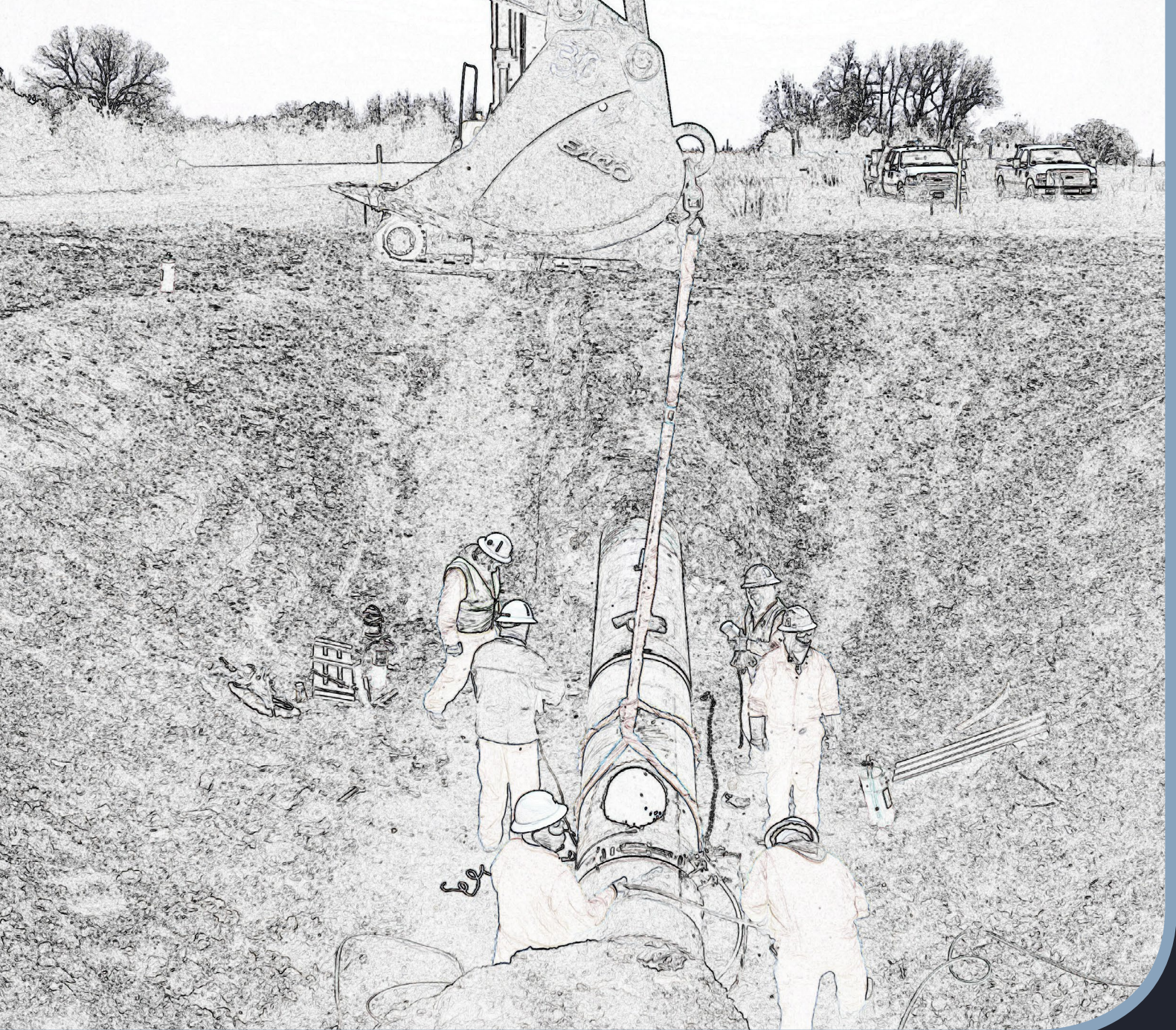




Natural Gas Pipeline Safety and Reliability: An Assessment of Progress



This report was prepared in 2015 by:



with the support of the



American Gas Foundation

Legal Disclaimer

This document was prepared by members of the American Gas Foundation and Van Ness Feldman, LLP (Authors). The purpose of this document is to inform interested parties about natural gas pipeline safety.

The Authors accept no liability of any kind to any party, and no responsibility for damages or loss suffered by any party, as a result of decisions made, or not made, or actions taken, or not taken, based on this document.

Contents

1

Executive Summary

Introduction.....	1
Recent Developments.....	1
Looking Forward.....	2

2

Background: Natural Gas Pipeline Safety in Perspective

Introduction.....	5
Comparative Transportation Safety Analysis.....	5
Gas Pipeline Safety Program Overview.....	6

3

Recent Efforts to Improve Natural Gas Pipeline Safety and Reliability

Introduction.....	13
Federal Initiatives.....	13
State Initiatives.....	27
Industry Initiatives.....	28

4

Ongoing Efforts to Improve Natural Gas Pipeline Safety and Reliability

Introduction.....	33
Federal Initiatives.....	33
Select State Initiatives.....	36
Industry Initiatives.....	37

5

The Future of Natural Gas Pipeline Safety and Reliability

Introduction.....	39
Integrity Verification.....	39
Expedite Publication.....	40
Financial Impacts.....	40
Industry Role.....	40

6

Conclusion

Conclusion.....	43
-----------------	----

7

Endnotes and Appendices

End Notes.....	45
----------------	----

This page intentionally blank.



Executive Summary

1



This page intentionally blank.

— Introduction

Pipelines are generally recognized as the safest and most reliable means of transporting energy products, and the natural gas industry devotes about \$19 billion annually to maintaining the integrity of the nation's 2.6 million miles of transmission and distribution pipelines. In addition to this ongoing investment, safeguarding the country's vast network of natural gas pipelines requires a closely integrated approach between the pipeline industry, its regulators at both the federal and state levels, and other interested stakeholders. This study describes coordinated efforts between these groups—the Pipeline and Hazardous Materials Safety Administration (PHMSA), the agency within the U.S. Department of Transportation (USDOT) that currently administers the federal pipeline safety program, the various state authorities that participate in that program, and the natural gas industry—that together provide for the safe and reliable transportation of natural gas.

— Recent Developments

Programs to ensure pipeline safety have experienced significant changes since the early 2000's. PHMSA established new integrity management program requirements for gas transmission and distribution lines, continuing its transition to more risk-based regulations, and created other new regulatory programs for qualifying pipeline personnel and managing pipeline control rooms. The pipeline industry has played a critical role in developing and advancing each of these initiatives. While more time is certainly needed to fully assess the cumulative impact of these changes, observations to date indicate that these new approaches are making meaningful contributions to pipeline safety and reliability. The rate of gas pipeline incidents involving third-party excavation damage has also declined significantly in recent years. That development coincides with the implementation of several key initiatives and demonstrates the positive impact that stakeholder cooperation can have on improving gas pipeline safety and reliability.

Integrity Management

One of the most notable new dimensions added to pipeline safety programs in recent years has been

The natural gas industry devotes about \$19 billion annually to maintaining the integrity of the nation's 2.6 million miles of transmission and distribution pipelines...

risk-based integrity management programs for both gas transmission and distribution. Congress directed USDOT to establish integrity management program regulations for gas transmission line operators in the Pipeline Safety Improvement Act of 2002 (2002 PSIA). That legislation, the product of several years' worth of research, analysis, and collaboration among various stakeholders, embodied a significant step forward in the transition from a prescriptive to a more risk-based regime for ensuring the safety of the nation's natural gas pipeline network.

The pipeline industry played a critical role in developing the integrity management program for gas transmission lines. Those efforts began in the late 1990s, with industry's participation in a series of risk management demonstration project and drafting of a new technical standard for pipeline integrity management, and continued throughout the legislative and rulemaking process. Moreover, pipeline operators, industry groups, regulators, and other interested parties have dedicated significant resources to successfully implementing the integrity management programs since the final rules went into effect. Although conclusive data on the effectiveness of the integrity management program will probably not be available for several more years, the results of initial studies conducted by the Government Accountability Office (GAO) and National Transportation Safety Board (NTSB) suggest that the rule is having a positive impact on pipeline safety.

Congress directed USDOT in the Pipeline Inspection, Protection, Enforcement, and Safety Act of 2006 (2006 PIPES Act) to establish integrity management rules for gas distribution pipelines. Given the unique characteristics of these systems, USDOT worked closely with the pipeline industry to determine the best approach for applying integrity management principles to distribution lines, which operate at much

lower pressures, are smaller in diameter, and are constructed of different materials than transmission lines. As a result of those efforts, USDOT issued a final DIMP rule in 2009 that embodies the collective input of multiple stakeholder groups. While still in the initial phase of implementation, early indications suggest that DIMP is improving pipeline safety.

Excavation Damage Prevention

Although historically a leading cause of pipeline failures, the rate of gas pipeline incidents involving third-party excavation damage has declined significantly in recent years. This sharp reduction in excavation-related damage to gas pipelines coincides with the implementation of a number of important initiatives by governmental authorities, the pipeline industry, and other stakeholder groups. For example, state regulators have strengthened damage prevention program requirements and used more aggressive enforcement strategies to ensure compliance by excavators. The pipeline industry has dedicated substantial resources to the development and implementation of damage prevention and public awareness programs. Perhaps most importantly, the Common Ground Alliance, an association dedicated to excavation damage prevention with a membership that represents the interests of nearly every stakeholder group, has developed best practices, collected information, identified new technologies, and promoted public awareness of the issue. USDOT and the pipeline industry were instrumental in creating the Common Ground Alliance.

Looking Forward

A number of forces are likely to influence pipeline safety, reliability and modernization efforts in the coming years. USDOT has initiated several proceedings to amend the gas pipeline safety regulations, and the lack of progress in that regard has created a great deal of regulatory uncertainty and discouraged investments in pipeline safety initiatives that may be negated or modified once USDOT issues its final rules. While some of these concerns can be alleviated through near-term policy initiatives, the completion of the rulemaking process and adoption of cost-effective regulations is vital to the safety and reliability of the nation's pipeline infrastructure over

the long term. USDOT's allocation of the additional financial resources provided in recent congressional appropriations will have an impact on pipeline safety and reliability efforts as well, particularly if those funds are used to improve certain aspects of the pipeline safety program and facilitate further investments in research and development projects.

Cost Recovery Considerations

Cost recovery programs will take on added significance as new pipeline safety regulations come into effect at the federal and state levels. The reach of these programs has expanded significantly in recent years, and all indications suggest that this trend will continue. As in the past, industry will continue to play a vital role in modernizing the nation's gas pipeline infrastructure through replacement, testing and repair of pipe; participation in programs that help the industry raise the bar on safety; participation in the regulatory process; implementation of voluntary initiatives; and strengthening of existing programs.

The states make critical contributions to pipeline modernization efforts by promoting the use of special cost recovery mechanisms to accelerate the repair, rehabilitation, and replacement of pipeline infrastructure. These mechanisms provide pipeline operators with a greater degree of financial certainty in undertaking these projects and protect the public by eliminating unnecessary deterrents to safety-related investments.

Industry Engagement

Industry will continue to play a vital role in ensuring the safety and reliability of the nation's gas pipeline infrastructure in the years ahead. Industry standards development organizations continue to create new standards, which further pipeline safety by establishing guidance and recommended practices for operators to follow. The pipeline industry has also been an active participant in USDOT's rulemaking proceedings, and that engagement should ensure that future regulatory changes are based on the best available scientific, technical, and commercial information.

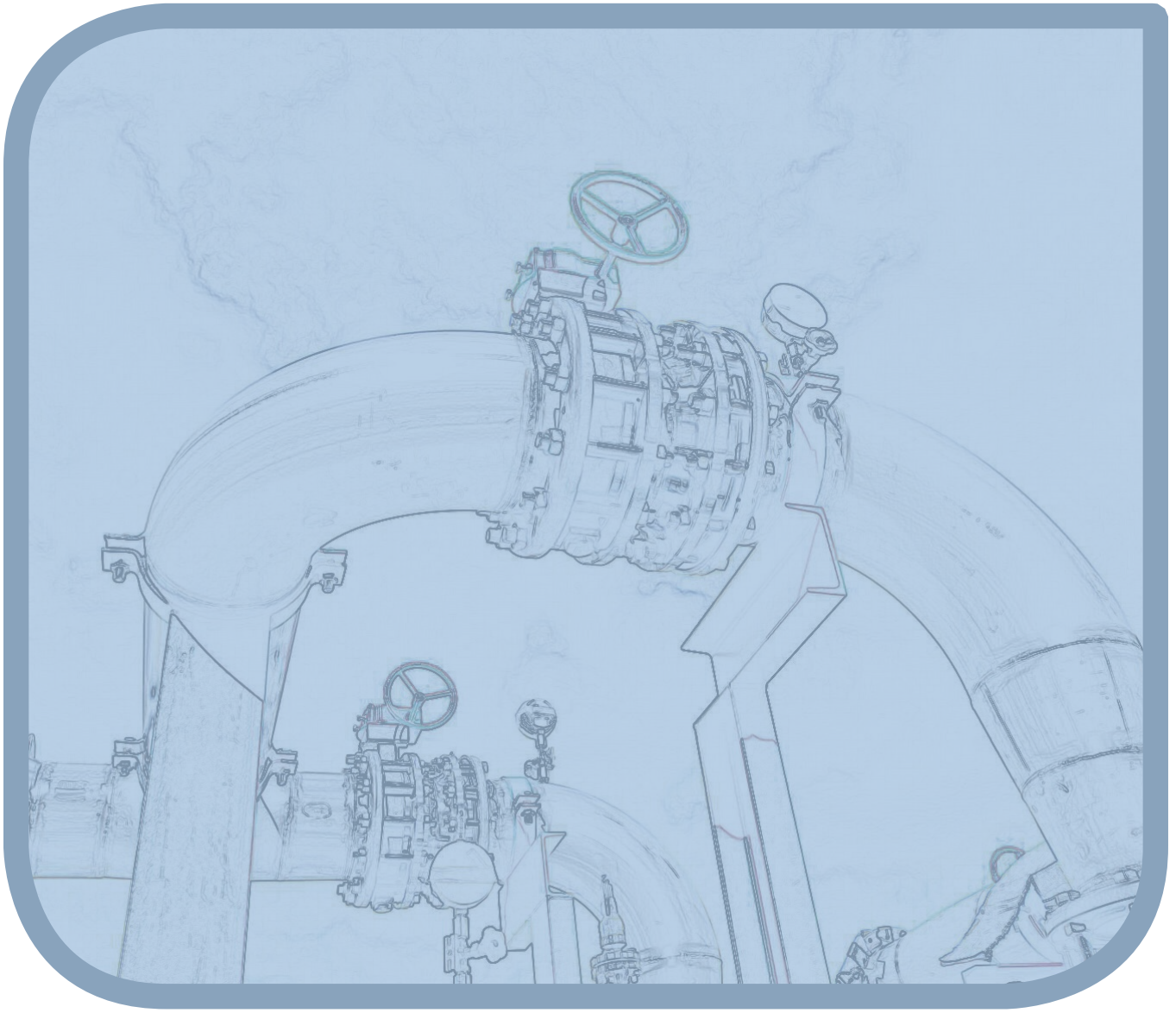
The industry's major trade organizations have committed to improving pipeline safety and reliability by adopting best practices that exceed current legal requirements and developing new

standards, including a recommended practice for safety management systems that is specifically tailored for pipelines. These efforts will provide a solid foundation for future pipeline modernization initiatives, particularly if PHMSA continues to foster a risk-based regulatory framework that provides operators with the flexibility to implement the lessons learned from these experiences.

— Conclusion

Over the past 200 years, the industry has grown from a handful of local lines serving a few communities to a nationwide network of gas gathering, transmission, and distribution pipelines that deliver this domestic fuel to every sector of the U.S. economy. America's gas pipeline network is safer and more reliable today than it has been at any other point in its history, largely as a result of technological advances, improvements in industry best practices, voluntary actions taken beyond regulations, and more effective regulatory programs. With continued collaborative efforts between industry and government actors, natural gas pipelines are likely to retain their status as the safest form of transportation in our energy sector for decades to come.





Background: Natural Gas Pipeline Safety in Perspective

2



This page intentionally blank.

— Introduction

This section provides background information on the transportation of energy products and safety of natural gas pipelines. Nearly all of the natural gas transported in the United States is carried by pipeline. Pipelines also transport most, but not all, of the nation's hazardous liquids. When compared to other modes of transportation, pipelines are generally regarded as the safest and most reliable means of making domestic shipments of energy products.

The gas industry emerged in the United States in the early 1800s, and the use of gas as an energy source expanded rapidly throughout the 19th century, particularly in urban areas. Technological advancements in the early 20th century set the stage for the transportation of natural gas in long-distance, steel pipelines, and a dramatic increase in demand led to a surge in pipeline construction in the post-World War II period. In response to these developments, the natural gas industry and state authorities began to establish standards for ensuring the safety of gas transmission and distribution lines.

In the late 1960s, the U.S. Congress enacted legislation authorizing USDOT to establish federal safety standards for gas pipeline facilities and to provide federal grant funding to state authorities for regulating the safety of intrastate gas pipeline facilities. For the next three decades, USDOT used the authority provided in that law and subsequent reauthorizations to adopt comprehensive federal safety standards for the design, construction, testing, operation, and maintenance of natural gas pipeline facilities. USDOT and its state partners also significantly expanded the number of employees dedicated to ensuring the safety and reliability of the nation's gas pipeline facilities.

The pipeline safety program has undergone dramatic changes in the past 15 years. USDOT has created a number of new regulatory programs—e.g., for gas transmission and distribution integrity management, the qualification of pipeline personnel, the management of pipeline control rooms, and the enforcement of state damage prevention laws—and initiated a number of other rulemaking proceedings to amend the gas pipeline safety regulations. The U.S. Congress has also made significant changes to

the federal pipeline safety laws and provided USDOT with a large increase in funding for administering the federal pipeline safety program.

— Comparative Transportation Safety Analysis

Most natural gas is transported in the United States by pipeline. According to PHMSA, the USDOT agency that currently administers the federal pipeline safety program, pipeline operators reported having 2,149,597 miles of regulated gas distribution lines, 302,777 miles of regulated gas transmission lines, and 17,620 miles of regulated gas gathering lines in 2013.¹ PHMSA estimates that there are approximately 223,000 miles of additional "state" gas gathering lines in rural areas, which are not covered under the current federal rules.² Data from the U.S. Energy Information Administration indicates that 23,794,011 million cubic feet of natural gas was delivered to consumers in 2013.³

Pipelines also carry most, but not all, of the hydrocarbon liquids transported in the United States.⁴ Pipeline operators reported having 192,417 miles of regulated hazardous liquid pipelines in 2013.⁵ That same year, according to the American Petroleum Institute (API) and Association of Oil Pipe Lines (AOPL), pipelines transported over 8.3 billion barrels of crude oil and 6.6 billion barrels of refined products and natural gas liquids.⁶ The amount of crude oil and petroleum products moved by non-pipeline modes of transportation has increased in recent years, particularly in the case of rail shipments.⁷

Pipelines are generally recognized as the safest and most reliable means of transporting natural gas and other energy products. Data compiled by the Bureau of Transportation Statistics (BTS), a statistical agency

Pipelines are generally recognized as the safest and most reliable means of transporting natural gas and other energy products.

within USDOT's Research and Innovative Technology Administration, shows that pipelines have been the cause of fewer fatalities and injuries than the trucking and rail industries over the past decade.⁸ PHMSA's data for the pipeline industry reflects a similar trend, showing a significant reduction in the number of incidents per year involving fatalities or injuries over the last two decades.⁹ The GAO concluded in two recent studies that the transportation of natural gas by pipeline results in far fewer fatalities and injuries than other methods of transportation, including by truck and railcar.¹⁰

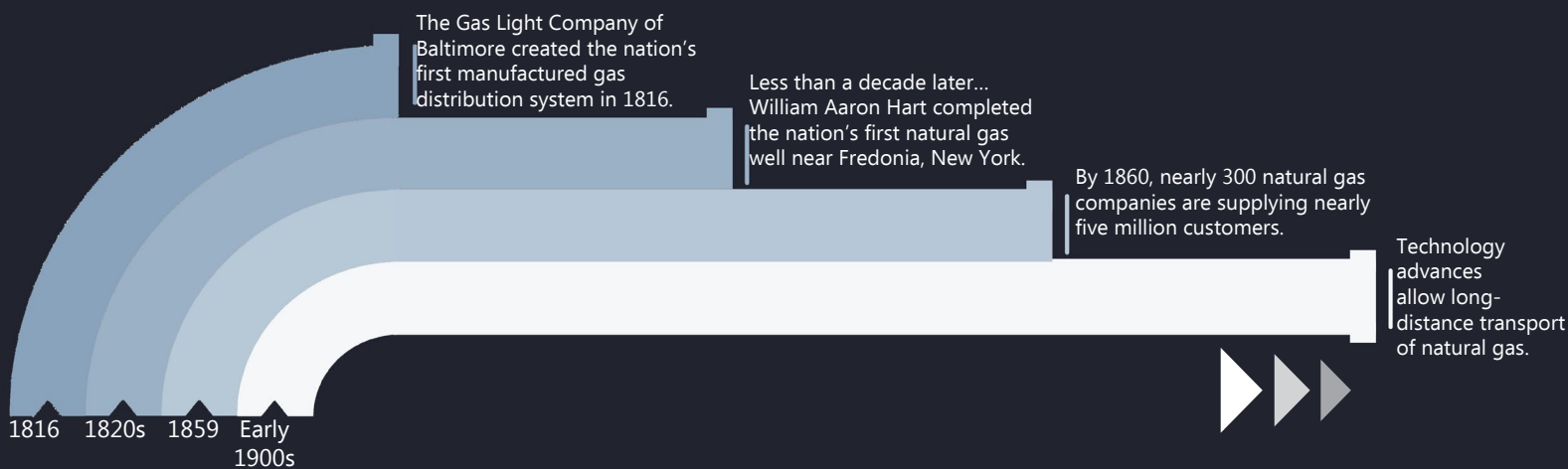
Several non-governmental studies provide further support for the superior safety and reliability of pipelines as a mode of transportation. The Allegro Energy Group found that for the 1992 to 1997 period "the likelihood of fatality, injury, or fire and/or explosion [wa]s generally lowest for pipelines," and that "[t]he rate of fatalities, injuries, and fires/explosions per ton-mile of oil transported for all other modes [wa]s typically at least twice—and in some cases more than 10 times—as great as the rate for the pipelines."¹¹ The Fraser Institute reached a similar conclusion after reviewing data for the 2005 to 2009 period, finding that "pipeline transportation is safer than transportation by road, rail, or barge, as measured by incidents, injuries, and fatalities—even though more road and rail incidents go unreported."¹² The Fraser Institute similarly determined in a subsequent report that the latest data from the United States and Canada shows that the transportation of energy products by rail is over 4.5 times more likely to result in an incident or

accident as compared to the use of a pipeline.¹³

The natural gas industry dedicates about \$19 billion annually to safeguarding the nation's 2.9 million miles of natural gas transmission and distribution lines, and the oil industry is spending more than \$2 billion annually to maintain the integrity of its nearly 200,000 miles of hazardous liquid pipelines.¹⁴ As a result of these investments, pipelines are widely recognized as the safest and most reliable means for transporting the nation's energy products. Despite these favorable statistics, federal and state regulators, the pipeline industry, and other stakeholders remain committed to improving the safety and reliability of the nation's pipeline network. PHMSA has pledged to "[r]educe the number of [annual] pipeline incidents involving death or major injury to between 26 and 37,"¹⁵ and the pipeline industry has vowed to achieve the ultimate goal of zero incidents.¹⁶

Gas Pipeline Safety Program Overview

The federal pipeline safety laws provide PHMSA with the authority to establish minimum federal safety standards for gas pipeline facilities and persons engaged in the transportation of gas. PHMSA's federal safety standards apply to most gas pipelines in the United States, and they are the only safety requirements that apply to interstate facilities, with the exception of qualified one-call damage



prevention laws.

The states (including the District of Columbia and Puerto Rico) are allowed to assume responsibility for regulating the safety of intrastate gas pipeline facilities. To do so, a state authority must submit an annual certification to PHMSA, agree to adopt the minimum federal safety standards, and meet other program requirements. A state authority that participates in the federal pipeline safety program can apply additional or more stringent safety standards to the pipeline facilities covered under the terms of its certification, so long as those standards are compatible with the minimum federal requirements.¹⁷

States can also assume a more limited oversight function by entering into a separate agreement with PHMSA. An agreement allows a participating state to conduct inspections of intrastate or interstate pipeline facilities to determine if an operator is complying with the federal safety standards. The results of these inspections are then shared with PHMSA, which retains the authority to enforce the federal pipeline safety standards under the terms of such an agreement.

All of the states, except Alaska and Hawaii, have submitted annual certifications in recent years to regulate the safety of intrastate gas pipelines.¹⁸ Eight states also entered into agreements to perform inspections of interstate gas pipelines.¹⁹

Origins and Early History

The origins of the gas industry in the United States date to the early 19th century. In 1816, the Gas Light Company of Baltimore established the nation's first gas utility in Baltimore, Maryland, to distribute manufactured gas (a fuel produced from the processing of coal or other combustible materials) for local street light service. Less than a decade later, in the early 1820s, William Aaron Hart completed the nation's first natural gas well near Fredonia, New York. Mr. Hart also installed a rudimentary piping system to carry the gas from his well to local customers.

The use of gas in the United States expanded rapidly in the decades that followed, particularly in urban areas. Gas companies formed in Boston, Brooklyn, and New York City in the 1820s; New Orleans, Philadelphia, Pittsburgh, and Louisville in the 1830s;

The pipeline safety program has undergone dramatic changes in the past 15 years.

and Cincinnati, Albany, and Washington, D.C., in the 1840s. Moreover, as Charles F. Phillips, Jr. observed in *The Regulation of Public Utilities*, the gas industry grew at an even faster pace in the second half of the 19th century:

In 1860, the American Gas-Light Journal reported that as of December 31, 1859, 297 gas companies, with a total capitalization of \$42,861,174, were supplying a population of 4,857,000 through 227,665 private meters. The second half of the nineteenth century saw equally remarkable expansion. Brown's Directory of American Companies, 1889 showed 999 companies with a total capitalization of \$400 million supplying a population of 24,500,000 in 885 towns with 60 billion cubic feet of gas. Thus, in the last forty years of the nineteenth century, the number of companies tripled, the population served quintupled, and the capital invested increased tenfold.

Despite the prolific growth experienced in the late 1800s, the gas industry remained largely a local enterprise throughout the century, primarily due to technological limitations. The materials and methods used in constructing early pipeline systems were not suitable for delivering gas to remote markets.²¹

However, technological advances in the early 1900s, including improvements in steelmaking and pipe manufacturing, paved the way for the use of large-diameter, high-pressure steel pipelines,²² and a growing network of interstate pipelines emerged to serve the nation's expanding base of gas consumers. By 1945, the United States had approximately 77,000 miles of gas transmission lines, 27,000 miles of gathering lines, and 181,000 miles of gas distribution lines.²³ The demographic changes that occurred after World War II led to a surge of additional gas pipeline development and set the stage for further long-term growth in the gas industry.

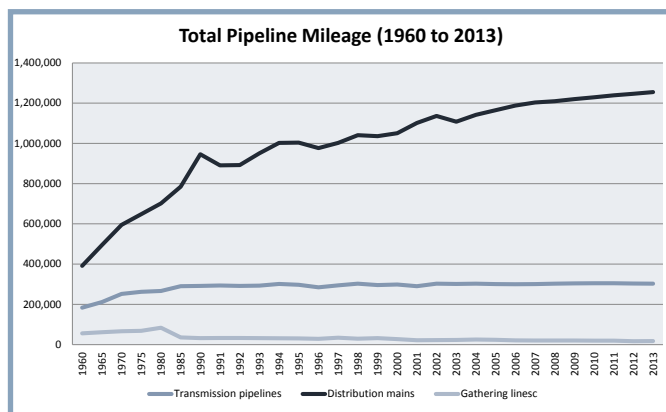
At about the same time, the gas industry and state regulators began to address the issue of pipeline safety. In 1952, the American Society of Mechanical Engineers (ASME) released the first edition of the

American Standard Code for Gas Transmission and Distribution Piping Systems (ASA B31.1.8-1952). Drawing on several years of experience administering a general code for pressure piping, the ASA B31.1.8-1952 was the first industry standard specifically tailored for the gas transmission and distribution sectors. The original edition of the code included minimum safety requirements for materials, piping components, pipe joints, fabrication, design, installation, testing, and operating pressure.

Starting a trend that would be repeated in later years, the New York Public Service Commission issued rules in 1952 that required gas transmission line operators to comply with the provisions in the ASA B31.1.8-1952, as well as additional safety standards for valves, depth of cover, corrosion control, compressor stations, testing, odorization, reporting, and other issues. A majority of other states followed suit and adopted safety standards during the 1950s and 1960s. Like New York, most of these early state pipeline safety codes incorporated the provisions in the original or subsequent editions of the ASA B31.1.8-1952.²⁴

The nation's total gas pipeline mileage nearly tripled in the two decades after 1945, with increasing natural gas demand and significant advances in pipe manufacturing, construction, and testing prompting a period of unprecedented growth in the industry.²⁵ By the late 1960s, there were approximately "800,000 miles of gas pipeline[s] in the United States[,] including 63,000 miles of gathering lines, 224,000

miles of transmission lines, and 536,000 miles of distribution lines."²⁶



In response to the surge of activity that occurred in the post-World War II period, the U.S. Congress enacted the first comprehensive federal law dedicated exclusively to ensuring the safety of the nation's gas pipeline systems.²⁷ That law, the Natural Gas Pipeline Safety Act of 1968 (1968 Act), authorized the newly-established USDOT to prescribe federal safety standards for gas pipeline facilities and persons engaged in the transportation of gas by pipeline. The states retained the ability to regulate the safety of intrastate gas pipelines under the 1968 Act through an annual certification process and could participate in the inspection of intrastate or interstate gas pipelines by entering into agreements with USDOT. However, the 1968 Act prohibited the states from directly regulating

The American Society of Mechanical Engineers releases the first edition of the American Standard Code for Gas Transmission and Distribution Piping Systems.

The Natural Gas Pipeline Safety Act authorizes USDOT to establish minimum federal safety standards for gas pipeline facilities and to make grants to states for regulation of intrastate gas pipeline facilities.

By 1974, 45 of the 52 eligible state jurisdictions had submitted annual certifications to regulate intrastate gas pipeline facilities.

USDOT establishes the first federal damage prevention program requirements for gas pipeline operators.

1952 1968 1974 Early 1980s



the safety of interstate gas pipelines and adopting additional or more stringent safety standards for intrastate gas pipelines that were not compatible with the federal provisions. The 1968 Act also imposed other substantive limitations on USDOT's authority (by prohibiting the retroactive application of certain safety standards and exempting gas gathering lines in rural areas from regulation) and preserved the Federal Power Commission's primacy in determining the location and routing of interstate natural gas pipeline facilities.

In the years immediately following the passage of the 1968 Act, USDOT focused primarily on developing the initial set of minimum federal safety standards for gas pipeline facilities. That initiative, spearheaded by a total federal workforce of approximately 20 employees, resulted in the issuance of new federal gas pipeline safety regulations in the early 1970s.²⁸ Like the state pipeline safety rules established in the 1950s and 1960s, USDOT's federal gas pipeline safety regulations relied heavily on the provisions in ASME's recently revised USA Standard Code for Pressure Piping, Gas Transmission and Distribution Piping Systems, USAS B31.8-1968. USDOT's rules also covered corrosion control and other topics not fully addressed in USAS B31.8-1968.

The 1970s saw strong state participation in the gas pipeline safety program, despite the relatively modest levels of federal grant funding available for reimbursement (e.g., Congress authorized \$1.8 million in federal grant funds for state pipeline programs in fiscal year (FY) 1975, with \$1.158 million actually appropriated, and \$2.5 million for FY 1976, with \$1.65 million actually appropriated).²⁹ In 1974, forty-five of the fifty-two eligible state jurisdictions submitted annual certifications to regulate intrastate gas pipeline facilities, and six other states entered into agreements.³⁰ By 1979, the number of states with certifications had expanded to 48,³¹ and the amount of federal grant funding available had increased considerably from previous levels (e.g., \$4.5 million authorized for FYs 1977 and 1978, with \$2.25 million and \$2.4 million actually appropriated, respectively).³² The 1970s also saw continued growth in the nation's gas pipeline network, but not at the historic pace experienced in the 1950s and 1960s. Total gas pipeline mileage increased from approximately 913,000 miles in 1970 to 1.05 million miles in 1980, with the installation of new gas

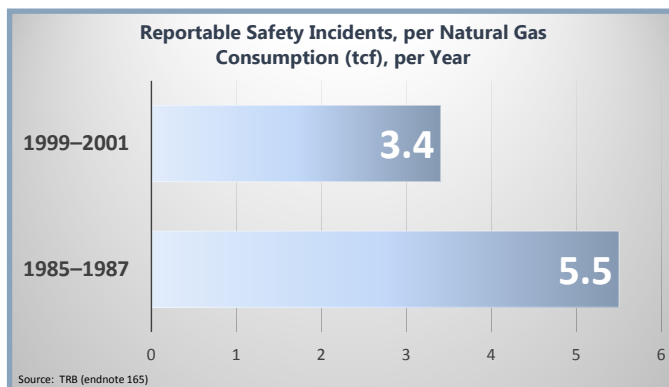
distribution pipelines accounting for 107,000 miles (or approximately 77%) of that increase.³³

The federal pipeline safety program continued to evolve in the 1980s and 1990s. Congress passed legislation reauthorizing the program on several occasions, enacting provisions that gave USDOT the authority to fund the federal pipeline safety program through the collection of user fees³⁴ and to override the historical exemption for rural gathering lines.³⁵ Congress also provided USDOT with more grant funding for state pipeline safety programs and directed the agency to address specific issues, such as establishing requirements for state one-call damage prevention programs. The federal pipeline safety staff grew by more than 150% during this period, increasing from 63 employees in 1979³⁶ to 105 employees in 1999, including 51 pipeline safety inspectors and other personnel located in Washington, D.C., and five other Regional Offices.³⁷ By the late 1990s, the 49 state agencies with certifications to regulate intrastate pipeline facilities employed about 300 additional pipeline safety inspectors and received approximately \$13 million in federal grant funding to cover the cost of administering these programs.³⁸ As in previous decades, the nation's gas pipeline network continued to expand in the 1980s and 1990s, especially the distribution sector, which grew from approximately 701,800 miles in 1980 to 1.05 million miles in 2000.³⁹

Recent History

As explained in more detail below, several noteworthy developments at the federal level have affected natural gas pipeline safety and reliability in the past 15 years. Congress passed legislation reauthorizing the federal pipeline safety laws on three separate occasions, generally providing USDOT with increased funding for the pipeline safety program and including other substantive changes to the federal pipeline safety laws. USDOT also issued a number of new regulations and continued to expand the pipeline safety workforce, increasing the number of federal employees to more than 200 and receiving additional funding from Congress in a recent omnibus appropriations bill to bring that total to more than 300.

In the 2002 PSIA, Congress reauthorized the federal pipeline safety program through the end of FY 2006,



providing increased annual appropriations to USDOT for its operations (beginning with \$45.8 million for the 2003 FY and ending at \$50 million for the 2006 FY) and awarding similar increases in the annual appropriations for state grant funding (beginning with \$19.8 million for the 2003 FY and ending at \$26.5 million for the 2006 FY).⁴⁰ Congress also made substantive changes to the federal pipeline safety laws, adding provisions related to best practices for damage prevention, the requirements for public education and operator qualification programs, and the development and implementation of integrity management programs for gas pipeline facilities.⁴¹

Following the passage of the 2002 PSIA, USDOT issued new regulations for gas transmission line integrity management, public awareness programs, and the regulation of rural gas gathering lines.⁴² The

federal pipeline safety workforce also grew during these years, expanding from approximately 135 people in 2002⁴³ to approximately 150 people in 2003,⁴⁴ with about half serving as pipeline inspectors. By early 2006, the federal pipeline safety staff stood at about 165 employees, with state pipeline agencies employing about 325 additional inspectors.⁴⁵

In the 2006 PIPES Act, Congress reauthorized the federal pipeline safety program through the end of the 2010 FY, providing increased annual appropriations to USDOT for administering the federal program throughout that period.⁴⁶ Congress also made further substantive changes to the federal pipeline safety laws, adding provisions related to damage prevention and public education and awareness, distribution integrity management, and pipeline control room management. USDOT initiated rulemaking proceedings to address many of these topics after the passage of the 2006 PIPES Act and continued its effort to expand the federal pipeline safety workforce, which reportedly reached 173 employees by the end of 2009.⁴⁷

In the Pipeline Safety, Regulatory Certainty, and Job Creation Act of 2011 (2011 Act), Congress reauthorized the federal pipeline safety program through the end of the 2015 FY.⁴⁸ The 2011 Act authorized a fixed, 3-year increase in the annual appropriations to USDOT for administering the

USDOT concludes that third-party excavation damage has caused approximately 41 percent of gas pipeline incidents under the period studied.

Total natural gas pipeline mileage nationwide exceeds one million miles.

USDOT requires states to adopt one-call damage prevention program to remain eligible for federal pipeline safety funding.

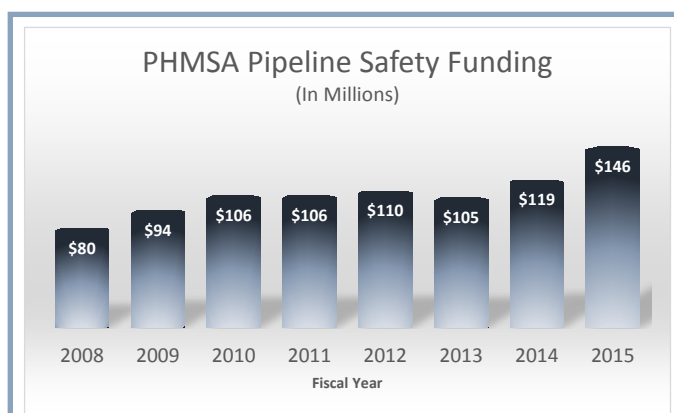
USDOT finds third party excavation damage to be the cause of one out of every three pipeline incidents.

1980s 1980 1990s Mid 1990s

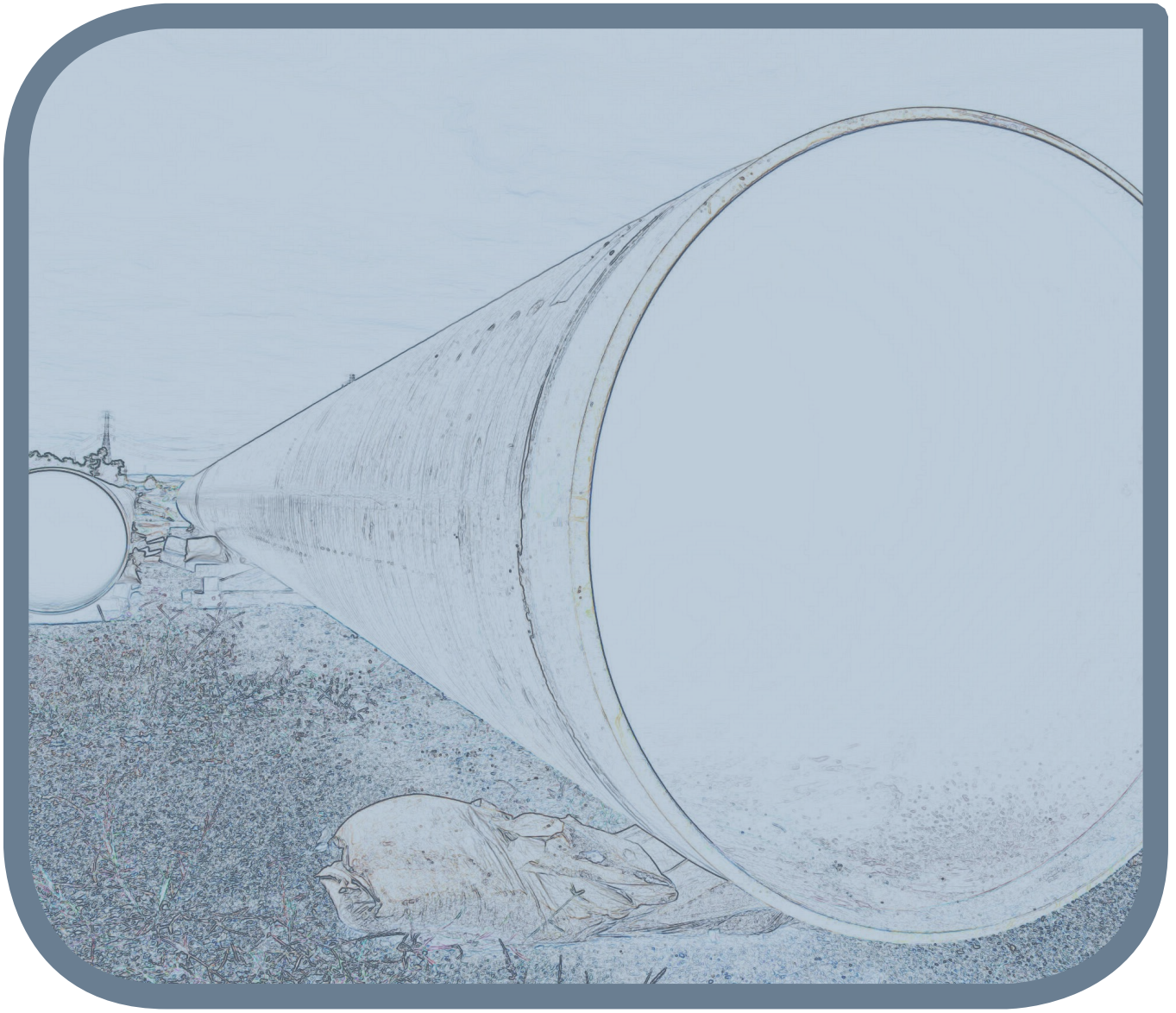


federal pipeline safety and state grant programs.⁴⁹ The 2011 Act also included significant substantive changes to the federal pipeline safety laws, with Congress adding provisions concerning incident notification timelines, the testing of certain gas transmission lines, and the requirements for valves, gathering lines, leak detection, integrity management, and class location.

PHMSA has issued four non-significant final rules since the passage of the 2011 Act, and currently has six other rulemaking proceedings underway, including a proposal to adopt substantial changes to the federal gas pipeline safety regulations.⁵⁰ PHMSA has issued a number of significant guidance documents,⁵¹ released the results of a congressionally-mandate study on leak detection,⁵² and created an online database to track progress in replacing cast iron and bare steel pipelines.⁵³



Finally, PHMSA received a sizeable increase in funding for the federal pipeline safety program in the omnibus appropriations bill enacted in December 2014.⁵⁴ The total funding for FY 2015 (\$145.5 million, representing a \$26.9 million increase from the previously authorized amount) included \$48.1 million for state pipeline safety grants (a \$10 million increase from the previously authorized amount) to reimburse up to 80% of eligible program costs and \$11.9 million for hiring 109 new federal pipeline safety positions, bringing PHMSA's total federal workforce to 336 people.⁵⁵



Recent Efforts to Improve Natural Gas Pipeline Safety and Reliability

3



This page intentionally blank.

— Introduction

This section examines recent federal, state, and industry efforts to improve the safety and reliability of natural gas pipelines. USDOT has created new, risk-based integrity management program requirements for gas transmission and distribution lines and adopted new regulations for qualifying pipeline personnel, managing pipeline control rooms, preventing excavation damage to pipelines, and installing excess flow valves. USDOT has also participated in the development of recommended practices for land use planning near existing gas transmission lines and funded a number of pipeline safety related research and development projects. The pipeline industry has played a critical role in developing and advancing each of these initiatives, and the early indications suggest that they have improved pipeline safety and reliability.

The states are making a critical contribution to pipeline safety and reliability by adopting special cost recovery mechanisms to accelerate the repair, rehabilitation, and replacement of pipeline infrastructure. These cost recovery mechanisms provide pipeline operators with a greater degree of financial certainty and protect the public by eliminating unnecessary deterrents to safety-related investments. The number of states with special cost recovery mechanisms has more than tripled in the past decade.

The pipeline industry has adopted best practices and initiated programs that exceed existing legal requirements. The industry's standards development organizations are also furthering the cause of pipeline safety through the publication of new technical standards, including a recently issued recommended practice for safety management systems that is specifically tailored for pipelines.

— Federal Initiatives

Gas Transmission Integrity Management Program

In the 2002 PSIA, Congress directed USDOT to establish integrity management program

regulations for gas transmission line operators.⁵⁶ That legislation, the product of several years of research, analysis, and collaboration among various stakeholder groups, embodied a significant step forward in the transition to a more risk-based regime for ensuring the safety of the nation's natural gas pipeline network. The pipeline industry played a critical role in developing the integrity management program for gas transmission lines. Those efforts started in the late 1990s, when the pipeline industry agreed to participate in a series of risk-management demonstration projects and began drafting a new consensus technical standard for pipeline integrity management, and continued throughout the rulemaking process. Pipeline operators, industry groups, regulators, and other stakeholders have dedicated significant resources to implementing the integrity management program since the regulations went into effect, and several recent studies suggest that the program is having a positive impact on pipeline safety.

By way of background, Congress directed USDOT in the Accountable Pipeline Safety and Partnership Act of 1996 (1996 Act) to establish "risk management demonstration projects" for gas and hazardous liquid pipeline operators.⁵⁷ The results of these demonstration projects would be used to evaluate whether a risk-based approach to pipeline safety would yield greater safety and environmental benefits than simply complying with minimum regulatory requirements. Six pipeline companies volunteered to participate in individual projects that ranged in scope from examining specific effects of excavation damage on a single pipeline segment, to developing a comprehensive risk assessment for entire interstate pipeline systems.

The pipeline industry played a critical role in developing the integrity management program for gas transmission lines.

USDOT used the knowledge gained from these risk management demonstration projects to create new integrity management rules for hazardous liquid pipelines.⁵⁸ The critical elements of the hazardous liquid pipeline integrity management rules included performing initial baseline assessments and periodic reassessments of pipelines that could affect high

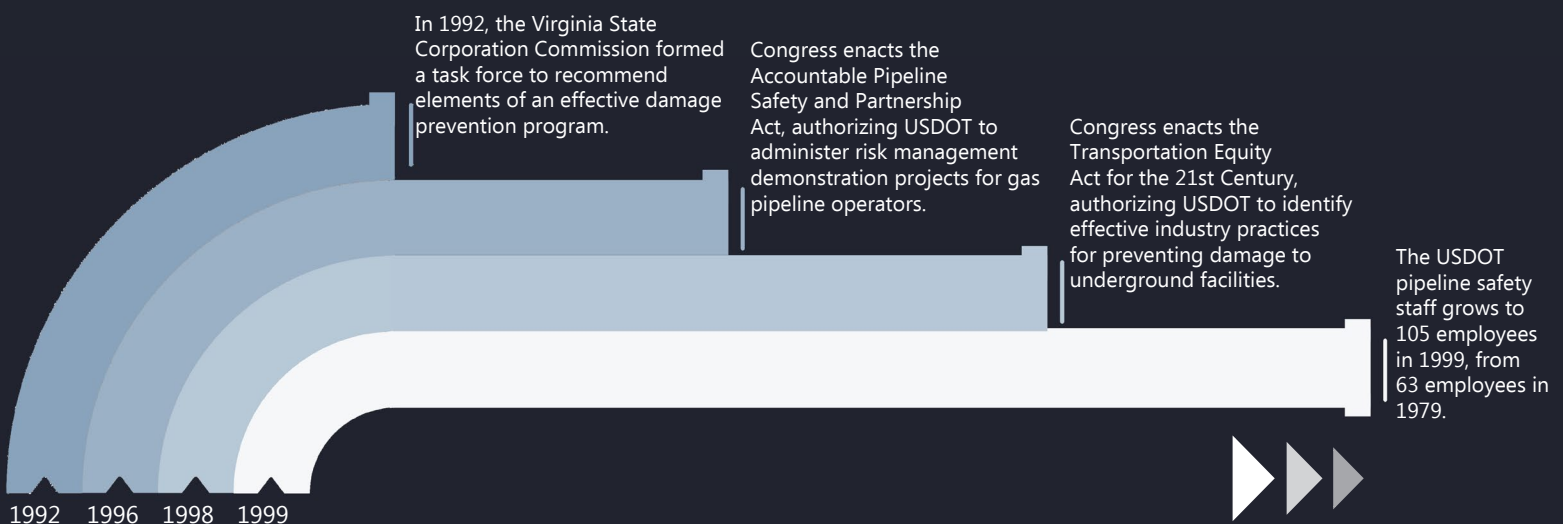
and repairs; implementing additional preventive and mitigative measures; and monitoring program effectiveness.⁵⁹ The Interstate Natural Gas Association of America (INGAA), American Gas Association (AGA), and other pipeline industry representatives were actively engaged in these discussions and helped to positively shape the initial framework for the gas transmission integrity management program.

USDOT issued its final integrity management rules for gas transmission pipelines in late 2003.⁶⁰ Those rules require operators to identify the HCAs along their pipelines (i.e., areas where a potential gas pipeline incident could cause significant harm to people and property, including more densely populated Class 3 and Class 4 locations and areas that contain other identified sites, such as facilities that house individuals who are confined, mobility-impaired, or hard to evacuate, and places where people gather for recreational or other purposes).⁶¹ Operators must then identify threats to pipeline segments within HCAs, perform a risk assessment to prioritize the segments most susceptible to the identified threats, and conduct baseline assessments that determine the current condition of those segments.⁶² Operators must repair or replace any sections requiring remediation, implement additional preventive and mitigative measures to protect pipeline segments in HCAs, address threats to pipeline integrity, and reassess pipeline segments located in HCAs at least every seven

years.⁶³ Operators are required to develop written integrity management plans explaining how each of these requirements will be implemented and must retain records documenting compliance with these provisions.⁶⁴

USDOT's integrity management program was largely based on ASME B31.8S, an industry standard developed outside of the rulemaking process by a cross-functional group of subject matter experts. ASME is an accredited Standards Developing Organization that uses a voluntary, consensus process that meets the requirements of the American National Standards Institute (ANSI) to develop a variety of technical standards. ASME released the first edition of B31.8S in 2002 and has published three revisions since that time (2004, 2012, and 2014). The 2004 edition of the standard is incorporated by reference in several provisions of the gas transmission integrity management regulations.

In addition to participating in establishing the early framework for the gas transmission integrity management program, the pipeline industry submitted comments that played an important role in shaping the final rules. For example, USDOT adopted INGAA's suggestion that a bifurcated approach for defining HCAs based on the surrounding class locations or number of residences within a potential impact circle be incorporated into the final integrity management rule.⁶⁵ Similarly, USDOT adopted AGA's recommendation that an



alternative reassessment regime be established for low-stress pipelines operating below 30% SMYS.⁶⁶ Responding to the results of a joint industry-government research effort, USDOT revised the final integrity management rule to remove restrictions on the use of direct assessment and incorporated the National Association of Corrosion Engineers' (NACE) recommended practice on external corrosion direct assessment.⁶⁷

Although conclusive data on the effectiveness of the integrity management program will probably not be available for several more years, the preliminary results suggest that the rule is having a positive impact on pipeline safety. A September 2006 GAO report concluded that integrity management assessments and repairs were improving the condition of transmission pipelines, and that operators had assessed approximately 33% of pipeline mileage located within HCAs and completed over 2,000 repairs by December 2005.⁶⁸ A subsequent report indicated that INGAA members had inspected over 90% of their pipeline mileage within HCAs by 2010, and that 89% of baseline assessments were completed using ILI technologies.⁶⁹ A January 2015 NTSB study observed that the increasing trend of significant incidents on gas transmission pipelines that occurred between 1994 and 2004 had leveled off since the implementation of the integrity management rules.⁷⁰ Qualitative evidence from various industry roundtables and workshops also indicates that the integrity management program has improved the safety and reliability of the nation's natural gas pipeline network.

Distribution Integrity Management Program (DIMP)

Congress directed USDOT in the 2006 PIPES Act to establish integrity management rules for gas distribution pipelines.⁷¹ Recognizing the unique characteristics of gas distribution systems, USDOT worked closely with the pipeline industry and other interested parties to determine the best approach for applying integrity management principles to these pipelines, which operate at much lower pressures, are smaller in diameter, and are constructed of different materials than transmission lines. As a result of those efforts, USDOT issued a final DIMP rule in 2009 that reflected the collective input of multiple stakeholder groups.⁷² While still in the initial phase of implementation, early indications

suggest that DIMP has improved pipeline safety.

By way of background, the American Gas Foundation (AGF) launched a study in 2003 on the safety and integrity of gas distribution pipeline systems. The study, entitled "Safety Performance and Integrity of the Natural Gas Distribution Infrastructure," analyzed data from 1990 to 2002 and was overseen by the Distribution Infrastructure Government-Industry Team (DIGIT). DIGIT included representatives from AGA, the American Public Gas Association (APGA), the National Association of Pipeline Safety Representatives (NAPSR), the National Association of Regulatory Utility Commissioners (NARUC), and USDOT.⁷³

Published in January 2005, the AGF study provided a detailed overview of current regulations and industry practices, described the unique characteristics of gas distribution pipelines and the key differences from gas transmission lines, and identified industry and government initiatives already in place to address distribution integrity issues. With regard to the latter, the study highlighted several existing voluntary industry initiatives aimed at addressing distribution integrity, such as:

- ◆ **The Plastic Pipe Data Collection Project.** In response to an NTSB recommendation, over 150 gas distribution utilities began to collect data on the performance of plastic pipe and periodically convene to discuss the data.⁷⁴
- ◆ **Gas Technology Institute.** A research effort relating to the development of minimum standards for the use of regrind material in plastic pipe manufacturing.⁷⁵
- ◆ **Common Ground Alliance.** A USDOT-sponsored group of distribution operators that promotes infrastructure damage prevention by developing best practices, preparing educational materials, and collecting data to identify areas that need improvement.⁷⁶
- ◆ **Voluntary Consensus Standards.** Industry participation in groups such as ASME, NACE, American Society for Testing and Materials (ASTM), and Gas Piping Technology Committee (GPTC).⁷⁷

Despite the success of these initiatives, the study acknowledged that gas distribution pipelines

continued to experience serious incidents. Of particular importance, the study concluded that the primary cause of serious incidents on gas distribution pipelines was outside force damage—specifically, third-party excavation damage.⁷⁸

USDOT subsequently formed four multi-stakeholder work/study groups to discuss excavation damage, data collection, risk control practices, and strategic operations for the gas distribution sector. The stakeholder groups included representatives from industry, state pipeline safety officials, USDOT, and members of the public, and were established to collect information and inform future regulations. In December 2005, USDOT submitted the Stakeholder Report on Phase 1 of Distribution Integrity Management to Congress.⁷⁹

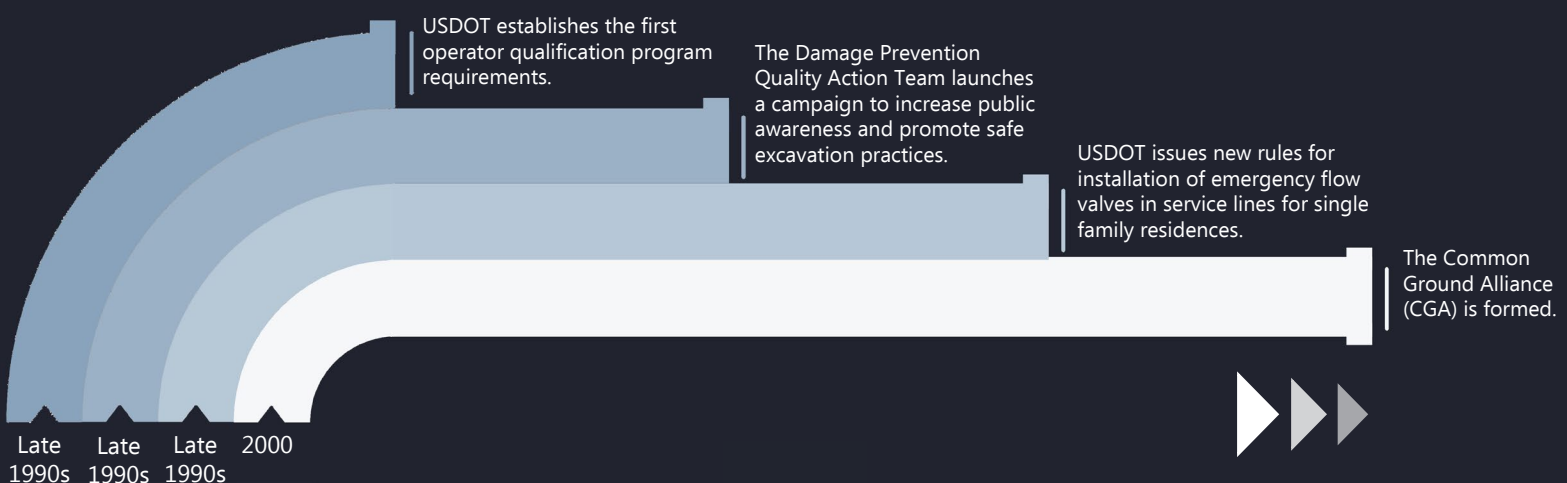
The Report concluded that the pipeline safety regulations for distribution lines did not adequately incorporate risk-based integrity management principles, and that it would be appropriate to modify those regulations to include a risk-focused process.⁸⁰ The stakeholders recommended a high-level, flexible federal regulatory program with seven key elements appropriate for distribution pipeline operators.⁸¹ The stakeholders also concluded that distribution integrity management should apply to entire distribution pipelines systems, rather than only to certain covered segments in HCAs, because distribution systems are primarily located in HCAs.⁸²

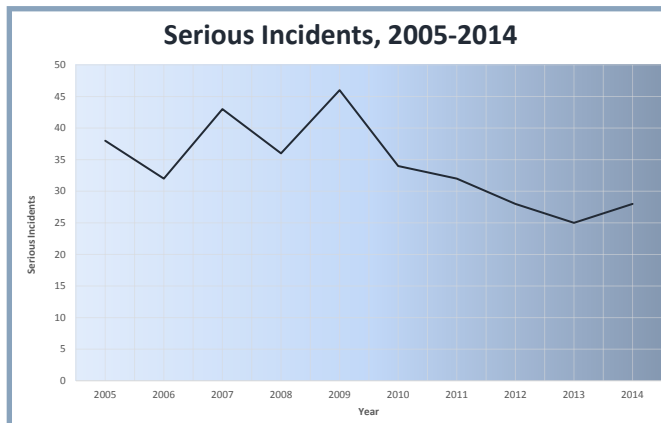
In December 2009, USDOT issued a final rule with new DIMP requirements.⁸³ The rule requires operators of

gas distribution lines and liquefied petroleum gas systems to develop and implement written DIMP plans.⁸⁴ These DIMP plans must contain procedures for developing and implementing the seven program elements, i.e., (1) system knowledge, (2) threat identification, (3) risk ranking and evaluation, (4) risk reduction and mitigation; (5) overall program effectiveness, (6) periodic evaluation and improvement, and (7) annual reporting.⁸⁵

Operators are also required to submit reports on each mechanical fitting failure that results in a hazardous leak,⁸⁶ and to keep records demonstrating compliance with the program for at least 10 years, including all previous versions of DIMP plans.⁸⁷ The rule allows operators to deviate from required periodic inspection frequencies upon a demonstration to USDOT that the proposal will provide an equal or greater overall level of safety.⁸⁸ The proposed deviation must be accepted by USDOT or the appropriate state regulatory agency.⁸⁹

As with the DIMP provisions that Congress included in the 2006 PIPES Act, the AGF Study, Stakeholder Report, and other previous industry initiatives had a substantial influence on the provisions in the DIMP rule. The final rule adopted industry's recommendations to apply DIMP to all segments in a gas distribution system and used the seven elements to establish the overall framework of the program. USDOT's previous experience developing integrity management program requirements for hazardous liquid and gas transmission pipelines





also had an effect on the provisions in the rule.

In addition, GPTC has developed comprehensive guidance materials for gas distribution pipeline operators to consider in complying with the DIMP rules at USDOT's request,⁹⁰ and the agency has developed a separate guidance document for master meter operators and small LPG operators (i.e., those serving fewer than 100 customers from a single source).⁹¹ The GPTC Guidance provides detailed information on each DIMP element, along with several sample approaches that operators may consult in developing programs unique to their pipeline systems. USDOT has also issued a series of Frequently Asked Questions that provide additional guidance and information on the DIMP rule,⁹² as well as several advisory bulletins relevant to issues implicated by DIMP.⁹³

In the years since the DIMP rule went into effect, industry has worked with regulators to assist operators with implementation by organizing workshops, seminars, and training programs to address a variety of topics, including the role of safety culture and the importance of continuous improvement, identification of threats, and adoption of meaningful performance measures. The Plastic Piping Data Collection Initiative (PPDC), which is composed of industry and government representatives, has also shifted its focus to providing both operators and regulators with data and information to assist in the implementation and evaluation of DIMP, and with the identification and understanding of material risks. Companies submit data on failures and leaks to the PPDC on a voluntarily basis to assist in compiling a comprehensive database aimed at identifying trends and patterns

in performance issues.

While conclusive data will probably not be available for several more years, the early results indicate that DIMP is contributing to the improvement of the nation's distribution infrastructure:

- ◆ A slight downward trend is reported for serious incidents occurring from 2005-2014, with the lowest rates of incidents in the last several years (10 year average of 27 incidents from 2005-2014; 3 year average of 23 from 2012-2014).⁹⁴
- ◆ The overall trend for significant incidents remained relatively flat (10 year average of 65 incidents from 2005-2014; 3 year average of 59 incidents from 2012-2014).⁹⁵
- ◆ Leak rate per mile decreased by about 15% since 2005, with most of the decrease up until 2011, and the trend flattening out since.⁹⁶
- ◆ The number of significant excavation damage incidents has slightly decreased since 2005 (11 year average of 19 incidents from 2005-2015; 5 year average of 17 incidents from 2011-2015). Excavation damage per 1,000 tickets also decreased between 2010-2014.⁹⁷
- ◆ Cast iron service lines decreased approximately 65% between 2005 and 2014 due to pipe replacement efforts. Cast iron mains have decreased around 25%.⁹⁸

The DIMP rule represents the culmination of industry and government efforts that preceded Congress' directive to establish risk-based integrity management regulations for gas distribution lines. Those efforts began with AGF's study on the safety and integrity of gas distribution system during the 1990s and early 2000s, continued with the formation of the stakeholder group that produced the Phase 1 Report to Congress, and ultimately led to the approach that USDOT largely adopted in the final DIMP rule. The pipeline industry has remained engaged during the implementation phase of the DIMP rule, developing comprehensive guidance through the GPTC and conducting workshops and training seminars. Although not conclusive, the early results indicate that DIMP is having a positive impact on the safety of the nation's gas distribution systems.

Operator Qualification Program

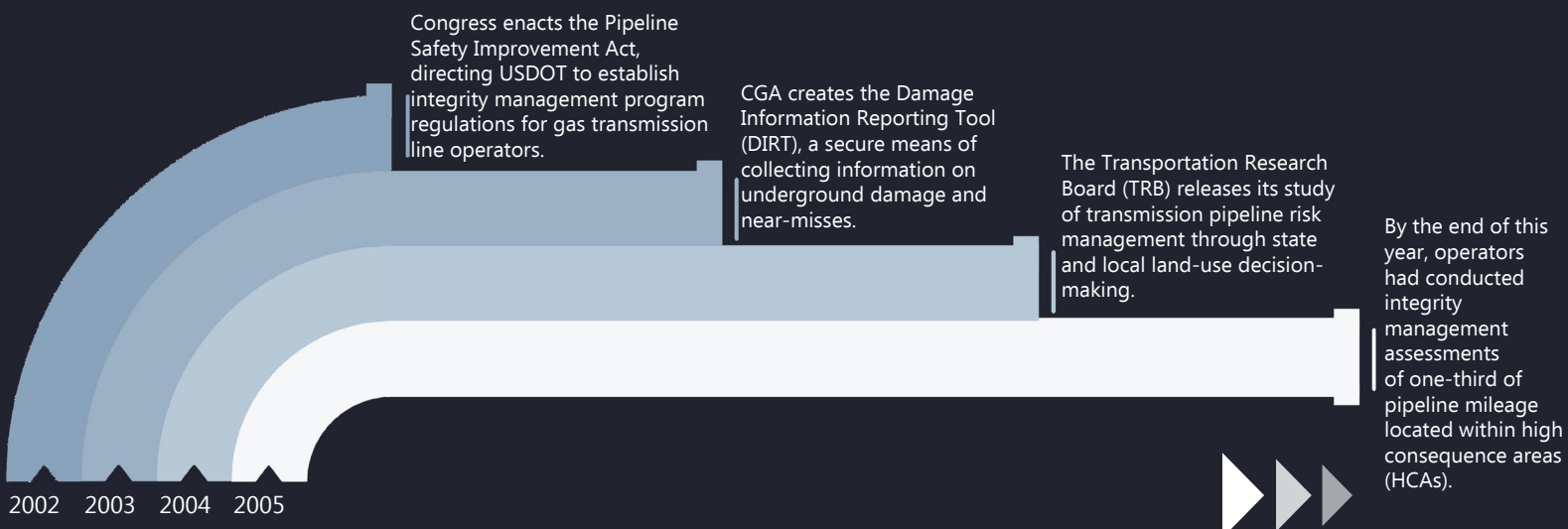
USDOT established operator qualification (OQ) program requirements in the late 1990s.⁹⁹ The original OQ rules were the product of a negotiated rulemaking process that USDOT initiated after abandoning a prior effort to establish those regulations in a traditional, notice-and-comment rulemaking proceeding.¹⁰⁰ A negotiated rulemaking committee, comprised of representatives from 14 different stakeholder groups, including the pipeline industry, regulatory organizations, organized labor, and a standards development body, developed the text of the proposed OQ regulations over a nearly two-year period. The negotiated rulemaking committee also participated in the preparation of the cost-benefit analysis for those rules.

The OQ regulations require operators to ensure, through the development and implementation of a written program, that individuals have the necessary qualifications to perform covered tasks on a pipeline facility.¹⁰¹ As part of the process, operators must identify the covered tasks performed on their pipeline facilities; conduct appropriate periodic evaluations to verify that the individuals responsible for performing these tasks are qualified to do so, whether on the basis of written or oral examinations, work performance, observations, training, simulations, or other forms of assessment; and

In July 2015, USDOT published a rulemaking proposal to expand the operator qualification program.

take steps to ensure that sufficient documentation is maintained to support these determinations.¹⁰² Since issuing the original OQ rule, USDOT has convened a number of public meetings to discuss implementation of the new program and made some minor amendments to the rules to address a congressional mandate.¹⁰³ USDOT also developed a series of Protocols¹⁰⁴ and Frequently Asked Questions¹⁰⁵ to assist operators in complying with the OQ rules, and recently issued an OQ enforcement guidance document describing the practices used by PHMSA in undertaking its compliance, inspection, and enforcement activities.¹⁰⁶ In July 2015, USDOT published a rulemaking proposal in the Federal Register to expand the OQ program to cover new construction, as well as additional operations, maintenance and emergency response activities, and to require operators to evaluate the effectiveness of their OQ programs.¹⁰⁷

To provide operators with additional guidance on the implementation of the OQ requirements, ASME published a new national consensus standard in 2010, the B31Q, Pipeline Personnel Qualification.¹⁰⁸



ASME released the first edition of the B31Q in 2006 after spending nearly three years developing that standard,¹⁰⁹ and recently published a third edition that includes further provisions on qualification exemptions, new technology and construction, and additional covered tasks such as pipeline purging and use of internal cleaning devices.

There are no comprehensive, quantitative studies directly assessing the effectiveness of the OQ program, but USDOT advised Congress in a 2007 report that operators had attributed safety improvements to the implementation of those regulations.¹¹⁰

Control Room Management

The 2002 PSIA required USDOT to conduct a pilot program to evaluate whether pipeline controllers and other control room personnel should be required to be certified.¹¹¹ The department began the four-year Controller Certification Project (C-CERT) pilot by developing a focus group composed of representatives from government, industry, trade associations, academia, and the public; soliciting information and comments at public workshops; and participating in discussions during the development of ASME's B31Q.¹¹² Three pipeline operators also voluntarily participated in a pilot study of controller training and qualification.

As a result of these efforts, USDOT submitted a report to Congress in January 2007 identifying several areas in need of improvement to enhance the safety performance of control rooms and minimize the risk of fatigue, such as:

- ◆ Clearly define controller roles and responsibilities in responding to abnormal operating conditions;
- ◆ Formalize procedures for recording and exchanging critical information during shift turnover;
- ◆ Validate controller qualification through senior executive review; and
- ◆ Establish shift lengths and rotations and educate controllers on fatigue mitigation.¹¹³

USDOT concluded that a single, uniform certification exam for the entire industry was not appropriate due to the wide variability among pipeline systems. Instead, it was recommended that operators validate,

review, and continuously improve the adequacy of controller training, qualification, and procedures. USDOT also recommended that industry continue to develop consensus-based best practices addressing controller issues, such as API RP 1168 on Control Room Management.¹¹⁴

In September 2008, USDOT issued a notice of proposed rulemaking (NPRM) incorporating the areas identified for improvement through the C-CERT Project, including three recommendations from an NTSB safety study on hazardous liquid pipeline SCADA systems.¹¹⁵ The NPRM also responded to a mandate in the 2006 PIPES Act directing USDOT to issue regulations for the development, implementation, and submission of a human factors management plan for pipeline control centers.¹¹⁶ USDOT proposed a performance-based approach that would require operators to incorporate certain elements into existing plans and procedures.¹¹⁷

USDOT issued a final rule on Control Room Management and Human Factors in December 2009.¹¹⁸ The final rule requires operators to incorporate and follow a written control room management procedure that includes the following elements:

- ◆ Define controller roles and responsibilities during normal, abnormal, and emergency operating conditions, and a method for recording shift changes;
- ◆ Provide controllers with adequate information to carry out the defined roles and responsibilities, including by implementing provisions of API RP 1168 whenever a SCADA system is added, expanded, or replaced;
- ◆ Establish a fatigue mitigation plan that reduces the risks of controller fatigue and educates controllers on fatigue mitigation strategies;
- ◆ Implement alarm management and change management plans;
- ◆ Incorporate lessons learned into control room management procedures;
- ◆ Establish a controller training program;
- ◆ Submit procedures to USDOT upon request to validate compliance; and

- ◆ Maintain records to demonstrate compliance and document the reasons for deviation.

The final rule also requires gas distribution pipelines serving less than 250,000 customers or gas transmission pipelines without compressor stations to comply only with fatigue management, validation, and compliance deviation requirements. The rule also includes an exemption for LNG facilities.¹¹⁹

Industry has contributed to the implementation process by hosting roundtables and forums, developing consensus standards, and issuing white papers on specific control room management issues. For example, the American Petroleum Institute has published two standards that provide operators with additional guidance on control room management issues, API RP 755: "Fatigue Risk Management Systems for Personnel in the Refining and Petrochemical Industries,"¹²⁰ and API RP 1168: "Pipeline Control Room Management".¹²¹ The Southern Gas Association has also released a "Gas Pipeline Industry Control Room Management Rule Compliance Framework Document,"¹²² and APGA has developed model control room management procedures for small gas pipeline operators.¹²³

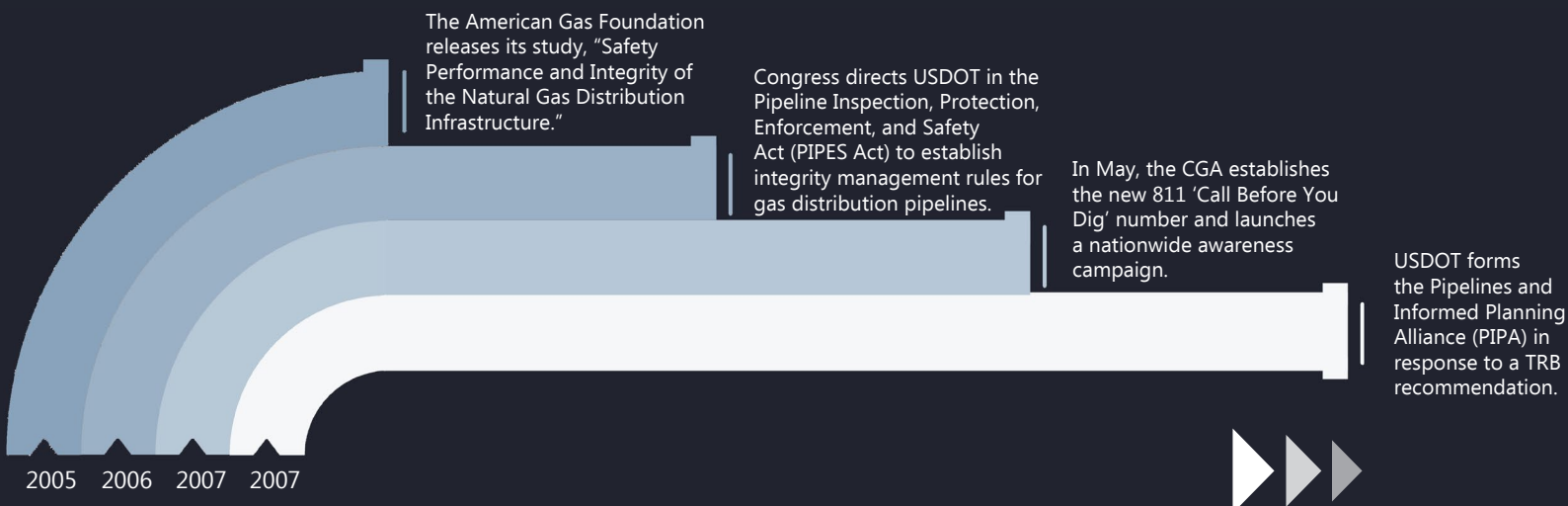
Although comprehensive data addressing the effectiveness of the control room management program is not yet available, qualitative evidence from government and industry forums suggests that the requirements are having a positive impact

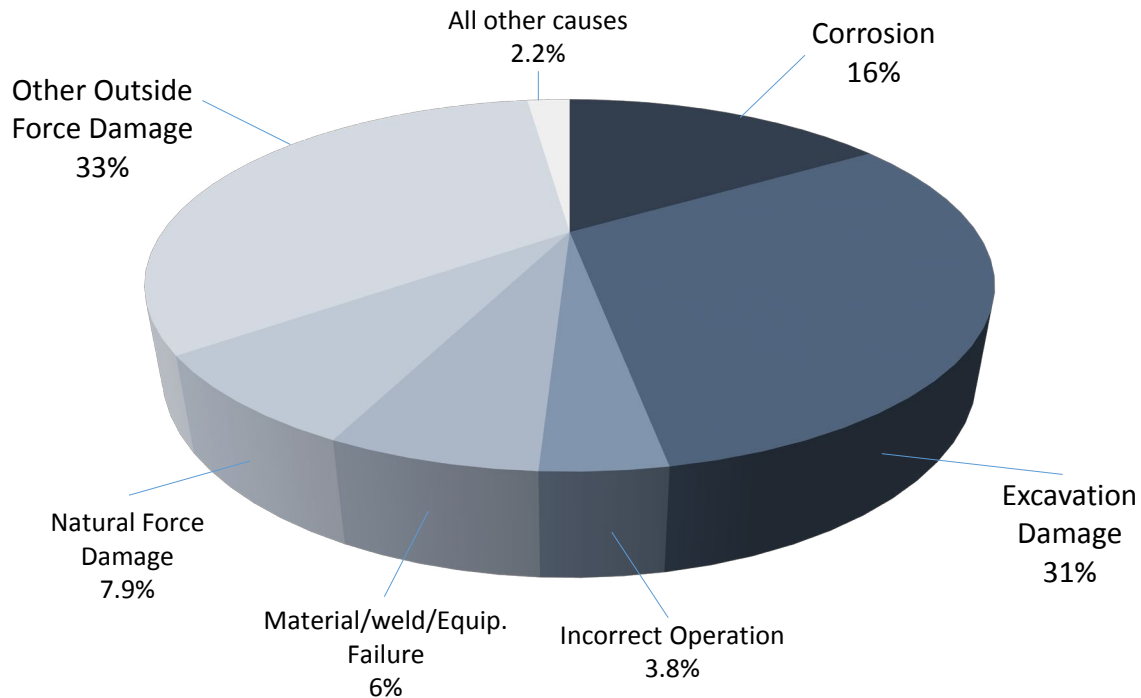
on pipeline safety.

Damage Prevention Program

Although third-party excavation damage has traditionally been a leading cause of gas pipeline incidents, particularly in the case of distribution systems, damage prevention programs have dramatically reduced the frequency and severity of such incidents over the last three decades.¹²⁴ In the 1980s, USDOT concluded that third-party excavation damage was the cause of approximately 41% (430 out of 1,039) of all reported gas pipeline incidents over a 42-month period (i.e., from July 1, 1984, to December 31, 1987).¹²⁵ USDOT reached a similar conclusion in the mid-1990s, finding that third-party excavation damage caused 33% (481 out of 1,456) of all reported gas pipeline incidents over a subsequent 6-year period (i.e., from January 1, 1988, to December 31, 1993).¹²⁶

However, an October 2014 PHMSA study found that the number of gas pipeline incidents caused by third-party excavation damage is falling dramatically.¹²⁷ For the 10-year period from 2003 to 2012, third-party excavation damage was the cause of only 30.0% of all reported gas distribution pipeline incidents, 12.0% of all reported onshore gas transmission line incidents, and less than 1% of all reported gas gathering line incidents.¹²⁸ And for the 3-year period from 2010 to 2012, third-party excavation damage was the cause of only 18.9%



Natural Gas Distribution Incidents, Nationally Reported, 2003-2012

Source: PHMSA 2014, endnote 214

of all reported gas distribution pipeline incidents, 8.9% of all reported onshore gas transmission line incidents, and no gas gathering line incidents.¹²⁹ The number of incidents caused by third parties each year also dropped dramatically from an average of 95 in the mid-1980's to an average of 31 from 2010 to 2012.¹³⁰

The recent decline in gas pipeline incidents caused by third-party excavation damage coincides with the implementation of several targeted safety initiatives. Federal and state regulators have established more comprehensive damage prevention and public awareness requirements, and industry stakeholders have invested substantial resources to addressing the issue. The Common Ground Alliance (CGA), an association that represents a broad coalition of interested stakeholders, has also played a critical role by developing best practices, collecting information and data, identifying new technologies, and promoting public awareness.

USDOT established the first federal damage prevention program requirements for gas pipeline operators in the early 1980s.¹³¹ USDOT's original rules required operators of gas pipelines in

populated areas to implement a written damage prevention program that met certain criteria. Gas pipeline operators could also satisfy those criteria by participating in a one-call system or other public service program for preventing excavation damage. USDOT expanded its efforts to address third-party damage in the 1990s, requiring states to adopt an acceptable one-call damage prevention program and one-call system in order to receive full federal grant funding for pipeline safety programs.¹³² USDOT also applied its damage prevention regulations to operators of gas pipelines in rural locations¹³³ and required all covered gas pipeline operators to participate in a "qualified one-call system" if such a program existed in the area.¹³⁴

Some states also contributed to the effort to reduce third-party excavation damage in the early years of the pipeline safety program, primarily by adopting damage prevention laws and regulations for underground utilities and third-party excavators, a group whose activities traditionally fell outside the scope of USDOT's regulatory authority under the pipeline safety laws. While less than half of the states had underground utility damage prevention programs in the late 1970s, the number

of jurisdictions with such programs had grown to 47 states and the District of Columbia by 1990.¹³⁵

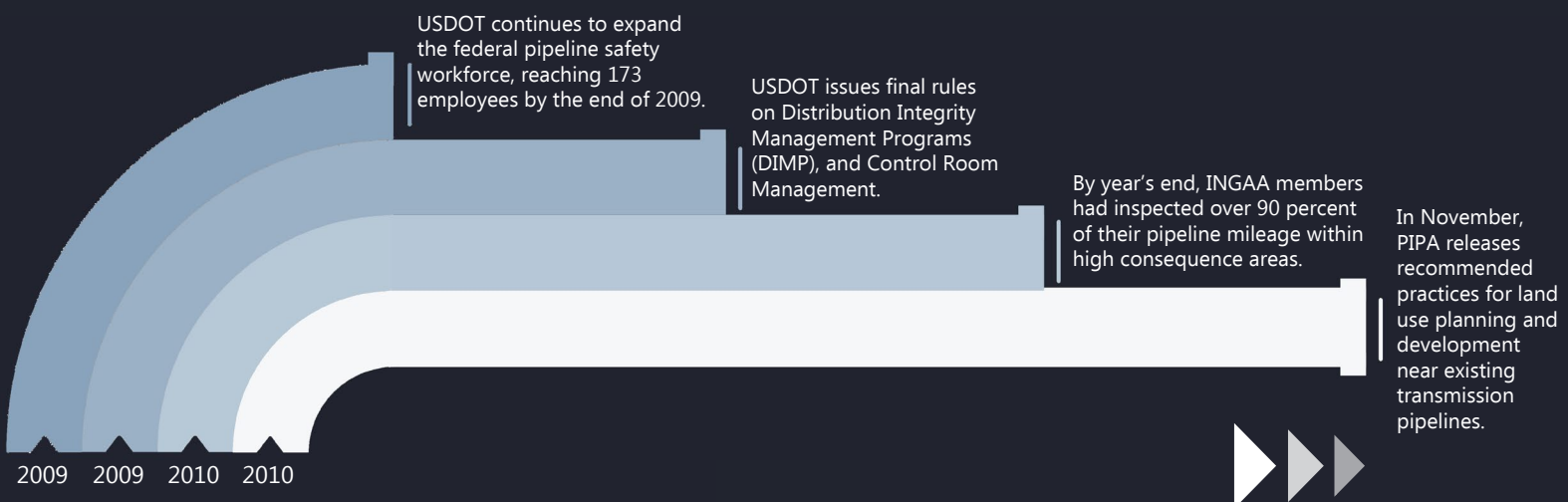
Industry played a critical part in addressing the issue of damage prevention as well. For example, the Damage Prevention Quality Action Team (DAMQAT), a joint government and industry initiative, launched a campaign to increase public awareness and promote safe excavation practices in the late 1990s.¹³⁶ As part of that initiative, the DAMQAT conducted a nationwide survey of 1,500 respondents to develop effective educational materials for damage prevention and then disseminated those materials in a variety of media platforms for a six-month period in three states.¹³⁷ Data collected from before and after the six-month period reflected a sharp increase in damage prevention awareness as a result of DAMQAT's campaign.¹³⁸

In the 1998 Transportation Equity Act for the 21st Century (TEA-21), Congress authorized USDOT to conduct a study to identify the most effective industry practices for preventing damage to underground facilities.¹³⁹ A broad coalition of interested stakeholders, including the pipeline industry and operators of other underground utilities, supported the addition of that provision to TEA-21. Representing the collective efforts of more than 160 stakeholders, the Common Ground: Study of One-Call Systems and Damage Prevention Best Practices (Common Ground Study) used the authority provided in TEA-21 to identify over 130

best practices for damage prevention and concluded that communication between stakeholders is the element most critical to the success of these programs.¹⁴⁰ Industry stakeholders played a vital role in completing the Common Ground Study, "contribut[ing] in excess of an estimated 20,000 hours and \$500,000 in direct-cost expenditures" in support of the effort.¹⁴¹

The CGA formed in 2000 to continue the damage prevention efforts embodied by the Common Ground Study. Now with over 1,700 members, the CGA provides a collective forum for identifying and publishing best practices, which it publishes on an annual basis, through a formal proposal and review process. In late 2003, the CGA also created the Damage Information Reporting Tool (DIRT), a secure internet application that allows stakeholder groups to submit information on underground damage and near-miss reports.¹⁴² The information collected in the system is used to develop the annual DIRT Report, which provides analysis and recommendations for improvements in excavation practices.

The CGA has worked in partnership with the federal government to improve the effectiveness of one-call systems. The TEA-21 also established minimum eligibility standards for state one-call notification programs to receive federal financial assistance.¹⁴³ Subsequently, the 2002 PSIA required USDOT, in conjunction with the Federal Communications Commission (FCC), to establish a nationwide three-



digit toll-free number to be used by state one-call systems.¹⁴⁴ In March 2005, the FCC issued an order adopting “811” as the national number to be used by state one-call systems to notify underground facility operators of planned excavation activities.¹⁴⁵ Concurrently with the number’s effect in May 2007, the CGA launched a nationwide campaign to conduct outreach, increase awareness, and encourage excavators to use the new 811 “Call Before You Dig” number.

Since that time, the CGA has been instrumental in raising public awareness through sports sponsorships, outdoor signs, news coverage, and sweepstakes. Composed of more than 70 partners, the CGA Regional Partners Committee conducts regional outreach targeting local stakeholders by hosting state-specific conferences, seminars, and skills competitions. Local damage prevention committees also provide a forum for local stakeholders to discuss concerns, share information, and develop partnerships.

API also made a critical contribution to damage prevention with the release of a Recommended Practice document on Public Awareness Programs for Pipeline Operators (API RP 1162).¹⁴⁶ Co-sponsored by AGA, INGAA, and APGA, and developed with the participation of USDOT and NAPSR, API RP 1162 was the first industry standard to provide guidance for pipeline operators to follow in developing effective public awareness programs. USDOT incorporated the provisions in API RP 1162 into a new public awareness requirement for gas pipelines in a May 2005 final rule.¹⁴⁷

The states have taken additional actions to address third-party excavation damage. For example, Virginia has consistently been a leader in damage prevention since the 1990s. In 1992, the Virginia State Corporation Commission (VSCC) formed a task force composed of stakeholder representatives to study the 1979 Underground Utility Damage Prevention Act and recommend elements of an effective damage prevention program. In 1995, the Act was revised to authorize the VSCC to enforce provisions of the Act and appoint a Damage Prevention Advisory Committee consisting of operators, excavators, locators, and regulators.¹⁴⁸ Subsequently, in the early 2000s, the VSCC compared the CGA’s “Best Practices” to state requirements and adopted rules to address deficiencies.¹⁴⁹ As a result

of these revised rules and statewide education and outreach efforts of approximately \$5 million per year, damages per 1,000 gas tickets decreased 67% between 1996 and 2012.¹⁵⁰

Other states are following Virginia’s lead and establishing more effective damage prevention programs. Nevada experienced a decline in the rate of gas pipeline incidents caused by third-party excavation damage after the Nevada Public Utilities Commission received additional authority to enforce the state’s damage prevention requirements in 2007.¹⁵¹ Washington¹⁵² and Ohio¹⁵³ also formed stakeholder groups to develop recommended changes for existing damage prevention laws, and those efforts led to the enactment of new legislation that authorized significant substantive changes and provided additional enforcement authority to state regulators. To prompt further changes at the state level, API and AOPL released a list of model one-call provisions in 2011 for adoption into state laws and regulations.¹⁵⁴

The Common Ground Alliance has worked in partnership with the federal government to improve the effectiveness of “one call” systems.

Congress addressed damage prevention programs in the last two reauthorizations of the federal pipeline safety laws. In the 2006 PIPES Act, Congress provided USDOT with the authority to regulate the activities of third-party excavators, a group of stakeholders traditionally beyond the scope of the agency’s jurisdiction.¹⁵⁵ USDOT also received the authority to exercise federal enforcement authority over excavators for damage prevention purposes, but only if USDOT determines that a state authority is not adequately enforcing its own damage prevention requirements on the basis of criteria established in a rulemaking proceeding.¹⁵⁶

In July 2015, USDOT issued a final rule using the additional authority provided in the 2006 PIPES Act. The final rule established nine criteria for evaluating the enforcement of damage prevention laws by

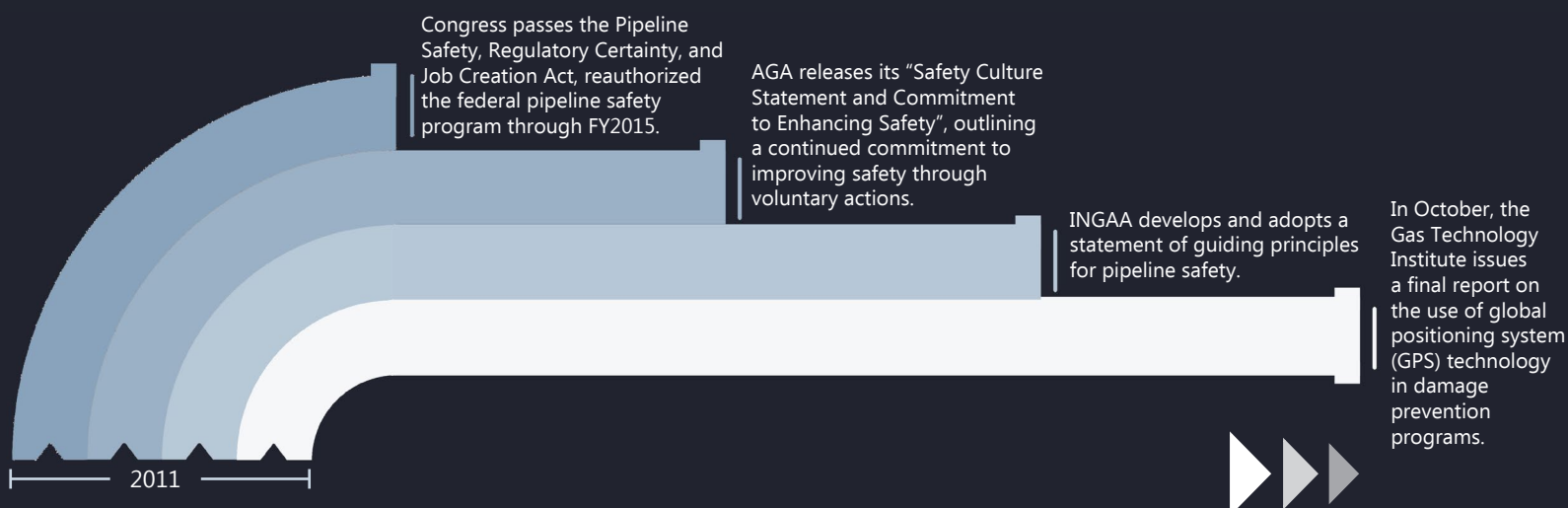
the states; an administrative process for making determinations on the adequacy of those efforts; federal damage prevention rules that will apply if a state's enforcement of its damage prevention laws is deemed inadequate; and procedures for adjudicating federal enforcement actions against excavators in those circumstances.¹⁵⁷ The results of assessments conducted by USDOT in 2009, 2011, and 2014 indicate that the states have already made progress toward satisfying the nine criteria established in the final rule for evaluating the adequacy of their damage prevention enforcement efforts.¹⁵⁸

Similarly, in the 2011 Act, Congress restricted eligibility for federal grant funding if a state exempts its agencies, municipalities, or their contractors from the one-call program notification requirements.¹⁵⁹ Although some states still have these exemptions, efforts are underway in Pennsylvania,¹⁶⁰ West Virginia,¹⁶¹ and other jurisdictions to repeal these provisions and restore eligibility for federal grant funding. For those state agencies that are eligible, USDOT's annual One-Call Damage Prevention Grant provides funding to projects and initiatives aimed at reducing excavation damages, such as legislation and regulatory compliance, development of one-call center statistics and membership, and damage prevention awareness campaigns and public service announcements.¹⁶²

Stakeholders have examined the potential role of

technology in reducing the rate of gas pipeline incidents caused by third-party excavation damage. Advances in locating equipment and technologies are improving the ability of operators to locate and mark underground facilities. In October 2011, the Gas Technology Institute issued a final report addressing the use of global positioning system (GPS) technology in damage prevention programs by excavators, utility operators, and one-call centers.¹⁶³ The report, the final stage of a three phase proposal that incorporated the results of earlier projects in Virginia, demonstrated that GPS technology could be used to improve damage prevention efforts, particularly if commercial and other barriers to widespread implementation are removed. In 2013, CGA also released its VAULT program, an online resource for obtaining information about damage prevention technologies.¹⁶⁴ The VAULT platform includes a reference of technology providers, a list of technologies that are consistent with particular CGA best practices, and additional information on damage prevention technologies.

In conclusion, the recent decline in gas pipeline incidents caused by third-party excavation damage coincides with the implementation of many key initiatives. Federal and state regulators have established more comprehensive requirements, and industry stakeholders have invested substantial resources in a variety of damage prevention and public awareness initiatives. The CGA has also played an important role by developing best practices,



collecting information and data, and identifying new technologies.

Pipelines and Informed Planning Alliance

In 2004, the Transportation Research Board (TRB), a private, non-profit division of the National Research Council, released a study on transmission pipelines and land use, including the management of pipeline risks through state and local land use decision-making.¹⁶⁵ The TRB study focused on land use practices, zoning ordinances, and the preservation of environmental resources within pipeline rights-of-way. In addition to offering a number of other findings and conclusions, TRB's report recommended that USDOT develop risk-based technical guidelines for making land-use decisions near transmission pipelines.

Industry standards are a vital and growing part of the pipeline safety program.

In 2007, USDOT responded to TRB's recommendation by forming the Pipelines and Informed Planning Alliance (PIPA).¹⁶⁶ Comprised of approximately 130 stakeholder participants, including representatives of the pipeline industry, municipalities, the public, developers, and regulators, PIPA's mission was to create a set of recommended practices for land use planning and development near transmission lines. PIPA agreed that a consensus approach would be used in developing these recommended practices, i.e., all participants had to concur that they could "live with" a particular recommendation or decision, which would encourage greater understanding of diverse views and provide an additional level of legitimacy to the process.

In November 2010, PIPA released a comprehensive final report with a series of "baseline" and new development recommended practices for land use planning and development near existing transmission lines.¹⁶⁷ The baseline recommended practices, tailored for implementation in preparation of future land use and development, covered topics

such as obtaining pipeline mapping data, managing land records, executing communications plans, and participating in state excavation damage prevention programs. The new development recommended practices, targeted for specific new land use and development projects, covered information gathering and coordination during the design and construction phase, initiating specific risk-reduction measures for the design and location of infrastructure projects, excavation and construction practices, and the development, use, and retention of records.

One of the most significant baseline recommended practices concerns the delineation of consultation zones by local governments. The consultation zone is an area within a specified distance of a transmission line where a mechanism is established for initiating early communication and engagement between a potential project developer and the transmission line operator. While site-specific information should be used in establishing consultation zone distances, the recommended practice suggests a standard consultation zone distance of 660 feet from the centerline for natural gas transmission pipelines and 660 to 1,000 feet from the centerline for hazardous liquid transmission lines.¹⁶⁸

The information provided in PIPA reports is a powerful tool for local governments and communities concerned with making sound land-use planning and development.

Another key baseline recommended practice relates to the creation of planning areas by local governments. A planning area is a zone in which additional regulations, standards, or guidelines may be warranted to ensure safety in the event that development occurs in the vicinity of a transmission pipeline. As with consultation zones, the recommended practices suggest that site-specific information should be used in establishing planning areas but suggests a standard planning area distance of 660 feet from the centerline for

natural gas transmission pipelines and 660 to 1,000 feet from the centerline for hazardous liquid transmission lines.¹⁶⁹

PIPA also released a new report earlier this year, Hazard Mitigation Planning: Practices for Land Use Planning and Development near Pipelines.¹⁷⁰ The report, sponsored by USDOT and the U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA), is designed to help local governments integrate the recommended practices from the original PIPA report in developing the hazard mitigation plans that are required under federal law and FEMA regulations.

While comprehensive data on the use of the PIPA recommend practices is not available, the information provided in the PIPA reports is a powerful tool for local governments and communities concerned with making sound land-use planning and development decisions.

Excess Flow Valves

Excess flow valves (EFVs) automatically stop the flow of gas in pipeline if an incident occurs. EFVs, which are primarily installed on service lines, limit the amount of gas released during ruptures or other significant events. EFVs do not prevent pipeline accidents and are not appropriate for use in all pipeline systems. Rather, EFVs protect the public by mitigating the consequences of certain pipeline accidents and enhancing other complimentary

safety initiatives, such as damage prevention and public awareness programs.

In the late 1990s, USDOT issued new rules for the installation of EFVs in service lines for single family residences (SFRs).¹⁷¹ The rules created a performance standard for the installation and use of EFVs and required operators to provide written notice about the availability of EFVs to customers with SFR service lines that met certain operating conditions.¹⁷² In December 2009, USDOT issued new standards requiring the installation of EFVs as part of the DIMP final rule.¹⁷³ Those standards, established in response to a provision in the 2006 PIPES Act and earlier National Transportation Safety Board recommendations, require operators to install an EFV on any new or replaced SFR service line that meets specific operating conditions.¹⁷⁴

In November 2011, USDOT issued an advance notice of proposed rulemaking asking for information and public comment on whether to expand the use of EFVs in gas distribution systems to applications other than SFR service lines.¹⁷⁵ Industry filed comments that generally supported expanding the use of EFVs in new and fully replaced service lines to applications beyond SFR service lines where it is determined to be economically, technically, and operationally feasible, consistent with the 2011 Act. However, industry groups cautioned that the application of EFVs to classes of customers other than SFRs is more complex due to the need

CGA released its VAULT program, an online resource for obtaining information about damage prevention technologies.

In April, AGA releases "Guidelines for Oversight of Construction for Transmission Pipelines, Distribution Mains and Services."

USDOT and NIST submit a Five-Year Plan identifying areas of focus for research on pipeline safety.

In October, a study by PHMSA finds that the number of gas pipeline incidents caused by third-party excavation damage is falling dramatically.

2013 2014



for case-specific engineering analyses and the propensity of these other classes of customers to make dramatic load changes over time, which can lead to inadvertent EFV trips or failures and disrupt gas service to a customer.

In July 2015, PHMSA issued proposed rules for expanding the use of EFVs in gas distribution systems.¹⁷⁶ The proposed rules, if adopted, would require operators to install EFVs on all new or replaced branched service lines that provide gas below a certain hourly volume to single family residences, multi-family residences, and small commercial entities. Operators would also be required to use a manual service line shut-off valve (e.g., curb valves) for new or replaced service lines with certain meter capacities. Finally, operators would have an obligation to “notify customers of their right to request installation of an EFV on service lines that are not being newly installed or replaced.”¹⁷⁷

Research and Development

Research and development (R&D) initiatives are a vital part of the pipeline safety program. USDOT, industry, and other stakeholder groups have collaborated on these efforts for decades, producing a number of significant technological advancements.

In the 2002 PSIA, Congress required USDOT, in conjunction with the Department of Commerce’s National Institute of Standards and Technology (NIST), to implement a research, development, demonstration, and standardization program to ensure the integrity of pipeline facilities.¹⁷⁸ USDOT and NIST were required to submit an initial Five-Year Interagency Research Development and Demonstration Program Plan to Congress.¹⁷⁹ In the 2011 Act, Congress required USDOT and NIST to prepare successive R&D plans in five year intervals and to submit a status report on those plans to Congress every two years.¹⁸⁰

Congress generally appropriated between \$5M and \$8M in pipeline safety R&D funding on an annual basis from 2002 to 2013, but appropriated a substantial increase in funding for 2014, providing \$12.2M to the pipeline safety R&D program.¹⁸¹ PHMSA has awarded these funds to projects that focused on three core areas: developing new technologies,¹⁸² strengthening industry standards,¹⁸³

and promoting general knowledge.¹⁸⁴ PHMSA also recently launched a new initiative that provides R&D funding to graduate-level students for pipeline safety projects.¹⁸⁵

State Initiatives

Ensuring the timely recovery of costs associated with the repair and replacement of infrastructure is a critical component of natural gas pipeline safety and reliability. Operators traditionally recovered the costs associated with infrastructure investments through the filing of a general rate case and upon approval of rates by the regulator. However, experience has shown that there is a significant delay in cost recovery under that approach. Most general rates cases take several years to complete, and an operator is often required to pay for an infrastructure improvement without knowing when any recovery from ratepayers will occur, which can serve as an unnecessary deterrent to such investments.

To address that disparity, many states have developed special cost recovery methods for infrastructure investments, including surcharges, trackers, deferred accounting, riders, and rate stabilization. These programs provide a greater degree of financial certainty for companies that want to accelerate the repair and replacement of pipeline infrastructure, including for purposes of complying with the gas transmission and distribution integrity management requirements. Since 2007, the number of states employing such mechanisms has more than tripled, and today, 39 states allow 90 utilities to recover infrastructure replacement costs through alternative rate structures.¹⁸⁶ Together, these regulatory initiatives will play a critical role in facilitating and supporting the nation’s pipeline modernization goals.

Industry Initiatives

In recent years, industry trade organizations and their members have renewed their dedication to safety by undertaking numerous voluntary initiatives beyond existing legislative and regulatory requirements. These commitments build on industry’s longstanding record of collaboration with

public officials, emergency responders, excavators, consumers, and the public to provide a safe and reliable service. The pipeline industry has also formed a number of research consortiums that provide funding and support for pipeline-safety-related R&D projects.

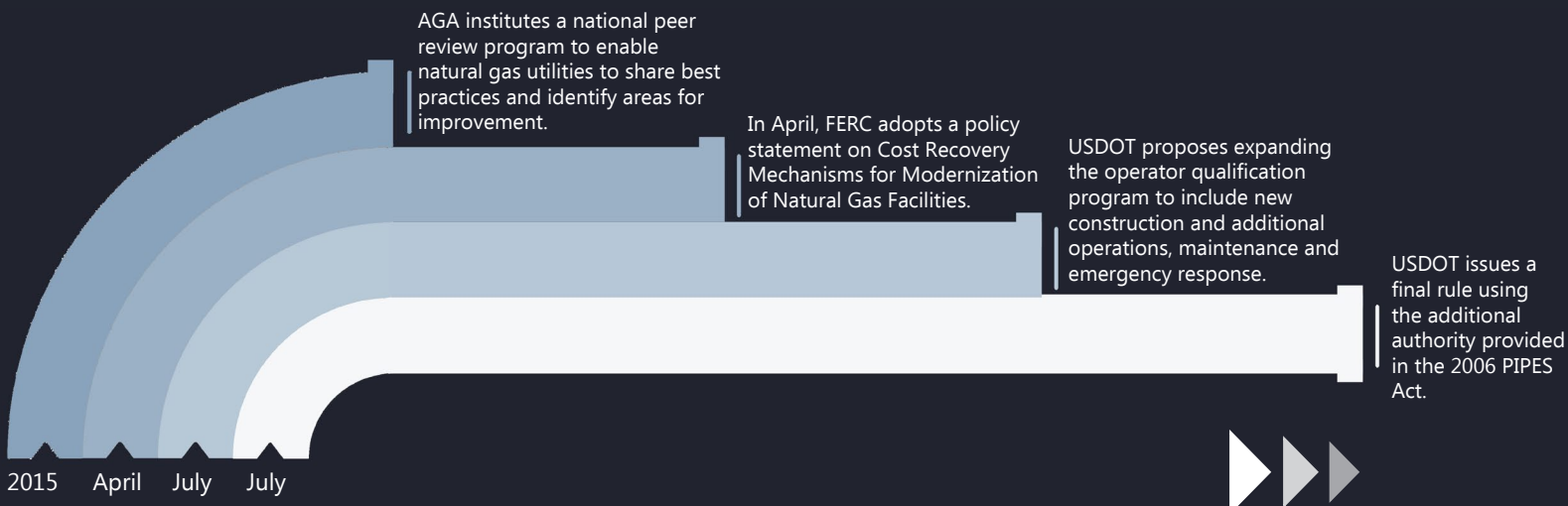
AGA represents more than 200 local utility companies, and these member companies deliver natural gas to more than 68 million consumers in the U.S, or approximately 94 percent of all natural gas provided by the nation's natural gas utilities. In February 2011, AGA released its Safety Culture Statement, a commitment by its members to promote a positive safety culture throughout the natural gas distribution industry.¹⁸⁷ The Safety Culture Statement described seven basic principles for achieving that objective: (1) a commitment by management, (2) open and honest communication, (3) identifying hazards, (4) managing risk, (5) plan development and implementation, (6) encouraging learning, and (7) personal accountability.¹⁸⁸

In October 2011, AGA issued its Commitment to Enhancing Safety,¹⁸⁹ which outlines AGA and its members' continued commitment to improving safety through a set of voluntary actions, including:

- ◆ Confirming the established maximum allowable operating pressure (MAOP) of transmission pipelines by utilizing AGA's Industry Guidance on Records Review for Re-affirming Transmission Pipeline MAOPs. AGA and its members have

met that objective and developed a webpage to compile information available to operators on MAOP record verification and testing.¹⁹⁰

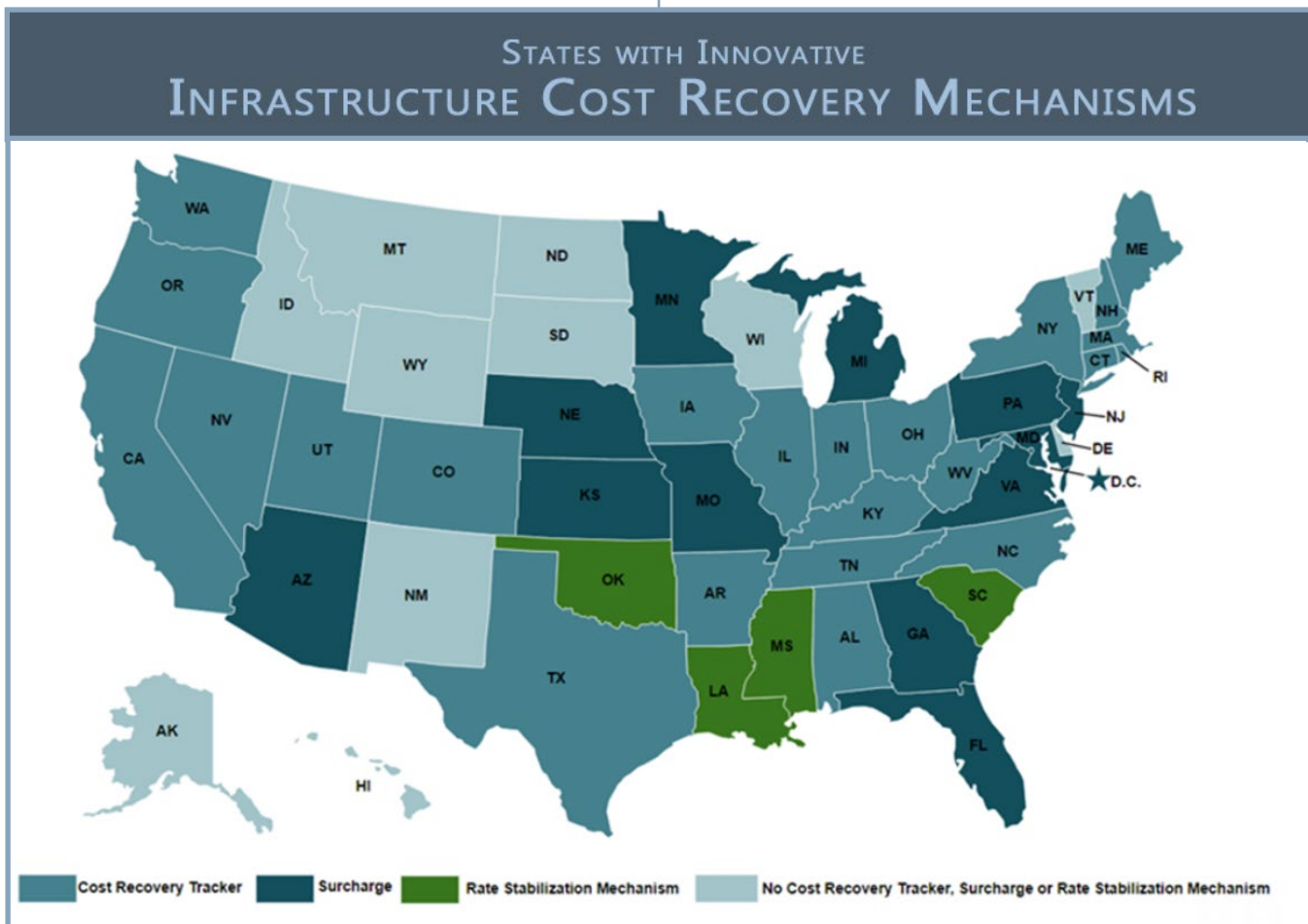
- ◆ Reviewing and revising construction procedures to provide for appropriate oversight of contractor-installed pipeline facilities. In April 2013, AGA released Guidelines for Oversight of Construction for Transmission Pipelines, Distribution Mains and Services which provides information for operators to consider in an effort to improve construction quality on new and fully replaced transmission and distribution pipelines.¹⁹¹ The guidance highlights elements that are essential to pre-installation, installation, and post-installation oversight taking into account the complexity of the activity and the training of the personnel.
- ◆ Expanding excess flow valve installation beyond single family residences to new and fully replaced branch services, small multi-family facilities, and small commercial facilities where economically, technically, and operationally feasible. AGA also committed to employing a risk-based approach to the installation of automatic and/or remote controlled valves on new or fully replaced transmission lines where economically, technically, and operationally feasible. AGA's March 2011 White Paper on Automatic Shut-off Valves and Remote Control Valves on Natural Gas Transmission Lines details this approach.¹⁹²



- ♦ Extending integrity management principles to transmission pipelines located beyond HCAs using a risk-based approach. AGA and its members have targeted extending integrity management to 70% of the population within the potential impact radius (PIR) by 2020, and to pipelines located in Class 1 and 2 locations by 2030. The implementation of this initiative is being deferred pending the outcome of further regulatory action by PHMSA.
- ♦ Collaborating with industry groups to conduct a comprehensive safety management study exploring safety initiatives underway in other sectors, and implementing actions that will enhance the sharing of safety information. This effort led to the development of AGA's new Peer-Review Program, which is described in more detail below.

In 2013 and 2014, AGA also piloted a voluntary peer-to-peer safety and operational practices review

program that allowed local natural gas utilities throughout the nation to observe their peers, share leading practices, and identify opportunities to better serve customers and communities. Volunteer companies hosted a peer review group composed of subject matter experts (SME) from other participating companies. The SMEs focused on the following areas: (1) safety culture; (2) worker procedures; and (3) pipeline safety risk management. The program fostered relationship building and facilitated the exchange of information, particularly with regard to leading industry practices. As a result of the positive experience with the pilot program, in January 2015 AGA instituted a national Peer Review Program that will provide over 200 natural gas utilities with the opportunity to observe peers, share best practices, and identify areas for improvement.¹⁹³ Recently, the Peer Review Program received a "Power of A" Gold Award from the American Society of Association Executives in recognition of the program's commitment to solving industry issues through engagement and collaboration with natural gas





operators.¹⁹⁴

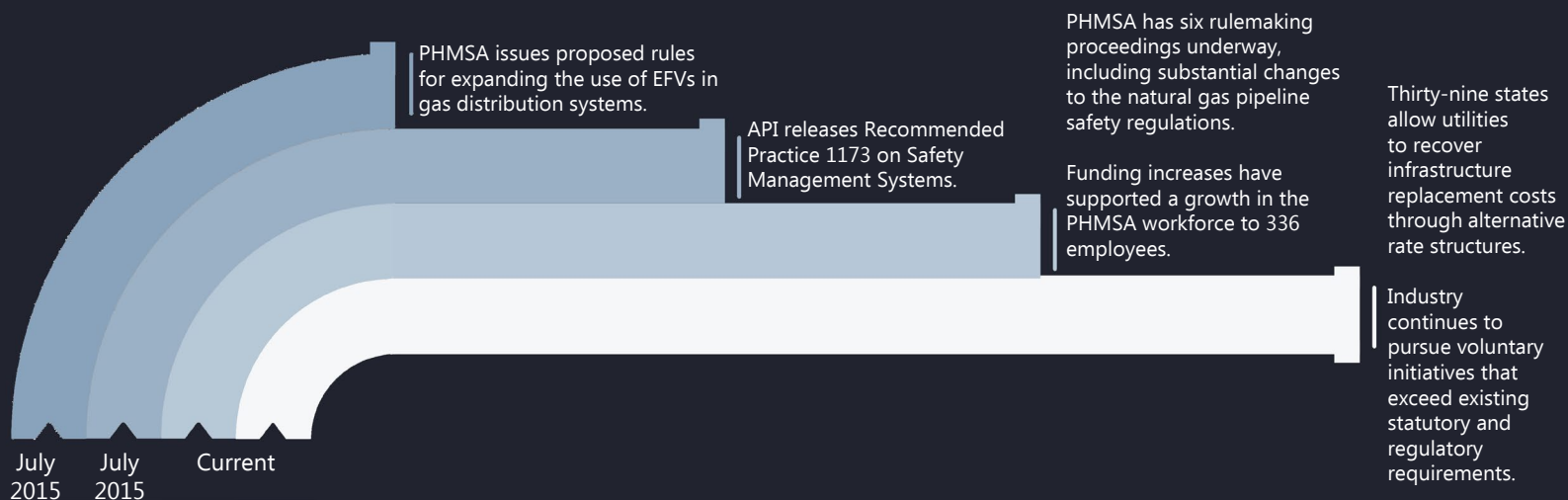
In March 2011, INGAA and its members adopted five “guiding principles” for pipeline safety, which included goals of zero incidents and applying integrity management principles to entire pipeline systems.¹⁹⁵ In July 2011, INGAA members agreed to an action plan to achieve these goals that included the following commitments:¹⁹⁶

- ◆ Expanding integrity management beyond HCAs and applying integrity management principles to the entire transmission system operated by

INGAA members by focusing on population within the PIR along the pipeline. INGAA members committed to expanding integrity management principles to 70 percent of the population within the PIR by 2020, and to 100% by 2030.

- ◆ Raising the standards for corrosion anomaly management to apply industry consensus standards to anomalies found within and outside of HCAs.
- ◆ Demonstrating that pre-regulation pipelines located in highly populated areas are fit for service through validation of records and confirmation of MAOP as part of INGAA’s Fitness for Service Protocol.
- ◆ Shortening pipeline isolation and response time in highly populated areas to one hour from incident recognition to the start of valve-closure procedures.
- ◆ Implementing PIPA recommended practices and collaborating with PIPA stakeholders to increase awareness and adoption of best practices.

Industry standards are a vital and growing part of the pipeline safety program. The ASA B31.1.8-1952, an industry standard developed in the early 1950s, provided the intellectual foundation for most of the original federal gas pipeline safety rules, and PHMSA incorporates dozens of industry



standards by reference into the federal pipeline safety regulations today. These standards address a broad range of safety issues, such as welding, corrosion, testing, and integrity management.¹⁹⁷ Many standards development organizations provide free public access to the standards incorporated by reference into the pipeline safety rules, which are also available for review at PHMSA and the Office of the Federal Register.¹⁹⁸

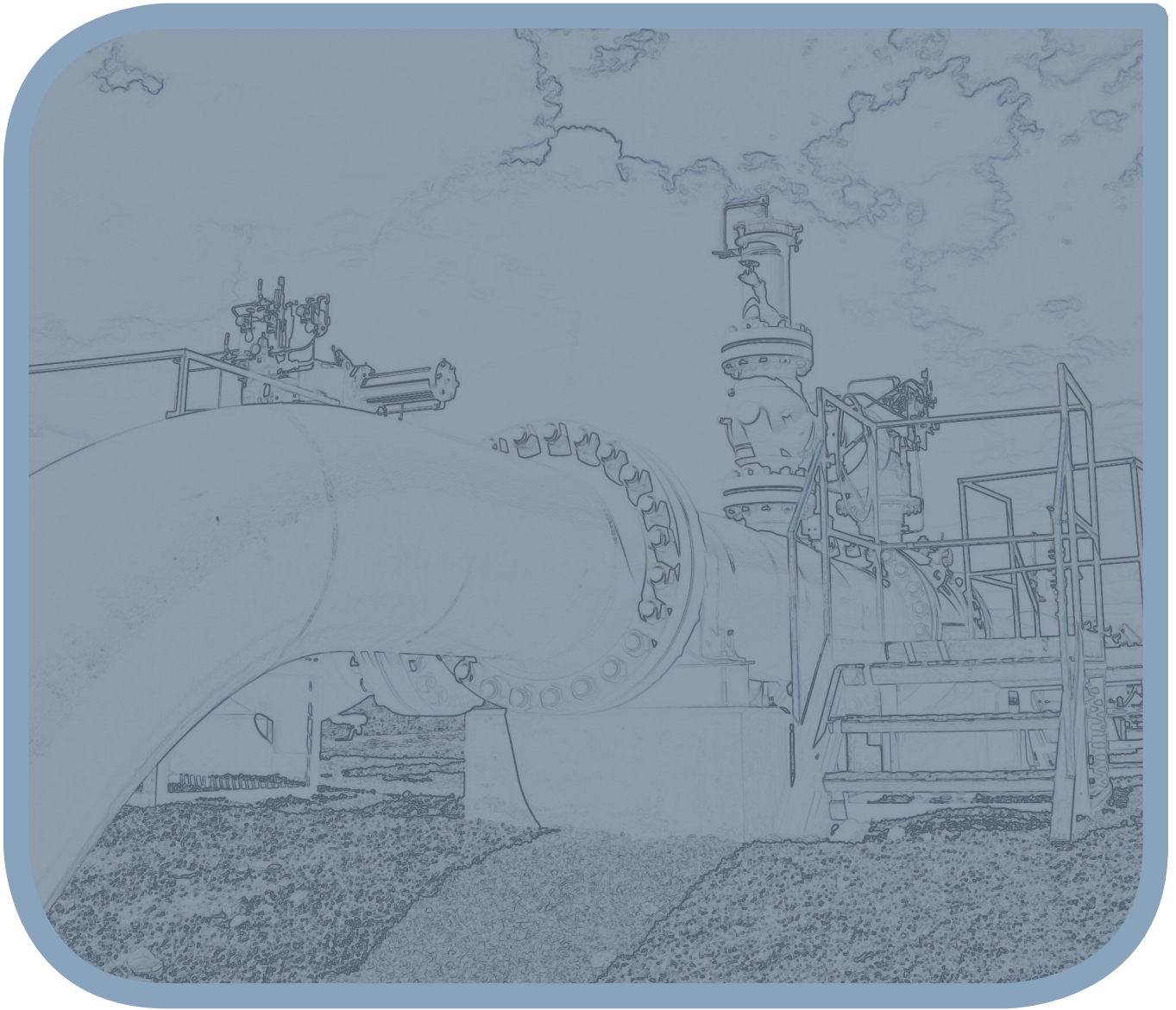
Industry standards also play an important role in furthering pipeline safety by establishing best practices that operators often follow in cases where compliance is not strictly required by law or regulation. In July 2015, for example, API released Recommended Practice 1173 (RP 1173) on Safety Management Systems, a voluntary consensus standard that addresses how leadership develops processes to identify and mitigate safety threats and ensures that compliance and risk reduction are routine and continuously improving.¹⁹⁹ RP 1173 provides operators with a comprehensive framework upon which they can build and tailor to their individual pipeline systems, and is composed of ten essential elements: (1) Leadership and Management Commitment; (2) Stakeholder Engagement; (3) Risk Management; (4) Operational Controls; (5) Incident Investigation, Evaluation, and Lessons Learned; (6) Safety Assurance; (7) Management Review and Continuous Improvement; (8) Emergency Preparedness and Response; (9) Competence, Awareness, and Training; and (10) Documentation and Recordkeeping. Although the provisions in RP 1173 are not incorporated by reference in the federal pipeline safety rules, industry participants are being encouraged to take steps to implement their own SMS by their respective trade representatives.

Finally, the pipeline industry has formed a number of research consortiums that provide funding and support for pipeline-safety-related R&D, including:

- ◆ NYSEARCH, a voluntary organization within the Northeast Gas Association;
- ◆ Operations Technology Development (OTD), a non-profit entity led by 23 members in the U.S. and Canada;
- ◆ Pipeline Research Council International (PRCI), an organization comprised of pipeline companies, vendors, service providers, manufacturers, and other stakeholders in the energy industry;

- ◆ Sustaining Membership Program (SMP), a collaborative R&D program managed by the Gas Technology Institute (GTI); and
- ◆ Utilization Research Development Program (URDP), a non-profit organization led by 16 members in the natural gas industry.

Many of these organizations participate in PHMSA R&D projects and are among the most significant contributors to recent technological advancements in the pipeline industry.



Ongoing Efforts to Improve Natural Gas Pipeline Safety and Reliability

4



This page intentionally blank.

— Introduction

This section examines ongoing federal, state, and industry initiatives to improve the safety and reliability of natural gas pipeline facilities. USDOT has initiated several rulemakings proceedings to amend the federal gas pipeline safety regulations and is continuing its efforts to advance pipeline safety R&D projects. The Federal Energy Regulatory Commission's (FERC) also recently released a Policy Statement on Cost Recovery Mechanisms for Modernization of Natural Gas Facilities, which should accelerate the recovery of certain capital expenditures by interstate gas transmission line operators for safety, environmental, or reliability issues. The states remain committed to expanding the use of cost recovery mechanisms to accelerate the repair, rehabilitation, and replacement of gas pipeline infrastructure. The pipeline industry is making substantial investments in pipeline-safety-related R&D projects and continues to improve pipeline safety by pursuing voluntary initiatives that exceed existing legal requirements.

— Federal Initiatives

PHMSA Rulemaking Proceedings

Several pipeline safety rulemaking proceedings are underway at the federal level that PHMSA expects to finalize in the coming years. These proceedings, which are in various stages of review, address a broad range of topics related to natural gas pipeline safety. The most significant proceeding is a rulemaking proposal that would adopt extensive amendments to the federal gas pipeline safety regulations in 49 C.F.R. Part 192. Other proceedings relate to federal enforcement of state damage prevention laws, the use of excess flow valves, leak detection standards, and plastic pipe.

Safety of Gas Transmission and Gathering Pipelines

PHMSA is developing an expansive rulemaking proposal that will likely contain significant changes to the Part 192 regulations for gas transmission and gathering pipelines. In an advance notice of proposed

rulemaking (ANPRM) issued in August 2011, PHMSA indicated that it was considering whether to expand its integrity management requirements, adjust the repair criteria for HCA and non-HCA areas, update its corrosion control requirements, include valve spacing and automation requirements, address seam weld issues, revise the maximum allowable operating pressure (MAOP) requirements, establish requirements for unregulated gas gathering pipelines, and require standards for management of change and quality management systems.²⁰⁰ PHMSA is also considering whether to issue regulations that would be applicable to underground gas storage facilities, which currently are not covered under Part 192.²⁰¹

Equally as important, the proposed rule is likely to contain the elements of a new integrity verification process (IVP) for substantiating the MAOP and materials properties for certain gas transmission lines. Developed in response to a provision in the 2011 Pipeline Safety Act, PHMSA has indicated that IVP will focus on pipelines with incomplete documentation, that present certain manufacturing or construction issues, or that have not been pressure tested according to certain standards. USDOT recently sent a draft version of the NPRM to the Office of Management and Budget for review, and PHMSA anticipates releasing its proposal for public comment in late 2015.

Enforcement of State Excavation Damage Laws

The 2006 PIPES Act provided PHMSA with the authority to establish federal damage prevention requirements for third-party excavators.²⁰² The 2006 PIPES Act also authorized PHMSA to initiate an enforcement action against excavators who violate certain minimum federal damage prevention requirements, but only if the agency determines that the state is not adequately enforcing its own damage prevention requirements on the basis of criteria established in a rulemaking proceeding.²⁰³

In July 2015, PHMSA issued a final rule on pipeline damage prevention programs exercising the additional authority provided in the 2006 PIPES Act.²⁰⁴ The final rule established nine criteria that PHMSA will use to evaluate the adequacy of state damage prevention enforcement programs and provided additional guidance on how PHMSA would

apply those criteria in future cases. The final rule also created an administrative process for making determinations on the adequacy of state damage prevention enforcement programs, i.e., PHMSA will issue a notice of inadequacy to the state, the state will be provided 30 days to submit a response before PHMSA issues a final decision, and the state will be afforded the opportunity to petition PHMSA for reconsideration of an adverse decision at any time based on changed circumstances. Finally, the final rule created “backstop” federal damage prevention rules that will apply to excavators if a state’s enforcement of its damage prevention laws is deemed inadequate, including requirements for conducting excavation activities and reporting damage to pipeline operators and emergency response authorities, as well as procedures for adjudicating federal enforcement actions against excavators who violate these provisions.

Other Rulemaking Proceedings

In addition to the comprehensive Part 192 revision and state excavation damage prevention rulemakings, PHMSA has initiated several other proceedings that will have an impact on natural gas pipeline safety.

- ◆ **OQ, Cost Recovery, and Other Changes.** In July 2015, PHMSA published a proposed rule addressing operator qualification, pipeline flow reversals and product changes, cost recovery for design reviews, accident and incident notification timelines, and other potential changes to the pipeline safety regulations.²⁰⁵
- ◆ **Excess Flow Valves.** In July 2015, PHMSA released a proposed rule to expand the use of EFVs in gas distribution systems that would require the installation of EFVs on new or replaced service lines for single family residences with branched lines and multi-family buildings and small commercial customers.²⁰⁶
- ◆ **Valves and Leak Detection.** PHMSA is developing a proposed rule that would require automatic shutoff valves, remote controlled valves, or equivalent technologies, and establish performance-based metrics for rupture detection on gas and liquid transmission pipelines. The rule would cover valves on pipelines located in or which could affect HCAs for both hazardous liquids and natural gas pipelines, including all

PHMSA Pipeline Damage Prevention Program Nine Essential Program Elements

1. Enhanced communication between operators and excavators.
2. Fostering support and partnership of all stakeholders in all phases (enforcement, system improvement, etc.) of the program.
3. Operator’s use of performance measures for persons performing locating of pipelines and pipeline construction.
4. Partnership in employee training.
5. Partnership in public education.
6. Enforcement agencies’ role as partner and facilitator to help resolve issues.
7. Fair and consistent enforcement of the law.
8. Use of technology to improve all parts of the process.
9. Analysis of data to continually evaluate/improve program effectiveness.

Class 3 and 4 locations for gas transmission pipelines. A significant open question is whether the NPRM will cover existing pipeline facilities in addition to new lines. PHMSA anticipates publishing an NPRM in early 2016.²⁰⁷

- ◆ **Plastic Pipe.** PHMSA recently issued a proposed rule addressing a variety of topics related to the use of plastic pipe, including polyethylene, polyamide-11, and polyamide-12 plastic pipe, 50-year pipeline markings, design factors, and risers, while incorporating by reference certain plastic pipe standards and pipe tracking and traceability.²⁰⁸

FERC Policy Statement

In April 2015, FERC adopted a policy statement on Cost Recovery Mechanisms for Modernization of Natural Gas Facilities (Policy Statement).²⁰⁹ The Policy Statement allows interstate natural gas pipelines to establish a surcharge or tracker mechanism to recover certain safety, environmental, or reliability capital expenditures made to modernize pipeline system infrastructure outside of a Natural Gas Act (NGA) Section 4 rate case, provided that five guiding principles are met. The Policy Statement takes effect on October 1, 2015.

The five guiding principles identified in the Policy Statement are:

- ◆ **Review of Existing Rates.** The pipeline's base rates must have been recently reviewed in either an Natural Gas Act (NGA) general section 4 rate proceeding or through a "collaborative effort" with customers.
- ◆ **Eligible Costs.** "[T]he eligible costs must be limited to one-time capital costs incurred to modify the pipeline's existing system to comply with safety or environmental regulations issued by PHMSA, [the U.S. Environmental Protection Agency (EPA)], or other federal or state government agencies, and other capital costs shown to be necessary for the safe or efficient operation of the pipeline, and the pipeline must specifically identify each capital investment to be recovered by the surcharge."
- ◆ **Avoidance of Cost Shifting.** "[T]he pipeline must design the proposed surcharge in a manner that will protect the pipeline's captive

customers from cost shifts if the pipeline loses shippers or must offer increased discounts to retain business."

- ◆ **Periodic Review of the Surcharge and Base Rates.** "[T]he pipeline must include some method to allow a periodic review of whether the surcharge and the pipeline's base rates remain just and reasonable."
- ◆ **Shipper Support.** "[T]he pipeline must work collaboratively with shippers to seek shipper support for any surcharge proposal."²¹⁰

Rather than a source of specific rules, the Policy Statement is a framework for how FERC will evaluate pipeline proposals for recovery of infrastructure modernization costs. The Policy Statement also represents a distinct shift from FERC's prior practice, which was to reject pipeline safety and environmental cost trackers unless agreed to as part of a near-unanimous settlement with the pipeline's customers. Finally, the Policy Statement is an acknowledgment by FERC of the need for coordinated federal action to advance pipeline modernization, including by focusing on pipeline safety and climate change matters.

Research and Development

USDOT and NIST submitted a Five-Year R&D Plan in July 2013 that identified six areas in which research efforts will be focused: (1) threat prevention; (2) leak detection and mitigation; (3) anomaly detection and characterization; (4) anomaly remediation and repair; (5) design, materials, and welding, and joining; and (6) alternative fuels and climate change.²¹¹ In March 2015, USDOT and NIST submitted an update to Congress on R&D progress made during the 2012-2013 fiscal years.²¹² The report indicated that individual agencies, including USDOT and Department of Interior (DOI), issued awards for 32 pipeline research projects. When combined with the awards for two interagency research projects, USDOT, the Department of Commerce (DOC), and DOI awarded a total of over \$10.3 million in funding and co-funding for pipeline initiatives, resulting in five technology demonstrations, three patent issuances, five commercialized technology improvements, and 11 publicly-available final reports.²¹³

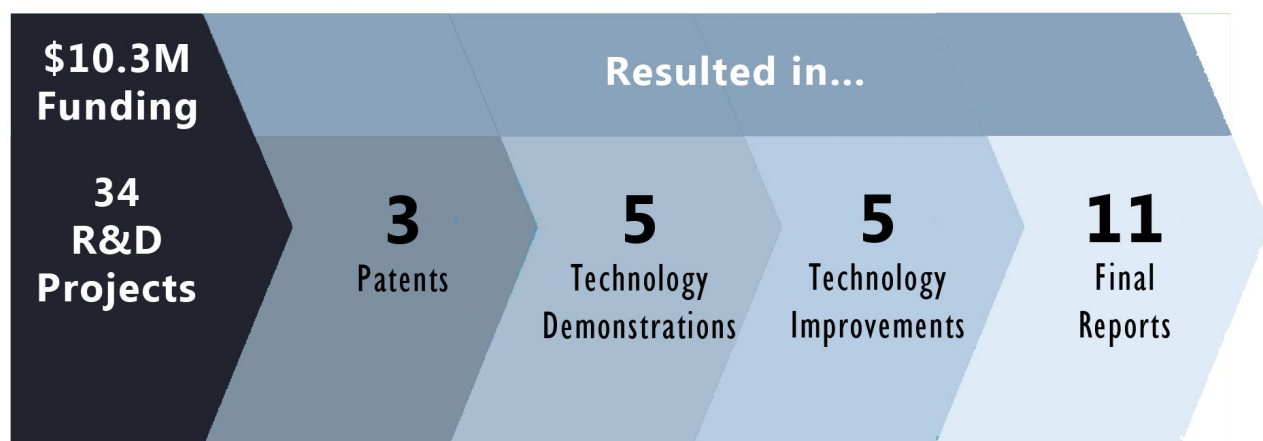
Select State Initiatives

The states are continuing to use special cost recovery mechanisms as a tool for implementing pipeline modernization programs, both through the approval of requests under existing authorities and the creation of new methods for ensuring accelerated cost recovery. For example:

- ◆ In January 2015, Entergy Gulf States received permission from the Louisiana Public Service Commission to begin replacing many of the legacy pipes that carry natural gas in Baton Rouge. Entergy is expected to replace about 25 miles of cast iron pipe, two miles of bare steel, and another 72 miles of vintage plastic pipe under the program.
- ◆ In February 2015, PECO, an electric and natural gas utility in Pennsylvania, filed a request with the Pennsylvania Public Utility Commission for approval to accelerate the modernization of the company's natural gas distribution system. PECO's plan would increase the company's modernization spending from \$34 million per year to \$61 million per year. If the proposed plan is approved, the replacement of existing cast iron, bare steel, wrought iron and ductile iron gas mains, and bare steel service lines would be accelerated from 34 years to 20 years.
- ◆ In March 2015, the Governor of West Virginia signed a law that provides natural gas utilities with the ability to file an application with the West Virginia Public Service Commission for a multi-year comprehensive plan for infrastructure replacements, upgrades, and extensions. The law became effective June 11, 2015.
- ◆ In March 2015, PSEG, an electric and natural gas utility in New Jersey, filed a proposal with the New Jersey Board of Public Utilities to invest \$1.6 billion over the next five years for the modernization of its gas pipeline systems. If the plan is approved, PSEG would replace an average of approximately 160 miles of cast iron and unprotected steel gas mains and about 11,000 unprotected steel service lines per year for the duration of the program.
- ◆ In April 2015, the New York Public Service Commission (NYPSC) issued an order instituting a proceeding to implement a cost recovery mechanism for accelerating the replacement of leak-prone pipe. The NYPSC's stated goal is to reduce the statewide average replacement timeline to 20 years.

Moreover, several states have either updated or are in the process of updating their pipeline safety standards to ensure consistency with the minimum federal requirements. Other states, such as Nevada, Oklahoma, and Pennsylvania, are considering proposals to strengthen their existing damage prevention laws and regulations through the imposition of increased penalties, the removal

R&D Program Progress 2012 - 2013



of exemptions, or the creation of new enforcement authority in state regulatory bodies.

— Industry Initiatives

Industry continues to support a variety of pipeline safety R&D initiatives. NYSEARCH, OTD, PRCI, SMP, URDP, and other industry-backed research consortiums are actively pursuing a number of projects, some of which receive additional federal R&D funding from PHMSA. For example, NYSEARCH is leading a project to develop robotics technology for performing internal assessments of pipelines that cannot be examined with traditional ILI tools. Similarly, PRCI, which recently opened a new Technology Development Center in Houston, Texas, is working on projects to expand the use of unmanned aerial surveillance technology for performing pipeline inspections, reduce methane emissions, and develop a test facility and qualification processes for evaluating ILI tools. OTD is spearheading the introduction of a new gas flow-stopping technology into the U.S. market, which will assist operators in performing operations and maintenance activities, and has successfully pursued other R&D projects in recent years, such as the development of handheld infrared ethane detectors, acoustic pipe location technology, automated mapping and leak detection technology, and risk management models for the gas distribution sector.

In addition to these efforts, Enbridge Pipelines, Inc., TransCanada Corp., and Kinder Morgan Canada Inc. recently announced a joint research initiative focused on aerial-based leak detection technologies. The companies collectively pledged over \$600,000 for research that will be conducted by Canada-based C-FER Technologies and target the detection of releases from pipelines carrying liquid hydrocarbons. Aerial leak detection technologies represent important innovation with regard to ensuring the safety of older infrastructure not capable of in-line inspection.

As important, industry continues to pursue voluntary initiatives that exceed existing statutory and regulatory requirements. AGA members remain dedicated to fulfilling the obligations agreed to in the Commitment to Enhancing Safety and the organization recently launched a new peer review

program. INGAA members are similarly committed to achieving the five guiding principles that the organization agreed to several years ago. However, the uncertainty generated by PHMSA's growing list of long-pending rulemaking initiatives is hampering these efforts, particularly for gas pipeline operators interested in making significant investments in the areas under consideration in these proceedings.

Industry also hosts a range of forums, workshops, seminars, and training course on pipeline safety and reliability issues. For example, in the first six months of this year, AGA has held meetings to discuss best practices, the development of new codes and standards, and operations, maintenance, and security issues. INGAA has convened meetings to discuss greenhouse gas reporting, construction, safety culture, pipe procurement and quality, and other matters. Similar events are sponsored by other industry organizations across the country on a routine basis, and pipeline companies are among the most active participants in government-led workshops, public meetings, and task forces on pipeline safety and reliability issues.





The Future of Natural Gas Pipeline Safety and Reliability

5



This page intentionally blank.

— Introduction

A number of initiatives are likely to influence pipeline integrity and modernization efforts in the coming years. Perhaps the most significant is USDOT's long-pending rulemaking proceeding to adopt comprehensive revisions to the federal gas pipeline safety standards. While those proposed revisions are not yet available for public review, it is expected that USDOT will address a number of outstanding congressional mandates in that proceeding, including the requirement to establish a testing protocol for confirming the MAOP of certain previously-untested, higher-risk gas transmission lines located in HCAs.

— Integrity Verification

USDOT released a draft version of its integrity verification process (IVP) for gas transmission lines in 2013 and provided the public with the opportunity to comment.²¹⁴ The draft IVP would require operators to identify pipe segments that are located in HCAs or "moderate consequence areas" (a new risk category that includes non-HCA pipe in more densely populated areas and some rural locations). The draft IVP also would require operators to screen those segments for conditions that fall within certain categories of concern. These categories of concern include segments installed prior to 1970 with an MAOP that is based on historic operating pressures (the "grandfather clause"), segments with a prior history of manufacturing and construction related failures, or segments that lack a sufficient pressure test. The draft IVP would require that operators re-establish the MAOP for such segments through the use of testing, pressure reductions, an engineering critical assessment, or replacement.

The congressional mandate that PHMSA is seeking to address in its IVP initiative emphasizes that inline inspections and other alternative methods should be considered as part of any new assessment methodology for gas transmission lines.²¹⁵ It also states that FERC and state regulators should be consulted in establishing a timeframe for completing that process, and that PHMSA must consider the potential effects on public safety, the environment,

costs, and service disruptions as part of that analysis. PHMSA's ability to effectively address these aspects of the congressional mandate, i.e., encouraging the use of new technologies and creating an effective timetable for completing the assessment process, will be critical in determining the success of future pipeline integrity and modernization initiatives. If pipeline operators are required to use outdated or unnecessarily restrictive assessment methods, an opportunity to advance the development of new technologies and broader interests of pipeline safety will be lost without producing any corresponding public benefit. A practicable schedule for completing the assessment process is also critical to maintaining the integrity of the nation's gas supply and avoiding unnecessary costs for pipeline operators and, ultimately, the consumers served by those systems.

PHMSA's ability to effectively address these aspects of the congressional mandate, i.e., encouraging the use of new technologies and creating an effective timetable for completing the assessment process, will be critical in determining the success of future pipeline integrity and modernization initiatives.

The uncertain outcome of PHMSA's overall rulemaking agenda is having an impact on the decisions pipeline operators are currently making related to pipeline testing, replacement, and other integrity and modernization efforts. Pipeline companies cannot make informed capital investment decisions in an environment where significant portions of the regulatory framework remain uncertain over extended time periods. Moreover, the pipeline companies who are willing to make large capital outlays run the risk of dedicating resources to a proposal that might not satisfy the regulatory requirements PHMSA issues in the future. The broad range of issues in play (e.g., the creation of additional and more stringent regulations for gas gathering lines, the potential expansion of the integrity management program requirements, the imposition of strength and materials testing requirements for legacy pipelines,

and the implementation of new leak detection and mitigation provisions) only serves to amplify and reinforce the adverse impact of these forces.

— Expedite Publication

The Administration can relieve some of this uncertainty in the short term by expediting the publication of the many pipeline safety rulemaking proposals that are currently undergoing review within USDOT or at the Office of Management and Budget. PHMSA can do the same by clearly stating that recently promulgated regulatory programs, such as the gas transmission and distribution integrity management requirements, will be afforded the opportunity for full implementation and analysis before any significant changes are given serious consideration. To encourage additional investment in pipeline modernization initiatives, PHMSA can include a safe harbor provision for significant capital expenditures in its pending rulemaking proceedings, or include exemptions that acknowledge the implementation of voluntary measures in the period prior to the issuance of a final rule. PHMSA can also facilitate the efficient allocation of resources by continuing to incorporate risk-based principles into new regulations and encouraging the use of new and emerging technologies in the areas of pipeline design, materials, testing, and inspections.

— Financial Impacts

The additional financial resources provided to PHMSA in recent congressional appropriations will have an effect on pipeline safety and reliability efforts as well. PHMSA received \$145.5 million for the federal pipeline safety program in the most recent omnibus appropriations bill, a significant increase from previous years. Although PHMSA has already committed to spend \$11.9 million on new federal pipeline safety positions, there are other areas of the program that could benefit from an injection of additional resources. Improvements in the collection and analysis of the various data that pipeline operators submit to PHMSA are needed to help prioritize the agency's policy agenda, ensure the issuance of timely, cost-effective regulations, and understand the full impact of existing regulatory

programs. The proper allocation of R&D funds for pipeline safety projects is also necessary to set the stage for the next generation of technological advancements. That objective can be more easily achieved if PHMSA consults with representatives from the pipeline industry and other stakeholder groups before establishing long-term R&D plans. There are also opportunities to partner with state pipeline safety agencies, emergency responders, and industry on public awareness and emergency responders.

Cost recovery programs will continue to have a significant influence on pipeline modernization efforts in the years ahead. Recognizing the importance of eliminating undue burdens on pipeline infrastructure investments, the states have significantly expanded the reach of these programs in recent years, and all indications suggest that this trend will continue in the future. FERC also issued a new policy statement on cost recovery mechanisms for federally-regulated interstate gas pipelines. With PHMSA and state authorities contemplating substantial changes to the gas pipeline safety regulations, these mechanisms will take on added significance in the coming years as pipeline operators and ratepayers reconcile the anticipated cost of regulatory compliance.

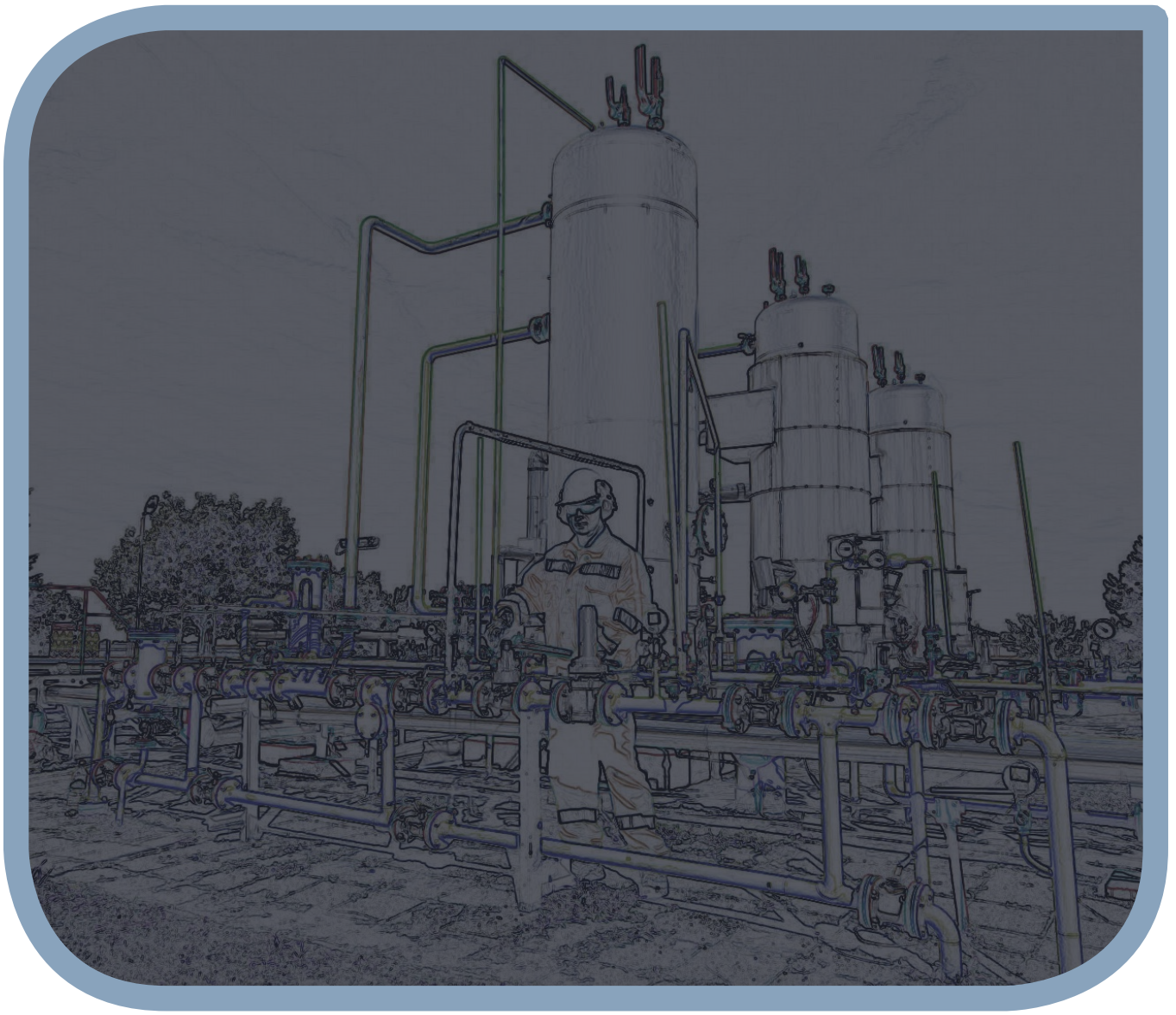
— Industry Role

As in the past, industry will continue to play a vital role in ensuring the safety and reliability of the nation's pipeline infrastructure in the future. Since the release of the first safety standard for gas transmission and distribution lines more than five decades ago, the industry has advanced the cause of pipeline safety through its various standards-writing organizations. Regulators have relied on these standards in developing increasingly complex programs, and many pipeline companies adhere to the best practices and guidance contained in such documents even in circumstances where compliance is not required by law. The industry's standards-writing organizations remain positioned at the forefront in addressing emerging issues in pipeline safety, such as the development of a new recommended practice for safety management systems and the creation of a new standard

specification for composite pipe materials.

The industry has also been an active participant in PHMSA's pending rulemaking proceedings, submitting data, information, and comments, and that level of engagement will continue in subsequent phases of the regulatory process. The industry is implementing a number of voluntary initiatives that exceed current legal requirements, and strengthening existing programs based on its review of the available data and information. These efforts will provide a solid foundation for future pipeline modernization initiatives, particularly if PHMSA continues to foster a risk-based regulatory framework that provides operators with the flexibility to implement the lessons learned from these experiences.

More than any other initiative, the campaign to reduce third-party excavation damage shows the results that can be achieved if the various stakeholder groups set aside narrower interests and focus on a common objective. Legislators, regulators, operators, excavators, first responders, and a variety of other parties have all contributed to that effort, particularly in recent years, thanks in large part to the work of the Common Ground Alliance. While the effective enforcement of state damage prevention laws, expanded use of new technologies, and continued improvement of best practices and public awareness are necessary to capitalize on these gains, the collaborative approach used in addressing the issue should serve as a model for addressing other matters that affect the safety and reliability of the nation's gas pipeline network in the future.



Conclusion

6



This page intentionally blank.

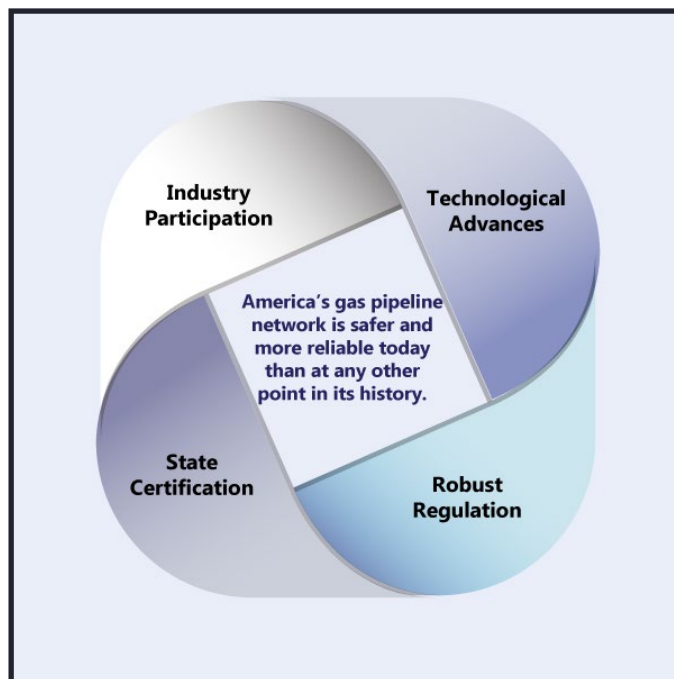
Conclusion

Pipelines are generally regarded as the safest and most reliable means of delivering natural gas to consumers, and the industry has been a vital and growing part of the U.S. energy sector for almost two centuries. Technological advancements in the early 20th century made the transportation of natural gas by pipeline to all regions of the country a reality, and the early efforts of industry to develop a comprehensive safety standard for gas transmission and distribution lines set the stage for the various state and federal pipeline safety codes that followed.

USDOT has been administering the nation's federal pipeline safety program for more than five decades. The program has expanded significantly during that period, growing from a fledgling agency with a handful of federal employees and very limited financial resources to a more robust regulator with a projected federal workforce of more than 300 federal employees and almost \$150 million in annual funding. With the strong support of the pipeline industry, the safety standards administered by USDOT have also undergone an evolution, particularly with the emergence in recent years of new risk-based integrity management programs for gas transmission and distribution lines.

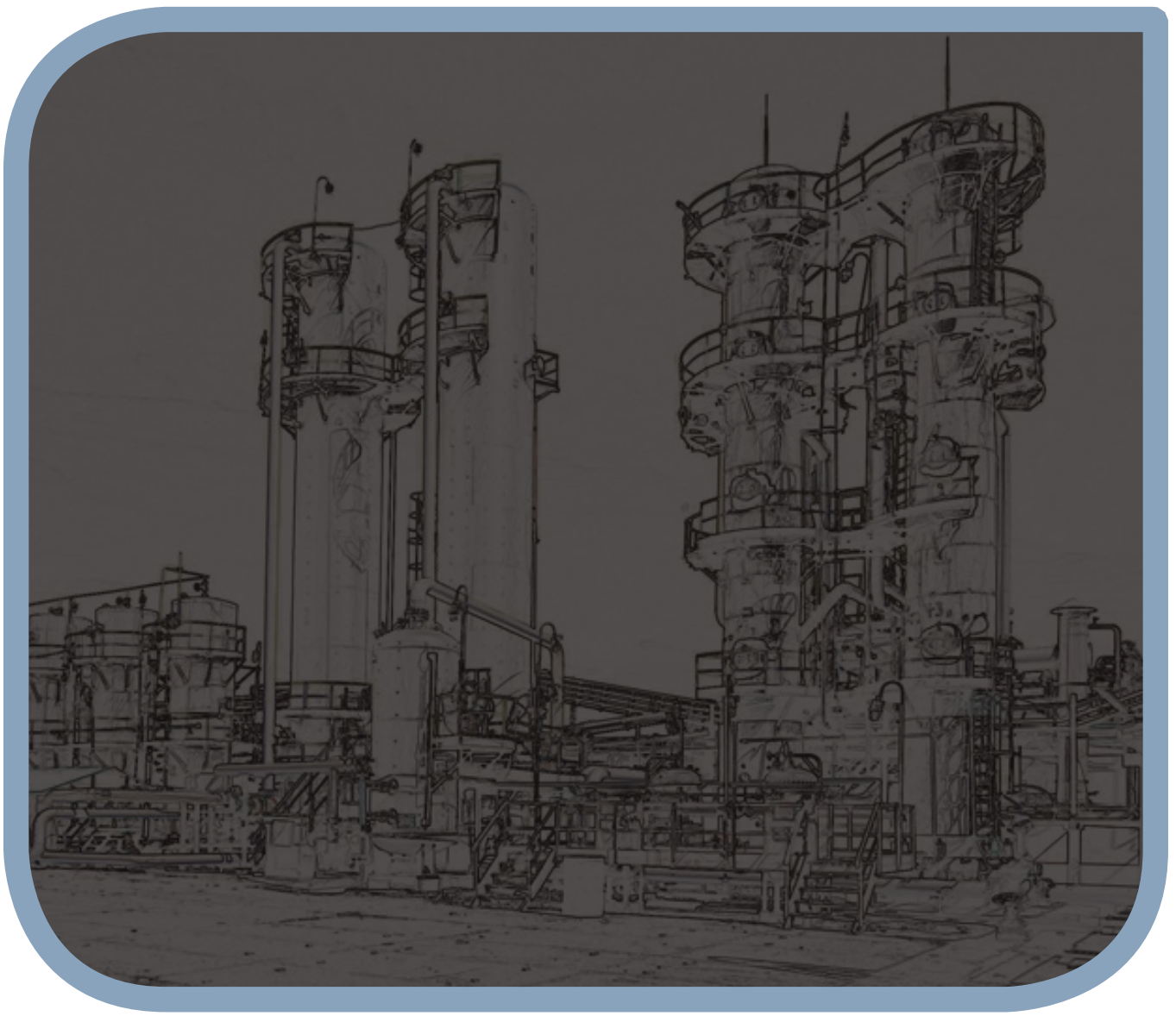
The states play a critical role in ensuring the safety and reliability of gas pipelines. Nearly all states have a certification from USDOT to regulate the safety of intrastate gas pipelines, and the overwhelming majority of gas pipelines in the U.S. are regulated under these programs. The states are also promoting pipeline modernization efforts through the implementation of special cost recovery programs, which allow operators to accelerate the repair, rehabilitation, and replacement of gas pipeline infrastructure.

The pipeline industry has long been at the forefront of the effort to improve natural gas pipeline safety and reliability. Industry representatives have participated in the development of key regulatory initiatives, drafted dozens of technical standards, and dedicated substantial resources to pipeline safety R&D initiatives. Industry has also honored its commitment to advancing pipeline safety and reliability by implementing voluntary initiatives, hosting seminars and workshops, and participating



in a number of similar activities.

History has shown that the nation can address the challenges confronting the safety and reliability of the nation's natural gas pipelines. In less than 200 years, the industry has grown from a rudimentary method for transporting natural gas from a shallow well to a few nearby customers in Fredonia, New York, to a thriving network of gas gathering, transmission, and distribution pipelines that spans more than 2 million miles. Despite these tremendous changes, America's gas pipeline network is safer and more reliable today than at any other point in its history, largely as a result of technological developments, improvements in industry best practices and standards, and the implementation of more effective regulatory programs. That trend bodes well for the future of natural gas pipeline safety and reliability in the country.



Endnotes and Appendices

7



This page intentionally blank.

— ENDNOTES

1. Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., Annual Report Mileage for Gas Distribution Systems (Aug. 3, 2015) <http://phmsa.dot.gov/pipeline/library/datastatistics/pipelinemileagefacilities> (follow "Annual Report Summary" hyperlink and "Gas Distribution" hyperlink).
2. Pipeline Safety: Safety of Gas Transmission Lines, 76 Fed. Reg. 53,086, 53,101 (Aug. 25, 2011) (providing estimate for regulated and unregulated gas gathering line mileage). Some shipments of liquefied natural gas (LNG) are also made by marine vessel or truck. The U.S. Department of Energy reported that in 2012 marine vessels carried approximately 157.8 billion cubic feet (Bcf) of imported LNG, 9.3 Bcf of exported LNG, and an additional 13.3 Bcf of re-exported (i.e., foreign-sourced) LNG. Office of Fossil Energy, U.S. Department of Energy, U.S. LNG Imports and Exports 2004 – 2012 at 2, 25, 28 (Jan. 11, 2013), <http://energy.gov/sites/prod/files/2013/04/f0/November%2012%20Bob%20LNG.pdf>. Comparable data on LNG trucking is not readily available.
3. U.S. Energy Information Administration, Natural Gas Consumption by End Use, http://www.eia.gov/dnav/ng/ng_cons_sum_dcu_nus_a.htm
4. Pipelines carried about 70% of the nation's crude oil and petroleum products from 2005 to 2009, with water carriers accounting for 23%, motor carriers accounting for 4%, and railroads accounting for 3%. Diana Furchtgott-Roth & Kenneth P. Green, Fraser Institute, Intermodal Safety in the Transport of Oil 7, Table 3 (Oct. 2013) [hereinafter Fraser Institute Report], <https://www.fraserinstitute.org/uploadedFiles/fraser-ca/Content/research-news/research/publications/intermodal-safety-in-the-transport-of-oil.pdf>.
5. Supra note 1 (follow "Annual Report Summary" hyperlink and "Hazardous Liquid" hyperlink).
6. API & AOPL, Annual Liquids Pipeline Safety Performance Report and Strategic Plan 6 (2015), <http://www.aopl.org/wp-content/uploads/2015/02/2015-Pipeline-Safety-Perf-Report-Strategic-Plan-s.pdf>.
7. Non-pipeline modes of transportation include vessels, trucking, and rail. See Fraser Institute Report at 4. See also John Frittelli, et al., Cong. Research Serv., Report No. R43390, U.S. Rail Transportation of Crude Oil: Background and Issues for Congress 4 (Dec. 4, 2014), <https://fas.org/sqp/crs/misc/R43390.pdf>.
8. Bureau of Transp. Statistics, Research and Innovative Tech. Admin., U.S. Dep't of Transp., Transportation Statistics Annual Report 2012 72 (Rev. 2013), http://www.rita.dot.gov/bts/sites/rita.dot.gov/bts/files/tsar_2012.pdf.
9. Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., Pipeline Incident 20 Year Trends, <http://www.phmsa.dot.gov/pipeline/library/datastatistics/pipelineincidenttrends> (last visited Aug. 28, 2015).
10. U.S. Gov't Accountability Office, GAO-13-168, Better Data and Guidance Needed to Improve Pipeline Operator Incident Response 8 (Jan. 2013); U.S. Gov't Accountability Office, GAO-14-667, Oil and Gas Transportation: Department of Transportation is Taking Actions to Address Rail Safety, but Additional Actions Are Needed to Improve Pipeline Safety 18-20 (Aug. 2014).
11. U.S. Gov't Accountability Office, GAO/RCED-00-128, Pipeline Safety: The Office of Pipeline Safety is Changing How It Oversees the Pipeline Industry 9-10 (May 2000) (citing Cheryl J. Trench, Allegro Energy Group, The U.S. Oil Pipeline Industry's Safety Performance (May 1999)).
12. Fraser Institute Report at 13.

13. Kenneth P. Green & Taylor Jackson, Frasier Institute, Safety in the Transportation of Oil and Gas: Pipelines or Rail? 7 (Aug. 2015), <http://www.frasierinstitute.org/uploadedFiles/fraser-ca/Content/research-news/research/publications/safety-in-the-transportation-of-oil-and-gas-pipelines-or-rail.pdf>.
14. API & AOPL, Annual Liquids Pipeline Safety Performance Report and Strategic Plan 1 (2015), <http://www.aopl.org/wp-content/uploads/2015/02/2015-Pipeline-Safety-Perf-Report-Strategic-Plan-s.pdf>; American Gas Ass'n, Gas Facts 90, 103 (2015).
15. <http://www.phmsa.dot.gov/> (under "About PHMSA" select "Mission & Goals").
16. INGAA adopts new pipeline safety guiding principles (Mar. 31, 2011), <http://www.ingaa.org/6211/11460.aspx>.
17. The National Association of Regulatory Utility Commissioners, in cooperation with the National Association of Pipeline Safety Representatives, prepared a comprehensive compendium listing information on all of the various state pipeline safety programs in the United States. A copy of the most recent edition of that report, released in September 2013, is available at <http://www.naruc.org/resources.cfm?p=397.gov/#!documentDetail;D=PHMSA-2013-0119-0047>.
18. Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., States Participating in the Federal/State Cooperative Gas and Hazardous Liquid Pipeline Liquid Safety Programs (Nov. 25, 2014), <http://phmsa.dot.gov/portal/site/PHMSA/m.6f23687cf7b00b0f22e4c6962d9c8789/?vgnextoid=60dc8f4826eb9110VgnVCM1000009ed07898RCRD&vgnnextchannel=a576ef80708c8110VgnVCM1000009ed07898RCRD&vgnnextfmt=print>.
19. Id.
20. Charles F. Phillips, Jr., The Regulation of Public Utilities 692 (3rd ed. 1993) (quoting Steven J. Dorner, Beginnings of the Gas Industry, American Gas Ass'n, Regulation of the Gas Industry vol. 1, 1-7).
21. Kiefner, J.F. and Trench, C. J., API, Oil Pipeline Characteristics and Risk Factors: Illustrations from the Decade of Construction, at 13-22, (Dec. 2001), http://www.api.org/%E2%80%8Boil-and-natural-gas-overview/transporting-oil-and-natural-gas/pipeline-performance-ppts/ppts-related-files/~/_media/files/oil-and-natural-gas/ppts/other-files/decadefinal.ashx.
22. Id.
23. H.R. Rep. No. 90-1390, at 9 (1968) (House Committee Report accompanying S. 1166, the Natural Gas Pipeline Safety Act of 1968), reprinted in 1968 U.S.C.C.A.N. 3223, 3225.
24. Natural Gas Pipeline Safety: Hearings on H.R. 6551, S. 1166 Before the H. Subcomm. on Commc'n and Power of the Comm. on Interstate and Foreign Commerce, 90th Cong. 32 (1967-1968) (study of State activities conducted by the Nat'l Ass'n of Regulatory Utility Comm'rs and the Dep't of Transp.).
25. Kiefner, J.F. and Trench, C. J., API, Oil Pipeline Characteristics and Risk Factors: Illustrations from the Decade of Construction, at 16-22 (Dec. 2001), http://www.api.org/%E2%80%8Boil-and-natural-gas-overview/transporting-oil-and-natural-gas/pipeline-performance-ppts/ppts-related-files/~/_media/files/oil-and-natural-gas/ppts/other-files/decadefinal.ashx.
26. H.R. No. 90-1390 at 9, reprinted in 1968 U.S.C.C.A.N. at 3225.
27. Natural Gas Pipeline Safety Act of 1968, Pub. L. No. 90-481, 82 Stat. 720 (codified at 49 U.S.C. § 60101 et seq.).
28. S. Rep. No. 92-829, at 3 (1972) (to accompany H.R. 5065, Natural Gas Pipeline Safety Act Amendments of 1972), reprinted in 1972 U.S.C.C.A.N. 3049, 3051.
29. Pipeline Safety Act of 1979, Hearings on S. 411 before the S. Comm. on Commerce, Sci., and Transp., 96th Cong. 177 (1979) (statement of George H. Lawrence, President, American Gas Association).

30. H.R. Rep. No. 93-1296, at 4 (1974) (to accompany H.R. 15205, Natural Gas Pipeline Safety Act Amendments of 1974).
31. Pipeline Safety Act of 1979, Hearing on S. 411 before the S. Comm. On Commerce, Sci., and Transp., 96th Cong. 142 (1979) (statement of Paul Rodgers, Administrative Director and General Counsel, National Association of Regulatory Utility Commissioners).
32. Pipeline Safety Act of 1979, Hearing on S. 411 before the S. Comm. On Commerce, Sci., and Transp., 96th Cong. 177 (1979).
33. Bureau of Transp. Statistics, Research and Innovative Tech. Admin., U.S. Dep't of Transp., National Transportation Statistics, Table 1-10 - U.S. Oil and Gas Pipeline Mileage (Updated April 2015), http://www.rita.dot.gov/bts/sites/rita.dot.gov/bts/files/publications/national_transportation_statistics/index.html.
34. Consolidated Omnibus Reconciliation Act of 1985, Pub. L. No. 99-272, § 7005, 100 Stat. 82, 140.
35. Pipeline Safety Act of 1992, Pub. L. No. 102-508, § 109, 106 Stat. 3289, 3294-95.
36. Pipeline Safety Act of 1979, Hearing on S. 411 before the S. Comm. On Commerce, Sci., and Transp., 96th Cong. 185 (1979).
37. U.S. Gov't Accountability Office, GAO/RCED-00-128, Pipeline Safety, The Office of Pipeline Safety is Changing How It Oversees the Pipeline Industry 8.
38. Id.
39. Bureau of Transp. Statistics, Research and Innovative Tech. Admin., U.S. Dep't of Transp., National Transportation Statistics, Table 1-10 - U.S. Oil and Gas Pipeline Mileage (Updated April 2015), <http://www.rita.dot.gov/bts/publications/>.
40. Pipeline Safety Improvement Act of 2002, Pub. L. No. 107-355 § 22, 116 Stat. 2985, 3010 (2002) (2002 PSIA).
41. In the Norman Y. Mineta Research and Special Programs Improvement Act of 2004, Pub. L. No. 108-426, 118 Stat. 2423 (2004), Congress established PHMSA as a new agency within USDOT. Effective February 20, 2005, PHMSA became responsible for regulating pipeline safety, a mission previously delegated to USDOT's Research and Special Programs Administration ("RSPA"). Pipeline and Hazardous Materials Safety Administration, and to the Administrator, Research and Innovative Technology Administration; Establishment and Delegation of Powers and Duties, 70 Fed. Reg. 8,299 (Feb. 18, 2005). The Materials Transportation Bureau, another agency with USDOT, had the responsibility for regulating pipeline safety before RSPA. Establishment of Materials Transportation Bureau, 40 Fed. Reg. 30,821 (July 23, 1975).
42. A comprehensive list of PHMSA's historical pipeline safety rulemaking proceedings from 1970 to the present is available at <http://www.phmsa.dot.gov/pipeline/historical-rulemaking>.
43. U.S. Gov't Accountability Off., GAO-02-785, Pipeline Safety and Security: Improved Workforce Planning and Communication Needed 5 (Aug. 2002).
44. U.S. Gov't Accountability Off., GAO-04-985T, Pipeline Safety: Preliminary Information on the Office of Pipeline Safety's Actions to Strengthen Its Enforcement Program 7 (July 2004).
45. U.S. Gov't Accountability Off., GAO-06-588T, Gas Pipeline Safety: Preliminary Observations on the Implementation of the Integrity Management Program 6 (Apr. 2006).
46. Pipeline Inspection, Protection, Enforcement, and Safety Act of 2006, Pub. L. No. 109-468, 120 Stat. 3486 (codified as amended at 49 U.S.C. §60101 (2006)) (2006 PIPES Act).

47. Implementation of the Pipeline Inspection, Protection, Enforcement and Safety Act of 2006 and Reauthorization of the Pipeline Safety Program, Hearing Before the Subcomm. on R.R., Pipelines and Hazardous Materials of the H. Comm. on Transp. and Infrastructure, 111th Cong. 114 (2010) (written statement of Cynthia L. Quarterman, Administrator, PHMSA).
48. Pipeline Safety, Regulatory Certainty, and Job Creation Act of 2011, Pub. L. No. 112–90, 125 Stat. 1904 (2012) (2011 Act).
49. *Id.* at § 32, 125 Stat. at 1922.
50. Pipeline Safety: Safety of Gas Transmission Pipelines, 76 Fed. Reg. 53,086 (Aug. 25, 2011).
51. Pipeline and Hazardous Materials Safety Admin., U.S. Dep’t of Transp., Agency Guidance, <http://www.phmsa.dot.gov/resources/library/guidance>.
52. Pipeline and Hazardous Materials Safety Admin., U.S. Dep’t of Transp., No. 12-173, Final Report on Leak Detection Study –DTPH56-11-D-000001 (Dec. 10, 2012), http://www.phmsa.dot.gov/pv_obj_cache/pv_obj_id_4A77C7A89CAA18E285898295888E3DB9C5924400/filename/Leak%20Detection%20Study.pdf.
53. Pipeline and Hazardous Materials Safety Admin., U.S. Dep’t of Transp., Pipeline Replacement Updates, http://opsweb.phmsa.dot.gov/pipeline_replacement/.
54. Consolidated Appropriations Act, 2015, Pub. L. No. 113-235, 128 Stat. 2130 (2014).
55. Pipeline and Hazardous Materials Safety Admin., U.S. Dep’t of Transp., Fact Sheet: FY 2015 Budget - Enacted Levels, <http://www.phmsa.dot.gov/portal/site/PHMSA/m.6f23687cf7b00b0f22e4c6962d9c8789/?vgnextoid=c4f8267d1ceda410VgnVCM100000d2c97898RCRD&vgnnextchannel=485b143389d8c010VgnVCM1000008049a8c0RCRD&vgnnextfmt=print>.
56. 2002 PSIA § 14, 116 Stat. at 3002 (codified at 49 U.S.C. § 60109).
57. Accountable Pipeline Safety and Partnership Act of 1996, Pub. L. No. 104-304, § 5, 110 Stat. 3793, 3798 (codified at 49 U.S.C. § 60126).
58. Pipeline Safety: Pipeline Integrity Management in High Consequence Areas (Hazardous Liquid Operators With 500 or More Miles of Pipeline), 65 Fed. Reg. 75,378 (Dec. 1, 2010). A second final rule applicable to operators of hazardous liquid pipelines of less than 500 miles was adopted a couple years later. Pipeline Safety: Pipeline Integrity Management in High Consequence Areas (Hazardous Liquid Operators With Less Than 500 Miles of Pipeline), 67 Fed. Reg. 2,136 (Jan. 16, 2002).
59. Pipeline Safety: Pipeline Integrity Management in High Consequence Areas (Gas Transmission Pipelines), 66 Fed. Reg. 34,318, 34,323–27 (June 27, 2001).
60. Pipeline Safety: Pipeline Integrity Management in High Consequence Areas (Gas Transmission Pipelines), 68 Fed. Reg. 69,778 (Dec. 15, 2003) (codified at 49 C.F.R. Part 192, Subpart O).
61. 49 C.F.R. § 192.905 (2014).
62. *Id.* § 192.911.
63. *Id.* §§ 192.933, 192.939.
64. *Id.* § 192.919.
65. Pipeline Safety: Pipeline Integrity Management in High Consequence Areas (Gas Transmission Pipelines), 68 Fed. Reg. at 69,779–80.
66. *Id.* at 69,780.

67. Id.
68. U.S. Gov't Accountability Office, GAO-06-946, Natural Gas Pipeline Safety: Integrity Management Benefits Public Safety, but Consistency of Performance Measures Should be Improved 2 (Sept. 2006).
69. Interstate Nat. Gas Ass'n of Am. (INGAA), Progress Made with Integrity Management (Mar. 27, 2012).
70. Nat'l Transp. Safety Board, NTSB SS-15/01, Safety Study: Integrity Management of Gas Transmission Pipelines in High Consequence Areas 20 (Jan. 2015).
71. 2006 PIPES Act § 9, 120 Stat. at 3493 (codified as amended at 49 U.S.C. §60101 (2006)).
72. Pipeline Safety: Integrity Management Program for Gas Distribution Pipelines, 74 Fed. Reg. 63,906 (Dec. 4, 2009), as amended by Pipeline Safety: Mechanical Fitting Failure Reporting Requirements, 76 Fed. Reg. 5,494 (Feb. 1, 2011).
73. Am. Gas Found., Safety Performance and Integrity of the Natural Gas Distribution Infrastructure (Jan. 2005), http://www.gasfoundation.org/researchstudies/safety_perf.htm.
74. Id. at app. O-3.
75. Id. at app. O-3.
76. Id.
77. Id.
78. Id. at 5-10.
79. USDOT, joint work study groups, Integrity Management for Gas Distribution Pipelines, Report of Phase 1 Investigations (Dec. 2005), <http://opsweb.phmsa.dot.gov/pipelineforum/docs/letters/DIMP%20Phase%201%20Report.pdf>.
80. Id. at 11.
81. Id. at 10.
82. Id.
83. Pipeline Safety: Integrity Management Program for Gas Distribution Pipelines, 74 Fed. Reg. 63,906 (Dec. 4, 2009), amended by Mechanical Fitting Failure Reporting Requirements, Final Rule, 76 Fed. Reg. 5,494 (Feb. 1, 2011). The DIMP rules are codified at 49 C.F.R. Part 192, subpart P.
84. 49 C.F.R. § 192.1005.
85. Id. § 192.1007.
86. Id. § 192.1009.
87. Id. § 192.1011.
88. Id. § 192.1013.
89. Id.
90. Gas Piping Technology Committee (GPTC), Guide for Gas Transmission and Distribution Piping Systems, ANSI Z380.1 (2012).

91. Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., Distribution Integrity Management: Guidance for Master Meter and Small Liquefied Petroleum Gas Pipeline Operators (2013), https://primis.phmsa.dot.gov/dimp/docs/PHMSA_DIMP_SmallOperatorGuidance_Rev1_022813.pdf.
92. Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., Gas Distribution Integrity Management Program: FAQs, <https://primis.phmsa.dot.gov/dimp/faqs.htm>.
93. Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., Advisory Bulletins, <http://phmsa.dot.gov/pipeline/regs/advisory-bulletin>.
94. A "serious incident" is one that results in a fatality or injury requiring in-patient hospitalization. Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., Pipeline Incident 20 Year Trends, "Serious Incident 20 Year Trend," <http://www.phmsa.dot.gov/pipeline/library/datastatistics/pipelineincidenttrends> (accessed August 11, 2015).
95. A "significant incident" includes an incident constituting a "serious incident," as well as one that results in any of the following: "\$50,000 or more in total costs, measured in 1984 dollars;" the release of five barrels or more of a highly volatile liquid, or 50 barrels or more of other liquid; or the release of liquid resulting in an unintentional fire or explosion. Id.
96. See Data & Statistics, <http://phmsa.dot.gov/pipeline/library/data-stats/raw-data>.
97. Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., National Pipeline Performance Measures, "Incidents Caused by Excavation Damage," <http://www.phmsa.dot.gov/pipeline/library/data-stats/performance-measures> (accessed August 7, 2015). An excavation ticket refers to an operator's receipt of notice through the One-Call system that a third party intends to excavate and marking of buried pipelines may be required. Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., Gas Distribution Integrity Management Program: Performance Measure Reporting, <http://primis.phmsa.dot.gov/dimp/perfmeasures.htm> (accessed August 7, 2015) (definition of excavation ticket).
98. Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., Pipeline Replacement Updates, Iron Gas Distribution Inventory Reports, http://opsweb.phmsa.dot.gov/pipeline_replacement/cast_iron_inventory.asp (accessed August 5, 2015).
99. See generally Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., Operator Qualification History & Milestones (Apr. 2, 2004), available at http://www.phmsa.dot.gov/pv_obj_cache/pv_obj_id_C7FBA353EC905F5DE84E9F373A167FB080B40000/filename/5_OQHistory.pdf.
100. Pipeline Safety: Qualification of Pipeline Personnel, 64 Fed. Reg. 46,853 (codified at 49 C.F.R. Parts 192, subpart N and 195, subpart G).
101. 49 C.F.R. §192.805.
102. Id.
103. See Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., Operator Qualification History & Milestones (Apr. 2, 2004), available at http://www.phmsa.dot.gov/pv_obj_cache/pv_obj_id_C7FBA353EC905F5DE84E9F373A167FB080B40000/filename/5_OQHistory.pdf.
104. Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., Operator Qualification: Protocols, <https://primis.phmsa.dot.gov/oq/protocols.htm>.
105. Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., Operator Qualification FAQs, <https://primis.phmsa.dot.gov/oq/faqs.htm>.
106. Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., Operator Qualification Enforcement (2014), available at http://phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Files/OQ_Enforcement_Guidance_06_24_2014.pdf.

107. Pipeline Safety: Operator Qualification, Cost Recovery, Accident and Incident Notification, and Other Pipeline Safety Proposed Changes, 80 Fed. Reg. 39,916 (July 10, 2015).
108. American Society of Mechanical Engineers (ASME), Pipeline Personnel Qualification, ASME B31Q-2010 (Revision of ASME B31Q-2006).
109. American Society of Mechanical Engineers (ASME), Pipeline Personnel Qualification, ASME B31Q-2014 (Revision of ASME B31Q-2010).
110. Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., Report to Congress: Qualification of Pipeline Personnel (Jan. 29, 2007), http://phmsa.dot.gov/pv_obj_cache/pv_obj_id_C4005F513C2404E63A69B34A27BD381468341500/filename/Report%20to%20Congress%20-%20Qualification%20of%20Pipeline%20Personnel.pdf. The 2007 report study also noted that pipeline operators were investing significant financial resources in OQ program implementation; for example, thirty-two members of the American Gas Association reported spending \$19 million annually on OQ program management costs and \$91 million annually on OQ training costs. *Id.* at 30.
111. See 2002 PSIA § 13, 116 Stat. at 3001 (codified at 49 U.S.C. § 60131).
112. *Id.*
113. Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., Report to Congress: Qualification of Pipeline Personnel 21.
114. *Id.* at 22.
115. Pipeline Safety: Control Room Management/Human Factors, 73 Fed. Reg. 53,076 (Sept. 12, 2008).
116. See 2006 PIPES Act § 12, 120 Stat. at 3495 (codified as amended at 49 U.S.C. §60137).
117. Pipeline Safety: Control Room Management/Human Factors, 73 Fed. Reg. at 53,085.
118. Pipeline Safety: Control Room Management/Human Factors, 74 Fed. Reg. 63,310 (Dec. 3, 2009).
119. Under the original final rule, operators had an obligation to develop procedures by August 1, 2011, and to implement those procedures by February 1, 2013. *Id.* at 63,311 (A correction to the final rule was published on February 3, 2010. The final rule established a program development deadline of August 1, 2011, and a subsequent implementation deadline of February 1, 2013.). However, USDOT accelerated the latter deadlines in a June 2011 final rule, requiring "operators to implement the procedures for roles and responsibilities, shift change, change management, and operating experience, fatigue mitigation education and training by October 1, 2011." Pipeline Safety: Control Room Management/Human Factors, 76 Fed. Reg. 35,130, 35,130 (codified at 49 C.F.R. Parts 192 and 195). The rule also changed the deadline "for pipeline operators to implement the other procedures for adequate information, shift lengths, maximum hours-of-service, and alarm management [to] August 1, 2012." *Id.* Training procedures also had to be implemented by August 1, 2012, with certain exceptions. *Id.*
120. Am. Petroleum Inst., API RP 755, Fatigue Prevention Guidelines for the Refining and Petrochemical Industries (2010).
121. Am. Petroleum Inst., API RP 1168, Pipeline Control Room Management (2013).
122. Southern Gas Association, Gas Pipeline Industry Control Room Management Rule Compliance Framework Document (2010).
123. Security & Integrity Found., Am. Pub. Gas Ass'n, Procedural Manual for Operations, Maintenance and Emergencies (Aug. 1, 2011).

124. According to a recent analysis of data provided by operators for all regulated pipeline systems, including onshore and offshore gas and hazardous liquid pipelines, USDOT estimates that third party excavation damage was the cause of 1,678 reported incidents from 1988 to 2012, resulting in 188 fatalities, 723 injuries, and approximately \$475 million in property damage. Pipeline Safety: Pipeline Damage Prevention Programs, 80 Fed. Reg. 43,836, 43,836 (Jul. 23, 2015).
125. Natural Gas and Hazardous Liquid Pipeline Damage Prevention Program, 53 Fed. Reg. 24,747, 24,748 (June 30, 1988).
126. Excavation Damage Prevention Programs for Gas and Hazardous Liquid and Carbon Dioxide Pipelines, 60 Fed. Reg. 14,646, 14,646 (Mar. 20, 1995).
127. Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., Study on the Impact of Excavation Damage on Pipeline Safety (2014), http://phmsa.dot.gov/pv_obj_cache/pv_obj_id_740C402C4402B86E135EAB7B73E81D77E318C600/filename/S10_140728_011_F_reduced.pdf.
128. Id. at 13.
129. Id.
130. Id.
131. Transportation of Natural and Other Gas by Pipeline; Damage Prevention Program, 47 Fed. Reg. 13,818 (Apr. 1, 1982).
132. Grants for State Pipeline Safety Programs; State Adoption of One-Call Damage Prevention Program, 55 Fed. Reg. 38,688 (Sept. 20, 1990).
133. Excavation Damage Prevention Programs for Gas and Hazardous Liquid and Carbon Dioxide Pipelines, 60 Fed. Reg. at 14,646.
134. Mandatory Participation in Qualified One-Call Systems by Pipeline Operators, 62 Fed. Reg. 61,695, 61,696 (Nov. 19, 1997).
135. Grants for State Pipeline Safety Programs; State Adoption of One-Call Damage Prevention Program, 55 Fed. Reg. 38,688 (Sept. 20, 1990).
136. Office of Pipeline Safety, U.S. Dep't of Transp., Common Ground: Study of One-Call Systems and Damage Prevention Best Practices 2 (Aug. 1999), <https://primis.phmsa.dot.gov/comm/publications/CommonGroundStudy090499.pdf>.
137. NTSB Safety Recommendation P-97-014, PHMSA Response (Apr. 24, 2000), <http://www.nts.gov/investigations/data/layouts/ntsb.recsearch/Recommendation.aspx?Rec=P-97-014>.
138. Id.
139. Transportation Equity Act for the 21st Century, Pub. L. No. 105-178, § 6105(a), 112 Stat. 107, 480 (1998).
140. Office of Pipeline Safety, U.S. Dep't of Transp., Common Ground: Study of One-Call Systems and Damage Prevention Best Practices at 165, <https://primis.phmsa.dot.gov/comm/publications/CommonGroundStudy090499.pdf>.
141. Id. at 11.
142. <http://commongroundalliance.com/programs/damage-information-reporting-tool-dirt>.
143. Transportation Equity Act for the 21st Century, § 6103, 112 Stat. at 479.
144. 2002 PSIA § 17, 116 Stat. at 3008.

145. Use of N11 Codes and Other Abbreviated Dialing Arrangements, 70 Fed. Reg. 19,321 (Mar. 14, 2005).
146. Am. Petroleum Inst., API RP 1162: Public Awareness Programs for Pipeline Operators (1st ed. 2003).
147. Pipeline Safety: Pipeline Operator Public Awareness Program, 70 Fed. Reg. 28,833 (May 19, 2005).
148. Va. Code § 56-265 (1995).
149. 20 Va. Admin. Code § 5-309 (2015).
150. Massoud Tahamtani, Virginia Damage Prevention Progress Report, at 3, <https://www.scc.virginia.gov/urs/mutility/pres/13dpc1.pdf>.
151. Ken Jones, One-Call Enforcement Program Implemented in Nevada (part I), Damage Prevention Prof'l, Winter 2011, at 29; Ken Jones, One-Call Enforcement Program Implemented in Nevada (part II), Damage Prevention Prof'l, Spring 2011, at 34.
152. Wash. Rev. Code § 19.122 (2015).
153. Ohio Rev. Code § 3781.25-32 (2015).
154. API & AOPL, Provisions of a Model State One Call Law (Aug. 2011).
155. 2006 PIPES Act § 2, 120 Stat. at 3487 (codified as amended at 49 U.S.C. §60114).
156. Id. (codified at 49 U.S.C. § 60114(f)).
157. Pipeline Safety: Pipeline Damage Prevention Programs, 80 Fed. Reg. 43,836.
158. Pipeline Safety: Pipeline Damage Prevention Programs, 77 Fed. Reg. 19,800 (Apr. 2, 2012).
159. 2011 Act, § 3, 125 Stat. at 1906 (codified at 49 U.S.C. § 6103(a)).
160. H.B. 445, Sess. of 2015 (Pa. 2015).
161. H.B. 3010, 2015 Reg. Sess. (W. Va. 2015).
162. Grants for State Pipeline Safety Programs; State Adoption of One-Call Damage Prevention Program, 55 Fed. Reg. at 38,690.
163. Gas Tech. Inst., GPS-Based Excavation Encroachment Notification, Project Nos. 20735, 20656 (Oct. 2011).
164. Common Ground Alliance, VAULT, <http://www.cga-vault.com/>.
165. Transp. Research Board, Nat'l Academies, Transmission Pipelines and Land Use: A Risk-Informed Approach, Special Report 281 (2004). TRB prepared that report at the request of USDOT to comply with a provision in the 2002 PSIA. See 2002 PSIA § 11, 116 Stat. at 2996.
166. U.S. Dep't of Transp., Pipelines and Informed Planning Alliance (PIPA), <http://www.PIPA-info.com>.
167. Pipelines and Informed Planning Alliance (PIPA), Partnering to Further Enhance Pipeline Safety In Communities Through Risk-Informed Land Use Planning, Final Report of Recommended Practices (Nov. 2010).
168. Id. at 26-27.
169. Id. at 30-31.
170. Pipelines and Informed Planning Alliance (PIPA), Hazard Mitigation Planning: Practices for Land Use Planning and Development near Pipelines (2015).

171. Excess Flow Valve—Performance Standards, 61 Fed. Reg. 31,449 (June 20, 1996) (codified at 49 C.F.R. § 192.381).
172. Excess Flow Valve—Customer Notification, 63 Fed. Reg. 5,464 (Feb. 1998) (codified at 49 C.F.R. § 192.383).
173. Pipeline Safety: Integrity Management Program for Gas Distribution Pipelines, 74 Fed. Reg. 63,906 (Dec. 4, 2009) (codified at 49 C.F.R. § 192.383).
174. *Id.* at 63,929 (codified at 49 C.F.R. § 192.383(b)). The DIMP final rule also included a requirement that operators report the number of installed EFVs to USDOT on annual basis. *Id.* Since issuing the DIMP final rule, USDOT has begun the process of considering whether to expand the requirement for installation of EFVs to applications other than SFR service lines, e.g., to service lines that provide gas to branched SFRs, apartment buildings, other multi-residential dwellings; commercial properties; or industrial facilities. In 2009, USDOT convened a pair of meetings with various stakeholders, including natural gas distribution system operators, trade associations, manufacturers, and public interest organizations, to discuss the feasibility of that proposal. Following these meetings, USDOT released a report, Interim Evaluation: NTSB Recommendation P-01-2 Excess Flow Valves in Applications Other Than Service Lines Serving One Single Family Residence, which addressed issues relating to the installation and use of EFVs in the United States and other countries. Pipeline and Hazardous Materials Safety Admin., U.S. Dep’t of Transp., Interim Evaluation: NTSB Recommendation P-01-2 Excess Flow Valves in Applications Other Than Service Lines Serving One Single Family Residence (2010).
175. Pipeline Safety: Expanding the Use of Excess Flow Valves in Gas Distribution Systems to Applications Other Than Single-Family Residences, 76 Fed. Reg. 72,666 (Nov. 25, 2011).
176. Pipeline Safety: Expanding the Use of Excess Flow Valves in Gas Distribution Systems to Applications Other Than Single-Family Residences, 80 Fed. Reg. 41,460 (Jul. 15, 2015).
177. *Id.* at 41,460.
178. 2002 PSIA § 12, 116 Stat. at 2997.
179. *Id.*
180. 2011 Act, § 32(f), 125 Stat. at 1923.
181. Pipeline and Hazardous Materials Safety Admin., U.S. Dep’t of Transp., Pipeline Safety Research Development and Technology, Natural Gas Infrastructure R&D and Methane Emissions Mitigation Workshop at 7 (Nov. 2014), http://energy.gov/sites/prod/files/2014/11/f19/NG-infrastructure-workshop_DOT-PHMSA-presentation.pdf. The 2002 PSIA required USDOT, in conjunction with the Department of Commerce’s National Institute of Standards and Technology (NIST), to implement a “research, development, demonstration, and standardization program to ensure the integrity of pipeline facilities.” 2002 PSIA § 12(a), 116 Stat. at 2997. USDOT and NIST were required to submit an initial Five-Year Interagency Research Development and Demonstration Program Plan to Congress. *Id.* § 12(d).
182. PHMSA awarded \$46.04M in R&D funding for 82 technology projects and 44 technology demonstrations from 2002 to 2014, resulting in 19 patent applications, 23 commercialized technologies, and a 34% commercialization success rate. Pipeline and Hazardous Materials Safety Admin., U.S. Dep’t of Transp., Research & Development: Technology Improvements, <https://primis.phmsa.dot.gov/rd/performance-technology.htm>.
183. In recent years, PHMSA awarded \$28.67M in R&D funding for projects related to the development and improvement of the various consensus industry standards that are incorporated into the pipeline safety regulations by reference. Pipeline and Hazardous Materials Safety Admin., U.S. Dep’t of Transp., Research & Development: Strengthening Consensus Standards, https://primis.phmsa.dot.gov/rd/performance_cs.htm.

184. PHMSA awarded \$54.36M for projects dedicated to promoting and improving general knowledge of pipeline safety issues. Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., Research & Development: Promoting Knowledge to Decision Makers, https://primis.phmsa.dot.gov/rd/performance_knowledge.htm.
185. In 2013, PHMSA launched the Competitive Academic Agreement Program (CAAP) as part of an effort to encourage pipeline safety research by university level graduate students. Projects are competitively selected for the CAAP and a cost sharing mechanism with university partners is included for part of the funding. PHMSA selected 8 CAAP projects in 2013, awarding \$814K in federal funding with an additional \$353K in university partner funding. PHMSA selected 7 CAAP projects in 2014, awarding \$699K in federal funding with an additional \$391K in university partner funding. Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., Research & Development: University Partnerships, <https://primis.phmsa.dot.gov/rd/universitypartners.htm>.
186. Am. Gas Ass'n, Natural Gas Rate Round-Up: A Periodic Update on Innovative Rate Designs at 1 (June 2012); Am. Gas Ass'n, State Infrastructure Replacement Activity (Sept. 8, 2015) (attached as Appendix 1).
187. Am. Gas Ass'n, Safety Culture Statement (2011) <https://www.aga.org/safety> (click on "AGA Safety Culture Statement here").
188. Id.
189. Am. Gas Ass'n, Commitment to Enhancing Safety at 2 (2011), <https://www.aga.org/safety> (click on "aga_commit_2_enhance_safety_final.pdf").
190. Am. Gas Ass'n, MAOP Verification and Pressure Testing for Transmission Pipelines, <https://www.aga.org/maop-verification-and-pressure-testing-transmission-pipelines>.
191. Am. Gas Ass'n, AGA Guidelines for Oversight of Construction for Transmission Pipelines, Distribution Mains and Services (Apr. 2013), <https://www.aga.org/aga-guidelines-oversight-construction-transmission-pipelines-distribution-mains-and-services-april>.
192. Am. Gas Ass'n, AGA White Paper, Automatic Shut-off Valves (ASV) And Remote Control Valves (RCV) On Natural Gas Transmission Pipelines (Mar. 25, 2011), <https://www.aga.org/aga-white-paper-automatic-shut-valves-asv-and-remote-control-valves-rcv>.
193. Am. Gas Ass'n, AGA Peer Review Program, <https://www.aga.org/aga-peer-review-program>.
194. Am. Soc'y of Ass'n Executives, ASAE Power of A Awards, <http://www.thepowerofa.org/awards/>.
195. Comment of the Interstate Natural Gas Ass'n of America on the PHMSA Draft Integrity Verification Process, Docket PHMSA-2013-0119 (Sept. 2013) (comments of the INGAA), <http://ingaa.org/File.aspx?id=20463>.
196. Submission by the Interstate Natural Gas Ass'n of America to "Pipeline Safety Report to the Nation" Docket – a Preliminary Report at 6-15, Docket No. PHMSA-2011-0127 (July 13, 2011), <http://www.regulations.gov/#!documentDetail;D=PHMSA-2011-0127-0017>.
197. 49 C.F.R. § 192.7.
198. Pipeline and Hazardous Materials Safety Admin., U.S. Dep't of Transp., Standards Incorporated by Reference, <http://phmsa.dot.gov/portal/site/PHMSA/m.6f23687cf7b00b0f22e4c6962d9c8789/?vgnextoid=d5af714769382310VgnVCM1000001ecb7898RCRD&vgnnextchannel=f0b8a535eac17110VgnVCM1000009ed07898RCRD&vgnnextfmt=print>.
199. Am. Petroleum Inst., API RP 1173, Pipeline Safety Management System Requirements, First Edition (July 2015).
200. Pipeline Safety: Safety of Gas Transmission Pipelines, 76 Fed. Reg. 53,086 (Aug. 25, 2011).

201. Id. at 53,097-98.
202. 2006 PIPES Act § 2, 120 Stat. at 3487 (codified as amended at 49 U.S.C. §60114).
203. Id. (codified at 49 U.S.C. § 60114(f)).
204. Pipeline Safety: Pipeline Damage Prevention Programs, 80 Fed. Reg. 43,836.
205. Pipeline Safety: Operator Qualification, Cost Recovery, Accident and Incident Notification, and Other Proposed Changes, 80 Fed. Reg. 39,916.
206. Pipeline Safety: Expanding the Use of Excess Flow Valves in Gas Distribution Systems to Applications Other Than Single-Family Residences, 80 Fed. Reg. 41,460.
207. Pipeline Safety: Amendments to Parts 192 and 195 to require Valve installation and Minimum Rupture Detection Standards (Rupture Detection and Valve Rule), Docket No. PHMSA-2013-0255, RIN 2137-AF06.
208. Pipeline Safety: Plastic Pipe Rule, 80 Fed. Reg. 29,263 (May 21, 2015).
209. Cost Recovery Mechanisms for Modernization of Natural Gas Facilities, 151 FERC ¶ 61,047, reh'g denied, 152 FERC ¶ 61,046 (2015).
210. Id. at P 20.
211. Nat'l Inst. of Standards and Tech., U.S. Dep't of Transp., Five-Year Interagency Research Development and Demonstration Program Plan For Pipeline Safety and Integrity at 10-12 (July 2013), https://primis.phmsa.dot.gov/rd/docs/Interagency_5_Year_Plan_2012_2016.pdf.
212. Nat'l Inst. of Standards and Tech., U.S. Dep't of Transp., Five-Year Interagency Research Development and Demonstration Program Plan For Pipeline Safety and Integrity, Update Report #1, Fiscal Years 2012-2013 (Mar. 2015), <http://www.phmsa.dot.gov/media/reports>.
213. Id.
214. PHMSA conducted a public workshop on the concept of Integrity Verification Process (IVP) on August 7, 2013. Pipeline Safety: Public Workshop on Integrity Verification Process, 78 Fed. Reg. 32,010 (May 28, 2013). In addition, PHMSA released an initial draft approach for IVP in the form of a complex flow chart, available at <http://www.regulations.gov/#!documentDetail;D=PHMSA-2013-0119-0047>.
215. 2011 Act § 23, 125 Stat. at 1918.