



June 2021

PIPELINE SAFETY

Performance Measures Needed to Assess Recent Changes to Hazardous Liquid Pipeline Safety Regulations



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GAO@100 Highlights

Highlights of [GAO-21-493](#), a report to congressional committees

Why GAO Did This Study

The U.S. hazardous liquid pipeline network runs for over 220,000 miles and is a critical component of the nation's economy. Pipelines are considered to be a relatively safe mode of transporting crude oil, refined petroleum products, and other hazardous liquids, but accidents can occur that result in loss of life and environmental damage. PHMSA, within the Department of Transportation (DOT), sets the federal minimum pipeline safety standards and generally ensures operator compliance.

In 2016, a pipeline safety statute included a provision for GAO to report on hazardous liquid pipeline safety after PHMSA issued a specific final rule amending its safety regulations, which it did in 2019. This report examines: (1) perspectives of selected pipeline stakeholders on the benefits and challenges of the amendments made by the 2019 Rule and (2) steps PHMSA has taken to inform stakeholders of these amendments and to measure their effects on pipeline safety. GAO reviewed relevant statutes and regulations; analyzed PHMSA accident data from calendar years 2011-2020; interviewed 11 pipeline operators—selected by pipeline type, miles, and product type—as well as pipeline industry and safety stakeholders, and PHMSA and pipeline safety officials from six states.

What GAO Recommends

PHMSA should develop and use performance measures to assess whether the changes made by the 2019 Rule achieve desired outcomes and improve safety. DOT concurred with GAO's recommendation.

View [GAO-21-493](#). For more information, contact Elizabeth Repko at (202) 512-2834 or repkoe@gao.gov.

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What GAO Found

In 2019, the Pipeline and Hazardous Materials Safety Administration (PHMSA) issued a final rule amending its hazardous liquid pipeline safety regulations. Selected pipeline operators and officials from PHMSA and selected states' pipeline safety offices said that these changes would enhance pipeline safety and present no significant challenges. They said the most beneficial changes expanded the scope of inspections. For example, in addition to existing requirements for operators to use specialized tools to inspect pipelines in "high consequence areas"—defined by population and environmental factors—the 2019 Rule requires such inspections outside of those areas. While operators noted the rule's potential to improve safety, all 11 operators GAO interviewed identified specific amendments that could increase their costs. For example, several operators said they would need to modify or replace some of their pipeline to allow for certain inspection tools required by the changes. PHMSA and state pipeline safety officials said they did not anticipate oversight challenges or additional costs because the changes did not alter their inspection process.

Specialized In-Line Inspection Tool Being Placed in a Launch Point on a Pipeline



Source: Texas Oil and Gas Association. | [GAO-21-493](#)

PHMSA held meetings with and provided guidance to operators and inspectors on the changes but has not developed measures to assess if the changes improve safety. Leading performance management practices call for agencies to track progress toward goals using measures that include targets for expected levels of performance and timeframes. While PHMSA has desired outcomes for the 2019 Rule, including safety improvements, PHMSA officials said they have not established performance measures for those outcomes because some of the changes have long-term compliance deadlines, and so data are not yet available to assess effectiveness. However, other changes have shorter-term deadlines for compliance and PHMSA could use data it already collects from operators for its assessment. Without performance measures, PHMSA cannot determine whether the changes made by the 2019 Rule are achieving their intended outcomes and contributing to PHMSA's safety goals.

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Abbreviations

API	American Petroleum Institute
DOT	Department of Transportation
HCA	high consequence area
NTSB	National Transportation Safety Board
OPID	Operator Identification Number
PHMSA	Pipeline and Hazardous Materials Safety Administration

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June 22, 2021

The Honorable Maria Cantwell
Chairman
The Honorable Roger Wicker
Ranking Member
Committee on Commerce, Science and Transportation
United States Senate

The Honorable Frank Pallone
Chairman
The Honorable Cathy McMorris Rodgers
Ranking Member
Committee on Energy and Commerce
House of Representatives

The Honorable Peter A. DeFazio
Chairman
The Honorable Sam Graves
Ranking Member
Committee on Transportation and Infrastructure
House of Representatives

The U.S. oil industry is a critical component of the nation's economy, providing energy for transportation, manufacturing, and residential use, while creating jobs and reducing imports. The nation's network of nearly 225,000 miles of hazardous liquid pipelines is primarily regulated by the Department of Transportation's (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA). According to PHMSA, pipelines are one of the safest and least costly ways to deliver hundreds of billions of gallons of crude oil, refined petroleum products, and other hazardous liquids each year.¹ However, accidents do occur that cause significant damage to life, property, and the environment. Risk factors for such accidents include pipeline corrosion and age, as well as severe weather events. For example, in July 2010, a pipeline in Marshall, Michigan, ruptured due to corrosion, causing about 840,000 gallons of crude oil to

¹Our report discusses pipelines that carry hazardous liquids including crude oil, refined petroleum products, highly volatile liquids (hazardous liquids that form a vapor cloud when released into the atmosphere), and non-petroleum fuel (e.g., biofuel). Our discussion also includes pipelines that carry liquefied carbon dioxide.

enter the surrounding wetlands and nearby rivers, resulting in cleanup costs exceeding \$767 million and in hundreds of people experiencing symptoms related to crude oil exposure, according to the National Transportation Safety Board's (NTSB) 2012 accident report.²

PHMSA, states, and pipeline operators each have a role in ensuring pipeline safety. PHMSA sets and enforces the federal minimum pipeline safety standards for interstate hazardous liquid pipelines, which transport these liquids across state borders.³ To ensure operators' compliance with pipeline safety regulations, PHMSA conducts inspections of interstate pipelines. PHMSA also sets the minimum safety standards for intrastate hazardous liquid pipelines, which operate within a single state. However, states may assume regulatory, inspection, and enforcement authority for intrastate pipelines after certifying to PHMSA that they have adopted and are enforcing applicable federal standards.⁴ PHMSA may also enter into agreements with states that permit them to participate in the oversight and inspection of interstate pipelines, but PHMSA retains enforcement authority. PHMSA takes a risk-based approach to pipeline safety and requires operators to have integrity management programs to identify and mitigate risks to pipelines located in areas where an accident would have greater consequences for public safety or the environment.

In October 2019, PHMSA issued a final rule amending its hazardous liquid safety regulations to improve the protection of the public, property, and environment.⁵ PHMSA made these changes in response to congressional mandates, lessons learned from pipeline accidents, and

²NTSB, *Enbridge Incorporated, Hazardous Liquid Pipeline Rupture and Release, Marshall, Michigan, July 25, 2010, Accident Report*, NTSB/PAR-12/01 (Washington, D.C.: July 10, 2012).

³PHMSA's general authority is under the Pipeline Safety Laws codified at 49 U.S.C. § 60101 et seq.

⁴States must submit these certifications to PHMSA annually. States with current certifications may adopt additional or more stringent safety standards as long as they are compatible with federal standards.

⁵Pipeline Safety: Safety of Hazardous Liquid Pipelines, 84 Fed. Reg. 52,260 (Oct. 1, 2019) (amending 49 C.F.R. pt. 195). We will refer to this as the 2019 Rule.

recommendations by NTSB and GAO.⁶ The Protecting our Infrastructure of Pipelines and Enhancing Safety Act of 2016 (PIPES Act of 2016) includes a provision for GAO to report on integrity management programs for hazardous liquid pipeline facilities after the publication of PHMSA's final rule on hazardous liquid pipeline safety.⁷ This report examines:

- perspectives of selected hazardous liquid pipeline stakeholders on the benefits and challenges of the amendments made by the 2019 Rule, and
- steps PHMSA has taken to inform stakeholders of the amendments and to measure their effect on the safety of hazardous liquid pipelines.

To address these objectives, we reviewed relevant statutes, regulations, and PHMSA's policies, procedures, and guidance for operators on pipeline safety practices and the roles and responsibilities of officials at the PHMSA's regional offices and state agencies. We also reviewed publications and studies from NTSB, industry, and non-industry groups on topics related to the safety of hazardous liquid pipelines. We used the most recent data from PHMSA's operator annual report (2019) to describe the characteristics of the U.S. hazardous liquid pipeline system, including pipeline miles, type of pipeline, and the number of pipeline operators that reported to PHMSA.

We also analyzed PHMSA's data over a 10-year period (from 2011 to 2020) on hazardous liquid pipeline accidents, including the number of accidents, barrels of product released, location, cause, and the number of accidents that met PHMSA's definition of an accident impacting people or the environment—a category of accident established by PHMSA and described in greater detail below. We assessed the reliability of PHMSA data by speaking with agency officials about data control procedures and

⁶See Pipeline Safety, Regulatory Certainty, and Job Creation Act of 2011 (2011 Pipeline Safety Act), Pub. L. No. 112–90, 125 Stat. 1904 (2012); Protecting our Infrastructure of Pipelines and Enhancing Safety Act of 2016 (PIPES Act of 2016), Pub. L. No. 114–183, 130 Stat. 514 (2016). Following the Marshall, Michigan pipeline rupture, NTSB made two recommendations for PHMSA to revise its safety regulations related to: (1) operators' assessment of crack defects and (2) notifying PHMSA of an expected date for information when a determination of pipeline threats is not obtained within 180 days of an inspection. In 2012, GAO recommended that PHMSA collect data from operators of federally unregulated hazardous liquid and gas gathering pipelines. GAO, *Pipeline Safety: Collecting Data and Sharing Information on Federally Unregulated Gathering Pipelines Could Help Enhance Safety*, [GAO-12-388](#) (Washington, D.C.: Mar. 22, 2012).

⁷PIPES Act of 2016 § 5.

reviewing agency documentation. We determined that these data were sufficiently reliable to describe characteristics of the pipeline network and accidents that occur along that network. In addition, we reviewed six key amendments PHMSA made by the 2019 Rule and reviewed PHMSA's *Regulatory Impact Analysis* of the final rule, which describes the costs and benefits of these changes.⁸ Appendix II describes the six key amendments in more detail.

To obtain stakeholder views of the changes made by the 2019 Rule, we provided selected hazardous liquid pipeline stakeholders with a summary of the six key changes, discussed in greater detail below, and interviewed them on the benefits and challenges of these changes, including related costs, feasibility, and effect on pipeline safety. These stakeholders included representatives from 11 hazardous liquid pipeline operators, three industry associations, four safety and environmental groups, one association that represents state pipeline safety personnel, six state pipeline safety offices, and PHMSA's five regional offices.⁹ We selected operators that manage a range of regulated pipeline systems, including those of different types (e.g., transmission and gathering, as discussed below); size (number of pipeline miles managed); and commodities transported (e.g., crude oil, refined petroleum products, and highly volatile liquids). The views presented in our report provide perspectives of a range of knowledgeable stakeholders on the changes, but are not generalizable to all stakeholders.

To assess the steps that PHMSA has taken to inform stakeholders of the changes made by the 2019 Rule and measure their effect on pipeline safety, we reviewed documentation, such as presentation materials provided at PHMSA-led meetings, PHMSA's responses to frequently asked questions to clarify the changes, and guidance on rule implementation. We also interviewed officials at PHMSA's headquarters office. We obtained stakeholder perspectives on PHMSA's outreach

⁸Pipeline and Hazardous Materials Safety Administration, Doc. No. PHMSA-2010-0229-0137, *Regulatory Impact Analysis: Safety of Hazardous Liquid Pipelines* (2019).

⁹We selected the national pipeline associations and the pipeline safety and environmental groups based on their written comments submitted to PHMSA on the amendments to the hazardous liquid pipeline safety regulations that it proposed in 2015 and that were finalized in the 2019 Rule. Pipeline Safety: Safety of Hazardous Liquid Pipelines, 80 Fed. Reg. 61,610 (proposed Oct. 13, 2015). We selected six of the 15 states' pipeline safety offices that have assumed authority over intrastate hazardous liquid pipelines, three of which also hold an interstate agreement with PHMSA to participate in the oversight of interstate hazardous liquid pipelines.

efforts by interviewing the selected operators, PHMSA regional offices, and states' pipeline safety offices noted above. We also reviewed PHMSA's intended safety outcomes of the 2019 Rule, as well as the department-wide performance goals in DOT's *FY 2021 Performance Plan*.¹⁰ We compared PHMSA's efforts to measure the effects of the 2019 Rule on the identified outcomes and performance goals against leading practices for strategic planning identified by our prior work and the requirements under the GPRA Modernization Act of 2010, as amended.¹¹ For a more detailed description of our methodology, see appendix I.

We conducted this performance audit from April 2020 to June 2021 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

Components of the National Network of Hazardous Liquid Pipelines

The U.S. economy relies on a network of hazardous liquid pipelines that transport a wide range of oil products supporting various sectors of the economy, including energy, transportation, and manufacturing. These products include crude oil, refined petroleum products—such as jet fuel, gasoline, and home heating oil—and liquefied gas products, such as carbon dioxide.¹² According to PHMSA, in 2019, about 157,000 of these miles were interstate hazardous liquid pipelines—pipelines that transport these liquids across states—and about 68,000 miles were intrastate hazardous liquid pipelines—pipelines transporting these liquids within a state.

¹⁰DOT, *FY 2021 Performance Plan and FY 2019 Performance Report* (Mar. 23, 2020).

¹¹GAO, *Agency Performance Plans: Examples of Practices That Can Improve Usefulness to Decisionmakers*, [GAO/GGD/AIMD-99-69](#), (Washington, D.C.: Feb. 26, 1999). GPRA Modernization Act of 2010, Pub. L. No. 111-352, 124 Stat. 3866 (2011).

¹²According to operator reports to PHMSA, in calendar year 2019, about 37 percent of the nation's hazardous liquid pipeline miles predominantly transported crude oil, 32 percent of the pipeline miles predominantly transported highly volatile liquids (e.g., propane, butane, and ammonia), 28 percent of the pipeline miles predominantly transported refined petroleum products like gasoline, and 2 percent of pipeline miles transported carbon dioxide and fuel grade ethanol.

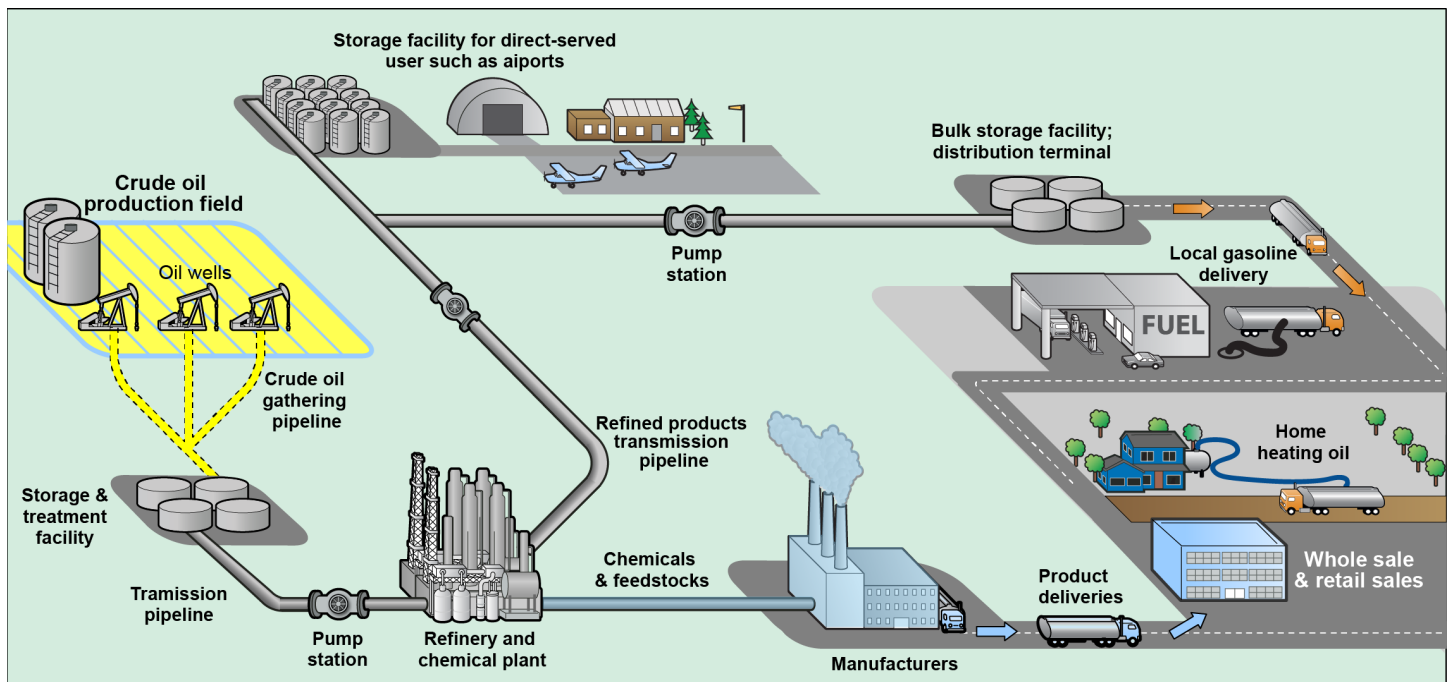
Within this nationwide network, there are two main types of hazardous liquid pipelines—gathering pipelines and transmission pipelines:

- *Gathering pipelines* transport hazardous liquids from oil well heads to storage and treatment facilities, before these liquids are sent to refineries for processing. Gathering pipelines are typically less than 9 inches in diameter and are generally located in rural areas.
- *Transmission pipelines* carry hazardous liquids from gathering lines to refining, processing, or storage facilities, and carry refined petroleum products, such as gasoline and fuel oils, to customers for use or further transportation. These pipelines are typically from 12 inches to 42 inches in diameter and have greater operating pressure than gathering pipelines. According to operator reports submitted to PHMSA, these pipelines made up about 98 percent (about 225,000 pipeline miles) of the pipeline network in 2019.¹³

Hazardous liquid pipeline networks also include pump stations, which move the product through the pipelines, and storage terminals. (See fig. 1.)

¹³Gravity pipelines are also a part of the hazardous liquid pipeline network. These pipelines carry product by means of gravity, and many are short and are located within tank farms or other pipeline facilities. Prior to the 2019 Rule, gravity pipelines were not regulated by PHMSA. The 2019 Rule extends reporting requirements to certain, previously unregulated gravity pipelines. Operators of these pipelines must now submit annual reports to PHMSA that include information such as the miles of gravity pipeline as well as accident and safety-related condition reports. In 2019, PHMSA stated that there was an estimated 28 miles of gravity pipelines, managed by a total of five operators that would be subject to these extended reporting requirements.

Figure 1: Hazardous Liquid Pipeline Network



Source: GAO, Association of Oil Pipe Lines, and Pipeline and Hazardous Materials Safety Administration. | GAO-21-493

These pipeline networks are owned and managed by hazardous liquid pipeline operators, which vary in the amount of pipeline they own, corporate structure, and management organization. An estimated 500 hazardous liquid pipeline operators manage networks ranging from fewer than 50 miles to more than 2,000 miles of pipeline. The corporate structures of operators also vary. For example, some operators may be independent and others may be subsidiaries of larger companies. Additionally, some operators form partnerships where networks are jointly owned, with one of the operators managing the network for all partners.

Federal and State Oversight

PHMSA sets the federal minimum safety standards for pipelines, such as specifications for their design, construction, testing, inspection, operation, and maintenance.¹⁴ PHMSA also oversees the risk-based regulatory

¹⁴PHMSA does not regulate all pipelines. For example, there are several types of hazardous liquid low-stress pipelines—pipelines that are operated in their entirety at a stress level of 20 percent or less of the specified minimum yield strength of the line pipe—that are not regulated by PHMSA as well as pipelines moving hazardous liquid through production, refining, or manufacturing facilities. 49 C.F.R. § 195.1(b).

program referred to as integrity management. Under PHMSA’s integrity management program, operators are required to systematically identify and mitigate risks to a pipeline located in or that could affect a high consequence area (HCA), where an accident would have greater consequences for public safety or the environment.¹⁵ PHMSA requires operators to determine likely threats to the pipelines within HCAs, evaluate the physical integrity of the pipe within the HCA, and repair or remediate any pipeline defects found.¹⁶ According to PHMSA, about 42 percent of the nation’s regulated hazardous liquid pipelines in 2019 were located in such an area.

To ensure operators comply with federal minimum safety standards and integrity management program requirements, PHMSA conducts inspections through its five regional offices and enters into agreements with certain states for them to conduct inspections. Under federal pipeline safety laws, states may assume regulatory, inspection, and enforcement responsibilities for *intrastate* pipelines through certification with PHMSA.¹⁷ PHMSA may also enter into agreements with states that have certifications to participate in the inspections of *interstate* pipelines as interstate “agents” of PHMSA.¹⁸ While state inspectors can identify and must report violations or probable violations of the federal pipeline safety regulations on interstate pipelines to PHMSA, PHMSA retains enforcement authority over these pipelines. As of 2021, 15 states have assumed jurisdiction over intrastate pipelines through certification, and five of those states also act as interstate agents.¹⁹ The frequency of interstate pipeline inspections depends on PHMSA’s determination of risk and priorities. Inspections may include on-site inspection of operator documentation, field inspection of pipelines, and briefings on findings with operators.

¹⁵Under the hazardous liquid pipeline regulations, HCAs generally include high population areas, other populated areas, certain navigable waterways, and areas unusually sensitive to environmental damage. 49 C.F.R. § 195.450.

¹⁶*Id.* § 195.452.

¹⁷49 U.S.C. § 60105.

¹⁸*Id.* § 60106.

¹⁹For calendar year 2021, the following states had the authority to inspect intrastate pipelines: Alabama, Arizona, California, Indiana, Louisiana, Maryland, Minnesota, New York, New Mexico, Oklahoma, Pennsylvania, Texas, Virginia, Washington, and West Virginia; and the following states had the authority to inspect both intrastate and interstate pipelines: Arizona, Minnesota, New York, Virginia, and Washington.

Safety Improvements

In recent decades, according to PHMSA, pipeline manufacturing and construction as well as operations and maintenance practices have improved steadily, helping to mitigate risks, such as corrosion and pipeline cracking, to pipeline safety. For example, according to PHMSA, since the early 1970s, improvements in pipeline materials and manufacturing, such as advances in the welding of seams that bind pipeline segments together, have made pipelines less susceptible to defects. Additionally, pipeline operators now can use technologies—for example, leak detection systems and tools for in-line inspection—that help determine the condition of pipelines and identify anomalies, such as corrosion, cracks, and dents. Leak detection systems use sensors and gauges placed along pipeline that can monitor the product passing through the pipelines and detect drops in pressure that might indicate a leak.²⁰ In-line inspections are conducted by inserting specialized tools into a pipeline through launch and retrieval points in the system to detect and record anomalies, such as metal loss and damage from corrosion (see fig. 2). In addition, the American Petroleum Institute (API) develops standards and recommended practices for industry to use to enhance various aspects of pipeline safety.²¹

²⁰Operators may also use computational monitoring systems that track changes in temperature, terrain, or distance from a pump station. These factors are all variables affecting product volume that can indicate a leak.

²¹API standards development is approved by the American National Standards Institute, which is a private, nonprofit organization whose mission is to promote and facilitate voluntary consensus standards and promote their integrity. API's membership is open to corporations involved in the oil and natural gas industry or that support the industry.

Figure 2: In-Line Inspection Tool Being Placed in a Launch Point on a Pipeline



Source: Texas Oil and Gas Association. | GAO-21-493

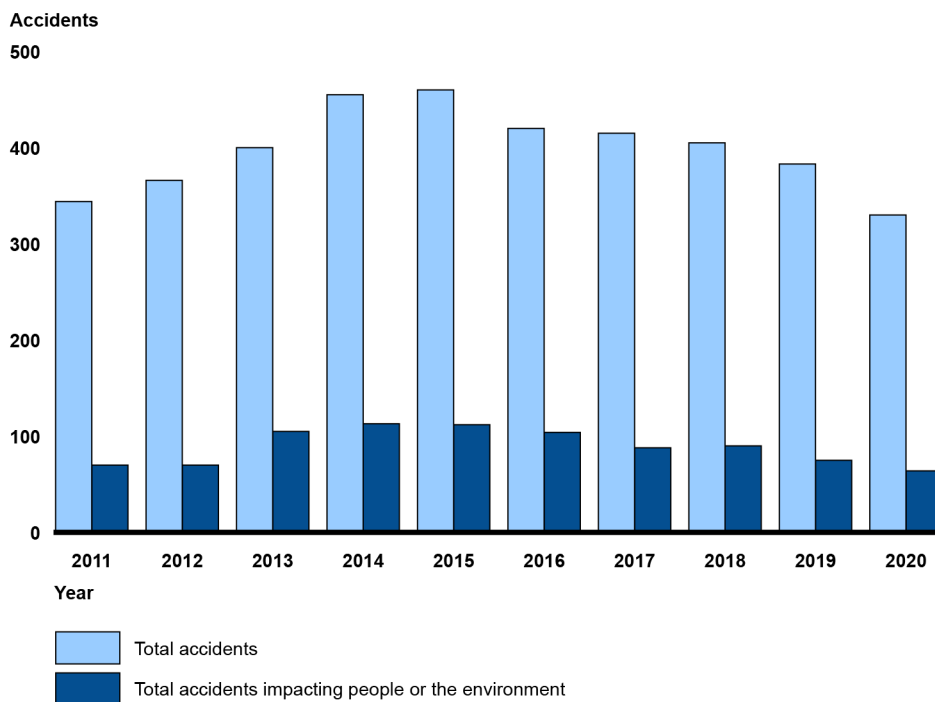
Data on Pipeline Accidents

PHMSA data show that while the number of pipeline accidents has declined in recent years, some accidents can have significant consequences. PHMSA requires operators to report information on pipeline accidents resulting in a release of hazardous liquids.²² Hazardous liquid pipeline accidents increased from 344 accidents in calendar year 2011 to 460 accidents in 2015, which had the most accidents over the 10-year period we reviewed. Operators reported 330 hazardous liquid pipeline accidents in calendar year 2020, a reduction of about 28 percent from 2015. In addition, accidents resulting in fatalities, injuries, or an impact on the environment have also declined. Specifically, accidents that PHMSA identifies as those impacting people or the environment—a performance measure that PHMSA developed with safety and industry groups—have declined about 43 percent since 2015

²²For example, PHMSA requires operators to submit information on accidents that release 5 gallons or more of product, including information on the amount, location, timing, impacts on people and the environment, and cause of the release. 49 C.F.R. § 195.50(b).

(see fig. 3).²³ According to PHMSA, while such accidents are relatively rare, they can have significant consequences. For example, according to PHMSA data, hazardous liquid pipeline accidents over the last 10 years have resulted in 8 fatalities and 14 injuries, and some accidents resulted in the release of hundreds of thousands of gallons of crude oil in HCAs.

Figure 3: Total Hazardous Liquid Pipeline Accidents and Accidents Impacting People or the Environment, Reported by Operators from Calendar Years 2011 through 2020



Source: GAO analysis of Pipeline and Hazardous Materials Safety Administration information. | GAO-21-493

²³PHMSA defines an accident as impacting people or the environment if it meets one of the following two criteria: (1) Regardless of the accident’s location, any of the following occur: a fatality, injury requiring in-patient hospitalization, ignition, explosion, evacuation, wildlife impact, contamination of specific water sources, or damage to public or private, non-operator property. (2) Where the accident’s location is not totally contained on operator-controlled property, any of the following occur: an unintentional release of equal to or greater than 5 gallons that is in an HCA, an unintentional release of equal to or greater than 5 barrels that is outside an HCA, surface water contamination, or soil contamination.

The majority of accidents in the last 10 years occurred on pipeline operators' property and were leaks rather than ruptures. PHMSA's data showed the majority of accidents in the last 10 years were contained on operator properties, such as pump stations and tank farms, and resulted in less than 5 barrels (approximately 210 gallons) of product released per accident.²⁴ For example, across the 10 years we examined (2011-2020), 72 percent of all accidents were contained on the operator's property and 61 percent of all accidents resulted in less than 5 gallons of product released per accident.²⁵ Furthermore, about 79 percent of all accidents that occurred from 2011 and 2020 were the result of a pipeline leak that, as we have previously reported, generally causes less damage than a pipeline rupture.²⁶ Only about 2 percent of all accidents that occurred from 2011 and 2020 were the result of a rupture.

Pipeline accidents are caused by a variety of factors, including manufacturing issues, like pipeline defects, and age-related integrity issues, like corrosion. From calendar years 2011-2020, PHMSA data show that the primary cause of about 50 percent of accidents impacting people or the environment was corrosion and equipment failure (see fig. 4). Corrosion can occur on the exterior or interior of a steel pipeline, and operators use a range of technologies to protect pipelines, including applying coatings and electrical current (known as cathodic protection) to prevent corrosion from occurring if a pipeline's coating is damaged.²⁷ Pipeline equipment can also fail, such as a valve malfunctioning (operators use valves to control the flow of products through pipeline) or pump cracking. Such failures may result in an accident.

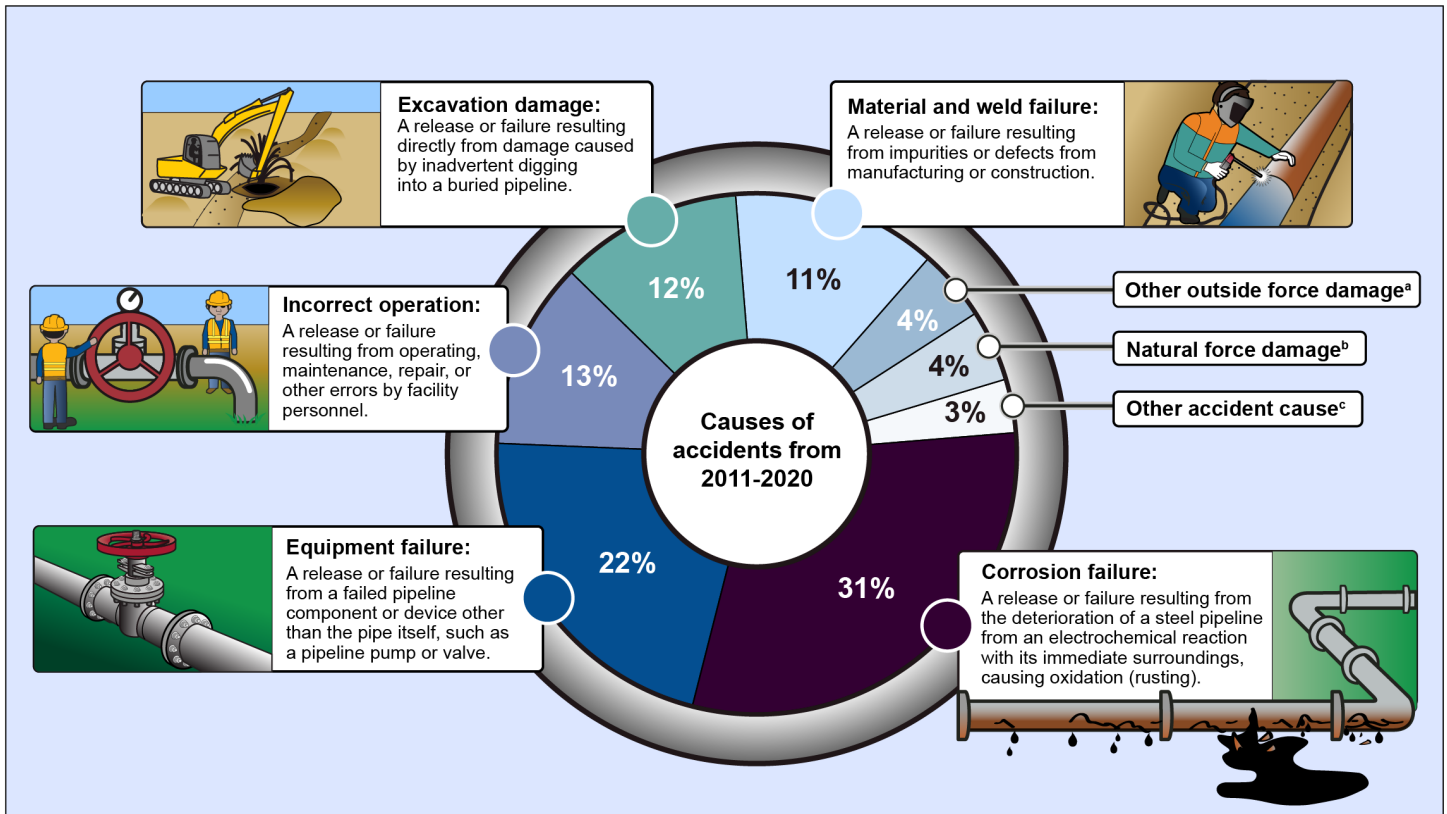
²⁴PHMSA does not require an accident report for all pipeline failures resulting in releases of hazardous liquid. For example, PHMSA does not require operators to report releases of less than 5 barrels of product resulting from pipeline maintenance activities, so long as it did not affect certain bodies of water, was confined to company property or pipeline right-of-way, was cleaned up promptly, and is not otherwise reportable. 49 C.F.R. § 195.50(b).

²⁵A barrel is equivalent to 42 gallons.

²⁶GAO, *Pipeline Safety: Better Data and Guidance Needed to Improve Pipeline Operator Incident Response*, [GAO-13-168](#) (Washington, D.C.: Jan. 23, 2013). A leak is a slow release of product over a small area and ruptures are breaches in the pipeline that may occur suddenly, resulting in hazardous liquids spilling or igniting and polluting the environment. PHMSA's accident reports also provide additional categories for release types, including mechanical puncture, overfill or overflow, and other types.

²⁷GAO, *Pipeline Safety: Additional Actions Could Improve Federal Use of Data on Pipeline Materials and Corrosion*, [GAO-17-639](#) (Washington, D.C.: Aug. 3, 2017).

Figure 4: Primary Causes of Hazardous Liquid Pipeline Accidents Impacting People or the Environment, Reported by Operators in Calendar Years 2011 through 2020



Source: GAO analysis of Pipeline and Hazardous Materials Safety Administration information. | GAO-21-493

^aOther outside force damage is a release or failure resulting from activities caused by outside parties or forces, such as vehicle or equipment contact not related to excavation, damage caused by accidents or fires from other businesses or industry that are nearby, vandalism, and sabotage or terrorism.

^bNatural force damage is a release or failure resulting from naturally occurring events, such as earthquakes, heavy rains and flooding, hurricanes, and lightning.

^cOther accident cause is a release or failure that cannot be accounted for by the other causes listed.

PHMSA’s Changes to Its Hazardous Liquid Pipeline Safety Regulations

From 2010 through 2019, PHMSA worked on amending its hazardous liquid pipeline safety regulations. In 2010, PHMSA issued an Advanced Notice of Proposed Rulemaking to amend these regulations based on the lessons learned from the Marshall, Michigan, accident that occurred

earlier that year.²⁸ In 2012, PHMSA became subject to congressional mandates to conduct studies on topics such as existing regulations for gathering lines. NTSB issued its accident investigation report on the Marshall, Michigan accident that included recommendations for PHMSA to revise and update its hazardous liquid pipeline safety regulations in that same year.²⁹ Also in 2012, we recommended that PHMSA collect data on unregulated gathering pipelines.³⁰ In response, PHMSA published a Notice of Proposed Rulemaking in 2015 to amend its hazardous liquid pipeline safety regulations and finalized these proposed amendments in the 2019 Rule.

The 2019 Rule generally expanded safety requirements for pipelines in or affecting HCAs, extended certain requirements to pipelines located outside HCAs, and modified integrity management program requirements. As described in table 1, each of these amendments to PHMSA's hazardous liquid pipeline safety regulations have different timeframes for operator compliance. Appendix II provides a detailed description of these amendments.

Table 1: Summary of the Pipeline and Hazardous Materials Safety Administration's (PHMSA) October 1, 2019, Final Rule Amending the Hazardous Liquid Pipeline Safety Regulations

Amendment	Description	Deadline for compliance
Extended reporting requirements to certain gravity and gathering lines	Operators must submit annual, accident, and safety-related condition reports on certain gravity and all previously unregulated rural gathering lines.	Annual reports: 03/31/21 Accident reports: 01/01/21 Safety-related condition reports: 01/01/21
Required inspections of pipelines in areas affected by extreme weather events and natural disasters	Operators must commence inspections of all potentially affected pipeline facilities within 72 hours after the cessation of extreme weather events or other natural disasters.	Effective 7/1/20 (ongoing)

²⁸Pipeline Safety: Safety of On-Shore Hazardous Liquid Pipelines, 75 Fed. Reg. 63,774 (proposed Oct. 18, 2010).

²⁹For example, NTSB recommended that PHMSA require operators to notify PHMSA when an operator has not obtained information about a condition to make a determination about its threat within 180 days and to indicate an expected date when such information will be available.

³⁰GAO, *Pipeline Safety: Collecting Data and Sharing Information on Federally Unregulated Gathering Pipelines Could Help Enhance Safety*, GAO-12-388 (Washington, D.C.: Mar. 22, 2012). Prior to the 2019 Rule, many gathering pipelines were not subject to PHMSA regulations because they are generally located away from population centers and operate at low pressures.

Amendment	Description	Deadline for compliance
Expanded use of leak detection systems	Operators must have leak detection systems for all covered pipelines in high consequence areas (HCAs) and non-HCAs.	For pipelines constructed prior to 10/01/19: completed by 10/01/24 For pipelines constructed on or after 10/01/19: completed by 10/01/20
Required integrity assessments of pipelines outside of HCAs	Operators must assess certain non-HCA pipeline segments with an in-line inspection tool at least once every 10 calendar years.	Initial assessment of segments to be completed by 10/01/29
Increased accommodation of in-line inspection tools	Operators must ensure that all pipelines located in HCAs and areas that could affect an HCA are made capable of accommodating in-line inspection tools.	Completed within 20 years (by 07/02/40), unless otherwise specified by regulation
Other key amendments	PHMSA made changes to operators' integrity management programs, such as requiring operators to consider certain new data when analyzing the integrity of pipeline segments and verify pipeline risk factors used to identify pipeline segments that could affect an HCA on at least an annual basis.	Must begin to integrate the new data elements starting on 10/01/20 with all attributes integrated by 10/01/22 First annual verification must be completed no later than 07/01/21

Source: GAO analysis of PHMSA's October 1, 2019 Final Rule. | GAO-21-493

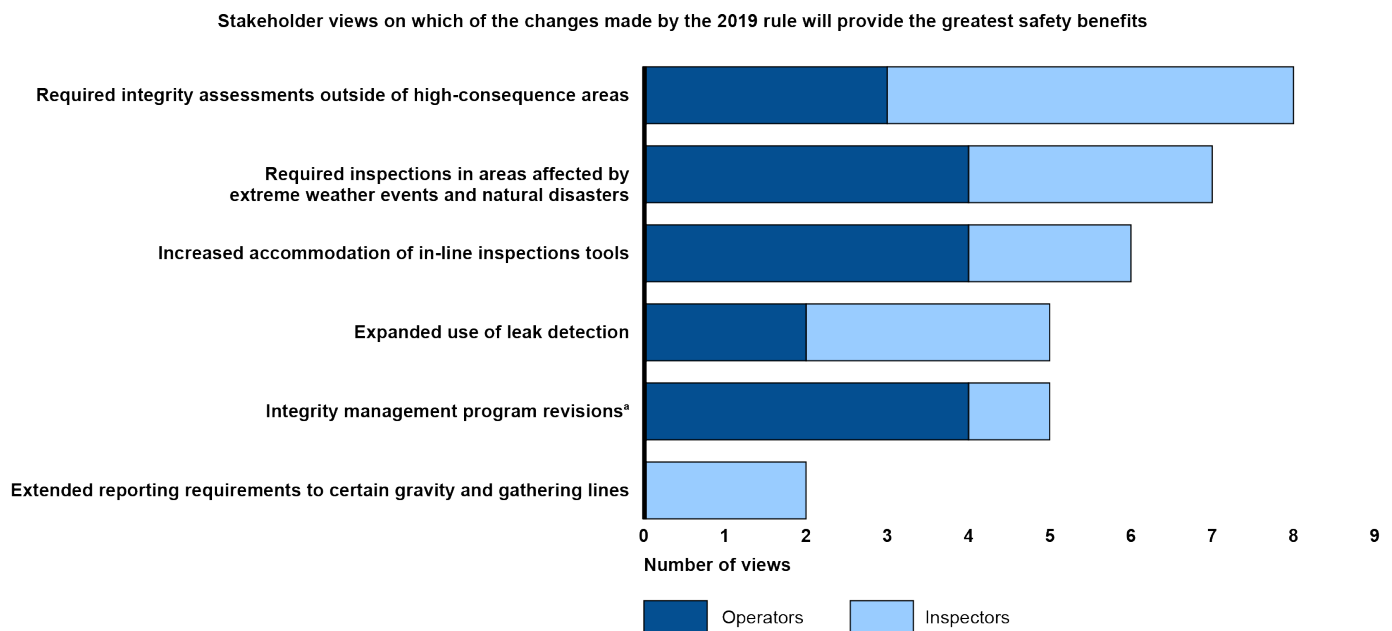
Note: Pipeline Safety: Safety of Hazardous Liquid Pipelines, 84 *Fed. Reg.* 52,260 (Oct. 1, 2019) (amending 49 C.F.R. pt. 195). There are certain pipelines and circumstances to which these amendments do not apply. Some of these exceptions are detailed in appendix II.

Selected Stakeholders Identified Likely Safety Benefits and Few Operational Challenges from PHMSA's Changes to Its Hazardous Liquid Pipeline Regulations

Selected Stakeholders Said Increased Inspection Requirements and Other Changes Made by the 2019 Rule Would Enhance Safety

Selected stakeholders we interviewed—including pipeline operators, officials from PHMSA, and selected state pipeline safety offices (state agencies)—generally told us that the changes made by the 2019 Rule would enhance the safety of hazardous liquid pipelines. We provided these stakeholders a list of the key changes and asked them to identify which among these would likely provide the greatest benefit to safety. Figure 5 below summarizes selected stakeholder views (see appendix II for the list and additional details of these amendments).

Figure 5: Views of Selected Pipeline Operators, of Pipeline and Hazardous Materials Safety Administration Officials, and of State Officials on which of the Changes Made by the 2019 Rule Will Likely Provide the Greatest Safety Benefits



Source: GAO analysis of stakeholder interviews. | GAO-21-493

Note: Selected stakeholders included 11 pipeline operators, officials from PHMSA’s 5 regional offices, and officials from 6 state pipeline safety offices. Some respondents identified more than one of the amendments made by the 2019 Rule. Pipeline Safety: Safety of Hazardous Liquid Pipelines, 84 Fed. Reg. 52,260 (Oct. 1, 2019) (amending 49 C.F.R. pt. 195).

^aIntegrity management program revisions include changes to information analysis, integrity management baseline assessment plans, and verifying covered segments. See appendix II for additional information.

While some operators and state agencies we interviewed said that all of the major rule changes would benefit pipeline safety, stakeholders most frequently cited two changes as offering the greatest safety benefit.

-
- **Integrity assessments of pipelines located outside HCAs.** This change generally required operators to assess onshore pipelines located in areas outside of HCAs (“non-HCAs”) at least once every 10 years from the year of the prior assessment.³¹ Pipelines in non-HCAs account for about 130,000 miles or about 58 percent of all regulated hazardous liquid pipelines, according to our analysis of PHMSA data. This change also requires operators to perform these integrity assessments of pipelines by using ILI tools to identify threats to pipeline segments, including any anomalies. Three operators and officials from five federal and state pipeline safety offices stated that conducting assessments of pipelines in non-HCAs would provide pipeline integrity information on a greater amount of pipeline and on pipelines that had not been previously assessed.
 - **Inspections of pipelines after extreme weather events or natural disasters.** This change requires operators to begin inspection of pipelines within 72 hours of extreme weather events, such as tropical storms, landslides, earthquakes, and other natural disasters that are likely to damage pipeline infrastructure. The change also requires operators to determine what damage may have occurred and to remediate any damage that has been discovered, as necessary. According to one operator we interviewed, this change built on existing recommended industry practices and a prior PHMSA advisory bulletin that had primarily addressed pipeline inspection after flooding events.³² Additionally, two operators as well as one federal and two state pipeline safety inspectors said that the change would broadly benefit pipeline safety because it elevated a voluntary practice to a regulatory requirement, which standardized it across the industry. Several operators we interviewed said they were already conducting such inspections as a matter of company policy.

In addition, selected stakeholders also cited other changes as providing safety benefits, including:

- **Accommodation of ILI tools.** This change required operators to ensure all pipelines located in HCAs or in areas that could affect an HCA can accommodate ILI tools within 20 years of the issuance of the

³¹As previously noted, under the hazardous liquid pipeline regulations, HCAs generally include high population areas, other populated areas, certain navigable waterways, and areas unusually sensitive to environmental damage. 49 C.F.R. § 195.450. An integrity management program is required for any transmission and non-rural gathering pipeline that the operator identifies as in or affecting an HCA. *Id.* § 195.452(a).

³²Pipeline Safety: Potential for Damage to Pipeline Facilities Caused by Flooding, River Scour, and River Channel Migration, 84 Fed. Reg. 14,715 (Apr. 11, 2019).

2019 Rule. Several operators said they would need to modify existing pipeline to accommodate ILI tools. One operator noted that ILI tools are a better means of detecting pipeline anomalies such as corrosion, cracks, or dents in the pipeline walls than other methods. However, the change made by the 2019 Rule also permits operators to petition PHMSA for a finding that this requirement does not apply if operators cannot modify the basic construction of a pipeline to accommodate ILI tools, or when the cost of modification would result in abandoning or shutting down the pipeline.

- **Leak detection systems.** This change required operators to install a system for detecting leaks on all segments of their pipelines, whether or not a segment is in an HCA. One of the selected operators said that leak detection systems enable the quick identification of leaks and mitigation of potential damage, and one of the selected state pipeline agencies said that expanded use of leak detection would formalize and apply to the industry at large a practice that had already been implemented by many operators.
- **Integrity management program revisions.** These changes: (1) added additional data elements for operators to integrate into their information analysis of the integrity of their pipelines;³³ (2) required operators to use ILI tools, when practicable, when preparing integrity assessments;³⁴ and (3) established the frequency at which operators must verify the risk factors they used in identifying pipeline segments that could affect an HCA.³⁵ One selected operator said that the requirement to analyze additional data collected through ILI or other inspections for information analysis would benefit pipeline safety because it would allow additional risk-based analysis to inform repair decisions. Another selected operator said that the change requiring expanded use of ILI tools when developing integrity management baseline assessment plans would help operators to identify pipeline anomalies before they might result in an accident.

³³For information analysis, operators must analyze all available information about the integrity of a given pipeline and the consequence of possible failure. 49 U.S.C. § 195.452(g). The amendment identified 21 data elements, including aerial photography, location of foreign line crossings, seismicity, and corrosion protection survey results that must be integrated into this information analysis by October 1, 2022.

³⁴If using ILI tools are impracticable, the 2019 Rule provides alternative methods for these assessments. This requirement became effective as of July 1, 2020.

³⁵Operators must complete the first verification no later than July 1, 2021 and conduct them on at least an annual basis, not to exceed 15 months.

Selected Stakeholders Identified Few Operational Challenges to Implementing PHMSA's Changes, but Operators Noted Potential Cost Increases

Selected Stakeholders Views on Challenges

Selected stakeholders we interviewed—including pipeline operators and federal and states' pipeline safety offices we interviewed—generally said changes made by the 2019 Rule would not pose significant operational challenges. For example, some stakeholders noted: (1) some of the more costly amendments, such as the accommodation of ILI tools, are mitigated by long phase-in periods; and (2) that the 2019 Rule codified and expanded in regulation certain safety practices that already existed as industry best practices or practices recommended in PHMSA advisory bulletins.³⁶

All 11 of the selected operators told us they were already performing at least one of the safety practices required by the amendments made by the 2019 Rule. For example, eight operators said that they were already performing integrity assessments of pipelines in non-HCAs prior to the issuance of the 2019 Rule. Additionally, one operator and a federal and a state pipeline agency noted that Texas already requires operators within its state to perform integrity assessments of pipelines in non-HCAs. Further, seven operators said that they were already conducting inspections of their pipelines after extreme weather events. Finally, another operator noted that since the rulemaking process had taken several years, it anticipated some of the changes and had begun taking steps to implement them prior to the issuance of PHMSA's 2019 Rule.

³⁶For example, in 2007, API published a recommended practice that among other things, established criteria for a specific type of leak detection system, known as a computational monitoring. API, *Computational Pipeline Monitoring for Liquids, Pipeline Segment*, Recommended Practice 1130, Third Edition (Washington, D.C., Sept. 2007). In addition, stakeholders told us that the change requiring inspections of pipelines after extreme weather events or natural disasters built upon information in PHMSA's April 2019 Advisory Bulletin that suggested operators take actions to prevent and mitigate damage to pipeline facilities caused by severe flooding. Pipeline Safety: Potential for Damage to Pipeline Facilities Caused by Flooding, River Scour, and River Channel Migration, 84 Fed. Reg. 14,715 (Apr. 11, 2019).

In addition to operators, officials from the five PHMSA regional offices and six selected state pipeline safety offices we interviewed generally said that they did not anticipate any oversight challenges resulting from the changes made by the 2019 Rule. For example, PHMSA officials said that to implement the changes, the agency added an additional 59 audit questions to its more than 5,000-question Inspection Assistant tool, a comprehensive set of audit questions that federal inspectors use for the various types of pipeline inspections. PHMSA and state agencies officials also stated that although the amendments will create some additional work for them, they will not affect their inspection costs.

PHMSA regional offices and state agency officials noted, however, that some of the amendments would require more effort to monitor operator's compliance with them than others would. For example, the officials stated that prescriptive requirements—such as whether an operator had filed a report by a deadline or had installed leak detection systems on their pipelines—would be the easiest for them to monitor. Conversely, the inspectors cited requirements that called for them to make performance-based evaluations—such as evaluating steps operators took to identify interactive threats—would require additional analysis or the application of criteria by the inspector. Moreover, PHMSA regional offices and state agency officials noted that much of the additional work resulting from the changes would depend on the circumstances of individual operators. For example, PHMSA officials said that some smaller operators, lacking the resources of larger entities, may need more assistance with bringing their safety program into compliance. Similarly, several state pipeline safety officials noted that the additional time inspectors would need to spend with a particular operator would depend on the experience, knowledge, and resources of that operator.

Selected Operators' Views on Potential Costs

While more than half of the selected operators said they had not attempted to quantify the potential costs, all identified specific amendments that could result in cost increases.³⁷ For example, they said potential cost areas would include:

- **Training and staffing.** While nearly all of the selected operators said that they would provide additional training to their staff to comply with

³⁷PHMSA's final regulatory impact analysis estimated the total annualized costs for all operators to comply with the amended regulations to be around \$21 million. Doc. No. PHMSA-2010-0229-0137, *Regulatory Impact Analysis: Safety of Hazardous Liquid Pipelines*, § 5.2 (2019). We did not assess the accuracy or reliability of PHMSA's cost estimate.

the changes, several of the smaller operators said they would likely need to hire contractors to do so. For instance, one small operator, with a fewer than 60 miles of hazardous liquid pipeline, said it would need to hire a contractor to conduct ILI inspections and data analysis to support integrity assessments of its pipelines located in non-HCAs. However, the medium and large operators we interviewed generally said that they did not anticipate having to increase their workforce to comply with the changes made by the 2019 Rule.³⁸ For example, two of the selected larger operators noted that, they had the staff to absorb the additional work required.

- **Pipeline modification.** Four of the selected operators said they would need to modify some of their pipelines to meet the amended requirement that pipelines in both HCAs and non-HCAs accommodate ILI tools within 20 years. For example, one large operator said that the greatest cost effect from the changes involve making all pipelines ILI compatible, particularly for older legacy pipelines that were built before the existence of ILI tools. According to this operator, about 10 percent of its more than 10,000 miles of hazardous liquid pipelines are not ILI compatible. Similarly, another large operator told us that it currently has more than 200 pipeline segments in its 50,000 miles of pipeline that are unable to accommodate ILI tools.³⁹
- **Equipment acquisition.** Six of the selected operators we interviewed said that they would likely need to buy additional instruments and software to comply with several of the amendments made by the 2019 Rule. For example, five of the selected operators said they would need to acquire additional software, including software to help analyze the spatial relationships of anomalies and pipeline conditions identified in ILI assessments, to integrate the new data elements into their information analysis for pipeline integrity as required. Two operators said they had already acquired, or would also need to acquire, additional hardware to expand their use of leak detection. For example, one small operator said that given the very rural location of its pipelines, it would need to acquire additional transmitters and meters for its leak detection systems.

³⁸We categorized operator size using the American Petroleum Institute's definition: extra-large (more than 20,000 miles of pipeline); large (2,000-20,000 miles); medium (300-2,000 miles) and small (fewer than 300 miles).

³⁹The 2019 Rule provides that if an operator believes that a pipeline's modification would be impracticable due to its basic construction or that the cost of compliance would result in abandoning or shutting down the pipeline, it may petition PHMSA for a finding that this requirement should not be applied to the pipeline.

PHMSA Has Taken Steps to Communicate the Changes Made by the 2019 Rule to Stakeholders but Has Not Developed Measures to Assess the Changes' Effect on Safety

PHMSA Has Conducted Outreach and Taken Other Steps to Inform Stakeholders of the Changes

PHMSA has taken several actions to inform stakeholders of the changes made by the 2019 Rule. In October 2019, PHMSA established an implementation team, including officials from PHMSA's regional offices and state pipeline safety offices, to oversee the implementation of the amendments. According to PHMSA, the purpose of the implementation team is to facilitate compliance with the amended pipeline safety regulations by hosting meetings with stakeholders, providing written guidance, and updating inspection and training materials.

- **Meetings.** According to PHMSA officials, PHMSA met with PHMSA regional offices and with representatives from the National Association of Pipeline Safety Representatives to brief them on the changes.⁴⁰ In February 2020, PHMSA's implementation team also held a public and web-based video workshop to discuss these changes, and the agency posted the taped webcast and associated workshop documents on its website.
- **Written guidance.** At its February 2020 workshop, PHMSA presented and sought stakeholder comment on a draft of frequently asked questions (FAQs), intended to help support stakeholders understanding of the changes. According to PHMSA, it often uses FAQs as guidance to help industry comply with its pipeline safety regulations. In November 2020, PHMSA published the revised

⁴⁰The National Association of Pipeline Safety Representatives represents states' pipeline safety personnel in the contiguous United States as well as the District of Columbia and Puerto Rico.

hazardous liquid pipeline FAQs on its website, which clarified the effective dates for changes, among other things.

- **Inspection materials.** PHMSA updated inspection materials, such as questionnaires, used by federal and state hazardous liquid pipeline inspectors to reflect the changes made by the 2019 Rule. According to PHMSA, when it inspects facilities for compliance with applicable regulations, PHMSA inspectors ask a predetermined set of questions to ascertain an operator's compliance with those regulations. PHMSA updated the hazardous liquid pipeline inspection questions to include additional questions related to the changes.
- **Training.** According to PHMSA officials, the agency provided training on the amendments made by the 2019 Rule to all of its regional offices and to state agency officials through the National Association of Pipeline Safety Representatives. In addition, PHMSA officials told us they are in the process of integrating information on the amendments into several courses provided at PHMSA's National Training Center in Oklahoma, which is where PHMSA provides federal and state inspectors with instructor-led training courses.

The majority of selected pipeline operators and PHMSA regional office and selected state agency officials told us that PHMSA's efforts to communicate the changes made by the 2019 Rule to stakeholders were sufficient for their needs. For example, officials from one PHMSA region told us that they benefited from having staff members assigned to PHMSA's implementation team because they were able to leverage these staff as a resource when reviewing the changes.

PHMSA Has Agency Safety Goals for Hazardous Liquid Pipelines, but Does Not Have Performance Measures to Assess the Changes

While PHMSA has identified several desired outcomes for its 2019 Rule that support PHMSA's agency goals for the safety of hazardous liquid pipelines, it has not established performance measures with targets or timeframes to monitor progress in achieving its desired outcomes.

The GPRA Modernization Act of 2010, as amended, requires that agencies prepare annual performance plans that include agency performance goals, establish performance measures to assess the progress towards the goals, and later evaluate whether the goals have

been met.⁴¹ We have previously found that these requirements for establishing goals and measures can serve as leading practices for planning programs and activities at lower levels of an organization, such as component agencies.⁴² These leading practices call for agencies to track progress of their activities toward achieving desired outcomes by using performance measures that include targets for expected levels of performance and timeframes for achieving that performance.⁴³ Additionally, our prior work has also found that agencies should use performance information to identify gaps between actual and expected performance, assess the effectiveness and efficiency of processes, and promote continuous improvement, in order to ensure that programs achieve their goals.⁴⁴

In accordance with the GPRA Modernization Act of 2010, PHMSA established agency goals for the safety of hazardous liquid pipelines and related performance measures with targets and timeframes for performance. Specifically, according to DOT's *2021 Annual Performance Plan*, PHMSA's agency safety goals include (1) reducing fatalities caused by pipelines and hazardous materials and (2) improving the safe delivery

⁴¹GPRA Modernization Act of 2010 § 3 (codified as amended at 31 U.S.C. § 1115). According to the Government Performance and Results Act of 1993 (GPRA), Pub. L. No. 103-62, 107 Stat. 285 (1993), which the GPRA Modernization Act of 2010 amended, the purpose of these requirements is to improve the effectiveness of federal programs by establishing a system for agencies to set goals for program performance and measure results. GPRA § 2(b). See also GAO, *Executive Guide: Effectively Implementing the Government Performance and Results Act*, [GAO/GGD-96-118](#) (Washington, D.C., June 1996). This guide defines a range of practices federal agencies can take to improve their overall performance.

⁴²[GAO/GGD-99-69](#). While GPRA, as amended, is applicable at the department or agency level, performance goals and measures are important management tools applicable to all levels of an agency, including the program, project, or activity level, consistent with leading practices and internal controls related to performance monitoring.

⁴³[GAO/GGD/AIMD-99-69](#).

⁴⁴[GAO/GGD-96-118](#).

of pipeline products and hazardous materials.⁴⁵ In addition, PHMSA's 2019 Rule states that its desired outcomes are to reduce: (1) injuries and fatalities; (2) cleanup and response costs; (3) property damage and product loss; and (4) ecosystem effects. However, PHMSA officials told us that they have not yet established performance measures that define the targeted level of performance within specific timeframes to achieve these outcomes.

According to PHMSA officials, the agency has not developed performance measures or targets to evaluate the changes made by the 2019 Rule because many of these changes have long-term deadlines for compliance and performance data will not be available for several years. However, some pipeline operators told us that they had begun implementing these long-term requirements. For example, although operators have until July 2, 2040, to ensure their pipelines can accommodate in-line inspection tools, one operator told us that it planned to prioritize pipeline modifications to segments that pose a higher safety risk, despite having 20 years to meet this requirement. While these changes have long-term deadlines, we have previously reported that agencies can use intermediate or multi-year goals or measures to define intended results and show an indication of the incremental progress or contribution toward relatively long-term goals.⁴⁶ In addition, there are amendments that have relatively short-term deadlines for compliance that PHMSA will have data available that would enable it to develop measures. For example, the amendment requiring operators to conduct pipeline inspections after extreme weather events and natural disasters became effective in July 2020, and the amendment requiring operators to report accidents on certain gravity and gathering lines became effective in March 2021.

⁴⁵DOT, *FY 2021 Performance Plan and FY 2019 Performance Report* (Mar. 23, 2020). The performance goal of reducing fatalities is measured by the annual number of confirmed fatalities caused by the release of hazardous materials transported via pipeline or surface transportation conveyance. The performance goal of improving the safe delivery of products is measured by the annual number of accidents involving death or major injury resulting from the transport of hazardous materials by all modes, including pipelines, by gross and net volume in barrels of pipeline hazardous liquid spilled; and the number of hazardous material accidents reported annually. The performance plan also identified preventing excavation damage to gas and hazardous liquid pipelines as a goal. For each of these measures, PHMSA established an annual target for the expected level of performance in its annual performance plan.

⁴⁶[GAO/GGD-99-69](#).

PHMSA has recognized the importance in measuring performance of its rules, but has not specified how it will do so for the changes made by the 2019 Rule. To guide the implementation of final rules, PHMSA prepared in February 2021 a *Fundamental Guide for Pipeline Safety Final Rule Implementation (the Guide)*.⁴⁷ The Guide provides examples of potential measures that could be used for assessing performance of rules—such as by examining safety factors that relate to injuries, deaths, and environmental impact or by assessing operational factors that relate to the number of inspections performed per year. PHMSA officials told us they intend to complete a more detailed standard operating procedure for the 2019 Rule’s implementation by December 2021, but it is not clear if the standing operator procedure will include guidance related to developing performance measures with targets and timeframes.

PHMSA has previously developed measures to assess the performance of its safety programs, and it is currently collecting data that could be helpful in assessing the safety effects of the changes made by the 2019 Rule. For example, in response to a recommendation in our 2019 report, PHMSA recently established performance goals and measures to demonstrate improvements to safety outcomes for the natural gas storage program.⁴⁸ Moreover, PHMSA already collects data from operators’ annual reports, accident reports, and safety-related condition reports that could be useful in assessing the safety effects of the changes.⁴⁹ For example, PHMSA officials told us that they could use these data to monitor changes in the number of safety-related conditions operators discover and the number of repairs operators make in complying with the amended safety regulations, such as the required integrity assessments for pipelines located outside HCAs or inspections after extreme weather events. PHMSA could also assess the number or percentage of non-HCA pipeline segments operators report as having

⁴⁷The *Guide* states that implementation plans should include goals and objectives, responsibilities of the implementation team, implementation schedule, resources, and contingency plans.

⁴⁸We previously recommended that PHMSA establish the level of performance to be achieved by its natural gas storage program to assess whether the program is supporting DOT’s department-wide goal to promote safety performance. GAO, *Natural Gas Storage: Actions Needed to Assess Inspection Workload and Progress toward Safety Outcomes*, [GAO-20-167](#) (Washington, D.C.: Oct. 16, 2019).

⁴⁹Safety-related conditions include general corrosion that has reduced the wall thickness of the pipeline to less than required for the maximum operating pressure, unintended movement of a pipeline by environmental causes such as a natural disaster that impairs its serviceability, or any material defect that impairs its serviceability. 49 C.F.R. § 195.55.

been inspected with an in-line inspection tool to assess their progress in complying with this change. Establishing performance measures with targets and timeframes to assess the changes made by the 2019 Rule would enable PHMSA to assess its progress towards achieving the goals, identify gaps between actual and expected performance, and make timely adjustments to improve performance, as needed.

Conclusions

Although hazardous liquid pipeline accidents are relatively infrequent, leaks and ruptures still occur and can cause fatalities, injuries, and environmental damage. PHMSA's 2019 Rule amending its hazardous liquid pipeline safety regulations has the potential to further improve the safety of hazardous liquid pipelines, which have seen reductions in accidents impacting people and the environment in recent years. However, because PHMSA has not developed performance measures for the amendments, it does not have a means to gauge whether these changes are helping it achieve the desired safety outcomes of its 2019 Rule or its broader safety goals for hazardous liquid pipelines. Developing measures that identify the expected level of performance to be achieved from the changes within specific timeframes would enable PHMSA to assess the extent to which the implementation of the 2019 Rule is achieving the desired outcomes, including improving safety. Further, such performance measures would give PHMSA information it can use to identify and implement any adjustments needed to better meet safety goals.

Recommendation for Executive Action

The PHMSA Administrator should develop and use performance measures to assess whether the amendments made by its 2019 Rule to its hazardous liquid pipeline safety regulations are achieving their desired outcomes and contributing to PHMSA's safety goals for hazardous liquid pipelines. These measures should include targets for the expected levels of performance to be achieved and specific timeframes in which to achieve these results. (Recommendation 1)

Agency Comments

We provided a draft of this report to DOT for comment. In written comments, DOT concurred with the report's recommendation and stated it would provide a detailed response to this recommendation within 180 days of the final report's issuance. The complete comment letter is reproduced in appendix III.

We are sending copies of this report to the appropriate congressional committees, the Secretary of Transportation, and other interested parties. In addition, the report is available at no charge on the GAO website at <https://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-2834 or repkoe@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made contributions to this report are listed in appendix IV.

A handwritten signature in black ink, appearing to read "Elizabeth Repko", followed by a long horizontal line extending to the right.

Elizabeth Repko, Acting Director
Physical Infrastructure Issues

Appendix I: Objectives, Scope, and Methodology

The Protecting our Infrastructure of Pipelines and Enhancing Safety Act of 2016 (PIPES Act of 2016) includes a provision for GAO to report on integrity management programs for hazardous liquid pipeline facilities within 18 months of the issuances of a specific final rule by the Pipeline and Hazardous Materials Safety Administration's (PHMSA) that would amend its hazardous liquid pipeline safety regulations.¹ In October 2019, PHMSA issued the final rule amending these regulations to improve protection of the public, property, and environment.² This report examines: (1) the perspectives of selected hazardous liquid pipeline stakeholders on the benefits and challenges of the amendments made by the 2019 Rule, and (2) the steps PHMSA has taken to inform stakeholders of the amendments and to measure their effect on hazardous liquid pipeline safety.

To address these objectives, we reviewed relevant statutes, regulations, and PHMSA's policies, procedures, and guidance for operators on pipeline safety practices and the roles and responsibilities of federal and state inspectors. We also reviewed publications and studies from the National Transportation Safety Board and industry and non-industry groups on topics related to the safety of hazardous liquid pipelines. These documents were selected based on a literature search and suggestions from PHMSA officials and stakeholders, among other things. We used the most recent data from PHMSA's operator annual report (2019) to describe the characteristics of the U.S. hazardous liquid pipeline system, including pipeline miles; type of pipeline (e.g., transmission and gathering); and the number of pipeline operators that reported to PHMSA.³ We also analyzed PHMSA's data from 2011 to 2020 on hazardous liquid pipeline accidents, including the number, barrels of product released, location, cause, and whether the accident is identified

¹Pub. L. No. 114-183, § 5, 130 Stat. 514, 517 (2016).

²Pipeline Safety: Safety of Hazardous Liquid Pipelines, 84 Fed. Reg. 52,260 (Oct. 1, 2019) (amending 49 C.F.R. pt. 195). We will refer to this as the 2019 Rule.

³Within the nationwide network of hazardous liquid pipelines, there are two main types of pipelines—gathering and transmission pipelines. Transmission pipelines carry hazardous liquids over hundreds of miles to where products, such as gasoline and fuel oils, are stored and then transported, typically by trucks, to gas stations or homes for heating. These pipelines are typically from 12 inches to 42 inches in diameter and have greater operating pressure than gathering pipelines. Gathering pipelines transport hazardous liquids from oil well heads to processing facilities, which in turn refine them and send the products to transmission pipelines. Gathering pipelines are typically less than 9 inches in diameter and are generally located in rural areas.

as one impacting people or the environment.⁴ We assessed the reliability of PHMSA data by speaking with agency officials about data control procedures and reviewing agency documentation. We determined that these data were sufficiently reliable to describe characteristics of the pipeline network and accidents that occur along that network. In addition, we reviewed six key amendments PHMSA made to its hazardous liquid pipeline safety regulations in its 2019 Rule and reviewed PHMSA's *Regulatory Impact Analysis*, which describes its analysis of the costs and benefits of these changes.⁵ Appendix II describes the six key amendments in more detail.

To obtain stakeholder views of the amendments made by the 2019 Rule, we provided selected hazardous liquid pipeline stakeholders with a summary of the six key amendments noted above and interviewed them on the benefits and challenges of complying with them, including related costs, feasibility, and effect on pipeline safety. These stakeholders included pipeline associations, safety and environmental groups, hazardous liquid pipeline operators, and officials from PHMSA's regional offices and state pipeline safety offices. The views presented in our report provide perspectives of a range of knowledgeable stakeholders on the changes, but are not generalizable to all stakeholders.

- **Pipeline associations and organizations.** We selected the national pipeline associations and pipeline safety and environmental advocacy groups based on their written comments submitted to PHMSA on the amendments to the hazardous liquid pipeline safety regulations that it

⁴PHMSA defines an accident as impacting people or the environment if it meets one of the following two criteria: (1) Regardless of the accident's location, any of the following occur: a fatality, injury requiring in-patient hospitalization, ignition, explosion, evacuation, wildlife impact, contamination of specific water sources, or damage to public or private, non-operator property. (2) Where the accident's location is not totally contained on operator-controlled property, any of the following occur: an unintentional release of equal to or greater than 5 gallons that is in an HCA, an unintentional release of equal to or greater than 5 barrels that is outside an HCA, surface water contamination, or soil contamination.

⁵Pipeline and Hazardous Material Safety Administration, Doc. No. PHMSA-2010-0229-0137, *Regulatory Impact Analysis: Safety of Hazardous Liquid Pipelines* (2019).

proposed in 2015 and which were finalized in the 2019 Rule.⁶ Based on these submissions, we selected three national pipeline associations and four pipeline-safety and environmental-advocacy organizations to interview (see table 2).

Table 2: Hazardous Liquid Pipeline Associations and Organizations Selected for Interviews

Stakeholder	Type of stakeholder
Association of Oil and Pipelines	Industry association
American Petroleum Institute	Industry association
GPA Midstream	Industry association
Pipeline Safety Trust	Safety association
Environmental Defense Center	Environmental advocacy organization
Environmental Law and Policy Center	Environmental advocacy organization
National Wildlife Association	Environmental advocacy organization

Source: GAO. | GAO-21-493

- Hazardous liquid pipeline operators.** We reviewed the most recent data from PHMSA’s operator annual report (2019) to identify operators for our interviews. We identified 512 hazardous liquid pipeline operators that have been assigned Operator Identification Numbers.⁷ We then selected a non-generalizable sample of 11

⁶Pipeline Safety: Safety of Hazardous Liquid Pipelines, 80 Fed. Reg. 61,610 (proposed Oct. 13, 2015). We reviewed 80 submissions to PHMSA’s 2015 Notice of Proposed Rulemaking and identified 14 pipeline associations, 28 pipeline safety and environmental advocacy organizations. From these, we selected 3 national pipeline associations which represent hazardous liquid pipeline operators overseeing transmission and gathering pipelines. We also selected 4 pipeline safety and environmental advocacy organizations which represented national and regional interests as they could provide a broad perspective on the 2019 Rule’s effect on hazardous liquid pipeline safety.

⁷Under PHMSA’s regulations, each operator of a hazardous liquid pipeline or pipeline facility must obtain from PHMSA an Operator Identification Number (OPID). 49 C.F.R. § 64. An OPID is assigned to an operator for the pipeline or pipeline system for which the operator has primary responsibility. *Id.* We estimated the number of hazardous liquid pipeline operators with OPIDs based on the annual reports submitted to PHMSA for hazardous liquid pipeline. Operators may have multiple OPIDs and so submit multiple reports for the pipelines for which operators have primary responsibility using the applicable OPID. We consolidated the OPIDs across the 2019 annual report to estimate the number of operators that reported to PHMSA. As operators may be assigned more than one OPID, the number of OPIDs assigned are not a one-for-one correspondence to the number of pipeline operators. In 2019, there were 278 distinct OPIDs that reported managing pipeline systems with fewer than 50 pipeline miles and 225 OPIDs managing pipeline systems over 50 pipeline miles.

operators that manage a range of regulated pipeline systems, including those of different types (e.g., transmission and gathering); size (pipeline miles); and commodities transported (e.g., crude oil, refined petroleum products, and highly volatile liquids) (see table 3). We categorized operator size using the American Petroleum Institute’s definition from its cost-benefit analysis of PHMSA’s 2015 Notice of Proposed Rulemaking: extra-large (more than 20,000 miles); large (2,000-20,000 miles); medium (300-2,000 miles); and small (fewer than 300 miles).⁸ Of the 11 operators we interviewed, one operator oversaw an extra-large pipeline system, four operators oversaw large pipeline systems; three operators oversaw medium pipeline systems; and three operators oversaw small pipeline systems.

Table 3: Hazardous Liquid Pipeline Operators Selected for Interviews

Pipeline operator	Total regulated hazardous Liquid pipeline miles (size)	Commodities transported
Moda Ingelside	50 (small)	Crude oil, highly volatile liquids
3 Bear Energy	53 (small)	Crude oil, highly volatile liquids
Enable Midstream	244 (small)	Crude oil, highly volatile liquids, refined and/or petroleum product
Crimson Gulf LLC	832 (medium)	Crude oil
Enlink	1,212 (medium)	Crude oil, highly volatile liquids, refined and/or petroleum product
True Company	1,673 (medium)	Crude oil, refined and/or petroleum product
BP Pipelines	3,133 (large)	Crude oil, highly volatile liquids, refined and/or petroleum product
Energy Transfer	3,528 (large)	Crude oil, highly volatile liquids
Marathon Pipeline	8,270 (large)	Crude oil, highly volatile liquids, refined and/or petroleum product
Phillips 66	12,111 (large)	Crude oil, highly volatile liquids, refined and/or petroleum product
Enterprise Products	25,896 (extra-large)	Crude oil, highly volatile liquids, refined and/or petroleum product

Source: GAO. | GAO-21-493

- PHMSA regional office and state agency officials.** We interviewed officials from PHMSA’s five regional offices and from selected state regulatory agencies that conduct inspections on certain regulated pipelines, as well as representatives from the association that represents states’ pipeline safety personnel (see table 4). We selected six state regulatory agencies based on total miles of regulated transmission pipeline, including three states that have

⁸American Petroleum Institute, *Hazardous Liquids Rule Cost/Benefit Analysis: A Review of the Hazardous Liquid Pipelines Notice of Proposed Rulemaking (NPRM) and Preliminary Regulatory Impact Analysis (PRIA)* (July 11, 2016).

assumed authority to inspect pipelines located within their states (intrastate pipelines) and three states that also are authorized by PHMSA to inspect pipelines that transport hazardous liquids from one state to another (interstate pipelines) as interstate agents.

Table 4: Pipeline and Hazardous Materials Safety Administration’s Regional Officials and State Agency (PHMSA) Officials Selected for Interviews

Stakeholder	Type of stakeholder or applicable pipeline safety agreement
PHMSA Eastern Region	Federal
PHMSA Southern Region	Federal
PHMSA Southwest Region	Federal
PHMSA Central Region	Federal
PHMSA Western Region	Federal
Minnesota Office of Pipeline Inspection	Interstate agent
New York Department of Public Service	Interstate agent
Washington Utilities and Transportation Commission	Interstate agent
Railroad Commission of Texas	Intrastate certification
Oklahoma Corporation Commission	Intrastate certification
California Department of Forestry and Fire Protection	Intrastate certification
National Association of Pipeline State Representatives	Association

Source: GAO. | GAO-21-493

To assess the steps that PHMSA has taken to inform stakeholders of the changes made by the 2019 Rule and measure their effect on pipeline safety, we reviewed documentation, such as presentation materials provided at PHMSA-led meetings, PHMSA’s responses to frequently asked questions to clarify the changes, and guidance on rule implementation. We also interviewed officials at PHMSA’s headquarters office. We obtained stakeholder perspectives on PHMSA’s outreach efforts by interviewing the selected operators, PHMSA regional offices, and state pipeline safety offices noted above. We also reviewed PHMSA’s intended safety outcomes of the 2019 Rule, as well as the department-wide performance goals in DOT’s annual *FY 2021 Performance Plan*.⁹ We compared PHMSA’s efforts to measure the amendments’ effect on the identified outcomes and performance goals

⁹DOT, *FY 2021 Performance Plan and FY 2019 Performance Report* (Mar. 23, 2020).

against leading practices for strategic planning identified by our prior work and the requirements under the GPRA Modernization Act of 2010, as amended.¹⁰ We also interviewed PHMSA officials—including policy and programmatic officials—about their planning efforts for the changes that were made by the 2019 Rule and about whether the agency has plans to evaluate how the amendments support PHMSA’s identified safety outcomes and performance goals.

We conducted this performance audit from April 2020 to June 2021 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

¹⁰GAO, *Agency Performance Plans: Examples of Practices That Can Improve Usefulness to Decisionmakers*, [GAO/GGD/AIMD-99-69](#), (Washington, D.C.: Feb. 26, 1999). GPRA Modernization Act of 2010, Pub. L. No. 111-352, 124 Stat. 3866 (2011).

Appendix II: Summary of Key Amendments by the Pipeline and Hazardous Materials Safety Administration's (PHMSA) October 1, 2019, Final Rule to 49 C.F.R. Part 195

We identified the following key amendments to PHMSA's hazardous liquid pipeline safety regulations in its October 1, 2019, final rule.¹ Table 5 describes these amendments and specifies the applicable regulatory provisions affected, compliance timeframes, and certain exceptions.

Table 5: Summary of Key Amendments by the Pipeline and Hazardous Materials Safety Administration's (PHMSA) October 1, 2019, Final Rule to 49 C.F.R. Part 195

Amendment	Description	Applicable section(s) of 49 C.F.R.	Deadline for compliance	Selected exceptions
Extended reporting requirements to certain gravity and gathering lines	Operators must submit annual, accident and safety-related condition reports for certain gravity and all previously unregulated rural gathering lines. Information in annual reports include mileage count, diameters, and whether lines are operating at greater or less than 20 percent specified minimum yield strength (SMYS).	§ 195.13 § 195.15	Annual reports: 03/31/21 Accident reports: 01/01/21 Safety-related condition reports: 01/01/21	Gravity lines that are low-stress, travel no farther than 1 mile from a facility boundary, and do not cross any waterways used for commercial navigation are exempted.
Required inspections of pipelines in areas affected by extreme weather events and natural disasters	Operators must commence inspections of all potentially affected pipeline facilities within 72 hours after the cessation of extreme weather events (e.g., tropical storms/hurricanes, landslides, earthquakes) or other natural disasters that are likely to damage infrastructure, assess any damage, and, as necessary, take remedial action. If an inspection cannot be commenced within 72 hours, the operator must notify the PHMSA regional director.	§ 195.414	Effective 7/1/20 (ongoing)	
Expanded use of Leak Detection Systems	Operators must have leak detection systems for all covered pipelines in high consequence areas (HCAs) and non-HCAs, and must evaluate the capability of their leak detection systems to protect the public, property, and the environment.	§ 195.134 § 195.444	For pipelines constructed prior to 10/01/19: completed by 10/01/24 For pipelines constructed on or after 10/01/19: completed by 10/01/20	Exempted pipelines include (1) regulated rural gathering lines, and (2) offshore gathering lines.

¹ Pipeline Safety: Safety of Hazardous Liquid Pipelines, 84 Fed. Reg. 52,260 (Oct. 1, 2019) (amending 49 C.F.R. pt. 195).

**Appendix II: Summary of Key Amendments by
the Pipeline and Hazardous Materials Safety
Administration's (PHMSA) October 1, 2019,
Final Rule to 49 C.F.R. Part 195**

Amendment	Description	Applicable section(s) of 49 C.F.R.	Deadline for compliance	Selected exceptions
Required integrity assessments of pipelines outside of HCAs	Operators must assess onshore, in-line inspection capable, and non-HCA pipeline segments with an in-line inspection tool at least once every 10 calendar years from the year of the prior assessment.	§ 195.416	Initial assessment of segments to be completed by 10/01/29	If performing an ILI is impracticable (e.g., due to pipe diameter), operators must use another method specified in regulation. Using a method not specified in regulation is permitted only with PHMSA's approval.
Increased accommodation of ILI tools	Operators must ensure that all pipelines located in HCAs and areas that could affect an HCA are made capable of accommodating ILI tools.	§ 195.452(n)	Completed within 20 years (by 07/02/40), unless otherwise specified by regulation	Operators may petition PHMSA for a finding that this requirement should not be applied to a pipeline due to impracticability, such as when a pipeline's basic construction cannot be modified to accommodate ILI tools or when the cost of doing so would result in shutting down the pipeline.
Other key amendments and clarifications	<u>Prioritizing repair</u> —operators must consider the risk to life, property, and the environment, in prioritizing the correction of any condition that could adversely affect the pipeline's operations, whether it is in an HCA or not.	§ 195.401(b)(3)	Effective 7/1/20 (ongoing)	
	<u>Information analysis</u> —operators with integrity management programs must integrate into their analysis new data elements, which include but are not limited to the physical attributes of the pipeline.	§ 195.452(g)	Must begin to integrate specified data elements starting on 10/01/20 with all attributes integrated by 10/01/22	
	<u>Integrity assessments of pipeline segments</u> —operators must use ILI tools for these assessments.	§ 195.452(c)	Effective 7/1/20 (ongoing)	If it is impracticable to use ILI tools, operators must use another method specified by regulation.
	<u>Verifying segments identifications</u> —operators must verify the risk factors used in identifying pipeline segments that could affect an HCA on at least an annual basis not to exceed 15 months. If a risk factor has changed, operators must perform a segment analysis.	§ 195.452(j)(2)	First annual verification must be completed no later than 07/01/21	

Source: GAO analysis of PHMSA's October 1, 2019 Final Rule. | GAO-21-493

Note: There are additional amendments in the final rule that we determined would likely have minimal impact on operators, and we are not including these in our review.

Appendix III: Comments from the Department of Transportation



U.S. Department of
Transportation

Office of the Secretary
of Transportation

June 2, 2021

Ms. Elizabeth Repko
Director, Physical Infrastructure Issues
U.S. Government Accountability Office (GAO)
441 G Street NW
Washington, DC 20548

Assistant Secretary
for Administration

1200 New Jersey Avenue SE
Washington, D.C. 20590

Dear Ms. Repko:

The mission of the Pipeline and Hazardous Materials Safety Administration (PHMSA) is to protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives. As part of this mission, PHMSA administers a national regulatory safety program for more than 224,000 miles of interstate and intrastate hazardous liquid pipelines in the United States. This program requires that pipeline operators design, construct, test, operate, and maintain their pipeline facilities in compliance with the Federal pipeline safety regulations. To help ensure that operators comply with these regulations, PHMSA and its state partners conduct inspections of pipeline facilities.

In October 2019, PHMSA issued a final rule, "Pipeline Safety: Safety of Hazardous Liquid Pipelines," (84 FR 52260) amending the hazardous liquid pipeline safety regulations to improve protection of the public, property, and the environment by closing regulatory gaps where appropriate, ensuring that operators are increasing the detection and remediation of pipeline integrity threats, and mitigating the adverse effects of pipeline failures.

Upon review of the draft report, PHMSA concurs with GAO's recommendation to develop and use performance measures to assess whether the amendments to the hazardous liquid pipeline safety regulations in the 2019 rule are achieving desired outcomes and contributing to the Agency's safety goals for hazardous liquid pipelines and include targets for the expected levels of performance to be achieved and specific timeframes in which to achieve these results. The Department will provide a detailed response to this recommendation within 180 days of the final report's issuance.

We appreciate the opportunity to respond to the GAO draft report. Please contact Madeline M. Chulumovich, Director of Audit Relations and Program Improvement, at (202) 366-6512, with any questions or if GAO would like to obtain additional details.

Sincerely,

A handwritten signature in black ink, appearing to read "Philip A. McNamara".

Philip A. McNamara
Assistant Secretary for Administration

Appendix IV: GAO Contact and Staff Acknowledgements

GAO Contact

Elizabeth Repko, Acting Director, (202) 512-2834 or repkoe@gao.gov.

Acknowledgements

In addition to the contact above, Matt Barranca (Assistant Director); Anne Doré (Analyst-In-Charge); Lindsay Bach; Melissa Bodeau; Erin Guinn-Villareal; Andrea Levine; Mary-Catherine P. Overcash; Malika Rice; Kelly Rubin; and Laurel Voloder made key contributions to this report.

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