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Standard Practice for Operation and Maintenance of Integrated Natural Gas Pipelines and Optical Fiber Systems[1]

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1. Scope

1.1 This practice covers the operation and maintenance of natural gas distribution and service pipelines containing optical fiber cable and the operation and maintenance of the optical fiber system.

1.2 This practice applies to distribution and service lines used to transport natural gas.

1.3 This practice does not apply to natural gas transmission lines.

1.4 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *Referenced Documents:*

ANSI Z 117.1-2003 Safety Requirements for Confined Spaces[2]

CFR 49 Code of Federal Regulations—Title 49, Part 192[3]

IEC 60825-1 Ed. 1.2 en 2001, Safety of Laser Products—Part 1: Equipment Classification, Requirements and User's Guide[4]

IEC 60050-731 Electrotechnical Vocabulary: Optical Fiber Communications[4]

OSHA Regulation 29 CFR Part 1910.146, Permit-Required Confined Spaces[5]

3. Terminology

3.1 *Definitions:*

3.1.1 *CFR*—U.S. Code of Federal Regulations.

3.1.2 *class location*—the specific criteria for Class Locations 1, 2, 3, and 4 as defined in CFR 49, Part 192.5.

3.1.3 *conduit*—plastic tubing used to house optical fiber cable that is connected to, but not inside of, a pipeline.

3.1.4 *confined space*—an enclosed area that is large enough and so configured that a person can bodily enter and has the following characteristics: (*1*) its primary function is something other than human occupancy, and (*2*) has restricted entry and exit. (Restricted entry and exit is a physical configuration which requires the use of hands or contortion of the body to enter into or exit from a confined space.)

3.1.5 *covered tasks*—as defined in CFR 49, Part 192.801 (b): "an activity, identified by the operator, that is performed on a pipeline; is an operations and maintenance task; is performed as a requirement of this part and affects operation or integrity of the pipeline."

3.1.6 *designated control point (DCP)*—specific documented locations in the pipeline system where the operations plan designates the control of gas.

3.1.7 *distribution lines*—a pipeline other than a gathering or transmission line.

3.1.8 *emergency incident*—an emergency incident may involve fire, damage to underground facilities, explosion, gas leak, injury, death, gas outage, district pressure problems, hazardous or toxic material spills, or response by fire, police, or other agencies.

3.1.9 *hot tapping*—a procedure for cutting or tapping into a gas pipeline under pressure.

3.1.10 *innerduct*—plastic tubing used to house optical fiber cable inside a natural gas pipeline.

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[2] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[3] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, http://www.access.gpo.gov.

[4] Available from International Electrotechnical Commission (IEC), 3 rue de Varembé, Case postale 131, CH-1211, Geneva 20, Switzerland, http://www.iec.ch.

[5] Available from Occupational Safety and Health Administration (OSHA), 200 Constitution Ave., NW, Washington, DC 20210, http://www.osha.gov.

3.1.11 *operator*—a person who engages in the transportation of gas.

3.1.12 *operator qualification program*—the minimum requirements for operator qualification of individuals performing covered tasks on a pipeline. The general requirements are described in CFR 49, Part 192.801.

3.1.13 *optical fiber cable*—a cable formed of one or more strands of optical fiber for transmission of data, video, audio, voice, or other information.

3.1.14 *optical fiber cable owner*—the entity holding legal rights to, and responsible for the operation and maintenance of, the optical fiber cable. The owner is also responsible for operation and maintenance of any components associated with the optical fiber system that are not part of the pipeline as defined in this standard.

3.1.15 *optical fiber system*—a group of components that comprise the elements necessary to enable optical fiber cable to be installed, maintained, and operated inside a natural gas pipeline. The optical fiber system owner and pipeline operator are typically one and the same entity.

3.1.16 *pipeline*—all parts of those physical facilities through which gas moves in transportation, including pipe, valves, and other appurtenance attached to pipe, compressor units, metering stations, regulator stations, delivery stations, holders, and fabricated assemblies.

3.1.17 *service line*—a distribution line that transports gas from a common source of supply to (*1*) a customer meter or the connection to a customer's piping, whichever is farther downstream, or (*2*) the connection to a customer's piping if there is no customer meter.

3.1.18 *transmission line*—a pipeline, other than a gathering line, that (*1*) transports gas from a gathering line or storage facility to a distribution center, storage facility, or (*2*) large volume customer that is not downstream from a distribution center, or operates at a hoop stress of 20 percent or more of specified minimum yield strength.

3.1.19 *vault*—a manhole, hand hole, or other enclosure used to store slack-loops of cable or fiber cable splice location, or both.

4. Summary of Practice

4.1 A gas pipeline containing optical fiber systems must be operated and maintained in a cost-effective manner with no significant negative impacts on gas customer service while maintaining or improving pipeline integrity and safety to employees, customers, and the public. In addition, the operation and maintenance of the optical fiber system and optical fiber cable must be accomplished with minimal impact on customers using the optical fibers for communication purposes and at an acceptable cost. In order to meet these criteria, the fittings, tools, and practices used to deploy and maintain an optical fiber system in gas pipelines must be well designed and employees responsible for implementation effectively trained to perform the required tasks. The areas specifically addressed in this standard practice are:

4.1.1 General safety considerations;

4.1.2 Emergency response procedures, including gas control, emergency pipe repair, and communication procedures;

4.1.3 Routine pipeline operation and maintenance activities, including service and main connections, pipe repair, leak detection, and leak inspection;

4.1.4 Routine optical fiber system operations and maintenance activities;

4.1.5 Cable and conduit marking; and

4.1.6 Operator qualification.

5. Significance and Use

5.1 This practice is intended to assist optical fiber cable owners and pipeline operators in developing operating and maintenance procedures and practices for the secondary use of gas pipelines as conduits for optical fiber cables. It must be kept in mind that the primary use of gas pipelines is for transportation of natural gas and any secondary use of the system must not materially impact the primary function. It is the responsibility of the optical fiber cable owner and pipeline operator to decide how best to integrate operating and maintenance procedures for the pipeline, the optical fiber system, and the optical fiber cable so that safety is not compromised, customers are served in the best way possible, and incremental costs are minimized.

5.2 Since the practice of integrating gas pipeline facilities and fiber optics for telecommunications purposes is a new and emerging activity, this standard will help establish guidelines for its rapid and safe deployment and will ensure that the facilities installed are maintained to operate on a long-term basis.

6. Operations and Maintenance

6.1 *General Safety Considerations:*

6.1.1 Employ proper grounding procedures when working on or near gas pipelines.

6.1.2 Take necessary steps to prevent buildup of static electricity during fiber cable system operations near gas pipelines. This includes operations involving pulling innerduct or optical fiber cable into the gas pipeline.

6.1.3 When working with optical fiber cables, care must be taken to avoid fiber penetration through the skin or laser-induced eye damage. For specific guidelines, refer to IEC 60825-1, Ed. 1.2, en 2001.

6.1.4 Always check for the presence of gas prior to and during work on optical fiber systems or optical fiber cable that are connected to, contiguous with, or in the vicinity of gas pipelines.

6.2 *Mapping and Record-Keeping:*

6.2.1 Each pipeline operator must keep adequate records of the type and location of all parts of the optical fiber system that are part of the pipeline. The operator should consider recording high consequence areas (in accordance with CFR 49) where optical fiber systems are located.

6.2.2 Records may be in the form of maps, drawings, notes, or any combination thereof.

6.2.3 The records must be available to the local operating personnel responsible for the pipeline where the optical fiber system is deployed.

6.2.4 Records should be employed by the pipeline operator to minimize the possibility that the optical fiber system is inadvertently damaged by pipeline operator activities.

6.3 *Emergency Response Procedures Involving Pipeline Facilities and Optical Fiber Systems:*

6.3.1 *Standard Requirements*—The pipeline operator must adhere to emergency procedures as required by CFR 49, Subpart F, Part 192.615. These procedures must be modified to account for any special conditions or tools needed to deal with emergency responses to pipelines containing optical fiber cable.

6.3.2 *On-Site Management Control*—For emergency incidents where there is a possibility of an unsafe condition involving natural gas or natural gas facilities, the pipeline operator employee on site must control all activities related to the incident and is required to follow their written emergency procedures. This means that any optical fiber cable owner representative present at the emergency site must consult with and defer to the pipeline operator regarding any proposed activity at or near the site. The pipeline operator will take steps to stabilize the emergency incident to eliminate any related safety issues as quickly as possible so that the optical fiber cable owner may take necessary steps to deal with any fiber cable issues, including installation of a temporary cable bypass connection in or near the emergency incident location.

6.3.3 *Incorporating Optical Fiber System Design into Emergency Response Procedures:*

6.3.3.1 *Use of Designated Control Points (DCP)*—An optical fiber system should be designed such that fiber cable exit and re-entry points afford an adequate space on the pipe to install one or more gas stopping fittings or to pinch close the pipe. At such locations, between exit and re-entry points in the pipe, fiber cable is not present and any conventional method of gas control is acceptable.

NOTE 1—Polyethylene pipe used in natural gas pipelines is generally designed to allow pinching only once at a given location.

6.3.3.2 *Design Distance Between DCPs*—The recommended maximum distance between pairs of exit and re-entry fittings should be chosen to minimize the requirements to control gas within the span length during emergency incidents. The pipeline operator should attempt to control gas at these designated fitting exit and re-entry locations during an emergency incident to avoid optical fiber cable damage. In many cases, effective control of a pipeline can be achieved without cable damage if the exit and re-entry fitting pairs are located no more than 1500 feet apart. In some cases, the pipeline operator may choose to reduce this maximum spacing depending on local conditions, and class location present.

6.3.3.3 *Controlling Gas Without DCPs*—If desired, a pipeline operator may also base emergency control procedures on controlling gas at locations in the pipe where optical fiber cable is present. However, damage of the optical fiber cable may occur and gas flow may not be stopped unless specially designed stopping fittings and pinching machines are used. These special tools may be available from optical fiber system vendors or vendors of conventional pipeline gas stopping tools.

6.3.3.4 If the operator controls gas at a location where innerduct is present by use of a pinching or stopping device, procedure should require checking the innerduct to ensure it is not damaged so that it becomes pressurized with gas (see 6.3.6). If it does, control gas in the innerduct using procedures developed or approved by the operator.

6.3.4 *Notification and Communication between Pipeline Operator and Optical Fiber Cable Owner:*

6.3.4.1 *Notification Contacts*—The pipeline operator and optical fiber cable owner or designee will notify each respective party of emergency incidents related to natural gas, pipeline facilities, or the optical fiber system. Usually, the pipeline operator will become aware of a gas facility-related emergency incident first and should notify the optical fiber cable owner representative in a manner covered in a written agreement between the parties. Likewise, if the optical fiber cable owner detects an optical fiber cable or innerduct break located in a gas pipeline through its monitoring equipment, it shall immediately notify the pipeline operator.

6.3.4.2 *Conditions for Notification*—If possible, the pipeline operator will contact the optical fiber cable owner prior to action being taken if:

(1) The pipeline operator must take action on the gas pipeline that may damage the optical fiber system,

(2) The damaged gas line contains optical fiber cable, and

(3) There is a possibility that assistance by the optical fiber cable owner may be required, but no immediate action is necessary.

6.3.4.3 *Documentation of Communication Protocol*—A written guideline should be developed and kept on file with both the pipeline operator and the optical fiber cable owner containing the following information:

(1) Pipeline operator contact information for emergency response,

(2) Optical fiber cable owner contact information for emergency response,

(3) Criteria for an event to trigger emergency response notification, and

(4) Agreement on hierarchy of notification and target time for notification after incident occurs.

6.3.5 *Damage to Gas Pipeline and Optical Fiber System:*

6.3.5.1 *Response*—Control of gas being released to the atmosphere, whether coming from the pipeline or the optical fiber system, is performed by the pipeline operator.

6.3.5.2 *Controlling an Unsafe Situation*—The pipeline operator must act in a manner consistent with its emergency response plan to control an unsafe situation. In most cases, controlling leaking or blowing gas can be achieved safely by use of stopping fittings, valves, or pipe pinching at DCPs as described in 6.3.3.1. If not, the pipeline operator must control the gas at an intermediate point where optical fiber cable or conduit, or both, are located as described in 6.3.3.3.

6.3.5.3 *Check Optical Fiber Cable System at Adjacent Vault Locations*—If the optical fiber cable system uses conduit to house the optical fiber cable outside the pipeline and the conduit terminates in a vault, the vaults adjacent to the

emergency incident should be checked for leaking gas. If the pipeline operator-approved design uses seals between the cable and conduit in the vault, test to make sure seals are secure. If the pipeline operator-approved design uses conduit vents in or near the vaults, secure gas flow through the vent by closing an in-line valve or by pinching.

6.3.5.4 *Repairing the Pipeline*—If a section of pipe must be removed to effectuate final pipe repair and the optical fiber cable owner must access the emergency incident location to restore temporary telecommunications service, the pipeline operator should consider a temporary repair. The final pipe repair should then be conducted at a time and in a manner that considers safety first and the economic needs of the pipeline operator and optical fiber cable owner second. These temporary procedures should be covered in emergency plans. These temporary repair procedures should be covered in the emergency plans.

6.3.5.5 *Repairing the Optical Fiber Cable*—This is generally achieved by splicing the cable at one or two points away from the emergency incident location and then re-installing the optical fiber cable in the repaired pipe section using the original installation method.

6.3.6 *Damage to Innerduct or Optical Fiber Cable Only*—In rare cases, the innerduct or optical fiber cable inside the pipeline may become damaged while the pipeline remains undamaged. For installations where an innerduct is used, a damaged or malfunctioning optical fiber cable can be extracted and repaired without impacting the pipeline. For installations where the optical fiber cable is directly installed or when the innerduct is also damaged, special procedure must be used to extract the optical fiber cable or innerduct, or both. These repair procedures must be documented by the optical fiber system vendor, approved by the operator, and available to parties responsible for repair activities prior to optical fiber system installation.

6.4 *Routine Operating Procedures:*

6.4.1 *Notification and Communication between Pipeline Operator and Optical Fiber Cable Owner:*

6.4.1.1 The pipeline operator and fiber cable system owner should notify the other entity as far in advance as possible for planned, routine operations.

6.4.1.2 If proper care is not taken, cable repair procedures may damage the pipeline or optical fiber system, creating an unsafe situation. Because of this potential risk, the pipeline operator must be notified as to the nature of the intended repair so he can determine if pipeline operator supervision or oversite is required during the repair.

6.4.2 *Pipeline Operations:*

6.4.2.1 *Hot Tapping*—If hot tapping processes are used, care must be taken to avoid cutting into the conduit and cable during the procedure. This may include marking the tapping shaft so that the cutter does not cut through the pipe any further than necessary.

6.4.2.2 *Welding Operations*—It may be possible to conduct some welding operations on steel pipe containing optical fiber cable without damaging the cable, conduit, or both. The operator should work with the optical fiber system vendor to define under what conditions welding is allowed.

6.4.2.3 *Optical Fiber Cable and Innerduct Removal*—There may be situations where it is desirable to temporarily or permanently remove the optical fiber cable or innerduct, or both, from the pipeline. Examples include pipeline repairs requiring removal of a pipe section, installation of a bottom-out fitting, cable re-routing, or termination of pipeline operator/optical fiber cable owner pipeline access agreement. Because of this, qualified procedures that safely enable the pipeline operator to accomplish this are required. In most cases, these procedures will be treated as a covered task in the operator qualification program. These procedures must be documented by the optical fiber system vendor and available to parties responsible for repair activities prior to fiber cable system installation.

6.4.2.4 *Service and Main Connections*—The optical fiber system vendor should provide procedures that describe accepted main connection practices that are compatible with the optical fiber system. In the absence of these procedures, the operator may choose to develop its own tested procedures for use in operations.

6.4.2.5 *Leak Detection*—Hazardous leaks must be repaired promptly by taking continuous action until the source of leaking gas is accurately determined and eliminated or other measures are taken to positively eliminate any hazard. If the underground leak is centered at an optical fiber system fitting or component, exercise proper care when excavating to avoid damage to the component. After the leak repairs are complete, recheck the area for additional leakage, residual accumulations of gas in street openings, sewers, and drains, and in, under, and around buildings. Take appropriate action to clear residual gas from above ground and below ground structures.

6.4.2.6 *Pipe Repair*—The optical fiber system vendor should provide procedures that describe accepted repair practices that are compatible with the optical fiber system. In most cases, any type of mechanical repair method is acceptable because damage potential to the optical fiber cable is minimal. PE fusion processes that do not require a circumferential cut through the pipe (for example, Saddle Fusion) are also acceptable. Welding on steel pipes may be acceptable under prescribed conditions that must be described or approved by the optical fiber system vendor.

6.4.3 *Optical Fiber Cable System Operations:*

6.4.3.1 *Accessing Vaults or Manholes*—For optical fiber cable system designs that include cable or conduit, or both, routed from the gas pipeline to a vault, hand hole, or other enclosure, use standard procedures to check for presence of combustible gas before accessing the structure. If the structure is classified as a confined space, adherence to safety precautions outlined in ANSI Z 117.1-2003 and OSHA Regulation 29, Part 1910.146, is required.

6.4.3.2 *Operations on Optical Fiber Systems Employing Conduit and Innerduct*—Some optical fiber systems use conduit and innerduct to house the cable. In closed-system designs, the cable is sealed to the conduit at the cable access location (for example, vault) so that gas cannot reach that point in the event of an inadvertent innerduct breach inside the pipeline. In other designs, a vent is integrated into conduit system so that gas entering the innerduct through a breach harmlessly enters

the atmosphere. For closed conduit systems, a means to check for the presence of gas pressure in the conduit system is required prior to breaking the seal between the cable and conduit.

6.4.3.3 *Optical Fiber Cable Fusion Splicing Operations*—Fiber fusion splicing equipment may provide a potential ignition source for gas-air mixtures. If fusion splicing using this type of equipment is conducted on the optical fiber cable at the same time the pipeline is exposed (for example, during optical fiber system installation), the pipeline operator must be consulted to determine if the proposed splicing location is at a safe distance away from the pipeline. If fusion splicing occurs in a vault, hand hole, or other structure, adhere to requirements outlined in 6.4.3.1. The safeguards outlined in this section are not necessary if mechanical splicing methods are used.

6.4.3.4 *Operations on Optical Fiber Cable Directly Installed into Pipelines*—Because these systems require a seal directly between the pipeline and the cable itself, movement of the cable past the seals is not possible without accessing the pipeline. If this is necessary, the operation becomes essentially similar to the initial installation and will require excavation to access the entry or exit seals, or both. Specific procedures must be documented by the optical fiber system vendor and available to parties responsible for these operational activities prior to fiber cable system installation.

6.5 *Routine Maintenance Procedures:*

6.5.1 *Pipeline Cathodic Protection*—As with any metallic component added to the pipeline system, metallic optical fiber system components attached to the pipeline must be coated and under appropriate cathodic protection according to pipeline operator procedures. Insulating conditions may be required.

6.5.2 *Pipeline Leak Inspection*—Since any optical fiber system fitting or component used on the pipeline will be tested and approved for use on pipelines by the pipeline operator, no additional or extraordinary leak inspection procedures are normally required.

6.5.3 *Vault Maintenance Inspection*—Vaults should be inspected for the following hazards on a routine basis:

6.5.3.1 Gas odor (by suitable detection device) or sound of leaking gas;

6.5.3.2 Vault lid damage;

6.5.3.3 Tight radius bend of cable or innerduct;

6.5.3.4 Open splice case;

6.5.3.5 Standing water; and

6.5.3.6 Pinches, nicks, or cuts in cable jacketing.

6.5.4 *Optical Fiber Cable*—The optical fiber cable owner and pipeline operator shall construct an agreement that specifies which components of the optical fiber system the optical fiber cable owner will need to access on a routine basis, notification requirements, and any requirement for pipeline operator presence during the operation. If a maintenance activity involves accessing a vault, proper precautions should be used to test for the presence of combustible gas. If a conduit system is in use, it may have a seal at the vault location between the optical fiber cable and conduit. If this seal must be broken to perform the maintenance activity, proper care must be taken to ensure the innerduct has not been breached and there is no gas present. A pressure gage installed on the conduit or a vent can be used for this purpose. Alternatively, a gas monitor can be used to sample the conduit space to ensure there is no leaking gas. (However, if natural gas was used during the installation pressure test, the conduit must be purged prior to a valid monitoring test.)

6.6 *Cable and Conduit Marking:*

6.6.1 *Optical Fiber Cable*—A unique marking indicating optical fiber cable that has contiguous sections installed in gas pipelines is required. This will ensure that optical fiber cable owners working on the cable know to check for any special provisions required by the pipeline operator.

6.6.2 *Conduit*—Conduit containing optical fiber cable (located outside of the pipeline) must be clearly and uniquely marked to minimize the chances that the pipeline operator will inadvertently damage the cable by cutting or pinching operations.

6.7 *Pipeline Operator Qualification:*

6.7.1 The pipeline operator must have a valid operator qualification program as defined by CFR 49, Part 192.801.

6.7.2 Any installation, operation, or maintenance procedure necessary to create the optical fiber system that can be considered a “covered task” as defined in CFR 49, Part 192.801 (b) must be incorporated into the operator qualification program.

6.7.3 Because each optical fiber system vendor’s procedures and technology are different to one extent or another, it is necessary for the pipeline operator to work with the vendor to identify specific covered tasks and to incorporate those into the operator qualification program.

6.7.4 Each optical fiber system vendor or installer must have documented and detailed procedures for the following tasks:

6.7.4.1 Placement of fiber cable or conduit into distribution mains (if applicable),

6.7.4.2 Placement of fiber cable or conduit into service lines (if applicable),

6.7.4.3 Installation of fiber cable access fittings and components,

6.7.4.4 Leak testing the innerduct,

6.7.4.5 Gas control method for pipeline containing optical fiber cable, and

6.7.4.6 Repair and removal of optical fiber system and optical fiber cable.

7. Report

7.1 Changes to pipeline operating plan must be documented in accordance with CFR 49, Part 192, and any applicable state or local requirements.

8. Keywords

8.1 fiber-in-gas; fiber installation method; gas pipelines; natural gas; operations and maintenance; optical fiber; telecommunications