Office of Inspector General

Audit Report

Pipeline Safety Program

Research and Special Programs Administration

Report No. RT-2000-069
Date Issued: March 13, 2000

Memorandum

U.S. Department of Transportation
Office of the Secretary
of Transportation
Office of Inspector General

Subject: ACTION: Audit of the Pipeline Safety Program
Report No. RT-2000-069

Date: March 13, 2000

Reply To
Attn. Of: JA-1

From: Alexis M. Stefani
Assistant Inspector General for Auditing

To: Research and Special Programs Administrator

This report presents the results of our review of the Pipeline Safety Program. The report is in response to a request from Senator Patty L. Murray following a pipeline accident in Bellingham, Washington.[1] Our objectives were to:

1. Determine what legislation might be needed to enhance the Office of Pipeline Safety's (OPS) ability to improve pipeline safety.
2. Assess OPS's efforts to utilize and develop pipeline inspection technologies.
3. Assess OPS's current efforts to address the major causes of transmission pipeline accidents.
4. Assess OPS's actions that address National Transportation Safety Board (NTSB) recommendations related to the major causes of transmission pipeline accidents.

Our scope and methodology are described in Exhibit A to this report.

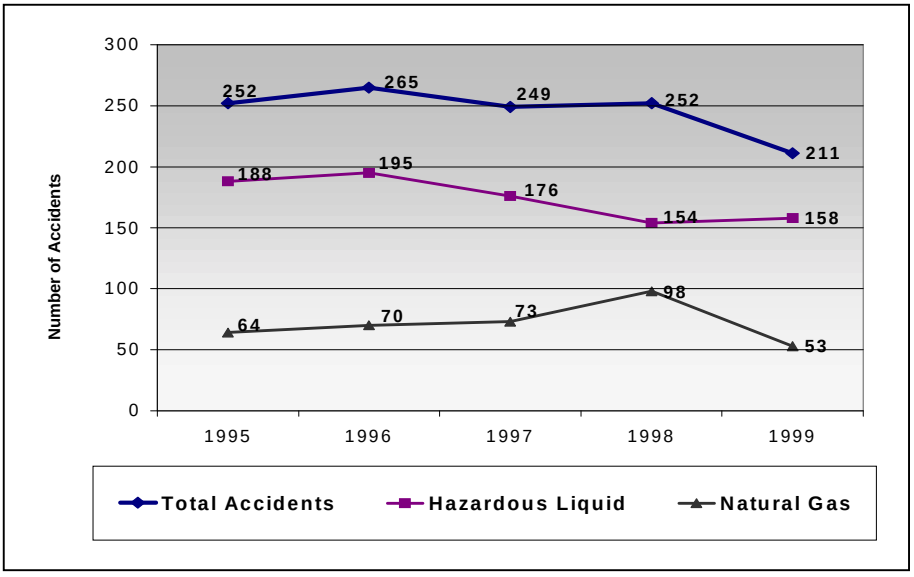
BACKGROUND

The nation's network of pipelines includes 325,000 miles of natural gas and almost 156,000 miles of hazardous liquid interstate transmission pipelines. Pipelines transport over 20 trillion cubic feet of natural gas and 616.5 billion ton-miles of oil and oil products each year. Pipelines are made of steel, cast iron, or plastic and are located aboveground, underground, and underwater where they are subject to forces of both nature and human actions that can cause potentially catastrophic accidents.

[1] On June 10, 1999, up to 277,000 gallons of gasoline spilled from an Olympic Pipe Line Co. transmission pipeline into a creek in Bellingham, Washington and was ignited, causing three fatalities and incinerating 1.5 miles of recreational parkland. The cause of the accident is under investigation by the National Transportation Safety Board.

Although the number of transmission pipeline accidents has been relatively constant from 1995 to 1998, any single accident may be catastrophic to people and property. The number of accidents declined from 252 in 1998 to 211 in 1999, attributable to a decrease in natural gas accidents, which fell from 98 in 1998 to 53 in 1999 (Figure 1).

Figure 1
Transmission Pipeline Accidents



The Pipeline Safety Act of 1992 (1992 Act) and the Accountable Pipeline Safety and Partnership Act of 1996 (1996 Act) were enacted to enhance the delivery of hazardous liquid and natural gas in a safe and environmentally responsible manner.[2] The 1992 Act required the Secretary of Transportation to establish criteria to identify high-density population areas and environmentally sensitive areas in order to determine where additional safety standards are necessary. The standards include increased inspections and additional safety devices. The Accountable Pipeline Safety and Partnership Act of 1996 expanded the types of critical areas to be included as environmentally sensitive and referred to them as unusually sensitive areas (USAs).

[2] P.L. 102-508 and P.L. 104-304, respectively.

RESULTS IN BRIEF

RSPA Must Finalize Actions to Implement Congressional Mandates

Congress established a mandate in the 1992 law that required improved pipeline inspection standards to protect USAs and high-density areas. Congress expected OPS to define these areas by October 1994. These actions have not been completed. OPS issued a Notice of Proposed Rulemaking in December 1999 that defines USAs for hazardous liquid pipelines. OPS developed a model USA definition and is testing it in three states. In addition, OPS is preparing to issue a proposed rule identifying USAs and high-density areas for large hazardous liquid pipeline operators by March 30, 2000. Until the definitions for USAs and high-density areas are established, OPS cannot create maps that can be overlaid with pipeline locations to identify those areas where additional safety requirements are necessary.

The 1992 Act also established a 1994 deadline for the Secretary to prescribe standards for periodic inspections to ensure the integrity of natural gas and hazardous liquid pipelines. Specifically, the 1992 Act mandated that OPS require safety inspections to utilize an instrumented internal inspection device, called a "smart pig," or an alternate, equally effective method. OPS has not yet established requirements for the use of instrumented devices, nor for the timing and frequency of inspections. According to the 1992 and 1996 acts, OPS must first identify USAs and high-density areas before additional safety standards including increased inspections can be established.

Research on Inspection Technology Should Be Expanded

Smart pigs are the most reliable method currently available to detect corrosion, metal loss, and circumferential mechanical damage without excavating a pipe. Smart pigs also can identify certain types of critical defects before leaks occur. But smart pigs are less effective at detecting defects in pipe materials. Furthermore, these internal inspection devices cannot be used in all types of pipelines since pipe diameters, valves, and configurations are different. An OPS official stated that while 90 percent of hazardous liquid pipelines could use this device without modifications, no estimate is available for natural gas pipelines, which constitute over two-thirds of all pipelines.

Consequently, OPS needs to focus its research and development (R&D) program on expanding the capabilities of smart pigs to detect more types of defects as well as alternative inspection and monitoring technologies for pipelines that cannot accommodate pigs. Of the $10 million in OPS's research program between 1995

and 1999, approximately 75 percent was spent on risk assessment, mapping, and information analysis. OPS has funded research on smart pig technology, spending $2.5 million from FYs 1995 through 1999 to assess and verify smart pig capabilities.

Inspector Training Curriculum Lacks Instruction on Smart Pig Technology

Even though OPS safety inspectors have access to an operator's pig data on routine inspections or accident investigations, the inspectors are not trained on the reading, or interpretation of technical data collected by smart pigs. The current program does provide extensive training on the inspection of new pipeline construction, and pipeline equipment and facilities located aboveground. Pipeline operators are now using smart pigs for inspections, and the use of smart pigs may increase once new inspection standards are established. OPS needs to expand its training curriculum to include instruction on the use, capabilities, and interpretation of smart pig data. Such training would provide OPS with an independent capability to evaluate internal inspection data.

Changes to Data Collection Instruments Required to Improve Accident Reporting Accuracy

OPS must have the information necessary to focus its inspection and research resources and to measure safety program performance. However, OPS does not collect sufficient data to precisely identify accident causes and trends, or to address Government Performance and Results Act (GPRA) measures. When accidents occur, pipeline operators are required to submit an accident report to OPS. Although the reports include information on the accident cause and origin, deaths or injuries, and estimates of property damage, the information is not adequate.

For example, OPS reported that 26 percent of all transmission pipeline accidents for 1998 listed the accident cause as "Other." Instructions on the form are incomplete and operators use the "Other" causal category to list unknown accident causes or causes not clearly defined in specific causal categories. OPS needs to expand the causal classification categories to collect more precise information about causes of accidents, and to clarify the instructions so that operators will be more consistent and accurate in reporting accident causes.

Additionally, the OPS accident database contains inaccurate accident causal information and understates property damage. This is partially due to the fact that erroneous accident reports are not corrected. OPS needs an enforcement capability to ensure that operators revise submitted accident reports later found to

be inaccurate. In eight transmission pipeline accidents investigated independently by the NTSB between 1994 and 1998, in only one case did the operator submit an updated accident form reflecting the NTSB results. In three of the cases, the NTSB investigation reported a different causal category, and in five of the cases, NTSB investigations reported $20.4 million more in property damage. Although, OPS has broad authority to regulate the pipeline industry, even when OPS knows the information in the original accident report is inaccurate, under current regulations, it cannot correct the database without an operator's written revision.

Timetables Needed to Address Open NTSB Recommendations.

The NTSB, an independent Federal agency, conducts pipeline accident investigations and issues safety recommendations to prevent future accidents and promote safety. DOT Order 2000.1D requires Operating Administrations to develop and submit timetables to NTSB for addressing "open" safety recommendations. RSPA has not complied with the DOT order.

There are 40 open NTSB recommendations dating back to March 1987 resulting from pipeline investigations. We reviewed 23 open recommendations that NTSB classified as an acceptable response, action, or alternative response. RSPA has not provided timetables in its replies to NTSB indicating when OPS would complete 21 of the 23 recommendations. OPS needs to establish timetables for implementing open NTSB recommendations with which it agrees and transmit the timetables to NTSB.

RECOMMENDATIONS

We recommend that the Research and Special Programs Administrator:

- Finalize actions required by the outstanding 1992 and 1996 Congressional mandates;

- Expand the focus of Research and Special Programs Administration (RSPA) research and development programs to include (a) smart pigs that can detect pipe material defects, and (b) alternative pipeline inspection and monitoring technologies for pipelines that cannot accommodate smart pigs;

- Design and implement a program to train OPS safety inspectors on the use and capabilities of pipeline inspection technologies and the reading and interpreting of the results of internal inspections;

- Implement revisions in the collection and processing of pipeline accident data to expand accident causal categories for more detailed trend analysis, and to

clarify accident form instructions so that operators will be more consistent and accurate in reporting accident causes;

- Revise OPS regulations to establish an enforcement mechanism to ensure operators submit revised accident reports when required; and

- Comply with the DOT order by establishing timetables to implement open NTSB pipeline safety recommendations with which they agree and transmitting the timetables to NTSB.

MANAGEMENT COMMENTS

On March 10, 2000, RSPA provided its response to our draft report (see Appendix). RSPA's position on each recommendation is summarized as follows.

1. Completing Congressional Mandates – RSPA noted three major actions it expects to complete during 2000 that address outstanding Congressional mandates, including rulemakings on defining USAs and pipeline integrity management. RSPA also noted efforts to complete base maps for pipeline location mapping.
2. Research on Inspection Technology – RSPA stated the FY 2001 funding request for research recognizes the need to begin development on alternative inspection and monitoring technologies.
3. Inspector Training – RSPA concurs with the importance of providing inspection technology training to OPS (and state) safety inspectors.
4. Collection and Processing of Accident Data – RSPA is revising the gas transmission accident report similar to the OIG recommendation and expects to complete the action during 2000.
5. Enforcement Mechanism – RSPA agrees that OPS needs the enforcement capability to ensure accident reports are accurate.
6. Timetables for NTSB Safety Recommendations – RSPA states it is in compliance with DOT Order 2000.1D and is resolving open recommendations.

OFFICE OF INSPECTOR GENERAL RESPONSE

We reviewed RSPA's reply. Our responses to its comments are as follows.

1. Completing Congressional Mandates – RSPA's response should identify when Congressional mandates from the 1992 and 1996 pipeline safety acts will be

complete. We encourage RSPA to move forward expeditiously to issue final rules meeting all requirements of the laws.

2. Research on Inspection Technology – We recognize that RSPA research has advanced the capabilities of smart pig technology. However, future research must focus on the detection of pipe material defects and alternative inspection and monitoring technologies for pipelines incapable of accommodating smart pigs.

3. Inspector Training – RSPA agrees with the need for such training. RSPA should develop a plan to accomplish the training as soon as possible.

4. Collection and Processing of Accident Data - RSPA proposes revisions to the natural gas accident form. This action should include revisions for expanding causal categories for both the natural gas and hazardous liquid accident forms, and improving accident form instructions.

5. Enforcement Mechanism – RSPA agrees that enforcement capabilities are inadequate. RSPA needs to identify the actions it will take to establish enforcement mechanisms.

6. Timetables for NTSB Safety Recommendations – DOT Order 2000.1D requires RSPA to transmit timetables it has established to complete NTSB recommendations to NTSB. Although RSPA indicates it has developed timetables for its responses, such timetables were not provided in the replies transmitted to NTSB that we reviewed. RSPA should transmit these timetables to NTSB.

FINDINGS AND RECOMMENDATIONS

OPS HAS NOT IMPLEMENTED CONGRESSIONALLY MANDATED INSPECTION AND EQUIPMENT STANDARDS

The Office of Pipeline Safety (OPS) has not met Congressional deadlines mandated in the Pipeline Safety Act of 1992 to establish criteria identifying high-density and environmentally sensitive areas, to inventory pipelines in these areas, and to prescribe additional safety inspection standards in these areas, including the use of internal inspection devices. The criteria to identify high-density population areas for both natural gas and hazardous liquid pipelines, and environmentally sensitive areas for hazardous liquid pipelines have not yet been completed, despite a Congressionally mandated deadline of 1994. Because these criteria form the basis for each of the mandates listed below, it is critical that OPS establish the necessary criteria.

Congressional Deadline	October 1994	October 1995	October 1996
Natural Gas Pipelines	• Establish criteria to identify high density areas • Inventory pipeline facilities located in high-density areas	• Establish additional safety standards related to periodic inspections in high-density areas	
Hazardous Liquid Pipelines	• Establish criteria to identify high-density and unusually sensitive areas • Inventory pipeline facilities located in high-density areas • Inventory pipeline facilities located in USAs • Survey and assess Emergency Flow Restriction Devices	• Establish additional safety standards related to periodic inspections in high-density areas • Establish additional safety standards related to periodic inspections in USAs	• Prescribe standards on the circumstances when an Emergency Flow Restriction Device must be used.

OPS has not Completed Criteria to Define High-Density Areas for Natural Gas and Hazardous Liquid Pipelines

OPS has not developed criteria to define high-density areas because of the need to modify existing "class locations" for natural gas pipelines and to develop measurements for hazardous liquid pipelines. OPS currently uses "class location units" as an indicator of population density along natural gas pipelines.[3] According to OPS officials, the current class location units do not identify all buildings at risk. For example, schools near pipelines in a rural area (class 1) do not receive the same level of safety protection as schools located in a densely populated area (class 4). OPS is now working with industry to identify such buildings in order to provide additional safety protection.

Hazardous liquid pipelines do not have class locations. OPS officials plan to issue a Notice of Proposed Rulemaking on an Integrity Management Plan (IMP) by March 30, 2000. Our review of the draft Notice of Proposed Rulemaking determined the IMP contains a definition of high-density areas for only large hazardous liquid pipelines operators (those that operate 500 miles of pipeline or more).

OPS has not Completed Criteria to Define Environmentally Sensitive Areas for Hazardous Liquid Pipelines

The Pipeline Safety Act of 1992 required the Secretary to establish criteria for operators to identify hazardous liquid pipeline facilities in areas described as being unusually sensitive to environmental damage. These standards were to be completed by October 24, 1994. The Accountable Pipeline Safety and Partnership Act of 1996 added additional areas to be included as unusually sensitive, such as critical aquifer protection areas, wildlife habitats, national parks, and wilderness areas.[4]

Since 1994, OPS has worked with Federal agencies, the public, concerned groups, and the pipeline industry to develop criteria to define USAs, but has not issued a final definition of USAs for hazardous liquid pipelines. A model definition has been developed and is being tested in three states to determine if the definition would accurately identify and locate unusually sensitive drinking water and ecological resources. OPS expects the results of the pilot tests in April 2000 and will publish the results for public comment.

[3] Class location units count the number of occupied buildings within 220 yards of a 1-mile length of pipeline.
[4] P.L. 104-304.

In December 1999, OPS issued a Notice of Proposed Rulemaking on the proposed USA definition to be used as the criteria in future regulations, but no date has been set to issue the final rule. According to OPS officials, the proposed rulemaking on the IMP contains the definitions of USAs for hazardous liquid pipelines, but like high-density areas, it will only apply to large pipeline operators (over 500 miles).

Inventory of Pipeline in High-Density and USAs will Rely on Voluntary Operator Efforts

The Pipeline Safety Act of 1992 also required the Secretary to prescribe standards that provide for the identification and nationwide inventory of pipelines in high-density areas and USAs by October 24, 1994. OPS plans to combine pipeline location data with U.S. Census Bureau population data to develop the inventory of high-density areas. OPS stated a major reason for the delay in identifying high-density areas was the need to develop computer software for combining Census data with pipeline mapping data. Additionally, OPS expressed concern over the complexity of combining population and mapping data to accurately identify high-density population areas.

Since 1994, OPS has worked with industry to create a National Pipeline Mapping System (NPMS) that depicts the location of major pipelines. In June 1998, a joint OPS and industry Mapping Quality Action Team published pipeline mapping data standards on electronic data submissions and paper map submissions for review and comment from the pipeline industry. During 1998, OPS held public workshops to educate pipeline operators on mapping data standards. In March 1999, OPS issued the final NPMS Standards for Pipeline and Liquefied Natural Gas Operator Submissions.

The NPMS standards request that operators voluntarily submit reasonably accurate location data for OPS to develop the nationwide pipeline inventory. According to OPS officials, OPS plans to meet the Congressional mandate for identification and inventory of pipelines through this voluntary initiative. If the voluntary submission of pipeline mapping data does not achieve a 70 percent submission rate by the end of 2000, OPS intends to issue a mandate requiring pipeline operators to submit pipeline mapping data. However, because a goal of 70 percent would not provide for a complete nationwide pipeline inventory, OPS needs to begin the rulemaking process to ensure a much higher level of compliance.

OPS has not Prescribed Periodic Inspection Standards for High-Density and Environmentally Sensitive Areas

The Pipeline Safety Act of 1992 required the Secretary to prescribe additional standards for periodic inspections of natural gas and hazardous liquid pipelines using an instrumented internal inspection device - "smart pig"- or an alternate inspection method that is at least as effective. OPS plans to develop periodic inspection standards on the type and frequency of required inspections for high-density areas and USAs after the final definitions are established. Without the definitions, operators cannot identify the locations where these new inspection standards would apply.

OPS stated there were problems implementing periodic inspection standards because the capabilities (such as locating corrosion) and availability of smart pigs were limited in the early 1990's. Interviews with pipeline operators in 1999 indicated smart pig capabilities have improved greatly. Nevertheless, there are only a limited number of pig vendors who own and operate these devices, and the availability of smart pigs remains a problem. In fact, a survey from the American Petroleum Institute dated February 17, 2000 reports that the current capability of smart pig vendors to serve hazardous liquid pipelines is about 20 percent of the total mileage.

The proposed Integrity Management Program will include a requirement for periodic inspections, and the use of smart pigs on large hazardous liquid pipelines. Again, no implementation date is set and the proposed program falls short of the Congressional mandate in that it does not apply to operators of natural gas transmission pipelines or small hazardous liquid transmission pipelines.

Emergency Flow Restriction Devices that Minimize Environmental Damage Caused by Leaking Hazardous Liquid Pipelines are not Required

Emergency flow restriction devices (EFRDs) are a type of remotely controlled valve for hazardous liquid pipelines that restrict product flow in the event of an accident. The Pipeline Safety Act of 1992 required the Secretary to survey and assess by October 24, 1994 the effectiveness of EFRDs to mitigate the consequences from a ruptured hazardous liquid pipeline. The Act also required standards on the circumstances under which an operator of a hazardous liquid pipeline facility must use an EFRD.

These Congressionally mandated requirements have not been implemented. OPS issued a study on the inspection of check valves, a type of EFRD, in 1997. However, the study did not address the effectiveness of EFRDs as required by Congress. The proposed rulemaking for the integrity management plan also

requires operators to take measures to mitigate the consequences of a pipeline failure in high-density population areas or USAs. The measures include conducting a risk analysis of the pipeline to determine if public safety or environmental protection would be enhanced by additional risk control actions, such as, but not limited to, installing EFRDs on the pipeline.

OPS SHOULD EXPAND PIPELINE TECHNOLOGY RESEARCH AND DEVELOPMENT AND INSPECTOR TRAINING

OPS funded research has shown that smart pigs, an internal inspection device, are effective at detecting corrosion, metal loss, and certain mechanical damage, but that they are less effective at detecting other defects, such as stress corrosion cracking and anomalies in pipe materials. OPS research and development (R&D) activities on pipeline inspection technology have not addressed these defects that can cause pipeline ruptures, and pipelines that cannot accommodate internal inspection devices. Although OPS safety inspectors are extensively trained in pipeline system inspections, accident investigation techniques, and compliance procedures, they are not trained to use smart pig information. This limits their independent capability to read and interpret internal inspection data when they are available during routine inspections or accident investigations.

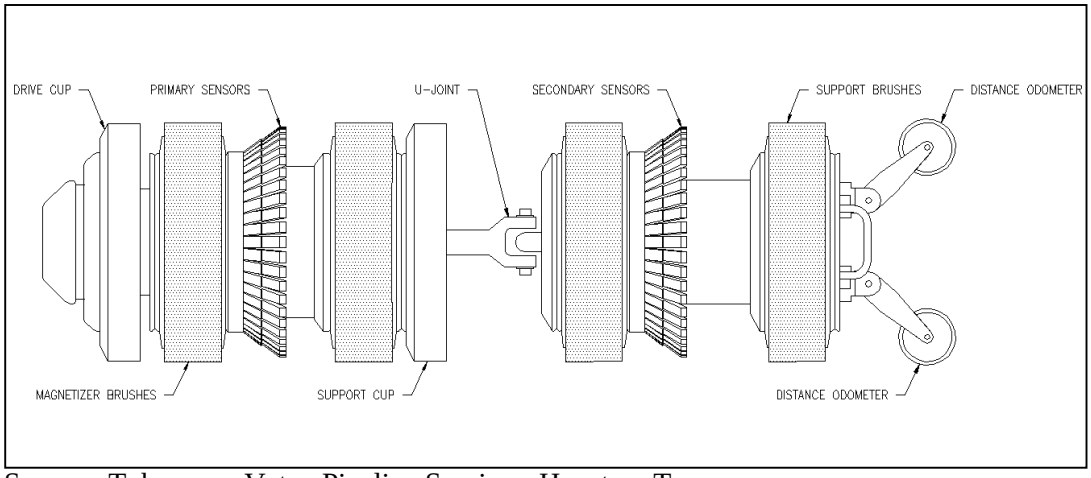
Internal Inspection Devices Used by the Pipeline Industry

To ensure the integrity and safe operation of its pipeline systems, pipeline owners/operators conduct both underground and aboveground inspections, using inspection methods that may include visual inspections, x-raying pipe welds, and hydrostatic pressure testing. In some cases, operators contract with a vendor to use a specialized tool that traverses a pipeline to detect potentially dangerous defects. The instrumented internal inspection device is commonly referred to as a "smart pig."

Smart pigs are computerized electro-magnetic or ultrasonic mechanical devices that can inspect internal and external pipe conditions and the thickness of the metal wall. For example, smart pig technology is capable of detecting metal loss, certain types of mechanical damage (typically circumferential gouges on a pipe caused by excavation work), and corrosion without excavating a pipe. Figure 2 presents a cross section of a smart pig.

Figure 2

Cross Section of a Smart Pig



Source: Tuboscope Vetco Pipeline Services, Houston, Texas

Internal Inspection Devices have been Developed but have Limitations

OPS has spent $2.5 million (25 percent of the $10.0 million pipeline R&D budget) from FYs 1995 through 1999 to assess and verify smart pig capabilities. The results indicated that the technology can detect internal pipe corrosion, metal loss, and certain mechanical damage, but it has limited ability to detect longitudinal mechanical damage, stress corrosion cracking, and defects at seam welds and in pipe materials. OPS has a pending contract for FY 2000 to improve the ability of smart pigs to detect longitudinal mechanical damage.

OPS Funded Research Should be Expanded

OPS has conducted research to improve the capability of smart pigs to detect corrosion and mechanical damage. However, the FY 2000 and 2001 research does not specifically address the capabilities of internal inspection devices to detect pipe material defects.

Another limitation of internal inspection devices is that they cannot be used in all types of pipelines since pipe sizes, valves, and configurations are different. Furthermore, natural gas pipelines require modifications in pipe configuration to run such devices, including the installation of smart pig launchers and containment devices. Although OPS does not have specific data on the number of miles of natural gas pipelines capable of accommodating a smart pig, an OPS official stated that 90 percent of hazardous liquid pipelines are capable of using these devices. This is almost identical to the findings in an American Petroleum Institute survey

released in February 2000 which concludes that 89 percent of hazardous liquid transmission pipelines can accommodate smart pigs. A major industry smart pig vendor we interviewed estimated that only 25 percent of all transmission pipelines can accommodate a smart pig.

The alternatives to smart pigs for testing pipelines are limited. Operators can use hydrostatic testing to determine if a pipeline contains defects that can cause a failure. However, hydrostatic testing, which tests the internal pressure a pipe can withstand, can be harmful to a pipe by causing microfractures or crack defects. In addition, this technique provides only a "snapshot" of a pipe's integrity and does not determine the extent or severity of any defects. The FYs 2000 and 2001 OPS R&D budget did not request funds to research alternative inspection technologies for those pipelines that cannot accommodate smart pigs.

OPS Safety Inspectors Need Inspection Technology Training

OPS has 47 safety inspectors who conduct inspections of transmission pipelines to ensure the pipeline's integrity and safe operation. In 1998, OPS inspectors conducted 768 inspections as part of a program to conduct inspections of each pipeline unit (pumps, pipelines, and components) every 2 to 5 years. Each inspector performs roughly 18 unit inspections per year, which may take from 2 days to as long as 3 weeks to perform.

We found that OPS's safety inspectors complete a core safety training program to conduct inspections. The core requirements include nine courses covering subjects such as gas pipeline system inspections, corrosion control systems, liquefied natural gas safety, materials joining, gas pressure regulation and overpressure protection, accident investigation techniques, regulation and compliance procedures, and hazardous liquid pipeline system evaluations.

However, OPS inspectors are not trained on smart pig technology as part of a core safety training program. Furthermore, OPS does not own or run smart pigs as part of routine safety inspections. When conducting an inspection, the OPS safety inspector must rely on summary reports prepared for the pipeline operator by the smart pig vendor without the expertise to verify the raw data or the summary report.

According to OPS officials, the proposed "Pipeline Integrity Management" rule would require operators to develop inspection plans that may include the use of smart pigs to detect defects that can cause pipeline ruptures. The proposed rulemaking underscores our concern that OPS inspectors must have the technical expertise to understand and make independent oversight decisions based on smart pig information.

OPS SHOULD REVISE THE COLLECTION AND PROCESSING OF PIPELINE ACCIDENT DATA

Sufficient data to accurately identify accident causes and trends, or to evaluate GPRA safety performance measures, are not collected through RSPA's current mechanisms. The OPS accident forms used to collect data lack precise causal categories and complete instructions. For example, 26 percent of 1998 transmission accidents in the OPS database were listed by the operators as caused by "Other." The OPS accident database contains inaccurate accident causal information and understates property damage estimates. For eight accidents investigated by NTSB, we found that the OPS database was inaccurate in five cases. With precise and complete accident data, OPS will be able to best focus its resources and measure safety program performance.

Accident data collected from the operator provide important information about accident causes. Within 30 days of a pipeline accident, pipeline operators are required to submit an accident report form to OPS. Regulations also require operators to submit a supplemental report when accident information changes.[5]

The OPS accident form uses four causal categories on the required natural gas form and seven causal categories on the required hazardous liquid form to track accident causes. Table 1 compares the causal category options on natural gas and hazardous liquid accident report forms and shows the percentage of accidents reported in each category in 1998.

Table 1

Accident Form Causal Categories and 1998 Reported Accident Occurrence

Accident Form Causal Category	Natural Gas		Hazardous Liquid	
	Category Applicable	Percentage Reported by OPS	Category Applicable	Percentage Reported by OPS
Corrosion	Yes	22%	Yes	26%
Outside Force Damage	Yes	37%	Yes	27%
"Other"	Yes	21%	Yes	29%
Construction/Material Defect	Yes	19%	No	
Malfunction of Control or Relief Equipment	No		Yes	6%
Incorrect Operation by Operator Personnel	No		Yes	5%
Failed Pipe	No		Yes	5%
Failed Weld	No		Yes	4%
Percentage Total:		99%*		102%*

*Totals do not add up to 100% because of rounding.
Source: Office of Pipeline Safety accident database

[5] 49 CFR parts 191.15 and 195.54

Accident Causal Categories Need to be Revised

The OPS natural gas and hazardous liquid accident forms do not contain uniform or precise causal categories to identify accident causes accurately and separate non-preventable accidents from preventable accidents. Additionally, instructions for completing the OPS accident forms provide insufficient guidance for operators to report accurately the causes of accidents. Together these conditions affect OPS's ability to report on a Government Performance and Results Act (GPRA) goal.

Our comparison of both the natural gas transmission and the hazardous liquid transmission accident forms found causal categories were not uniform and could not identify accident causes as precisely as possible. For example, unlike hazardous liquid form, the natural gas form lacks a causal category to identify when an operator performed an incorrect operation that resulted in an accident. Consequently such accidents are now reported as caused by "Other."

The OPS accident database shows 21 percent of the 1998 natural gas and 29 percent of the 1998 hazardous liquid accidents as caused by "Other." We reviewed accident forms for 65 natural gas and hazardous liquid accidents. Based on the narrative provided by the operator, we reclassified 11 hazardous liquid reports. As a result, the "Other" category for hazardous liquid was reduced from 29 percent to 21 percent. This difference was attributed to operator classification errors and OPS's procedure of relying on the "box" checked and not reviewing the narrative on the form.

Both a 1998 NTSB and a 1999 American Petroleum Institute (API) report recommended that accident reporting should be revised to request more comprehensive data. To make the OPS hazardous liquid accident form more precise, API recommended expanding the current causal categories. For example, the "Outside Force Damage" category contains both non-preventable natural events as well as preventable accidents caused by excavation activities. A non-preventable "Outside Force Damage" accident could be caused by earthquakes, landslides, or lightning. A preventable "Outside Force Damage" accident could include a telephone company hitting an underground pipeline while laying a cable line or an operator striking its own buried pipeline while uncovering it for an inspection. Combining non-preventable accidents of nature in a category with preventable man-made accident masks the information OPS needs to best focus its resources on the most frequent, preventable accident causes.

We noted instructions for completing the OPS natural gas and hazardous liquid accident forms do not supply accident causal definitions needed by the operator to

accurately report the accident cause. For example, neither the accident form nor the supplemental instructions defined the meaning of "Outside Force Damage" for the operator. In our examination of 1998 hazardous liquid narrative sections from 44 accident reports where "Other" was the listed causal category, we found 9 instances where the accident cause should have been reported as "Outside Force Damage." In our opinion, the lack of instructions resulted in the operator listing the accident cause as "Other" rather than "Outside Force Damage." Consequently, hazardous liquid "Outside Force Damage" accidents were underreported by 18 percent.

The inability to correctly identify accident causes also impacts the Department's reporting of a GPRA goal. OPS used accident causal data to establish GPRA measurements and to track goal attainment. The goal is to reduce "Outside Force Damage" accidents by 5 percent over the next 3 years. For this performance measurement to be accurate, OPS needs precise causal categories and accident form instructions in order to ensure that accidents attributable to "Outside Force Damage" are correctly reported.

OPS Needs to Ensure Accuracy of Operator-Reported Accident Information

OPS does not ensure the accuracy of accident data submitted by operators. Although OPS has a process to verify accident data, the process is dependent upon the operator submitting revised accident information to OPS. Monthly, operator accident reports and corresponding data summary sheets are received by OPS regions for review. When regional personnel find a suspected reporting error, the operator is contacted and requested to supply a revised accident report.

To determine if operators provided updated accident information on causal categories and property damage estimates, we compared the results of several NTSB investigations to accident reports submitted by operators. In the eight transmission pipeline accidents NTSB investigated from 1994 through 1998, only one operator submitted an updated accident form reflecting the NTSB results.

We found that accident causes differed between the operator and NTSB for three pipeline accidents. Furthermore, NTSB investigations reported $20.4 million more in property damage than five pipeline operators reported to OPS. As a result, the OPS accident database contains inaccurate accident causal information and understates property damage.

An OPS official stated that errors submitted on an operator's report cannot be corrected in the OPS database without an operator's written revision. However, the official stated that OPS lacks enforcement authority to compel operators to

submit revised accident forms. Therefore, even when OPS knows a form is inaccurate, it does not currently have authority to make corrections.

OPS HAS NOT SET REQUIRED TIMETABLES FOR IMPLEMENTING NTSB SAFETY RECOMMENDATIONS

RSPA needs to provide timetables, as specified in DOT Order 2000.1D, to the NTSB indicating when OPS will implement 21 pipeline safety recommendations dating back to 1987. Following a pipeline accident investigation, NTSB issues safety recommendations to prevent similar accidents in the future. DOT Order 2000.1D, *Procedures for Handling National Transportation Safety Board Recommendations,* establishes a policy that NTSB recommendations will receive prompt attention and actions will be pursued expeditiously, including the setting of timetables to adopt or implement recommendations.

NTSB decides whether to conduct safety investigations of pipeline accidents that meet certain criteria: one or more fatalities; multiple injuries; property damage in excess of $1 million; extensive liquid release; or, significant environmental damage. NTSB's recommendations result from accident investigations, accident trends, and safety studies. A safety recommendation is NTSB's suggested course of action to an Operating Administration to correct a transportation safety deficiency. Recommendations are intended to assist the Operating Administrations in preventing similar accidents and otherwise promoting safety.

Since 1987, NTSB has issued a total of 80 pipeline safety recommendations to OPS. As of February 2000, NTSB has designated 40 of the 80 recommendations as "open," three of which date back to March 1987.[6] The remaining recommendations have been closed.

DOT Order 2000.1D establishes uniform procedures within DOT for acting upon and responding to NTSB recommendations. The order requires Operating Administrations to transmit a substantive reply to NTSB covering the merits of the recommendation. Where the Operating Administration agrees to adopt the recommendation, the reply should describe actions already taken if the recommendation has been completed. In cases where actions are incomplete, the reply must indicate intentions to adopt or implement the recommendation in full or in part, or to adopt alternative actions. In these cases, a timetable for implementation is required. Timetables establish completion dates and allow RSPA to measure OPS's progress in implementing NTSB recommendations.

We reviewed 23 open NTSB recommendations related to both natural gas and hazardous liquid accidents caused by corrosion (4) and outside force damage (19).

[6] There are five classifications of "open" recommendations, describing the quality of the recipient's response and the actions taken to adopt or implement the recommendation: open – await response; open – response received; open – acceptable action; open – acceptable alternate response; and open – unacceptable response.

Combined, the two causes represent more than 50 percent of natural gas or hazardous liquid transmission pipeline accidents for 1998. RSPA has not provided timetables in its replies to NTSB indicating when OPS will implement 21 of the 23 open pipeline safety recommendations. Furthermore, three recommendations were issued over 10 years ago, none of which have implementation timetables. Exhibit B illustrates the status of the 23 NTSB safety recommendations we reviewed.

RECOMMENDATIONS

We recommend that the RSPA Administrator:

1. Finalize actions required by the outstanding 1992 and 1996 Congressional mandates;

2. Expand the focus of Research and Special Programs Administration research and development programs to include (a) smart pigs that can detect pipe material defects, and (b) alternative pipeline inspection and monitoring technologies for pipelines that cannot accommodate smart pigs;

3. Design and implement a program to train OPS safety inspectors on the use and capabilities of internal pipeline inspection technologies and the reading and interpreting of the results of internal inspections;

4. Implement revisions in the collection and processing of pipeline accident data to expand accident causal categories for more detailed trend analysis, and to clarify accident form instructions so that operators will be more consistent and accurate in reporting accident causes;

5. Revise OPS regulations to establish an enforcement mechanism to ensure operators submit revised accident reports when required; and

6. Comply with the DOT order by establishing timetables to implement open NTSB pipeline safety recommendations with which they agree and transmitting the timetables to NTSB.

MANAGEMENT COMMENTS

On March 10, 2000, RSPA provided its response to our draft report (see Appendix). RSPA's position on each recommendation is summarized as follows.

1. Completing Congressional Mandates – RSPA noted three major actions it expects to complete during 2000 that address outstanding Congressional mandates, including rulemakings on defining USAs and pipeline integrity management. RSPA also noted efforts to complete base maps for pipeline location mapping.
2. Research on Inspection Technology – RSPA stated the FY 2001 funding request for research recognizes the need to begin development on alternative inspection and monitoring technologies.

3. Inspector Training – RSPA concurs with the importance of providing inspection technology training to OPS (and state) safety inspectors.
4. Collection and Processing of Accident Data – RSPA is revising the gas transmission accident report similar to the OIG recommendation and expects to complete the action during 2000.
5. Enforcement Mechanism – RSPA agrees that OPS needs the enforcement capability to ensure accident reports are accurate.
6. Timetables for NTSB Safety Recommendations – RSPA states it is in compliance with DOT Order 2000.1D and is resolving open recommendations.

OFFICE OF INSPECTOR GENERAL RESPONSE

We reviewed RSPA's reply. Our responses to its comments are as follows.

1. Completing Congressional Mandates – RSPA's response should identify when Congressional mandates from the 1992 and 1996 pipeline safety acts will be complete. We encourage RSPA to move forward expeditiously to issue final rules meeting all requirements of the laws.

2. Research on Inspection Technology – We recognize that RSPA research has advanced the capabilities of smart pig technology. However, future research must focus on the detection of pipe material defects and alternative inspection and monitoring technologies for pipelines incapable of accommodating smart pigs.

3. Inspector Training – RSPA agrees with the need for such training. RSPA should develop a plan to accomplish the training as soon as possible.

4. Collection and Processing of Accident Data - RSPA proposes revisions to the natural gas accident form. This action should include revisions for expanding causal categories for both the natural gas and hazardous liquid accident forms, and improving accident form instructions.

5. Enforcement Mechanism – RSPA agrees that enforcement capabilities are inadequate. RSPA needs to identify the actions it will take to establish enforcement mechanisms.

6. Timetables for NTSB Safety Recommendations – DOT Order 2000.1D requires RSPA to transmit timetables it has established to complete NTSB recommendations to NTSB. Although RSPA indicates it has developed timetables for its responses, such timetables were not provided in the replies

transmitted to NTSB that we reviewed. RSPA should transmit these timetables to NTSB.

ACTION REQUIRED

We request RSPA to respond to the OIG with a list of specific actions taken or planned in response to our recommendations and the estimated completion dates within 30 days of this final report.

EXHIBIT A: SCOPE AND METHODOLOGY

The scope of this review was limited to natural gas and hazardous liquid interstate transmission pipelines.

We reviewed Departmental and OPS regulations and conducted interviews with OPS program officials, state pipeline agency personnel, and industry experts. We also interviewed 14 small and large natural gas and hazardous liquid pipeline operators and 3 trade associations. The pipeline operators we interviewed (in Houston, Texas, and Herndon, Virginia) provided information on the causes and prevention of pipeline accidents, the use of instrumented internal inspection devices, and the need for provisions in the reauthorization of the pipeline safety program.

We reviewed OPS progress in completing congressional mandates issued in the 1992 and 1996 pipeline safety acts (P.L. 102-508 and P.L. 104-304). We also reviewed correspondence and reports documenting progress implementing NTSB recommendations on pipeline accidents. We reviewed the accuracy of the OPS accident database using accident reports submitted by operators. We summarized operator 1998 causal data from operator reports and compared this to OPS reports on the causes of 1998 pipeline accidents. We also compared OPS accident reports with NTSB pipeline accident investigation reports.

At the Gas Research Institute test facility in Columbus, Ohio, we interviewed project officials and observed a demonstration of the capabilities of a smart pig used to detect pipeline damage and defects. We observed a facility and equipment inspection on a hazardous liquid pipeline in Arkansas and an operations and maintenance inspection at an operator's office in Missouri.

We conducted our review from August 1999 through February 2000 in accordance with Government Auditing Standards prescribed by the Comptroller General of the United States.

EXHIBIT B: STATUS OF NTSB PIPELINE SAFETY RECOMMENDATIONS SINCE 1987

	Recommendation No.	Date Issued	Accident Cause	NTSB Status	Established Timetable
1	P-87-04	03/24/87	Corrosion	OUA	No
2	P-87-34	09/24/87	Outside Force Damage	OAA	No
3	P-90-21	05/10/88	Outside Force Damage	OUA	No
4	P-90-29	10/01/90	Outside Force Damage	OAR	No
5	P-95-04	02/07/95	Outside Force Damage	OAA	No
6	P-97-08	01/06/98	Outside Force Damage	OAR	No
7	P-97-14	01/06/98	Outside Force Damage	OAR	No
8	P-97-15	01/06/98	Outside Force Damage	OAR	No
9	P-97-16	01/06/98	Outside Force Damage	OAAR	No
10	P-97-17	01/06/98	Outside Force Damage	OAAR	No
11	P-97-18	01/06/98	Outside Force Damage	OAAR	No
12	P-97-19	01/06/98	Outside Force Damage	OAR	October 1998
13	P-97-20	01/06/98	Outside Force Damage	OAR	No
14	P-97-21	01/06/98	Outside Force Damage	OAR	No
15	P-97-22	01/06/98	Outside Force Damage	OAR	No
16	P-97-23	01/06/98	Outside Force Damage	OAR	No
17	P-97-24	01/06/98	Outside Force Damage	OAR	No
18	P-98-25	10/16/98	Outside Force Damage	OAR	No
19	P-98-34	11/18/98	Corrosion	OAR	May 1999
20	P-98-35	11/18/98	Corrosion	OAR	No
21	P-98-36	11/18/98	Corrosion	OAR	No
22	P-98-37	11/18/98	Outside Force Damage	OAR	No
23	P-98-38	11/18/98	Outside Force Damage	OAR	No

Status as of February 9, 2000

Legend to NTSB Status:

OAR – Open, Acceptable Response
OAA – Open, Acceptable Action
OAAR – Open, Acceptable Alternative Response
OUA – Open, Unacceptable, Action

EXHIBIT C: MAJOR CONTACTS

- Industry Interviews/Site Visits

    - Pipeline Companies:
      ARCO, Houston, TX
      Colonial Pipeline Company, Atlanta, GA
      Duke Energy, Houston, TX
      Dynergy, Houston, TX
      Enron Gas Pipeline Group, Houston, TX
      Enterprise Products, Houston, TX
      Equilon Pipeline Company, Houston, TX
      Equistar Chemical, Houston, TX
      Kinder-Morgan, Alvin, TX
      Koch Gateway, Houston, TX
      (including locations in Missouri and Arkansas)
      Midcoast Energy, Houston, TX
      Plantation Pipe Line Company, Atlanta, GA
      Tennessee Gas Pipeline, Houston, TX
      Williams Gas, Houston, TX

- Pipeline Research and Inspection Technology
    - Gas Research Institute, Columbus, OH
    - Battelle Memorial Institute, Columbus, OH
    - Tuboscope Vetco Pipeline Services, Houston, TX

- Industry Trade Associations
    - American Petroleum Institute, Washington, DC
    - American Association of Oil Pipelines, Washington, DC
    - Interstate Natural Gas Association of America, Washington, DC

- National Transportation Safety Board, Washington, DC

- Office of Pipeline Safety Headquarters and Regional Offices

- State Pipeline Agencies
    - Alabama
    - Arkansas
    - Minnesota
    - Mississippi
    - Nevada
    - New York

EXHIBIT D: MAJOR CONTRIBUTORS TO THIS REPORT

The following is a list of the major contributors to the audit of the Pipeline Safety Program.

Jackie Goff	Program Director
Sydney Verinder	Project Manager
Mark Rielly	Auditor
Lisa Mackall	Auditor
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APPENDIX