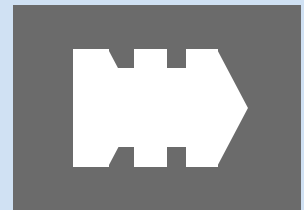# API-AOPL Annual Liquids Pipeline Safety Excellence Performance Report & Strategic Plan

2016

ASSOCIATION OF OIL PIPE LINES (AOPL)
represents liquids pipeline owners and operators
transporting crude oil, petroleum products like gasoline,
diesel, jet fuel, and home heating oil and industrial
products like propane and ethane

AMERICAN PETROLEUM INSTITUTE (API)
is the only national trade association that represents
all aspects of America's oil and natural gas industry

A Letter from America's Liquids Pipeline Leadership

Dear Reader,

Pipelines are one of the safest ways to deliver the liquid energy our American families and workers need. A barrel of crude oil or petroleum products traveling through a pipeline reaches its destination safely greater than 99.999% of the time. Nevertheless, pipeline operators are continuously working to improve pipeline safety with an ultimate goal of zero pipeline incidents.

This report outlines the specific industry-wide actions liquids pipeline operators are taking to improve pipeline safety and reduce the number of pipeline incidents. Pipeline operators are not standing by or waiting for new safety requirements. Instead, pipeline operators are pushing forward with new technologies to keep pipelines safe, new methods for inspecting, monitoring, building, and performing preventative maintenance on pipelines, and new systems for managing pipeline safety programs.

The Pipeline Safety Excellence chapter of this report gives an overview of the following: industry-wide shared pipeline safety principles, the API and AOPL teams of operator employees working to improve different aspects of pipeline safety, industry's commitment to annually review pipeline safety performance, and the process to develop a pipeline safety improvement strategic plan.

The Pipeline Safety Performance chapter goes further by analyzing our industry-wide safety record, including where performance is improving and which areas hold challenges. This in-depth examination of safety performance not only allows us to gauge progress, but also helps prioritize safety efforts.

The Pipeline Safety Improvement chapter describes goals for improving pipeline safety and Strategic Initiatives the pipeline industry will undertake toward those goals. To help shape these, each year the pipeline industry reaches out to stakeholders, including federal and state regulators and safety advocates, to gain their perspective on improving pipeline safety. We also reviewed past safety performance data, safety expert recommendations, regulatory advisories, and our own lessons learned from experience operating pipeline systems. Strategic Initiatives developed for 2016 focus on advancing in-line inspection "smart pig" technology and enhancing pipeline emergency response and planning, as well as support implementation of new industry-wide recommended practices for these focuses: safety management systems; detecting, analyzing and responding to potential pipeline cracking and managing leak detection programs.

As you will see, pipeline operators are hard at work to improve pipeline safety. It is a team effort and only possible through an industry-wide commitment. If you have any questions on the strategic initiatives, safety plans, efforts or data presented in this report, please don't hesitate to contact us. Further contact information for API and AOPL may be found on the back cover of this report.

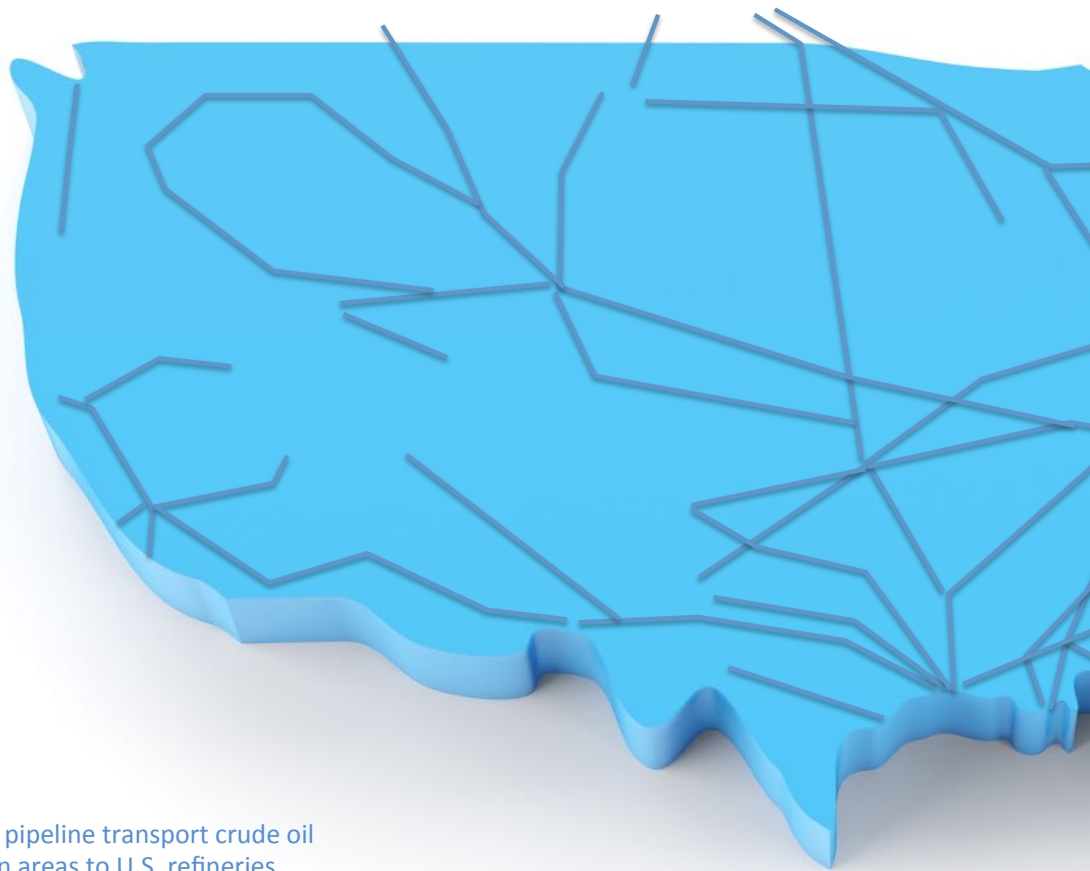Sincerely,

Andrew J. Black
Association of Oil Pipe Lines

David Murk
American Petroleum Institute

Pipelines Fuel America

207,800 miles of liquids pipeline cross America from production areas to refineries to consumers & manufacturers, a 13% increase from 2011 to 2015

72,400 miles of pipeline transport crude oil from production areas to U.S. refineries, a 29% increase over the last 5 years

67,500 miles of pipeline transport natural gas liquids to farmers and industrial manufacturers, a 15% increase over the last 5 years

Table of Contents

62,600 miles of pipeline deliver gasoline, diesel and jet fuel to drivers, workers and travelers, a 3% decrease over the last 5 years

16.2 billion barrels of crude oil and petroleum products delivered by pipeline in 2014, a 20% increase since 2010

9.3 billion barrels of crude oil delivered by pipeline in 2014, a 2.1 million barrel or 31% increase since 2010

6.9 billion barrels of petroleum products delivered by pipeline in 2014, an 8% increase since 2010

Executive Summary

Liquids Pipeline Industry Performance Summary

207,800 miles of liquids pipeline cross America delivering crude oil, refined petroleum products and natural gas liquids, a 13% increase over the last 5 years - page 4
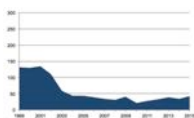
16.2 billion barrels of crude oil and petroleum products delivered by pipeline in 2014, a 20% increase since 2010 - page 5

99.999%   99.999% of crude oil and petroleum products delivered by pipeline reach their destination safely - page 13
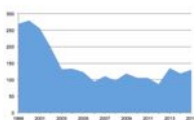
Pipeline incidents potentially impacting people or the environment outside of operator facilities are down 52% since 1999 - page 14

Corrosion caused pipeline incidents potentially impacting people or the environment outside of operator facilities are down 68% since 1999 - page 14
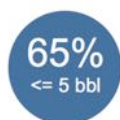
65% <= 5 bbl   In 2015, 65% of pipeline incident releases were less than 5 barrels - page 16

<= 5 bbl +27%
>= 50 bbl -11%
>= 500 bbl -32%
For incidents under 5 barrels, incidents per mile increased 27% over the last 5 years. Incidents per mile larger than 500 barrels decreased by 32% - page 16

A dozen industry-wide teams staffed by member companies and supported by API and AOPL are busy addressing different aspects of pipeline safety - page 10

Pipeline industry initiatives in 2016 will improve inspection technologies, leak detection program management, emergency response and safety management programs – page 25

Pipeline Safety Excellence

Pipeline Safety Excellence™ Initiative

Launched in 2014, the Pipeline Safety Excellence™ initiative is the U.S. liquids pipeline industry's safety performance improvement program. It reflects the shared values and commitment of operators to building and operating safe pipelines. It builds upon our industry's decades of commitment to pipeline safety to include:

Shared Pipeline Safety Principles

These safety principles represent not only aspirational goals, such as zero incidents, but also everyday ways of doing business that promote continuous improvement and excellent safety performance:

ZERO INCIDENTS – Only with a goal of zero safety incidents can accidents be minimized

ORGANIZATION-WIDE COMMITMENT – Safety is emphasized at every level of the organization from employees who accept personal responsibility for safety to managers who are vital to reinforcing a safety culture

A CULTURE OF SAFETY – A workplace culture where safety is an enduring value that all employees share

CONTINUOUS IMPROVEMENT – Pipeline operators believe that no matter how safe they already are, they can always improve safety

LEARN FROM EXPERIENCE – Pipeline operators learn how they can improve safety from their own experiences and from other pipeline operators

SYSTEMS FOR SUCCESS – Safety management systems bring a consistent, holistic structure to safety management, helping to improve safety performance

EMPLOY TECHNOLOGY – From "smart pigs" to innovative ways to interpret integrity data, operators constantly develop new ways to advance pipeline safety

COMMUNICATE WITH STAKEHOLDERS – Operators know communicating and establishing a positive relationship with the public and stakeholders who value safety is vital to improving safety

Industry-Wide Safety Efforts

More than a dozen API and AOPL groups and teams comprised of volunteers from member companies work on safety initiatives that will benefit the entire industry. These efforts often result in new or updated API Standards, Recommended Practices or Technical Reports providing operators direction and guidance on safe pipeline construction and operation. Operations and safety personnel gather to share insights and learn lessons from each other's experiences. Members pool financial and personnel resources to support pipeline research and development. Industry-wide R&D develops greater understanding of threats to pipeline integrity and technologies operators can use to inspect and monitor pipeline safety.

Annual Pipeline Safety Performance Reporting

Every year, liquids pipeline operators measure and report industry-wide safety spending and performance results to the public. An in-depth examination of safety performance not only allows us to gauge safety improvement progress, but also guides safety improvement efforts toward the actions and initiatives that can do the most to protect the public and environment.

Annual Pipeline Safety Strategic Planning

Liquids pipeline operators annually review and revise a pipeline safety strategic plan to guide industry-wide efforts toward improving pipeline safety. Strategic initiatives reflect recommendations from stakeholders including operator experiences, regulators, safety experts and safety performance data.

Industry-Wide Safety Efforts

Through the contribution of resources, both financial and personnel, pipeline operators are pushing forward new advances in pipeline safety knowledge, technology and capabilities.

Safety Improvement Teams

Member companies of API and AOPL volunteer operations and safety professionals at all levels in the organizations to share their expertise for the benefit of the entire pipeline industry. Pipeline executives guide industry-wide safety efforts through the *Pipeline Safety Excellence Steering Committee.* Senior managers share safety experiences and lessons learned through the *Performance Excellence Team.* Managers and personnel expert in specific areas of pipeline safety, such as leak detection, integrity management and emergency response, staff the *Operations & Technical Group, Pipeline Integrity Group, Cybernetics Work Group, Public Awareness Group, Environment, Health & Safety Group, Operator Qualification Work Group* and *Emergency Response Team*

Safety Sharing Meetings & Events

API and AOPL groups and teams meet frequently for pipeline safety sharing conferences, meetings and calls. API hosts its annual Pipeline Conference each spring where the entire industry gathers for sessions on improved operations and safety. Each fall API hosts an information exchange forum called the Pipeline Information eXchange to facilitate member companies sharing lessons learned from incidents and near-misses. Throughout the year, API convenes live "tailgates," informal safety meetings, to share the latest safety advances.

Standards, Recommended Practices & Technical Reports

Pipeline operators, through API, develop, publish and regularly update pipeline safety standards, recommended practices and technical reports. Developed through a transparent, multi-stakeholder process, accredited through the American National Standards Institute, these API safety tools set the standard across industry for safe, quality operations. Given their technical soundness, many API safety documents are incorporated by reference into federal regulation.

Research & Development

API and AOPL member companies individually and collectively, through AOPL, contribute financial support and volunteer expertise toward energy pipeline research and development projects. Conducted through the Pipeline Research Council International, member companies are advancing pipeline safety technical understanding and capabilities.

In Focus: API Pipeline Integrity Group

The Pipeline Integrity Group (PIG) is one of several API standing committees devoted to improving pipeline safety. Member companies of API and AOPL volunteer professionals responsible for ensuring the integrity of their pipelines meaning they oversee programs to evaluate, inspect and perform maintenance on their pipeline systems. As part of PIG, they share learnings and best practices as well as develop new industry-wide standards and recommended practices to improve pipeline integrity management. Many of the industry-wide Strategic Initiatives undertaken through the *API-AOPL Annual Liquids Pipeline Safety Excellence Strategic Plan* are led by PIG:

RP 1176

Recommended Practice for Assessment and Management of Cracking in Pipelines – API RP 1176 helps pipeline operators better understand the threat mechanisms associated with pipeline cracking, apply the most appropriate integrity assessment technology and modeling, employ the appropriate repair strategies, establish preventative and mitigative practices and evaluate program performance.

TR 1178

Data Management and Integration Guideline – API TR 1178 provides operators a compendium of methodologies and processes they can use to spatially integrate and normalize data in preparation for pipeline integrity data integration.

TR 1179

Guidelines for Use of Hydrostatic Testing as an Integrity Management Tool – API TR 1179 describes for pipeline operators the scenarios where hydrostatic testing is recommended, where it might be damaging, or where another inspection technology may be more effective in identifying potential threats to pipeline integrity. The TR will also instruct operators on what to consider when designing their own hydrostatic pressure tests.

RP 1160

Managing System Integrity for Hazardous Liquid Pipelines – API RP 1160 presents guidance for defining high consequence areas around pipelines, identifying threats and calculating risks to pipeline integrity, employing inspection technology and assessing inspection results, and conducting maintenance programs to repair pipelines and ensure their operational safety. PIG will update RP 1160 to incorporate the latest learnings and industry-wide guidance for assessing and managing cracking, integrating threat data, conducting hydrostatic testing, and utilizing pipeline safety management systems.
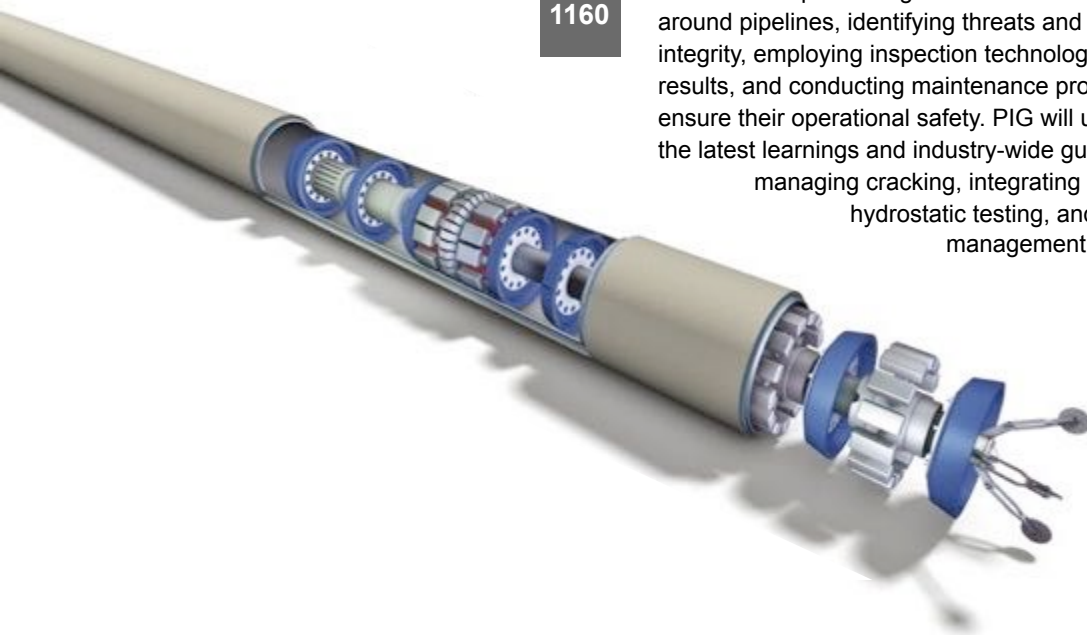
Pipeline Safety Performance

Annual Pipeline Safety Performance Reporting

Pipelines are an exceedingly safe way to transport energy products. Safety performance reporting allows pipeline operators to focus and prioritize their efforts on areas needing the most improvement and avoid diverting resources to actions that will have less of an impact on improving pipeline safety. The following information presents transmission liquids pipeline safety data provided through PHMSA incident data collection and surveys of operator spending and practices. Supporting data for each table or chart is provided in the Pipeline Safety Data chapter.

99.999%
of crude oil & petroleum product barrels are delivered safely by pipeline

Pipeline Safety Spending & Activities

$2.2 Billion

Evaluation, Inspection & Maintenance

Liquids pipeline operators reported spending $2.2 billion evaluating, inspecting and performing maintenance on their pipeline systems in 2014, the most recent year of operator inspection and maintenance data. Operators spent $1.6 billion on existing pipelines, $329 million on storage tanks and $268 million on new pipeline hydrostatic testing.

1,635 Runs

In-Line Inspection "Smart Pig" Tool Runs

Liquids pipeline operators performed 1,635 inspections of their pipelines using in-line inspection smart pig tools in 2014. Traveling along the inside of a pipeline using using calipers or scanning technology similar to a medical MRI or ultrasound, smart pigs made 702 runs inspecting for dents, 709 runs for corrosion, 255 runs inspecting for cracks and 155 runs for other anomalies.

46,695 Miles

Miles of Pipe Inspected with "Smart Pig" Tools

Liquids pipeline operators inspected 46,695 miles of pipeline with smart pigs in 2014. Operators used smart pigs to inspect 28,506 miles of pipeline for dents, 28,104 miles for corrosion, 16,876 miles for cracks and 9,199 miles for other anomalies.

Long-Term Pipeline Safety Trends

Pipeline Incidents Potentially Impacting People or the Environment Outside of Operator Facilities are Down 52% Since 1999

The number of pipeline incidents per year in public spaces (i.e. outside of operator facilities) have declined by more than half since 1999, the first year pipeline operators began collecting detailed incident data. This sharp decrease reflects the success of the pipeline Integrity Management program adopted in regulation by PHMSA in the early 2000s.
The program's requirements of regular inspections and preventative maintenance coupled with advances in smart pig inspection tools designed to find corrosion produced a large drop in annual pipeline incidents.

Total Liquids Pipeline Incidents Outside of Operator Facilities
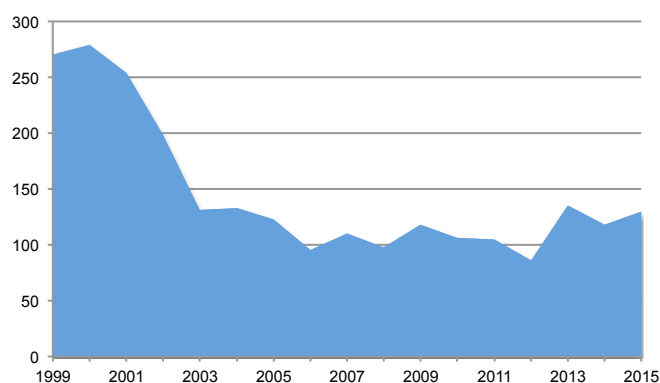
Corrosion Caused Incidents Potentially Impacting People or the Environment Outside of Operator Facilities are Down 68% Since 1999

An example of improved pipeline safety from the Integrity Management program and use of advanced technology and preventative maintenance is the steep drop in corrosion-caused incidents. Pipeline incidents in public spaces caused by corrosion are down 68% since 1999. To achieve these safety performance gains, pipeline operators harnessed smart pig inspection tools using magnetic flux leakage (MFL) technology. MFL tools can detect metal loss, or corrosion, from pipe walls. Through regular inspections with these technologies, operators can detect the early signs of corrosion and perform maintenance on the pipe before it becomes a safety issue.

Corrosion Caused Liquids Pipeline Incidents Outside of Operator Facilities
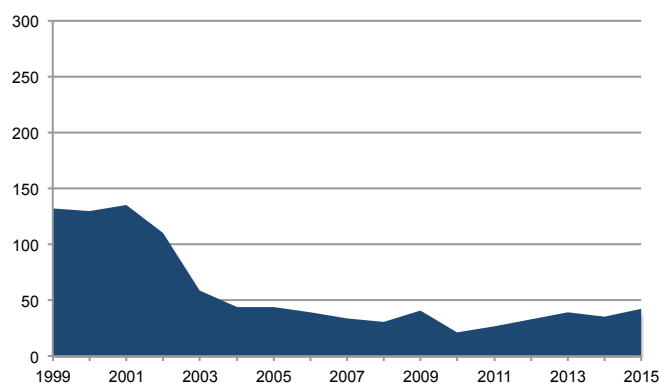
Pipeline Integrity Management Program

Under the Integrity Management program, pipeline operators evaluate, inspect and perform maintenance on their pipelines in scheduled intervals, with the operator constantly cycling through different segments in its pipeline system. Segments in High Consequence Areas (HCAs), defined as impacting the public or environment, are the focus of the Integrity Management program, leading to the steep drop in incidents impacting the public or environment, which is shown in the charts.

Pipeline Incidents by Location

Total Liquids Pipeline Incidents
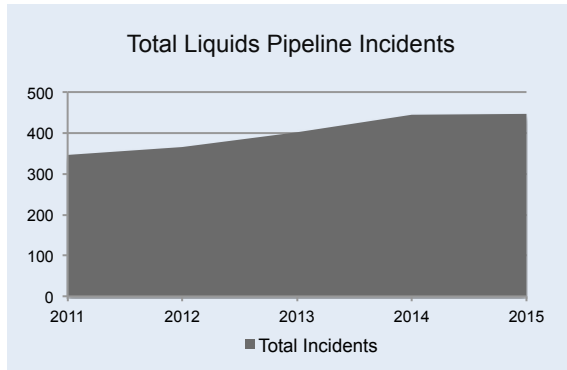
Total Pipeline Incidents

In 2015, there were approximately 454 total U.S. liquids transmission pipeline incidents. This total figure includes incidents of all sizes and locations. A number of these were contained wholly within a pipeline operator's facility and some reached public spaces or the environment. Over the last 5 years, total pipeline incidents increased 31 percent.

Incidents Contained Inside Operator Facilities
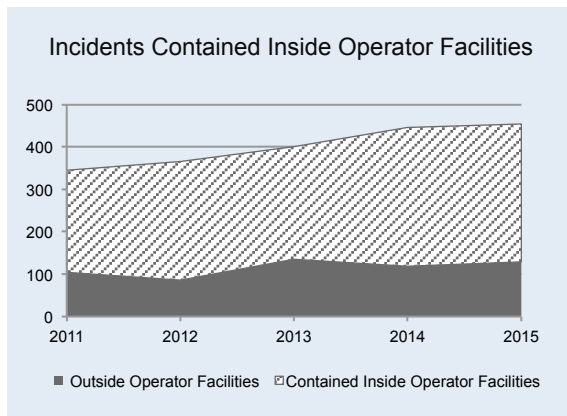
Most Incidents Contained Inside Pipeline Operator Facilities

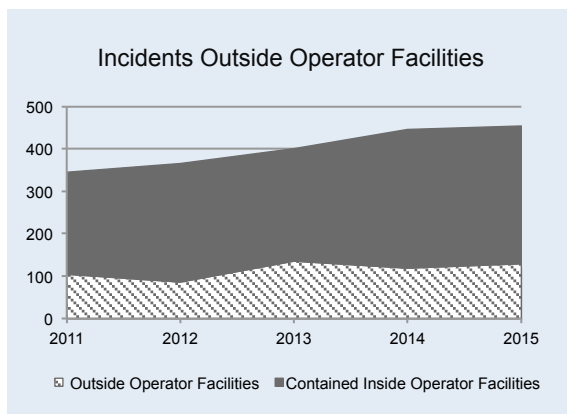In 2015, 71% of pipeline incidents occurred and were contained wholly within a pipeline operator's facility. Examples of pipeline operator facilities include pump stations, tank farms and tanker transfer racks. PHMSA requires pipeline operators to report these incidents, and they are a useful measure of operations, but by definition they do not reach public spaces or the environment. In 2015, there were 324 facility incidents, a 34% increase from 2011. The increase in facility incidents was the predominant reason for the overall increase in total incidents.

Incidents Outside Operator Facilities

29% of Pipeline Incidents Outside Operator Facilities

In 2015, there were 130 incidents reaching or occurring in outside operator facilities representing 29% of the total that year. While representing approximately ¼ of total incidents, reducing pipeline incidents impacting public spaces or the environment is the prime focus of pipeline operator safety improvement efforts.

Pipeline Incidents by Size
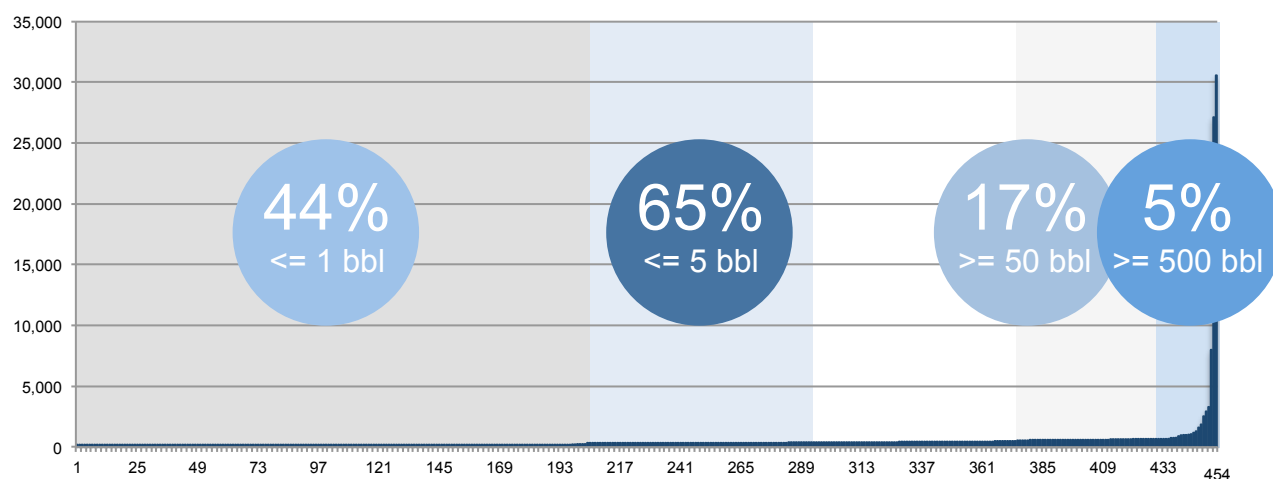
Each Liquids Pipeline Incident in 2015 by Barrel Size

Most Pipeline Incidents Are Small in Size

Nearly two-thirds of pipeline incidents are 5 barrels or less. In 2015, 44% of pipeline incidents were 1 barrel or smaller and 65% of incidents were 5 barrels or smaller. Incidents 50 barrels or larger represented 17% of total incidents in 2015, with only 5% of incidents 500 barrels or larger.

Large Incidents Are Occurring Less Frequently

Over the last 5 years, the number of large pipeline incidents has decreased markedly. Pipeline incidents per mile larger than 500 barrels are down 32% from 2011 to 2015. The number of incidents per mile 50 barrels and larger are down 12% since 2011. However, incidents per mile 5 barrels or smaller in size are up 27% over the last 5 years. This corresponds with the increase in facility-related incidents, which are small in size. discussed above. Most facilities incidents are small in size, and most small incidents occur within operator facilities.

Incidents per Mile Over the Last 5 Years

<= 5 bbl
+27%

>= 50 bbl
-12%

>= 500 bbl
-32%

Pipeline Incidents by Commodity Type

Pipeline Miles
- Other 3%
- Natural Gas Liquids 33%
- Crude Oil 35%
- Refined Products 30%

Number of Incidents
- Other 2%
- Natural Gas Liquids 14%
- Crude Oil 55%
- Refined Products 29%

Barrels Released
- Other 1%
- Crude Oil 20%
- Refined Products 7%
- Natural Gas Liquids 72%
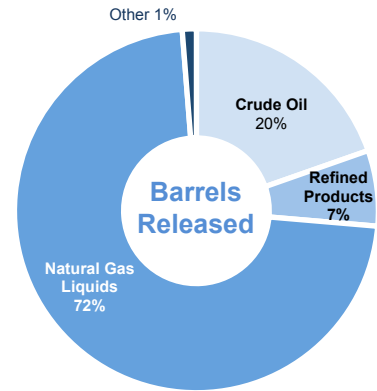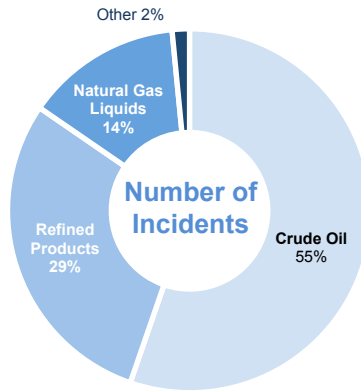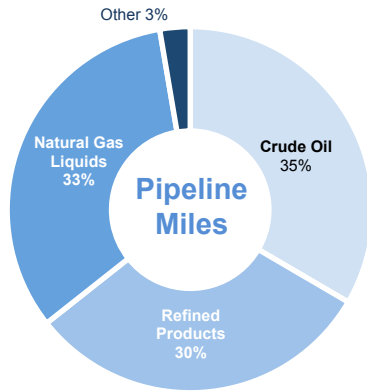
Incidents by Commodity from 2011 to 2015

(area chart, y-axis 0 to 500, x-axis 2011 to 2015)

■ NGL   ■ Refined Products   ■ Crude

Commodity Type Affects the Size of the Release

Liquids pipeline mileage is spread roughly equally between pipelines delivering crude oil, refined products such as gasoline and diesel fuel, and natural gas liquids (NGL) pipelines carrying products like propane or ethane. Statistically, crude oil incidents are the most frequent, representing 55% of total incidents in 2015, whil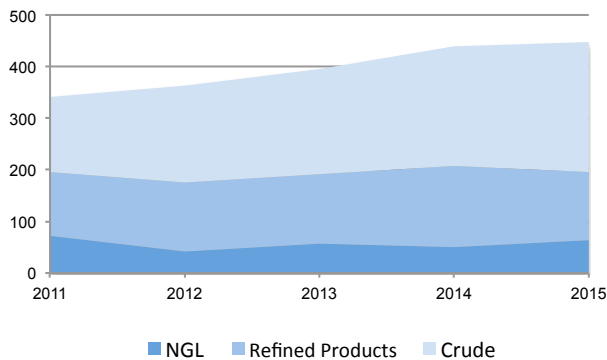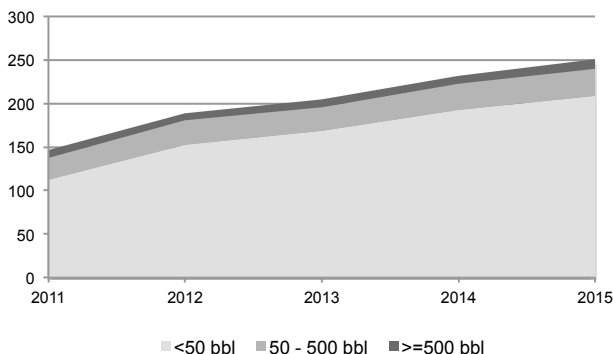e NGL releases are the largest with 72% of barrels released in 2015. NGLs travel through the pipeline as a liquid under pressure. Upon release, NGL will convert to a gas and escape into the atmosphere in large volumes.

Crude Oil Incidents by Size

(area chart, y-axis 0 to 300, x-axis 2011 to 2015)

■ <50 bbl   ■ 50 - 500 bbl   ■ >=500 bbl

Increase In Crude Oil Incidents from Smaller Incidents

The number of crude oil incidents has grown over the last 5 years, up 71% since 2011, or 32% higher adjusted for crude oil mileage growth. However, the number of large crude incidents, 500 barrels or greater, are relatively flat in real numbers over the last 5 years and down 15% per mile of crude oil pipeline. Medium-sized crude oil incidents per mile between 5 and 50 barrels are flat. The increase in total crude oil incidents over the last 5 years is driven by smaller incidents under 50 barrels, which are up 87% in real numbers and 45% per mile.

Barrels Released from Pipelines

Total Barrels Released from 2011 to 2015
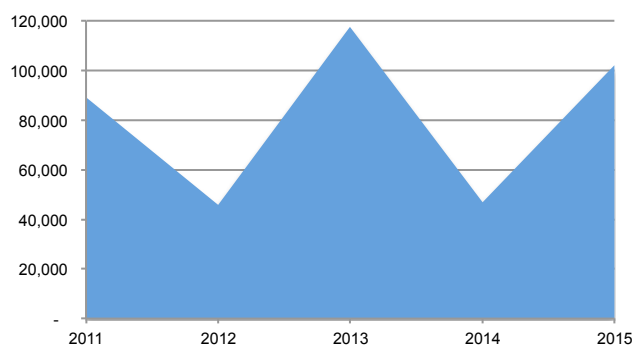
Barrels Released Varies Greatly from Year to Year

Barrels released from liquids pipelines can vary greatly from year to year. For example, in 2013, nearly 120,000 barrels were released from liquids pipelines. While in 2012 and 2014, the years immediately before and after, 46,000 and 47,000 barrels respectively were released from liquids pipelines.

Barrels Released by Commodity

Crude Oil ■ Refined Products ■ Natural Gas Liquids

Large Natural Gas Liquids Releases Responsible for Swings in Total Barrels Released

Releases of natural gas liquids, such as propane or ethane, which become gases and vent into the air in large quantities during a release, are the primary cause 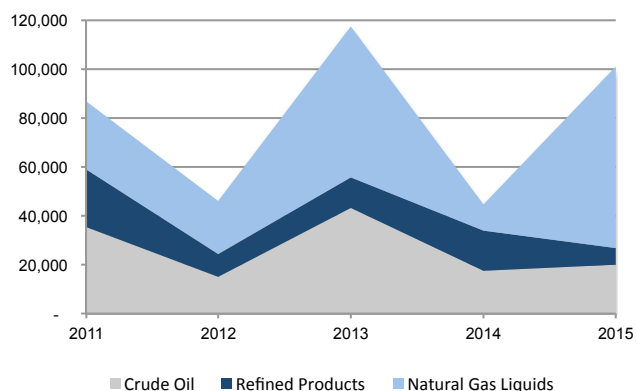in large swings in total barrels released. A single incident in 2013 released the equivalent of 23,700 barrels of petroleum gas. Another 2013 incident released the equivalent of 18,000 barrels of ethane and propane into the atmosphere. Neither of the incidents significantly impacted the public or environment, but both contributed to a spike in total barrels released that year.

Crude Oil Barrels Released to High Consequence Areas
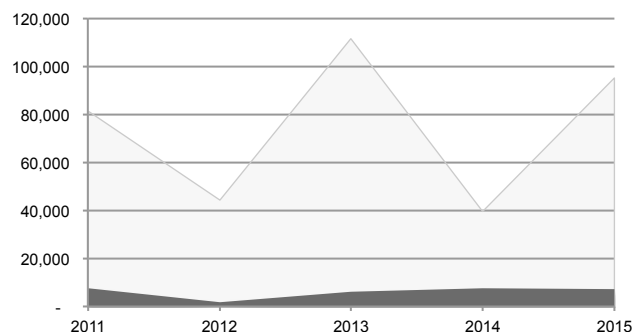
Crude Oil Released to High Consequence Areas a Small Percentage of Total Releases

Crude oil released to high consequence areas (HCAs), defined as dense population or environmentally sensitive, were only a fraction of total reportable releases.
As discussed above, natural gas liquid releases vented to the air, or releases contained in operator facilities, represented most barrels released from pipelines.
Crude oil released to HCAs were only 7% of total barrels released in 2015 and declined 6% over the last 5 years.

Incidents Related to Operations, Maintenance & Integrity Management

Incidents causes may be grouped together into major categories reflecting natural or outside forces beyond a pipeline operator's control, actions of operator personnel operating or maintaining equipment or pipe conditions:

Operations & Maintenance: equipment failure (pump failure, defective relief valve, loose fitting), incorrect operation (storage tank overfill, valve in wrong position), excavation damage by the pipeline operator or contractor

Integrity Management: corrosion (internal or external), cracking, pipe weld failure

Natural Damage or Outside Forces: natural forces (lightning, landslide), other outside forces (barge strike), third party excavation damage.

Operations & Maintenance Issues Cause Most Number of Incidents

In 2015, O&M represented 59% of pipeline incidents. While occurring more often, O&M incidents are usually small in nature. Many of the incidents under 5 barrels are O&M-related. A pump seal failure within an operator's facility may fail and cause a release of only a few gallons. Nonetheless, that is an incident recorded and reported to PHMSA. Thus, while O&M is responsible for 59% of incidents, O&M caused only 32% of the total barrels released in 2015. When analyzing crude releases to high consequence areas (HCAs), O&M issues caused 10% of crude oil barrels released into HCAs in 2015.

Integrity Management Issues Cause Most Barrels Released in an HCA

Pipeline integrity management issues result in fewer, but larger releases. For example, a failed weld seam opens up a larger portion of the pipe than a defective pump seal. In 2015, integrity management-related issues represented 27% of the total number of pipeline releases and 72% of crude barrels released into HCAs.

Natural Damage or Outside Forces

Natural or other outside forces are infrequent, but can result in a single release that skews the data, such as in 2011 (flooding) or 2012 (vehicle accident).

Total Number of Incidents

Crude Barrels Released in an HCA

2015

2014

2013

2012

2011

■ **Operations & Maintenance** (e.g. equipment failure)

■ **Integrity Management** (e.g. corrosion & cracking)

■ **Outside Force Damage**

□ **Other**
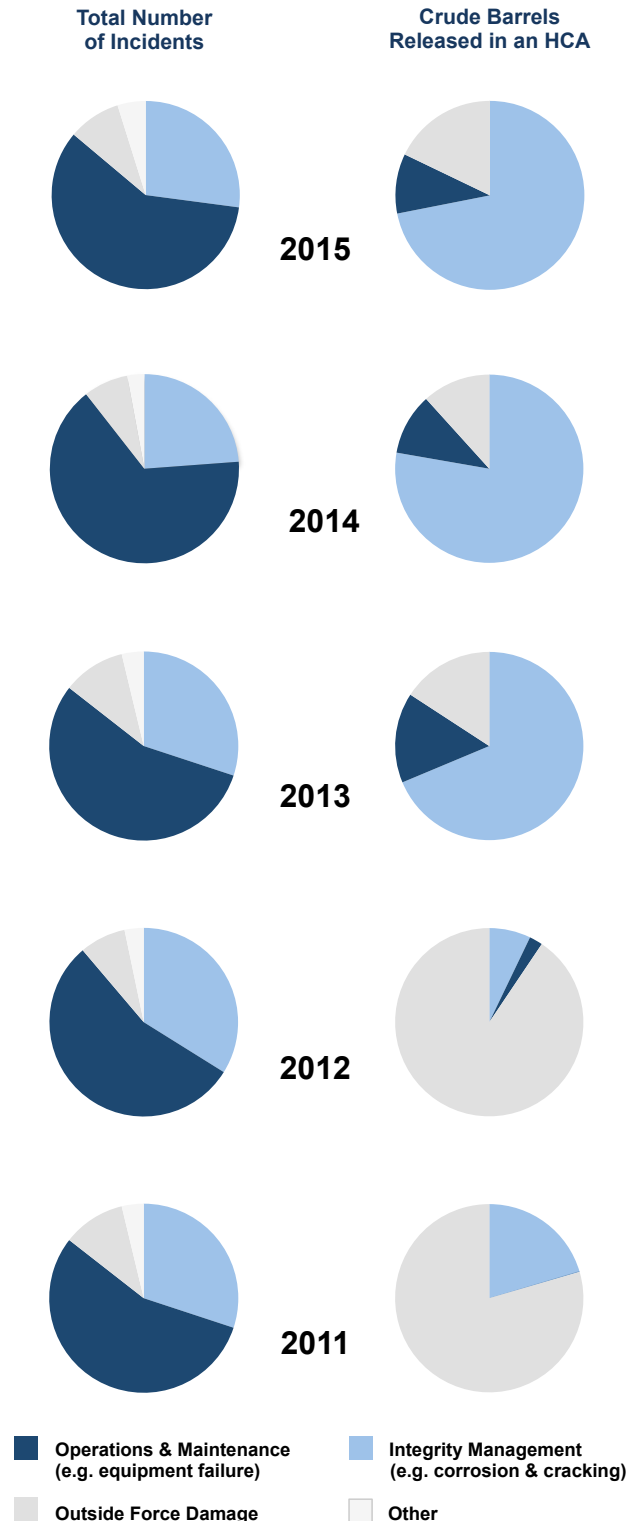
Pipeline Incidents by Cause

	Total	**Corrosion**	**Equipment Failure**
Incidents in 2015	454	20%	45%
Incidents Last 5 Years			
Barrels Released			
Barrels per Incident			
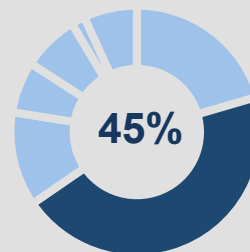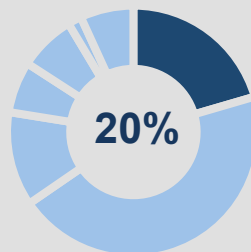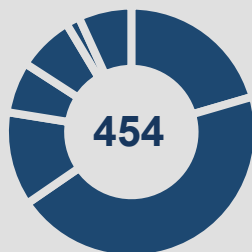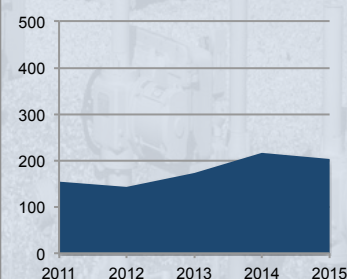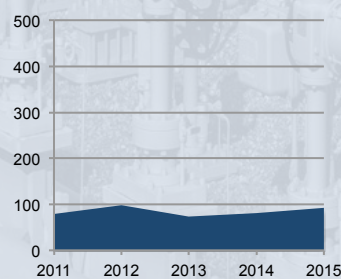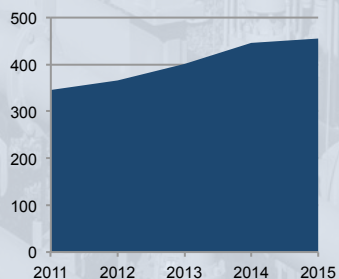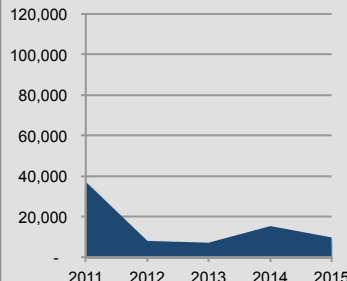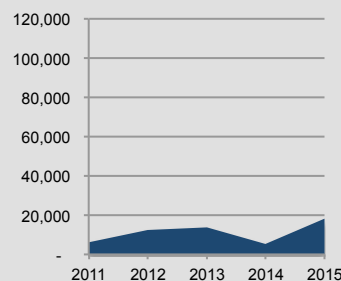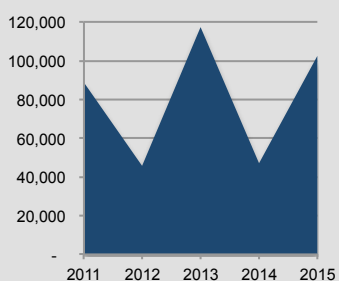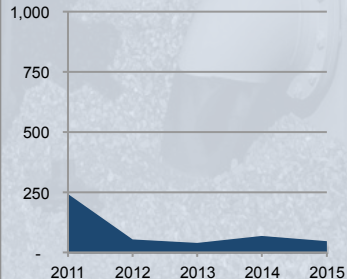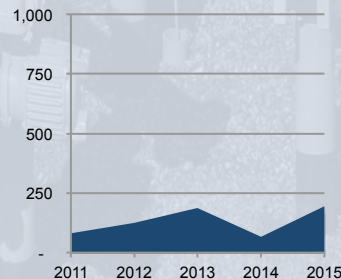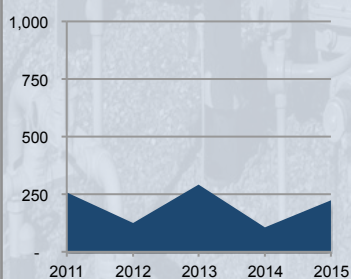
Incorrect Operation	Materials & Welds	Outside Forces	3rd Party Damage
12%	**7%**	**7%**	**2%**
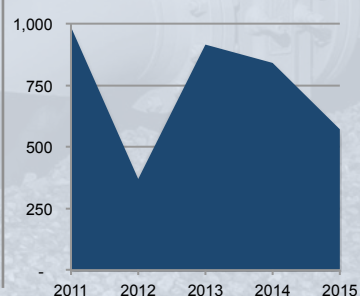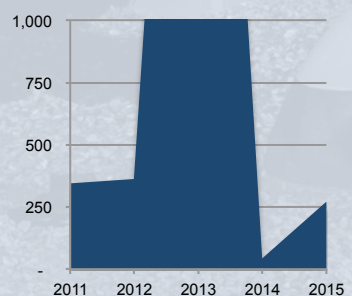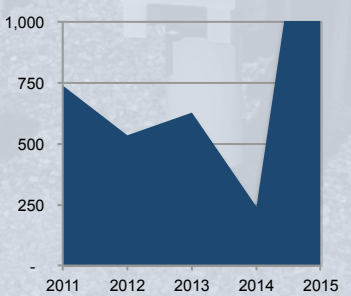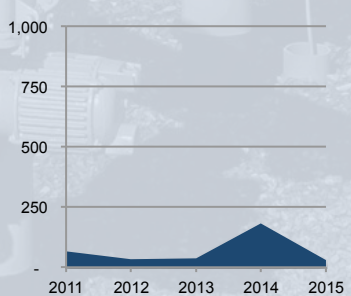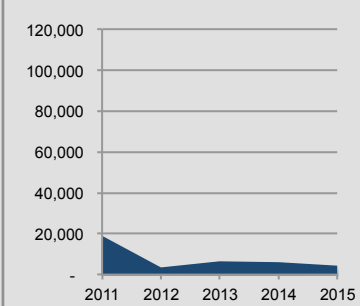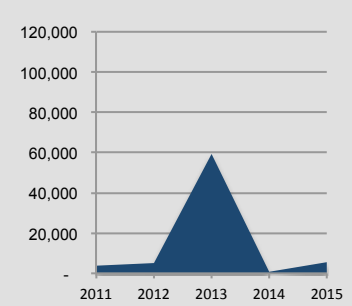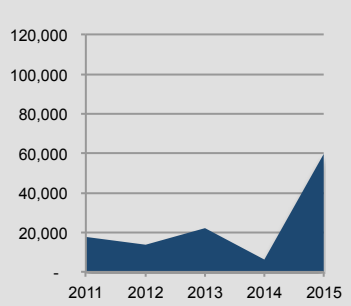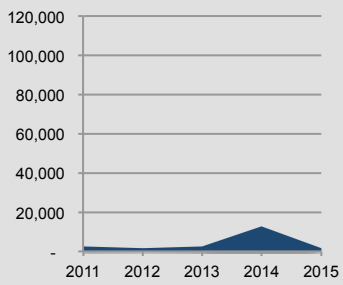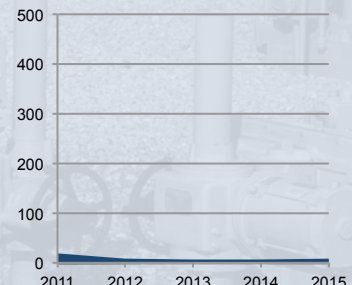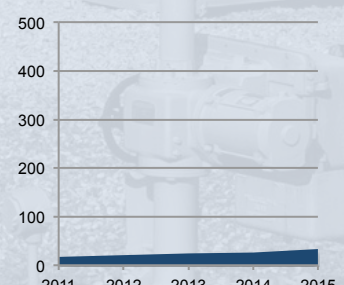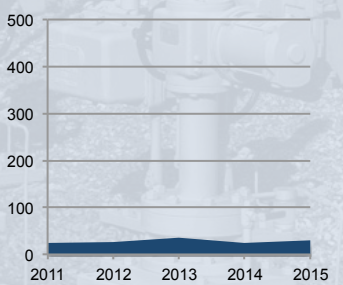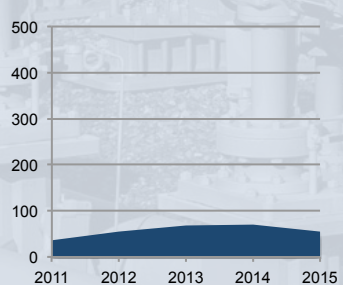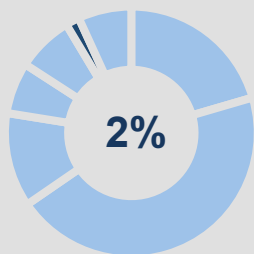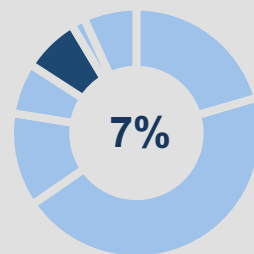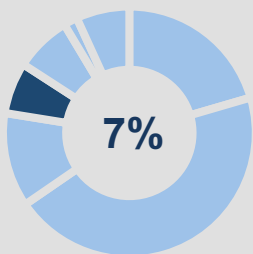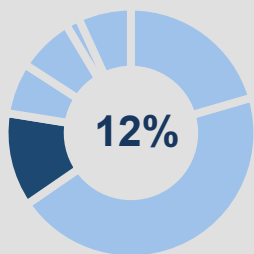
Pipeline Safety Improvement

Pipeline Safety Strategic Planning

Improving Pipeline Safety Efforts

Liquids pipeline operators annually develop a pipeline safety strategic plan to guide industry-wide efforts to improve pipeline safety. Pipeline operators want to focus their efforts where they will have the greatest impact on pipeline safety and do the most to protect the public and environment. Through strategic planning, safety efforts will address persistent problems, halt growing trends or bring new levels of success to previous safety accomplishments.

Learning from Experience and Outreach with Stakeholders

Pipeline operators use the strategic planning process to benefit from lessons learned on pipeline safety. Pipeline operators, regulators, and safety investigators all have valuable insights on what can cause pipeline safety issues and how to prevent future pipeline incidents. The strategic planning process incorporates recommendations made from safety investigators, such as the U.S. National Transportation Safety Board, and input from federal and state pipeline regulators along with the advisory bulletins of the U.S. Pipeline and Hazardous Materials Safety Administration. Pipeline operators also incorporate the safety lessons provided and shared by operators through industry-wide safety information exchange forums, safety teams and regular discussion of safety priorities. Members of the public provide important perspective from the communities in which pipelines operate. Pipeline operators incorporate input from pipeline safety advocates as part of the strategic planning process.

Guided by Data

Pipeline safety performance data is an important input into the strategic planning process. Data provides insight into which areas of pipeline safety are improving, which may reflect trends or growing issues, and which areas benefit from broader perspective. Not all pipeline incidents have the same cause or impact. As seen in the Pipeline Safety Performance chapter, some of the most frequent incident causes, such as equipment failure or operator error, are also some of the smallest incident sizes and occur mainly inside operator facilities without impact on the public. Conversely, some incident causes, such as material or weld failure, occur less frequently, but are larger in size when they do occur. Therefore, safety initiatives addressing the most frequent incident causes or those of individual incidents might not necessarily address incidents with greatest impact on the public or environment. Therefore, strategic planning guided by data helps operators design safety efforts not only to reduce the overall number of incidents, but also pursue initiatives that will have the greatest benefit to the public and environment.

Safety Goals and Initiatives

In 2016, pipeline operators are pursuing four goals to improve pipeline safety: 1) Improve Inspection Technology Capabilities, 2) Enhance Threat Identification & Response, 3) Expand Safety Culture & Management Practices, and 4) Boost Response Capabilities. Each of these goals advance pipeline operators' abilities to prevent incidents before they occur or respond quickly and effectively if an incident does occur. Strategic initiatives under Goals 1 and 2 will help pipeline operators find potential issues before they become a safety problem. Better inspection technologies will help operators scan their pipelines for signs of trouble. Better methods for analyzing the results of inspections and predicting when a pipeline needs preventive maintenance will help operators avoid pipeline incidents. Strategic initiatives under Goal 3 will help pipeline operators manage their safety programs and organizations more holistically and effectively. Managing safety systematically captures safety lessons and provides mechanisms for continuous safety improvement. Improving safety culture adds the human element needed to raise safety beyond mere compliance and prevent unintended safety issues brought on by carelessness or inattention. And while pipeline incidents are relatively rare given the vast quantities of energy moved every day, Goal 4 will help operators have robust plans in place and be prepared to detect and respond to a pipeline emergency.

Strategic Planning Process

Check & Adjust Process

Engage Stakeholders

Review
Last Year's
Process

Update &
Improve
Planning
Process

Survey
Pipeline
Operators

Interview Key
Government
& Public
Stakeholders

Each year, an industry-wide strategic planning
team of senior pipeline operations managers
supported by API and AOPL develops a strategic
plan for improving pipeline safety performance.
The team begins by reviewing past experiences
and making improvements to the planning
process.

Review Safety
Advisories &
Recommendations

Review Lessons
Learned

Recommendations
from Industry
Safety Teams

Review
Current
Efforts

Review
Historic
Incident
Data

Identification
of Priority
Issue Areas

Continuous improvement and learning from experience are core
values of the liquids pipeline industry. The planning team engages
stakeholders, such as PHMSA and state regulators, public
pipeline safety advocates and member companies. The team also
reviews available PHMSA and NTSB recommendations, as well
as safety performance data.

Development
of Detailed
Plans

Approval by
Industry
Leadership

Execution by
Industry-Wide
Teams

Improve Safety

Develop Strategic
Goals & Initiatives

Oversight by
Executive
Champions

The completed strategic plan describes the
industry-wide efforts pipeline operators will undertake to keep
pipelines operating safely and the public and environment protected.

2016 API-AOPL LIQUIDS PIPELINE SAFETY EXCELLENCE STRATEGIC PLAN

Goal 1: Improve Inspection Technology Capabilities

Strategic Initiative 1.1:   **Improve In-Line Inspection (ILI) "Smart Pig" Technology Capabilities to Diagnose Cracking and Corrosion**

Goal 2: Enhance Threat Identification & Response

Strategic Initiative 2.1:   **Implement New API Recommended Practice on Crack Detection, Analysis and Response**

Strategic Initiative 2.2:   **Implement New Industry-Wide Guidance on Integrating Threat Data Management and Integration**

Strategic Initiative 2.3:   **Implement Industry-Wide Guidance on the Appropriate Uses of Hydrotesting to Ensure Pipeline Safety**

Strategic Initiative 2.4:   **Update Industry-Wide Recommended Practice for Water Crossings**

Strategic Initiative 2.5:   **Update Industry-Wide Recommended Practice for Integrity Management**

Goal 3: Expand Safety Culture & Management Practices

Strategic Initiative 3.1:   **Implement New API Recommended Practice on Pipeline Safety Management Systems**

Strategic Initiative 3.2:   **Foster Pipeline Safety Culture with an Industry-Wide Sharing, Learning and Improvement Program**

Strategic Initiative 3.3:   **Develop an Industry-Wide Construction Quality Management System**

Goal 4: Boost Response Capabilities

Strategic Initiative 4.1:   **Implement New API Recommended Practice for Pipeline Leak Detection Program Management**

Strategic Initiative 4.2:   **Deploy a Nation-Wide Pipeline Emergency Response Training, Outreach and Standards Program**

Strategic Goal 1	Improve Inspection Technology Capabilities

2015 Accomplishments

2015 Strategic Initiative #1.1: Improve the Capabilities of In-Line Inspection (ILI) Technologies to Detect and Diagnose Cracks

In 2015, pipeline operators working through the joint research and development organization Pipeline Research Council International completed their project report *In-Line Inspection Crack Tool Performance Evaluation.* The project compared over 50,000 data records of ILI smart pig measurements, in person field measurement or both. Features examined in the pipe included both stress corrosion cracking in the pipe body and cracking in pipe weld seams. The final report provided a better understanding of the real-world performance of ILI smart pigs designed to identify cracking. Results included a 90% rate of detection for features larger than 2mm depth by 50mm length. The findings also provided a comparison of ILI measurements, which can detect features within the wall of the pipe, and field-reported measurements examining the surface of the pipe.

2016 Strategic Initiative 1.1

Improve the Capabilities of In-Line Inspection (ILI) Technologies to Detect and Diagnose Pipeline Cracking

Description	Conduct ILI tool technology research and development for difficult and challenging features, such as cracking in weld seams and corrosion or cracking in pipe dents. One 2016 project will assess the capabilities of current ILI technologies to detect and discriminate metal loss within pipe dents (both through corrosion and gouging) and cracking. A second 2016 project will focus on detecting and sizing cracking in longitudinal seams of pipe, with an emphasis on low frequency electric resistance weld (LF-ERW) and flash weld (FW) pipe.
Outcomes:	• Improved ILI capabilities to detect and accurately measure potential anomalies in LF-ERW and FW pipe seams • Improved understanding of ILI capabilities to detect and discriminate metal loss and cracking in dents
Timeline	2016
Lead	PRCI Research Project Team with API/AOPL Research & Development Team, OTG and PIWG

<table>
<tr><td>**Strategic Goal 2**</td><td>**Enhance Threat Identification
& Response**</td></tr>
</table>

2015 Accomplishments

2015 Strategic Initiative #2.1: Develop an API Recommended Practice on Crack Detection, Analysis and Response with an Emphasis on Seam-Related Cracks

In 2015, liquid pipeline operators working through the API Pipeline Integrity Work Group completed development of API Recommended Practice 1176 on crack detection, analysis and response. This new RP focuses on the specific threat area of pipeline cracks, with an emphasis on seam-related cracks. The RP provides crack management program recommendations and guidance on the inspection, assessment and mitigation of cracking threats, addressing both seam related and environmentally induced mechanisms. The RP provides extensive discussion of cracking mechanisms as well as the methods and technologies for detecting, sizing and assessing cracks, in order to determine how and when to respond to the threat. In 2015, the development group began its outreach to API and AOPL member companies starting with a session with company executives on the importance of the RP.

2015 Strategic Initiative #2.2: Develop Industry-Wide Guidance on Implementing Threat Data Management and Integration

In 2015, through the API Pipeline Integrity Work Group, an industry-wide team of member companies developed a guideline for managing and integrating data to empower comprehensive and holistic integrity analysis of pipelines. Although the document addressed a spectrum of data types from different sources, paticular emphasis was given to integrity centric data such as ILI results and field inspections. The guidance responds to NTSB incident recommendations and PHMSA advisory bulletins encouraging improved integration capabilities for data used to assess the integrity of pipelines.

2015 Strategic Initiative #2.3: Develop Industry-Wide Guidance on the Appropriate Uses of Hydrotesting to Ensure Pipeline Safety

In 2015, an industry-wide team of pipeline integrity professionals developed guidance for the appropriate uses of hydrotesting pipelines. There are situations, such as after construction before going into service, where pipeline operators test the integrity of their pipelines by pumping water at high pressure through the pipe to ensure there are no leaks. However, subjecting pipelines to too high a pressure can damage the pipelines, undercutting safety efforts. The guidance development team gathered technical experts from 10 operating companies and held knowledge sharing sessions in 5 cities across the country to collect data on hydrotesting practices and experiences. Participants provided information on test purposes, pressure levels, hold times, failure histories and re-testing intervals. The resulting guidance differentiates the potential goals and uses of hydrotesting, such as establishing a pipe as fit for service, determining the integrity of a pipeline, or identifying its specific tolerances or limitations. The guidance describes the scenarios or situations where hydrotesting is recommended, where it might be damaging, or where another inspection technology provides a pipeline operator with more pipeline safety benefits than hydrotesting.

2016 Strategic Initiative 2.1

Implement the New API Recommended Practice on Crack Detection, Analysis and Response

Description	Encourage and assist liquids pipeline operators to adopt the new industry-wide API recommended practice (RP) on crack detection, analysis and response. With finalization of the crack RP and early implementation efforts underway in 2016, an industry-wide team will continue to educate operators on the new RP. The team will participate in a number of forums and events to discuss the RP and strategies for its successful implementation.
Outcomes	• An RP implementation plan to outline steps industry will take to educate, encourage and assist industry adoption of the RP • Implementation tools designed to assist operators as appropriate • Host or participate in industry sessions or events to educate, encourage and assist member adoption of the RP • Development of mechanisms to collect information on level of RP adoption, associated program changes and resulting performance improvements resulting from adoption of the RP
Timeline	2016
Lead	Pipeline Integrity Work Group

2016 Strategic Initiative 2.2

Implement Industry-Wide Technical Report on Pipeline Threat Data Management and Integration

Description	Encourage and assist liquids pipeline operators to adopt the new API Technical Report on integrating pipeline threat data. After development of the report in 2015, a development team will educate pipeline operators on the report at industry-wide events throughout the year. Pipeline operator executives will reinforce the value of the report to their organizations.
Outcomes	• Implementation tools (summary and operator examples) designed to assist operators, as appropriate • Participate in industry sessions or events to educate encourage and assist member adoption of the guidance • Development of mechanisms to collect information on level of guidance adoption, associated program changes and resulting performance improvements

- Incorporation of technical report into 2016 update of API 1160 on Managing System Integrity, as appropriate

Timeline	2016
Lead	Pipeline Integrity Work Group

2016 Strategic Initiative 2.3

Implement Industry-Wide Guidance on the Appropriate Uses of Hydrotesting to Ensure Pipeline Safety

Description	Educate liquids pipeline operators on the new industry-wide guidance on appropriate uses for hydrotesting and integrate the guidance into industry-wide integrity management recommended practice. After development of the guidance, an industry-wide team will educate operators on the guidance throughout the year at industry-wide events and conferences. The team will ensure the lessons of the guidance are incorporated as appropriate into the 2016 revision of the industry-wide recommended practice on pipeline integrity management.
Outcomes	- Participate in industry sessions or events to educate pipeline operators on the guidance - Assist incorporation of guidance lessons into revised API Recommended Practice on Pipeline Integrity Management
Timeline	2016
Lead	Pipeline Integrity Work Group

2016 Strategic Initiative 2.4

Update Industry-Wide Recommended Practice for Water Crossings

Description	Update API Recommended Practice 1133 to more fully address surveying, assessing, mitigating, and monitoring of existing pipelines near or crossing watercourses, including onshore rivers and coastal waters. Current API RP 1133 *Guidelines for Onshore Hydrocarbon Pipelines Affecting High Consequence Floodplains* focuses primarily upon constructing new pipelines across river crossings. A team from the API Pipeline Integrity Working Group will expand this RP to include additional information on the programs and practices needed to safely operate and maintain the integrity of existing water crossings.

Outcomes	• Expanded API RP 1133 will address surveying, assessing, mitigating, and monitoring existing pipelines near or crossing watercourses, including onshore rivers and coastal waters.
Timeline	2016
Lead	Pipeline Integrity Work Group

2016 Strategic Initiative 2.5

Update Industry-Wide Recommended Practice for Integrity Management

Description	Update API RP 1160, *Managing Systems Integrity for Hazardous Liquids Pipelines,* to include the latest pertinent safety learnings and advances, such as the number of new documents including RPs for the assessment and management of pipeline cracking and pipeline safety management systems, as well as TRs on data integration and the appropriate uses of hydrostatic pressure testing. There should also be inclusion of the relevant material from the 2016 revision to the RP on water crossings and findings from PHMSA and NTSB reports. In addition, PHMSA's Safety of Hazardous Liquid Pipelines rulemaking will revise integrity management repair criteria, which is a critical piece of the RP. API RP 1160 is the primary integrity management tool for operators giving guidance on pipeline risk assessment, in-line inspection "smart pig" tool usage, repair criteria, anomaly growth modeling and inspection reassessment intervals, so effort should be taken to include all new material.

Outcomes	• An updated API RP 1160, Managing System Integrity for Hazardous Liquids Pipelines, which incorporates, as appropriate:
	   ○ RP 1133, Hydro-technical Pipeline Hazards at Onshore Waterway Crossings and within Coastal Zones
	   ○ RP 1163, In-line Inspection System Qualification
	   ○ RP 1173, Pipeline Safety Management Systems
	   ○ RP 1176, Assessment and Management of Pipeline Cracking
	   ○ TR 1178, Data Management and Integration Guideline
	   ○ TR 1179, Guidelines for Use of Hydrostatic Testing as an Integrity Management Tool
	   ○ Additional improvement opportunities, such as:
	      – PHMSA changes to repair criteria
	      – Findings from PHMSA and NTSB Incident Reports
	      – Strain thresholds
	      – Weather and outside forces (lightning, seismic, etc.)
	      – Santa Barbara, CA release

Timeline	2016
Lead	Pipeline Integrity Work Group

Strategic Goal 3	Expand Safety Culture & Management Practices

2015 Accomplishments

2015 Strategic Initiative #3.1: Deploy Pipeline Safety Management Systems to Improve Pipeline Safety Performance

In 2015, liquids and gas pipeline operators, federal and state pipeline safety regulators, and expert members of the public completed API Recommended Practice 1173 for Pipeline Safety Management Systems (PSMS). As development of the new RP concluded, a liquids pipeline industry PSMS Implementation Team was formed and developed a multi-phased plan. Phase I – Commitment Phase was completed in 2015. Phase I included API and AOPL member companies committing to implement API RP 1173. A Commitment letter was sent to liquid pipeline operators asking them to begin their implementation of PSMS and share progress updates with API/AOPL as requested. Operators will have the opportunity to utilize a PSMS logo in response to a signed commitment letter. By the end of the year, XX pipeline operating companies signed the commitment letter. Phase I also included development of a series of introductory resource documents for operators and external stakeholders on: 1) Why do I need the PSMS, 2) An overview of PSMS, and 3) How to implement PSMS. In addition, Executives of pipeline operator API and AOPL member companies received several briefings on the RP and participated in an interactive session discussing the executive's role in management systems and safety culture.

2015 Strategic Initiative #3.2: Foster Pipeline Safety Culture with an Industry-Wide Sharing, Learning and Improvement Program

In 2015, the industry-wide Sharing Practices & Learnings Leadership Team developed a Pipeline Safety Learnings Library to house pipeline safety sharings. The system will hold member company presentations from industry-wide sharing events, such as the Pipeline Information eXchange (PIX). It will also serve as a location for documents developed by operators, who previously did not have a database to store files developed initially just for distribution within their organizations but that are beneficial for all. In November, operators hosted the day-long PIX workshop for operators to hear from their colleagues on incidents and near misses over the last year and the lessons learned from them. Operators also convened a number of conference call "virtual tailgates" throughout the year to share safety and operational lessons, ensuring all pipeline personnel, including managers and staff, received the latest news on learnings.
Operators also engaged each other in peer-to-peer meetings to benefit from company exchange of safety lessons. Additionally, pipeline executives held moderated sessions at each of their industry-wide meetings on the topic of safety culture.

2015 Strategic Initiative #3.3: Develop an Industry-Wide Construction Quality Management System

Given the significant increase in new pipeline construction across the US, the industry identified a need for a guidance on minimum quality management system (QMS) processes for organizations that own, operate, construct, or provide construction-related services for liquids pipelines. A team was organized in 2015 to develop a new recommended practice (RP) to address this opportunity. The group has been working diligently, and their work will build on the principles detailed in the recently-released RP 1173, Pipeline Safety Management Systems, including the "Plan-Do-Check-Act" methodology. The new Construction QMS RP will also detail elements needed to appropriately oversee the many, complex steps

involved in constructing and starting up a pipeline. Finally, the document will expand upon and include valuable information recently developed from others.

2016 Strategic Initiative 3.1

Implement the Newly Developed Pipeline Safety Management System to Improve Pipeline Safety Performance

Description	As development of the new RP concluded in 2015, a liquids pipeline industry PSMS Implementation Team was formed and developed a multi-phased plan. Phase I – Commitment of the plan was completed in 2015. Phase II – Implementation Tools will be completed in 2016. Several detailed tools will be developed to conduct a gap analysis, undertake peer-to-peer sharing sessions, and perform assessments including a common set of specific tasks to review for implementation of PSMS. The team will host multiple industry-wide interactive workshops emphasizing how to implement PSMS and utilization on the newly developed tools with operators in the U.S. and Canada.
Outcomes	• Gap analysis tools to compare current operator programs and operations to the requirements of the PSMS RP • Formalized peer-to-peer information sharing tool to empower small groups of operators to compare programs and lessons learned • Assessment tool identifying key PSMS RP implementation tasks reflecting operator adoption of the RP and resulting pipeline safety performance • End of year analysis and reporting on PSMS RP adoption among liquids pipeline operators
Timeline	2016
Lead	Performance Excellence Team

2016 Strategic Initiative 3.2

Foster Pipeline Safety Culture with an Industry-Wide Sharing, Learning and Improvement Program

Description	Complete development of the pipeline safety learnings management system and mechanisms for inclusion of learnings into the system. The new platform and process to document learning among sharing recipients will enable operational changes reflecting lessons learned and measurement of resulting improved pipeline safety performance.

Outcomes	• Complete Pipeline Safety Learnings Library
	• Develop the process for including new information into the Pipeline Safety Learnings Library
	• A summary report of sharing, learning, and improvement examples at end of each year
Timeline	2016
Lead	Performance Excellence Team Safety Culture Subteam with the Sharing Practices and Learning Leadership Team

2016 Strategic Initiative 3.3

Develop an Industry-Wide Construction Quality Management System

Description	Complete development of an industry-wide RP for liquids and gas pipeline construction QMS. The document will allow operators to manage the construction process comprehensively and systematically from initial design, through materials manufacturing, construction, testing, and initiation of operations.
Outcomes	• An industry-wide Pipeline Quality Management System Recommended Practice
Timeline	2016
Lead	Pipeline Construction QMS Task Team

Strategic Goal 4 — Boost Response Capabilities

2015 Accomplishments

2015 Strategic Initiative #4.1: Develop an API Recommended Practice for Leak Detection Program Management

In 2015, a team of liquids pipeline leak detection and control room managers with participation from PHMSA worked together to develop a new API recommended practice for LDP (leak detection program) management. The RP builds upon existing API standards (e.g. API RP 1130) by focusing on holistic management of LDSs (leak detection systems). The RP provides guidance on developing a leak detection culture and strategy, selection of LDSs , monitoring both individual LDSs and the overall LDP

performance, testing, alarm management, control center procedures, training, roles and responsibilities, equipment maintenance, management of change and leak detection performance improvement.

2015 Strategic Initiative #4.2: Deploy a Nationwide Pipeline Emergency Response Training, Outreach & Standards Program

The API-AOPL Emergency Response Team undertook multiple activities in 2015 to boost operator and first responder pipeline emergency preparedness and response capabilities. The Team completed development of API Recommended Practice 1174 for Pipeline Emergency Response and Planning. The new RP provides pipeline operators with recommended practices for incident discovery, response activation, resource mobilization, incident command, response preparedness, planning, training and exercises. In June, the team hosted a national pipeline emergency response forum in Fort Worth, TX, which allowed pipeline operators, emergency responders and agencies to exchange insights and learnings. The daylong session reviewed recent pipeline responses, discussed successful tactics and areas for future improvement. In May and November, the team convened the Emergency Response Advisory Board of pipeline executives, senior government officials, and leaders of the fire, law enforcement and emergency notification communities to gather the insights of those stakeholders on improving pipeline emergency preparedness and response. The team continues to participate in NFPA committees to advocate for mandatory pipeline emergency response training. The team also began consideration of mutual-aid strategies to enable operators to pool and share emergency response resources. Additionally, representatives of the team exhibited and presented industry-wide emergency response efforts at numerous conferences of fire, law enforcement and emergency response professionals. The team also partnered with the Interstate Natural Gas Association of America to prepare seven short videos to educate first responders about pipeline emergencies.

2016 Strategic Initiative 4.1

Implement the Newly Developed API Recommended Practice 1175 for Pipeline Leak Detection Program Management

Description	The implementation phase will encourage and assist liquids pipeline operators with adoption of the newly developed API RP 1175. The implementation team will participate in a number of forums and events to discuss the guidance and strategies for its successful implementation. Pipeline operator executives will reinforce the value of the guidance to their organizations, and plan for their staff's participation at industry-wide events throughout the year. This initiative will provide repeated opportunities for operators to hear the importance of the Recommended Practice, receive guidance on its implementation, and share learnings and successes from its adoption.
Outcomes	• Conduct peer-to-peer events to discuss RP revision and understanding, as well as share individual operator practices • Host one day workshop for technical personnel to generate understanding of RP and alignment as to the importance of its implementation • Share updates and paths-forward about RP at industry events, such as API Pipeline Conference and Cybernetics Symposium

- Develop gap analysis tool for operators to determine understanding and implementation ability
- An end of the year report on the degree of RP adoption and issues identified

Timeline   2016

Lead   Cybernetics Work Group

2015 Strategic Initiative 4.2

Deploy a Nationwide Pipeline Emergency Response Training, Outreach and Standards Program

Description   Execute a multi-pronged strategy to boost pipeline emergency preparedness and response capabilities of pipeline operators and first responders. Major 2016 efforts include promotion, operation and improvement of the free, online pipeline emergency training portal , publicizing and implementation of API RP 1174 for Pipeline Emergency Response and Planning, conducting the annual emergency response forum of pipeline operators and responders, continuation of the bi-annual emergency response advisory board of pipeline executives and leaders of the law enforcement and response community, studying the feasibility of mutual aid for pipeline operations, and additional industry outreach through various media platforms and major annual gatherings of first responder professionals.

Outcomes
- Activities to encourage, educate and assist implementation of API RP 1174 for Pipeline Emergency Response and Planning
- An annual forum for pipeline operator emergency response personnel and first responder officials
- Two meetings of the Emergency Response Advisory Board
- Exhibition and presentation at multiple first responder conferences
- Prepare and distribute emergency response outreach messages using various media platforms
- Develop mutual aid strategy

Timeline   2016

Lead   API-AOPL Emergency Response Team

Pipeline Safety Data

| Miles of U.S. Transmission Pipeline	2011	2012	2013	2014	2015
Total	183,580	186,221	192,417	199,703	207,806
Crude Oil	56,100	57,463	61,087	66,813	72,440
Refined Products	64,130	64,042	63,351	61,767	62,555
Natural Gas Liquids (NGLs)	58,599	59,861	62,768	65,826	67,549

Source: U.S Pipeline & Hazardous Materials Administration, Annual Report Mileage for Hazardous Liquid or Carbon Dioxide Systems

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Barrels Delivered by U.S. Transmission Pipeline	2010	2011	2012	2013	2014
Total	13,537,610,970	13,671,611,732	14,079,190,262	14,967,097,599	16,178,517,987
Crude Oil	7,147,234,555	7,031,632,001	7,460,710,613	8,324,012,774	9,289,972,460
Petroleum Products	6,390,376,415	6,539,979,731	6,618,479,649	6,643,084,825	6,888,545,527

Source: Compiled from annual filings of pipeline operators to the U.S Federal Energy Regulatory Commission
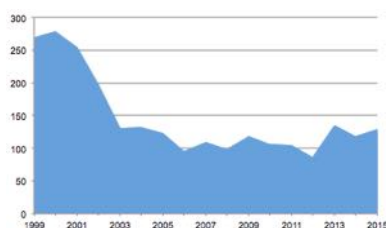
Page 4

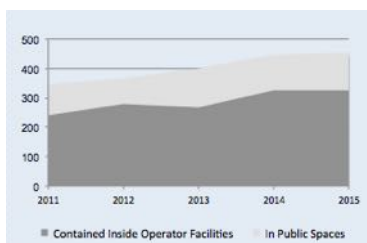| Total Liquids Pipeline Incidents	1999	2000	2001	2002	2003
Total Liquids Pipeline Incidents Along the Public Right of Way, Outside of Operator Facilities	270	279	254	198	131
	2004	**2005**	**2006**	**2007**	**2008**
	133	123	95	110	98
	2009	**2010**	**2011**	**2012**	**2013**
	118	106	105	86	135
	2014	**2015**			
	118	130			

Sources: 1999 – 2010, American Petroleum Institute, Pipeline Performance Tracking System; 2011 – 2015, PHMSA Pipeline Safety – Flagged Incidents as of April 29, 2016 (note: detailed pipeline incident data under 5 barrels back to 1999 unavailable from PHMSA)

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Corrosion Caused Liquids Pipeline Incidents	1999	2000	2001	2002	2003
Corrosion Caused Liquids Pipeline Incidents Along the Public Right of Way, Outside of Operator Facilities	132	130	135	110	59
	2004	**2005**	**2006**	**2007**	**2008**
	44	44	39	34	31
	2009	**2010**	**2011**	**2012**	**2013**
	41	21	27	33	39
	2014	**2015**			
	35	42			

Sources: 1999 – 2010, American Petroleum Institute, Pipeline Performance Tracking System; 2011 – 2015, U.S. Pipeline & Hazardouls Materials Safety Administration, PHMSA Pipeline Safety – Flagged Incidents as of April 29, 2016 (note: detailed pipeline incident data under 5 barrels back to 1999 unavailable from PHMSA)

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| Liquids Pipeline Incidents by Location	2011	2012	2013	2014	2015
Total Liquids Pipeline Incidents	346	366	401	445	454
Incidents Contained within Operator Facilities	241	280	266	327	324
Incidents in Public Spaces	105	86	135	118	130

Source: U.S Pipeline & Hazardous Materials Administration, PHMSA Pipeline Safety – Flagged Incidents as of April 29, 2016

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| Liquids Pipeline Incidents by Size	2011	2012	2013	2014	2015
Total	346	366	401	445	454
<= 1 barrel	138	153	172	190	199
<= 5 barrels	207	232	260	291	297
>= 50 barrels	75	66	63	66	75
>=500 barrels	30	18	20	20	23
Total / mile	.001885	.001965	.002084	.002228	.002185
<= 1 barrel / mile	.000752	.000822	.000894	.000951	.000958
<= 5 barrels / mile	.001128	.001246	.001351	.001457	.001429
>=50 barrels / mile	.000409	.000354	.000327	.000330	.000361
>=500 barrels / mile	.000163	.000097	.000104	.000100	.000111
Source: U.S Pipeline & Hazardous Materials Administration, PHMSA Pipeline Safety – Flagged Incidents as of April 29, 2016					
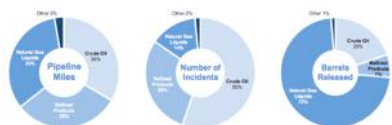
| Incidents in 2015 by Commodity	Miles	Incidents	Barrels
Total	207,806	454	102,342
Crude	72,440	251	20,091
Refined Products	62,555	131	6,882
NGL	67,549	63	74,088
Other	5,262	7	1,281
Miles Source: 2015 mileage estimated from U.S Pipeline & Hazardous Materials Administration, Annual Report Mileage for Hazardous Liquid or Carbon Dioxide Systems data by applying 2013 to 2014 growth rate to 2014 mileage Incidents and Barrels Source: U.S Pipeline & Hazardous Materials Administration, PHMSA Pipeline Safety – Flagged Incidents as of April 29, 2016			
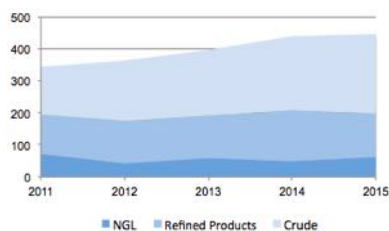
Incidents by Commodity	2011	2012	2013	2014	2015
Total	346	366	401	445	454
Crude	147	189	205	232	251
Refined Products	123	134	134	157	133
NGL	72	41	57	50	63
Source: U.S Pipeline & Hazardous Materials Administration, PHMSA Pipeline Safety – Flagged Incidents as of April 29, 2016					
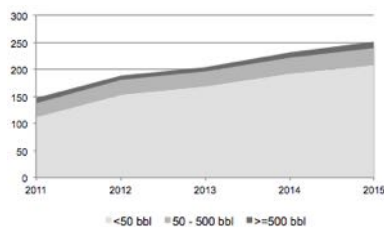
Crude Oil Incidents by Size	2011	2012	2013	2014	2015
Total	147	189	205	232	251
< 50 barrels	112	153	169	193	209
50 to 500 barrels	25	28	27	30	31
>= 500 barrels	10	8	9	9	11
Source: U.S Pipeline & Hazardous Materials Administration, PHMSA Pipeline Safety – Flagged Incidents as of April 29, 2016					

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Pipeline Barrels Released	2011	2012	2013	2014	2015
Total	89,111	45,884	117,467	46,973	102,342
Source: U.S Pipeline & Hazardous Materials Administration, PHMSA Pipeline Safety – Flagged Incidents as of April 29, 2016					

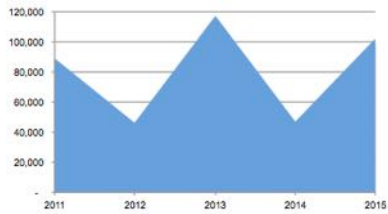| Barrels Released by Commodity	2011	2012	2013	2014	2015
Crude	35,359	15,025	43,048	17,523	20,091
Refined Products	23,351	9,403	12,485	16,378	6,882
NGL	27,860	21,437	61,883	10,879	74,088
Source: U.S Pipeline & Hazardous Materials Administration, PHMSA Pipeline Safety – Flagged Incidents as of April 29, 2016					

Barrels Released to High Consequence Areas	2011	2012	2013	2014	2015
Total Barrels Released from All Commodities	89,111	45,884	117,467	46,973	102,342
Crude Oil Released to High Consequence Areas	7,681	1,722	6,016	7,416	7,202
Source: U.S Pipeline & Hazardous Materials Administration, PHMSA Pipeline Safety – Flagged Incidents as of April 29, 2016					

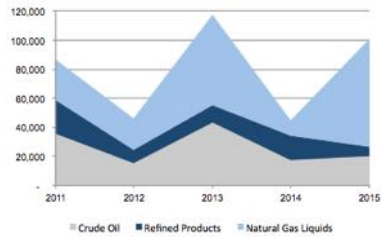

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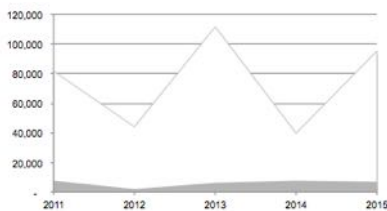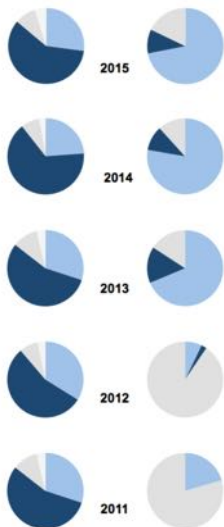| Number of Incidents	2011	2012	2013	2014	2015
Total	346	366	401	445	454
Integrity Management	104	124	109	106	123
Operations & Maintenance	192	201	249	292	268
Outside Force Damage	37	29	31	34	41
Other	13	12	12	13	22
Source: U.S Pipeline & Hazardous Materials Administration, PHMSA Pipeline Safety – Flagged Incidents as of April 29, 2016					

Crude Barrels Released in an HCA	2011	2012	2013	2014	2015
Total	9,341	1,722	6,016	7,391	6,444
Integrity Management	1,915	123	4,133	5,746	4,634
Operations & Maintenance	-	39	932	780	659
Outside Force Damage	7,426	1,560	951	865	1,152
Other	-	-	-	-	-
Source: U.S Pipeline & Hazardous Materials Administration, PHMSA Pipeline Safety – Flagged Incidents as of April 29, 2016					

Total Incidents	2011	2012	2013	2014	2015
Incidents in 2015					454
Incidents Last 5 Years	346	366	401	445	454
Barrels Released	89,111	45,884	117,467	46,973	102,342
Barrels per Incident	258	125	293	106	225
Source: U.S Pipeline & Hazardous Materials Administration, PHMSA Pipeline Safety – Flagged Incidents as of April 29, 2016					

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Corrosion Incidents	2011	2012	2013	2014	2015
Incidents in 2015					93
Incidents Last 5 Years	80	98	74	81	93
Barrels Released	6,351	12,414	13,926	5,362	18,092
Barrels per Incident	79	127	188	66	195
Source: U.S Pipeline & Hazardous Materials Administration, PHMSA Pipeline Safety – Flagged Incidents as of April 29, 2016					

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Equipment Failure Incidents	2011	2012	2013	2014	2015
Incidents in 2015					204
Incidents Last 5 Years	155	144	174	217	204
Barrels Released	37,411	7,929	7,072	15,241	9,697
Barrels per Incident	241	55	41	70	48
Source: U.S Pipeline & Hazardous Materials Administration, PHMSA Pipeline Safety – Flagged Incidents as of April 29, 2016					

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Incorrect Operation Incidents	2011	2012	2013	2014	2015
Incidents in 2015					55
Incidents Last 5 Years	36	55	68	70	55
Barrels Released	2,426	1,762	2,637	12,660	1,590
Barrels per Incident	67	32	39	181	29
Source: U.S Pipeline & Hazardous Materials Administration, PHMSA Pipeline Safety – Flagged Incidents as of April 29, 2016					

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Materials & Welds Incidents	2011	2012	2013	2014	2015
Incidents in 2015					30
Incidents Last 5 Years	24	26	35	25	30
Barrels Released	17,771	13,942	21,974	6,053	59,766
Barrels per Incident	740	536	628	242	1,992
Source: U.S Pipeline & Hazardous Materials Administration, PHMSA Pipeline Safety – Flagged Incidents as of April 29, 2016					

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Outside Forces Incidents	2011	2012	2013	2014	2015
Incidents in 2015					33
Incidents Last 5 Years	18	20	24	27	33
Barrels Released	3,793	5,102	59,545	934	5,690
Barrels per Incident	345	364	4,253	42	271
Source: U.S Pipeline & Hazardous Materials Administration, PHMSA Pipeline Safety – Flagged Incidents as of April 29, 2016					

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3rd Party Damage Incidents	2011	2012	2013	2014	2015
Incidents in 2015					8
Incidents Last 5 Years	19	9	7	7	8
Barrels Released	18,722	3,318	6,419	5,901	4,565
Barrels per Incident	985	369	917	843	571
Source: U.S Pipeline & Hazardous Materials Administration, PHMSA Pipeline Safety – Flagged Incidents as of April 29, 2016					

Definitions & Notes

Barrels – One barrel of crude oil or petroleum products contains 42 gallons

Barrels Released – Pipeline operators report to PHMSA the number of barrels released unintentionally during each pipeline incident. Unintentionally released barrels of crude oil and petroleum products forms the basis of barrels released data and analysis in this report. PHMSA also requires operators to report intentional releases of natural gas liquids in gas form into the atmosphere during maintenance activities. This process, called "blowdown," vents the gas product from the section of pipeline set to undergo maintenance. Barrels released data in this report does not include intentional blowdown releases.

In-Line Inspection Device or "Smart Pig" - An in-line inspection (ILI) device, commonly referred to as a "smart pig", is a diagnostic tool that travels inside the pipeline scanning the pipe walls for imperfections and recording the data for later analysis.

Natural Gas Liquids – Petroleum products that are liquid when traveling through a pipeline under high pressure and a gas at atmospheric pressure are referred to generally as natural gas liquids (NGLs). Examples of NGLs transported by pipeline include: propane, ethane and butane. They occur naturally in petroleum deposits and are produced along with crude oil or natural gas (methane). NGLs are separated from the crude oil and natural gas after production and sent to manufacturers (ethane, butane) as an industrial raw material or to other commercial, agricultural or residential uses (propane).

PHMSA Incident Reporting – Pipeline operators regulated by PHMSA are required to report data related to pipeline incidents including location, cause and consequences. PHMSA compiles this information in a publicly available online database. As noted in the Pipeline Safety Data chapter, analysis of incident data reported to PHMSA as of April 29, 2016, forms a substantial portion of this report.

Pipeline Performance Tracking System – The liquids pipeline industry tracks pipeline safety performance internally through the Pipeline Performance Tracking System (PPTS) maintained by the American Petroleum Institute. Created in 1999, PPTS allows the pipeline industry to know the state of the overall pipeline system, analyze emerging trends, and focus its resources on the issues most important to improving pipeline system. Consistent reporting of pipeline incident data since 1999 makes PPTS an important source of long-term pipeline safety trends.

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