In-ground Facility Identification Practice

1. Objective

The objective of this practice is to identify and recommend that permanent devices be installed with buried facilities which will allow those facilities to be detected in the future through non-invasive methods.

2. Requirements

This practice applies to all new utility installations buried in public rights-of-way as well as utility easements. This practice may also apply to replacement facilities as deemed practical based on the length of the replacement.

This practice applies to the repair of existing utilities only if the existing facility already has a detection mechanism. The repair of any facility that utilizes a detection device, such as tracer wire, shall also include the restoration of the detection device to original condition.

3. Practice Statement

All new in-ground facilities will be installed with permanent devices that allow a means of detecting or designating the facility in the future through non-invasive methods.

4. Practice Description

A number of non-invasive technologies have been developed to assist in detecting underground facilities from the ground surface. These include ground penetrating radar (GPR), infrared thermography, and other electromagnetic methods. Many of these methods are expensive and have limited applications.. The description of these numerous and often site-specialized geophysical detection methods is beyond the scope of this document. For more information on methods not covered in this practice, refer to The American Society of Civil Engineers (ASCE) Standard, CI/ASCE 38-02.

One common and relatively inexpensive electromagnetic detection method utilizes pipe or cable locators to detect facilities. For simplicity this method will be referred to as Electromagnetic Pipe Detection (EPD). EPD is the primary focus of this practice. It is recommended that all new facilities be installed to accommodate EPD as described in this practice.

There is also a variety of inexpensive products available to aid in facility identification and detection purposes. These include marker and warning tape. These products and EPD are discussed in the following sections.

4.1. Electromagnetic Pipe Detection (EPD)

EPD is a common and widely used method of detecting underground facilities. This electromagnetic method requires a signal to be directly or indirectly induced across the facility by a transmitter. The signal is then detected with a receiver. The transmission of

this signal requires a conductive element, therefore, the facility must be metallic or the facility must be accompanied by a conductive element, such as tracer wirer.

The indirect signal method utilizes the generation of signals from just above the ground surface to induce a response in the facility or tracer wire. Specifically, the aboveground transmitter creates a fluctuating electromagnetic field in the ground that induces a current in the facility. The current or signal is then followed with an aboveground receiver to detect the facility location.

The direct signal method requires direct connection from the transmitter to the facility or the tracer wire. This method requires access points along the facility route for direct connection. To complete the circuit, a ground lead is also connected from the transmitter to ground. The current is directly applied and the signal is detected and followed with a receiver. Direct connection provides the strongest signal and provides the most reliable detection.

This practice recommends the use of EPD with direct connection for all future facilities.

4.1.1 Tracer Wire

Tracer wire is also known as locating wire. It is used to enable the detection of buried plastic pipes, fiber optics, and non-conducting facilities by providing the facility a metal conductor. It is common practice to use THHN or THWN building wire for this function. THHN and THWN are building wires with a nylon jacket. THHN is intended for use in dry locations, while THWN is designed for use in wet locations. However, neither wire is designed specifically for use as a buried tracer wire. Observations over time have shown that these building wires often do not hold up well in buried conditions and become ineffective due to corrosion.

It is recommended that all new construction require the use of tracer wire designed specifically for the purpose of detecting buried facilities. The specifications for tracer wire should require a minimum 12 AWG copper wire coated with a minimum 30 mil polyethylene jacket designed specifically for buried use.

It is appropriate to note the limitations of the tracer wire technology. The effectiveness of the installed system is dependent on an uninterrupted continuous tracer wire system. An un-repaired cut in the tracer wire will likely render the wire unable to carry a signal that can be read by the aboveground receiver. Thus, facility detection will not be possible. It is a given that tracer wire cuts will happen. Consequently, it is important to mandate the repair of all tracer wire cuts as they occur, thus enabling continued integrity and functioning of the tracer wire system.

4.2. Markers

Markers are devices that physically mark a facility at intermittent locations along the facility. Various physical marker systems are available including electronic and visual systems. The markers should conform to the American Public Works Association (APWA) utility color code specifications and can be used to supplement tracer wirer

systems. For facilities buried at excessive depths, electronic or surface markers provide a good facility identification solution.

4.2.1. Above Ground Markers. There are a number of above ground utility markers available. Flat surface markers and pavement markers are installed flush with the ground surface and are marked with utility information. Flags, stakes and various post type markers protrude above grade and are typically highly visible. Subsequently, extensive use of flags and posts may be more appropriate for rural as opposed to city or metropolitan areas. As an option, some of these markers are made to be flush with the surface and then can be extended above grade when locate requests are made.

4.2.2. Electronic Markers. Electronic markers can be buried at various depths or placed near the ground surface over key facilities such as valve boxes, splices, service stubs and facility paths. The markers contain a passive antenna that can be identified with detection equipment and do not require an internal power source. Electronic markers can be supplied with unique frequencies for each type of utility.

4.3. Warning Tape

Warning tape is typically a thin polyethylene tape 3 to 6 inches wide continuously inscribed with a description of the utility and conforming to APWA color codes. It is usually buried 12 to 18 inches directly above an underground utility. During excavation, the warning tape is encountered prior to the utility, thereby warning the excavator of the utility's location.

Some warning tape includes a foil layer that allows the tape to be detected with pipe or cable detectors. Since the primary function of warning tape is to act as a physical warning during excavation, it is usually not protected with the same care as a facility and it likely that it will be damaged during excavation. This practice does not recommend the use of detectable warning tape in lieu of tracer wire.

4.4. Emerging Technologies

Other ways of detecting and locating facilities are being developed or are currently being used in limited capacities. One available product is HDPE innerduct with embedded tracer wire. This product eliminates the need for the installation of separate tracer wire, reducing installation costs. At least two manufacturers, Moore DP, LLC and Carlon are producing this innerduct.

A product still under development is magnetic polyethylene (PE) pipe. The magnetic PE pipe is extruded from polyethylene material that contains strontium ferrite particles. The magnetic particles allow the pipe to be located without the use of tracer wire; however, the pipe requires a special three-axis locator. The magnetic PE pipe and three-axis locator are not commercially available at this time.

5. Practice Procedures

All new non-metallic underground facilities should be installed with tracer wire or a combination of tracer wire and markers. Metallic pipes do not require additional tracer wire. Metallic pipes do require access points along the route for direct connection.

Tracer wire should be installed continuously along the new facility route with access points placed every 300 hundred feet maximum. Tracer wire should be brought to the ground surface at the access points. Access points may include valve boxes, handholes, manholes, vaults or other covered access devices. Access point covers should be clearly marked with the type of facility. Splices in the tracer wire should be connected by means of a split bolt or compression type connector to ensure continuity. Wire nuts should not be used. A waterproof or corrosion-proof connector for direct bury applications is highly recommended.

After installation, tracer wire should be tested to verify continuity of the tracer wire system and a report indicating continuity should be submitted to the permitting authority as part of the as-built construction records.

5.1. Direct Buried Facilities

A tracer wire shall be installed in the trench with all direct buried facilities. The wire should be placed adjacent to or above, but not touching, the pipe. The tracer wire should not be wrapped around the facility. The maximum distance from the utility pipe to the tracer wire should be 6 inches. Non-metallic spacers can be used to keep the tracer wire a set distance from the facility.

In addition to the tracer wire, all direct buried utilities should have plastic warning tape installed above the facility. The warning tape should specify the system buried below. Warning tape should be made of polyethylene, a minimum 3.5 mils thick, and a minimum of 3" wide with black lettering imprinted on a color-coded background that conforms to APWA color code specifications. Tape should be installed 12 to18 inches above the facility and at least 6" below grade.

5.2. Trenchless Placed Facilities

A tracer wire should be installed with all non-metallic pipe constructed by trenchless methods. The tracer wirer can be pre-installed in conduits and innerduct or it can be blown in after conduit or innerduct installation. In the case where conduit or innerduct is not used, the tracer wire should be installed at the same time as the pipe as an integral part of the pipe installation. Attempting to install the tracer wire separately will not guarantee an accurate position of the tracer wire relative to the facility position.

6. References

- U.S. Department of Transportation, Research and Special Programs Administration, Office of Pipeline Safety, Common Ground, Study of One-Call Systems and Damage Prevention Best Practices, August 1999.

- American Society of Civil Engineers, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, CI/ASCE Standard No. 38-02, Preliminary Copy, 2002.

- Jacque Washburn, 3M Telecommunications, Electronic Markers Ease Locating Challenges, available at http://www.underspace.com/uf/ndx/articles/013-341.htm, on the Internet.

7. Practice Outcomes

The cost of a tracer wire system is low relative to a project's total cost. The practice of installing a tracer wire system, with access points for direct connection, will allow the facility to be easily detected by common electromagnetic detection practices. The benefits of being able to easily detect and accurately mark an underground facility significantly dwarf the cost of installation.

If a tracer wire system is required on all future projects, the number of facilities that are non-detectable or/and improperly marked should be significantly reduced over time. Accurately detecting and marking a facility prior to construction will reduce the likelihood of unknowingly striking the facility during excavation. The end result should be a reduction in damaged facilities leading to reduced repair and down time costs.

7.1. Evaluating the Practice

Documenting the specific success of this practice may be somewhat difficult. It is more likely that a specific failure will be identified rather than a specific success. For example, consider a tracer wire system installed with a new facility per this practice. At some point in the future the facility is damaged during an excavation project. It should then be possible to determine if the damage is a result of a failed tracer wire system, improper implementation of the tracer wire system, or other factors unrelated to the tracer wire system.