

United States Department of Transportation FY 2020 Annual Modal Research Plans

Pipeline and Hazardous Materials Safety Administration (PHMSA)

May 1, 2019

William Schoonover (PHH-1) and Alan Mayberry (PHP-1)

Executive Summary

The Pipeline and Hazardous Materials Safety Administration's (PHMSA) role in the safe transportation of hazardous materials (hazmat) and energy products is essential to improved safety and security in the daily lives of Americans. PHMSA funds research that improves safety, supports supply reliability, and improves business and government productivity. To advance safety, improve pipeline infrastructure, and foster innovation, PHMSA will pursue its Research, Development, and Technology (RD&T) goals in Fiscal Year (FY) 2020 through a variety of projects carried out by its two main units: the Office of Pipeline Safety (OPS) and the Office of Hazardous Materials Safety (OHMS).

PHMSA remains focused on collaboration with all stakeholders to leverage investment and successes to date. PHMSA makes continual efforts to remove duplication, while engaging academia and a wide range of stakeholders to fund and co-fund critical research to develop new technology, products, and knowledge.

Chapter 1. Introduction / Agency-Wide Research Approach

PHMSA's mission is to protect people and the environment by advancing the safe transportation of energy products and other hazardous materials that are essential to our daily lives. PHMSA oversees the transportation of hazardous materials, including energy products, through all modes of the transportation industry. PHMSA operates in a dynamic and challenging environment in which changes in technology, manufacturing, and energy production affect transportation safety. We anticipate that the scope and complexity of our safety mission will continue to grow, requiring us to continuously evaluate how we use information and technology to achieve the Department of Transportation's (DOT) safety goals. PHMSA partners with those who share the goal of developing new technology, products, and knowledge aimed at improving safety in all its research. The research agenda adapts to address existing and future safety threats.

While funding sources, funding amounts, and legislative requirements vary, both research programs seek to spur innovation and solve safety problems using a collaborative and transparent approach.

Research Portfolio Information

Pipeline and hazmat research programs remain fully represented in the U.S. DOT Research Hub and the Repository and Open Science Access portal, as relevant. In each contract, PHMSA mandates several actions that the researcher must take to promote project results. This is our approach for all

PHMSA R&D awards. Mandated actions include promoting commercialization at the end of the contract. For example, demonstrating a technology in front of vendors who may seek to commercialize it for use in the hazmat transport industry is encouraged. In some cases, this commercialization happens long after the end of the contract, limiting PHMSA's ability to observe and track it. PHMSA ensures that awarded research is promoted to decision makers, by contractually obliging awardees to:

- Submit results to peer reviewed public conferences, forums, symposiums, workshops, or trade journals.
- Report any application for a U.S patent.
- Conduct an outcome-focused final meeting via a webinar or in person with invited decision makers and stakeholders.
- Collaborate at public events, such as R&D Forums and workshops, where ongoing work or results are presented.

In addition, PHMSA's research has public project pages filed under the USDOT Research Hub and NTL Digital Library. The OPS program identifies pipeline safety research projects that have successfully led to product commercialization, which are publicly-available on PHMSA's *Technology Research & Development: Success Stories* webpage (<https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=234>). Research program managers maintain their program information on PHMSA webpages and participate in coordinating the transfer of required data fields to the broader DOT, through the USDOT Research Hub and Repository and Open Science Access Portal (ROSA-P).

Acquisition/Assistance

All PHMSA research continues to use a competitive procurement process to manage the pre-award activities leading up to new project awards. PHMSA publicly announces all research project solicitations either on the FedBizOpps website at [FBO.gov](https://www.fbo.gov) or on [Grants.gov](https://www.grants.gov).

All PHMSA research appropriations are available for a 3-year period. PHMSA's Pipeline Safety Research Program (PSRP) is also federally mandated in Section 22 of the PIPES Act 2016¹ to co-fund and share research project costs with non-federal sources. Technology projects require 50 percent cost-sharing. Knowledge generation projects require 20 percent cost sharing. Basic research projects with institutions of higher learning require 20 percent cost sharing. Cost sharing allocations may include monies, material, or personnel.

For the Pipeline program, a PSRP Merit Review Panel (MRP) will evaluate white papers or proposals received using established review criteria to find the best researchers for each project. The PSRP MRPs are comprised of representatives from PHMSA, other federal and state agencies, and the hazardous liquid, natural gas transmission, and natural gas distribution industries. Stakeholder input helps PHMSA leverage successes and remove duplication when compiling a list of award recommendations. A PSRP MRP typically reviews several dozen submitted white papers and proposals and recommends 15 to 20 new project awards.

For the Hazardous Materials Safety Research Program, PHMSA has historically used a competitive procurement process to manage the pre-award activities leading up to new project awards; we intend to continue doing so. Solicitations are publicly announced on the FedBizOpps website.

¹ Public Law 114-183.

PHMSA review panels use focused evaluation criteria to find the best researchers for each project. Review panels comprise subject matter experts for each strategic area, from both PHMSA and other federal agencies. The three-year availability of research funds allows for focused stakeholder and end use agreement. This review process typically begins with 75 to 100 submitted white papers and proposals; from these, the review panels select approximately 15 new projects for funding annually.

The full solicitation and award lifecycle can take the better part of a calendar year, due to the large number of proposals received by both PHMSA programs. Furthermore, this can also mean that there is no standard number of funded research projects from year to year. PHMSA anticipates no sole-source acquisitions in FY 2020.

Technology Transfer (T2)

PHMSA seeks to promote the use of technology from its R&D programs in commercial applications and therefore tracks a variety of research performance measures. PHMSA's policy is to plan for and continually track T2 activities, when possible following-up even in cases where activities occur beyond the contractual timeline of research projects. Final-end users and technology service providers cannot be fully identified until after projects are awarded and T2 occurs. For this reason, PHMSA includes several contractual stipulations in its agreements with research partners to promote and track the transfer of technology to the market. PHMSA uses the best practices below to increase the likelihood of successful transfer of research results to the market:

1. Plan for technology transfer while identifying research priorities.
2. Involve end users (i.e., regulators, pipeline operators, and service providers) in the research gap analysis and road mapping activities; and.
3. Gauge a technology's readiness using demonstrations in front of potential service providers and other end-users.

In each contract, PHMSA mandates several actions that the researcher must take to promote project results, such as promoting commercialization at the end of the contract. In some cases, this commercialization happens long after the end of the contract, limiting PHMSA's ability to observe and track it. PHMSA ensures that awarded research promotes the use of newly gained knowledge by decision-makers by contractually obliging awardees to:

- Submit results to peer reviewed public conferences, forums, symposiums, workshops, or trade journals.
- Report any application for a U.S patent.
- Conduct an output-focused final meeting with invited decision makers and stakeholders via a webinar or in-person.
- Collaborate at public events, such as R&D forums and workshops, where ongoing work or results are presented; and.
- Participate in annual R&D Peer Reviews, where knowledge from research is reviewed and shared.

Information about research projects awarded by PHMSA is made publicly-available on the U.S. DOT Research Hub, the NTL Digital Library, and PHMSA's website. Information for both programs is available at <https://www.phmsa.dot.gov/research-and-development/phmsa-research-and-development>.

Evaluation/Performance Measurement

PHMSA manages the planning, implementation, and reporting of the R&D projects through internal systems implemented by the engineering staff. PHMSA employs close relationships with research partners throughout a project to ensure that it remains on track and is achieving its intended results. PHMSA program managers use project management best practices to track and evaluate project progress towards defined objectives/outcome goals, ensure agreed to milestones and commitments with planning documents are on track, monitor/control program risk, and monitor program funds to ensure they are expended in a timely manner. Additionally, they evaluate projects with respect to research needs, considering key aspects such as timeframes for when results are needed, alignment to the DOT strategic goals, likelihood of achieving expected benefits, criticality, risk, interdependencies, and available funding.

Tasks are put in place to ensure contractor results align with DOT strategic goals. These have been tracked since 2002, which is the modern inception of the program via Public Law No. 107-3552002. These are then presented as relevant to the *DOT Strategic Plan*, *Annual Performance Plan*, or any Program Evaluation requested of this program. The number of projects that develop and demonstrate new technology helps the program assess how many U.S. patent applications have occurred as a result. To promote knowledge for use by decision makers, publicly available final reports are given, along with conference and journal papers, websites, downloaded files. The number of stakeholders reached via public events is also recorded.

Program managers incorporate results of completed projects into concept planning during periodic evaluations of concept status and progress.

The OPS program identifies pipeline safety research projects that have successfully led to product commercialization, which are publicly-available on PHMSA's *Technology Research & Development: Success Stories* webpage. Furthermore, OPS coordinates with its researchers, end users, and known commercial vendors to commercialize technology and measures its impact through tracking tools. OPS tracks those research-funded projects through performance metrics as follows: 1) Technology Demonstrations; 2) Patent Applications (U.S. + Other); 3) Commercialized Technologies (i.e., those products utilized for commercialization); and 4) Commercialization Success Rate (i.e., frequency of each completed research project resulting in commercialization).

Chapter 2. High Priority Project Descriptions

New High-Priority Research Projects for FY 2020

Investigating the Safety and Damage Prevention Issues Surrounding Unlocatable Plastic Pipe

PHMSA is further investigating this issue because pipeline damage from excavation activities is historically a leading cause of incidents. By the end of 2018, there were 1,441,951 miles of plastic pipe. This number will continue to grow, as new plastic pipe is added to accommodate both urban and rural development and as outmoded cast iron pipe is replaced. Technology service providers and the pipeline industry seek to partner with PHMSA to release additional tools to the market that will have higher potential for technology transfer and acceptance by regulated companies. PHMSA has invested in this topic in the past and believes there are further opportunities. The proposed project will develop a solution that can both locate currently unlocatable plastic pipe and differentiate its burial depth and orientation from other underground utilities. The project would also seek information about the deployment of damage prevention solutions and their impact on reducing excavation damage incidents.

Solutions sought under this project align with the DOT Strategic Goal of Safety by reducing the risk of excavation damage to underground pipelines. This research was further encouraged by the Consolidated Appropriations Act of 2019.² PHMSA was authorized to fund continued research regarding unlocatable plastic pipe up to \$2 million. PHMSA investments will be matched with up to 50 percent cost sharing from non-federal sources.

Developing In-Line Inspection Technologies for Detecting Circumferential Anomalies and Bending Stresses

The project will conduct research regarding In-Line Inspection (ILI) technology to detect cracking in pipeline dents in the circumferential orientation. The project will quantify bending stresses, including those caused by geotechnical and environmental conditions. This is a safety challenge identified at multiple prior research forums. While pursuing such research has been a priority for PHMSA in the past, PHMSA has not previously invested in this topic, as it was not able to secure a suitable partner as solicited under its most recent research announcement (693JK3191RA01). PHMSA is not aware of any industry group currently funding the development of such a technology solution.

A technology with this capability would align with the DOT Strategic Goal of Safety by enabling the industry to find such anomalies before failure (i.e., based on the ILI results, the maximum bending stress can be calculated on the pipeline to determine safe operating conditions). Collectively, PHMSA and the pipeline industry have invested in ILI technology, and have met with success in addressing a variety of other integrity threats. However, there has been limited funding to conduct research on pipeline circumferential cracking detection and characterization in dents (particularly bottom side dents). To help further improve pipeline safety, additional research is warranted.

PHMSA anticipates a total project cost of \$750,000, with PHMSA investments matched with up to 50 percent cost-sharing from non-federal sources.

Preventing, Monitoring, or Mitigating Pipeline Corrosion

This project will fund research to address the prevention of corrosion, from the standpoints of design, materials, and how to best monitor corrosion prevention. Research on prevention and mitigation of pipeline corrosion was initiated by PHMSA in 2013. Research and development projects on the prevention and mitigation of corrosion have also been conducted both by pipeline and other industries. Solutions under this project align to the DOT Strategic Goal of Safety and will improve pipeline safety by allowing the industry to deploy and operate pipelines less susceptible to corrosion threats.

Today, industry research focused on corrosion is largely targeted at detection and remediation to comply with integrity management requirements. However, pipeline corrosion in its various forms also remains difficult for industry to prevent and, thus remains one of the greatest areas of safety concern for PHMSA. Academia is highly interested in partnering with PHMSA to further investigate solutions to prevent corrosion from occurring in the first place. Furthermore, developing and implementing innovative corrosion monitoring technology to be more accurate and timely will allow operators to prevent and mitigate pipeline failures caused by corrosion.

PHMSA is pursuing research in this area because, left untreated, corrosion can make pipelines more susceptible to other stresses and increases the risk of other types of pipeline failures. PHMSA will fund corrosion research to address the improper application of specific aspects of design, materials, and

² H.J. Res. 31/Public Law 116-6

coatings, as well as to address the failure to monitor changes in the parameters germane to corrosion prevention.

PHMSA anticipates a total project cost of \$250,000, with at least 20 percent of costs funded by non-federal sources.

Hazardous Materials Commodity Flow

In the execution of our mission to protect people and the environment by advancing the safe transportation of over 1.2 million daily shipments of energy products and hazardous materials that are essential to our daily lives, PHMSA establishes national regulations, develops national policies, and conducts compliance inspections. A founding principle of these efforts is containment of hazardous materials within their packaging. PHMSA obtains information on packaging from industry, investigators, engineers, and incidents, but no formal quantifiable collection exists of the types and quantities of hazmat packaging in transportation. Data on the volume of hazmat transported is currently collected, but such data is only available every five years as part of the U.S Census Bureau economic census collection activities. Data gaps exist when a rulemaking or risk assessment requires an accurate snapshot of a packaging type, or when exposure is gauged using hazmat volumes from five years ago. This project, conducted in cooperation with the Census Bureau and the Economic and Statistics Administration, will bridge those data gaps by giving PHMSA yearly hazmat volumes by commodity, as well as detailed packaging information.

The first phase of this project will consist of: a literature review on hazmat packaging; the development of a background data crosswalk on the costs required to design, test, and manufacture each packaging; development of a data collection instrument; development of an estimation technique; and the development of data products. Subsequently, the Census Bureau will collect detailed hazmat shipment information by commodity and packaging from a sample of approximately 10,000 businesses that are representative of PHMSA's entire regulated community of shippers. These survey responses will be incorporated into national aggregates of commodity and packaging type.

The objective of this project is to validate and provide context to the hazardous material packaging, transport, and incident data that is collected by the agency. This validated commodity flow data will help PHMSA avoid and eliminate burdensome regulation and quickly and precisely calculate the changing risks associated with transport of hazardous materials. The product of this research will be a collection instrument, background research, and data products produced through the development and execution of an annual survey.

PHMSA anticipates a total project cost of \$1,400,000 with cost-sharing from non-federal sources.

Mitigating the Risks and Consequences Associated with Hazardous Material Packaging Rupture

Both industry and PHMSA report that more than 5 million metric tons of commercial explosive materials are transported annually for use in the commercial blasting industry. The continuing industry trend is for higher explosive capacities in larger quantities, which results in increased transportation risk. A vast majority of these materials are transported in bulk containers via water, rail, and highway. Despite the caution of carriers and conservatism of the hazardous materials regulations, accidents continue to occur. Although the national crash rate for bulk explosive transporters is better than that of the average carrier, including those carrying other types of hazmat, the threat of a crash resulting in fire and subsequent detonation of the explosive materials being transported is significant enough to warrant continued research in mitigation and prevention strategies.

This project will research the design and development of improved containers for bulk explosives with a specific focus on cost-effective alternatives to the current steel-based packaging technology. The primary benefits of this novel technology may include:

- Significant reduction—and potential elimination—of risk to the public from the explosion or detonation of explosives transported in bulk by water, rail, and highway.
- Lower life-cycle costs for the blasting and transport industries.
- Use of lighter-weight packaging material, which will reduce both trips needed and transport risk. Lighter weight material equates to more payload or additional safety equipment on each vehicle.

PHMSA expects that the bulk explosives transportation industry will benefit from this work in the ways described and is highly likely to voluntarily adopt the materials and design.

PHMSA anticipates a total project cost of \$1,000,000, with no cost-sharing from non-federal sources.

Fiber Reinforced Plastics Tanks

Fiber reinforced plastics (FRP) can be engineered to meet the performance standard of traditional engineering materials (e.g., steel), while weighing only a fraction of their weight and being inherently corrosion resistant. The use of FRP composite materials for packaging in lieu of steel can reduce not only fuel consumption, but also the vehicle/rolling stock traveling loads placed on the transportation infrastructure. Moreover, FRP materials can be engineered to meet targeted performance requirements, which means manufacturers can “customize” the material design with characteristics that will mitigate damage to hazmat packaging during transportation and thereby improve safety.

PHMSA has issued nearly a dozen special permits with renewable terms for commercial companies to manufacture, sell, and use glass fiber-reinforced plastic (GFRP; a type of FRP made with glass) cargo tanks for the highway transportation of hazmat. Use of GFRP cargo tanks is increasingly common, and they have become the industrial standard for transporting corrosive hazmat. In 2012, the Truck Trailer Manufacturers Association (TTMA) submitted a petition for rulemaking to adopt the provisions in some of these special permits into the Hazardous Materials Regulations (HMR).³

Based on decades of experience evaluating FRP under its special permit authorization, PHMSA is undertaking this project to develop a scientific basis and performance data which will allow FRP packagings to be incorporated in the HMR. At the completion of this project, PHMSA will establish experimental testing procedures and develop a finite element analysis framework for evaluating the performances and determining the specifications of FRP cargo tanks for highway hazmat transportation, and will provide performance data and technical parameters to develop uniform performance standards to be adopted in the rulemaking of the FRP cargo tanks.

PHMSA anticipates a total project cost of \$1,200,000, with no cost-sharing from non-federal sources.

High-priority projects completed in FY 2018/ 2019

Natural Gas Pipeline Leak Rate Measurement System

³ Petition to Expand the HMR to Specifically Provide for FRP Cargo Tanks, P-1608 (November 15, 2012).

This project supported development of the Heath MobileGuard™⁴ gas leak detection system, which consists of a methane/ethane analyzer, a GPS device, a sonic anemometer, and proprietary leak detection software that presents real-time geospatial maps of multiple gas-in-air concentrations. The software's sophisticated leak detection algorithm combines gas concentrations (CH₄, C₂H₆) measured by the system, local coordinates (GPS), and local wind velocity (sonic anemometer) to estimate the leak location. Readings are stored in the device and can be transmitted in real time for centralized monitoring. Due to PHMSA research funding that further improved the technology; the laser-based sensor has a sensitivity and precision more than 3,000 times greater than legacy methods. This enables identification of leaks several hundred feet away from the source.

The project's total investment of \$456,794 addressed both the Department's Safety and Infrastructure Goals, with \$226,794 in funding from PHMSA and \$230,000 from non-federal sources. Although no further PHMSA investment will be made in this specific technology for mobile-based applications, both PHMSA and industry partners will further invest in methane leak detection technology to cover all aspects of natural gas pipeline operating environments.

Improving Emergency Response

PHMSA is committed to promoting the safe transportation of hazardous materials through populated areas and to help first responders better respond to mishaps involving hazmat. To improve hazard communication and emergency response, PHMSA has begun developing the platform, through which different alerting and notification systems are used to alert and protect the public from hazardous material incidents and releases. The primary focus of the research undertaken was to facilitate timely multi-stakeholder information exchange by joining various information and communication technologies into one system that would be available to multiple stakeholders in a real-time environment.

PHMSA research utilized two approaches for this system. The first effort developed a mobile application that provides cargo-specific hazmat data to first responders in the event of a hazmat incident. The app provides real-time information about potential hazmat hazards, including explosive quantity-distances, the potential for a toxic cloud, spill data, and other surface danger zone considerations. Cargo-specific information can be incorporated and obtained through radio frequency identification, to include the amount of hazmat being carried, secondary hazard considerations based on other cargo, and safe distance calculations based upon the amounts of each. Finally, the app can track the location of responding personnel and warn on-site personnel of new or increasing hazards as they arise.

The second effort constructed a foundational HazSMART suite, which leveraged existing communication frameworks and existing technologies such as AskRail⁵, telematics, UAV application support, HM-ACCESS and GIS data. This HazSMART system is intended to be accessible through desktop or mobile devices and will allow real-time sharing of critical information to diverse group of stakeholders. PHMSA is currently beta-testing these programs and plans to make them available to interested cities, states, or regions, as well as local law enforcement and first responders.

⁴ <https://heathus.com/>.

⁵ AskRail is a trademark of Railinc Corp. and the Association of American Railroads. Copyright © 2020 Association of American Railroads. <http://askrail.us/>

Chapter 3. – FY 2020 Program Descriptions

FY 2020 RD&T Program Funding Details ⁶

RD&T Program Name	FY 2020 Enacted (\$000)	FY 2020 Basic (\$000)	FY 2020 Applied (\$000)	FY 2020 Development (\$000)	FY 2020 Technology (\$000)
Pipeline Safety	\$16,363			\$16,363	
Threat Prevention	\$2,600			\$2,600	
Leak Detection	\$2,555			\$2,555	
Anomaly Detection/ Characterization	\$2,945			\$2,945	
Underground Gas Storage	\$900			\$900	
Liquefied Natural Gas	\$1,000			\$1,000	
Transportation Technology Center	\$3,000			\$3,000	
Competitive Academic Agreement Program	\$2,000			\$2,000	
Administrative Expenses	\$1,363			\$1,363	
Hazardous Materials Safety	\$8,116		\$8,116		
Risk Management and Mitigation	\$1,400		\$1,400		
Emerging Technology	\$2,400		\$2,400		
Packaging Integrity	\$2,500		\$2,500		
Technical Analysis to Aid Risk Assessments	\$1,270		\$1,270		
Administrative Expenses	\$546		\$546		
Totals	\$24,479		\$8,116	\$16,363	

⁶ PHMSA's research activities fall under a small number of programs. To provide a better understanding of the research, the details in this plan have been reported at the project level.

FY 2020 RD&T Program Budget Request by DOT Strategic Goal

RD&T Program Name	FY 2020 Enacted (\$000)	SAFETY (\$000)	INFRA- STRUCTURE (\$000)	INNOVATION (\$000)	ACCOUNT- ABILITY (\$000)
Pipeline Safety	\$16,363	\$13,135	\$3,228		
Threat Prevention	\$2,600	\$1,705	\$895		
Leak Detection	\$2,555	\$1,900	\$655		
Anomaly Detection/ Characterization	\$2,945	\$1,995	\$950		
Underground Gas Storage	\$900	\$900			
Liquefied Natural Gas	\$1,000	\$1,000			
Transportation Technology Center	\$2,500	\$2,500			
Competitive Academic Agreement Program	\$2,500	\$2,000			
Administrative Expenses	\$1,363	\$1,135	\$228		
Hazardous Materials Safety	\$8,146	\$5,146		\$2,970	
Risk Management and Mitigation	\$1,400	\$1,100		\$300	
Emerging Technology	\$2,400	\$1,200		\$1,200	
Packaging Integrity	\$2,500	\$1,500		\$1,000	
Technical Analysis to Aid Risk Assessments	\$1,270	\$1,000		\$270	
Administrative Expenses	\$546	\$346		\$200	
PHMSA Totals	\$24,479	\$18,781	\$2,728	\$2,970	

Pipeline Safety

Funding Request (\$16,363,000)

Program Description/Activities/Objectives:

PHMSA's Pipeline Safety Research Program (PSRP) supports the PHMSA mission by sponsoring research that will improve safety, protect the environment, and enhance the reliability of the Nation's pipeline transportation system. The primary RD&T objectives are to develop new technology or products and to generate and promote the use of new knowledge by pipeline decision-makers at any level.

In executing our program strategy, PHMSA creates public-private partnerships with stakeholders who share our safety objectives; employs a coordinated and collaborative approach to address pipeline challenges; focuses on removing technical and regulatory barriers for given challenges; measures research results, outputs, and outcomes; and posts all program processes, actions, and data on our program website (<http://www.phmsa.dot.gov/pipeline/research-development>).

PHMSA's PSRP seeks to achieve our program objectives by awarding new research in the following subprogram areas.

Preventing Pipeline Threats/Damage

Activities in this subprogram include examining tools to alert pipeline operators to possible intrusions to pipelines (e.g., excavation damage), helping operators map existing pipelines, making new plastic pipes intrinsically locatable, or making unlocatable plastic pipes locatable in advance of planned excavations. Further opportunities in this subprogram area include investigating high-altitude imaging, artificial intelligence or machine learning, and predictive analytics to mitigate external threats to our Nation's pipeline infrastructure.

Improving Pipeline Leak Detection Systems

Activities in this subprogram are developing new or improved tools and technology solutions for locating, quantifying, and reducing the volume of uncontrolled product released into the environment. Further opportunities in this subprogram area include using artificial intelligence or machine learning in identifying small leaks before they lead to catastrophic ruptures.

Improving Anomaly Detection and Characterization

Activities in this subprogram are designed to support the pipeline industry in making integrity management decisions and finding and removing critical defects in their systems. This subprogram will support efforts to identify interacting threats within pipelines and will provide operators with effective instrumentation allowing for accurate remediation measures. PHMSA seeks solutions that are both "in-ditch" and internal to the pipeline.

Improving Safety Systems for Underground Gas Storage (UGS)

Activities in this subprogram support refinement of integrity requirements for UGS to prevent incidents such as the 2015 Aliso Canyon gas storage well release of more than five billion cubic feet of methane. These activities further support the development of new policy for the safe operation of these types of

facilities and for the reduction of environmental impact due to uncontrolled releases.

Improving Safety Systems for Liquefied Natural Gas (LNG) Facilities

Activities in this subprogram examine regulatory requirements and standards incorporated into the Code of Federal Regulations for LNG, performance gap analyses, and Quantitative Risk Assessment methodologies so that they can keep pace with growing demand to export LNG. Further opportunities in this subprogram area include addressing performance-based risk reduction at every type of LNG facility during site location, design, construction, operations, maintenance, and fire protection activities.

Pipeline Safety Research, Development & Testing Facility

PHMSA's efforts to utilize the U.S. DOT Transportation Technology Center (TTC) offers an opportunity to improve pipeline safety by expanding the research and innovation capabilities of the pipeline industry to a level currently unavailable today and facilitate cooperative research partnerships amongst PHMSA stakeholders. TTC can be used to streamline research, evaluate new technologies, and address pipeline safety gaps in an environment simulating near real-world scenarios. The TTC facility can support a test-bed approach to provide a greater understanding and facilitation of implementation of innovative technologies, and demonstrate the viability of the technology. PHMSA is pursuing near-term projects in this subprogram area based on stakeholder input and discussions leveraging TTC's current capabilities as follows:

- Utilize Vibration Test Unit to identify pipe fatigue damage occurring during transportation on railroad flat cars that will develop new load bracing and blocking standards industry-wide.
- Analyze load/stress effects and operating integrity on uncased pipelines installed under railroad tracks to determine if casing is still required.
- Utilize existing advanced metallurgy lab to examine failed/damaged pipeline segments and validate the results of ILI tool technologies.
- Utilize the TTC Emergency Response Training School to provide gas pipeline fire simulator hands-on training provided to firefighters.
- Study underground pipelines with simulated (inert) gas and liquid leaks to advance drone and satellite detection of sub-surface pipeline leaks and aid in inspection during emergency response situations.

Competitive Academic Agreement Program (CAAP)

The CAAP will potentially address research in any of the subprograms that establishes a proof of concept and is designed to transition to further investigations within CAAP or demonstration and deployment work leading to commercialization in the market.

Statutory Requirements:

The PSRP is congressionally mandated to carry out a program of research, development, demonstration, and standardization to help ensure the integrity of pipeline facilities. This requirement was instituted via the *Pipeline Safety Improvement Act of 2002* and subsequently amended by the *Pipeline Safety, Regulatory Certainty and Job Creation Act of 2011* and the *Protecting our Infrastructure of Pipelines and*

Congress noted in the *Consolidated Appropriations Act of 2019* that it is encouraged by PHMSA's ongoing efforts to address safety and damage prevention issues surrounding unlocatable plastic pipe and the resultant excavation hazards.¹⁰ It authorized PHMSA to spend up to \$2,000,000 to continue to research, analyze, and encourage the deployment of technologies in this area. PHMSA will solicit research applications for this topic in FY 2019 and will obligate FY 2019 funding early in FY 2020.

Program Alignment with Strategic Goals:

In FY 2020, the PSRP will help advance the safe transportation of energy products essential to the economy and our daily lives by conducting research supporting the Department's Safety and Infrastructure strategic goals. Effects of this work address both national and local challenges in urban and rural communities. The PSRP is focused on systemic, performance-based approaches to ensure pipeline transportation safety and preserve the environment, ensuring the safety and cost-effectiveness of transportation of energy by pipelines. It will also investigate pipeline assets to optimize material cost and durability.

DOT Strategic Goal	Research Topic Areas
Safety Infrastructure	Systemic Safety Approach State of Good Repair Environment Stewardship

USDOT Research Priorities:

Program Alignment with Research Priorities:

The Pipeline Safety Research Program (PSRP) addresses the following Department Research Priorities:

Economic Impact of Regulatory Reform

PHMSA's research proposals explore new technologies, assess emerging risks, strengthen industry consensus standards, and inform safety policy decision makers. This research supports the Department's regulatory reform goals by identifying opportunities for regulatory relief. The PSRP analyzes and attempts to select forward-looking initiatives in technology that can diminish possible rulemaking challenges and build upon existing peer-supported scientific research. The PSRP supports industry compliance with existing standards and works to identify and implement improved standards. Through this process, the PSRP will support the Department's regulatory reform goals while building upon PHMSA's safety mission by facilitating the development, deployment, and evaluation of safety products and systems.

Economic Impact of Permitting Reform

Industry often requests PHMSA's special permits because opportunities for improved efficiency can be

⁷ Public Law 107-355

⁸ Public Law 112-90

⁹ Public Law 114-183

¹⁰ H.J. Res. 31/Public Law 116-6

achieved—with equivalent safety performance—using new technology or processes. The PSRP provides data, research outcomes, and technology to industry that can enhance these permitting opportunities and allow industry to improve the cost effectiveness of their regulatory compliance. Over time, as data are accumulated that further demonstrate more efficient or cost-effective technologies that present an equivalent or better level of safety, PHMSA can incorporate these findings into subsequent deregulatory rulemakings.

Performance Based Regulations

In some cases, PHMSA’s regulatory system establishes minimum safety requirements, while allowing industry to determine how best to comply. Industry has the discretion to employ techniques, processes, and technologies that are developed through the PSRP to improve its operational efficiency and find the most cost-effective method to comply with safety standards.

Research Collaboration Partners:

PSRP’s collaboration and interaction with research partners and stakeholders is consistent across all identified subprogram areas. PHMSA periodically sponsors Pipeline R&D Forums, announced in the Federal Register and on social media, to conduct technical gap analyses and generate research topics in cooperation with hundreds of public and private stakeholders. These stakeholders identify technology and knowledge gaps within our subprogram areas, which are then incorporated into PHMSA pipeline research solicitations. This process allows PHMSA to focus on these identified gaps and avoid duplicating efforts from other public or private funding entities. This process creates stakeholder-based justifications for federal investment in nationally recognized pipeline safety challenges. The most recent forum example can be found at: https://primis.phmsa.dot.gov/rd/mtg_091118.htm.

PHMSA has been considering measures to further expand stakeholder involvement and engagement, in addition to the interaction at research forums. In March 2019, the PSRP released a Special Notice for “Identifying Pipeline Safety Research Ideas” in the Federal Business Opportunities portal. The Special Notice invited any interested stakeholder to submit ideas for future research. This notice will be open year-round and revised every six months to reflect further guidance for interested stakeholders. PHMSA is taking this action to widen the participation in formulating its future PSRP strategy. Currently, this inaugural action is managed by forms submitted on research ideas, but will be revised to a web-based portal for future notices. Please find more information at: <https://www.fbo.gov/spg/DOT/PHMSA/PHMSAHQ/693JK319SN0001/listing.html>.

The PSRP tracks all research collaboration partner and stakeholder interaction via its Management Information System. The following metrics are available by request and are tracked on the program webpage:

- Number of Public Research Events Held;
- Number of Public Research Event Attendees;
- Number of R&D Program Downloads;
- Number of R&D Project Deliverables Downloads;
- Number of Program Website Visits; and
- Number of Submitted Research Ideas.

In developing future program strategy, Congress directed PHMSA to consult with the widest array of

stakeholders possible via Section 12, Paragraph 2 of the *Pipeline Safety Improvement Act of 2002*.¹¹ Congress also provided PHMSA with direction on the required level of co-funding of its pipeline research via Section 22 of the *Pipeline Safety, Regulatory Certainty and Job Creation Act of 2011*.¹²

The benefits of research collaboration and stakeholder engagement are many. PHMSA understands that engagement enriches the program so that it remains focused on addressing the highest priorities, leverages successes by others, and supports meeting our mandates. Robust engagement also ensures that all stakeholders are mutually aware of program implementation and the location of reported research results. To ensure that the most capable researchers are selected for award and to minimize duplication, other federal and state agencies—as well as representatives from the natural gas transmission and distribution and hazardous liquid pipeline industries—assist in the pre-award merit review of submitted research proposals. Finally, academia assists the PSRP in a post-award peer review of progress made, collaboration, content, and quality of research projects. The post-award peer review results in recommendations to raise the likelihood of success.

Government and non-government research partnerships are frequent, and provide clear opportunities to leverage prior or ongoing successes, co-fund research on mutual challenges, and remove duplication. PHMSA briefs trade associations and the pipeline industry throughout the year on the research programs and consults with them on individual projects when such projects are in their sphere of expertise. A list of research collaboration partners, including many government organizations (GO) and non-government organizations (NGOs) and partners who co-fund research with PHMSA, is provided below.

- American Gas Association (NGO)
- American Petroleum Institute (NGO)
- American Public Gas Association (NGO)
- American Society of Mechanical Engineers (NGO)
- Association of Oil Pipe Lines (NGO)
- California Energy Commission (GO)
- Department of Agriculture (GO)
- Department of Commerce: National Institute of Standards and Technology (GO)
- Department of Energy (GO)
- Department of the Interior: Bureau of Safety and Environmental Enforcement (GO)
- Environmental Protection Agency (GO)
- Interstate Natural Gas Association of America (NGO)
- NACE International (NGO)
- National Association of Pipeline Safety Representatives (GO)
- National Energy Board of Canada (GO)
- Northeast Gas Association/NYSEARCH (NGO)
- Operations Technology Development (NGO)

¹¹ Public Law 107–355

¹² Public Law 112-90

Hazardous Materials Safety

Funding Request (\$8,116,000)

Program Description/Activities/Objectives:

R&D plays a vital role in helping OHMS achieve its goal of enhancing the safe transport of hazardous materials. While hazardous materials are transported daily by licensed and trained professionals operating in well-defined systems, accidents resulting in loss of life and environmental damage still occur. In FY 2020, OHMS intends to continue its focus on research efforts within the core areas of risk management and mitigation, package integrity, emerging technologies, and technical analysis to aid risk assessments.

Risk management and mitigation research aims to minimize the probability of hazmat transport incidents and associated consequences. Specific projects in this strategic area include identification and development of risk management methods to assess hazmat transport, as well as identification of communication tools and best practices to ensure results are communicated to the transport industry. The goal of the risk management program is to improve public safety and protect the environment by identifying transport risks and developing mitigation strategies. Risk reduction strategies are designed to lower transport-related injuries and fatalities, increase packaging and operational safety, and improve system reliability. Specific outcomes for projects funded under the initiative include: improving transport safety through development and application of new risk models and methodologies; using data analytics in hazmat transport research; raising public confidence in regulatory agencies by incorporating stakeholder feedback; fostering transportation industry innovation; supporting the development of national and international transport and packaging standards; and identifying industry best practices and publicizing lessons learned.

OHMS research also focuses on packaging integrity (i.e., ensuring hazmat remains contained within its packaging during transport). Accordingly, R&D efforts in this strategic area are designed to evaluate and verify the suitability and effectiveness of packaging standards and practices and improve transport safety by developing, evaluating, and testing new packaging technologies and materials. Specific research areas will include testing and evaluation of existing packaging materials and packaging technologies; analysis, evaluation, and performance evaluation of emerging packaging materials and methods; and evaluation of component materials of combination packaging. The goal of the packaging integrity program is to improve public safety and protect the environment by improving bulk and non-bulk packaging designs, packaging standards, and packaging performance test requirements. Improved package design and performance testing will lower transportation-related injuries and fatalities and better protect the environment because they will do a better job of containing materials, making them easier to handle and transport. Outcomes for projects funded under the initiative will decrease transportation accidents and incidents by improving packaging integrity, thereby enhancing a package's ability to contain its contents during hazmat-transportation incidents and accidents. This program will decrease deaths and serious injuries resulting from package failure or improper use of packages, as well as improve safety, by promoting better understanding of packaging performance. Lastly, it will decrease accidents and incidents caused by human error by improving and simplifying operating and handling instructions.

OHMS research focuses on understanding and promoting emerging technologies. Transport of emerging technology expands proportionally to the increase in U.S. production efforts. This expansion includes new energy sources, transport systems, and packaging technologies. Research is designed to identify and analyze emerging materials, processes, packaging technologies, and transport operations, as well as to assess their potential risks or benefits to the existing hazmat transport network. PHMSA hazmat research

on emerging technologies and materials will focus on analysis of emerging energy products, including various grades of crude oil and liquefied natural gas; analysis of new packaging materials and technologies; analysis of transportation systems and operations; and international collaborative research to improve export of U.S. energy products. The goal of the emerging technology program is to improve public safety and protect the environment by developing new packaging materials and new transport systems. This risk reduction strategy is designed to lower the probability of hazmat transport incidents or accidents, and lower the consequences of such incidents and accidents through enhanced containment of hazmat. Outcomes for projects funded under the initiative will demonstrate the feasibility of innovative transport systems and technologies to improve the safety of hazmat transport, share PHMSA's successes with its modal and industry partners, and advance the development of new packaging materials and technologies to improve package performance. Lastly, it supports the improvement of packaging safety standards, the development of hazmat transport best practices, and the documentation of lessons learned in safety operations.

Lastly, OHMS research focuses on technical analysis to aid risk assessments. Change is a constant in both the hazmat and transportation industries. The risk assessments, conceptual models and frameworks, and the evaluation methods OHMS uses to evaluate activities, events, and incidents must adapt constantly to keep pace. Research strives to identify options to prevent fatalities and injuries resulting from hazmat transportation incidents. Planned research activities include analysis of individual incidents and accidents involving hazmat to determine root cause; determination of patterns or anomalies within packaging or systems; and development of new inspection and test methods to classify materials and certify packaging. The goal of the technical assessment program is to improve public safety and protect the environment by using data analytics, accident analysis, failure modelling, and newly developed risk-management methodologies and strategies to lower accident rates and decrease material releases. Projects funded under the initiative will provide the hazmat transportation community with the means to improve safety by applying the preventative and corrective measures that result from the modeling, research, and analysis of transport accidents and incidents. Projects will also provide the transport community with the means to take advantage of technology and integrate affordable and sustainable technology solutions that improve transport safety. Lastly, projects will increase effectiveness and efficiency of hazmat transportation by identifying processes and methods that support continuous improvement in transportation industry, safety management, and regulatory development.

Statutory Requirements:

The research programs conducted by OHMS support the mandate for R&D found in the *Fixing America's Surface Transportation Act of 2015*, or the FAST Act. Section 6014 of the FAST Act authorizes PHMSA to conduct research activities including, but not limited to, emergency planning and response (including information and programs that can be readily accessed and implemented in local jurisdictions); risk analysis and perception and data assessment; commodity flow data (including voluntary collaboration between shippers and first responders for secure data exchange of critical information); integration of safety and security; cargo packaging and handling; hazmat release consequences; and materials and equipment testing.

Required LNG research through the National Academies of Science: The joint explanatory report to the enacted appropriations for FY 2020, P.L. 116-94 states, "Liquefied Natural Gas (LNG) by Rail - The agreement provides \$1,000,000 for PHMSA to enter into an agreement with the National Academies of Sciences, Engineering, and Medicine, within 45 days of enactment of this Act, and to complete a study

through the Transportation Research Board, no later than 18 months after enactment of this Act, on the transportation of LNG in rail tank cars. The study should inform rulemaking.

Alignment with Strategic Goals:

The OHMS research and development program directly supports DOT's Safety and Innovation strategic goals. The program's mission is designed to solve complex problems in the packaging and movement of hazardous materials. This includes identification of best practices regarding hazmat transportation (e.g., better classification of the most dangerous products), development of new packaging materials and methods to contain such products, and the conduct of engineering and scientific analysis to reduce regulatory burdens. The program funds multi-modal programs supporting improved packaging and equipment designs that improve performance of highway transport vehicles, rail cars, airplane cargo holds, and vessels used to transport hazmat. It places significant emphasis on innovative ways to facilitate efficiency of commerce, while enhancing safety.

Program Alignment with Research Priorities:

Economic Impact of Regulatory Reform

OHMS's research proposals explore new technologies, assess emerging risks, strengthen industry consensus standards, and promote the use of knowledge to decision makers. This research supports the Department's regulatory reform goals by identifying new projects that present opportunities for regulatory relief. OHMS's R&D program analyzes and attempts to select forward-looking initiatives that can diminish possible rulemaking delays and build upon existing peer-supported scientific research. PHMSA's R&D program supports industry compliance with existing standards and works to identify and implement improved standards. Through this process, OHMS R&D will support the Department's regulatory reform goals while building on OHMS's safety mission by facilitating the development, deployment, and evaluation of safety products and systems.

OHMS's research in technical analysis to support risk assessments will be used to identify better, more efficient regulatory requirements. Existing requirements are sometimes prohibitively restrictive because their basis may be out of date or flimsy (built upon inadequate operational experience or a risk assessment method that was inadequate).

Risk management and mitigation research seeks to identify and communicate best practices in hazardous materials transport methods that the industry can adopt without the need for additional regulation. Research includes development of new inspection and test methods used to classify materials and to certify packaging. For example, OHMS's research in the development of new packaging materials would have a positive economic impact on regulatory reform through potential incorporation of new technology into next-generation packaging. OHMS's investments in leak detection technologies expand the options that operators have for complying with accident response requirements, allowing operators to select an optimal technology for their specific operating circumstances.

Economic Impact of Permitting Reform

OHMS's special permits are often requested by industry because opportunities for improved efficiency can be achieved—with equivalent safety performance—using new technology or processes. The R&D program provides data, research outcomes, and technology to industry that can enhance these permitting

opportunities and allow industry to improve the cost effectiveness of its regulatory compliance. Over time, as data are accumulated that further demonstrate that more efficient or cost-effective technologies present an equivalent or better level of safety, OHMS can then incorporate these findings into subsequent deregulatory rulemakings. OHMS's research in emerging energy products will identify new packaging materials and technologies to improve transport and facilitate potential export. Initial use of these technologies may occur under a permitting regime allowing the operator and OHMS to gain experience with the technology prior to full implementation.

Performance Based Regulations and Safety

In some cases, OHMS's regulatory system establishes minimum safety requirements while allowing industry to determine how best to comply. Industry has the discretion to employ techniques, processes, and technologies that have been developed through the R&D program to improve their operational efficiency and find the most cost-effective method to comply with safety standards. OHMS's current research will support development of standards in all types of packaging materials, including testing and evaluation of existing packaging materials and packaging technologies, as well as analysis and performance evaluations of emerging packaging materials and methods.

Additionally, OHMS's research in improving emergency response guidance has potential to help facilitate timely multi-stakeholder communication and information exchange to achieve rapid, effective responses to a variety of safety and security events by creating an integrated, flexible solution that meets the hazmat transportation sector's unique requirements. This research opportunity will allow stakeholder access to relevant, proximity-based information on desktop and mobile platforms, so that any safety precautions or actions can be implemented swiftly and efficiently.

Improving the Mobility of Freight

OHMS's research in hazardous materials packaging serves to enhance the mobility of freight by providing designs and specifications for packages that will perform well independently of transportation mode. Developing standards that encompass all modes reduces potential bottlenecks in intermodal freight transportation. It also allows OHMS's regulations to be harmonized with international standards, removing barriers to U.S. exports. Examples include research and potential implementation of a systematic approach to improve packaging design and promote the safe and efficient shipment of hazardous materials by multi-modal transportation, as well as research in improving hazard communication for consistency and efficiency in a multi-modal environment.

Feasibility of Micro-Transit

OHMS's initial research in Automated Vehicles (AV) will identify any potential hazardous materials-related barriers to very small vehicle transportation. Autonomous technology, including drones, may revolutionize how we travel, transport goods, and connect. The objective of OHMS's research into the carriage of hazardous materials by AV is to identify, characterize, and quantify risks associated with pairing emerging technology and hazardous materials transport in a multi-modal, micro-transit environment.

Improving Mobility for Underserved Communities

The Department's ongoing AV initiative highlights the importance of ensuring that rural and other underserved communities are not forgotten in outreach and research initiatives. OHMS's initial research

in AV will identify any potential barriers to the potential use of AV technology for the transport of hazardous materials in these underserved communities.

Research Collaboration Partners:

PHMSA periodically sponsors OHMS R&D Forums to conduct technical gap analysis and research topic road-mapping with hundreds of public and private stakeholders. These stakeholders identify technology and knowledge gaps within our strategic areas, which are then incorporated into PHMSA's hazmat research-needs statements. This process allows PHMSA to focus on actual technology and knowledge gaps and avoid duplicating the efforts of other public or private funding entities. This process creates stakeholder-based justifications for federal investment in nationally recognized hazmat safety challenges. The most recent OHMS R&D Forum took place in October 2019.

PHMSA coordinates with other DOT Operating Administrations to identify mutually beneficial partnerships through monthly department research meetings, as well as meetings between PHMSA and individual modes. These partnerships provide such benefits as clear opportunities to leverage prior or ongoing successes and to co-fund research on mutual challenges. Modal authorities (including the Federal Railroad Administration, the Federal Aviation Administration, the Federal Motor Carrier Safety Administration, and the U.S. Coast Guard) are consulted and briefed on the overall research program and on projects relevant to their specific mode. This coordination allows PHMSA to eliminate duplication, as well as helping to illuminate whether the government should lead in a specific area or defer to industry. PHMSA receives support in conducting and verifying safety gap analyses and developing programs to address gaps. PHMSA also provides feedback on research and program plans through the National Academies of Sciences and the Transportation Research Board's Hazardous Materials Cooperative Research Program. PHMSA also solicits research-needs statements and enters into agreements with federal entities, including Volpe National Transportation Systems Center, Argonne National Laboratory, Sandia National Laboratory, National Institute of Standards and Technology, and the Transportation Research Board. PHMSA also coordinates with international regulatory entities, including the United Nations, the International Maritime Organization, the International Civil Aviation Organization, and the International Atomic Energy Agency. The list below provides additional external entities with which PHMSA has partnered and which are options for future projects in FY19.

Association of American Railroads	Institute of Makers of Explosives
American Chemistry Council	Industrial Packaging Alliance of North America
American Fuel and Petrochemical Manufacturers	National Association of Chemical Distributors
American Pyrotechnic Association	National Industrial Transportation League
American Petroleum Institute	National Propane Gas Association
American Short line and Regional Railroad Association	National Tank Truck Carriers
American Trucking Associations	Rechargeable Battery Association
Compressed Gas Association	Reusable Industrial Packaging Association
Chlorine Institute, Inc.	Railway Supply Institute
Council on Safe Transportation of Hazardous Articles	Fertilizer Institute
Commercial Vehicle Safety Alliance	Sulphur Institute
Dangerous Goods Advisory Council	

Chapter 4. FY 2021 Program Descriptions

Pipeline Safety

Program Description/Activities/Objectives:

The PSRP mission and strategy for program execution will remain unchanged in FY 2021. Public-private partnerships will remain a priority in technology development, and the active engagement of all stakeholders will help shape the specific FY 2021 agenda. The makeup of subprogram areas may change due to several influences, including input from industry incident rates, stakeholder and research program partner participation at future research forums, and new research ideas submitted in response to the annual Special Notice to identify pipeline safety research ideas. In reauthorizing PHMSA's pipeline safety program in 2020, Congress may revise research appropriation levels and program subject areas.

Program Alignment with Strategic Goals:

The PSRP will continue to play an important role in advancing the safe transportation of energy and other hazardous materials essential to our daily lives by conducting research supporting Safety and Infrastructure strategic goals. Results of this work will continue to address both national and local challenges in urban and rural communities. The PSRP remains focused on systemic, performance-based approaches to ensure pipeline transportation safety, preserve the environment, and ensure the cost-effectiveness of alternative transportation energy. The FY 2021 Annual Modal Research Plan will provide further specificity on problems addressed and expected outcomes.

DOT Strategic Goal	Research Topic Areas
Safety Infrastructure	Systemic Safety Approach State of Good Repair Environment Stewardship

Hazardous Materials Safety

Program Description/Activities/Objectives

R&D plays a vital role in helping OHMS achieve its goal of enhancing the safe transport of hazardous materials. While hazardous materials are transported daily by licensed and trained professionals operating in well-defined systems, accidents resulting in loss of life and environmental damage still occur. In FY 2021, OHMS intends to continue its focus on research efforts within the core areas of risk management and mitigation, package integrity, emerging technologies, and technical analysis to aid risk assessments.

Risk management and mitigation research aims to minimize the probability of hazmat transport incidents and associated consequences. Specific projects in this strategic area include identification and development of risk management methods to assess hazmat transport, as well as identification of communication tools and best practices to ensure results are communicated to the transport industry.

OHMS research also focuses on packaging integrity (i.e., ensuring hazmat remains contained within its packaging during transport). Accordingly, R&D efforts in this strategic area are designed to evaluate and verify the suitability and effectiveness of packaging standards and practices and to improve transport

safety by developing, evaluating, and testing new packaging technologies and materials. Specific research areas will include testing and evaluation of existing packaging materials and packaging technologies; analysis, evaluation, and performance evaluation of emerging packaging materials and methods; and evaluation of component materials of combination packaging.

OHMS research focuses on understanding and promoting emerging technologies. Transport of emerging technology expands proportionally to the increase in U.S. production efforts. This expansion includes new energy sources, transport systems, and packaging technologies. Research is designed to identify and analyze emerging materials, processes, packaging technologies, and transport operations, as well as to assess their potential risks or benefits to the existing hazmat transport network. PHMSA hazmat research on emerging technologies and materials will focus on analysis of emerging energy products, including various grades of crude oil and liquefied natural gas; analysis of new packaging materials and technologies; analysis of transportation systems and operations; and international collaborative research to improve export of U.S. energy products.

Lastly, OHMS research focuses on technical analysis to aid risk assessments. Change is a constant in both the hazmat and transportation industries. The risk assessments, conceptual models and frameworks, and the evaluation methods OHMS uses to evaluate activities, events, and incidents must adapt constantly to keep pace. Research strives to identify options to prevent fatalities and injuries resulting from hazmat transportation incidents. Planned research activities include analysis of individual incidents and accidents involving hazmat to determine root cause; determination of patterns or anomalies within packaging or systems; and development of new inspection and test methods to classify materials and certify packaging.

Program Alignment with Strategic Goals:

The OHMS research and development program directly supports DOT's safety and innovation strategic goals. The program's mission is designed to solve complex problems in the packaging and movement of hazardous materials. This includes identification of best practices regarding hazmat transportation (e.g., better classification of the most dangerous products), development of new packaging materials and methods to contain such products, and the conduct of engineering and scientific analysis to reduce regulatory burdens. The program funds multi-modal programs supporting improved packaging and equipment designs that improve the performance of highway transport vehicles, rail cars, airplane cargo holds, and vessels used to transport hazmat. It places significant emphasis on innovative ways to facilitate the efficiency of commerce, while enhancing safety.

DOT Strategic Goal	Research Topic Areas
Safety	Systemic Safety Approach
Innovation	Environment Stewardship

[END]