

**United States Department of Transportation
Annual Modal Research Plan FY 2026
Program Outlook FY 2027**

Pipeline and Hazardous Materials Safety Administration

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Table of Contents

Executive Summary	i
Chapter 1 – FY 2026 RD&T Programs	1
Office of Pipeline Safety	1
Office of Hazardous Materials Safety	11
Chapter 2 – FY 2027 RD&T Programs	17
Office of Pipeline Safety	17
Office of Hazardous Materials Safety	18

Executive Summary

The Pipeline and Hazardous Materials Safety Administration’s (PHMSA) mission is to protect people, property, and the environment by advancing the safe transportation of energy and hazardous materials. To do this, PHMSA establishes national policy, sets and enforces standards, educates, and conducts research to prevent incidents. PHMSA also prepares the public and first responders to reduce consequences if an incident does occur.

PHMSA carries out its mission through two primary safety programs: the Office of Pipeline Safety (OPS) and the Office of Hazardous Materials Safety (OHMS). Due to the vital role that energy and other hazardous materials play in our economy—and the safety risks imposed by their transportation—research to improve America’s transportation system’s safety, resilience, and performance is essential. In fiscal year (FY) 2026, PHMSA’s will focus on enhancing safety, accelerating the safe movement of energy products, modernizing infrastructure, promoting innovation, and ensuring accountability in managing existing assets. To achieve these goals, PHMSA will support a variety of pipeline and hazardous materials safety research projects through its OPS and OHMS Research and Development (R&D) programs.

Although PHMSA’s primary mission is safety, its R&D programs support all Department of Transportation (DOT) strategic goals, including investing in infrastructure, leading in development and deployment of innovative technology, and improving efficiency, and effectiveness. Table 1 presents FY 2026 R&D programs’ funding details, and Table 2 indicates FY 2026 R&D program budget requests by DOT strategic goal.

STRATEGIC GOAL

STRATEGIC OBJECTIVE

SAFETY

Reaffirm that safety is the Department's top priority.

- 1.1 Improve aviation safety
- 1.2 Reduce surface transportation-related fatalities and serious injuries
- 1.3 Improve transportation worker safety
- 1.4 Develop improved safety management systems across transportation modes

INFRASTRUCTURE

Invest in high-quality transportation infrastructure capacity to unlock American prosperity.

- 2.1 Accelerate project delivery
- 2.2 Construct projects to expand system capacity
- 2.3 Improve system condition and reliability
- 2.4 Position the U.S. transportation sector for economic competitiveness at home and abroad

INNOVATION

Lead the world by bringing the best of American ingenuity to transportation.

- 3.1 Reduce regulatory burden
- 3.2 Enable transportation technology development and adoption
- 3.3 Invest in transformative technologies

EFFICIENCY

Improve efficiency and accountability across the Department.

- 4.1 Modernize DOT operations

Table 1 - FY 2026 RD&T Program Funding Details

RD&T Program Name	FY 2026 President's Budget Request* (\$000)	Applied (\$000)	Technology Transfer (\$000)	Facilities (\$000)	Experimental Development (\$000)	Major Equipment, R&D Equipment (\$000)
Office of Pipeline Safety	12,500	12,500	N/A	N/A	N/A	N/A
Underground Natural Gas Storage	2,000	2,000	N/A	N/A	N/A	N/A
Pipeline Threat/Anomaly Detection	500	500	N/A	N/A	N/A	N/A
Pipeline Leak Detection (liquid)	3,000	3,000	N/A	N/A	N/A	N/A
Pipeline Threat Prevention	2,000	2,000	N/A	N/A	N/A	N/A
Repair/Rehabilitation	1,500	1,500	N/A	N/A	N/A	N/A
LNG Safety	2,000	2,000	N/A	N/A	N/A	N/A
Design, Materials, and Welding/Joining	1,500	1,500	N/A	N/A	N/A	N/A
Hydrogen	-	-	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>
Office of Hazardous Materials Safety	7,570	7,570	N/A	N/A	N/A	N/A
Risk Reduction for Emergency Response	1,500	1,500	N/A	N/A	N/A	N/A
Efficient Safety Standards	1,000	1,000	N/A	N/A	N/A	N/A
Innovative Packaging	2,500	2,500	N/A	N/A	N/A	N/A
Safe Energy Storage Technologies	2,570	2,570	N/A	N/A	N/A	N/A
Administrative Expenses	1,846	1,846	N/A	N/A	N/A	N/A
Pipeline Safety	1,214	1,214	N/A	N/A	N/A	N/A
Hazardous Materials Safety	632	632	N/A	N/A	N/A	N/A
Totals:	21,916	21,916	N/A	N/A	N/A	N/A

The AMRP reflects funding as found in the annual President's budget request per 49 U.S.C. § 6501 Research Planning. The enacted numbers will be posted as part of the President's budget request for the ensuing fiscal year.

Table 2 - FY 2026 RD&T Program Budget Request by DOT Strategic Goal

RD&T Program Name	FY 2026 President's Budget Request* (\$000)	Safety (\$000)	Infrastructure (\$000)	Innovation (\$000)	Efficiency (\$000)
Office of Pipeline Safety	12,500	12,500	N/A	N/A	N/A
Underground Natural Gas Storage	2,000	2,000	N/A	N/A	N/A
Pipeline Threat/Anomaly Detection	500	500	N/A	N/A	N/A
Pipeline Leak Detection (liquid)	3,000	3,000	N/A	N/A	N/A
Pipeline Threat Prevention	2,000	2,000	N/A	N/A	N/A
Repair/Rehabilitation	1,500	1,500	N/A	N/A	N/A
LNG Safety	2,000	2,000			
Design, Materials, and Welding/Joining	1,500	1,500	N/A	N/A	N/A
Hydrogen	-	-	N/A	N/A	N/A
Office of Hazardous Materials Safety	7,570	7,570	N/A	N/A	N/A
Risk Reduction for Emergency Response	1,500	1,500	N/A	N/A	N/A
Efficient Safety Standards	1,000	1,000	N/A	N/A	N/A
Innovative Packaging	2,500	2,500	N/A	N/A	N/A
Safe Energy Storage Technologies	2,570	2,570	N/A	N/A	N/A
Administrative Expenses	1,846	1,846	N/A	N/A	N/A
Pipeline Safety	1,214	1,214	N/A	N/A	N/A
Hazardous Materials Safety	632	632	N/A	N/A	N/A
Totals	21,916	21,916	N/A	N/A	N/A

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Chapter 1 – FY 2026 RD&T Programs

Office of Pipeline Safety \$13,714,000

Program Description:

The Pipeline and Hazardous Materials Safety Administration's (PHMSA) Office of Pipeline Safety (OPS) oversees the design, construction, operation, and maintenance of more than 3.3 million miles of pipelines that transport nearly all the natural gas and about two-thirds of the liquid petroleum energy products consumed domestically.

The Pipeline Safety Research and Development (R&D) Program carries out PHMSA's mission and supports the Administration's priorities through sponsored R&D projects to improve the safety of the Nation's pipeline transportation system. In Fiscal Year (FY) 2026, PHMSA's Pipeline Safety R&D solicitations will focus on the following priority areas: Liquefied Natural Gas (LNG) Safety; Pipeline Anomaly Detection and Characterization; Hazardous Liquid Pipeline Leak Detection; Pipeline Threat Prevention; Repair And Rehabilitation; Design, Material, and Welding or Joining; and Underground Natural Gas Storage (UNGS) Facility Safety. PHMSA employs a coordinated and collaborative approach to address pipeline safety challenges.

In FY 2026, the Pipeline Safety R&D Program will be executed through four sub-programs: the Core Program; the Competitive Academic Agreement Program (CAAP); Small Business Innovative Research (SBIR); and 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.

OPS's four research sub-programs work collaboratively to improve the safety, resiliency, and efficiency of pipelines. CAAP funds entry-level academic research, supporting students and university teams to explore new ideas and build early evidence. The Core Program takes those and other findings further with advanced research, engineering, and technology development that produces ready-to-use tools, methods, and technical support for regulators and operators. The SBIR supports small businesses in developing innovative technologies and helps move promising prototypes toward commercial use. The IAA brings in other Federal agencies, laboratories, and partners to share expertise, data, and resources for larger or more specialized projects. Together, these sub-programs close knowledge gaps, test and scale practical solutions, encourage industry adoption, and coordinate efforts so pipeline safety, reliability, and efficiency improve for operators, regulators, and communities. Figure 1 describes the R&D sub-programs by which OPS carries out its R&D Program strategy.

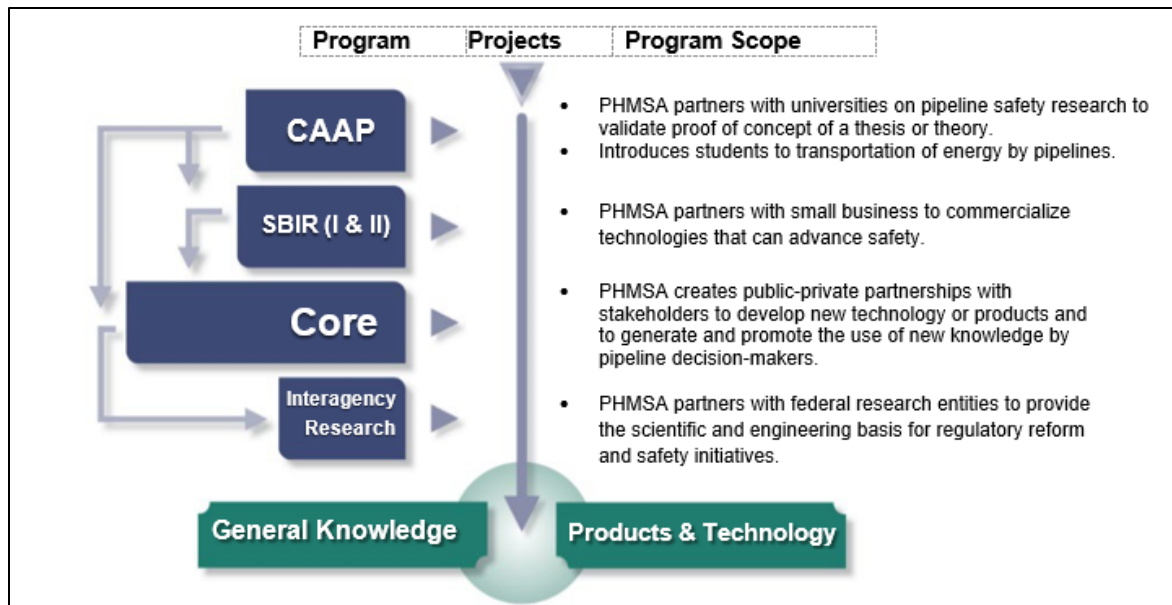


Figure 1 – Comprehensive R&D Program Execution Strategy

Major Program Objectives:

In FY 2026, the Pipeline Safety R&D Program will remain focused on improving pipeline safety through research that provides engineering solutions, applications, and advancement of the safe transportation of energy products. The main objectives are to:

- Help advance a safe and reliable pipeline transportation system for the American public by providing the scientific and engineering basis for improved industry standards and rulemaking.
- Promote emerging technologies that improve safety and efficiency within the pipeline industry.
- Identify and address pipeline safety challenges and research gaps, and invest in research projects that address DOT's strategic goals.
- Explore ways to accelerate safely pipeline transportation of hazardous liquid, natural gas, and emerging fuels consistent with Executive Order (E.O.) 14154, Unleashing American Energy and other Administration initiatives.

PHMSA achieves these objectives through public-private R&D partnerships with pipeline stakeholders and sponsored R&D projects. These efforts aim to fund and to leverage existing resources to develop new technologies, products, and knowledge while promoting stakeholder engagement and transparency.

PHMSA uses its pipeline data along with information gained from public forums, meetings, and its website to establish future research agendas and solicitations.

OPS holds R&D forums on a biannual basis to inform the FY 2026 and FY 2027 funding strategy and R&D solicitations for the CAAP, Core, SBIR, and IAA research sub-programs. The next forum, planned for fall of 2025, will allow stakeholders to discuss current research gaps and challenges in the pipeline industry. OPS staff will identify and lead working groups on various topics, and will include a wide range of attendees from industry, academia, government agencies, and other stakeholders and competency. In addition, this forum will have a roundtable discussion on technology transfer and commercialization, which will provide insight on how to advance innovations and technologies into widespread field application and implementation. In addition, this discussion will better facilitate the role of OPS's R&D program in advancing those technologies. Successful technology transfer is essential for ensuring the use of appropriated funds and promising tools and approaches that can employ real-world impact on safety.

Further, PHMSA regularly invites research partners with commercialized technology funded by OPS to present on their technology and to share lessons learned and success stories with Federal and State inspectors and other PHMSA staff.

The Pipeline Safety R&D Program ensures technology transfer and deployment outcomes by structuring each research initiative with commercialization in mind from the outset. This is partially achieved through technical advisory panel (TAP) requirements on each project. Advisory panels are required to include both industry and academia participation and also may include subject matter experts and other organizations as appropriate. This approach ensures investments are fully leveraged through the demonstration and deployment of resulting products and technologies, accelerating the adoption of transportation innovations. The program also emphasizes identifying leading-edge transportation technologies or products that can be manufactured in the United States. In addition, it advances coordinated interagency efforts to reduce barriers to participation, streamlines access to funding opportunities, and promotes the domestic production of new technologies. Through these efforts, the Pipeline Safety R&D Program bridges the gap between research and real-world application efficiently and effectively.

Figure 2 shows what considerations will inform the Pipeline Safety R&D Program strategy and direct research funding in the upcoming year.¹



Figure 2 – Developing an R&D Program Strategy

Anticipated Program Activities:

For FY 2026, PHMSA plans to invest in the following pipeline safety focus areas consistent with Section 12 of the Pipeline Safety Improvement Act (PSIA) of 2002.

LNG Safety

As expansion of the LNG sector continues, PHMSA will coordinate with LNG stakeholders to develop research solutions addressing performance-based risk reduction at LNG facilities during site location, design, construction, operations, maintenance, and fire protection activities.

The Core and CAAP Research solicitation for FY 2025 included the following research topics related to LNG safety: 1) Acceptable Methods for Modeling Shrouding or Obstructions for LNG Pressurized Liquid Leaks; and 2) Evaluation of Overpressure Technologies for LNG Facilities.

PHMSA’s investments in the new National Center of Excellence for Liquefied Natural Gas (LNG) Safety (Center) support research activities that address safety risks and operational challenges at LNG facilities. In fiscal year 2023, Congress allocated \$2.4 million to establish the Center with up to \$6 million available for LNG focused research. This Center aims to make the U.S. a global leader in LNG safety and operations.

The Center collaborates with Federal agencies, industry, and other stakeholders on research priorities, and responds to emerging trends and needs in the LNG sector. It also will manage research outcomes and create an online repository for sharing best practices with LNG facility operators and others, as required by Section 111 of the PIPES Act of 2020.

The Center is partnering with a national laboratory in FY 2025 to support two safety focused efforts: 1) Nil-wind vapor cloud explosion (VCE) research; and 2) Validation of the Fire Dynamics Simulator (FDS).

¹ Through PHMSA’s R&D online portal, any member of the public may submit ideas for research topics that may require a greater understanding to improve safety. “Collaboration partners” is used to describe all stakeholders participating in providing feedback and information that drives development of the R&D Program portfolio. PHMSA’s internal goals and initiatives are a driving factor in annual strategy planning as well.

Pipeline Anomaly Detection and Characterization

PHMSA will continue investing in solutions to address threats such as corrosion, cracks, dents, and gouges by improving tools and processes to integrate people, processes, and technologies more effectively. Detection capabilities must handle complex and interacting threats, such as multiple defects at once (a mix of dents, cracks, gouges, and corrosion). Improving or developing new methods and technologies to detect issues in multiple materials, such as bending strain or defects in non-steel pipe materials, is also needed. Future research will improve how we detect and characterize defects and develop technology to manage pipeline integrity more effectively.

The Core and CAAP research solicitation for FY2025 includes the following research topics on pipeline anomaly detection and characterization: 1) Inspection Technologies for Facility and Station Piping, Tanks, and Equipment; 2) Technology for Unpiggable or Difficult to Inspect Pipelines; and 3) Non-Metallic Pipe Inspection Technology.

Hazardous Liquid Pipeline Leak Detection

PHMSA will continue to invest in research to improve liquid pipeline leak detection as it is a critical component of ensuring the safe and efficient operation of pipelines. Timely and accurate detection of leaks directly supports public safety, infrastructure integrity, and service reliability. Failures in leak detection can result in hazardous incidents such as fires, explosions, or structural failures—posing significant risks to workers, emergency responders, and nearby communities. In addition, undetected leaks can lead to operational disruptions, increased product loss, and costly unplanned maintenance. Advancing leak detection capabilities supports proactive risk management, enhancing system performance, and enabling more effective oversight of pipeline operators. This research contributes to the development of more reliable and responsive technologies that strengthen safety standards and operational efficiency across the pipeline sector.

The Core and CAAP research solicitation for FY 2025 includes the following research topic on liquid leak detection: Innovative Technologies for Locating Hazardous Liquid Pipeline Leaks.

Pipeline Threat Prevention

Preventing threats and damage to critical energy infrastructure is essential to ensuring safe, reliable, and environmentally responsible operations. Physical damage to oil and gas assets—whether caused by excavation activities, natural hazards, equipment failure, human error, or malicious intent—can lead to severe safety incidents, service disruptions, and long-term operational and financial consequences.

External threats such as third-party excavation, natural forces, and right-of-way encroachments continue to be leading causes of pipeline incidents.² These events pose serious risks to public safety, pipeline integrity, and continuous system operation. Despite existing regulations, technologies, and industry practices, incidents stemming from external interference remain a persistent challenge, often resulting in injuries, environmental harm, costly repairs, and loss of service.

² <https://www.phmsa.dot.gov/data-and-statistics/pipeline/national-pipeline-performance-measures>

Improving the prevention, detection, and mitigation of these threats is critical to reducing the likelihood and impact of future pipeline failures. This research supports the development of advanced tools, strategies, and data-driven approaches that enable pipeline operators and regulators to effectively anticipate, manage, and respond to external threats—thereby enhancing the resilience, safety, and reliability of pipeline infrastructure.

The Core and CAAP research solicitation for FY 2025 includes the following research topics on pipeline threat prevention: 1) Risk Evaluation of Outside Force Damage on Pipeline Equipment and Facilities; and 2) Technology, Equipment, or Procedures to Prevent Human Error.

Repair and Rehabilitation

Damaged coatings, corrosion, and other pipeline damage or defects are major risks to pipeline safety. PHMSA will continue to focus on improving existing, and creating new, reliable repair methods. The Program will focus on enhancing repair materials, techniques, processes, tools, and technology to support this objective.

If the program review process identifies this as a priority for FY 2026, one or more of the Core, CAAP, SBIR, or IAA sub-programs may publish solicitations and seek proposals to address it.

Design, Material, and Welding or Joining

Improvements in automation and inspection capabilities of welding and joining lead to improvements in the safety of construction activities. PHMSA's research in pipeline design and materials aims to identify and minimize integrity threats to all pipelines.

The Core and CAAP research solicitation for FY 2025 includes the following research topic on design, materials and welding or joining: Testing, Modeling, and Verifying Strain Capacity in Pipelines.

The R&D Program is pursuing a partnership with a national laboratory in FY 2026 to support increased efficiency in pipeline design parameters and updating standards. New standards on liquid natural gas pipeline toughness requirements via innovative measurement science and statistical treatment of fracture resistance data.

Underground Natural Gas Storage (UNGS) Facility Safety

The October 2015 Aliso Canyon Gas Storage failure prompted Congress to direct PHMSA to regulate underground natural gas storage (UNGS). In 2018, PHMSA began funding research and building a portfolio of solutions to develop integrity management programs applicable to more than 17,000 wells associated with UNGS facilities in the U.S. PHMSA used lessons learned from facility inspections and investigations conducted over the years to identify research gaps in UNGS. This research is resulting in improved UNGS safety and better management of UNGS facilities through data-driven insight and integration of new technologies. PHMSA will continue research into design and reliability improvements of storage well equipment and maintenance practices while analyzing future research needs in order to improve the safety of UNGS facilities over their life cycle.

If the program review process identifies this as a priority for FY 2026, one or more of the Core, CAAP, SBIR, or IAA sub-programs may publish solicitations and seek proposals to address it.

Potential Program Outputs, Outcomes, and Impacts on Technologies and Practices:

Investments in pipeline, LNG, and UNGS research generate a range of valuable outcomes, including analytical studies, small- and full-scale testing, and the development of new technologies that may result in patents and commercial products. These research outputs support improved safety and operational efficiency, and provide essential scientific and engineering evidence for PHMSA's safety activities, including regulatory rulemaking, inspections, enforcement proceedings, and policy development. Research results are made available publicly through final reports published on the PHMSA website and the National Transportation Library. Researchers also are required to disseminate their findings through conference presentations, proceedings, or peer-reviewed journal articles to ensure broad visibility and impact.

While not all research outcomes are immediately quantifiable, PHMSA's R&D investments have led to measurable safety and efficiency improvements, including the commercialization of 35 technologies to date. The program is actively working to improve the rate of commercialization by identifying opportunities to assist researchers and developers in transitioning innovations into market-ready solutions. To support further technology transfer and encourage adoption across the pipeline industry, PHMSA is expanding stakeholder engagement and outreach initiatives aimed at strengthening the impact and real-world application of funded research. The Pipeline Safety R&D Program's anticipated outputs, outcomes, and impacts are further described below including the related technologies developed:

LNG Safety

Ongoing research projects will result in identifying new methodologies for applying passive protection systems to equipment, piping, and pipe supports to improve fire safety risks; developing new experimental data sets for calculating the extent of fire hazards to the public; and gaining greater understanding of causes, consequences, and prevention of catastrophic failure of LNG storage tanks for emergency response. Research outputs will support the ongoing Title 49 Code of Federal Regulations Part 193 update efforts for design, construction, operation, maintenance, and fire protection to reduce operational safety risks to employees and the public.

Pipeline Anomaly Detection and Characterization

This research is designed to identify critical defects more consistently and accurately within pipelines; improve detection of difficult to detect anomaly types; and improve our ability to inspect traditionally challenging types of pipes and equipment, such as non-metallic and facility piping. Research outcomes will better inform PHMSA and pipeline operators in their integrity management decisions on steel and composite pipe systems to support safer operations and aid in determining pipeline fitness for service. Impacts from the research results will increase stakeholder confidence in pipeline technologies and the accuracy of improved decision-making tools for integrity management. Furthermore, the research impacts will provide pipeline operators with effective instrumentation for detection, allowing for accurate remediation measures that reduce the likelihood of pipeline failures harming the public or environment.

Research resulting in commercialized technology examples include:

- 1) Electro-Magnetic Acoustic Transducer (EMAT) ILI Sensor
<https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=653&text1=>
- 2) Laser Deformation Sensor (LDS)
<https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=496&text1=>
- 3) Applus RDT, Inverse Wave Field Extrapolation (IWEX) technology
<https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=503&text1=>

Hazardous Liquid Pipeline Leak Detection

Projects will develop processes to predict leaks more accurately, and develop, test, and deploy advanced leak detection platforms (ground-based, aerial, and satellite) and protocols under real-time field conditions to provide pipeline operators with critical knowledge on product behavior and real-time data to help locate and quantify pipeline leaks. Impacts from the research findings will lead to further development of advanced leak detection monitoring and identification.

Research resulting in commercialized technology examples include: SmartBall® is a new innovative leak detection technology for oil, gas and petroleum products pipelines larger than four-inch (100 mm) diameter. <https://primis.phmsa.dot.gov/matrix/prjhome.rdm?prj=234>

Pipeline Threat Prevention

PHMSA will continue to invest in research to prevent pipeline threats and damage, including preventing accidents caused by incorrect operation and vehicle collisions. PHMSA incident data shows these causes are associated with a disproportionately high number of injuries and fatalities. Research outcomes aim to assist operators in preventing these high-risk incidents and reducing the rate of injuries and fatalities to both operator personnel and the public.

Research resulting in commercialized technology includes:

- 1) Live Gas Mapper (LGM-2) tool by REDUCT, can map buried live gas pipes with an ID range of 50mm up to 100mm (2" to 4").
<https://primis.phmsa.dot.gov/matrix/prjhome.rdm?prj=734>
- 2) Acoustic Pipe Locator (APL) system detection system is able to resolve multi-utilities with spacing less than 15" for the stepping distance of 6".
<https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=490>

Repair and Rehabilitation

Research outputs will provide reliable methods to repair damaged pipe or coatings, manufacturing defects, and corrosion damage; repair defects in difficult to reach areas; and rehabilitate aging, in-service pipelines. Research outcomes will provide the pipeline industry with validated and safe solutions to complete repairs rapidly and to return pipelines to service, reducing economic losses and customer inconvenience; and to make preemptive repairs more effectively to prevent incidents or shutdowns from occurring. Impacts from these research investments will advance technological solutions and safety by informing improvement of aging pipelines with updated methods for repair, rehabilitation, and replacement.

Design, Material, and Welding or Joining

The development of quality management system guidelines to improve construction-related quality issues can reduce the likelihood of girth weld failures shortly after welding, during lowering-in, during hydrostatic testing, and when in service. Research activities will improve industry's ability to design and construct safe, long-lasting pipelines using the most appropriate materials and welding and joining procedures for the operating environment, and improved knowledge of existing materials can keep existing pipelines operating safely for longer. This research could advance new methods and materials, leading to stronger, more leak-resistant pipelines, and reducing the risk of failures. In addition, research might explore using locally sourced materials, when possible, to extend pipeline lifespans, reducing the frequency of replacements and benefitting local economies.

Research resulting in commercialized technology examples include eStress™ system for residual stress assessment of pipeline damage: <https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=441>

UNGS Facility Safety

Research outputs from UNGS projects will provide reliability-based methodologies focused on well integrity management. Furthermore, research outcomes will provide operators with improved efficiency in managing casing corrosion, potentially reducing delayed maintenance-driven well casing incidents.

Potential Economic or Societal Impacts:

The pipeline infrastructure in the United States is the primary means of transporting natural gas and most hazardous liquids from production basins and ports to areas of consumption. The importance of energy pipelines to the United States economy and the American standard of living requires these assets be maintained for safety and reliability and, where appropriate, transitioned or expanded to meet energy demands while maintaining efficiency and economic strength.

The Pipeline Safety R&D Program plays a significant role in finding solutions to national, regional, and local pipeline operational safety and reliability challenges. The outcomes from Pipeline Safety R&D investments will assist pipeline operators with finding the most suitable technology to meet or exceed efficiently and effectively all Federal and State pipeline safety and integrity regulatory requirements. Knowledge-based research investments will strengthen critical industry consensus standards with the latest scientific information and data to support the safe design, construction, operation, maintenance, and repair of pipelines.

Potential Progress Toward Achieving Modal Strategic Goals:

In FY 2026, PHMSA's Pipeline Safety R&D Program will continue to advance PHMSA's safety mission and the Department's strategic goals as outlined in the DOT FY 2026-2030 Strategic Plan.

- **Safety – Reduce Transportation-Related Fatalities and Serious Injuries Across DOT Transportation Systems.** The OPS R&D Program supports efforts promising outcomes of increased safety through pursuance of better technology or obtaining new knowledge and data.

- ***Infrastructure*** – Invest in Infrastructure to Ensure Safety, Mobility, and Accessibility and to Stimulate Economic Growth, Productivity, and Competitiveness for American Workers and Businesses. The OPS R&D Program prioritizes projects that modernize and extend the utility and longevity of existing assets to accelerate energy product transportation.
- ***Innovation*** – Lead in the Development and Deployment of Innovative Practices and Technologies that Improve the Safety and Performance of the Nation’s Transportation System. The OPS R&D Program focuses resources on developing new technologies and knowledge with feasible implementation.
- ***Efficiency*** – Improve transportation system efficiency by embracing innovation and accountability. The OPS R&D Program embodies efficiency through its diligent stewardship of resources. PHMSA is committed to ensuring that every investment delivers a significant return in advanced technologies and methods which improve safety outcomes.

Collaboration Partners:

The R&D Program is designed to be a collaborative program with industry, academia, government organizations (GOs), and non-government organizations (NGOs). OPS coordinates and collaborates on R&D topics through workgroups, conferences, and meetings with international partners, other Federal and State agencies, and pipeline stakeholders. PHMSA’s R&D forum planned in fall 2025 will continue to foster collaboration and outreach with stakeholders and researchers, discuss current and emerging safety issues, and identify research opportunities to address safety gaps.

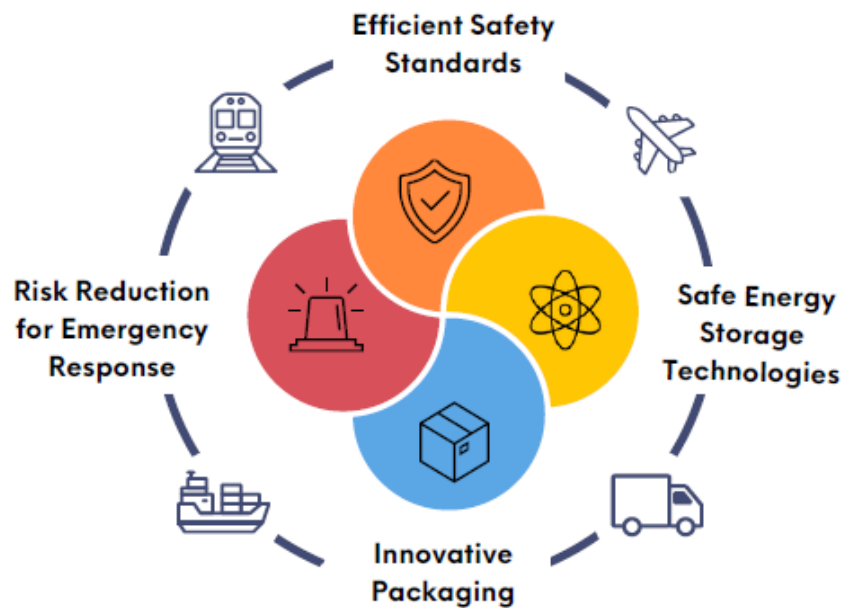
Historically, OPS has established interagency agreements with the Departments of Energy and Interior, and the National Institute of Standards and Technology within the Department of Commerce to conduct materials research. OPS also partners with academic institutions through CAAP. PHMSA ensures that the CAAP publicizes funding opportunities to all higher education institutions. In addition, PHMSA staff participate in the Interagency Coordinating Committee on Oil Pollution Research (ICOPR), a 16-member interagency committee established by Title VII of the Oil Pollution Act of 1990 (Section 7001) to coordinate a comprehensive program of oil pollution research and technology development among Federal agencies, in cooperation and coordination with industry, universities, research institutions, State governments, and other nations.

Office of Hazardous Materials Safety
\$8,202,000

Program Description:

More than 2.3 million hazardous materials shipments move across the U.S. every day, totaling 3.3 billion tons of product per year. There are continuous new developments in hazardous materials transportation, including innovative products, such as novel lithium-ion battery chemistries, advances in packaging design, and alternative methods of transportation. Research provides critical solutions to ongoing and new challenges that make transporting these essential goods around the country safe for all.

The Hazardous Materials Research & Development, Analysis & Technical Assessment Program (OHMS R&D Program) carries out PHMSA's mission and supports the Administration's priorities through sponsored R&D projects aimed at mitigating risks associated with hazardous materials transportation. In FY 2026, PHMSA's OHMS R&D Program will invest in four key areas of research: Efficient Safety Standards; Safe Energy Storage Technologies; Innovative Packaging; and Risk Reduction for Emergency Response.



For FY 2026, the OHMS R&D Program will be executed through various research solicitation avenues, including the Small Business Innovative Research program, Inter-Agency Agreements (IAAs), and projects initiated by subject matter experts. Moreover, PHMSA will collaborate actively with academia and industry, initiating research projects driven by stakeholder input garnered from its research forum and expertise within PHMSA.

Major Program Objectives:

In FY 2026, the OHMS R&D Program will remain focused on improving the safe transportation of hazardous materials through a proactive and holistic approach that enables innovative research, extensive collaboration, and data-driven decision-making. The main objectives are to:

- Reduce the number of injuries and fatalities related to incidents involving hazardous material transportation.
- Continue to engage and collaborate with modal partners on joint research projects and review studies.
- Work with industry to promote emerging technologies and innovative risk mitigation techniques, such as leak detectors and sensors.
- Identify and address the challenges and research gaps in transporting hazardous materials, and support projects that will advance safety.
- Leverage PHMSA's expertise and resources to address the ongoing challenges posed by the transportation of hazardous materials.

Anticipated Program Activities:

In FY 2026, PHMSA will work with its subject matter experts, stakeholders, and modal partners to continue its activities within the following four key areas of research:

Efficient Safety Standards

Through gathering and analyzing robust data, PHMSA will inform changes to hazardous materials safety standards. PHMSA is conducting research to update efficiently the safety standards for the transport of hazardous materials, such as aerosols and de minimis quantities of explosives. This research advances safety by better understanding safety needs and risks, and can reduce unnecessary cost and material burdens on manufacturers. Projects include researching and developing testing and performance standards for understanding the hazards caused by accidental sprays from canisters, and reevaluating de minimis standards for certain explosives.

Safe Energy Storage Technologies

There is growing demand for new energy storage technologies as our daily lives are supported further by personal electronics, micro-mobility devices, and electric vehicles, like long-haul trucks. Demand for more batteries leads to novel safety concerns as we move these energy dense devices all over the country. Since FY 2019, PHMSA has focused on battery safety research and will continue this work into FY 2026 as electrification expands. PHMSA is exploring strategies such as managing end-of-life batteries, finding alternatives to lithium-ion batteries, and assessing battery state-of-charge (SOC) risks. These efforts aim to enhance safety and reduce hazards associated with transporting any energy storage system. Some of these projects include developing a state-of-charge detector, investigating the abuses batteries can incur, and exploring the transportation safety risks associated with alternatives to lithium-ion batteries.

Innovative Packaging

PHMSA also will focus on developing innovative and novel packaging materials and designs to alleviate safety and reliability issues in hazardous materials transportation. This research addresses safety holistically by researching solutions for adverse transportation conditions that can affect a package's integrity. Projects under this research area include expanding innovative battery packaging, investigating packaging requirements in an unmanned aerial systems (UAS) environment for last mile delivery, and developing safety standards to help determine safe wall thickness for aerosol cans.

Risk Reduction for Emergency Response

PHMSA is continuing its investment in research on the safe and effective emergency response to hazardous materials incidents, which present unique risks to responders that need to be well understood and appropriately mitigated. The anticipated projects concentrate on developing leak detection technology for autonomous vehicles, enhancing tracking systems for hazardous material shipments, and improving data to support first responders in hazardous material identification.

Potential Program Outputs, Outcomes, and Impacts on Technologies and Practices:

Efficient Safety Standards

This takes a holistic review of the hazardous material regulation in conjunction with stakeholder interest to understand areas where regulations can be streamlined for efficiency while still maintain an equivalent level of safety.

PHMSA has initiated research into the Determination of Hazards from Accidental Spray Canister Transportation Fires. This project provides vital insights into the risks posed by aerosol canisters during transit. By analyzing the associated hazards from aerosols that can result from an accidental release and identifying key risk factors, it delivers insights and data-driven guidance to improve safety protocols across the transportation industry. These outputs help prevent hazardous material fires, protect workers, and reduce threats to communities near transport routes. Ultimately, the project supports DOT's mission by enhancing public safety and ensuring the secure movement of everyday consumer goods.

Safe Energy Storage Technologies

PHMSA recognizes the importance of researching various energy storage systems, their chemistry, their impact on transportation, and the risks they present. These efforts aim to provide stakeholders across the supply chain with critical information to enhance safety and efficiency. The results will guide hazardous material carriers and shippers in handling, disposal, and transportation while also informing future regulatory changes. By leveraging innovative technologies and data-driven insights, this work ensures PHMSA remains ahead of evolving energy storage trends.

The Safe Li+on project is developing a portable device to measure the State-of-Charge (SOC) and State-of-Health of lithium-ion batteries during transport. This technology helps industry assess the level of risk associated with battery shipments, enabling safer handling and more informed decision-making. By supporting compliance with hazardous materials regulations, it reduces the likelihood and impact of incidents. The effort strengthens transportation safety,

protects workers and communities, and advances DOT’s mission to safeguard the American public.

Innovative Packaging

PHMSA's research aims to enhance hazardous materials transportation by developing innovative solutions to minimize risks associated with packaging failures, strengthening hazard communication, and adapting transportation methods to emerging technologies. By identifying critical safety gaps and implementing practical solutions, this work promotes a more resilient hazardous materials transportation system and informs future regulatory developments.

Notably, PHMSA’s inaugural SBIR Phase II project Battery Logistics Safety System (BLISS) focuses on developing an intelligent packaging solution designed to predict and to contain hazardous effects from batteries in thermal runaway. At the end of Phase II, the small business had functional patent pending prototypes that integrated the BLISS system into a Conex Box, Fire Blanket, and 55-Gallon Drum. BLISS moved into OHMS R&D Program’s first Phase IIB to finish product development and begin pilot testing with industry partners. Ultimately, the BLISS system will provide operators a solution for early thermal runaway detection, and provide first responders a safe method to protect themselves and the public during thermal runaway event.

Risk Reduction for Emergency Response

The safety of first responders is a high priority for PHMSA. In FY26 PHMSA will research ways to support first responders in their mission to protect the public. This research will include updating the emergency response guidebook, developing enhanced personal protective equipment for hazmat response, and streamlining the delivery of critical information during hazmat incidents. PHMSA aims to equip first responders with the highest quality hazmat safety information.

For example, PHMSA will research risks associated with transporting hazardous materials via heavy duty electric vehicles (EVs). The output of this project yields valuable data and testing methodologies on the risk that can be posed in various scenarios between traditional internal combustion engines (ICEs) and EVs, informing the appropriate response to EV HAZMAT incidents. In addition, in FY 2026, PHMSA will continue its work on the survivability of hazardous material placards; specifically, a small business was issued a Phase II award, where the team will refine their prototypes performance and focus on upscaling for commercialization. Potential outcomes from the Phase II award may improve the durability and readability of placards, reducing placard replacement costs for industry while improving life-saving emergency services for the public as responders more easily identify commodities on site and respond accordingly.

Potential Economic or Societal Impacts:

The research activities conducted by PHMSA have a multifaceted impact on society. PHMSA continues to address the variety of risks that batteries introduce into the transportation system, especially as demand for larger energy storage devices grows. This translates into safer, cheaper energy prices for consumers at the pump and other hazardous materials essential to our daily lives. PHMSA aims to deepen the understanding of the risks associated with end-of-life or damaged, defective, or recalled (DDR) batteries within the supply chain and transportation

system. This enhanced comprehension informs regulations and charts a clearer course for safe and efficient critical materials recovery.

Potential Progress Toward Achieving Modal Strategic Goals:

PHMSA's OHMS R&D Program activities directly align with the Department's strategic goals of safety, innovation, and efficiency, as shown in Table 3. PHMSA's core mission is safety and, as such, approaches every project with this core safety mission in mind. This includes everything from evaluating safety standards to protecting against novel materials, such as batteries, and providing critical information for first responders. PHMSA also advances the Department's innovation and efficiency strategic goals by investing in research that reviews and provides data to assist with modernizing existing safety standards. This approach identifies opportunities to reduce regulatory burden and supports the integration of new technologies to maintain and to enhance transportation safety and effectiveness.

Table 3 - OHMS R&D Program Activities Alignment to DOT Strategic Goals

		DOT Strategic Goal			
		Safety	Infrastructure	Innovation	Efficiency
OHMS' Program Activities	Efficient Safety Standards	X			X
	Safe Energy Storage Technologies	X		X	
	Innovative Packaging	X		X	
	Risk Reduction for Emergency Response	X			

Collaboration Partners:

Hazardous materials are transported daily by all modes of transportation (air, rail, highway, and water), underscoring the critical need for collaboration with Federal partners. PHMSA prioritizes joint efforts with these partners to enhance safety and efficiency across the transportation system. PHMSA has forged impactful collaborations with the Federal Railroad Administration (FRA), spanning various projects concerning impact and fire testing on tank cars, portable tanks, and the transportation of liquefied natural gas (LNG). In FY 2026, PHMSA will continue to work with the Federal Aviation Administration (FAA) on Unmanned Aircraft Systems (UAS) safety performance and other risks relating to the packaging system within the UAS. In addition, PHMSA collaborates with the Volpe Center on projects such as fiber-reinforced plastic Cargo Tank Motor Vehicles, risk measurements, and metrics.

PHMSA also engages with an array of external stakeholders and partners who share its objectives. These include other Federal entities such as the National Laboratories, the

Department of Energy (DOE), the Environmental Protection Agency, the Naval Research Lab, the United States Coast Guard, and the National Academy of Sciences. Notably, in FY 2024, PHMSA established an agreement with Pacific Northwest National Lab, within DOE, on innovative hazardous material commodity flow measurement. PHMSA also hosts the Working Group for Lithium-Ion Battery Research. The working group brings together more than 30 regular attendees from more than 10 Federal agencies to discuss ongoing research on lithium-ion battery safety. This helps to increase the flow of ideas and reduce the risk of duplicative work. These partnerships signify a commitment to mutual benefits and shared successes.

Through the SBIR program, PHMSA collaborates with numerous small businesses to identify knowledge gaps, explore innovative research topics, and disseminate new insights to inform regulatory changes.

PHMSA collaborates internationally through communication with Transport Canada and the Interagency Advanced Power Group. Collaboration includes sharing reports and presentations to ensure that PHMSA's work advances hazardous materials safety in the United States and worldwide.

Chapter 2 – FY 2027 RD&T Programs

The AMRP FY2027 outlook in the annual plan is not developed in alignment with the President’s Budget Request of the same year due to the AMRP development schedule per 49 U.S.C. § 6501 – Annual Modal Research Plans.

Office of Pipeline Safety

Program Description:

PHMSA’s Pipeline Safety R&D Program will continue to review incident trends and evaluate the progress of current projects and completed research. In addition, the R&D Program plans to bolster its stakeholder engagement through in-person and virtual meetings to present results from completed projects. The R&D Program will identify additional research gaps and research topics to be funded in FY 2027, including follow-up research determined based on the research outputs from projects completed in prior years.

Major R&D Program Objectives:

The Pipeline Safety R&D Program’s objectives for FY 2027 will continue to focus on safety, innovation, and the safe movement of energy products. PHMSA will conduct a comprehensive review of research projects awarded in FY 2024 through 2026 and, combined with the results of the 2025 Pipeline Safety R&D Forum, identify the strategic research needs and priorities.

Anticipated R&D Program Activities:

Activities from FY 2026 are anticipated to extend into FY 2027, with the Pipeline Safety R&D Program continuing to pursue research investments that align with DOT’s strategic goals and research objectives, and PHMSA’s safety mission. The FY 2027 Pipeline Safety R&D Program will continue to invest in pipeline safety research in the following focus areas: LNG Safety; Pipeline Anomaly Detection and Characterization; Hazardous Liquid Pipeline Leak Detection; Pipeline Threat Prevention; Repair and Rehabilitation; and Design, Material, and Welding or Joining; and UNGS Facility Safety. R&D Program activities also may address emerging safety risks, such as mitigating the effects of geohazards (land movement, landslides, heavy rains, and floods, etc.) on pipelines.

The Pipeline Safety R&D Program will continue to engage with the public and its stakeholders with the goal to advance technological solutions and knowledge that improve the overall safety and reliability of pipeline systems. The Pipeline Safety R&D Program will communicate with stakeholders through public meetings, requests for comments, web site publications, and conferences. The Pipeline Safety R&D Program continues to facilitate interactions with key industry sectors to understand their technology needs, success stories, and challenges, and share those developments through public forums.

Office of Hazardous Materials Safety

Program Description:

In FY 2027, PHMSA's Hazardous Materials Research & Development, Analysis & Technical Assessment Program (PHMSA) will continue initiatives to reduce the risks of hazardous materials transportation and advance new technologies to facilitate the safe, secure, and efficient transportation of hazardous materials. PHMSA will achieve these initiatives through four key areas of research in FY 2027: Efficient Safety Standards; Safe Energy Storage Technologies; Innovative Packaging; and Risk Reduction for Emergency Response.

Major Program Objectives:

PHMSA will continue to focus on the safe transportation of energy products and other hazardous materials by identifying risk management and mitigation tools, improving packaging technologies and designs, and identifying and developing new and emerging transportation technologies through its research projects.

PHMSA's main objectives are to:

- Reduce the number of injuries and fatalities related to incidents involving hazardous material transportation.
- Continue to engage and collaborate with modal partners on joint research projects and review studies.
- Work with small businesses to promote emerging technologies and innovative risk mitigation techniques, such as leak detectors and sensors.
- Identify and address the challenges and research gaps in transporting hazardous materials and support projects that will advance safety and eliminate undue burden on businesses.

Anticipated Program Activities:

PHMSA's FY 2027 research activities will continue to play an important role in advancing the safe transportation of hazardous materials and energy products essential daily lives. Planned projects will investigate emerging battery types; safety assessments at the nexus of automation and HAZMAT transportation; and investigating more efficient and less burdensome safety standards while maintaining safe HAZMAT transportation.

PHMSA is dedicated to safety standards that are practical and effective. PHMSA's OHMS R&D Program supports this by addressing outdated standards, identifying areas of relief, and providing a robust data foundation to inform improvements. FY 2027 projects will encompass these areas. Additional information about DOT Research can be found at <https://researchhub.bts.gov/search>.