

Five Year Interagency Research and Development Program Plan

For Pipeline Safety and Integrity

**Department of Transportation, the
Department of Energy and the
National Institute of Standards and Technology**

May 2004

Interagency Research and Development Five-Year Program Plan For Pipeline Safety and Integrity

As mandated by statute, the Department of Transportation, after extensive coordination with the Department of Energy and the National Institute of Standards and Technology, submits this five-year pipeline safety research and development program plan and the first required report on implementation of the program plan. Future R&D annual reports to Congress will describe progress made in implementing the plan.

Executive Summary

The pipeline infrastructure is a critical element in the energy delivery system across the United States. Its failure can affect both public health and safety directly and indirectly through impacts on the energy supply. Recent pipeline ruptures in the states of Washington, New Mexico and Arizona have reemphasized the fact that failures of this infrastructure adversely can impact residential or recreational areas, environmentally sensitive areas, or commercially navigable waterways. The nation's pipeline system is also critical to maintaining a continuous energy supply that drives economic activity, and its failure can impact this supply. The pipeline infrastructure is aging, while at the same time Research & Development (R&D) funding from the pipeline industry to develop technologies to assure its integrity is decreasing. In addition, total R&D funding is being further reduced through the elimination of in-house programs resulting from restructuring within the energy industry.

The Pipeline Safety Improvement Act of 2002 (PSIA-2002) mandates that the Department of Transportation (DOT), the Department of Energy (DOE) and the National Institute of Standards and Technology (NIST) in the Department of Commerce (DOC) "shall carry out a program of research, development, demonstration and standardization to ensure the integrity of pipeline facilities." A fundamental component of this program is a five-year program plan to guide and integrate R&D activities of these agencies.

This five-year program plan is the result of initial collaboration among agencies. It defines the process for working together to achieve shared objectives. The first step in working together is identifying focus areas to provide alternatives, avoid duplication of effort, and improve communications. This process will result in leveraging expertise and funding harmonization among agencies in the development and demonstration of promising technologies.

Processes described in this plan are designed to better integrate the activities of each participating agency, including collaboration in seeking stakeholder perspective on critical issues, promising technologies and areas deserving the highest priority for R&D funding. These processes will serve to maximize the effectiveness of our investment in R&D. Key methods of collaboration for the participating agencies in the near-term include:

- Semiannual interagency meetings to assess progress on projects and overall program effectiveness;

- Periodic joint R&D solicitations, including publication of an integrated interagency procurement schedule to increase the predictability of the procurement process, thereby assisting proposers to respond effectively to appropriate solicitations. Procurements would continue to be agency-by-agency;
- Annual joint R&D Forum to gather stakeholder input on issues, candidate technologies and development priorities;
- Technology demonstrations involving interagency hand-off of R&D project responsibility as technology is proven feasible but needs additional effort to demonstrate; and
- Technology applications and transfer promoted by joint agency efforts.

In addition, the participating agencies will share practices by which the effectiveness of R&D investments can be measured and monitored.

1. Introduction

1.1. Motivation for Enhanced and Better-Focused R&D

During the past few years, several significant accidents impacting life and property have occurred on both hazardous liquid and natural gas pipelines. These accidents have focused public and Congressional attention on the need for improved technologies to support pipeline safety and integrity. Responding to Congressional mandates, the Office of Pipeline Safety (OPS) in the Department of Transportation's Research and Special Programs Administration (RSPA) has moved aggressively forward in developing and promulgating process and performance-based regulations on the management of pipeline integrity. Major examples are the rules on integrity management of hazardous liquid and gas pipelines. The national consensus standards supporting these regulations have highlighted issues whose resolution requires new technologies to support better understanding and management of the integrity of an aging pipeline infrastructure. The fact that these new regulations are process and performance-based provides incentives for operators to seek out and implement new technologies that better address their unique safety and integrity issues.

In addition to renewed public focus on the integrity of the existing pipeline infrastructure, the demand for natural gas (as well as the potential future demand of hydrogen transportation infrastructure) as a clean source of energy both for residential use and for power generation is increasing. Demand for petroleum products also continues its historic growth. Expansion of the existing pipeline infrastructure to satisfy increasing demand presents opportunities to increase long-term assurance of integrity through use of advanced materials, coatings, fabrication techniques and integrity monitoring technologies.

A significant historic source of R&D support has been the funding that the Federal Energy Regulatory Commission (FERC) mandated be set aside by gas pipeline operators for pipeline R&D. This FERC-mandated R&D set-aside is being phased out at the end of FY 2004. The situation clearly demands the use of available R&D funding to address the most pressing issues with the most promising technologies. Methods to identify technology gaps while focusing R&D efforts to ensure wise investments in pipeline R&D are needed, as are performance metrics that demonstrate the wisdom of R&D investments.

1.2. Background of the Program Plan

The Federal government has a long history of funding pipeline-related R&D. Federally funded R&D has been conducted under the management of several agencies, including the Office of Pipeline Safety (OPS) in the Department of Transportation (DOT), the Department of Energy (DOE), the Minerals Management Services (MMS) in the Department of the Interior (DOI), and the National Institute of Standards and Technology (NIST) in the Department of Commerce (DOC). Each of these agencies has independently focused on priorities mandated in its authorizing legislation. These priorities have included pipeline system safety and integrity, the reliability and efficiency of pipeline operation, both on-shore and off-shore pipelines, and long-term high-risk research as well as development designed to promote near-term technology application. The extent and focus of these R&D activities have varied over the years. The degree of coordination among Federal agencies to assure the completeness and consistency of funded R&D activities has been limited in the past.

The agencies historically responsible for conducting R&D have long recognized the need for better coordination of their activities. Beginning in 1999, the DOE responded to the growing need for increased coordination of the department's overall natural gas strategy by forming the Strategic Center for Natural Gas (SCNG). In response to its recognition of the growing importance of pipeline safety and integrity issues resulting from the aging infrastructure, OPS conducted a broad-based R&D planning workshop in November 2001. This workshop brought together representatives of government, industry and the public to share perspectives on key safety and integrity issues, to identify gaps in ongoing R&D designed to resolve these issues, and to suggest approaches to continue the coordination of R&D planning among the diverse group of organizations supporting pipeline R&D.

As a result of its interest in achieving technological advances in support of improving pipeline safety and integrity, Congress more than tripled the OPS R&D budget from fiscal year 2001 to 2003. OPS has allocated these funds to a number of projects identified from the workshop held in November 2001.

1.3. The Pipeline Safety Improvement Act of 2002

Perceiving a need for a systematic program to coordinate pipeline R&D, Congress enacted the Pipeline Safety Improvement Act of 2002 (PSIA-2002, see Appendix A.1). Among other requirements, this Act mandates that the Department of Transportation (DOT), the Department of Energy (DOE) and the National Institute of Standards and Technology (NIST) in the Department of Commerce (DOC) "shall carry out a program of research, development, demonstration and standardization to ensure the integrity of pipeline facilities." A fundamental component of this Act is the mandate to develop a five-year program plan to guide R&D activities of the above agencies. In the preparation of this program plan, the participating agencies were required to "consult with or seek the advice of appropriate representatives of..." all stakeholders in pipeline safety. In addition, the Act requires that the agencies participating in this planning process be those listed above, and it also mandated that the plan should account for related activities of other Federal agencies, such as the Minerals Management Service (MMS) in the Department of the Interior (DOI).

Other R&D-related provisions of the Act include the mandates to develop a Memorandum of Understanding (MOU) detailing the respective responsibilities of each participating agency to address a specified set of ten program elements, and to prepare an annual report to Congress summarizing the status and results of implementation of the interagency program plan. Table A.2 in Appendix A.2 shows a comparison between agency priorities prior to the PSIA 2002 and the program elements required by the statute, and reveals significant consistency in this comparison.

1.4. Accomplishments Subsequent to PSIA-2002

Subsequent to the enactment of PSIA-2002, the participating agencies have moved collaboratively to address its mandates. The first substantive action was the conduct of a joint government – industry pipeline R&D Forum. The goals of this Forum held on December 11 and 12, 2003, included identification of key challenges facing industry and government, current research efforts, and research that can meet the challenges. The results from this Forum are being used in the planning of R&D initiatives by the participants for the coming year.

The second substantive action was drafting the initial interagency five-year R&D program plan. This document is the program plan. This plan has been structured to summarize the background and historic R&D perspective of participating agencies (Section 2), to describe R&D program goals and objectives (Section 3) and the approach to managing attainment of these goals, including areas of collaboration (Section 4). Supporting material is either included or referenced in the Appendices. The Appendices summarize available supporting information and reference web sites where details of this supporting information can be located.

The ten program elements on which the participating agencies are focused are listed in the PSIA-2002 presented in Appendix A.1. While each agency has distinct areas of focus, some potential for overlap as well as some opportunity for collaboration in meeting shared agency goals is inevitable, even desirable. The development and execution of this program plan clarifies areas in which collaboration will contribute to efficient attainment of shared goals and prevents needless duplication of effort.

In addition to requiring development of a five-year R&D program plan, the PSIA-2002 required formalization of a Memorandum of Understanding (MOU) among the participating agencies detailing their respective responsibilities. Within weeks of signing of the PSIA-2002, the participating agencies began discussions leading to a MOU. This MOU (see Appendix A.4), which has been signed by the participating agencies, includes only provisions consistent with the statute. The major provisions of the MOU are reflected in this Program Plan. Completion of this MOU is the third substantive action taken in response to the PSIA-2002.

Finally, The Office of Pipeline Safety has sought advice from both of its statutorily mandated technical advisory committees (see Appendix A.3) and has incorporated their perspectives in this program plan.

2.0. Background and Focus of Participating Agency R&D Activities

The historic focus of the R&D activities of the participating agencies has reflected the mandate of their respective authorizing legislation. These historic areas of focus along with the direction

provided in the PSIA-2002 are summarized below. Appendix A.4 provides additional information on the participating agencies as well as citations to web sites where more information on individual agency R&D programs is available. As described, the areas of focus completely cover the ten program elements described in the PSIA-2002.

2.1. Department of Transportation, Office of Pipeline Safety

Within the Department of Transportation, the Office of Pipeline Safety (OPS) in the Research and Special Programs Administration (RSPA) has responsibility for regulating the safety and integrity of the nation's pipeline transportation infrastructure for both hazardous liquids and natural gas. In this capacity, it regulates approximately 2.2 million miles of natural gas transmission, natural gas distribution, and hazardous liquid pipelines, as well as Liquefied Natural Gas (LNG) facilities.

As the principal authority on pipeline safety issues at the federal level, OPS has taken deliberate steps to strengthen both the regulatory framework and oversight of the nation's pipeline network. These steps include bolstering existing regulations and creating new management and performance-based regulations designed to focus resources on areas where the consequences of failures could be the greatest. The OPS is also creating new public information tools, including information to support community officials responsible for planning, emergency response, and security issues, to function effectively and to help their communities live safely with pipelines.

Through execution of its regulatory responsibilities, OPS has become the primary government source of expertise in pipeline inspection, integrity management and damage prevention, and therefore have the lead role in pipeline safety R&D. OPS conducts research in support of regulatory and enforcement activities and provides the technical and analytical foundation necessary for planning, evaluating, and implementing the pipeline safety program. OPS is sponsoring research and development projects focused on providing near-term solutions that will increase the safety and integrity of the transportation of hazardous liquid, and of both the transportation and distribution of natural gas, and of LNG facilities.

OPS-managed R&D projects are focused on providing technologies to address critical safety and integrity functions in transportation and distribution including: leak detection; improved repair techniques; identification and characterization of existing defects; detection of mechanical damage; damage prevention; improved pipeline system controls, monitoring, and operations; and improvements in pipeline materials. These projects are addressing technological solutions that can be implemented to improve pipeline safety and integrity in the near-term (within five years).

2.2. Department of Energy

The Department of Energy's Delivery Reliability Research and Development Program is managed by the Office of Fossil Energy (FE) and implemented by the National Energy Technology Laboratory (NETL). The DOE program has historically focused on developing new and advanced infrastructure technologies having greater developmental risk and expected to be commercialized over a longer time frame (three to eight years).

In FY 2003 and 2004, DOE continued congressionally directed research to ensure the reliability and integrity of the gas transmission and distribution network, develop small automated inside pipeline inspections sensor systems, conduct research on obstacle detection systems for horizontal boring applications for laying distribution pipelines, develop systems capable of detecting external force damage, develop technology to improve efficiency for reciprocating and turbo compressors, and develop advanced technology capable of determining pipeline wall integrity. In an effort to avoid duplication, the Administration has proposed to transfer responsibility for developing these pipeline safety technologies to the Department of Transportation's Office of Pipeline Safety.

2.3. National Institute of Standards and Technology (NIST)

Founded in 1901, NIST is a non-regulatory federal agency within the administration of the U.S. Department of Commerce. NIST's mission is to develop and promote measurement, standards, and technology to enhance productivity, facilitate trade, and improve the quality of life. RSPA/OPS has partnered with NIST to avail itself of the agency's expertise in three research areas: standards development, pipeline materials issues related to reliability and third party damage, and fire safety.

Standards development relies on materials testing methodologies able to produce meaningful data for pipeline service conditions. The materials-related research at NIST supports standards development and may include developing new methodologies or examining existing methodologies for stress and fracture analysis, detection of cracks, corrosion, abrasion, fatigue, and other abnormalities inside pipelines that lead to pipeline failure, assessing crack arrest toughness for new pipeline materials, and assessing adhesion and stress development of new pipeline coating material. As appropriate, NIST may also expand its R&D on cybersecurity standards for systems used for control and monitoring of gas pipelines.

In the area of fire safety, NIST has on-going fire research programs that address the fundamentals of potential pipeline fires. As priorities dictate, this focus will be expanded to include research looking at specifics of pipeline fire safety issues. The focus will be on development of knowledge-based tools for use by industry, standards organizations, code officials and first responders.

2.4. Department of the Interior, Minerals Management Service (MMS)

While it is not one of the agencies formally required to participate in the development of the interagency five-year program planning, MMS is the Federal agency responsible for managing the mineral resources (such as oil and natural gas) in offshore Federal waters of the United States and for collecting and disbursing the revenues from the production of these resources.

The MMS regulatory program incorporates the Technology Assessment & Research (TA&R) Program. The TA&R Program supports research associated with operational safety and pollution prevention as well as oil-spill response and cleanup capabilities. This program was established in the 1970's to ensure that industry operations on the outer continental shelf incorporated the use of the best available and safest technologies, subsequently required through the 1978 OCS Lands Act amendments. The TA&R Program is comprised of two functional research activities: operational

safety and engineering research, and oil-spill response research. Offshore pipeline research is just one component of this multidiscipline research program.

3. R&D Program Goals and Objectives

3.1 Goal of Inter-Agency R&D Program

As stated in the PSIA-2002, the goal of the five-year R&D program plan is to “guide activities needed to carry out a program of research, development, demonstration and standardization to ensure the integrity of pipeline facilities”. Attainment of this goal must involve recognizing legitimate differences in individual Agency priorities and harmonizing these priorities to ensure complete coverage of critical developmental needs and opportunities.

3.2. Objectives of Interagency R&D Program

The participating agencies believe that attainment of this goal requires joint pursuit of the following objectives:

1. *Identify Safety & Integrity Issues* Understand stakeholder perspectives on the issues that must be resolved to ensure integrity of current and future pipeline facilities;
2. *Identify Opportunities to Resolve Issues* Identify a broad spectrum of opportunities for resolving these issues through research, development, demonstration and standardization activities;
3. *Identify Gaps Between Needs and Available Technologies* Understand the gaps between existing technologies and those needed to resolve the key issues;
4. *Solicit & Select Projects* Collaborate in solicitation, selection and management of the projects needed to fill identified gaps;
5. *Promote Continuity in Technology Development* For proof-of-concept conformation and to promote continuity of technology development from the concept stage through demonstration and validation;
6. *Evaluate Project and Program Results* Evaluate the results of program activities using jointly designed performance measures and jointly managed evaluation processes;
7. *Increase Accessibility of R&D Results to Users(Promote Application)* Support increased accessibility of R&D results to users; and
8. *Seek Promising Technologies from Outside Sources* Collaboration with other agencies and stakeholder organizations in recognition, development and demonstration of promising new technologies.

The approaches planned to achieve these objectives are discussed in Section 4.2.

4. Management Plan

4.1. Areas of Responsibility

The PSIA-2002 enumerated ten R&D program elements as the focus of the agencies participating in the pipeline safety and integrity R&D program. These program elements are presented in Appendix A.1.

Lead agency responsibilities for each of these program elements are shown in Table 1.

Table 1 Summary of planned Lead Agency Responsibilities from PSIA 2002 R&D Program Elements

Program Elements	On-Shore	Off-Shore
1. Materials inspection	DOT	DOI
2. Pipe anomaly detection	DOT	DOI
3. Internal inspection and leak detection technologies	DOT	DOI
4. Methods of analyzing content of pipeline throughput	DOT	DOI
5. Pipeline security	DOT	DOI
6. Risk assessment methodology	DOT	DOI
7. Communication, control, and information systems surety	DOT	DOI
8. Fire safety of pipelines	NIST	DOI
9. Improved excavation, construction, and repair technologies	DOT	DOI
10. Other appropriate elements	DOT	DOI
a. Materials analysis & development	NIST	NIST
b. Standardization activities	NIST	NIST

General agency responsibilities related to these ten R&D program elements are summarized below:

- DOT: Assuring the safety and integrity of hazardous liquid and natural gas pipelines through R&D activities designed to support identification, characterization, detection and management of risks to safety and integrity;
- DOE: Historically focused on developing new and advanced infrastructure technologies having greater developmental risk and expected to be commercialized over a longer time frame. The Administration has proposed to transfer responsibility for developing these pipeline safety technologies to the Department of Transportation’s Office of Pipeline Safety.
- NIST: Developing standards, advanced materials and fire safety technologies; and
- DOI: Through the Minerals Management Services, assuring pipeline safety and integrity through regulation and inspection of offshore pipelines.

4.2. Management Processes to Achieve Objectives (How will we work together?)

The objectives of the interagency pipeline safety and integrity R&D program are listed in Section 3.2. The planned processes to achieve these objectives are discussed below.

Semiannual interagency meetings to assess progress on projects and overall program effectiveness

The participating agencies plan to carry out semiannual meetings designed to assess progress on projects as well as overall program effectiveness. These meetings will involve several activities, including: review of major issues and their priorities, identification of gaps between high priority safety and integrity issues and R&D designed to support their resolution, identification of promising technologies, review of measures of performance, updating and integration of plans for future solicitations, and updating project portfolios.

Periodic joint solicitation The participating agencies plan to evaluate how best to increase the simplicity and predictability of agency solicitation and procurement processes. One approach to achieve this objective is through the use of periodic announcements or solicitations. Should this mechanism seem appropriate and manageable, issue joint announcements or solicitations. In addition, the participating agencies plan to continue interagency review of individual agency proposals.

Annual joint R&D Forum The participating agencies plan to conduct an annual joint R&D forum. During the first year, the five-year plan will be introduced to industry, and participating stakeholders will share perspectives on major issues, promising technologies and priorities. Future conferences (after first year) may involve individual project reviews and will offer industry participants and other stakeholders the opportunity to provide feedback on the content and direction of R&D programs.

Collaborative technology demonstrations The participating agencies are considering collaborative technology demonstrations involving interagency hand-off of R&D project responsibility from DOE/FE to DOT/OPS as technology is proven feasible and needs additional effort to demonstrate.

Integrated interagency procurement schedule An integrated interagency procurement schedule will be prepared to aid predictability of the procurement process. This schedule will be maintained current so potential bidders on R&D projects will be able to make bid decisions.

Technology transfer Participating agencies are exploring how best to promote industry awareness of newly developed technology applications and how to collaborate in this technology transfer process.

The participating agencies are committed to continuously refine the definition and implement practices in each of these areas of collaboration and to initiate a process that assures deadlines are met. The relationship between the major objectives of this Plan (itemized in Section 3.2) and the processes through which we expect to attain these objectives is depicted in Table 2.

**Table 2 Summary of Collaborative Processes to Achieve Objectives
Of Five-Year R&D Program Plan**

Processes to Achieve Objectives						
Objectives	Semiannual Interagency Meetings	Periodic Collaborative Solicitation	Annual Joint R&D Forum	Technology Hand-offs & Demos	Integrated Procurement Schedule	Technology Application & Transfer
Identify Safety & Integrity Issues	▼		▼			
Identify Opportunities to Resolve Issues	▼	▼	▼		▼	
Identify Gaps Between Needs and Available Technologies	▼		▼			
Solicit & Select Projects	▼	▼		▼	▼	
Promote Continuity in Technology Development	▼	▼		▼	▼	
Evaluate Project and Program Results	▼		▼			
Increase Accessibility of R&D Results to Users (Promote Application)			▼			▼
Seek Promising Technologies from Outside Sources	▼		▼			

4.3. Program Evaluation: Measuring Performance (How will we know whether we have been successful?)

Presently each participating agency has developed or is developing its own unique process for evaluating performance. The General Accounting Office (GAO) recently issued a report (Systematic Process Needed to Evaluate Outcomes of Research and Development Program, GAO-03-746) recommending that DOT/OPS develop and implement a systematic process for evaluating the outcomes of DOT/OPS' R&D program, and include information on the results of R&D evaluations in its annual reports to Congress. As part of its developing performance measurement practices, DOT/OPS has incorporated within each contract measures of success on which the contractor must report. In addition, DOT/OPS is developing a set of measures designed to monitor the overall effectiveness of its R&D program, and is planning to employ a peer review process to seek outside perspective on program effectiveness. DOT/OPS has a commitment to work with the Blue Ribbon R&D Panel, specifically constituted of expert stakeholders to advise DOT/OPS on the design and implementation of its R&D program, to evaluate candidate measures, and to formalize a systematic process to measure the effectiveness of the OPS investment in R&D.

The National Energy Technology Laboratory (NETL) has incorporated within each contract measures of success on which the contractor must report. DOE, Office of Fossil Energy has also implemented the *Joule* system for performance management of on-going R&D portfolios. This tool evaluates the impact of the DOE portfolio of R&D projects on the attainment of its primary research objectives. The National Research Council (NRC) of the National Academy of Science has performed an external review of the NETL technical research programs over that last 22 years and is beginning work on a Fossil Energy prospective benefits study.

NIST has a rigorous external peer review of its technical programs performed biennially under the direction of the National Research Council (NRC). The NRC review evaluates the technical quality, performance, and merit of NIST programs. The NIST process for evaluating its programs and technical projects has been designed to be systematic, comprehensive, and well established in its operational programs and managerial culture.

Although each agency has specific areas of expertise, the agencies will work together in an effort to develop measures that will evaluate the effectiveness of the collaborative effort. In addition, the participating agencies will share information on measures that each uses to evaluate projects and overall program performance.

4.4. Consultation

All of the participating agencies utilize a formal consultation process to seek expert and other stakeholder advice on research and development needs, priorities and promising technologies to address these needs. Two recent examples of this consultation process were the joint government and industry-sponsored R&D Forum held on December 11 - 12, 2003 and on February 8, 2004; DOE hosted a joint government and industry natural gas infrastructure R&D road mapping forum. The major focus of these annual R&D Forums were to share information on various industry and government-sponsored R&D efforts and to poll the assembled experts along with other stakeholders at the meeting on R&D needs including gaps between these needs and ongoing or planned R&D projects. Forum participants were also asked to draw on their diverse backgrounds to identify technologies developed for application in other industries that may have promise in filling recognized gaps.

Other examples of the recent formal consultation activities include the annual R&D Industry Forum and the Roadmapping Workshop sponsored by DOE, the Blue Ribbon Panel organized by DOT/OPS to review the R&D program status and direction, and the public meeting organized by DOT/OPS and held in November of 2001 to explore R&D needs and priorities in preparation for the formalized Broad Agency Announcement process initiated over a year ago.

As required by Congress, DOT/OPS has presented the R&D program to its two advisory committees, one for hazardous liquid pipelines and one for gas pipelines, to obtain their perspectives and approval to proceed with the program. The results from these two advisory committee meetings are summarized in Appendix A.4. Both committees approved the direction DOT/OPS has taken, offered suggestions on features of the program, and expressed a strong interest in continuing to monitor program progress. The current program plan incorporates the features suggested by the committees.

Beyond these program-focused meetings, the participating agencies have sponsored and actively participated in workshops on critical R&D safety issues. During calendar year 2003 safety issue meetings were sponsored by OPS on stress corrosion cracking and on direct assessment. In addition, the agencies have supported and actively participated in working sessions sponsored by the Common Ground Alliance on ways to reduce the impact of excavation on pipelines. These meetings have facilitated sharing of information of the status and direction of R&D on key safety issues.

4.5. Communication of R&D Results (How will deployment of technology be achieved?)

The participating agencies currently use several mechanisms to make potential users aware of newly developed technologies. These individual efforts will continue into the future. In addition, several mechanisms will be explored to increase the consistency and quality of the processes used to communicate R&D results. Discussed below are the primary means of communicating R&D results between the agencies, stakeholders, and industry.

In addition to individual agency websites, the participating agencies will develop a joint site that will facilitate operator identification of needed R&D results. Industry comments have highlighted the value of reducing the number of meetings operators must attend to be aware of ongoing and completed R&D activities. To meet this need, participating agencies are considering how best to carry out joint interagency presentations of R&D projects and results. One means of improving communication of R&D results being actively considered is use of presentations at technology and industry conferences designed to communicate R&D results with stakeholder groups at their traditional gatherings. Communications will also be facilitated through the planned joint semiannual conferences involving participating agencies.

5. Initial Steps

Issuance of the interagency Five-Year R&D Program Plan represents a key step in addressing the Congressional mandate. However, implementing the steps outlined in the plan will require continuing interaction among the agencies. Some of the interagency actions recently implemented to achieve our objectives are listed below:

- December, 2003 Interagency R&D Forum
- May, 2004 Release of the five year plan

The next interagency actions planned for implementation to achieve our objectives are listed below:

- May 19, 2004 Interagency coordination team meeting
- TBD Initial cooperative solicitation

Appendices

A.1. Provisions of the Pipeline Safety Improvement Act of 2002

Section 12 of the Pipeline Safety Improvement Act of 2002 contains several provisions related to development and implementation of an interagency R&D program plan. These provisions are quoted below.

SEC. 12. PIPELINE INTEGRITY, SAFETY, AND RELIABILITY RESEARCH AND DEVELOPMENT.

(a) In General.--The heads of the participating agencies shall carry out a program of research, development, demonstration, and standardization to ensure the integrity of pipeline facilities.

(b) Memorandum of Understanding.--

(1) In general.--Not later than 120 days after the date of enactment of this Act, the heads of the participating agencies shall enter into a memorandum of understanding detailing their respective responsibilities in the program authorized by subsection (a).

(2) Areas of expertise.--Under the memorandum of understanding, each of the participating agencies shall have the primary responsibility for ensuring that the elements of the program within its expertise are implemented in accordance with this section. The Department of Transportation's responsibilities shall reflect its lead role in pipeline safety and expertise in pipeline inspection, integrity management, and damage prevention. The Department of Energy's responsibilities shall reflect its expertise in system reliability, low-volume gas leak detection, and surveillance technologies. The National Institute of Standards and Technology's responsibilities shall reflect its expertise in materials research and assisting in the development of consensus technical standards, as that term is used in section 12(d)(4) of Public Law 104-13 (15 U.S.C. 272 note).

(c) Program Elements.--The program authorized by subsection (a) shall include research, development, demonstration, and standardization activities related to--

(1) Materials inspection;

(2) Stress and fracture analysis, detection of cracks, corrosion, abrasion, and other abnormalities inside pipelines that lead to pipeline failure, and development of new equipment or technologies that are inserted into pipelines to detect anomalies;

(3) Internal inspection and leak detection technologies, including detection of leaks at very low volumes;

(4) Methods of analyzing content of pipeline throughput;

(5) Pipeline security, including improving the real-time surveillance of pipeline rights-of-way, developing tools for evaluating and enhancing pipeline security and infrastructure, reducing natural, technological, and terrorist threats, and protecting first response units and persons near an incident;

(6) Risk assessment methodology, including vulnerability assessment and reduction of third-party damage;

(7) Communication, control, and information systems surety;

(8) Fire safety of pipelines;

(9) Improved excavation, construction, and repair technologies; and

(10) Other appropriate elements.

(d) Program Plan.--

(1) In general.--Not later than 1 year after the date of enactment of this section, the Secretary of Transportation, in coordination with the Secretary of Energy and the Director of the National Institute of Standards and Technology, shall prepare and transmit to Congress a 5-year program plan to guide activities under this section. Such program plan shall be submitted to the Technical Pipeline Safety Standards Committee and the Technical Hazardous Liquid Pipeline Safety Standards Committee for review, and the report to Congress shall include the comments of the committees. The 5-year program plan shall be based on the memorandum of understanding under subsection (b) and take into account related activities of other Federal agencies.

(2) Consultation.--In preparing the program plan and selecting and prioritizing appropriate project proposals, the Secretary of Transportation shall consult with or seek the advice of appropriate representatives of the natural gas, crude oil, and petroleum product pipeline industries, utilities, manufacturers, institutions of higher learning, Federal agencies, pipeline research institutions, national laboratories, State pipeline safety officials, labor organizations, environmental organizations, pipeline safety advocates, and professional and technical societies.

(e) Reports to Congress.--Not later than 1 year after the date of enactment of this Act, and annually thereafter, the heads of the participating agencies shall transmit jointly to Congress a report on the status and results to date of the implementation of the program plan prepared under subsection (d).

(f) Authorization of Appropriations.--

(1) Department of transportation.--There is authorized to be appropriated to the Secretary of Transportation for carrying out this section \$10,000,000 for each of the fiscal years 2003 through 2006.

(2) Department of energy.--There is authorized to be appropriated to the Secretary of Energy for carrying out this section \$10,000,000 for each of the fiscal years 2003 through 2006.

(3) National institute of standards and technology.--There is authorized to be appropriated to the Director of the National Institute of Standards and Technology for carrying out this section \$5,000,000 for each of the fiscal years 2003 through 2006.

(4) General revenue funding.--Any sums appropriated under this subsection shall be derived from general revenues and may not be derived from amounts collected under section 60301 of title 49, United States Code.

(g) Pipeline Integrity Program.--Of the amounts available in the Oil Spill Liability Trust Fund established by section 9509 of the Internal Revenue Code of 1986 (26 U.S.C. 9509), \$3,000,000 shall be transferred to the Secretary of Transportation, as provided in appropriation Acts, to carry out programs for detection, prevention, and mitigation of oil spills for each of the fiscal years 2003 through 2006.

(h) Participating Agencies Defined.--In this section, the term "participating agencies" means the Department of Transportation, the Department of Energy, and the National Institute of Standards and Technology.

A.2. Current R&D Activities

As evidence of the focus of recently funded R&D activities, the matrix below (Table A.1) shows ongoing activities categorized by the areas on which these activities are focused. This matrix presents R&D projects structured under the priority categories on which each agency has historically been focused. In all cases the focus areas were derived from Congressional mandates with stakeholder involvement in fine-tuning which issues were most important. The matrix also displays the amount of funding from the government (Agency Funding) along with the funding levels of the projects provided by industry (Co-funding).

There is a remarkable degree of consistency between the priorities the participating agencies have pursued and the program elements mandated by Congress. The consistency of the historic agency R&D priorities with those mandated in the PSIA 2002 is shown in Table A.2. Here the ten “Program Elements” from PSIA 2002 are compared with the historic agency priorities. The only program elements not substantively addressed through historic priorities are Methods of Analyzing Content of Pipeline Throughput (Throughput Analysis) and fire Safety of Pipelines (Fire Safety).

Table A.1 Matrix of currently funded R&D Activities¹

R&D Topic (Agency)	Number of Ongoing Projects	Agency Funding (\$)	Co-funding (\$) (industry cost share)
Assessment of non-Piggable Pipelines (DOT/OPS) ²	7	\$1,847,100	\$2,148,400
Damage Prevention (DOT/OPS)	2	\$534,500	\$600,600
Improved In-Line Inspection (DOT/OPS)	3	\$809,900	\$920,000
Pipe Construction (DOT/OPS)	3	\$646,300	\$751,300
Coating Improvement (DOT/OPS)	1	\$80,000	\$80,000
Repair Methods (DOT/OPS)	4	\$614,700	\$879,200
Defect Severity Characterization (DOT/OPS)	1	\$196,000	\$221,000
Inspection Technologies (DOE/NETL) ³	16	\$5,522,955	\$2,566,093
Remote Sensing (DOE/NETL)	14	\$3,968,437	\$2,724,593
Materials Development (DOE/NETL)	7	\$2,980,032	\$774,856
Operational Technologies (DOE/NETL)	8	\$4,603,481	\$2,483,358
Completed Projects (DOE/NETL)		\$2,437,922	\$817,078
Leak Detection and Remote Sensing (DOI/MMS) ⁴	2	\$140,500	\$15,500
Inspection Technology (DOI/MMS)	1	\$152,000	0
Enhanced Design (DOI/MMS)	2	\$136,000	\$60,000
Damage Prevention (DOI/MMS)	1	\$50,000	\$50,000
Pipeline Decommissioning (DOI/MMS)	1	\$36,000	\$36,000
Control System Security Technology Testing (NIST) ⁵	1	\$150,000	0

¹. Table does not indicate future funding for these projects will be proposed.

². Funding for ongoing DOT/OPS projects were provided in fiscal years 2002-2003.

³. Funding for ongoing DOE/NETL projects were provided in fiscal years 2001-2003

⁴. Funding for ongoing DOI/MMS projects were provided in fiscal year 2003

⁵. Funding for ongoing NIST project was provided in fiscal year 2003.

Table A.2 Comparison of Historic Agency Priorities with Congressional Program Elements from PSIA-2002

PSIA-2002 Program Element

R&D Priority (Agency)	Matls Insp	Anomaly Assess	Leak Detect (small)	Thru-put Analysis	Security	Risk, TPD	Control Sys Surety	Fire Safety	Excav & Repair Tech	Others
Assessment of non-Piggable Pipelines (DOT/OPS)	▼	▼				▼				
Damage Prevention (DOT/OPS)					▼	▼			▼	
Improved In-Line Inspection (DOT/OPS)	▼	▼				▼				
Pipe Construction (DOT/OPS)									▼	▼
Coating Improvement (DOT/OPS)									▼	▼
Repair Methods (DOT/OPS)					▼				▼	
Defect Severity Characterization (DOT/OPS)	▼	▼				▼				
Inspection Technologies (DOE/NETL)	▼	▼								
Remote Sensing (DOE/NETL)			▼			▼				
Materials Development (DOE/NETL)										▼
Operational Technologies (DOE/NETL)							▼			▼
Leak Detection and Remote Sensing (DOI/MMS)			▼			▼				
Inspection Technology (DOI/MMS)	▼	▼				▼				
Enhanced Design (DOI/MMS)										▼
Damage Prevention (DOI/MMS)						▼				
Pipeline Decommissioning (DOI/MMS)										▼
Control System Security Technology Testing (NIST)					▼		▼			

A.3. Comments from Advisory Committees

The Technical Pipeline Safety Standards Committee (TPSSC)

The Technical Pipeline Safety Standards Committee (TPSSC) is the congressionally mandated advisory committee that advises DOT gas pipelines. During its meeting on July 31, 2003, the TPSSC reviewed the draft outline for the interagency R&D five-year program plan. Comments from the TPSSC are summarized below. These comments have been carefully considered and addressed within the plan.

The TPSSC identified several issues it felt would be constructive to treat in the R&D Five Year Plan.

One member commented that OPS should consider adding a section on “technology evaluation”. Such a section would include three subsections:

- (a) *Identification of Applicable Technology.* Recognize completed and ongoing R&D relevant to pipeline safety and integrity both inside and outside the government. Such R&D represents opportunities to solve pipeline-specific problems using technology developed for other applications.
- (b) *Gap Analysis.* Evaluate the gap between current safety and integrity needs and the available technology to address these needs.
- (c) *Technology Value Assessment.* Assess the value of selected technologies that require some further customization or validation to reliably address pipeline safety or integrity problems in an effort to focus resource expenditure on the best available technologies.

The concepts described above have been incorporated in the Five Year Plan. The major focus of the first annual R&D Forum, held on December 11 and 12, 2003, was to poll the assembled experts and other stakeholders at the meeting on R&D needs and on gaps between these needs and ongoing and planned R&D projects. Forum participants were also asked to draw on their diverse backgrounds to identify technologies developed for application to other industries that may have promise in filling recognized gaps.

Another TPSSC member noted that recent experience in the development of the technologies needed to support the integrity management standard and the subsequent rule suggested the need to designate/identify R&D funds to support similar focused development efforts. Such funds might be allocated only when significant co-funding, demonstrating a significant need, is available. Such R&D might be related to study activities intended to better focus on the real problem or on process or technology development activities needed to support completion of the standard and rule. The committee member noted that the current BAA process does not support collaboration on addressing near-term needs.

While explicit provisions have not yet been incorporated in the Five Year Plan to identify funds to support standards-driven R&D efforts, the annual R&D Forum will provide opportunity for all stakeholders to identify technology gaps requiring R&D to resolve. The integration of the R&D solicitation schedule across participating agencies will make the timing for funding decisions clearer and better support timely conduct of R&D on pressing issues.

The Technical Hazardous Liquids Pipeline Safety Standards Committee (THLPSSC)

The Technical Hazardous Liquid Pipeline Safety Standards Committee (THLPSSC) is the congressionally mandated advisory committee that advises the DOT hazardous liquid pipelines program. During its meeting on August 6, 2003, the THLPSSC reviewed the draft outline for the interagency R&D five-year program plan. Comments from the THLPSSC are summarized below. These comments have been carefully considered and addressed within the plan.

Issues raised at the THLPSSC meeting focused on the need to ensure that industry priorities, as expressed by Pipeline Research Council International (PRCI), are recognized and incorporated in the Five Year Plan. (The PRCI is the manager of significant pipeline R&D, and uses a structured process involving senior representatives of both the gas and hazardous liquid industry to develop its priorities.) This concern is being addressed both through routine interactions and information exchange among stakeholders and through the annual R&D Forum. The initial R&D Forum was held on December 11 and 12, 2003.

A.4. Sources of Additional Information

This Appendix presents supplemental information on currently funded R&D programs of the participating agencies by identifying available supporting information and citing web sites where this supporting information can be located.

Department of Transportation/Office of Pipeline Safety

The U.S. Department of Transportation (DOT) has developed a website specifically designed to communicate information on its R&D program. This site, <http://primis.rspa.dot.gov/rd>, includes information on current and past R&D projects organized in the form of a matrix to help potential users to locate the R&D projects of interest to them.

Department of Energy

The U.S. Department of Energy's (DOE) Strategic Center for Natural Gas (SCNG) website (www.netl.doe.gov/scng) provides access to information on DOE's natural gas R&D programs.

The U.S. Department of Energy's (DOE) Office of Scientific and Technical Information (OSTI) (www.osti.gov) provides access to energy, science, and technology research and development (R&D) information.

National Institute of Standards and Technology

Founded in 1901, NIST is a non-regulatory federal agency within the U.S. Commerce Department's Technology Administration. The Pipeline Safety Improvement Act of 2002 provides NIST, OPS, DOE, and MMS an opportunity for increased coordination and collaboration on natural gas and hazardous liquid pipeline facility research, development, demonstration and standardization. As part of this Program and subject to the availability of funding, NIST research in pipeline safety and security will focus on three areas: standards, pipeline materials issues related to reliability and third party damage, and fire safety. Additional information is available on the NIST Website (<http://www.nist.gov/>).

Minerals Management Service

The Department of Interior, Minerals Management Service carries out its research activities through the Technology Assessment & Research (TA&R) Program. The TA&R Program supports research associated with offshore oil & gas operations to consider operational safety and pollution prevention as well as oil-spill response and cleanup capabilities. To be able to assess the safety, risks, and reliability of offshore pipelines, MMS uses the TA&R Program to fund projects in the following areas/categories:

1. Corrosion of the ageing infrastructure and deepwater pipelines;
2. Repair and inspection of the ageing infrastructure and deep-water pipelines;
3. Risk assessment and reliability of pipelines;
4. Identification and mitigation of geo-hazards on pipelines;
5. Operational development issues related to pipelines (*i.e.*, hydro-testing, leak detection).

The MMS research Webpage is <http://www.mms.gov/tarphome/index.htm>.