CHAPTER 5
Piping and Pipelines

This chapter summarizes:

- *Underground and aboveground piping*
- *Loading and unloading racks*

5.1 Common Causes of Leaks

Most leaks from both underground storage tank (UST) and aboveground storage tank (AST) systems occur in the piping and connections that are a result of faulty installation, poor preventive maintenance, and lack of adequate protection from corrosion. Aboveground piping also is at risk of releases from physical damage such as vehicle collision; therefore, it is important to install, maintain, and operate piping properly.

5.2 Underground Piping

To safeguard underground piping, use a contractor who installs piping according to a nationally recognized code of practice. Nationally recognized codes, standards, and test methods include:

- National Association of Corrosion Engineers (NACE) International Standard Practice SP 0285, "External Corrosion Control of Underground Storage Tank Systems by Cathodic Protection"
- NACE International Standard Practice SP 0169, "Control of External Corrosion on Underground or Submerged Metallic Piping Systems"
- American Petroleum Institute Recommended Practice 1632, "Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems"
- American Petroleum Institute Recommended Practice 570, "Piping Inspection Code: In-service Inspection, Rating, Repair, and Alteration of Piping Systems"
- Steel Tank Institute Recommended Practice R892, "Recommended Practice for Corrosion Protection of Underground Piping Networks Associated with Liquid Storage and Dispensing Systems"
- NACE International Test Method TM0497, "Measurement Techniques Relate to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems"

Have the contractor certify that the piping was installed correctly in accordance with the certification of installation requirements found in 40 CFR 280.20(e). In addition, take the following steps:

- Equip the piping with continuous **leak detection**.
- Provide the piping with **corrosion protection**.
- Provide the piping with **secondary containment.**

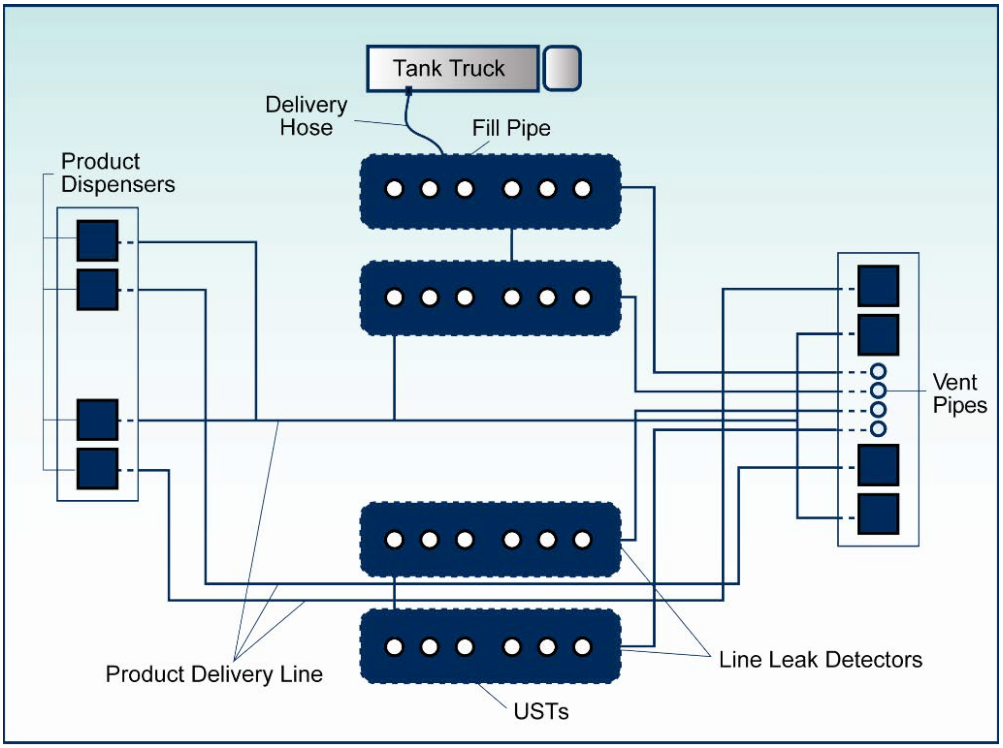
The Law Says

- ***Leak detection*** *requirements for UST pressurized piping installed prior to April 11, 2016 are in 40 CFR 280.41(b)(1)(i) and those for suction piping are in 40 CFR 280.41(b)(1)(ii). Piping installed or replaced after April 11, 2016 must meet the requirements in 40 CFR 280.41(b)(2).*
- ***Corrosion protection*** *requirements for UST piping are in 40 CFR 280.20(b) and 280.31.*
- ***Interstitial monitoring*** *requirements for UST piping are in 40 CFR 280.43(g). This applies to all UST piping installed after April 11, 2016, except for suction piping that meets the requirements of 40 CFR 280.41(b)(1)(ii)(A) through (E).*
- ***Closure*** *requirements for UST piping are found in 40 CFR Part 280, Subpart G.*
- ***Release*** *reporting and recordkeeping requirements for UST piping are found in 40 CFR Part 280, Subpart E.*

- Follow applicable regulations when conducting pipe **closure**.
- Report and record any **releases**.

For a typical schematic of piping for UST systems, see *Exhibit 5–1*.

EXHIBIT 5–1
Overhead Schematic of Piping at a UST Facility



5.2.1 Operation and Maintenance Requirements

Overall operation and maintenance (O&M) requirements for USTs (see *Chapter 3, Underground Storage Tanks*) may be generally applied to piping. Piping-specific O&M requirements are identified below:

- Operate and maintain corrosion protection systems to continuously provide protection to the metal components of piping that routinely contain regulated substances and are in contact with the ground (40 CFR 280.31(a)).
- Replace metal pipe sections and fittings that have released product because of corrosion or other damage (40 CFR 280.33(c)).
- Repair fiberglass (non-corrodible) pipes and fittings in accordance with the manufacturer's specifications (40 CFR 280.33(c)).
- Conduct line tightness testing on repaired piping within 30 days of the repair (40 CFR 280.33(d)).Test cathodic protection systems within 6 months of repair (40 CFR 280.33(e)).

5.2.2 Leak Detection for UST Piping

At least every 30 days, UST systems (tanks and piping) must be monitored for leaks using proper leak detection methods. Leak detection methods must be able to detect a leak from any portion of the tank and connected underground piping that routinely contains product. Leak detection must be installed, calibrated, operated, and maintained according to the manufacturer's instructions. There are two main types of piping: (1) pressurized piping and (2) suction piping. Pressurized piping and suction piping must use the leak detection methods described below.

5.2.2.1 Pressurized Piping

Each pressurized piping run must have one of the line leak detection methods, as well as monitoring methods, provided in *Exhibit 5–2*.

EXHIBIT 5–2
Pressurized Piping Release Monitoring

Pressurized Piping Installed or Replaced on or prior to April 11, 2016	Pressurized Piping Installed or Replaced after April 11, 2016
Piping must have devices that automatically shut off, restrict flow, or trigger an alarm that indicates a leak [1] AND **annual** line tightness test of the piping must take place, or in lieu of the annual tightness test, one of the following **monthly** methods must be used: - Interstitial monitoring[2] - Groundwater monitoring[2] - Vapor monitoring[2] - Continuous in-tank leak detection - Statistical inventory reconciliation - Other methods approved by the implementing agency	In addition to the requirements on the left, pressurized piping installed or replaced after April 11, 2016 must have secondary containment with interstitial monitoring.[2]

[1] An automatic line leak detector (LLD) that is an automatic flow restrictor, an automatic flow shutoff, or continuous alarm system.

[2] Interstitial monitoring, vapor monitoring, groundwater monitoring, and statistical inventory reconciliation have the same regulatory requirements for piping as they do for tanks. (See Chapter 4, Underground Storage Tanks)

5.2.2.2 Suction Piping

Each suction piping run must have one of the line leak detection methods, as well as monitoring methods, provided in *Exhibit 5–3*.

Did You Know?

Line tightness testing must be:

- *Able to detect a 0.1 gallon per hour leak rate 1.5 times the operating pressure.*
- *Conducted annually. If the test is performed at pressures lower than 1.5 times operating pressure, the leak rate to be detected must be correspondingly lower.*

Automatic LLDs and line tightness tests must also be able to meet the federal regulatory requirements regarding probabilities of detection and false alarm.

EXHIBIT 5–3
Suction Piping Release Monitoring

Suction piping installed or replaced on or prior to April 11, 2016	Suction piping installed or replaced after April 11, 2016
Suction piping meeting the description below does not need release detection: - Below-grade piping operating at less than atmospheric pressure is sloped so that the piping's contents will drain back into the storage tank if the suction is released. - Only one check valve is included in each suction line and is located directly below the suction pump. Suction piping that does meet the above criteria must either have line tightness testing at least every 3 years or any of the following **monthly** monitoring: - Vapor monitoring - Groundwater monitoring - Interstitial monitoring - Statistical inventory reconciliation - Other approved methods	Suction piping installed or replaced after April 11, 2016, must have secondary containment with interstitial monitoring, except suction piping meeting the description to the left.

5.2.3 Closure of UST Piping

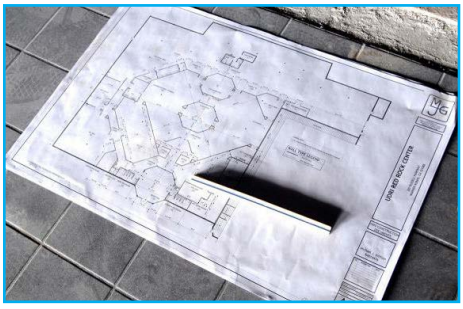
Temporary and permanent closure requirements for UST piping are the same as for USTs (see *Chapter 3, Underground Storage Tanks*).

5.2.4 Recordkeeping and Reporting

Recordkeeping and reporting requirements for underground piping are the same as for USTs (see *Chapter 3, Underground Storage Tanks)*.

5.3 Spill Prevention, Control, and Countermeasure Requirements

Piping and pipelines (underground and aboveground) for transporting petroleum within the facility are regulated under the Spill Prevention, Control, and Countermeasure (SPCC) regulations. For information on the applicability of the SPCC regulations, refer to *Chapter 1, Environmental and Emergency Response Planning* and *Chapter 4, Aboveground Storage Tanks and Containers*. If your facility is subject to SPCC regulations, you must demonstrate compliance with the piping requirements in your facility's SPCC Plan. The contents of this plan with respect to piping are listed below:



- ***Facility Diagram***: The plan must include a facility diagram that includes all transfer stations and connecting pipes, including intrafacility gathering lines that are otherwise exempt (40 CFR 112.7(a)(3).
- ***Security***: The plan must contain a description of how to secure out-of-service and loading and unloading connections of oil pipelines (40 CFR 112.7(g)).

5.3.1 Underground Piping

The SPCC Plan must describe procedures for meeting the following technical requirements for underground piping:

- ***Secondary Containment***: Secondary containment or diversionary structures are required for underground piping to prevent releases to navigable waters and adjoining shorelines and to capture the discharge of oil until cleanup occurs. Double-walled piping is the most common method of containment, although other options are allowed as long as they are consistent with good engineering practice and approved by a licensed Professional Engineer (PE) reviewing the SPCC Plan.
- ***Corrective Actions***: Whenever buried piping is exposed, examine it for corrosion damage and take any necessary corrective actions. The plan must describe procedures to promptly correct visible discharges that result in a loss of oil from seams, gaskets, piping, pumps, valves, rivets, and bolts (40 CFR 112.8(c)(10)). If corrosion damage is discovered, additional examination and corrective action, as indicated by the magnitude of the damage, must be performed (40 CFR 112.8(d)(1)).
- ***Protective Coating and Corrosion Protection***: Buried piping must be protected with wrapping and coating. Cathodic protection that satisfies the corrosion protection standards (40 CFR 112.8(d)(1)) must be provided. Where cathodic protection of underground piping is not used, a facility could use double-walled piping combined with an interstitial leak detection system as an alternative. Another option would be to implement a comprehensive monitoring, detection, and prevention maintenance program for piping where effective cathodic protection is not reasonably achievable to detect and address potential discharges.
- ***Leak Detection***: Conduct integrity and leak testing at the time of installation, modification, relocation, retrofitting, upgrading, or replacement.

Your SPCC Plan must describe any environmental protection alternatives deemed equivalent to cathodic protection that must be certified by the sealing PE.

5.3.2 Aboveground Piping

The SPCC Plan must describe procedures for meeting the following technical for aboveground piping:

- ***Secondary Containment:*** Secondary containment or diversionary structures are required for aboveground piping to prevent releases to navigable waters and adjoining shorelines and to capture the discharge of oil until cleanup occurs. Double-walled piping is the most common method of containment, although other options are allowed as long as they are consistent with good engineering practice and approved by a licensed Professional Engineer (PE) reviewing the SPCC Plan.
- ***Piping Supports***: Design pipe supports to prevent sagging, minimize corrosion, and allow for expansion and contraction (40 CFR 112.8(d)(3)).

The Law Says...

SPCC Plan regulations require that loading and unloading racks be properly designed, operated, and maintained:

- *Secondary Containment requirements are found in 40 CFR 112.7(h)(1).*
- *Connection/Disconnection Safety Methods to prevent vehicles from departing before complete disconnection of lines are found in 40 CFR 112.7(h)(2).*
- *Truck Inspection requirements are found in 40 CFR 112.7(h)(3).*

The Law Says...

- *Pipelines that transport fuel off facility grounds must comply with the safety, operating, testing, and reporting requirements of 49 CFR 195.*
- *The Pipeline and Hazardous Materials Safety Administration (PHMSA) requires a Pipeline Response Plan for certain onshore pipelines (49 CFR 194). For reference, see Chapter 1, Environmental and Emergency Response Planning.*

- ***Piping Inspections***: Inspect all aboveground pipelines regularly. Check the conditions of the pipe supports, connecting joints, valves, gauges, pumps, and catch basins. They should be free of leaks, drips, and oil-stained soil underneath (40 CFR 112.8(d)(4)).
- ***Maintenance***: Promptly replace and repair defective or leaking piping and equipment, and keep records of any repairs. Flow valves must be periodically packed with grease, and gaskets must be replaced to prevent leaks. Pumps may require periodic rebuilding, and connecting lines may need to be resealed to prevent leaks (40 CFR 112.8(c)(10)).
- ***Warning Signs***: Post warning signs to alert traffic of aboveground piping, or verbally warn drivers, as appropriate (40 CFR 112.8(d)(5)).
- ***Out-of-Service***: When lines are taken out-of-service or are in standby for extended periods, cap or blind-flange and mark the connection at the transfer point.

5.3.3 Loading and Unloading Racks

A loading and unloading rack is a fixed structure (such as a platform or gangway) necessary for loading or unloading a tank truck or tank car. A loading arm is essential for a loading and unloading rack that typically includes at least one swivel joint. Other components may include any combination of the following: piping assemblages, valves, pumps, shutoff devices, overfill sensors or personnel safety devices.

SPCC regulations require that loading and unloading racks have secondary containment to contain the contents from the largest single compartment of a tank car or tank truck. The most common system of secondary containment for loading and unloading racks is a covered, curbed, graded area that drains to a sump (sometimes called a quick drainage system). If the drainage system does not flow to a catchment basin or wastewater treatment system, then the area should have curbing. One option to meet this requirement is to use an oil/water separator as part of a quick drainage system.

Other requirements for loading and unloading racks are:

- Warning lights, physical barriers, warning signs, wheel chocks, or vehicle brake interlock systems must be used to prevent a vehicle from leaving before it is completely disconnected from the fuel transfer lines (40 CFR 112.7(h)(2)).
- Tank car or tank truck drains and outlets must be closed and inspected for leaks prior to filling and prior to departure (40 CFR 112.7(h)(3)).

Loading and unloading areas that use a single hose and connection or standpipe are not considered racks. These transfer areas must meet the general secondary containment requirements but do not necessarily need to be sized for the largest compartment of the tank car or truck. However, containment size must be based on good engineering judgment (see *Chapter 4, Aboveground Storage Tanks and Containers* for examples of general secondary containment measures).

5.4 Transportation Pipeline Systems

The U.S. Department of Transportation (DOT) shipping regulations address requirements for loading and unloading of packages and cargo as well as liquids via loading and unloading racks. Other DOT regulations address interstate and cross-country pipeline operations.

5.4.1 Loading and Unloading Racks

All drivers must follow loading and unloading procedures established by DOT regulations in 49 CFR 177 Subpart B for highway shipments via tank trucks and 49 CFR 174 Subpart C for railway tank car loading.

In general, the following requirements apply to tank cars and tank trucks:

- No smoking is allowed while loading and unloading explosives, flammable liquids, solids, and gases, and oxidizing agents (40 CFR 177.834(c)).
- Hand brakes must be securely set and other precautions taken to prevent motion during loading and unloading (40 CFR 177.834(e)).
- Drivers or designated employees must attend to or observe loading and unloading activities (40 CFR 177.834(i)).

Refer to the DOT regulations for additional requirements for specific materials, such as flammable or combustible liquids and flammable gases.

5.4.2 Cross-country Pipelines

Pipelines used to transport fuel outside facility grounds (such as cross-country pipelines) are subject to the design, construction, operation, and safety standards established by the DOT Office of Pipeline Safety (49 CFR 195). DOT regulates the transportation-related portion of the pipeline running to, or from, a fuel terminal while the U.S. Environmental Protection Agency (EPA) regulates the terminal and transfer operations. Cross-country pipelines regulated by DOT include associated pipeline pumping stations and breakout tanks.

5.4.2.1 Steel Pipeline Systems

You must meet the following requirements for new carbon steel pipeline systems and existing steel pipe systems that are relocated, replaced, or otherwise changed:

- Comply with the minimum design requirements of 49 CFR 195 Subpart C, including pipe, valve, fitting requirements, and internal inspection devices.
- Construct your pipeline systems according to the minimum requirements of 49 CFR 195 Subpart D, including using qualified personnel and conducting the proper inspections. Cathodic protection, welding work, pumping stations, and breakout tanks must meet certain requirements. Keep construction records for the life of each pipeline facility.

Do not operate your pipeline unless it has been pressure tested without leakage according to 49 CFR 195 Subpart E.

5.4.2.2 Operation and Maintenance

Operate your cross-country steel pipeline system at the level of safety required by 49 CFR 195 Subpart F. For each pipeline system, prepare and follow a manual of written procedures for conducting normal O&M activities and for handling emergencies. Additional requirements include the following:

- Establish and conduct a continuing training program to instruct O&M personnel and emergency response personnel.
- Maintain current maps and records of your pipeline systems.
- Maintain the operating pressure at or below the pipeline design pressure.
- Provide a communication system for the transmission of information necessary for the safe operation of your pipeline system.
- Place and maintain line markers over each buried pipeline, especially at road and railroad crossings.
- Conduct the appropriate tests, inspections, and repairs of pipeline, valves, and fittings to maintain good working order at all times.
- For each pumping station and breakout station, maintain adequate firefighting equipment and the appropriate signs and prevent unauthorized entry.
- Prepare a written program to prevent damage to buried pipelines by excavation activities.

The O&M manual must be reviewed annually for accuracy and effectiveness.

U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration

5.4.2.3 Pipeline Safety and Integrity

DOT requires a written report within 5 to 10 working days of discovery of any of the pipeline safety-related conditions described in 49 CFR 195.55. For instance, reportable conditions include corrosion damage, material defects, unintended pipeline movement (for example, from earthquakes or floods), and malfunctions resulting in a pressure rise of more than 110% of its maximum operating pressure.

The Safety-Related Condition Report must be sent to the PHMSA via its on-line portal (see *Section 5.7, For More Information*) or via fax 202–366–7128. Alternatively (but least desirable), it can be mailed to Information Resources Manager, Pipeline and Hazardous Materials Safety Administration, PHP–20 1200 New Jersey Avenue SE, Washington, DC, 20590.

DOT published Pipeline Integrity Management regulations in 49CFR 195.452 for pipelines in highly populated areas, in environmentally sensitive areas, and near commercially navigable waters.

To reduce the potential for failure in these critical areas, the rules require continual assessment and evaluation of pipeline integrity. This consists of inspections or testing to identify corrosion and other damage, automatic or remotely operated values for rapid shutdown of pipelines, risk analysis of pipeline segments, and corrective measures or repairs to prevent rupture. Pipeline operators must document their integrity management program in writing and periodically review and update it.

5.4.2.4 Written Public Awareness Programs

Each cross-country pipeline operator is required to develop and implement a written continuing public education program in accordance with 49 CFR 195.440. The program must educate the public, emergency agencies, local public officials, and persons engaged in excavation about the possible hazards of unintended releases, emergency notification procedures, and safety steps in the event of a pipeline release. Awareness activities and events given for the public and nearby municipalities, schools, or businesses should be documented. Additional requirements for the written program are found in the API Standard 1162, *Public Awareness Programs for Pipeline Operators*. Pipeline operators, including interstate and intrastate petroleum pipelines, is required to submit their written program to PHMSA upon request. In addition to the requirements described above, other submissions, reports, and procedures, required by pipeline operators are identified in *Exhibit 5-4*.

EXHIBIT 5–4
Required Plans, Procedures, Notifications, Submittals, and Written Programs

Plan, Procedure, Notification, Submittal, Written Program	Requirement
Conversion to Service Procedures	49 CFR 195.5
Safety Procedures for Regulated Rural Gathering Lines	49 CFR 195.11
Integrity Management (IM) Program and Baseline Assessment Plan	49 CFR 195.12 and .452
Annual Report	49 CFR 195.49
Accident Reports	49 CFR 195.50 and .52
Written Procedure to Calculate Amount of Release	49 CFR 195.52(c)
Safety-Related Condition Reports	49 CFR 195.55 and 56
Facility Abandonment or Deactivation Report	49 CFR 195.59
Provide National Pipeline Mapping System Geospatial Data to PHMSA Annually	49 CFR 195.61
Welding Procedures	49 CFR 195.214
Nondestructive Weld Testing Procedures	49 CFR 195.234
O&M Procedural Manual for Operations (Normal)	49 CFR 195.402
O&M Procedural Manual for Operations (Abnormal and emergencies)	49 CFR 195.402
Public Awareness and Education Program	49 CFR 195.440
Damage Prevention Program	49 CFR 195.442
Written Control Room Management Procedures	49 CFR 195.446
Qualification Program	49 CFR 195.505

Spill and accident reporting requirements for pipeline facilities are summarized in *Chapter 2, Incident and Spill Reporting*.

5.5 Cross-Country Pipelines—DLA Energy Requirements

In response to public concern over U.S. pipeline incidents, DLA Energy created a program to safeguard all cross-country pipelines under its operational control. This includes requirements to:

- Inspect and evaluate pipeline and pipeline components at rivers, streams, and other water crossings.
- Conduct a close-interval survey of cathodic protection.
- Conduct caliper pig surveys to identify irregularities and obstructions to flow. Excavate, repair, and inspect segments identified as problem areas.
- Conduct **ultrasonic** or **magniflux** surveys (using sound or magnetism) to determine internal pipe conditions. Excavation of underground pipes at random locations may be required for ultrasonic testing of actual wall thickness.
- Compute the internal design pressure after actual wall thickness is determined (if design records are unavailable).
- With the above information and safe operating pressure, conduct a pressure test to verify the absence of leaks. Other leak detection technologies may be accepted by regulatory agencies.

Although specifically developed for **government-owned, contractor-operated (GOCO)** facilities, the above recommendations can be applied to any fuel facility operation.

State Requirements

5.6 State Requirements

Some states may have piping requirements that are more stringent than federal regulations. For example, Florida has additional construction and secondary containment requirements for integral UST piping. Be sure to check your state UST or AST regulations for piping and loading rack requirements. In addition:

- See *Chapter 3, Underground Storage Tanks, Section 3.7, State Requirements*.
- See *Chapter 4, Aboveground Storage Tanks and Containers: Section 4.9, State Requirements* and *Appendix 4-1, States with Aboveground Storage Tank Regulations.*

Also, check your state pipeline safety agency (often the utility commission) for pipeline requirements more stringent than federal regulations. Refer to the "Compendium of State Pipeline Safety Requirements and Initiatives Providing Increased Public Safety Levels" compared to the CFR (referenced in *Section 5.7, For More Information)*. States and their respective more stringent requirements compared to 49 CFR 195 are identified in *Exhibit 5-5*.

EXHIBIT 5–5
More Stringent State Pipeline Regulations Compared to Federal Regulations

More Stringent State Piping Regulations Compared to Federal Regulations in 49 CFR 195								
State	Enhanced Reporting	More Direct Oversight	Corrosion Control	Design and Install	Pressure Testing	Leak Tests	Damage Prevention	Broader in Scope
AZ	x	x	x	x				
CA	x	x		x	x	x		
LA	x							
NM	x							
PA	x							
TX	x	x	x				x	x
WA	x	x	x			x	x	

5.7 For More Information

For More Information

For Information On…	See…
Piping Related Agencies	
EPA Office of Underground Storage Tanks	www.epa.gov/UST (800) 424–9346
DOT Pipeline and Hazardous Materials Safety Administration (PHMSA)	www.phmsa.dot.gov (202) 366–4433
PHMSA Portal (for submitting reports)	https://portal.phmsa.dot.gov/portal Users must be registered and assigned an Operator ID number.
American Petroleum Institute (API)	www.api.org
U.S. National Response Team	www.nrt.org
EPA Office of Emergency Management	www.epa.gov/emergencies/index.htm
Call 811 Before You Dig	www.call811.com
Documents and References	
API Standard 570–Piping Inspection Code: Inspection, Repair, Alternation, and Rerating of In– service Piping Systems	https://www.api.org/products-and-services/standards
API Recommended Practice 1162, Public Awareness Programs for Pipeline Operators	https://www.api.org/products-and-services/standards
PHMSA Advisory Bulletin ADB–06–02, Submission of Public Awareness Program for Review	https://www.gpo.gov/fdsys/pkg/FR-2006-06-16/html/E6-9400.htm
Compendium of State Pipeline Safety Requirements and Initiatives Providing Increased Public Safety Levels Compared to Code of Federal Regulations	https://psc.mo.gov/CMSInternetData/NaturalGas/Publications/Compendium-NAPSR-Second-Edition-CLEAN-gl-100313.pdf

Action Items

5.8 Action Items

Item	Date Started	Date Completed	N/A	Comment(s)
Engineer and construct your piping systems in accordance with recognized national standards, including cathodic protection systems, and pipe supports.			☐	
Use certified installers to install or modify piping systems.			☐	
Maintain adequate emergency response equipment, including spill response and fire control measures.			☐	
Periodically pressure test your piping for integrity to prevent accidental failures.			☐	
Prepare your SPCC contingency and response plans to prevent releases, and establish a plan of action in the event of a piping failure.			☐	
Train your staff in piping spill response.			☐	
Routinely inspect your piping for actual or potential product releases.			☐	
Properly manage piping wastes (including spill cleanup, removed paint), especially if hazardous waste.			☐	
Notify and report to regulatory agencies in the event that a release is detected.			☐	
Maintain records of training, inspections, testing, pipe repairs, and self- inspections to prove compliance.			☐	