
Committee on Energy and Commerce
U.S. House of Representatives
Washington, D.C. 20515

Dear Chairman Guthrie:

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April 22, 2026

The Honorable Frank Pallone, Jr.
Ranking Member
Committee on Energy and Commerce
U.S. House of Representatives
Washington, D.C. 20515

Dear Ranking Member Pallone:

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The Honorable Tom Cole
Chairman
Committee on Appropriations
U.S. House of Representatives
Washington, D.C. 20515

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The Honorable Rosa L. DeLauro
Ranking Member
Committee on Appropriations
U.S. House of Representatives
Washington, D.C. 20515

Dear Ranking Member DeLauro:

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Report to Congress

Pipeline Safety Testing Enhancement Study

April 22, 2026

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Acronyms

AGA	American Gas Association
AI	Artificial Intelligence
APGA	American Public Gas Association
API	American Petroleum Institute
CAAP	Competitive Academic Agreement Program
CFR	Code of Federal Regulations
CO ₂	Carbon Dioxide
Core	Pipeline Core Research Program
DOT	U.S. Department of Transportation
EMAT	Electromagnetic Acoustic Transducer
FFRDC	Federally Funded Research and Development Centers
FRA	Federal Railroad Administration
FY	Fiscal Year
H ₂	Hydrogen
IAA	Inter-Agency Agreement
ILI	In-Line Inspection
ISC	Industry Stakeholder Committee
ITF	Independent Testing Facility
LEPA	Liquid Energy Pipeline Association
MOU	Memorandum of Understanding
NIST	National Institute of Standards and Technology
NTSB	National Transportation Safety Board
O&M	Operations and Maintenance
OHMS	Office of Hazardous Materials Safety
OPP	Overpressure Protection
OPS	Office of Pipeline Safety
PHMSA	Pipeline and Hazardous Materials Safety Administration
PIPES Act	Protecting our Infrastructure of Pipelines and Enhancing Safety Act of 2020
PRCI	Pipeline Research Council International
PSIA	Pipeline Safety Improvement Act of 2002
R&D	Research and Development
RDT	Research, Development, and Testing
ROW	Right-of-Way
SBIR	Small Business Innovation Research

SCADA	Supervisory Control and Data Acquisition
SDO	Standards Developing Organization
TAS	Test Assembly Station
TQ	Training and Qualifications
TTC	Transportation Technology Center
UAS	Unmanned Aerial System
UNGS	Underground Natural Gas Storage
UPI	Universal Pegasus International

Executive Summary

The U.S. Department of Transportation (DOT), Pipeline and Hazardous Materials Safety Administration (PHMSA or Agency) prepared this report to satisfy the requirements in section 105 of the Protecting Our Infrastructure of Pipelines and Enhancing Safety (PIPES) Act of 2020 (Pub. L. No. 116-260). Section 105 of the PIPES Act of 2020 directed the Secretary of Transportation (Secretary) to submit a report to Congress, addressing:

- (1) Research and development (R&D) capabilities of the Agency, in accordance with section 12 of the Pipeline Safety Improvement Act (PSIA) of 2002.
- (2)(A) Development of additional testing and research capabilities through the establishment of an independent pipeline safety testing facility under DOT;
- (2)(B) Whether an independent pipeline safety testing facility would be critical to the work of the Agency;
- (2)(C) Costs and benefits of developing an independent pipeline safety testing facility under DOT; and
- (2)(D) Costs and benefits of co-locating an independent pipeline safety testing facility at an existing training center of the Agency.
- (3) Ability of the Agency to use existing testing facilities of the DOT, other Federal agencies, or federally funded R&D centers.

PHMSA considered each of these requirements in preparing this report and offers the following analysis, findings, and conclusions:

PHMSA's R&D Capabilities. Administered in accordance with the requirements in section 12 of the PSIA of 2002, the Pipeline Safety Research Program (the Program) operates through contracts and collaborative partnerships with a variety of stakeholders. The Program is efficiently managed within allocated funding at relatively low administrative costs, is sourced from a wide range of organizations across the U.S., and relies on research conducted at multiple testing sites operated by universities and research institutions. The Program has supported more than 445 research projects—with 35 commercialized technologies currently in use—and produced more than 338 publicly available reports.

Independent Pipeline Safety Testing Facility. A pipeline safety independent testing facility (ITF) could be established under DOT but is not critical to the work of PHMSA. The costs of developing an ITF would depend on several factors, including cost of materials and labor for development and construction, the amount of individual test stations or testing options/services available, and costs for additional land acquisition and environmental assessment/remediation (if not located within an existing facility). The benefits of an ITF could include increasing public transparency and trust, providing a reliable and adaptable venue for testing and validating new technologies, and offering additional workforce development opportunities. An ITF could be located at the Transportation Technology Center (TTC) in Pueblo, Colorado, a 52-square-mile

site administered by the Federal Railroad Administration (FRA) with an established record of supporting research and testing for the transportation sector. An ITF could also be located at the PHMSA Training and Qualifications (TQ) Center in Oklahoma City, Oklahoma, although a lack of space and cost concerns would make that location far less favorable than the TTC.

General Conclusions. Development of a pipeline ITF would be costly, and the success of the existing Pipeline Safety Research Program demonstrates that establishing an ITF is not necessarily critical to the work of PHMSA. PHMSA is not aware of any critical R&D projects that could not be completed over the past two decades. Neither is PHMSA aware of any critical R&D projects on the horizon that would require the use of an ITF to be completed. PHMSA also received valuable input from stakeholders, many of whom felt industry has adequate research facilities and is in the best position to pursue more comprehensive R&D.

1.0 Introduction

Section 105 of the PIPES Act of 2020 directed the Secretary to submit this report to Congress addressing certain issues related to the R&D capabilities of PHMSA and development of an ITF under DOT. PHMSA prepared this report to address the requirements in section 105 on behalf of the Secretary pursuant to the delegations of authority in 49 CFR §§ 1.96(a), 1.97(a).

2.0 National Pipeline Infrastructure

PHMSA's mission is to protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives. PHMSA regulates the safety of approximately three million miles of gas, hazardous liquid, and carbon dioxide (CO₂) pipelines and pipeline facilities in the U.S. as shown below:

Table 2.1-1 – Gas Pipeline Miles by System Type¹ (2024)		
System Type	System Detail	Miles
Gas Distribution	Main Miles	1,378,865
	Service Miles	991,888
Gas Gathering	Miles	110,248
Gas Transmission	Miles	300,711
Grand Total:		2,781,712

Table 2.1-2 – Liquid Pipeline Facilities by Commodity (2024)		
Commodity²	Tanks	Miles
Biofuel	11	22
CO ₂	0	5,345
Crude Oil	3,348	83,164
Highly Volatile Liquids	245	75,706
Refined Petroleum Products	4,924	64,244
Grand Total:	8,528	228,479

Table 2.1-3 – Other Facilities (2024)	
LNG Plants ³	183
Underground Natural Gas Storage (UNGS) Facilities ⁴	396
Hazardous Liquid Reporting Regulated ⁵	40,304 miles
Natural Gas Gathering Reporting Regulated ⁶	269,532 miles

3.0 PHMSA R&D Capabilities

PHMSA’s Office of Pipeline Safety (OPS) is responsible for pipeline safety oversight, including research. The Pipeline Safety Research Program sponsors R&D projects focused on providing near-term solutions to help ensure the safe and reliable operation of the Nation’s pipeline system, LNG facilities, and UNGS facilities.

¹ Data for Table 2.1-1, 2.1-2, and 2.1-3 from <https://www.phmsa.dot.gov/data-and-statistics/pipeline/pipeline-mileage-and-facilities>, (the data above reflects portal data as of February 20, 2026. The actual numbers subject to change based on when the link is reviewed).

² 49 CFR part 195, *Transportation of Hazardous Liquids by Pipeline*.

³ 49 CFR part 193, *Liquefied Natural Gas Facilities: Federal Safety Standards*.

⁴ 49 CFR § 192.12, *Underground natural gas storage facilities*.

⁵ 49 CFR § 195.13, *What requirements apply to pipelines transporting hazardous liquids by gravity?*

⁶ 49 CFR § 192.8, *How are onshore gathering pipelines and regulated onshore gathering pipelines determined?*

3.1 Pipeline Safety Improvement Act (PSIA) of 2002

Section 12 of the PSIA of 2002⁷ directs DOT, the Department of Energy, and the National Institute of Standards and Technology (NIST) to carry out a program of research, development, demonstration, and standardization to ensure the integrity of pipeline facilities.

Section 12(b) requires participating agencies to enter a memorandum of understanding (MOU) detailing their respective responsibilities in the program. The subsequent MOU, executed in January 2004,⁸ assigned PHMSA the lead role for pipeline facility research, development, demonstration, and standardization for natural gas and hazardous liquid pipeline safety, integrity management, and damage prevention. PHMSA established the Pipeline Safety Research Program to satisfy the requirements in the PSIA of 2002 and the resulting MOU.

Section 12(d) of the PSIA of 2002 requires the participating agencies to submit a five-year program plan to Congress. Section 12(d) further provides that “[i]n preparing the program plan and selecting and prioritizing appropriate project proposals, the Secretary of Transportation shall consult with or seek the advice of appropriate representatives of the natural gas, crude oil, and petroleum product pipeline industries, utilities, manufacturers, institutions of higher learning, Federal agencies, pipeline research institutions, national laboratories, State pipeline safety officials, labor organizations, environmental organizations, pipeline safety advocates, and professional and technical societies.” This collaborative approach to developing R&D plans and priorities has continued to be a driving force in the overall PHMSA Pipeline Safety Research Program process implemented by OPS.

3.2 Pipeline Safety Research Program Overview

The Pipeline Safety Research Program sponsors R&D projects that provide solutions for the Nation’s pipeline transportation system, LNG facilities, and UNGS facilities to improve safety, reduce environmental impacts, and enhance reliability. The research program strategy development process involves a variety of inputs. The primary method of input is through biennial R&D forums where participants can provide significant input through interactive working groups. PHMSA also evaluates gap ideas submitted through a web portal and other feedback from stakeholders, such as Federal agencies, public interest groups, research organizations, and the pipeline industry. Input related to important initiatives within DOT/PHMSA or the Administration are also considered. All these inputs are factored into a research agenda for soliciting and awarding research projects.

⁷ [https://primis.phmsa.dot.gov/rd/pdfs/docs/PSIA_2002_Public_Law_107_355\(SECTION_12\).pdf/](https://primis.phmsa.dot.gov/rd/pdfs/docs/PSIA_2002_Public_Law_107_355(SECTION_12).pdf/).

⁸ <https://primis.phmsa.dot.gov/rd/pdfs/docs/MOU.pdf>.

3.2.1 Annual Focus Areas

The Pipeline Safety Research Program’s areas of focus are adjusted annually based on the strategic process described in the preceding section and available funding levels.

3.2.2 Implementation

The Pipeline Research Program pursues its goals through four sub-programs:⁹

- Pipeline Core Research Program (Core)
- Competitive Academic Agreement Program (CAAP)
- Small Business Innovation Research (SBIR)
- Inter-Agency Agreements (IAAs)

The sub-programs address different research requirements and are designed to develop concepts from their initial stages to industry or government adoption. The PHMSA Pipeline Research Program is executed through competitive awards, cost-sharing agreements, grants, and IAAs. Research funding comes from user fees and the Oil Spill Liability Trust Fund as directed by Congress.

Table 3.2.2-1 presents the number of projects and associated funding levels of the respective sub-programs since 2002. Figure 3.2.2-1 presents the overall execution flow of the research program and sub-programs.

Sub-Program	Number of Projects	% Number of Projects	Amount Funded (Million)	% Amount Funded
CORE	295	66	\$150.8	73
CAAP*	76	17	\$26.4	13
SBIR	54	12	\$19.5	9
IAA	21	5	\$11.2	5
Total:	446	100	\$207.9	100
* CAAP launched in 2013				

3.2.2.1 Pipeline Core Research Program (Core)

PHMSA executes the Pipeline Safety Research Program primarily through the Core program, the main focus of which is on developing new technologies or products indicated to be promising from the Program’s findings and results. The Core program evaluates and resolves challenges associated with technology transfer and product commercialization.

⁹ DOT, *Annual Modal Research Plans FY 2023 Program Outlook FY 2024, Pipeline and Hazardous Materials Safety Administration* (Nov. 8, 2022, original submission) (July 12, 2023, revised submission).

The Core program has accounted for approximately 66 percent of total Pipeline Research Program projects and 73 percent of overall Pipeline Research Program funding since 2002.

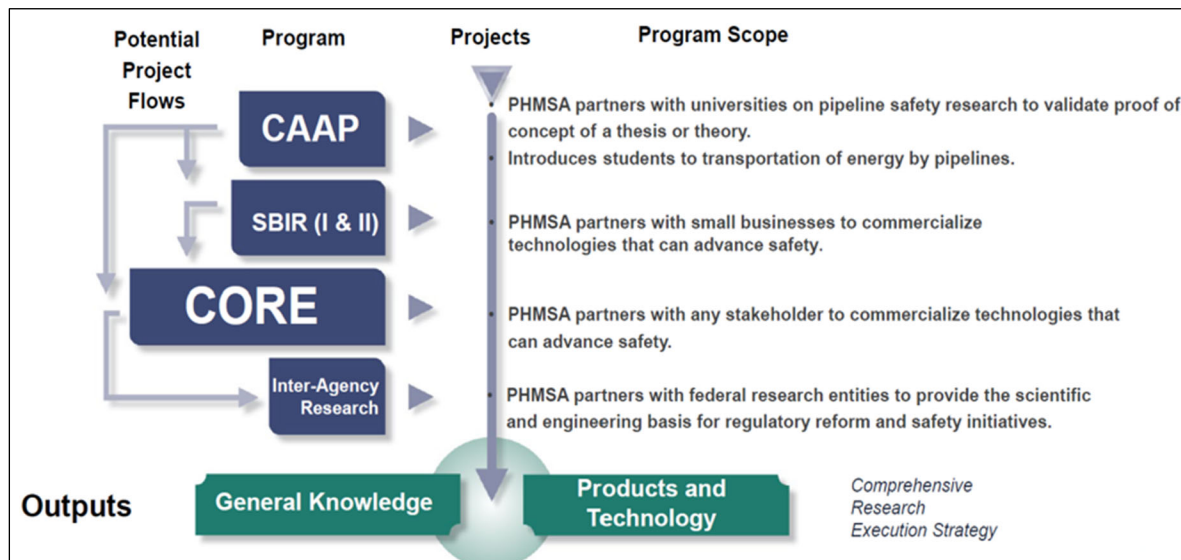


Figure 3.2.2-1 – PHMSA Pipeline Research Program Execution

3.2.2.2 Research Through Academic Institutions – Competitive Academic Agreement Program (CAAP)

PHMSA launched CAAP in 2013 to provide funding for academic research and provide tomorrow’s pipeline safety workforce with an early opportunity to contribute to safety solutions. CAAP is focused on theoretical and high-risk projects for a wide range of pipeline safety challenges. Promising CAAP theoretical research results may be handed off to the Core program for further development. CAAP also exposes college and university students to both the pipeline industry and common pipeline safety challenges to show them how highly valued and needed their engineering and technical disciplines are in the pipeline field.

The cooperative agreements are competitively selected, and the number of awards depends on the quality of submissions and budget limitations. PHMSA prioritizes projects based in part on their potential to deliver preliminary pipeline safety findings (e.g., validating a thesis or theory’s proof of concept) that can be further investigated through PHMSA’s Core research program or future CAAP projects.

3.2.2.3 Small Business Innovation Research (SBIR)

The SBIR program was established in 1982 to “strengthen the role of the small, innovative firms in federally funded research and development, and to utilize Federal research and development as a base for technological innovation to meet agency needs and to contribute to the growth and strength of the Nation’s economy.”¹⁰ PHMSA uses the SBIR program to identify innovative small businesses that provide novel concepts and prototype pipeline safety technologies that can later lead to commercialization. In addition, PHMSA’s SBIR program collaborates with small

¹⁰ Small Business Innovation Development Act of 1982, Pub. L. No. 97-219.

businesses that can leverage successes in other economic sectors, such as medical or defense, toward resolving pipeline safety challenges.

As applied to PHMSA, the SBIR program is structured in two phases:

- Phase I. The objective of Phase I is to establish the technical merit, feasibility, and commercial potential of the proposed R&D efforts; and to determine the quality of performance of the small business awardee prior to providing further Federal support in Phase II. SBIR Phase I awards are generally for six months.
- Phase II. The objective of Phase II is to continue the efforts initiated in Phase I. Funding is based on the results achieved in Phase I, and the scientific and technical merit and commercial potential of the project proposed in Phase II. Typically, only Phase I awardees are eligible for a Phase II award. SBIR Phase II awards are generally for two years.

3.2.2.4 Research with Federal Partners – Inter-Agency Agreements (IAAs)

PHMSA partners with government research organizations through IAAs to conduct technical research. PHMSA currently has IAAs with the U.S. DOT Volpe National Transportation Systems Center, Oak Ridge National Laboratory, Sandia National Laboratories, NIST, U.S. Department of Energy Office of Fossil Energy and Carbon Management, and other Federal entities. PHMSA frequently enters into IAAs to utilize the expertise of Federal labs to bring innovative solutions forward.

3.2.3 PHMSA Pipeline Research Program Performance Measurement

PHMSA measures the program success, effectiveness, and desired impact of the Pipeline Safety Research Program, in part, by monitoring three areas of program outcomes:¹¹

- Developing innovative technology (Table 3.2.3-1).¹²
- Strengthening consensus standards (Table 3.2.3-2).
- Promoting knowledge to decision makers (Table 3.2.3-3).¹³

Developing and bringing new technologies to market is a multiple step process beginning with proof of concept,¹⁴ followed by laboratory testing and development, then several broadening phases of successful field testing—initially experimental and expanding until the prototype or technology has demonstrated success on operational pipelines—to demonstrate a new technology’s readiness level to be developed for commercialization. PHMSA’s program focuses

¹¹ <https://primis.phmsa.dot.gov/rd/splan/>.

¹² <https://primis.phmsa.dot.gov/rd/tech-impact/>.

¹³ <https://primis.phmsa.dot.gov/rd/meetings/>.

¹⁴ Technology research investigating proof of concept is often completed before PHMSA and its partners invest in deployable solutions to optimize available funding.

on projects that can result in solutions within one to three years, while recognizing that some technologies require up to five years for commercialization.

Table 3.2.3-1 – PHMSA Pipeline Safety Research Program Technology Impacts		
Technology Impact Metric	Description	Result
Technology Projects	Number of projects initiated to determine the viability of new technologies.	156
Technology Demonstrations	Number of projects resulting in field testing conducted by the Program to demonstrate technology readiness level.	78
Patent Applications (U.S. + Other)	Number of applications for patents for technologies developed by technology projects.	49
Patents Granted (U.S. + Other)	Number of patents granted for technologies developed by technology projects.	29
Commercialized Technologies ^A	Number of technologies that have been commercialized because of technology projects.	35
Commercialization Success Rate ^A	Percent of technology projects that have resulted in successful commercialization of a new technology.	28%
A. The measurement of “Commercialized Technologies” only occurs on non-active or completed projects (data pulled September 2025).		

As technology continually advances, the Program ensures that standard development organizations (SDOs) have the information relevant to a specific standard for consideration of updates through the standard development processes. The Program’s research produces findings that fill knowledge gaps to inform revisions of industry standards, as well as development of new standards. Data provided in Table 3.2.3-2 illustrates PHMSA’s efforts to conduct research that contributes to enhancing industry standards of many of the SDOs that author the standards incorporated by reference in PHMSA’s regulations and provide invaluable guidance to the Nation’s pipeline operators.

Table 3.2.3-2 – PHMSA Pipeline Safety Research Program Status: Impact on Participating Standards Development Organization		
No.	Organization Name	Standard Relevance Count ^A
1.	American Petroleum Institute (API)	62
2.	American Society of Mechanical Engineers (ASME)	54
3.	American Society for Testing and Materials (ASTM)	16
4.	American Welding Society (AWS)	3
5.	Det Norske Veritas (DNV)	3
6.	Association for Materials Protection and Performance (AMPP) (formerly NACE International and Society for Protective Coatings (SSPC))	36
7.	National Fire Protection Association (NFPA)	13
A. The total number of PHMSA projects, relative to current consensus standards, that may influence updates issued by an SDO (data pulled September 2025).		

Table 3.2.3-3 – PHMSA Pipeline Safety Research Program Status: Promoting Knowledge	
Knowledge Promotion Metric	Count ^A
Final Reports Publicly Available	340
Conference or Journal Papers	515
Public Events	48
Patent Applications (U.S. + Other)	82
Patents Granted (U.S. + Other)	39
A. Data pulled September 2025.	

3.2.4 Program Project Completion and Commercialization

As noted in section 3.2.3, one of the ways that PHMSA measures Pipeline Safety Research Program performance is with respect to technology improvements. Given that technology R&D is, by definition, a process where many concepts do not result in a successful outcome, PHMSA applies three basic concepts to improve the chances of success:

- Plan for technology transfer from day one.
- Involve end users (*i.e.*, pipeline operators and regulators) from day one.
- Integrate potential service providers into the plan as soon as possible.

PHMSA believes it is important to convey and articulate a technology’s story from proof of concept to commercialization to ensure transparency about the role of public funding. The Program invests in projects with promise to deploy solutions and commercialize technology within a few years.

As an example, recent technology successes of the Pipeline Safety Research Program related to pipeline anomaly detection and characterization include:

- *In-Ditch Validation Methodology for Determination of Defect Sizing DTPH56-13-T-000008L (04/13/2020)*

The research, development, and validation success in this project supported incorporating Inverse Wavefield Extrapolation technology onto calibration tools, seam weld inspections, and magnetic crawlers for pipeline stress corrosion cracking inspections.

- *Development, Field Testing & Commercialization of a Crack & Mechanical Damage Sensor for Unpiggable Natural Gas Transmission Pipelines DTPH56-13-T-000006 (02/08/2021)*

The research developed and thoroughly demonstrated a cracking and mechanical damage sensor for use in the inspection of unpiggable natural gas pipelines.

- *Electromagnetic Acoustic Transducer Sensor for Small Diameter and Unpiggable Pipes; Prototype and Testing DTPH5615T00018L (6/23/2022)*

The project developed and demonstrated the ability of the electromagnetic acoustic transducer (EMAT) crack tool to detect tight/closed cracks down to two millimeters deep for eight-inch diameter pipes in traditionally difficult to inspect pipelines. The intellectual property from this research and from the prior research project under PHMSA contract #DTPH56-13-T-000007 evolved into a free-swimming tool that operates at two meters per second, navigates 1.5 diameter bends, and can be pressurized to 2,200 pounds per square inch. The EMAT Crack In-Line Inspection (ILI) tool is now available for use by the pipeline industry.

A summary of the Pipeline Safety Research Program technology demonstrations, patents, and commercialized technologies is shown in Table 3.2.4-1. The PHMSA R&D website lists all Pipeline Safety Research Program awards in a searchable format.¹⁵

¹⁵ <https://primis.phmsa.dot.gov/matrix/>.

Table 3.2.4-1 – PHMSA Pipeline Safety Research Program Technology Research Impact						
Category	Technology Projects	Technology Demonstrations	Patent Applications (U.S. + Other)	Patents Granted (U.S. + Other)	Commercialized Technologies ^A	PHMSA (\$ M)
Threat Prevention	48	20	10	4	8	24.6
Leak Detection	21	11	1	1	6	11.3
Anomaly Detection	46	34	27	16	17	32.3
Anomaly Characterization	9	3			1	4.3
Anomaly Repair	1	1	6			1.0
Pipe Remediation/ Rehabilitation	1					2.4
Materials	13	1	2	2	1	14.3
Welding	8	5	1	1	2	5.6
Joining	3	2	1	1		1.4
UNGS	4	1				2.4
Grand Totals:	156	78	49	29	35	99.6
A. The measurement of “Commercialized Technologies” only occurs on non-active or completed projects (data pulled September 2025).						

3.2.5 Impact on PHMSA Regulatory Initiatives

The Pipeline Safety Research Program impacts PHMSA’s regulatory initiatives. PHMSA research projects help inform rulemakings to address safety oversight needs, including mandates from Congress and recommendations from the National Transportation Safety Board (NTSB). For example, PHMSA sponsored research to improve and validate processes for calculating the predicted failure pressure of low-frequency electric resistance welded pipe with cracks or crack-like defects (including selective seam corrosion).^{16, 17} This research informed the gas pipeline final rule that addresses reconfirmation of maximum allowable operating pressure in response to section 23(c) of the Pipeline Safety, Regulatory Certainty, And Job Creation Act of 2011 and NTSB Recommendation P-11-14.¹⁸

¹⁶ Young, B.A., et al., *Comprehensive Study to Understand Longitudinal ERW Seam Failures (2017)*, (<https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=390>).

¹⁷ Interim Report for Phase II—Task 5 of the Comprehensive Study to Understand Longitudinal ERW Seam Failures, “*Summary Report for an Integrity Management Software Tool*,” May 2017 (<https://primis.phmsa.dot.gov/matrix/FilGet.rdm?fil=11469>).

¹⁸ NTSB/PAR-11/01, *Accident Report, Pacific Gas and Electric Company Natural Gas Transmission Pipeline Rupture and Fire San Bruno, California*, Sept. 9, 2010 (<https://www.nts.gov/investigations/accidentreports/reports/par1101.pdf>).

4.0 Development of Additional Testing and Research Capabilities Through Establishment of an Independent Pipeline Safety Testing Facility (ITF) Under DOT

Section 105 of the PIPES Act of 2020 directed PHMSA to prepare and submit a report on the development of additional testing and research capabilities through the establishment of an ITF under DOT. Section 105 also directed PHMSA to address in that report whether an ITF would be critical to the work of the Agency.

As outlined in section 3.2.2, the existing Pipeline Safety Research Program relies primarily on other entities to conduct research, development, and testing (RDT). There are certain limitations that may arise in using a third-party-only approach for pursuing R&D projects. These may include a perception that projects performed by outside entities may reflect their biases; potential limited access to operational environments for testing new and innovative technologies due to commercial availability; lengthy Federal procurement processes; and challenges in maintaining multi-year performance objectives in a contract-oriented environment, particularly if turnover occurs between technical providers.

Some of these potential limitations could be addressed by establishing an ITF under DOT to serve as the hub for collaboration, coordination, and oversight of RDT activities for the Pipeline Safety Research Program and PHMSA. Such a facility would represent a change to the existing program and could help accelerate the rate of change in pipeline transportation safety and technology. PHMSA notes, however, that the existing research program has been effective at testing and developing successful new technologies and the potential limitations discussed above have not hindered the work of the agency.

The success of the Pipeline Safety Research Program demonstrates that establishing an ITF is not critical to the work of PHMSA. The Pipeline Safety Research Program has supported more than 445 research projects—with 35 commercialized technologies currently in use—and produced more than 338 publicly available reports over the past two decades. There were no critical R&D projects that were not completed during that time due to lack of an ITF. Nor is PHMSA aware of any critical R&D projects on the horizon that would have required the use of an ITF to be completed.

4.1 Public Comments on Independent R&D Facilities (Docket PHMSA-2022-0148)

In response to section 105 of the PIPES Act of 2020, PHMSA established docket PHMSA-2022-0148¹⁹ to provide the opportunity for stakeholder feedback and comment on any of the discussion points identified in the congressional mandate regarding the potential establishment of an ITF; and held a “Pipeline Safety Testing Enhancement Study: Stakeholder Collaboration Event” on November 30, 2022. PHMSA received 13 applicable comments on the public docket:

- Six supported an ITF and several commentors provided specific recommended areas of technical focus.

¹⁹ <https://www.regulations.gov/document/PHMSA-2022-0148-0001>.

- Six believed that an ITF is not necessary given the existence of numerous testing facilities already available.
- One recommended performing a needs assessment relative to existing facilities and capabilities before building another research and testing facility.

As included in the above comments, the American Public Gas Association (APGA) and API did not support the establishment of an ITF, while the American Gas Association (AGA) supported the establishment of an ITF.

Commenters who supported the establishment of an ITF offered reasons that included:

- Filling existing gaps in pipeline R&D.
- Improving the likelihood that meaningful R&D projects will make it to commercialization and industry adoption.
- Accelerating the pace of research to address the anticipated increased transportation of CO₂, H₂, and other non-traditional fuels (*e.g.*, renewable natural gas) and their impacts to pipeline infrastructure.
- Increasing R&D for the underrepresented gas distribution sector.

Commenters who did not support the establishment of an ITF offered reasons that included:

- There are existing commercial facilities in the U.S. that can fulfill pipeline R&D needs. Adding another is superfluous.
- PHMSA has not yet investigated how to maximize the use of all the available commercial and industry facilities (Pipeline Research Council International and others) before committing to building another one.
- PHMSA should leverage the existing testing facilities that are available throughout the country, as those with significant capabilities should be able to address most pipeline safety research and technology development.

Appendix A contains a summary of each of the respective comments received.

5.0 Costs and Benefits of Developing an Independent Pipeline Safety Testing Facility

In 2020, PHMSA contracted with Universal Pegasus International (UPI) to develop plans for an expanded RDT Program proposed to be built within the Federal Railroad Administration's (FRA) Transportation Technology Center (TTC) located outside of Pueblo, Colorado.

TTC is a 52-square-mile site owned by the FRA on land leased long term from the State of Colorado. TTC has been used historically for research and testing for the railroad industry but is

now open to all surface transportation modes. Although the government-owned facility is managed by a single contractor (ENSCO), DOT has encouraged expanded use of the TTC site by non-railroad entities. Under the current site management arrangement, all of DOT can utilize the TTC through the issuance of task orders under the site contract vehicle.²⁰ Figure 6-1 includes an overview of the TTC site, including a potential location of an independent Pipeline Testing Facility. The scope of an expanded RDT Program and new facility included a test bed configuration with the flexibility to accommodate existing and future technologies associated with safe and effective pipeline development, operation, and inspection activities.²¹

PHMSA formed an Industry Stakeholder Committee (ISC)²² to provide clarification of need, definition, and input to the process of developing a potential test facility. The committee comprised such representatives as pipeline operators, service providers, pipeline industry organizations, the public, and government entities.

²⁰ *Ordering Guide for Use of the Indefinite Delivery Indefinite Quantity (IDIQ) Contract at the Transportation Technology Center (TTC)*, U.S. DOT FRA, April 2022.

²¹ *Recommendations for the PHMSA RDT Program at TTC*, UPI document number 25086-110-RPT-0001, 11/6/2020.

²² *Data and Findings of ISC Input for PHMSA*, UPI Doc. D.Number 25086-110-RPT-0002, 11/6/2020.

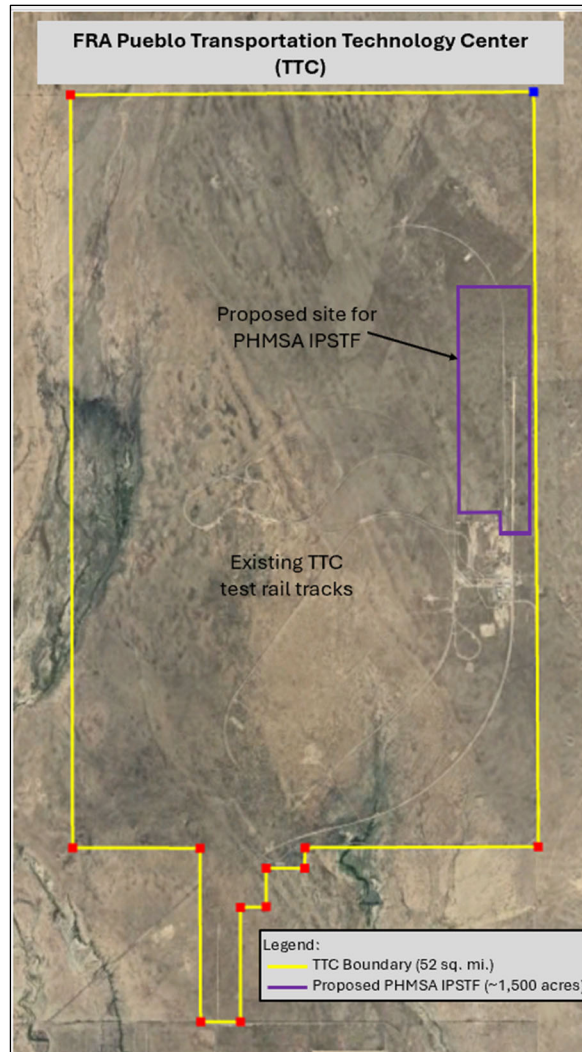


Figure 6-1 – FRA TTC Site Overview and Proposed Pipeline Research Facility Location

The RDT development effort was paused in January 2021.²³ At that time, the effort had progressed to include a conceptual design,²⁴ a “total installed cost” estimate,^{25, 26} and various other supporting documentation, such as site drawings and project implementation schedules for development of the RDT.

PHMSA did not attempt to duplicate or recreate any of the paused RDT Program development work in preparing this report, particularly given that the RDT Program effort gathered significant stakeholder input via the previously noted industry stakeholder committee process. Instead,

²³ *Project Pause Report for PHMSA’S Research, Development, and Testing (RDT) Program at the Transportation Technology Center*, UPI Doc. Number 25086-110-PCL-0001, 2/2/2021.

²⁴ *Recommendations for the PHMSA RDT Program at TTC*, UPI document number 25086-110-RPT-0001, Nov. 6, 2020.

²⁵ *Total Installed Cost (TIC) Estimate*, UPI document number 25086-122-TIC-0001, Nov. 6, 2020.

²⁶ *Basis of Estimate for PHMSA RDT Program at TTC*, UPI document number 25086-122-BOE-0001, Nov. 6, 2020.

PHMSA assumed that any eventual ITF would have a scope of activity, capability, and physical footprint similar to the previously developed RDT Program. Certain technical aspects, scope of activities, and costs would need to be updated or revised should an ITF be authorized and funded by Congress.

5.1 Description: Pipeline Research Facility at DOT (FRA TTC Site)

As originally envisioned, a proposed ITF would consist of 10 individual test stations—referred to as test assembly stations (TASs)—as listed below. Each TAS would serve a specific research, development, or testing purpose, and could be repurposed or expanded as needs evolve over time. For example, if the need to evaluate aspects of transporting new or different energy products were identified and prioritized, or a particular accident failure mode needed to be further investigated for applicability to other pipelines, one or more of the originally anticipated test stations could be replaced or put into standby status. The initial TAS would consist of:

1. ILI pipeline loop.
2. Pull string.
3. Hydrostatic testing and pressure cycling.
4. Gas transmission operation and maintenance (O&M) and hazardous liquid O&M.
5. Damage prevention.
6. Corrosion and cathodic protection.
7. Gas migration and leak detection.
8. Gas distribution O&M.
9. Drone and fixed wing patrolling.
10. Operations control center.

To access the test stations and to provide operational control, the existing TTC infrastructure would be utilized to provide services, such as:

- Utility corridor.
- Water supply.
- Power supply.
- Firewater supply.
- Site access.

To outline the capabilities of an ITF better, a more detailed description of each TAS is included in Appendix B. As noted previously, the TAS would be designed with the optionality to add testing capabilities later if additional needs arise. In addition, the RDT Program plan included three “auxiliary” TASs that could readily be developed for emergent testing and research needs.

5.2 Cost: Pipeline Research Facility at the FRA TTC Site

According to the UPI estimate in November 2020, the proposed RDT facility at TTC would cost \$46.26 million to design and construct.²⁷ As the facility would be sited within the existing FRA TTC, the estimate did not include costs for land acquisition and environmental assessment/remediation. Table 6-2.1 provides estimates for the TTC site. PHMSA cannot provide a detailed updated cost estimate, but costs would be even higher today due to factors such as inflation. It should also be noted that estimates throughout this report are not entirely comparable as they were conducted at different times. For instance, another estimate later in the report for a facility at PHMSA’s Training and Qualifications Center was conducted in January 2024. Ballpark estimates from a variety of sources indicate that costs between 2020 and 2024 escalated around 35.4% on average for general construction to even more for pipeline facility construction, or an updated overall total \$63,000,000-\$68,000,000 or more for a 2020 estimate in 2024 dollars.

Table 6.2-1 – Pipeline Research Facility Cost Estimate – DOT FRA TTC Site¹	
Category Description	Cost Estimate
Engineering and Third Party	\$4,200,000
Materials	\$23,000,000
Development/Construction	\$15,000,000
Services (to Startup)	\$3,600,000
Freight	\$900,000
Total:	\$46,700,000

1. Operating and administrative costs are not included. Estimates done in 2020.

5.3 Benefits: Pipeline Research Facility at DOT (FRA TTC Site)

As noted in section 5, establishing an ITF would represent a change to the existing pipeline RDT program . Potential benefits from the establishment of an ITF could include:

- Developing a new “center of knowledge” within PHMSA as related to pipeline operations and leading-edge pipeline research and technology development.
- Allowing the Pipeline Safety Research Program to develop into more of a “learning” program wherein PHMSA staff (including inspectors) and emerging practitioners can grow their technical expertise by direct involvement in ongoing RDT activities.

²⁷ *Total Installed Cost (TIC) Estimate*, UPI document number 25086-122-TIC-0001, Nov. 6, 2020.

- Providing greater opportunities for collaboration and engagement between government, industry, pipeline technology innovators, and academic researchers in an independent environment that provides improved transparency and increased public confidence in the fidelity of results achieved.
- Allowing for the long-term continuity of research and testing projects that may be challenging or costly to continue at non-DOT facilities.
- Facilitating the process of addressing emergent technical research challenges by having an existing facility in place that can rapidly adapt to changes in pipeline safety R&D priorities
- Possibly reducing time needed for the current contracting process used to perform research at external vendor locations.
- Providing PHMSA with an independent testing laboratory to support post-accident testing and failure analysis of pipeline components and hazardous materials, along with any follow-up research needs.

In addition to potential programmatic benefits, co-locating the ITF at the FRA TTC site could provide other advantages, including:

- TTC is a federally owned and managed site established for RDT activities. As such, the site has built-in accommodations for activities involving real-world pipeline commodities, such as natural gas, flammable gas, or gas that is toxic or corrosive, and hazardous liquids (including highly volatile liquids), as operated in high-pressure configurations. This is of potential importance for possible PHMSA Pipeline Research Program activities involving such areas as LNG, underground gas storage (*e.g.*, natural gas, H₂), and underground hazardous liquids storage (*e.g.*, propane).
- Certain elements of existing infrastructure, facilities, and staff could be shared (*e.g.*, metallurgical lab, on-site dedicated fire department, technicians).
- Infrastructure and utilities to operate the facility can be accessed, as well as the ease of movement of heavy machinery and components, including access to freight rail transportation.
- Utilization of the TTC site could expedite ITF startup time, compared to other potential locations, given that additional land would not have to be procured, site environmental assessments have been established, and various site use permits are in place. TTC site has land availability for all proposed test assembly stations and has ample space for any increased PHMSA activities.
- TTC has domestic and international collaborative experience and site access processes are established and in place.

- Previous PHMSA investment in the suspended RDT design at the TTC site could be utilized for the final design of an ITF.

Conducting and accomplishing activities at a facility operated by PHMSA staff versus outside parties could provide additional efficiencies, such as:

- Ability for a greater number of experiments to be conducted for a given project budget (as compared to an outside provider).
- Economies of scale when research is co-located so that equipment and research facilities can be shared among researchers.
- Flexibility of using a dedicated facility to conduct research and testing in contrast to being subject to prioritization at outside facilities.
- An independent location for industry to evaluate its technology in a non-biased environment.
- Potential to increase the transparency of data and results, thereby fostering greater equity in the pipeline research and standards field.
- Facilitation of faster evaluation of new pipeline-safety technologies and future fuels than is presently possible in support of the safety of the complex pipeline system.

However, the extent of savings and efficiencies would be specific to each project and, thus, very hard to quantify in the absence of project specifics. In addition, the benefits of technology development aspects—such as providing greater access for innovative technology testing in realistic pipeline operating conditions versus seeking opportunities at industry facilities—are also very challenging to estimate without significant uncertainty.

The change in the way PHMSA conducts pipeline safety RDT is difficult to quantify; therefore, the benefits aspect of the cost and benefits evaluation is more qualitative.

6.0 Costs and Benefits of Developing an Independent Pipeline Safety Testing Facility at PHMSA TQ Center

PHMSA operates a TQ Center in Oklahoma City, Oklahoma, that provides training courses for Federal and State pipeline safety inspectors and investigators.²⁸ Activities at the TQ Center include in-depth classroom training and a limited selection of outdoor/lab areas to provide inspectors with hands-on opportunities to experience actual field scenarios. Consistent with section 105 of the PIPES Act of 2020, PHMSA evaluated the potential to co-locate an ITF at, or near, the TQ Center in preparing this report.

²⁸ <https://www.phmsa.dot.gov/training/pipeline/inspector-training-and-qualifications-overview>.

6.1 Description: Pipeline Research Facility at PHMSA TQ Training Division

The PHMSA TQ Center is located in a mostly developed area just north of the Oklahoma City airport. As shown in Figure 7.1-1 and Figure 7.1-2, the TQ Center occupies approximately seven acres of land with an office building and parking lot covering just over four acres. The center also has close to three acres of additional land that has several outdoor demonstration/lab areas to enhance the realism of training exercises.

In addition to other general benefits an ITF would offer, a primary advantage of locating the ITF at the TQ Center would be the opportunities for collaboration between the TQ Center and the Pipeline Research Facility (e.g., personnel/ inspector training and training/testing staff).

For the purposes of evaluation consistency, it was assumed that a full-scope ITF would require a facility site size similar to the 1,500 acres proposed for the FRA TTC site. Under this assumption, the current TQ Center would not serve as a viable colocation site.

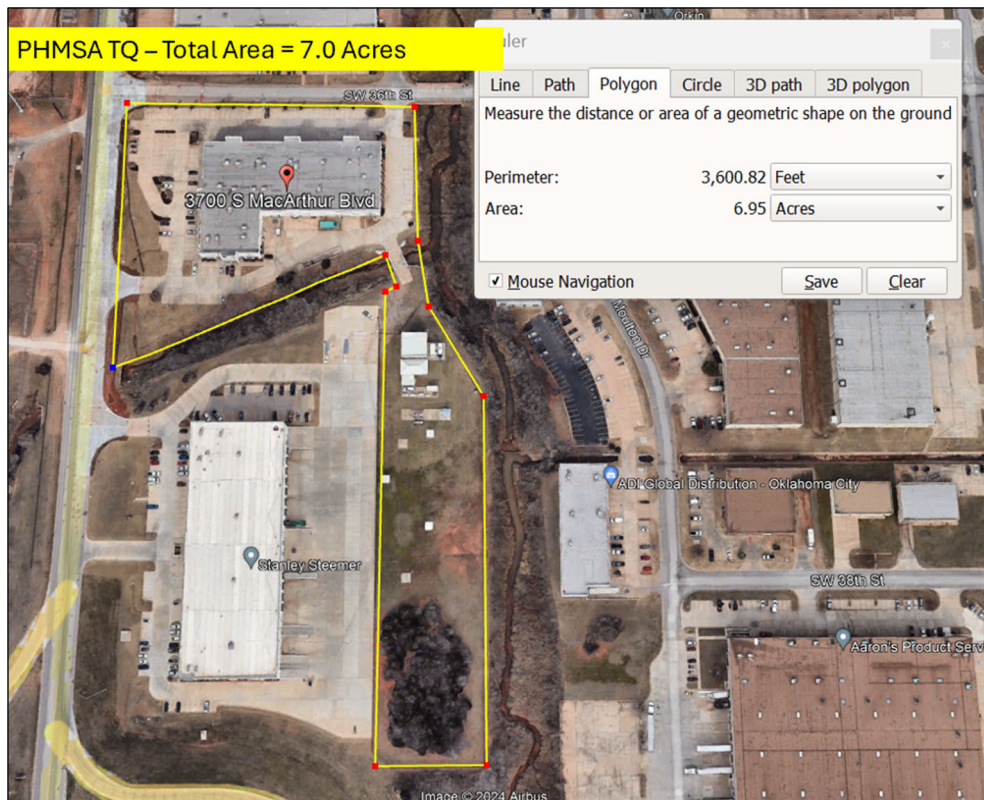


Figure 7.1-1 – PHMSA TQ Center Site: Total Area

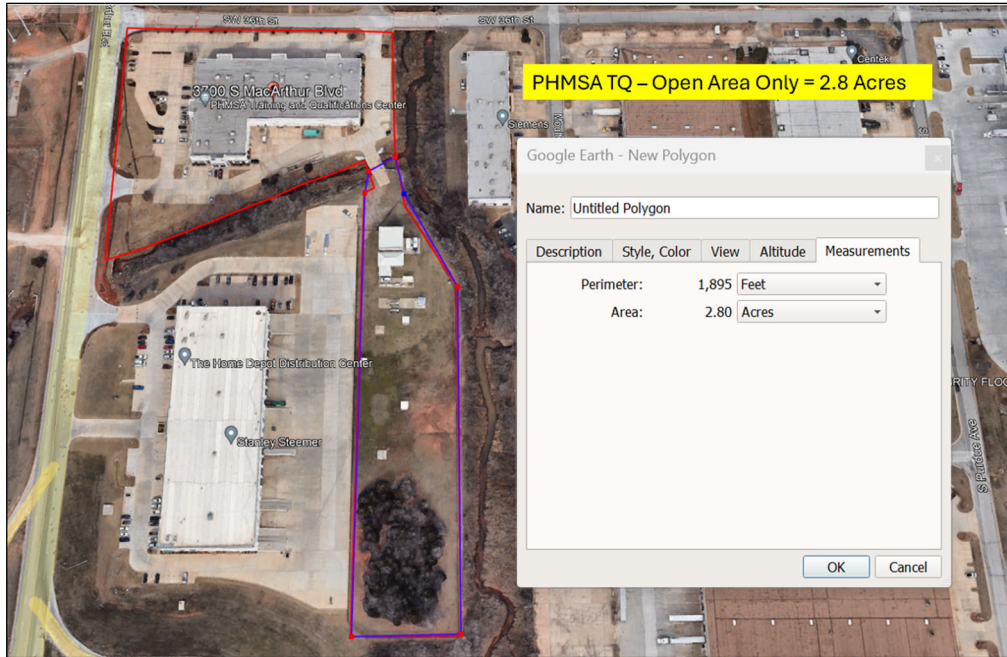


Figure 7.1-2 – PHMSA TQ Center Site: Open/Outside Lab Area

As an alternative, locating an ITF in the general Oklahoma City area was explored:

- There appears to be no vacant land near the TQ Center that could accommodate the size of an ITF. While land acquisition was not investigated in depth, obtaining acreage of this magnitude would likely have to be well outside of the immediate Oklahoma City vicinity. A preliminary estimate conducted in January 2024 indicated that land acquisition cost would be close to \$10 million based on a search of available large tracts of land within 50 miles of the TQ Center.
- Locating the ITF well away from the TQ Center would significantly diminish the benefits of co-locating an ITF at an existing training center.
- Siting an ITF at a completely new location would likely require the permitting and installation of extensive new utility infrastructure.
- Time to develop a new site from project approval to facility startup would be substantially longer than an actual co-location.
- Although not quantified as an explicit cost, the TQ Center location does not provide the opportunity for site resource sharing as compared to the TTC location.

6.2 Cost: Pipeline Research Facility at PHMSA TQ Center

Given that actual co-location of an ITF at the current PHMSA TQ Center location is not physically possible, the cost for a location in the general Oklahoma City area (*i.e.*, within 50 miles) was estimated instead. For comparison with the FRA TTC site, the same general

development costs were assumed with additional new-location-specific costs for land acquisition and initial environmental assessment.

As shown in Table 7.2-1, the cost estimate for an ITF on the same order of scale as evaluated for the FRA TTC site, but with additional costs associated with a new Oklahoma location, is \$69.4 million. As noted in the FRA TTC section, estimates throughout this report are not entirely comparable as they were conducted at different times. The TTC estimates were conducted in 2020. This estimate may not be an entirely fair comparison to the 2020 estimate for TTC.

Table 7.2-1 – Pipeline Research Facility Estimate in New Oklahoma Location	
Category Description	Pipeline Research Facility Estimate
Engineering and Third Party	\$4,700,000
Materials	29,000,000
Development/Construction	19,000,000
Services (to Startup)	4,000,000
Freight	1,200,000
Land	11,300,000
Environmental	200,000
Total:	\$69,400,000

6.3 Benefits: Pipeline Research Facility at PHMSA TQ Center

The primary benefits of locating an ITF at the TQ Center would be the same as discussed for the FRA TTC location in section 6.3. Additional benefits to siting an ITF in conjunction with the existing PHMSA TQ Center would be to take advantage of:

- An existing PHMSA-specific site.
- Collaborative opportunities between ITF staff and TQ activities (*e.g.*, TQ staff participation in ITF projects, ITF staff participation in TQ as instructors, and real-world operational environment training opportunities for TQ students).

However, given the very limited space available at the current TQ Center location, a true colocation is not possible. While collaborative opportunities would still exist if an ITF were to be sited in the general Oklahoma City area (*i.e.*, within 50 miles), this would not represent an actual colocation opportunity. Other options could be evaluated, such as moving the current TQ Center’s location to a proposed ITF site in Oklahoma, but this would involve additional costs beyond those estimated in Table 7.2-1 and was not evaluated as part of this study.

7.0 PHMSA Use of DOT, Other Federal Agencies, or Federally Funded Research and Development Centers

The Federal Government operates several sites related to RDT activities. One example is a special class of research institutions referred to as federally funded research and development

centers (FFRDCs), which are owned by the Federal Government but operated by contractors, including universities, other nonprofit organizations, and industrial firms. FFRDCs are intended to provide Federal agencies with R&D capabilities that cannot be effectively met by the Federal Government or the private sector alone. FFRDCs are required to have a long-term strategic relationship with the Federal agency that supports them.²⁹ There are 43 FFRDCs. Of these, one FFRDC—Center for Advanced Aviation System Development—is associated with DOT.

A wide variety of other RDT type of facilities exist within Federal agencies. For example, NIST has five “laboratories” that specialize in specific technical areas.³⁰

Within DOT, individual operating administrations have mission-specific facilities, such as the National Highway Traffic Safety Administration’s Vehicle Research and Test Center³¹ and the Federal Aviation Administration’s Flight Operations Simulation Laboratory.³²

Each of these Federal facilities, however, is optimized to support the Federal agency that it is either part of or with which it has a strategic relationship. Pipeline safety involves a broad range of applicable technical areas and disparate topics, such as metallurgy, cybersecurity, human factors, leak detection technologies, release transport pathways, ILI devices, and often involves flammable or hazardous commodities. In addition, it is important that facilities be readily accessible by academia, industry, private, government, and international personnel to observe and conduct experiments, including full scale equipment testing.

Other criteria for facilities to be considered as potential sites for an ITF could include:

- Facilities with ample land availability to place all the proposed test assembly stations, along with the potential for future expansion of PHMSA activities.
- Available infrastructure and utilities to operate the ITF, including the shipping and handling of heavy machinery and components.
- Co-located testing laboratories that could be utilized to aid in pipeline research and failure investigations, such as a metallurgical lab.

Thus, while other existing Federal facilities may involve one or more of these pipeline safety-specific technical areas, none were identified as having sufficient commonality to warrant further investigation for colocation of an ITF.

8.0 Summary of Findings and Conclusions

An ITF could be established under DOT at TTC in Pueblo, Colorado, a 52-square-mile site administered by FRA with an established record of supporting research and testing for the

²⁹ *FFRDCs: Background and Issues for Congress*, R44629, Congressional Research Service, April 3, 2020.

³⁰ <https://www.nist.gov/>.

³¹ <https://www.nhtsa.gov/research-data/vehicle-research-testing>.

³² https://www.faa.gov/about/office_org/headquarters_offices/avs/offices/afx/afs/afs400/afs430/fosl.

transportation sector. However, such a facility is not critical to the work of PHMSA, and the cost of the facility is not justified by the potential benefits.

The benefits could include providing a reliable and adaptable venue for testing and validating new technologies and offering additional workforce development opportunities. The success of the existing Pipeline Safety Research Program, however, demonstrates that establishing an ITF is not critical to the work of PHMSA. The Pipeline Safety Research Program has supported more than 445 research projects—with 35 commercialized technologies currently in use—and produced more than 338 publicly available reports over the past two decades. PHMSA is not aware of any critical R&D projects that could not be completed during that time. Neither is PHMSA aware of any critical R&D projects on the horizon that would require the use of an ITF to be completed.

Establishing an ITF is not critical to the agency and would require significant resources that would place an undue burden on regulated entities. PHMSA's pipeline safety programs are supported primarily by user fees paid by industry. This facility could require a 33 percent or more increase in user fees charged to pipeline operators (a potential increase of \$47 million over current levels).

Appendix A – Summary of Individual Comments Received: Docket PHMSA-2022-0148

PHMSA received 13 comment submissions, as summarized below. [Note: Two additional commenters, one of which was anonymous, provided comments not applicable to the Pipeline Research Facility.]

Comment document #: PHMSA-2022-0148-0003	By: Ragula Tech
<p>Recommends establishing a technical advisory council with the industry directly to address operational needs, requirements, and standards fully. Include potential commercializers as early as possible in a project, since they play a key role in the future for successful commercialization. Terminate projects as soon as they are found to have no practical application or use.</p>	
Comment document #: PHMSA-2022-0148-0004	By: Marathon Pipeline
<p>General comment:</p> <p>We support any research that improves pipeline safety through the promotion of technology transfer and commercialization. There has been good collaboration between PHMSA and the Pipeline Research Council International (PRCI) on pipeline safety research projects, which optimizes the use of research funding to produce useful results for pipeline operators. Marathon Pipeline recommends this collaboration continue to minimize any redundancy in testing facilities and to promote the continued optimization of research funding. We do not think there is a strong need for an additional materials-testing laboratory, as there are numerous commercial laboratories available throughout the United States.</p>	
Comment document #: PHMSA-2022-0148-0005	By: Yahui Yang
<p>Supports R&D for bringing down the cost and improving the reliability and responsiveness of leak monitoring technologies and networks.</p> <p>Impacts of H₂ on pipeline systems. With the increasing generation and consumption of green H₂, more systems are repurposed or built for H₂ transportation. There has been a knowledge gap in this area and more research is needed.</p>	

Comment document #: PHMSA-2022-0148-0006	By: APGA
<p>APGA is most interested in R&D that impacts the natural gas distribution sector. Traditionally, PHMSA has put a large emphasis on projects that are upstream of distribution piping, focusing on facility and transmission pipeline challenges.</p> <p>APGA believes the most impactful investment PHMSA can make on R&D projects is in the later stages of technology development. Investing at this stage can assist promising technologies to reach commercialization and industry adoption.</p> <p>There are already numerous testing facilities throughout the U.S. operated by various research organizations and technology providers. Adding another facility would only increase the competition for these important pipeline samples.</p> <p>APGA supports realizing efficiencies between Federal agencies and the shared utilization of facilities where possible and practicable.</p>	

Comment document #: PHMSA-2022-0148-0007	By: Gary Young
<p>I believe that more targeted research is needed in the areas of characterization of pipe condition from the surface or air.</p> <p>I have trouble envisioning how a government owned lab would be of great benefit.</p>	

Comment document #: PHMSA-2022-0148-0008	By: TC Energy
<p>...we do not see a pressing need for another facility for testing as there are no critical gaps in the testing options available.</p>	

Comment document #: PHMSA-2022-0148-0009	By: AGA
<p>AGA believes that an independent pipeline safety testing facility would allow PHMSA to be more responsive, agile, and adaptive in prioritizing and executing its R&D activities.</p> <p>Recommends R&D into these areas may also result in modifications to existing leading practices for pipeline design, construction, operations, maintenance, and emergency response:</p> <ul style="list-style-type: none"> • Gas distribution leak detection and mitigation • Higher-percentage blending of H₂ in natural gas pipelines, particularly gas distribution pipelines • Renewable natural gas • Welding, plastic fusion, and repair methods of gas distribution piping • Non-destructive material verification for steel pipelines • Potential impact radius determination 	

Comment document #: PHMSA-2022-0148-0010	By: Leonard Bond
<p>There is a need for new pipeline testing facilities. One need I see as important is for an ILI “test run.”</p>	

Comment document #: PHMSA-2022-0148-0011	By: World Wide Nondestructive Testing
As an exclusive natural gas/propane third-party testing facility, we support PHMSA’s recommendation of an independent third-party facility.	

Comment document #: PHMSA-2022-0148-0013	By: Eric Amundsen, Energy Transfer
PHMSA should consider how to maximize the use of all available facilities (PRCI and others) before committing to building another one. Consider the benefit that could be realized of investing those resources in needed research projects and achieving outcomes versus a lengthy development process, construction, staffing, startup, etc., of an independent facility, which realistically will not produce any outcomes for years to come.	

Comment document #: PHMSA-2022-0148-0014	By: Mississippi SAR Dogs
Commentor only provided recommended focus areas.	

Comment document #: PHMSA-2022-0148-0015	By: PRCI
PRCI’s opinion is that there is a gap in research facilities that could be fulfilled by PHMSA. There are few facility options to perform testing that is injurious to population, property, or environment. Domestic, full-scale testing sites for H ₂ , H ₂ -blend, or CO ₂ failures are not widely available, and given the changes on the energy horizon, a central location or expansion of existing assets for the physical testing could be timely.	

Comment document #: PHMSA-2022-0148-0016	By: API and Liquid Energy Pipeline Association (LEPA)
API and LEPA support PHMSA’s efforts to leverage the existing testing facilities that are available throughout the country with significant capabilities available to address the majority of the pipeline safety research and technology development. There are sufficient industry-wide capabilities to support PHMSA R&D testing through existing facilities at federally funded national laboratories such as the National Renewable Energy Laboratory, NIST, and jointly funded R&D facilities (<i>e.g.</i> , PRCI and GTI Energy), as well as privately operated laboratories that conduct pipeline research and failure incident analysis. API and LEPA recommend that PHMSA’s Pipeline Safety Testing Enhancement Study include a comprehensive assessment of existing pipeline R&D facilities’ capabilities before funding a new facility.	

Appendix B – Test Assembly Station Descriptions

ILI Pipeline Loop TAS – Sophisticated and sensitive ILI tools, with onboard data collection and recording, can travel through a pipeline and measure and record irregularities, and identify their location on the pipe, which may represent corrosion, cracks, laminations, deformations (*e.g.*, dents, gouges, etc.), or other defects in the pipeline. These ILI tools are often referred to as “smart pigs.” ILIs or “smart pigs” are one of the most important tools used by pipeline operators to assess pipeline integrity.

There are different types of ILI tools, and each type has advantages, disadvantages, and limitations for detecting and measuring various pipeline irregularities or defects that could affect pipeline integrity. Improving ILI technologies is considered an important priority, given the direct and significant impact to improving pipeline safety through enhanced detection of various types of pipeline defects using ILI. Once a pipeline ILI discovers potentially injurious defects to the pipeline, they can be repaired or replaced before they cause a pipeline release/incident.

This test station would provide multiple pipeline ILI test loops of different pipe diameters, approximately one mile in length, to allow for testing of different ILI tools and new ILI technologies in real-world pipeline flow conditions to improve the technology. This station would have the ability to run ILI tools in likely scenarios through several designed pipe defects. The irregularities found by the ILI tool would be compared against the designed defects in the pipe to assess for tool accuracy to provide ILI tool validation of hardware and programming through testing and evaluate real-world scenarios at full scale.

Pull String TAS – Certain types of ILI testing do not require the utilization of a pipeline loop for capabilities testing. The Pull String TAS would complement the ILI Pipeline Loop TAS by performing different tests on ILI tools through various diameters of pipe by mechanically or hydraulically pulling the tool through a 600-foot-long pipe test segment. This station would also allow the ILI tools to be tested for compliance with design specifications prior to running in the ILI Pipeline Loop.

Hydrostatic Testing and Pressure Cycling TAS – Hydrostatic pressure testing of pipelines is another vital tool used by pipeline operators to assess the strength of their pipelines. Pipeline hydrostatic testing is used both as an assessment method and a predictive tool to support the integrity management program of a pipeline operator for evaluating all types of pipeline irregularities/defects, including dents, cracks, defects in seam welds, vintage girth welds, and wrinkles. This station would include capabilities to perform operational pipeline pressure testing and pressure cycling for fatigue and flaw (crack) growth to test and validate existing and potential finite element analysis models. The full-scale pipe testing station would be able to evaluate pipe flaw growth models realistically for crack-like features. Pressure cycle fatigue testing introduces cumulative damage to simulate future potential service conditions. Cyclical pressure testing can be used to evaluate fatigue life for an anomaly or combined with operational protocols such as future hydrotests. This technique is useful for forecasting how a pipeline with similar defects might perform. Full-scale testing provides opportunities for evaluating remediation techniques and establishing reassessment intervals. Testing also provides insights regarding the in-service behavior of pipeline assets, including potential failure conditions in a safer, controlled environment.

Gas Transmission O&M and Hazardous Liquid O&M TAS – One of the significant causes of pipeline incidents³³ is equipment/material failure, mainly of control, relief, and overpressure protection equipment. This station would be utilized for testing the operation, maintenance, and inspection procedures used by pipeline operators for various types of pipeline control equipment, valves, valve seats, materials (possibly under cryogenic temperatures), piping configurations, and other appurtenances, as needed for both gas transmission and hazardous liquid pipelines. This station would also have the capability to test overpressure protection (OPP) devices and other safety devices, which are of critical importance to pipeline safety, in a controlled environment with increased safety protocols and instrumentation capable of monitoring continuous conditions—ultimately leading to the development of predictive modeling analysis. This station would provide a test bed for completed piping assemblies, such as meter skids and the common configuration of pipeline control and regulating functions. Liquid and gas meters, as well as control valves, mainline valves, and other pipeline control devices, are also candidates for utilization in this test bed.

Damage Prevention TAS – Excavation damage to gas and hazardous liquid pipelines, usually caused by third parties in the public domain, is a significant cause of life-threatening incidents.³⁴ Preventing damage to pipelines and facilities from excavation activities, such as digging, trenching, blasting, boring, tunneling, backfilling, or by any other digging activity, is a top priority for pipeline operators.

This station would provide for the RDT of current and new technologies related to pipeline damage prevention, as well as a test bed for pipeline failure investigations. The station would include a geo-referenced known field of different diameters, types, and depths of cover of pipelines (including distribution-type pipelines) and would be used to evaluate risk and likelihood of damage in specific environments. Pipes made from steel, polyethylene, polyamide, other plastics, or composites of multiple layers of different materials could be used with and without varying degrees of damage prevention and construction technologies for testing purposes. Such technologies may include fiber optic, global positioning systems, geographic information systems, aerial/satellite imagery, tracer wire, tracing tape, infrared, pipeline strain measurement, or combinations of technologies to provide some level of notification. The station could also provide a testing/proving ground for the evaluation and testing of pipeline (steel and non-steel) locating equipment technologies. In addition, utility crossings and possible uses for new and existing technologies for detection of third-party encroachment, third-party intrusion related to existing lines, or other scenarios could be tested and evaluated.

Corrosion and Cathodic Protection TAS – As pipeline corrosion is a significant cause of pipeline incidents³⁵ and concern for pipeline operators, this test station would provide the ability to investigate and improve pipeline corrosion mitigation methods in real-world conditions and provide training opportunities for pipeline operators and regulators. Tools to accurately measure corrosion in pipelines have improved over time, but corrosion still represents the single greatest controllable threat to pipeline integrity. Cathodic protection systems help keep steel pipelines

³³ Source: <https://www.phmsa.dot.gov/data-and-statistics/pipeline/pipeline-incident-20-year-trends>.

³⁴ *Ibid.*

³⁵ *Ibid.*

from corroding. Breaks in coating, stray electric current from other electrified facilities, and many other variables can accelerate pipeline corrosion and shorten service life. The TTC's existing electric rail tracks can be used to evaluate "stray current" (corrosion accelerant) effects between pipelines and other steel infrastructure.

Gas Migration and Leak Detection TAS – This station would be utilized for RDT of new technologies relating to gas detection/migration studies. The station will utilize a field of different diameter piping with various detection equipment for gas migration and gas detection under a variety of real-world conditions using designed and controlled small releases from the pipe. It would provide valuable data to test and understand underground gas migration and the measurements that can be made below and aboveground to characterize such events. Potential technologies include detection by fiber optics, thermal imaging, mercaptan detection, and others. Future fuels and research/testing of associated design consideration could be accomplished by this station. Gas migration patterns at the test station could be developed from the data gathered from controlled releases within the field, at different locations, depths, volumes, pressures, and soil conditions through perforated sections of pipe. The migration patterns could be used to improve existing capabilities and contribute to developing new technologies. It may be worth noting that there is an existing facility through Department of Energy and Colorado State University that does some leak detection and gas migration studies.

Gas Distribution O&M TAS – The gas distribution station is proposed with testing beds for enhancing O&M activities, such as testing of pressure regulation and evaluation of OPP equipment, including the use of H₂ and biogas as supplemental gas. This station would simulate a distribution piping system, including meters, excess flow valves, regulator stations, odorizing equipment, and new/emerging technologies. A manifold system would allow for different pressures by using various styles of regulators and meters. A small compressor would provide various levels of high-pressure gas, regulated, and metered throughout the manifold system with modular designs.

The distribution system could contain a combination of different types of plastic piping, carbon steel, and cast-iron piping for various testing purposes. A simulated distribution system would also allow for the ability to test different gas odorization techniques based on odorizer type (*i.e.*, bypass, wick type, liquid injection type, and drip systems); long-term studies on biogas usage, distribution simulation software, leak detection, and supervisory control and data acquisition (SCADA); purging procedures; and monitoring/elimination of water in the system, etc. Depending on configuration, the station could be sourced by site-specific natural gas connections or supplied through the utility corridor.

Drone and Fixed Wing Patrolling TAS – This station would support the need to identify pipeline threats along the right-of-way (ROW) faster than traditional patrolling methods to improve pipeline safety. These pipeline threats typically include the potential for excavation damage, ROW encroachments, and detection of pipeline leaks.

Methane from natural gas pipelines causes harm and property damage when ignition occurs. Leaks from liquid pipelines can cause significant harm to waterways, potable water systems, and the public. Monitoring for leakage and pipeline ROW activities helps protect the public living near pipelines.

Most pipeline operators currently perform ROW surveillance with manned vehicles and small aircraft. This station would utilize pipeline leak detection and monitoring technologies by miniaturized aerial platforms and other unmanned methods to enhance pipeline threat detection and potential small leaks. Various unmanned aerial systems (UASs) can also be deployed in a pipeline emergency response to assess the magnitude of the incident when it is not safe to send personnel on-site.

The station would include the ability to test UAS technology using light detection and ranging and imagery in possible conjunction with fiber optics to identify third-party encroachments, land movement, pipeline leaks, and other issues within a pipeline ROW.

The station would focus on surveillance of a pipeline ROW using an approximately one-mile-long buried pipeline. Piping elements would be designed to support realistic testing requirements. Various soil types with varying compaction and moisture content would be used to simulate a variety of test conditions. The pipeline test segment would be designed to create controlled releases in a variety of test scenarios by activating or isolating specific sections during the migration and detection evaluations for a refined and detailed testing.

The station could also examine how the technologies complement each other to provide a more complete understanding of existing threats in each environment—for example, via application of artificial intelligence (AI) and other predictive learning methods.

Additional uses for this station include possible applications of leak detection, atmospheric corrosion inspections, gas migration, or other research areas at-scale.

Operations Control Center TAS – The control center will provide command and control, data aggregation, analysis, and safety coordination between the TAS operational areas via the utility corridor. It would consist of modular buildings and serve as both the central control for testing activities at the respective test stations and a test bed for pipeline control center equipment for monitoring equipment and activity at each TAS such that specific areas can be monitored and shut down from a centralized safe location if required during testing.

Data acquisition and data storage servers are to be integrated at this center and potentially could serve as an industry collaboration center with servers for machine learning and AI technology research. Such subjects as reviewing ILI tool data, probability of detection, leak detection systems, satellite-based monitoring systems, and other multi-variant analysis modalities are emerging technologies that show potential benefit to the industry through the integration of AI systems. Other design considerations may encompass SCADA studies, intrusion detection system studies, and other safety and security studies.