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DEPARTMENT OF TRANSPORTATION

Pipeline and Hazardous Materials Safety Administration

[Docket No. PHMSA-2019-0087]

Pipeline Safety: Potential for Damage to Pipeline Facilities Caused by Earth Movement and Other Geological Hazards

AGENCY: Pipeline and Hazardous Materials Safety Administration (PHMSA), DOT.

ACTION: Notice; Issuance of Advisory Bulletin.

SUMMARY: PHMSA is issuing this advisory bulletin to remind owners and operators of gas and hazardous liquid pipelines of the potential for damage to pipeline facilities caused by earth movement from both landslides and subsidence in variable, steep, and rugged terrain and for varied geological conditions. These conditions can pose a threat to the integrity of pipeline facilities if those threats are not identified and mitigated.

FOR FURTHER INFORMATION CONTACT: Operators of pipelines subject to regulation by PHMSA should contact the appropriate PHMSA Region Office. The PHMSA Region Offices and their contact information are as follows:

- Eastern Region: 609-771-7800
Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, and West Virginia
- Southern Region: 404-832-1147
Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, Puerto Rico, South Carolina, and Tennessee
- Central Region: 816-329-3800

Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin

- Southwest Region: 713-272-2859

Arkansas, Louisiana, New Mexico, Oklahoma, and Texas

- Western Region: 720-963-3160

Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming

Intrastate pipeline operators should contact the appropriate state pipeline safety authority. A list of state pipeline safety authorities is available at <http://www.napsr.org/state-program-managers.html>.

For general information about this notice contact Mike Yazemboski, Project Manager, PHMSA Eastern Region, at 609-771-7800 or by email at Mike.Yazemboski@dot.gov.

SUPPLEMENTARY INFORMATION

I. Background

The purpose of this advisory bulletin is to remind owners and operators of gas and hazardous liquid pipelines, particularly those with facilities located in inland areas, about the serious safety-related issues that can result from earth movement and other geologic hazards.

Natural gas and hazardous liquid pipelines are required to be designed to withstand external loads including those that may be imposed by geological forces. Specifically, natural gas pipelines must be designed in accordance with 49 CFR 192.103 and hazardous liquid pipelines must be designed in accordance with § 195.110. To comply with these regulations, the design of new pipelines, including repairs or replacement, must consider load that may be imposed by geological forces.

Once operational, § 192.317(a) of the pipeline safety regulations for natural gas pipelines states that “[t]he operator must take all practicable steps to protect each transmission line or main from washouts, floods, unstable soil, landslides, or other hazards that may cause the pipeline to move or to sustain abnormal loads. In addition, the operator must take all practicable steps to protect offshore pipelines from damage by mud slides, water currents, hurricanes, ship anchors, and fishing operations.” This advisory bulletin addresses those protective requirements associated with damage caused by geological factors.

In addition, § 192.705 requires operators of gas transmission lines to have a patrol program to observe surface conditions on and adjacent to the transmission line right-of-way for indications of leaks, construction activity, and other factors affecting safety and operation and the frequency of patrols must be based upon the size of the line, operating pressures, class locations, terrain, seasonal weather conditions, and other relevant factors. One of the primary reasons for this patrol requirement is to monitor geological movement, both slowly occurring or acute changes, which may affect the current or future safe operation of the pipeline.

Furthermore, § 192.613(a) states that “[e]ach operator shall have a procedure for continuing surveillance of its facilities to determine and take appropriate action concerning changes in class location, failures, leakage history, corrosion, substantial changes in cathodic protection requirements, and other unusual operating and maintenance conditions.” Section 192.613(b) further states that “[i]f a segment of pipeline is determined to be in unsatisfactory condition but no immediate hazard exists, the operator shall initiate a program to recondition or phase out the segment involved, or, if the segment cannot be reconditioned or phased out, reduce the maximum allowable operating pressure in accordance with § 192.619(a) and (b).”

Section 195.401(b)(1) of the pipeline safety regulations for hazardous liquid pipelines states that “[w]henver an operator discovers any condition that could adversely affect the safe operation of

its pipeline system, it must correct the condition within a reasonable time. However, if the condition is of such a nature that it presents an immediate hazard to persons or property, the operator may not operate the affected part of the system until it has corrected the unsafe condition.” Section 195.401(b)(2) further states that “[w]hen an operator discovers a condition on a pipeline covered under [the integrity management requirements in] § 195.452, the operator must correct the condition as prescribed in § 195.452(h).” Land movement, severe flooding, river scour, and river channel migration are the types of unusual operating conditions that can adversely affect the safe operation of a pipeline and require corrective action under §§ 192.613(a) and 195.401(b). Additional guidance for identifying risk factors and mitigating natural force hazards on pipeline segments, that could affect high consequence areas, are outlined in Appendix C, section B, to Part 195.

Sections 192.935 and 195.452(i) require an operator to take additional preventative and mitigative measures to prevent a pipeline failure and to mitigate the consequences of a pipeline failure that could affect a high consequence area. An operator must base the additional measures on the threats the operator has identified for each pipeline segment. If an operator determines there is a threat to the pipeline, such as outside force damage (e.g., earth movement, floods), the operator must take steps to prevent a failure and to minimize the consequences of a failure under these regulations.

PHMSA is aware of recent earth movement and other geological-related incidents/accidents and safety-related conditions throughout the county, particularly in the eastern portion of the United States. Seven of the more notable events are briefly described below:

- On October 21, 2016, a pipeline release of over 1,238 barrels of gasoline spilled into the Loyalsock Creek in Lycoming County, Pennsylvania. The release was caused by extreme localized flooding and soil erosion.
- On December 5, 2016, approximately 12, 615 barrels of crude oil was released into Ash Coulee Creek in Billings County, North Dakota. The metallurgical and root cause failure analysis

indicated the failure was caused by compressive and bending forces due to a landslide impacting the pipeline. The landslide was the result of excessive moisture within the hillside creating unstable soil conditions.

- On April 30, 2018, a pipeline failure occurred in a remote mountainous region of Marshall County, West Virginia resulting in the release of 2,658 barrels of propane. The failure and subsequent release was caused by lateral movement of the 8-inch intrastate pipeline due to earth movement along the right-of-way.
- On June 7, 2018, a rupture occurred on a 36-inch pipeline located in a rural, mountainous area near Moundsville, West Virginia, resulting in the release of approximately 165,000 MCF of natural gas. The failed sections of the pipeline were sent to a metallurgical laboratory to determine the probable cause behind the failure of the pipeline. According to the analysis, the cause of the rupture was due to earth movement on the right-of-way due to a single overload event. Overloading of the pipeline likely resulted from a series of lateral displacements with accompanying bending.
- On January 9, 2018, a failure occurred on a 22-inch transmission pipeline in Montecito California. The incident resulted in a fire and explosion and the release of an estimated 12,000 MFC of natural gas within a Class 3 location.¹ It is believed that heavy rains and localized flooding contributed to the incident. Automated safety equipment designed to stop the flow of gas to the effected segment activated to shut off gas flow to the damaged segment of pipeline.
- On January 31, 2018, a portion of a pipeline experienced an in-service rupture near the city of Summerfield, Ohio. The rupture of the 24-inch interstate pipeline resulted in the release of approximately 23,500 MCF of natural gas in a rural forested area. A root cause analysis concluded that the girth weld failure was caused by axial stress due to movement of the pipe

¹ See 49 C.F.R. § 192.5(b)(3) (defining Class 3 locations).

that exceeded the cross-sectional tensile strength of the net section weld zone surrounding the crack initiation location. This determination is supported by metallurgical analysis, strain capacity evaluation and geotechnical findings.

- On January 29, 2019, a pipeline ruptured near the town of Lumberport in Harrison County, West Virginia. The rupture was located at a girth weld of an elbow on the 12-inch interstate pipeline. The root cause investigation concluded that a landslide about 150 yards from the rupture moved the pipeline approximately 10 feet from its original location causing excessive stress on the pipe resulting in the rupture.

II. Advisory Bulletin (ADB-2019-02)

To: Owners and Operators of Gas and Hazardous Liquid Pipeline Systems.

Subject: Potential Damage to Pipeline Facilities Caused by External Loads Imposed by Earth Movement and Other Geologic Hazards on and Adjacent to Pipeline Right-of-Way Corridors.

Advisory: All owners and operators of gas and hazardous liquid pipelines are reminded that earth movement, particularly in variable, steep, and rugged terrain and with varied geological subsurface conditions, can pose a threat to the integrity of a pipeline if those threats are not mitigated. Pipeline operators should consider taking the following actions to ensure pipeline safety:

1. Identify areas surrounding the pipeline that may be prone to large earth movement, including but not limited to slope instability, subsidence, frost heave, soil settlement, erosion, earthquakes, and other dynamic geologic conditions that may pose a safety risk.
2. Utilize geotechnical engineers during the design, construction, and ongoing operations of a pipeline system to ensure that sufficient information is available to avoid or minimize the impact of earth movement on the integrity of the pipeline system. At a minimum, this should include soil strength characteristics, ground and surface water conditions, propensity for erosion or scour of underlying soils, and the propensity of earthquakes or frost heave.

3. Develop design, construction, and monitoring plans and procedures for each identified location, based on the site-specific hazards identified. When constructing new pipelines, develop and implement procedures for pipe and girth weld designs to increase their effectiveness for taking loads, either stresses or strains, exerted from pipe movement in areas where geological subsurface conditions and movement are a hazard to the pipeline integrity.
4. Monitoring plans may include:
 - Ensuring during construction of new pipelines that excavators do not steepen, load (including changing the groundwater levels) or undercut slopes which may cause excessive ground movement during construction or after operations commence.
 - Conducting periodic visits and site inspections; increased patrolling may be necessary due to potential hazards identified and existing/pending weather conditions. Right-of-way patrol staff must be trained on how to detect and report to appropriate staff the conditions that may lead to or exhibit ground movement.
 - Identifying geodetic monitoring points (i.e. survey bench marks) to track potential ground movement;
 - Installing slope inclinometers to track ground movement at depth which may otherwise not be detectable during ROW patrols;
 - Installing standpipe piezometers to track changes in groundwater conditions that may affect slope stability;
 - Evaluating the accumulation of strain in the pipeline by installing strain gauges on the pipeline.

- Conducting stress/strain analysis utilizing in-line inspection tools equipped with Inertia Mapping Unit technology and High Resolution Deformation in-line inspection for pipe bending and denting from movement.
 - Utilizing aerial mapping light detection and ranging or other technology to track changes in ground conditions.
5. Develop mitigation measures to remediate the identified locations.
6. Mitigation measures should be based on site-specific conditions and may include:
- Re-routing the pipeline right-of-way prior to construction to avoid areas prone to large ground movement such as unstable slope areas, earthquake fault zones, permafrost movement, or scour.
 - Utilize properly designed horizontal directional drilling (HDD) to go below areas of potential land movement.
 - Installation of drainage measures in the trench to mitigate subsurface flows and enhance surface water draining at the site including streams, creeks, runs, gullies or other sources of surface run-off that may be contributing surface water to the site or changing groundwater levels that may exacerbate earth movement.
 - Reducing the steepness of potentially unstable slopes, including installing retaining walls, soldier piles, sheet piles, wire mesh systems, mechanically stabilized earth systems and other mechanical structures.
 - Installing trench breakers and slope breakers to mitigate trench seepage and divert trench flows along the surface to safe discharge points off the site or right-of-way.
 - Building retaining walls and/or installing steel piling or concrete caissons to stabilize steep slope areas as long as the corrosion control systems are not compromised.

- Reducing the loading on the site by removing and/or reducing the excess backfill materials to off-site locations. Soil placement should be carefully planned to avoid triggering earth movement in other locations.
- Compacting backfill materials at the site to increase strength, reduce water infiltration, and to achieve optimal moisture content.
- Drying the soil using special additives such as lime-kiln dust or cement-kiln to allow the materials to be re-used and worked at the site. Over-saturated materials may require an extensive amount of time and space to dry.
- Regrading the pipeline right-of-way to minimize scour and erosion.
- Bringing the pipeline above ground and placing them on supports that can accommodate large ground movements, (e.g. transitions across earthquake fault zones or unstable slopes, without putting excessive stress or strain on the pipeline).
- Reducing the operating pressure temporarily or shutting-in the affected pipeline segment completely.
- Re-routing the pipeline when other appropriate mitigation measures cannot be effectively implemented to maintain safety.

If a pipeline has suffered damage or is shut-in as a precautionary measure due to earth movement or other geologic hazards, the operator should advise the appropriate PHMSA regional office or state pipeline safety authority before returning the line to service, increasing its operating pressure, or otherwise changing its operating status. Per § 190.239, PHMSA may propose additional safety measures, including testing of the pipeline, or design changes to address external loads induced by ground movement, be taken to ensure that the serviceability of the pipeline has not been impaired or

that the condition will not worsen over time. Furthermore, reporting a safety-related condition as prescribed in §§ 191.23 and 195.55 may also be required.

Issued in Washington, DC on April 29, 2019, under authority delegated in 49 CFR 1.97.

Alan K. Mayberry,

Associate Administrator for Pipeline Safety.

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