

Development of an Underground Utility Damage Prevention Plan (UUDPP)

for Company XYZ

by

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A Research Paper

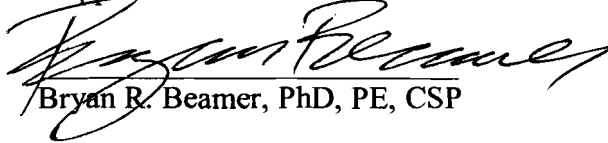
Submitted in Partial Fulfillment of the

Requirements for the

Master of Science Degree in

Risk Control

Approved: 2 Semester Credits



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May, 2008

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Title: *Development of an Underground Utility Damage Prevention Plan
(UUDPP) for Company XYZ*

Graduate Degree/ Major: MS Risk Control

Research Adviser: Bryan J. Beamer, Ph.D.

Month/Year: May, 2008

Number of Pages: 139

Style Manual Used: American Psychological Association, 5th edition

ABSTRACT

Every year there are hundreds of thousands of incidents involving contractors and accidental strikes to underground utilities. Inadvertent damages to buried utility lines while performing intrusive activities may not only cost millions of dollars in direct and indirect losses, but also could result in severe harm or even death to employees and innocent bystanders. While the network of underground utilities continues to increase, the contractor's risk of inadvertently damaging one of these lines also increases.

The purpose of this study is to develop an Underground Utility Damage Prevention Program (UUDPP) for Company XYZ that will minimize the risk of inadvertently causing damage to underground utilities located in Company XYZ project areas. The UUDPP was developed through an evaluation of Company XYZ's existing in-house damage prevention practices, loss potential, loss history, and a review of existing best practices performed by similar industries.

Although to date, Company XYZ has not incurred any substantial losses resulting from an underground utility line strike, current prevention practices were determined to be inadequate in minimizing Company XYZ's risk. Inconsistent prevention practices frequently performed by Company XYZ employees were determined to stem from a lack of a company-wide prevention program. Based on these findings and an analysis of industry best practices, an appropriate UUDPP was developed for Company XYZ.

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Chapter I: Introduction

Company XYZ, an environmental/engineering consulting firm consisting of approximately 120 engineers, geologists, scientists, and logisticians, provides technical services to various federal government agencies. Services performed by Company XYZ include the environmental cleanup of Department of Defense (DoD) sites located throughout the United States.

Cleanup activities performed at these properties often include intrusive activities that require drilling and excavation beneath the ground surface. The clearance of underground utilities must be performed prior to the initiation of any subsurface investigation or remediation activities to avoid accidental damage to the buried utilities. However, the process that outlines the necessary steps used to clear underground utilities has not been specified by the company; therefore, the manner in which the utility clearance is performed is often inconsistent from project to project. The lack of a company-wide Underground Utility Damage Prevention Plan (UUDPP) is placing Company XYZ at risk of incurring substantial loss of, or causing damage to, life, health, property, the environment, or essential public services.

Goals of the Study

The purpose of this study is to develop a company-wide UUDPP that will minimize the risk of inadvertently causing damage to underground utilities that may be located in the vicinity of Company XYZ project areas where intrusive activities are required. The goal of the UUDPP is to verify the presence or absence of subsurface utilities in the project area to avoid causing damage to people, property, and the environment. The UUDPP was developed through a comprehensive evaluation of: 1) existing practices presently performed in-house by Company XYZ employees, 2) losses and near misses incurred/occurred using existing in-house practices,

3) evaluation of present loss potential using existing in-house practices, and 4) best practices adopted by similar companies that commonly perform intrusive subsurface activities.

Background and Significance

Company XYZ's Environmental Services Group has performed over 100 multi-phase, multi-discipline projects involving Resource Conservation and Recovery Act (RCRA)- or Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)-based projects at numerous DoD sites located throughout the United States. These projects include various stages of cleanup, including assessment, investigation, design, construction, and remediation.

The projects commonly range from sites located on active military bases to formerly used defense sites. Formerly used defense sites are properties that were operated under the jurisdiction of the Secretary of Defense and either previously owned by or leased by the United States Government (usually World War II era). These properties are now owned by private individuals, corporations, and other governmental agencies; however, the DoD is still liable for the cleanup of these properties.

Investigative and cleanup actions performed on these properties often include intrusive activities. Intrusive activities performed by Company XYZ during an investigation may include drilling or direct push sampling techniques to facilitate the collection of environmental media samples (i.e. soil and/or groundwater). Data generated through the laboratory analysis of collected soil and groundwater samples is typically used to evaluate the presence, absence, magnitude, and horizontal/vertical extent of contamination. Drilling activities may also be performed to install injection or groundwater extraction wells that are used to remediate contaminated groundwater. Other intrusive activities often performed by Company XYZ during

environmental cleanup include excavation activities. Environmentally impacted soils are often excavated from the subsurface using heavy earth moving equipment (e.g. track hoes, front end loaders, etc.) for subsequent removal from the site. Trenches are also excavated by Company XYZ to facilitate the installation of reactive barriers and/or collection trenches used for remedial purposes.

By law, the clearance of underground utilities must be performed prior to the initiation of any intrusive activities. Utility clearance may be executed by various individuals within the organization (e.g. field operations leader, site supervisor, geologist, engineer, technician, etc.), and this task is often delegated to junior staff by the Project Manager. The utility clearance is a required task that is typically specified in Company XYZ's project Work Plans, Field Sampling Plans, and site safety and health plans (SSHPs). However, the process that outlines the necessary steps for clearing the underground utilities, which includes various office and field tasks, is usually vague and/or not specified in the project plans. In addition, Company XYZ has not developed any company-wide Standard Operating Procedures (SOPs) pertaining to the clearance of utilities for a project.

Therefore, the manner in which the utility clearance is performed at Company XYZ is inconsistent from project to project and often performed by inexperienced junior staff. Even when the utility clearance is performed by more experienced staff, as a result of schedule and budgetary constraints, these individuals often do not take the necessary precautionary procedures to minimize the risk of inadvertently damaging underground utilities. Losses resulting from inadvertent damage to underground utilities may include (but not limited to) death or harm to workers and innocent bystanders, and physical damage to or destruction of property, the environment, or essential public services.

Assumptions of the Study

Assumptions of this study include:

1. This UUDPP has been developed for Company XYZ; however, may be implemented with slight modification for other companies that perform similar intrusive activities.
2. The simple development of this UUDPP will not be effective in reducing the potential for incurring substantial loss of, or causing damage to, life, health, property, the environment, or essential public services, unless it is properly implemented and managed within the organization.

Definition of Terms

Activity Hazard Analysis (AHA): An AHA defines the activity being performed, the hazards posed, and recommended control measures required to perform the work safely.

Critical Areas: The subsurface spaces within 10 feet of a structure where items may exist that if compromised could result in injuries, damaged equipment, damaged property, or at a minimum, disruption of utility services (AntiEntropics, 2005).

Direct Push Sampling Methodology: A drilling technique that uses percussion hammer or hydraulic ram to push or hammer various sample devices into the subsurface to facilitate the collection of soil or groundwater samples (AntiEntropics, 2005).

Intrusive Activity: Any activity that is performed using mechanical equipment resulting in an intended disturbance of the ground surface (CGA, 2003).

Ground Penetrating Radar (GPR): A geophysical device that uses radar to search for underground structures without physically penetrating the ground. Operates on the principal that electromagnetic waves emitted from a transmitter antenna are reflected

from objects beneath the ground that have different electrical properties than the surrounding material (AntiEntropics, 2005).

Vacuum Excavation (a.k.a. Potholing, Daylighting): Performing small excavations along the intended work area where potential utility conflicts have been identified. The excavations are commonly performed using vacuum excavation to minimize the risk of damaging utilities (Pollock, 2007).

Chapter II: Literature Review

Major topics to be discussed in this chapter include: 1) a brief summary of the nature of the high level of risk associated with the performance of intrusive activities (as they relate to underground utilities) and the need for UUDPPs; 2) a general overview of the number of losses (and their associated magnitude) incurred by third party damage to underground utilities in the history of the United States; and 3) an overview of best practices performed by other industries conducting similar intrusive activities in connection with preventing damage to underground utilities. This literature review is structured to provide background and information in order to develop a company-wide UUDPP for Company XYZ that will minimize the risk of inadvertently causing damage to underground utilities that may unknowingly be located in the vicinity of Company XYZ's project work areas.

Risks Associated with Performing Intrusive Subsurface Activities

There are millions upon millions of miles of utility lines buried beneath the ground. With the number of aboveground utility lines strung between utility poles on the decline due to the public's desire to improve the esthetic quality of the environment, the number of utility lines that are being buried beneath the ground continues to increase (Cowgill, 1981; USDA, 1999). Electric, phone, cable television, water, sanitary, and natural gas lines are often included in this buried utility network. Other utility lines found beneath the ground may include petroleum pipelines, national defense communication lines, drainage and flood control facilities, traffic signals, and street lighting circuits (USDA, 1999).

It is estimated that a common home located in the city may alone have up to 15 utility lines buried beneath their property (Wilmoth, 2007). Utility easements and right-of-ways usually contain many more utility lines, which may be stacked vertically in a common trench, grouped in

a single conduit (or duct bank), or grouped in common utility tunnels referred to as utilidors (USDA, 1999).

With the vast network of underground utilities continuing to increase, the chance for a contractor to inadvertently damage one of these lines while performing intrusive activities will therefore continue to increase. The risk of accidentally hitting one of these buried utility lines is also elevated because of the inability to accurately locate these lines (both horizontally and vertically) in the field. For example, utility records, typically consisting of drawings and maps, identifying the locations of existing utility lines are often incomplete and/or inaccurate (USDA, 1999). Much of this problem stems from the fact that many of these lines, particularly in older cities, were installed more than 100 years ago when as-built drawings (if existed) referred to surface features that are no longer present (Pollock, 2007). In addition, these utility lines typically consist of a wide variety of construction materials and may be buried at various depths in a variety of soil types with differing conductivities (e.g. sand, clay, bedrock, etc.). Therefore, the ability to accurately locate the exact location of these utilities in the field requires an array of locating instruments utilizing various technologies (e.g. pipe and cable locator and tracer, electromagnetic tracing receiver, ground penetrating radar (GPR), etc.) (USDA, 1999; USDOE, 1996).

Conduits may range in construction from steel, cast iron, and ductile iron pipes to clay, polyethylene, polyvinyl chloride, and fiberglass reinforced plastic pipes. Cable may be copper or fiber optics. These lines can have different shapes, compositions, densities and diameters. Traditionally, dry utility lines were buried to depths ranging from 2 to 4 feet (or less), and wet utilities were typically 5 to 9 feet deep; however, due to more advanced methods often used to install underground utilities (i.e. horizontal directional drilling), the depths of the utilities may

extend to depths greater than 100 feet (USDA, 1999; Carpenter, 2003). For reasons such as these, underground utilities are often mismarked, leading to accidental utility damage during excavation or other intrusive activities.

Underground utility lines are often energized, pressurized, or may contain a variety of hazardous substances. Accidentally hitting ones of these utilities can cause serious damage or loss of life to workers or other individuals located in the vicinity of the work area. Essential public services (e.g. electricity, water, telecommunications, etc.) for homes, businesses, hospitals, air traffic control operations, and emergency service providers may temporarily be placed out-of-service for extended periods of time (USDOE, 1996; CGA, 1999; Bernold, 2003a). Costs associated with “loss of use” of the utility can result in significant monetary judgments for the utility company to recover revenues lost while the utility line was placed out-of-service due to damage by the contractor (Ariaratnam and Proszek, 2006).

Other direct losses associated with third party utility damage to underground utilities include physical damage to or destruction of property, repair costs, emergency services costs (fire, police, rescue team, etc.), costly litigation expenses, costly work stoppages, and delayed work schedules. As part of a Florida Department of Transportation (FDOT) study, a contractor is delayed three out of every ten times (or 30% of the time) that a utility strike occurred on the project (University of Florida Department of Civil and Coastal Engineering, 2003). Indirect losses may include increased insurance premiums, loss of insurance, a reputation for performing unsafe work practices, and loss of business (Bernold, 2003a; Griffin, 2007a).

The following incident is one example that demonstrates the magnitude of direct costs that may be associated with damaging underground utility lines. In North Carolina, an underground natural gas pipeline was accidentally damaged and out-of-service for six hours. The

cost to physically repair the damaged pipeline was only \$15,000. However, the actual cost incurred by the contractor for lost of business by the gas company for loss of use for six hours was over \$300,000 (\$50,000 per hour), not including legal fees (Carver, Bernold, Lorenc, 1998). Additionally, in 2000, a jury awarded damages of \$1.2 million to AT&T for damages to two fiber-optic lines caused by a contractor representing Qwest Communications. The punitive damages awarded were \$350 million; however, the actual settlement was much smaller (Ball, 2000).

The most common and well advertised method used to locate buried utilities is the National One Call System (further discussed below in “Best Practices”) (Wilmoth, 2007). In 1994, the Department of Transportation’s Office of Pipeline Safety issued federal regulations mandating participation in One Call system for natural gas and liquid pipeline operations (CGA, 2007a). However, many utility companies are still not participants in the One Call system (Note: Some states require participation by every utility company while others do not) (Thelen Reid Brown Raysman & Steiner LLP, 2006a). In addition, there are several other inadequacies with the existing One Call system, even when the system is used by a contractor/individual. Some examples of these inadequacies include:

- Mis-locates performed by the locating contractor;
- Depth information is not provided when marking utilities;
- The One Call system will only identify and notify utility companies that show a utility in the requested area to be “cleared”;
- Does not include private utilities; and
- Problems occur with demand for locates and timing of locates relative to performing intrusive activities (USDA, 1999).

Therefore, the contractor cannot rely on the One Call system alone. The inclusion of other essential key elements (as described below in “Best Practices”) are essential in the development

of an effective UUDPP that will minimize the potential for incurring substantial loss of, or causing damage to, life, health, property, the environment, or essential public services.

Summary of Losses: A Historical Perspective

On December 11, 1998, four people died and 15 were injured in St. Cloud, Minnesota when construction workers accidentally punctured a 1 1/8-inch plastic gas line while drilling a hole to facilitate the installation of a guy wire for a telecommunications pole. The explosion resulted in the damage and destruction of eight buildings, and 14 other buildings required extensive repairs. The property damages exceeded \$1 million. As a result of this incident, the City of St. Cloud adopted an Excavator Safety Program in 2000. Under this program, all excavation work performed near a natural gas line in the City right-of-way, must be performed under a Gas Safety Plan. This Gas Safety Plan must be attached to the permit application to perform the work. In addition, the excavation work must be supervised by an employee qualified and training the city approved Excavator Safety Program. As a result of this program, the number of incidents have been reduced and no injuries or significant property damage has been incurred (Griffin, 2002; Bernold, 2003b).

Another incident involving the rupture of an underground natural gas line occurred on March 16, 2005, when a contractor hit an underground pipeline while installing a high speed internet line in a residential neighborhood using horizontal directional drilling techniques. When an 18 year old boy and his younger sister returned home from school, the workers motioned to them that it was safe to go into their house. Ten minutes later, the two-story home was leveled and the 18 year old boy was critically injured (suffering second degree burns over 40 percent of his body). Nearly 8,000 similar accidents involving the unintentional damage to underground

natural gas pipelines have occurred over the last 20 or so years, resulting in an estimated 400 deaths and 1,900 injuries (Sherman, 2006).

Serious accidents also occur while working in the vicinity of underground electrical conduits. While performing excavation-related activities for the installation of a sump in a basement on January 17, 1996, a worker was severely injured when he hit a buried 13,320-volt electrical line with a jackhammer. The worker received serious burns and was placed in a coma. The workers were not aware that utility clearance activities were required for concrete cutting and sub-slab excavation inside a building (USDOE, 1996).

In another incident, the planner mistakenly read the drawing as showing an underground electrical conduit. The line, which was uncovered on February 7, 1995, was actually an abandoned underground radioactive waste transfer pipe on a Department of Energy property. The worker who was hand digging in a trench received an estimated dose of five to seven millirems (mrem) before the pipe was identified as radioactive (USDOE, 1996).

There are thousands upon thousands of *documented* incidents involving accidental strikes of underground utility lines which caused substantial loss to people, equipment, and property, and probably just as many cases (or more) which were left undocumented. For the purpose of collecting underground utility damage information in order to help learn why events occur and how actions by industry can prevent them in the future, in November 2003, the Common Ground Alliance (CGA) launched the Damage Information Reporting Tool (DIRT). This secure and interactive web application allows users to anonymously submit damage and near miss reports. The collected data is analyzed to identify root causes, perform trend analysis, and help educate all stakeholders so that damages can be reduced through effective practices and procedures (CGA, 2007b).

Based on the analysis of the 2005 data (in the most recent CGA DIRT Analysis and Recommendations report), it is estimated that each year there are approximately 680,000 accidents causing damages to underground utilities (CGA, 2006). Between 2003 and 2005, more than 60 people died from excavation accidents resulting in damage to underground utilities. These damages also resulted in losses costing millions of dollars (Griffin, 2005).

Best Practices

In accordance with the 29 Code of Federal Regulations (CFR) 1926.651(b)(1), “The estimated location of utility installations, such as sewer, telephone, fuel, electric, water lines, or any other underground installations that reasonably may be expected to be encountered during excavation work, shall be determined prior to opening an excavation” (United States Department of Labor, 2007, p. 1).

In the past, many contractors used the hit-and-miss approach as their alternative to a UUDPP. Under this alternative, contractors operated under the theory that if and when they hit a utility line, they would then repair it (Pollock, 2007). However, as many contractors have learned from past experiences, sometimes the costs of not knowing what is beneath the ground can greatly exceed expenditures used to safely identify and locate underground utilities in the project area prior to the initiation of intrusive activities. Losses resulting from a single accidental strike of an underground utility line can range from as little as a couple hundred dollars for simply cutting/repairing a small water line to millions of dollars from hitting a natural gas lines that could lead to an explosion, loss of life, and substantive damage to property.

According to CGA’s Best Practices Study (1999), damages to underground utilities are usually preventable and are most commonly caused by a breakdown in the damage prevention process. To prevent such occurrences, many organizations and industries that perform intrusive

activities have developed best practices necessary to prevent damage to underground utilities. Examples of organizations and groups that have developed best practices include the CGA, public works municipalities, drilling, railroad, telecommunications, gas, electric, and the construction industries. A review of best practices developed by the aforementioned groups/industries indicates that most contain common key elements used in the successful development of an effective UUDPP. Some of the most common key elements that were included in multiple UUDPPs include: 1) pre-planning and site investigative activities; 2) effective use of the One Call system; 3) accurately locating and marking utilities in the field; and 4) proper excavation practices.

The CGA was established under the congressional Transportation Equity Act for the 21st Century (TEA-21), Title VII, Subtitle C, SEC. 7301 (United States of America, 1998), which states:

. . . unintentional damage to underground facilities during excavation is a significant cause of disruptions in telecommunications, water supply, electric power, and other vital public services, such as hospital and air traffic control operations, and is a leading cause of natural gas and hazardous liquid pipeline accidents. (p. 415)

Under TEA-21, the Department of Transportation sponsored the Common Ground Best Practices study, which was completed in 1999. The purpose of the study was to identify and validate existing best practices performed in connection with preventing damage to underground utilities. The study engaged more than 160 experts in damage prevention from multiple industries and government. The best practices were to be shared among stakeholders involved with and dependent upon the safe and reliable operation, maintenance, construction, and protection of underground facilities (CGA, 1999). These best practices were most recently updated in 2007 by the CGA and was entitled “Best Practices Version 4.0” (CGA, 2007c). The CGA study has

become an accepted performance standard for state-managed One Call programs (Shively, 2006).

Pre-Planning and Site Investigative Activities

Planning plays an important role the identification of site hazards and should be the first step in the damage prevention process. Planning includes the preparation of comprehensive project plans, which should include safety provisions for the prevention of damage to underground utilities. Proper planning will help to ensure that the project will be completed safely and on schedule (AntiEntropics, 2005; Roe, n.d.).

Whether the project is in the design phase or the construction phase, the contractor must exercise due diligence in their efforts to determine the actual locations of existing, abandoned, and out-of-service underground utilities within the project area. If the project is in the design phase, these utilities should also include proposed utilities that may be installed prior to and during the project (CGA, 2007c). Many states require the contractor to make a One Call notification in the design phase of a project that is going to require intrusive subsurface activities (Balin, 2006). The designer must notify the facility owners not less than 10 days, nor more than 90 days before the final design is approved (Balin, 2005). Planning documents and drawings should include the locations of all existing utilities (CGA, 2007c). In a FDOT study, construction plans were observed as inaccurate fifteen percent of the time that damage to an underground utility line occurred (University of Florida Department of Civil and Coastal Engineering, 2003).

As a demonstration of due care, the contractor's efforts should include a review of all reasonably attainable drawings and records pertaining to the project area. Drawings and records that should be reviewed may include, but not necessarily limited to:

- Civil/utility drawings;
- Historic site information (maps, photos, files);

- Site as-built drawings;
- Plats, which include utility easements;
- Historic plot plans;
- Previous site investigations;
- Fire insurance plans;
- Proposed utility plans; and
- Elevations and coordinates maps.

Not all, or even some of these records will be available for every project; however, the contractor should maintain detailed and accurate notes and documentation in the project file that demonstrate that the contractor performed proper due diligence (AntiEntropics, 2005). Although the accuracy of many of the aforementioned drawings/plans may be questionable (as previously noted), the value of the information that may be obtained by reviewing these records cannot be disregarded.

Methods of gathering information may include contacting the State One Call Center, facility owners/operators, coordinating committees/councils, engineering societies, and governmental agencies as a means of identifying facility owners/operators in the project area (CGA, 2007c). The contractor should interview personnel who are familiar with the property, the layout of the site utilities, and have historic knowledge of the site. Such individuals may include past/present property owners, and the property manager or facility engineer (AntiEntropics, 2005).

Site investigative activities should also be conducted during the project planning phase. Site investigative activities ought to include a walk around of the site to identify the area(s) proposed for intrusive activities. During the site walk, aboveground indicators of underground utilities should be noted. Aboveground indicators may include permanent signs or markers, manhole covers, valve boxes, vent pipes, pad mounted devices, riser poles, power and communication pedestals and valve covers (CGA, 2007c). Subsequently, activities such as a

manhole investigation may be performed (i.e. lifting manhole covers) to identify the direction and proximity of the utility lines in relation to the project area (AntiEntropics, 2005).

The site walk should also be used to identify potential critical areas for the project. Critical areas are those areas within 10 feet of a subsurface structure (e.g. underground storage tank, utility line) or high pressure pipeline, which if accidentally damaged due to intrusive activities could result in death, injuries, damaged equipment/property, or a disruption of utility services. Critical areas should be twice reviewed prior to intrusive activities (AntiEntropics, 2005).

Effective Use of the One Call system

On June 9, 1998, TEA-21 Title VII Subtitle C – Comprehensive One Call Notification (a.k.a. “Call Before You Dig”) was signed into law and each state was required to develop a One Call System. To simplify the system, and as of May 1, 2007 (the number was designated by the Federal Communications Commission in 2005 at the direction of congress), the caller simply has to dial “811”. By dialing “811”, the caller is automatically connected to the nearest local One Call Center (e.g. Gopher State One Call for Minnesota, Wisconsin State One Call, etc.). Before the creation of “811”, there were 62 One Call Centers across the nation, each with a different call number. The 811 system is designed to encourage more people to call by making the number easier to remember, which will result in fewer incidents (Griffin, 2006; Wilmoth, 2007).

The One Call notification system is used to inform the underground facility operators of intended intrusive activities. The One Call Center serves as the communication network and acts as the point of contact between the excavator and the underground facility operators. In Minnesota, State Statute Chapter 216D requires anyone who engages in any type of excavation to provide advance notice of at least two working days to the Gopher State One Call (Gopher

State One Call, 2007). In Wisconsin, State Statute Chapter 182.0175 requires anyone who engages in any type of excavation to provide advance notice of at least three working days to Wisconsin State One Call (Wisconsin State One Call, 2007).

Prior to the initiation of the National One Call System in 1998, protection of underground utilities was less coordinated and intentional than today's system and mainly was the responsibility of the utility companies. As early as 1974, some individual states had adopted notification systems to find and mark buried utilities prior to excavation (Shively, 2006). However, the state systems received varying degrees of participation.

In order to process the notification, the caller provides the following information, at a minimum, to the State One Call Center operator (CGA, 2007c):

- Caller's name and phone number;
- Company's name, address and phone numbers;
- Where is the work being conducted;
- Start date and time of the excavation; and
- Description of the activity.

More detailed information (e.g. Latitude/Longitude, highway mile markers, subdivision and lot number, etc.) may be required to help determine the specific location of the excavation (CGA, 2007c). Prior to working in a particular state, the state's One Call Statutes should be reviewed to identify necessary required information. The caller is then issued a reference ticket number from the One Call Center that verifies that they have notified the underground facility operators via the One Call system. It is the responsibility of the underground facility operators to then locate and accurately mark the positions of their buried utilities, in relation to the caller's project area.

At the beginning of the adoption of the National One Call system in 1998, each individual utility responded by sending out their own crew members to locate and mark their buried utilities. It was later determined that a single provider could operate more efficiently and

effectively in locating all of the buried utilities (e.g. electric, water, sewer, telecommunications, etc.) at a jobsite. Subcontracted locating service providers began to specialize in providing locating and marking services to various utility companies (Shively, 2006). The use of a single locator has several advantages to the facility operator and excavating communities including: 1) more responsive to the excavation community, 2) better communication with the excavation community (fewer points of contact), and 3) maps of multiple facilities (CGA, 2007c).

In most states, the locate ticket number is only active in the range of 10 to 30 calendar days (although the typical is 14 calendar days). If the project extends beyond the active period for that particular state, the contractor must contact the One Call Center to extend the active period before it expires (Roe, n.d.; Thelen Reid Brown Raysman & Steiner LLP, 2006b).

The costs for most State One Call systems are paid by underground facility operators that are members of the One Call system. Each state's One Call system has their own set of standards and statutes and the contractor should be familiar with the state's standards that he/she intends to work.

The primary cause of accidental damage to underground utilities is failure to provide notice of intent to perform intrusive activities prior to beginning excavation and other intrusive activities (Griffin, 2007b). In almost half (43.4 percent) of the reportedly estimated 680,000 utility strikes that occur each year, no notification calls were made to the appropriate One Call Centers of their intent to perform intrusive activities. This information led CGA to conclude that damage prevention awareness programs, and education and training for excavation best practices needed to be targeted towards professional contractors, government organizations, and facility owners/operators (CGA, 2006).

Accurately Locating and Marking Utilities in the Field

Accurately locating and properly marking utilities in the field is a fundamental step in preventing accidental damage to underground utilities for intrusive activities. However, mismarked utilities remain a leading cause of inadvertent damage to underground utilities (Griffin, 2003). Data collected in 2005 using the DIRT program indicated that 11.1 percent of the reported incidents were a result of insufficient locating practices (Griffin, 2007b).

Mismarked utilities may be a result of the employment of under qualified locating personnel. As a result, the National Utility Locator Contractor Association (NULCA), which was formed in 1994, developed the locating industry's first locating and training standards and procedures in 1996. Since development, these standards and procedures have been refined and improved and were adopted by the CGA. Subject covered under the NULCA standards and procedures include: theory of electronic magnetic location; use of transmitter and receiver locating equipment; marking procedures; visual observation skills; safe work practices; documentation and mapping; national, state, and local regulations; interaction with customers; and procedures for locating pipelines in the United States. The training concludes with both a written and field test for competency. Most NULCA member organizations have adopted these standards and procedures into their training programs; therefore, it is recommended that persons locating utilities on your worksite belong to companies that are NULCA members (Griffin, 2003).

As previously noted, following the launch of the 1998 One Call system, third party locating service companies began providing locating and marking services to various utility companies. As a result, a single locating service provider may be sent out to locate all of the buried utilities when a One Call notification is initiated (Shively, 2006). One of the concerns of

many contractors in relation to locating underground utilities is that third party utility locators sometimes perform a poor job of locating the utilities. Part of the problem is because third party locate companies traditionally have constant employee turnover. For example, in cases where a locate company did not perform well, the company typically loses the contract to another company. The replacement company often hires some of the same employees. If the training system has not improved, the new locate company usually will face the same performance issues. As a result, many contractors have had to purchase and train their employees to use more advanced locating equipment to supplement the One Call utility locates (Carpenter, 2003).

Markings typically consist of spray paint, flags, chalk, or stakes. When considering the design of a proper marking system for a project, the most important factor is visibility. For example, a marker may be too short and get lost in overgrown vegetative areas. These markers may also then cause a tripping hazard on the work site (Landes, 2007).

Once a marking system is in place, it needs to be maintained through the life of the project. The preservation of the utility marks is the responsibility of the contractor. When the marks are faded or destroyed, the contractor must re-notify the One Call Center (Thelen Reid Brown Raysman & Steiner LLP, 2006b; Landes, 2007).

As indicated in the American Public Works Association (APWA) Color Code Chart for Marking Underground Utility Lines (Table 1), proposed locations/areas for borings, excavations, or other intrusive activities should be marked in white. Red is used for electric lines, yellow for gas and oil, orange for communications, green for sewer, and blue for water.

Table 1: APWA Color Code Chart (APWA, 2001)

	White	- Proposed Excavation
	Pink	- Temporary Survey Markings
	Red	- Electric Power Lines, Cables, Conduit, and Lighting Cables
	Yellow	- Gas, Oil, Steam, Petroleum or Gaseous materials
	Orange	- Communication, Alarm or Signal Lines, Cable or Conduit
	Blue	- Potable Water
	Purple	- Reclaimed Water, Irrigation and Slurry Lines
	Green	- Sewer and Drain Lines

Other recommended marking guidelines were adopted by the APWA in 2001. For example, if no conflict exists by a utility owner on an excavation site, it is recommended that a marking should be placed indicating at a minimum the initials of the underground facility owner (e.g. “NO/AT&T”, or a circle with a “/” through it accompanies by the owners initials). A copy of APWA’s Recommended Marking Guidelines for Underground Utilities is included in Appendix A (APWA, 2001). After the lines have been marked, the field crew may begin intrusive activities; however, they must maintain specific distances from the marked lines.

Every state requires a certain degree of precision when utility companies mark their utility lines. This degree of precision is reflected in safety/tolerance zone requirements prescribed in the One Call statutes. A safety/tolerance zone indicates the distance (usually in inches) on either side of the marking in which the contractor must assume the presence of a utility line. These safety zones typically range from 18 to 30 inches (Thelen Reid Brown Raysman & Steiner LLP, 2006a).

Some states require that the contractor must determine the exact location of a utility line (both horizontally and vertically) with hand tools, prior to using mechanical equipment (Thelen

Reid Brown Raysman & Steiner LLP, 2006b). In-field clearance methodologies are used to physically uncover an underground utility location and are the surest method of determining the exact location of utilities (recognized as such by the Occupational Safety & health Administration (OSHA)) (Ortiz, 2005, Roe, n.d.). These in field clearance methodologies can be broken down into two categories. One involves direct contact to reveal a subsurface structure, and the other attempts to avoid direct contact with the subsurface structure. Direct contact, which is not a universally acceptable technique, typically involves proper hand-digging tools (e.g. hand augers, post-hole diggers, steel rods) and digging techniques as to not damage the utility line. Methods that avoid direct contact include vacuum excavating (a.k.a. potholing or “soft” excavating), air knifing, and water jetting (Griffin, 2001, AntiEntropics, 2005).

Proper hand-digging tools and techniques, which should only be performed by experienced personnel, will help to protect both the workers and the utility. A blunt-nosed shovel is used to loosen the soil using a gentle prying action, whereas, a pickax or a pointed spade should never be used. The worker should dig at an angle, so the shovel will slide along the surface of the wire, conduit, or pipe, and never stab at the soil or stomp on the shovel with both feet. An alternate technique is to dig to the expected depth the utility line, but off to the side. A prying motion can then be used to break away the soil as the utility line is approached laterally. A regular shovel may be used to remove the soil from the excavated area (AntiEntropics, 2005).

Vacuum excavation (or potholing) typically consists of performing small excavations along the intended route where potential conflicts with underground utilities have been marked (Pollock, 2007). Vacuum excavation is typically performed in conjunction with air knifing or water jetting methodologies, usually depending on the subsurface conditions. Pressurized air or water (typically 90 to 100 pound-force per square inch gauge (psig)) is used to break, cut, or

loosen the underlying soil structure for subsequent vacuum removal. Air knifing is commonly used where the soils are sandy and soft, and water jetting is more commonly used in clayey and stiffer soils (AntiEntropics, 2005; Ortiz, 2005).

There are several other factors that may influence the choice between air and water systems while performing vacuum excavation. Although water jetting systems are less expensive than air systems and effective in most soil conditions, the use of water jetting systems are limited by the nearby supply of water. Also, non-compressible water, when used at high pressure, has the potential to cut through cables, and soft or damaged pipes. The wet spoils produced by water jetting are sometimes more difficult to handle and dispose of than dry material produced by air knifing and are not suitable backfill material (Griffin, 2001; Hawk, 2001). The use of air (versus water) would also be more advantageous where environmental media samples are collected, as to not compromise the composition, characteristics or chemistry of the collected soil or groundwater samples (AntiEntropics, 2005).

The vacuumed soils are stored in a collection tank. If the excavated material is appropriate backfill, some of the excavated material is deposited next to the hole and reused for backfilling purposes. Typical excavation depths do not exceed 6 feet. Following the completion of the identification of the utility conflict, the hole is then backfilled, compacted, and repaired with a temporary asphalt patch (Civil Engineering, 1993; Griffin, 2001; Pollock, 2007).

Where the potential conflict is located beneath the pavement and the removal and replacement of asphalt and/or concrete is required, the repair to the pavement and excavation is often expensive and disruptive. Using conventional techniques, the pavement is often saw-cut and removed using jack-hammers and excavators. The new technique of “keyholing”, involves coring an 18-inch diameter hole through the pavement (including asphalt and concrete). After

completion of the vacuum excavation, the hole is then backfilled/compacted and then the core that was originally cut from the pavement is reinserted back into the road surface with a special bonding compound that results in a permanent repair. Due to the resulting mechanical bond between the core and the surrounding pavement, the original performance capacity of the road is replaced and traffic can be restored within 30 minutes of core replacement (Pollock, 2007).

The contractor is typically required to notify the One Call Center at least two to 10 working days (depending on the state) prior to intrusive activities. However, not all utility companies respond within the statutorily prescribed time frame. In the event that a mismarked utility line is discovered, many states require that the One Call Center be re-notified. One Call statutes dictate that a contractor may not proceed with intrusive activities until every utility company has marked their utility lines, regardless of how many notifications have been given (Thelen Reid Brown Raysman & Steiner LLP, 2006b).

As previously noted, privately-owned facilities will typically not be located under the National One Call notification. These privately-owned facilities are typically utility lines that are located on private properties and are owned by private parties. These private utilities are underground lines or pipes that were not installed by the utility company and are those that were installed beyond the utility meter (typically located at the property line). For example, electric and water service lines that exist between the utility meter and a residence or commercial building are commonly owned by private parties and would not be located under the National One Call system. For this reason, a contractor who is working on private property would need to hire a private utility locator. Other examples of private utilities may include buried electric lines providing power to parking lot lights, lawn sprinkler piping, communication lines for satellite dishes, and in service lines from propane tanks (AntiEntropics, 2005). As previously noted by

Griffin (2003), because contractors that are members of the NULCA are more likely to have adopted the industry accepted locating standards and procedures into their employee training programs; it is therefore recommended that private utility locators that are locating utilities on your worksite also be members of the NULCA.

Proper Excavation Practices

Data collected in 2005 using the DIRT program indicated that 22.2 percent of the reported incidents were a result of insufficient excavation practices (Griffin, 2007b). Excavation represents any operation using non-mechanical or mechanical equipment or explosives used in the movement of earth, rock, or other material below existing grade and includes, without limitation to, augering, blasting, boring, digging, ditching, dredging, drilling, driving- in, grading, plowing- in, pulling- in, ripping, scraping, trenching, and tunneling (CGA, 2003).

Proper excavation practices are those that can be used to reduce the possibility and/or severity of damage to underground facilities during the excavation process. In accordance with 29 Code of Federal Regulations (CFR) 1926.651(b)(3), “When excavation operations approach the estimated location of underground installations, the exact location of the installations shall be determined by safe and acceptable means” (United States Department of Labor, 2007, p. 1). The Common Ground study of 1999 identified 28 best practices (as tabulated in Appendix B) used during excavation of, and around, underground facilities. These best practices were divided into four phases of the excavation project: Project Preparation, On-Site Preparation/Ground Breaking, On-going Excavation Procedures, and Project Restoration/Completion (USDOT, 1999). In addition, these best practices were updated in 2007 by the CGA (Version 4.0) (CGA, 2007c). As previously noted, these best practices were most recently updated in 2007 by the CGA (Version 4.0) (CGA, 2007c). In Version 4.0, these 28 best practices remained unchanged and two

additional best practices (numbers 29 and 30) were added. As a note, some of these best practices are (to varying degrees) duplicates of some of previously discussed best practices included in the previous three key elements above (pre-planning and site investigative activities, effective use of the One Call system, and accurately locating and marking utilities in the field).

Summary

Every year, there are thousands upon thousands of incidents involving accidental strikes to underground utility lines that are unknowingly located in the vicinity of a work area. With the number of utility lines that are buried beneath the ground continually increasing, a contractors risk of striking a buried utility line while performing intrusive activities will also continue to increase. Because underground utility lines are often energized, pressurized, or contain hazardous substances, accidentally hitting ones of these utilities can cause substantial losses to people, equipment, and property. Therefore, it is critical that every company develop, implement, and manage an effective UUDPP that has the support and commitment of upper management. Based on a review of best practices developed by groups/industries that regularly perform intrusive activities, there are common key elements used in the successful development of an effective UUDPP. These common key elements include: 1) pre-planning and site investigative activities; 2) effective use of the One Call system; 3) accurately locating and marking utilities in the field; and 4) proper excavation practices.

Chapter III: Methodology

Introduction

To minimize the potential for losses (to life, health, property, environment, or essential public services) resulting from accidental damage to underground utilities, Company XYZ employees commonly perform an underground utility clearance prior to initiating intrusive activities associated with investigative and remedial actions. However, the manner in which underground utility clearance activities are performed at Company XYZ is often inconsistent from project to project, resulting in an increased potential for striking an underground utility line. The purpose of this study is to develop a company-wide UUDPP for Company XYZ that will minimize the risk of inadvertently causing damage to underground utilities that may unknowingly be located in the vicinity of Company XYZ project areas.

Subject Selection and Description

Company XYZ was selected as the subject of this study. Company XYZ is an environmental/engineering consulting firm consisting of approximately 120 engineers, geologists, scientists, and logisticians. Company XYZ's Environmental Services Group often performs environmental cleanup activities at active and inactive DoD sites located throughout the United States. Cleanup activities at these sites typically require intrusive activities beneath the ground surface, such as drilling and excavation.

The researcher is currently employed as a full-time Hydrogeologist/Project Manager at Company XYZ and has access to company files and professional contacts within the company. The selected individuals that were surveyed were chosen based on their role within the Environmental Services Group at Company XYZ.

Data Required

Data required for this study included: 1) A compilation and assessment of existing underground utility clearance practices presently performed in-house by Company XYZ employees; 2) An evaluation of Company XYZ's underground utility damage history (accidents, losses, near misses, etc.) while using existing in-house practices; 3) An evaluation of current loss potential associated with intrusive activities (e.g. drilling, excavation, etc.) commonly performed at Company XYZ; and 4) A literature review of existing best practices utilized by similar industries performing intrusive activities.

Data Collection Procedures

Existing In-House Utility Clearance Practices

Underground utility clearance practices presently performed at Company XYZ tend to vary from project to project because standardized procedures have not been developed or implemented on a company-wide basis. Typical underground utility clearance practices consist of both office and field activities that are performed prior to the initiation of intrusive activities. This study included a compilation and assessment of underground utility clearance practices presently performed by Company XYZ employees. Existing in-house underground utility damage prevention practices were ascertained through the collection and review of company-wide and project-specific documents (both past and present), and the performance of a simple survey of select Company XYZ employees within the Environmental Services Group. Not only will this study attempt to compile and evaluate the types of underground utility clearance practices presently being performed, but also the frequency in which they are performed and their overall effectiveness in minimizing the company's risk.

Both paper and electronic copies of existing company-wide and project-specific documents were obtained for review. The researcher made verbal requests to the Company XYZ's Health and Safety Coordinator and Environmental Services Group Program Manager to obtain copies of and get permission to use these documents for the purpose of this study. A copy of the company-wide Safety and Health Program was obtained from Company XYZ's Health and Safety Coordinator. Project-specific documents included electronic copies of Work Plans, SSHPs, and Field Sampling Plans that were downloaded from Company XYZ's computer server. The researcher selected 15 project-specific documents to provide a broad overview of these documents (five of each project-specific document type: Work Plans, SSHPs, and Field Sampling Plans).

These documents were randomly selected from the computer server with the intention of collecting a representative sample of project planning documents generated by Company XYZ. It was the intent of the researcher that the selected documents provided a broad overview of project-specific documents and included: 1) a variety of project types that are commonly performed at Company XYZ (e.g. assessment, remediation, etc.); 2) documents that were generated by a various project managers (both existing and previous); and 3) a broad range of operating years for Company XYZ.

Each selected document was reviewed with the following objectives:

1. Did the document make any reference to the performance of underground utility clearance activities (yes/no)?
2. If the performance of underground utility clearance activities were referenced, did the document outline specific activities and procedures to be executed (yes/no)?

3. If specific underground utility clearance activities and procedures were outlined in the document, would the activities and procedures be effective in minimizing the risk of inadvertently striking an underground utility line (yes/no)?
4. If the answer was “yes” question number three. Should these activities and procedures be retained for inclusion in the development of a company-wide UUDPP (yes/no)?
5. If the answer was “yes” to question numbers three and four. Specify those recommended activities and procedures for retention in Company XYZ’s UUDPP.

The results (to the above questions) for each of the reviewed documents were recorded on a document review form included in Appendix C. For evaluation purposes, the results of the document review were summarized in tabular form (Table C.1) also included in Appendix C. Information regarding the type (assessment, remediation, etc.), year generated, and the project manager for the project is also summarized in Table C.1 to help identify any trends and commonalities. To maintain confidentiality, each project and project manager was assigned a random number.

The second instrument employed during this portion of the study was an employee survey that was designed by the researcher to *further* identify what underground utility damage prevention practices are commonly performed by Company XYZ employees and the frequency in which they are performed. Additionally, for the purpose of evaluating the company’s *Loss History* (next portion of this methodology section), the survey attempted to gather further information concerning historical accidents, near misses, and losses that may not previously have been documented. The survey utilized was developed specifically for this study.

Engineers, geologists, and scientists within Company XYZ's Environmental Services Group were contacted to discuss the purpose of this study and the possibility of participating in the survey portion of the study. In general, those selected and surveyed employees consisted of all employees within Company XYZ's Environmental Services Group that would be tasked with the role of a Project Manager and/or Field Operations Leader (due to the relatively small size of the service group, employees often perform both roles). It is these individuals who are typically responsible for either performing or delegating the underground utility clearance activities for a project. Consent forms were provided via electronic mail to the eight selected individuals. If the individuals agreed to participate in the study, they completed the consent form and returned it via electronic mail to the researcher prior to initiation of the survey. A discussion of the methods used to analyze the document review and survey data is included at the end of this chapter.

The survey was administered by the researcher on various dates in March and April 2008 (specific dates are recorded on the completed survey forms included in Appendix D) and consisted of one-on-one telephone interviews with the subject employees. The survey questions consisted of a combination of closed and open ended questions. Closed ended questions received "yes" or "no" responses, while open ended questions provided free-form verbal responses. As presented on the blank survey form (Appendix D), a total of eight questions (some in multiple parts) were developed for the survey.

Responses to the questions were recorded by the researcher on survey forms. A copy of the completed survey for each employee is included in Appendix D. For evaluation purposes, the results are summarized in tabular form (Table D.1) also included in Appendix D.

Loss History

As a result of unintentional damage to an underground utility lines, potential losses (both direct and indirect) resulting from a utility line strike may not only cost hundreds of thousands of dollars in damages to property, equipment, and the environment, but also could result in death or severe harm to employees, subcontractors, and innocent bystanders. As part of this study, a compilation of all underground utility strikes (and near misses) incurred by Company XYZ was performed. By compiling the number of past incidents and near misses, this information was used to assist in the evaluation of the effectiveness of Company XYZ's existing in-house underground utility damage prevention practices. Where an analysis of the cause of the accident was conducted, the root cause of these accidents was also assembled and evaluated for trends and commonalities.

The main instrument employed during this portion of the study consisted of the evaluation of existing data/information. As it relates to unintentional damage to underground utilities, the researcher gathered all available documents and information pertaining to Company XYZ's loss history. Accidents reports and OSHA 200/300 logs were obtained from Company XYZ's Health and Safety Coordinator. The reports and logs were reviewed by the researcher and the data was summarized on Table 2 of Chapter 4. In addition, question number eight of the above employee survey was also used to evaluate Company XYZ's loss history.

Current Loss Potential

Environmental cleanup activities performed by Company XYZ's Environmental Services Group often includes intrusive activities, which require various types of drilling and excavation beneath the ground surface. To assist in evaluation of Company XYZ's loss potential (as it relates to underground utility damage), the researcher attempted to review those Activity Hazard

Analysis (AHA) that have been generated for Company XYZ. An AHA is prepared for every major task that is conducted in the field by Company XYZ employees or their subcontractors. An AHA defines the activity being performed, the hazards posed, and recommended control measures required to perform the work safely. The purpose of this section and the review of Company XYZ AHAs is to compile a list of those activities that are typically performed by Company XYZ and would require the clearance of underground utilities.

As noted above, the researcher reviewed various project-specific SSHPs to compile and evaluate those in-house underground utility damage prevention practices presently performed by Company XYZ. The documents selected provided a broad overview of typical projects and tasks that are performed by Company XYZ's Environmental Services Group. During this review, the researcher also reviewed those AHAs that were included in each SSHP to compile a list of those activities that would be considered an "intrusive activity" and would require the clearance of underground utilities. For the purposes of this study, an "intrusive activity" is any activity that is performed using mechanical equipment resulting in an intended disturbance of the ground surface. A list of those activities that are commonly performed by Company XYZ employees (or their subcontractors) and would require the clearance of underground utilities is included in Table E.1 of Appendix E. This list will be included in the UUDPP and will be an indicator for when Company XYZ employees are required to perform underground utility clearance activities.

Industry Best Practices

As a necessity, many organizations and industries that perform intrusive activities have developed and implemented best practices that have been effective in the prevention of damaging underground utilities. As part of this study, the researcher performed a review of published literature containing best practices developed and utilized by other/similar industries.

Reviewed published literature was obtained from magazines and newspapers by searching the University of Wisconsin – Stout Indexes and Databases website. Indexes and Databases searched included: Cambridge Scientific, EBSCO Host, Emerald Library, Lexis Nexis, and Wilson Web. In addition, the researcher used the Dogpile and Google Scholar search engines to identify additional informational websites, organizations, and articles that may identify best practices for this study. Examples of key words and phrases that were used during the search included: Underground Utility Damage Prevention Plan, Underground Utility Incidents, Underground Utility Strikes, Excavation Protection Programs, Underground Utility Location, and Underground Utility Protection.

Concurrent with the review of published literature, the researcher compiled a list of best practices that have been developed by other industries. This list of best practices was cross referenced with those intrusive activities that are commonly performed by Company XYZ (Table E.1 of Appendix E). Those best practices that were determined by the researcher to be effective in minimizing the potential hazards associated with those common intrusive activities performed by Company XYZ for inclusion in Company XYZ's UUDPP are summarized in Table F.1 of Appendix F.

Data Analysis

The information obtained through the review of existing company data/information, performance of an employee survey, evaluation of current loss potential, and the review of published literature was evaluated based on the established goals of this study. Information collected from the review of company documents and the employee survey was analyzed based on trends, commonalities, comparisons, and contrast of information from the participants and best practices obtained from published literature.

Limitations

Limitations of the study include:

1. Company XYZ was founded in 1985 and has maintained limited safety records.
2. A limited number of years of project-specific documents are maintained on Company XYZ's computer server and files.
3. The information obtained from the employee survey was limited by the number of individuals presently employed in Company XYZ's Environmental Services Group.
4. The results of the survey depended on the subjects' motivation, honesty, memory, and willingness to respond.

Chapter IV: Results

Company XYZ is often contracted to conduct environmental cleanup activities at various federally-owned facilities located throughout the United States. As part of the various stages of cleanup at these sites, Company XYZ's employees often perform intrusive activities, which typically consist of drilling and/or excavation beneath the ground surface.

To minimize the potential for losses (to life, health, property, environment, or essential public services) resulting from accidental damage to underground utilities, the identification and location of underground utilities is required prior to initiating intrusive activities in the project area. The underground utility clearance task is typically incorporated into the planning documents (i.e. Work Plans, Field Sampling Plans, and SSHPs) for each project. However, the process that outlines the necessary steps for clearing the underground utilities is usually vague and/or not specified in the project plans. Therefore, the manner in which underground utility clearance activities are performed at Company XYZ is often inconsistent from project to project, resulting in an increased potential for striking an underground utility line. The purpose of this study is to develop a company-wide UUDPP for Company XYZ that will minimize the risk of inadvertently causing damage to underground utilities that may unknowingly be located in the vicinity of Company XYZ project areas. The ultimate goal of the UUDPP is to verify the presence or absence of subsurface utilities in the project area to avoid causing damage to people, property, and the environment.

The UUDPP was developed through a comprehensive evaluation of: 1) existing underground utility clearance practices presently performed in-house by Company XYZ employees, 2) Company XYZ's underground utility damage history (accidents, losses, near misses, etc.) while using existing in-house practices, 3) evaluation of current loss potential

associated with common intrusive activities (e.g. drilling, excavation, etc.) performed at Company XYZ, and 4) best practices developed and used by similar industries that commonly perform intrusive subsurface activities.

Presentation of Collected Data

Existing In-House Utility Clearance Practices

Existing in-house underground utility damage prevention practices were ascertained through the collection and review of available company-wide and project-specific documents (both past and present), and the performance of a simple survey of select Company XYZ employees. The researcher not only attempted to compile and evaluate the types of underground utility clearance practices presently being performed, but also to ascertain the frequency in which they are performed and their overall effectiveness in minimizing the company's risk.

In addition to reviewing a copy of the company-wide Safety and Health Program, the researcher reviewed randomly selected Work Plans, SSHPs, and Field Sampling Plans to provide a representative sample of project-specific planning documents prepared by Company XYZ. The results of the document review are summarized in Table C.1 and were recorded on the document review forms also included in Appendix C.

The results of the document review indicate that Company XYZ's Health and Safety Program makes no reference to the performance of underground utility clearance activities. With a single exception, almost all of the project-specific Work Plans, SSHPs, and Field Sampling Plans make some reference to the performance of underground utility clearance activities. However, very few of these documents outline specific clearance activities and procedures.

Of the documents reviewed, only two of the project-specific planning documents outlined specific clearance activities and procedures. These two documents were both prepared for a

recent (2007) remediation project. Of the specific clearance activities and procedures reviewed, the researcher determined the following activities should be retained for inclusion in the UUDPP:

- Contact State One Call System;
- Review available drawings for the presence and location of underground utility lines;
- Use of hand tools in areas requiring excavation located near marked underground utilities;
- Use of locating equipment (e.g. electronic magnetic locator; transmitter and receiver locating equipment);
- Obtain an excavation permit from the facility (typically applies to federally-owned facilities); and
- Document the completion of the utility clearance.

In addition, eight engineers, geologists, and scientists within Company XYZ's Environmental Services Group were surveyed from March 26, 2008 to April 7, 2008, to further identify which underground utility damage prevention practices are commonly performed by Company XYZ employees and the frequency in which they are performed. A copy of the completed survey for each employee is included in Appendix D. In addition, the results are summarized in Table D.1 of Appendix D.

All surveyed employees indicated that underground utility clearance activities are always conducted for Company XYZ projects prior to the initiation of intrusive activities. With the exception of a single employee, the surveyed individuals indicated that project-specific documents (i.e. Work Plans, Field Sampling Plans, SSHPs) generated at Company XYZ require that utility clearance activities be conducted prior to the initiation of intrusive activities.

Based on the employee survey, the following underground utility clearance activities are performed by Company XYZ employees and should be retained for inclusion in the UUDPP:

- One Call Notification;
- Site Walk;
- Review of Drawings;

- Excavation or Dig Permit (as required for federal facilities); and
- Private Utility Locating Service (use of detection equipment).

Five of the employees surveyed indicated that a checklist or form (in the form of a site-specific excavation/dig permit application required by some federal facilities) is currently utilized by Company XYZ, which documents that the utility clearance activities were performed for a project. None of these checklists or forms were observed in the project-specific planning documents during the document review portion of this study. Those surveyed employees who were not aware of a utility clearance checklist or form agreed that such a checklist or form would be useful to document that utility clearance were performed for a project.

Finally, seven of the nine employees surveyed feel that the existing underground utility clearance practices presently performed in-house by Company XYZ employees are adequate in minimizing the risk of striking an underground utility line on a project. Underground utility clearance activities recommended by those surveyed employees who felt that the present clearance activities are inadequate included soft digging practices and a separate utility check of the area.

Additionally, for the purpose of evaluating the company's loss history, the survey (Question #8) attempted to gather further information concerning historical accidents, near misses, and losses that may not previously have been documented. The results of this portion of the survey are discussed in the *Loss History* section.

Loss History

Company XYZ's underground utility damage history (accidents, losses, near misses, etc.) while using existing in-house practices was evaluated through the review of existing data/information. The researcher attempted to gather existing information identifying all underground utility strikes (and near misses) incurred by Company XYZ. Specifically, available

accidents reports and OSHA 200/300 logs were obtained and reviewed. Where an analysis of the cause of the incident was conducted, the root cause was assembled and evaluated for trends and commonalities. The loss history data is summarized in Table 2.

Table 2: Summary of Company XYZ Incident Reports/OSHA Logs

Year	Accident Report or Incident Pertaining to Underground Utilities		OSHA 200/300 Log for Incident Pertaining to Underground Utilities	
	Yes/ No	Details	Yes/ No	Details
1985	NA		NA	--
1986	NA		NA	--
1987	NA		NA	--
1988	NA		NA	--
1989	NA		NA	--
1990	NA		NA	--
1991	NA		NA	--
1992	NA		NA	--
1993	NA		NA	--
1994	NA		NA	--
1995	NA		NA	--
1996	NA		NA	--
1997	NA		NA	--
1998	NA		NA	--
1999	No		NA	--
2000	No		NA	--
2001	No		NA	--
2002	No		NA	--
2003	No		No	--
2004	No		No	--
2005	No		No	--
2006	No		No	--
2007	Yes	On May 25, 2007, contacted a water line (8 feet below grade) with a Direct Push rig. The water utility was not a member of State One Call. Root Cause(s): - Water line was not marked by the Property Manager. - Property Manager checked drawings and "cleared" the location prior to direct push sampling. - A survey using field locating equipment was not conducted.	No	--
2008	No		No	--

Notes:

NA = Not Available

Based on a review of available incident reports and OSHA 200/300 logs, only a single incident regarding damage to underground utilities has been documented for Company XYZ. As presented in Table 2, this incident was documented on Company XYZ's incident report and was not defined as a recordable incident (according to OSHA 29 CFR 1904) because no injuries or

illness were associated with the incident. According to the incident report, on May 25, 2007, Company XYZ's subcontractor contacted a water line at approximately 8 feet below grade while performing soil sampling with a direct push sampling rig. The private water utility was not a member of the State One Call system, which was notified by the subcontractor prior to initiating the intrusive activities. According to the incident report, the root causes were as follows: 1) water line was not marked by the property manager, 2) property manager checked drawings and "cleared" the location prior to direct push sampling activities, and 3) a survey using field locating equipment was not performed.

In addition, question number eight of the employee survey (Table D.1) was also used to evaluate Company XYZ's loss history. Based on the results to Question #8 of the survey, none of surveyed employees have worked on or managed a project where underground utilities were unintentionally damaged or had a near miss regarding underground utilities.

Current Loss Potential

Company XYZ's loss potential (as it relates to underground utilities) is most often associated with intrusive activities that are commonly performed by its employees or subcontractors. To assist in evaluation of Company XYZ's loss potential, the researcher reviewed existing AHAs that have been previously generated by Company XYZ for every major task that is commonly performed by their employees or subcontractors. An AHA defines the activity to be performed, the hazards posed, and recommended control measures required to perform the work safely. Through the review of the AHAs, a list of those activities that would be considered an "intrusive activity" are included in Table E.1 of Appendix E. These activities are placing Company XYZ at the highest risk of striking an underground utility line and would require the employee (or their subcontractor) to perform the clearance of underground utilities.

Those activities that would be defined as “intrusive” and would require clearance activities were divided into two groups based on the stage of cleanup that the activity is commonly performed. The two groups include: 1) Assessment/Investigative, and 2) Remediation. In general, the majority of the activities are associated with the drilling and/or excavation beneath the subsurface using mechanical means. The potential hazards associated with drilling and excavation techniques include contact of the underground utilities with downhole drill/direct push equipment and mechanical earth moving equipment. Exceptions include the coring, sawing, and removal of concrete, where the potential hazards include contacting utilities located within or immediately below the concrete.

Table E.1 of Appendix E should serve as a reference list in the UUDPP and be used by those employees who are unsure if their work activity requires that they perform an underground utility clearance.

Industry Best Practices

Best practices performed by other industries conducting similar intrusive activities in connection with preventing damage to underground utilities were reviewed from published literature obtained during this study (Chapter II: Literature Review). The literature review indicated that most contain common key elements that are necessary in the development of an effective UUDPP. Some of the most common key elements include: 1) pre-planning and site investigative activities; 2) effective use of the One Call system; 3) accurately locating and marking utilities in the field; and 4) proper excavation practices.

These existing best practices and key elements were compiled by the researcher and then evaluated to determine which practices would be effective in minimizing the potential hazards associated with those common intrusive activities performed by Company XYZ (Table E.1 of

Appendix E) and included in Company XYZ's UUDPP. Those best practices that were retained for inclusion in Company XYZ's UUDPP are included in Table F.1 of Appendix F and are discussed in further detail below in Company XYZ's UUDPP.

Discussion

With each passing year, the number of miles of utility lines buried beneath the ground continually increases. Consequently, for those companies that perform intrusive activities, the risk of striking one of these lines also continues to increase. Because underground utility lines are often energized, pressurized, or contain hazardous substances, accidentally hitting ones of these utilities not only can cost thousands (or even millions) of dollars in property and environmental losses, but also could result in severe injury or even death to workers and innocent bystanders. Therefore, it is imperative that those companies that perform intrusive activities, develop, implement, and manage preventative practices that are effective in minimizing the risk of inadvertently causing damage to underground utility lines.

The results of this study revealed that although Company XYZ regularly performs underground utility damage prevention practices, the lack of a company-wide damage prevention program has lead to inconsistencies regarding manner in which these practices are performed. Each project performed by Company XYZ contains planning documents which outline the objectives of the project, tasks to be performed, and the procedures to be followed to successfully complete these tasks. A review of these planning documents, which are written by various individuals within the company, indicated that although most make some reference to requiring underground utility clearance activities, very few of them outline specific clearance activities and procedures.

It is the opinion of the researcher that the majority of the reviewed planning documents prepared by Company XYZ would be ineffective in minimizing Company XYZ's risk of inadvertently striking an underground utility line. The failure of these planning documents to outline and specify the necessary activities and procedures to clear underground utilities is the likely cause for the inconsistency in which the utility clearance is performed from project to project.

Much to the surprise of the researcher, six of the nine employees surveyed indicated that the utility clearance activities and procedures are clearly outlined in the project-specific planning documents. These results are contradictory to the results of the document review.

Although Company XYZ regularly performs a variety of intrusive activities as a part of their projects, a review of available information regarding their loss history indicates that Company XYZ has recorded only a single incident and incurred no substantial losses as it relates to underground utility line damage. This information may at first indicate to the reader that Company XYZ's existing in-house damage prevention practices are adequate in minimizing the company's risk of striking an underground utility line. However, as an employee of Company XYZ for more than five years, it is the opinion of the researcher that Company XYZ has been very fortunate to not have incurred more frequent and severe losses. It is this concern that instigated the development of this UUDPP for Company XYZ.

Company XYZ UUDPP L.J.

The purpose of this company-wide UUDPP is to outline those practices and procedures that must be performed prior to the initiation of intrusive activities by Company XYZ (or their subcontractors). An "intrusive activity" may be defined as any activity that is performed using mechanical equipment resulting in an intended disturbance of the ground surface. A list of those

activities that would be considered an “intrusive activity”, are commonly performed by Company XYZ, and would require the clearance of underground utilities is presented in Table E.1 of Appendix E. Examples of intrusive activities commonly performed by Company XYZ are also presented in Figure 1.

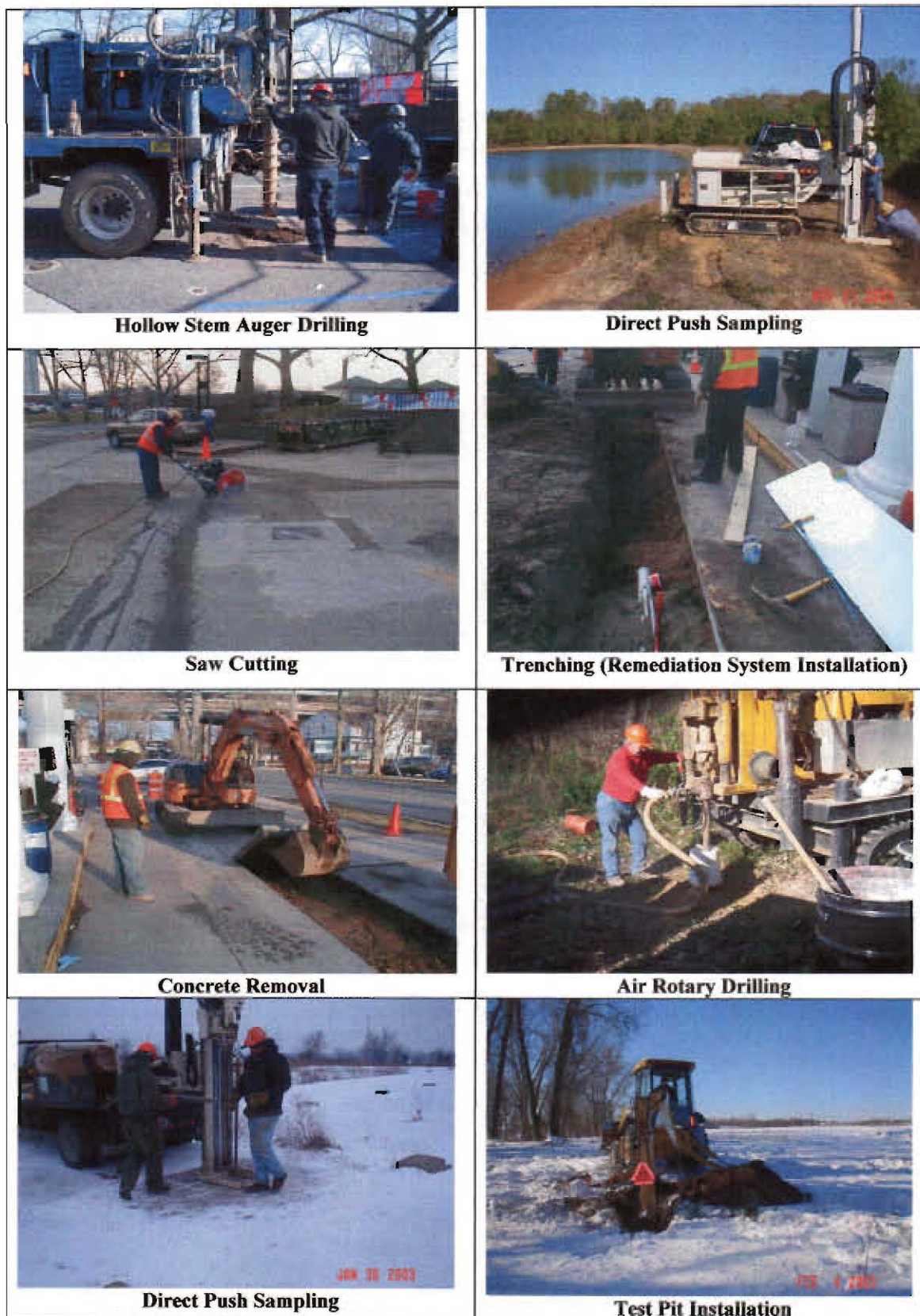


Figure 1: Photographs of Common Intrusive Activities Performed by Company XYZ

These intrusive activities are placing Company XYZ at the highest risk of striking an underground utility line that may unknowingly be located in the vicinity of Company XYZ project areas. It must be noted that Table E.1 of Appendix E is not an all inclusive list, and if there is any question as to whether a proposed activity is categorized as an “intrusive activity”, the employee should contact Company XYZ’s Health and Safety Coordinator.

The goal of this UUDPP is to verify the presence or absence of subsurface utilities in the project area prior to the initiation of intrusive activities to avoid causing damage to people, property, and the environment. Based on a review of best practices developed by groups/industries that regularly perform intrusive activities, there are common key elements used in the successful development of an effective UUDPP. These common key elements include: 1) pre-planning and site investigative activities; 2) effective use of the One Call system; 3) accurately locating and marking utilities in the field; and 4) proper excavation practices. These existing best practices and key elements were compiled and then evaluated to determine which practices would be effective in minimizing the potential hazards associated with those common intrusive activities performed by Company XYZ (Table E.1) and included in Company XYZ’s UUDPP. Those best practices that were retained for inclusion in this UUDPP are included in Table F.1 of Appendix F and discussed in the sections below. In addition, a copy of the Underground Utility Clearance Form/Checklist that has been prepared for inclusion in this UUDPP is included as Appendix G. A copy of the completed Underground Utility Clearance Form/Checklist for each project should be maintained in the company files.

Pre-Planning and Site Investigative Activities

Planning plays an important role the identification of site hazards and should be the first step in the damage prevention process. As part of this process, project-specific planning

documents (i.e. Work Plans, SSHPs, and Field Sampling Plans) are prepared. These project-specific planning documents should include safety provisions for the prevention of damage to underground utilities.

Drawings included in the planning documents should depict the actual locations of all existing, abandoned, and out-of-service utilities within the project area. Proper due diligence must be exercised in an effort to determine the locations of these underground utility lines. As a demonstration of due care, the employee's efforts should include a review of all reasonably attainable drawings and records pertaining to the project area. Drawings and records to be reviewed may include, but not necessarily limited to:

- Civil/utility drawings;
- Historic site information (maps, photos, files);
- Site as-built drawings;
- Plats, which include utility easements;
- Historic plot plans;
- Previous site investigations;
- Fire insurance plans;
- Proposed utility plans; and
- Elevations and coordinates maps.

Not all, or even some of these records will be available for every project; however, accurate and detailed notes and documentation should be maintained in the project file that demonstrates that proper due diligence was performed. Although the accuracy of many of the aforementioned drawings/plans may be questionable, the value of the information that may be obtained by reviewing these records cannot be disregarded.

As part of the pre-planning process, the State One Call Center should also be notified. Following the marking of the utilities in the field by the facility owner/operator, the marked locations of the utilities in the project area may be incorporated into the planning documents/drawings. Additional methods of gathering underground utility information may

include contacting persons who are familiar with the property and the layout of the site utilities. Such individuals may include past/present property owners, property managers, and facility engineers.

As part of the pre-planning phase, site investigative activities should also be conducted. Site activities include a walk around of the project area. During the site walk, the area(s) proposed for intrusive activities should be identified (“white lining” activities may also be performed at this time). Aboveground indicators of underground utilities should also be noted during the site walk. Aboveground indicators may include (but not limited to) the following:

- permanent signs or markers;
- manhole covers;
- valve boxes;
- vent pipes;
- pad mounted devices;
- riser poles;
- power and communication pedestals; and
- valve covers.

Subsequent utility investigation activities, such as a manhole investigation (i.e. lifting manhole covers), may be performed to identify the direction and proximity of the utility lines in relation to the project area (AntiEntropics, 2005).

The site walk should also be used to identify potential critical areas for the project. Critical areas are those areas within 10 feet of a subsurface structure (e.g. underground storage tank, utility line) or high pressure pipeline, which if accidentally damaged due to intrusive activities could result in death, injuries, damaged equipment/property, or a disruption of utility services. Critical areas should be twice reviewed prior to intrusive activities (AntiEntropics, 2005).

Effective Use of the One Call system

The One Call notification system is used to inform the underground facility owners/operators of intended intrusive activities. The One Call Center serves as the communication network and acts as the point of contact between the excavator and the underground facility operators.

By dialing “811”, the caller is automatically connected to the nearest local One Call Center (e.g. Miss Utility of Virginia, Gopher State One Call for Minnesota, Wisconsin State One Call, etc.). A copy of the National One Call Directory is included in Appendix G and provides the contact numbers of the One Call Centers by state. The One Call Center must be notified at least two to 10 working days (depending on the state) prior to the initiation of intrusive activities. Access to the One Call Centers is available 24 hours per day and seven days per week.

In order to process the One Call notification, the caller provides the following information, at a minimum, to the State One Call Center operator (CGA, 2007c):

- Caller’s name and phone number;
- Company’s name, address and phone numbers;
- Where is the work being conducted;
- Start date and time of the excavation; and
- Description of the activity.

More detailed information (e.g. Latitude/Longitude, highway mile markers, subdivision and lot number, etc.) may be required to help determine the specific location of the excavation (CGA, 2007c). Prior to working in a particular state, the state’s One Call statutes should be reviewed to identify necessary required information.

A reference ticket number is issued from the One Call Center, which verifies the caller has notified the underground facility operators. In most states, the locate ticket number is only active for 10 to 30 calendar days (review particular state’s statutes for active period). If the

project extends beyond the active period, the One Call Center must be re-notified to extend the active period before it expires. In addition, those utility owners/operators that are to be notified under the referenced ticket number should be recorded by the caller. This list will later be used to identify those utility owners/operators that have issued positive responses by marking and which ones have cleared the area.

Please note that not all utility owners/operators are members of the One Call system. All non-member utilities should be contacted separately (see next section for discussion of privately-owned facilities).

Accurately Locating and Marking Utilities in the Field

Privately-owned facilities are typically not located under the One Call notification. These private utilities are underground lines or pipes that were not installed by the utility company and are those that were installed beyond the utility meter. Examples of private utilities may include buried electric lines providing power to parking lot lights, lawn sprinkler piping, communication lines for satellite dishes, and in service lines from propane tanks. For this reason, it is often necessary to hire a private utility locator. It is recommended that private utility locators that are hired to locate utilities on Company XYZ worksites be members of the NULCA. Private utility locators that are members of the NULCA are more likely to have adopted the industry accepted locating standards and procedures.

Markings typically consist of spray paint, flags, chalk, or stakes and should be marked in accordance with the APWA Color Code Chart for Marking Underground Utility Lines (Table 1). Proposed locations/areas for borings, excavations, or other intrusive activities should be marked in white (often referred to as “white lining”). Other recommended marking guidelines were adopted by the APWA in 2001 (Appendix A). Once the marking system is in place, it must be

maintained through the life of the project. The preservation of the utility marks at the property is the responsibility of Company XYZ employees (or their subcontractors). When the marks are faded or destroyed, the One Call Center must be re-notified (Thelen Reid Brown Raysman & Steiner LLP, 2006b; Landes, 2007).

For those marked utilities on the property, a safety/tolerance zone is typically used to indicate the distance (usually in inches) on either side of the marking in which the employee must assume the presence of a utility line. These safety/tolerance zones typically range from 18 to 30 inches (Thelen Reid Brown Raysman & Steiner LLP, 2006b).

In some instances, the exact location of a utility line (both horizontally and vertically) must be determined prior to the initiation of intrusive activities. In-field clearance methodologies may be broken down into two categories:

- Direct contact with the subsurface structures; and
- Avoiding direct contact with the subsurface structures.

Direct contact typically involves the use of proper hand-digging tools (e.g. hand augers, post-hole diggers, steel rods) and digging techniques as to not damage the utility line. The use of hand-digging tools to identify the location of a utility line should only be performed by experienced personnel. Methods that avoid direct contact with the utility line often includes vacuum excavating (a.k.a. potholing or “soft” excavating), air knifing, and water jetting.

Proper Excavation Practices

Proper excavation practices are those that can be used to reduce the possibility and/or severity of damage to underground facilities during the excavation process. For the purposes of this UUDPP, “excavation” should include any intrusive activities performed by Company XYZ that will disturb the ground surface using mechanical means. This will include those activities presented in Table E.1 of Appendix E.

As previously indicated, the contractor is typically required to notify the One Call Center at least two to 10 working days prior to intrusive activities. An on-site pre-excavation meeting between Company XYZ field representatives, the utility owners/operators, and locators (where applicable) is recommended on large projects or that are located near critical or high priority facilities (e.g. high-pressure gas, high voltage electric, fiber optic communication, and major pipe or water lines).

It should be noted that not all utility owners/operators may respond to the One Call notification within the statutorily prescribed time frame. In the event that a mismarked utility line is discovered, many states require that the One Call Center be re-notified. One Call statutes dictate that a contractor may not proceed with intrusive activities until every utility owner/operator has marked their utility lines, regardless of how many notifications have been given. However, at the end of two working days, unless otherwise specified in state/provincial law, the contractor may proceed if due care is exercised.

Prior to the initiation of intrusive activities at the site, the actual placement of all utility markings should be documented in the field using pictures, videos, or sketches. For subsequent reference purposes, this documentation should include the actual distances between the utilities markings to nearby fixed objects. The locations of all known underground utility lines should be reviewed with all on-site personnel prior to starting the intrusive activities.

The One Call reference ticket number should be maintained at the work site throughout the project by site personnel. In the event that a utility owner/operator stops at the site, the reference ticket number may be used to verify that Company XYZ (or its subcontractors) has notified the underground facility owners/operators via the One Call system. In addition, the names and phone numbers of utility owners/operators contacts should also be maintained on-site.

During intrusive activities, Company XYZ and their subcontractors should use reasonable care to avoid damaging underground utility lines. Due care should include, but not be limited to:

- The use of an excavation observer to assist the equipment operator when operating mechanical equipment around known underground utilities.
- Support and protect exposed underground utilities from damage.
- Protecting all underground utilities from damage when backfilling an excavation.

Additional best practices that may be used during excavation of, and around, underground facilities are included in Appendix B.

Summary L.J.

Although to date, no severe losses have been incurred by Company XYZ as a result of unintentional damage to an underground utility line and the use of existing in-house damage prevention practices, the lack of a company-wide UUDPP is placing Company XYZ at risk of incurring substantial losses. Potential losses (both direct and indirect) resulting from a utility line strike may not only cost hundreds of thousands of dollars in damages to property, equipment, and the environment, but also could result in death or severe harm to employees, subcontractors, and innocent bystanders. Based on an evaluation of existing in-house preventative practices performed by Company XYZ, its loss history, common intrusive activities performed by Company XYZ, and a review of best practices performed by similar industries performing intrusive activities, the researcher has developed this UUDPP that will be effective in minimizing future risk of inadvertently causing damage to underground utility lines. In order for this UUDPP to be successful on a company-wide basis, it is imperative that the implementation and management of this UUDPP have the continued support and commitment of upper management.

Chapter V: Conclusions and Recommendations

The purpose of this study was to develop a company-wide UUDPP for Company XYZ to minimize their risk of inadvertently causing damage to underground utilities while performing intrusive activities. The ultimate goal of the UUDPP is to verify the presence or absence of subsurface utilities in project areas to avoid causing damage to people, property, and the environment. The UUDPP was developed through a comprehensive evaluation of: 1) existing practices presently performed in-house by Company XYZ employees, 2) losses and near misses incurred/occurred using existing in-house practices, 3) evaluation of present loss potential using existing in-house practices, and 4) best practices adopted by similar companies that commonly perform intrusive subsurface activities.

Conclusions

Through the review of information gathered during this study, the following significant points were identified as they relate the need and development of an UUDPP for Company XYZ:

- Company XYZ regularly performs underground utility damage prevention practices prior to the initiation of intrusive activities. However, the manner in which (and extent to which) they are performed varies from project to project due to the lack of a company-wide damage prevention program.
- The majority of project-specific planning documents prepared by Company XYZ require their employees (or subcontractors) to perform underground utility clearance activities prior to the initiation of intrusive activities. However, very few of these documents outline specific clearance activities and procedures that must be performed, therefore, increasing Company XYZ's risk of inadvertently striking an underground utility line.

- Although to date, no severe losses have been incurred by Company XYZ as a result of unintentional damage to an underground utility line and the use of existing in-house damage prevention practices, the lack of a company-wide UUDPP is placing Company XYZ at risk of incurring more frequent and substantial losses.
- A review of best practices performed by similar industries in connection with preventing damage to underground utilities indicated that most contain common key elements that are necessary in the development of an effective UUDPP: 1) pre-planning and site investigative activities; 2) effective use of the One Call system; 3) accurately locating and marking utilities in the field; and 4) proper excavation practices.
- Through a review of those common intrusive activities performed by Company XYZ, those best practices that were determined by the researcher to be most effective in minimizing the potential of causing damage to an underground utility line were incorporated into a UUDPP developed for Company XYZ.

Recommendations

It is recommended that the UUDPP developed in Chapter 4, and its accompanying form/checklist for documentation purposes, should be incorporated into Company XYZ's Corporate Safety and Health Program. The practices and procedures outlined in the UUDPP should also be included in future project-specific planning documents (i.e. Work Plans, Field Sampling Plans, and Site Safety and Health Plans) where intrusive activities are proposed.

Areas of Further Research

In December 2006, Congress passed a law requiring all contractors or individuals who knowingly damage an underground natural gas pipeline to immediately call 911. This law originated from an accident that occurred in 2005, where a home was destroyed and an 18 year

old boy was critically injured when a contractor knowingly hit an underground pipeline while installing a high speed internet line in a resident's front yard. The contractor did not contact emergency responders and as a result, the nearby residents were not alerted to the leaking gas line (Sherman, 2006).

With the passing of this 2006 law and the extreme potential hazards (e.g. high pressure gas, high voltage electric, hazardous materials) associated with underground utilities, it is recommended that Company XYZ develop and implement an emergency action plan in the event that Company XYZ (or one of their subcontractors) unintentionally strikes an underground utility line. Not only should this action plan require the employee to immediately call 911, but should include additional response actions to mitigate Company XYZ's direct and indirect losses as a result of an underground utility line strike.

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Appendix A: Recommended Marking Guidelines for Underground Utilities

The APWA Marking Recommendations Committee (APWA, 2001)

The APWA Marking Recommendations Committee was organized and operated under guidelines similar to those used by the Common Ground: Best Practices committees.

- Anyone on the committee could propose or recommend existing marking practices.
 - Only those practices receiving a consensus of all committee members were included in the final recommendations.
 - The committee felt that the original name for the committee: “APWA Marking Standards Committee” be changed to the “APWA Marking Recommendations Committee”, this change was agreed to by all committee members. Henceforth, all proposals from the committee will be referred to as *recommendations* versus *standards*.
1. **“Utility lines will be indicated by markings using current APWA color codes. Markings should be 18”-24” in length and 2” in width.”**
 2. **“The owner of a facility should be indicated by initials or by name in letters 6” high at the beginning and end of the locate. On long locates the facility owner should be indicated every 100’.”**
 3. **“When known, the total number of lines within the ground will be indicated.”** The number of lines indicated should be based on the physical lines “that you could place your hands on”. Multiple cables twisted together to form a single facility, as in the case of electric lines, would be considered one cable for locate purposes.
 4. **“If a facility is known to be present but the total number of lines for a facility cannot be determined a corridor marker may be used. The corridor marker should indicate the approximate width of the facility.”** A marking resembling the letter “H” lying on its side will indicate the corridor marker.
 5. **“When known, the size of the line being located will be indicated. Line size will indicate the outside diameter of the pipe or structure. The oversized utility marking should indicate the approximate size of pipe or structure.”** A mark resembling the letter “H” lying on its side, bisected by line extending along its length will indicate the oversized utility marking. The committee discussions centered on indicating sizes of single physical structures such as gas lines, sewer lines, water lines, and storm drains.
 6. **“Duct structures, whether a single duct or multiple ducts, will be indicated by duct symbol indicating the approximate width of the duct structure.”** The duct marker will be indicated by a marking resembling a diamond bracketed by two parallel lines. The committee did not state whether indicating size should extend to indicating size of duct structures (telecommunications, electric) or indicating pair count for telephone lines.

7. **“When known, the pressure of a gas facility will be indicated.”** Gas pressure will be indicated as either low pressure, intermediate high pressure or high pressure. The committee did not determine whether gas pressure would be indicated in instances of high pressure only or for all pressures. The committee did not determine whether the type of pipe should be indicated (plastic, steel, cast iron, etc.).
8. **“When known, termination points, dead ends and stub outs should be indicated.”** The committee reviewed NULCA’s recommendation, which resembles the letter “T” with drop downs.
9. **“When there is a strong likelihood that marks may be destroyed offsets should be used.”** Offsets are indicated on a permanent surface and are placed parallel to the running line of the facility. The offset should indicate the distance from the offset to the facility and should identify the facility owner and if necessary size of the facility.

The following issues were discussed but either a consensus could not be reached or further discussion was considered necessary:

1. How does a locator indicate that access could not be gained to a yard or location and the locate request could not be completed. This is usually due to locked fences, dogs or other physical obstructions. The committee felt that a marking standard for this issue would not be developed. Suggestions that would be acceptable included the use of door hangers (indicating that the locator needed access to the property) and/or telephone calls to the requestor.
2. How and when do we indicate the presence of buried, abandoned facilities? Excavators felt that the utilities should indicate ALL facilities in the ground regardless of status. Utility records often do not indicate the presence of abandoned facilities. Access may not be available to abandoned facilities or those facilities may not be capable of being located. An additional issue is whether the abandoned facility should be identified as abandoned.
3. How to indicate the presence of electronic markers (EM’s).
4. How to indicate the presence of buried splices, valves and manholes.

The following are samples on how the above suggestions would look:

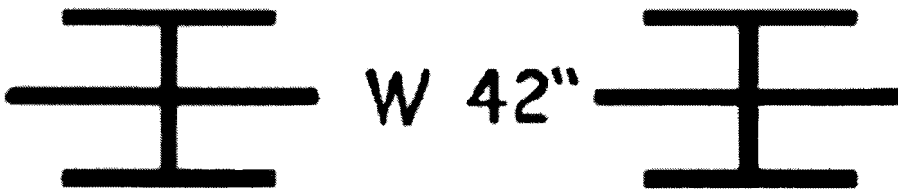
Line Markings


$$f(x) = \frac{1}{2} \left(1 + \frac{x}{\sqrt{1+x^2}} \right) \quad \text{for } x \in \mathbb{R}.$$

Corridor Markings


$$\begin{aligned} \sum_{k=0}^{\infty} \frac{1}{k!} \left(\frac{d}{dx} \right)^k f(x) &= e^{x \frac{d}{dx}} f(x) = f(e^x x) \\ &= f(x e^x) \end{aligned}$$

Oversized Utility Markings



0. 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820. 821. 822. 823. 824. 825. 826. 827. 828. 829. 830. 831. 832. 833. 834. 835. 836. 837. 838. 839. 840.

Conduit Markings



USW DUCT

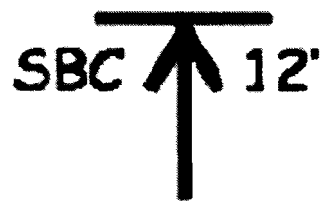
Marking Gas Lines – High Pressure



Marking Termination Point, Dead End, Stub Outs



Marking Offsets



Utility and property boundaries
are shown in red.

No Conflict (No utilities within the requested area)

NO/MCI

NO/EPG

Appendix B: Excavation Best Practices

Excavation Best Practices (USDOT, 1999; CGA, 2007c)

| Best Practice | | Practice Statement | Practice Description |
|---|-----------------------------------|---|--|
| A. Project Preparation (Phase 1) | | | |
| 1. | One-Call Facility Locate Request. | The excavator requests the location of underground facilities at each site by notifying the facility owner/operator through the one-call system. Unless otherwise specified in state/provincial law, the excavator calls the one-call center at least two working days and no more than ten working days prior to beginning excavation. | Currently 48 states have passed one-call legislation and have established one-call notification systems recognizing that excavation performed without prior notification poses a risk to public safety, excavators, the environment, and disruption of vital services provided by facility operators. Increased participation in this one-call notification system provides for improved communication between excavators and facility operators necessary to reduce damage. Laws in 41 states call for a minimum of 2 days prior and laws in 16 states call for no more than 10 days. |
| 2. | White Lining | When the excavation site can not be clearly and adequately identified on the locate ticket, the excavator designates the route and/or area to be excavated using white pre-marking prior to the arrival of the locator. | The route of the excavation is marked with white paint, flags, stakes, or a combination of these to outline the dig site prior to notifying the one-call and before the locator arrives on the job. Pre-marking allows the excavators to accurately communicate to facility owners/operators or their locator where excavation is to occur. Laws in some states provide for face-to-face meetings between operators and excavators on projects that are too large for or not conducive to pre-marking. Facility owners/operators can avoid unnecessary work locating facilities that are not associated with planned excavation. |
| 3. | Locate Reference Number. | The excavator receives and maintains a reference number from the one-call center that verifies the locate was requested. | All calls from excavators processed by the One Call Center receive a unique message reference number, which is contained on all locate request messages. The excavator records this number; it is proof of notification to the members. The computer generated request identifies the date, time, and sequence number of the locate request. Each locate request ticket (notification) is as signed a unique number with that one-call center, the requestor and the facility owner/operator. This number separates this ticket from all other tickets so that it can be archived and recalled upon request with the details of that request only. |
| 4. | Pre-Excavation Meeting. | When practical, the excavator requests a meeting with the facility locator at the job site prior to the actual marking of facility locations. Such pre-job meetings are important for major, or unusual, excavations. | The meeting will facilitate communications, coordinate the marking with actual excavation, and assure identification of high priority facilities. An on-site pre-excavation meeting between the excavator, the facility owners/operators and locators (where applicable) is recommended on large projects or that are located near critical or high priority facilities (e.g. high-pressure gas, high voltage electric, fiber optic communication, and major pipe or water lines). |
| 5. | Facility Relocations. | The excavator coordinates work which requires temporary or permanent interruption of a facility owner/operator's | Any temporary or permanent interruption requires the active participation by the facility owner/operator and the excavator to |

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| | | service with the affected facility owner/operator in all cases. | ensure protection of facilities through a joint preplanning meeting or conference calls. One-call centers note/special contractor requests for a joint meeting on the ticket to the facility owner/operator to initiate the process. |
| 6. | Separate Locate Requests. | Every excavator on the job has a separate one call reference number before excavating. | Often, there are several excavators on a job site performing work. The construction schedule may dictate different types of work requiring excavation from different specialty contractors simultaneously. In these situations it is imperative for each excavator to obtain a one-call reference number before excavation to ensure that the specific areas have been appropriately marked by any affected underground facility owner/operator. |
| 7. | One-Call Access (24x7). | The excavator has access to a one-call center 24 hours per day, 7 days a week. | Utilities service the public needs 24x7 and thus should be protected the same amount of time. Certain conditions exist which requires excavators to work during off-hours. |
| 8. | Positive Response. | The excavator is notified by the underground facility owner/operator of the tolerance zone of the underground facility by marking, flagging, or other acceptable methods at the work site, or is notified that a no conflict situation exists. This takes place after notification from the one-call center to the underground facility owner/operator and within the time specified by state/provincial law. | Positive response is a term used to describe the two types of action to be taken by a facility owner/operator after it has received notification of intent to excavate. The facility owner/operator is required to 1) mark its underground facilities with stakes, paint or flags or 2) notify the excavator that the facility owner/operator has no underground facilities in the area of excavation (area is "clear"). This notification by the facility owner/operator to the excavator may be provided in any reasonable manner including, but not limited to: face-to-face communications; phone or phone message, facsimile or other electronic means; posting at the excavation of demolition area; or marking the excavation or demolition area.

This process allows the excavator to begin work on time or in a timely manner. When the excavator makes the request to the one-call center, he/she is told which facility owners/operators will be notified. The excavator logs these facilities on his/her job sheet so that he/she can identify which facility owners operators have responded by marking and which ones have cleared the area. |
| B. On-Site Preparation/Ground Breaking (Phase 2) | | | |
| 9. | Facility Owner/Operator Failure to Respond. | If the facility owner/operator fails to respond to the excavator's timely request for a locate (e.g., within the time specified by state/provincial requirements) or if the facility owner/operator notifies the excavator that the underground facility cannot be marked within the time frame and a mutually agreeable date for marking cannot be arrived at, the excavator re-calls the one-call center. However, this | It is determined that the facility owner/operator and the excavator will partner together to ensure facilities are marked in an acceptable time frame to allow for underground facility protection. |

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| | | does not preclude the excavator from going on with the project. The excavator may proceed with excavation at the end of two working days, unless otherwise specified in state/provincial law, provided the excavator exercises due care in his endeavors. | |
| 10. | Locate Verification. | Prior to excavation, excavators verify they are at the correct location and verify locate markings and, to the best of their ability, check for unmarked facilities. | Upon arrival at the excavation site prior to beginning the excavation, verify that the dig site matches the one-call request and is timely. Verify that all facilities have been marked, reviewing color codes if in doubt. Verify all service feeds from buildings and homes. Check for any visible signs of underground facilities, such as pedestals, risers, meters, and new trench lines. Check for any facilities that are not members of the one-call and contact someone to get them located. Use of a pre-excavation checklist is recommended. |
| 11. | Documentation of Marks. | An excavator uses dated pictures, videos, or sketches with distance from markings to fixed objects recorded, to document the actual placement of markings. | If locate markings are adequately documented through the use of photographs, video tape, or sketches before excavation work begins, it will be easier to resolve disputes if an underground facility is damaged due to improper marking, failure to mark, or markings that have been moved, removed, or covered. It is important for excavators and locators to document the location of markings before excavation work begins. |
| 12. | Work Site Review with Company Personnel. | Prior to starting work, the excavator reviews the location of underground facilities with site personnel. | Sharing information and safety issues during an on-site meeting between the excavator and his excavating crews will help to avoid confusion and needless damage to underground facilities. |
| 13. | One-Call Reference Number at Site. | The excavator's designated competent person at each job site has the one-call ticket number. | This serves as constant reminder that all excavators (including projects with multiple crews) will be required to call the one-call center to request a locate before they start excavation. If a representative for the facility owner/operator sees work being conducted and is unaware of the work being done, he/she can 1) stop and verify that the excavator does indeed have a valid ticket number or 2) check the third-party locator's work.

If an excavator is found working without a valid one call ticket number, he/she should be requested to stop work immediately and appropriate actions should be taken. Another positive aspect of this practice will be that it should speed up the notification process back to the one-call center should the excavator find a facility incorrectly marked or not marked at all. Requiring personnel at the job site to have this number should minimize or eliminate calls to a supervisor, foreman, dispatcher, or other personnel to find the correct number if a problem is encountered. |

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| | | | When multiple crews are working on the same project at separate locations, each crew should be responsible for having a designated competent person responsible for having this one-call ticket number in their possession. |
| 14. | Contact Names and Numbers. | The excavator's designated competent person at each job site has access to the names and phone numbers of all facility owner/operator contacts and the one-call center. | Situations arise on the job site that require immediate notification of the facility owner/operator, one-call center or local emergency personnel. To avoid costly delays, the excavator ensures the designated job site personnel have all appropriate names and phone numbers. |
| 15. | Facility Avoidance. | The excavator uses reasonable care to avoid damaging underground facilities. The excavator plans the excavation so as to avoid damage or minimize interference with the underground facilities in or near the work area. | Foremost on any construction project is safety. Excavators using caution around underground facilities significantly contribute to safe excavation of existing facilities. |
| C. On-Going Excavation Procedures (Phase 3) | | | |
| 16. | Federal and State Regulations. | The excavator adheres to all applicable federal and state/provincial safety regulations, which includes training as it relates to the protection of underground facilities. | Although most existing state/provincial damage prevention legislation does not include reference to federal and state/provincial regulations, it is important to include reference to worker safety and training in the best practices. Excavators are required to comply with federal and state/provincial occupational safety and health requirements to protect employees from injury and illness. These regulations include reference to training each employee in how to recognize and avoid unsafe conditions and the regulations applicable to his/her work environment to control or eliminate any hazards or exposures to illness or injury. Therefore, the excavator's crew, as part of its safety training, is informed of the best practices and regulations applicable to the protection of underground facilities. |
| 17. | Marking Preservation. | The excavator protects and preserves the staking, marking, or other designations for underground facilities until no longer required for proper and safe excavation. The excavator stops excavating and notifies the one-call center for re-marks if any facility mark is removed or no longer visible. | During long complex projects, the marks for underground facilities may need to be in place far longer than the locating method is durable. Paint, staking and other marking techniques last only as long as the weather and other variables allow. When a mark is no longer visible, but work continues around the facility, the excavator requests a re-mark to ensure the protection of the facility. |
| 18. | Excavation Observer. | The excavator has an observer to assist the equipment operator when operating excavation equipment around known underground facilities. | The observer is a worker who is watching the excavation activity to warn the equipment operator while excavating around a utility to prevent damaging that buried facility. |
| 19. | Excavation Tolerance Zone. | The excavator observes a tolerance zone which is comprised of the width of the facility plus 18" (or more if required by state/provincial law) on either side of the outside edge of the underground facility on a horizontal | See Practice Description for #20 below. |

| | | plane. | |
|-----|------------------------------------|--|--|
| 20. | Excavations within Tolerance Zone. | When excavation is to take place within the specified tolerance zone, the excavator exercises such reasonable care as may be necessary for the protection of any underground facility in or near the excavation area. Methods to consider include: hand digging, soft digging, vacuum excavation methods, pneumatic hand tools, and other mechanical methods with the approval of the facility owner/operator. | Safe, prudent, non-evasive methods that manually determine a facility are considered "safe excavation practices" in a majority of state/provincial laws (38 states). A majority of states outline safe excavation practices to include hand digging or pot holing (16 states). Some states specifically allow for the use of power excavating equipment for the removal of pavement. |
| 21. | Mismarked Facilities. | The excavator notifies the facility owner/operator directly or through the one-call system if an underground facility is not found where one has been marked or if an unmarked underground facility is found. Following this notification, the excavator may continue work if the excavation can be performed without damaging the facility, unless specified otherwise in state/provincial law. | When an excavator finds an unmarked or inaccurately marked facility, excavation stops in the vicinity of the facility and notification takes place. If excavation continues, the excavator plans the excavation to avoid damage and interference with other facilities and protects facilities from damage. |
| 22. | Exposed Facility Protection. | Excavators support and protect exposed underground facilities from damage. | Exposed facilities can shift, separate, or be damaged when they are no longer supported or protected by the soil around them. Excavators support or brace exposed facilities and protect them from moving or shifting which could result in damage to the facility. This can be accomplished in different ways, for example, by shoring the facility from below or by providing a timber support with hangers across the top of an excavation to insure that the facility does not move or bend. In addition, workers are instructed not to climb on, strike, or attempt to move exposed facilities which could damage protective coatings, bend conduit, separate pipe joints, damage cable insulation, damage fiber optics, or in some way affect the integrity of the facility. |
| 23. | Locate Request Updates. | The excavator calls the one-call center to refresh the ticket when excavation continues past the life of the ticket (sometimes, but not always, defined by state/provincial law). | Refreshing the ticket recognizes that markings are temporary and provides notification to facility owners/operators of ongoing excavation when a job is started but not completed as planned. Any excavation not begun during the life of the ticket is recalled to the one-call center.

This practice also gives the facility owner/operator another chance to identify the location of their facilities and to avoid a possible damage and disruption of service should something have been marked incorrectly or missed on a previous locate. |
| 24. | Facility Damage Notification. | An excavator discovering or causing damage to underground facilities notifies the facility owner/operator and the one-call center. All breaks, leaks, nicks, dents, gouges, groves, or other damages to facility lines, conduits, | A majority of states require notification for damage or substantial weakening of an underground facility (27 states). The possibility of facility failure or endangerment of the surrounding population dramatically increases when a facility has been damaged. While the |

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| | | coatings or cathodic protection will be reported. | facility may not immediately fail, the underground facility owner/operator should have the opportunity to inspect the damage and make appropriate repairs. |
| 25. | Notification of Emergency Personnel. | If the damage results in the escape of any flammable, toxic, or corrosive gas or liquid or endangers life, health, or property, the excavator responsible immediately notifies 911 and the facility owner/operator. The excavator takes reasonable measures to protect themselves and those in immediate danger, general public, property, and the environment until the facility owner operator or emergency responders have arrived and completed their assessment. | This practice is already required by many of the states' one-call legislation. This practice minimizes the danger to life, health or property by notifying the proper authorities to handle the emergency situation. In these situations, local authorities are able to evacuate as appropriate and command substantial resources unavailable to the excavator or underground facility owner/operator. The excavator takes reasonable measures based on their knowledge, training, resources, experience and understanding of situation to protect themselves, people, property and the environment until help arrives. The excavator responsible remains on site to convey any pertinent information to responders that may help them to safely mitigate the situation. |
| 26. | Emergency Excavation. | In the case of an emergency excavation, maintenance or repairs may be made immediately provided that the excavator notifies the one-call center and facility owner/operator as soon as reasonably possible. This includes situations that involve danger to life, health or property, or that require immediate correction in order to continue the operation of or to assure the continuity of public utility service or public transportation. | This allows excavation to begin immediately to restore service or stop a hazardous situation from getting worse in the case of gas or pipeline leak, telephone cable cut, or other facility damage. |
| 27. | Backfilling. | The excavator protects all facilities from damage when backfilling an excavation. Trash, debris, coiled wire, or other material that could damage existing facilities or interfere with the accuracy of future locates are not to be buried in the excavation. | Extra caution must be taken to remove large rocks, sharp objects, and large chunks of hard packed clay or dirt. No trash or pieces of abandoned lines are backfilled into the trench. This will avoid any inadvertent damage to the facility during the backfill process. |
| D. | Project Restoration/Completion (Phase 4) | | |
| 28. | As-Built Documentation. | Contractors installing underground facilities notify the facility owner/operator if the actual placement is different from expected placement. | In order for a facility owner/operator to maintain accurate records of the location of their facilities, it is critical that the contractor installing the new facility be required to notify the facility owner/operator of deviations to the planned installation. |
| These best practices were most recently updated in 2007 by the CGA (Version 4.0) (CGA, 2007c). In Version 4.0, these 28 best practices remained unchanged and two additional best practices (numbers 29 and 30) were added. | | | |
| 29. | Trenchless Excavation. | All stakeholders adhere to all Best Practices and the following general guidelines prior to, during and after any trenchless excavation (as applicable). | <ul style="list-style-type: none"> • The excavator requests the location of underground facilities at the entrance pit, trenchless excavation path, and the exit pit by notifying the facility owner/operator through the one-call system. • The trenchless equipment operator performs a site inspection |

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| | | | <p>walking the trenchless excavation path prior to commencing work and has a good understanding of the job.</p> <ul style="list-style-type: none"> • The trenchless excavation operator confirms and maintains the path and minimum clearances established by the project owner and design engineer by tracking and recording the path of the trenchless excavation until complete. Means of tracking trenchless excavations include: electronic locating / guidance devices, pipe lasers, water levels, visual inspection, etc. • When existing facilities are known to be present but cannot be potholed due to local conditions the facility owner and the excavator meet to discuss how to safely proceed with the excavation. • Stop the trenchless excavation operations if an abnormal condition, unknown substructure or other hidden hazard is encountered. Proceed safely only after positive identification has been made. |
| 30. | Emergency Coordination with Adjacent Facilities. | Emergency response planning includes coordination with emergency responders and other above and/or underground infrastructure facility owner/operators identified by the Incident Commander through the Incident Command System/Unified Command (ICS/UC) during an emergency. | <p>During emergency situations there are many stakeholders involved: excavators; locators; owner/operators; first responders; one-call center; and the general public. Any actions taken by one stakeholder could adversely affect other stakeholders. Accordingly, emergency planning and response should be coordinated.</p> |

Appendix C: Document Review Forms

Table C.1: Summary of Company XYZ Internal Document Review

| Document | | Review Objectives ⁽¹⁾ | | | | |
|---|---|---|---|---|--|---|
| # | Project Type (Date, Assessment/ Remediation, Project Manager #) | #1 – Reference Underground Utility Clearance Activities? (yes/no) | #2 – Outline Specific Clearance Activities and Procedures? (yes/no) | #3 – Effective at Minimizing Risk? (yes/no) | #4 – Retain for Inclusion in UUDPP? (yes/no) | #5 – Specify Activity for Inclusion in UUDPP |
| Company-Wide Health and Safety Program | | | | | | |
| 16 | 2002 Company XYZ Health and Safety Program | No | NA ⁽²⁾ | NA | NA | -- |
| Work Plans | | | | | | |
| 2 | 2007, Remediation, #1 | Yes | Yes | Yes | Yes | 1) Hand tools should be used in areas requiring excavation located directly above or adjacent to marked underground utilities. The marked-out utility will be hand excavated until found and then protected before excavation with equipment will be performed.
2) Contact State One Call system.
3) Obtain an excavation permit from the Facility. |
| 5 | 2004, Assessment, #2 | Yes | No | NA | NA | -- |
| 8 | 2004, Remediation, #4 | Yes | Yes | No | NA | -- |
| 10 | 2005, Remediation, #5 | Yes | No | NA | NA | -- |
| 15 | 2004, Assessment, #2 | Yes | No | NA | NA | -- |
| Site Safety and Health Plans | | | | | | |
| 1 | 2007, Remediation, #1 | Yes | No | NA | NA | -- |
| 3 | 2007, Remediation, #1 | Yes | Yes | Yes | Yes | 1) Contact State One Call system.
2) Review available drawings.
3) Use locating equipment.
4) Hand tools should be used in areas requiring excavation located near marked underground utilities. |

| Document | | Review Objectives ⁽¹⁾ | | | | |
|-----------------------------|---|---|---|---|--|--|
| # | Project Type (Date, Assessment/ Remediation, Project Manager #) | #1 – Reference Underground Utility Clearance Activities? (yes/no) | #2 – Outline Specific Clearance Activities and Procedures? (yes/no) | #3 – Effective at Minimizing Risk? (yes/no) | #4 – Retain for Inclusion in UUDPP? (yes/no) | #5 – Specify Activity for Inclusion in UUDPP |
| | | | | | | 5) Document the completion of utility clearance. |
| 4 | 2007, Assessment, #2 | Yes | No | NA | NA | -- |
| 7 | 2001, Assessment, #3 | Yes | No | NA | NA | -- |
| 11 | 2005, Remediation, #5 | Yes | No | NA | NA | -- |
| Field Sampling Plans | | | | | | |
| 6 | 2001, Assessment, #3 | Yes | Yes | No | NA | -- |
| 9 | 2004, Remediation, #4 | No | NA | NA | NA | -- |
| 12 | 2003, Assessment, #6 | Yes | No | NA | NA | -- |
| 13 | 2003, Assessment, #3 | Yes | No | NA | NA | -- |
| 14 | 2003, Assessment, #3 | Yes | No | NA | NA | -- |
| Totals | | Yes (14) / No (2) | Yes (4) / No (10) / NA (2) | Yes (2) / No (2) / NA (12) | Yes (2) / No (0) / NA (14) | |

(1) Review Objectives:

1. Did the document make any reference to the performance of underground utility clearance activities?
2. If the performance of underground utility clearance activities were referenced, did the document outline specific activities and procedures to be executed?
3. If specific underground utility clearance activities and procedures were outlined in the document, would the activities and procedures be effective in minimizing the risk of inadvertently striking an underground utility line?
4. If the answer was "yes" question number three. Should these activities and procedures be retained for inclusion in the development of a company-wide UUDPP?
5. If the answer was "yes" to question numbers three and four. Specify those recommended activities and procedures for retention in Company XYZ's UUDPP.

(2) NA=Not Applicable

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Review: 03-17-08

Document Review: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ

Document Review Conducted by Researcher: Lance J. Dockter of Company XYZ

Method: Existing in-house underground utility damage prevention practices were ascertained through the collection and review of company-wide and project-specific documents (both past and present). These randomly selected documents were reviewed with the following objectives:

Document Number: 1

Document Year: June 2007

Project Manager #: 1

Document Type: SSH P

1. Did the document make any reference to the performance of underground utility clearance activities?

Yes or No (circle one)

2. If the performance of underground utility clearance activities were referenced, did the document outline specific activities and procedures to be executed?

No ~~Yes~~ or ~~No~~ (circle one) ^{LTD} References EM385-1-1 Sections 25, A.01 + A.11

3. If specific underground utility clearance activities and procedures were outlined in the document, would the activities and procedures be effective in minimizing the risk of inadvertently striking an underground utility line?

Yes or No (circle one) NA

4. If the answer was "yes" question number three, Should these activities and procedures be retained for inclusion in the development of a company-wide UUDPP?

Yes or No (circle one)

NA

5. If the answer was "yes" to question numbers three and four, Specify those recommended activities and procedures for retention in Company XYZ's UUDPP.

"Utility clearance ^{will be} Documented by NA FOL"

The results are summarized in Table 2 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Review: 03-17-08

Document Review: Development of an Underground Utility Damage Prevention Plan (UDPP) for Company XYZ

Document Review Conducted by Researcher: Lance J. Dockter of Company XYZ

Method: Existing in-house underground utility damage prevention practices were ascertained through the collection and review of company-wide and project-specific documents (both past and present). These randomly selected documents were reviewed with the following objectives:

Document Number: 2

Document Year: Sept 2007

Project Manager #: 1

Document Type: Work Plan

1. Did the document make any reference to the performance of underground utility clearance activities?

☒ Yes or No (circle one)

2. If the performance of underground utility clearance activities were referenced, did the document outline specific activities and procedures to be executed?

☒ Yes or No (circle one)

3. If specific underground utility clearance activities and procedures were outlined in the document, would the activities and procedures be effective in minimizing the risk of inadvertently striking an underground utility line?

☒ Yes ☒ Yes or ☒ No (circle one)

Not alone USD

4. If the answer was "yes" question number three, Should these activities and procedures be retained for inclusion in the development of a company-wide UDPP?

☒ Yes or No (circle one)

5. If the answer was "yes" to question numbers three and four, Specify those recommended activities and procedures for retention in Company XYZ's UDPP.

① In areas of marked underground utilities, hand tools should be used. The marked out utility will be hand excavated until found + then protected before excavation w/ equipment. ② Call for locate. ③ Obtain The results are summarized in Table 2 of Chapter 4. Excavation Permit from Corps.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Review: 03-17-08

Document Review: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ

Document Review Conducted by Researcher: Lance J. Dockter of Company XYZ

Method: Existing in-house underground utility damage prevention practices were ascertained through the collection and review of company-wide and project-specific documents (both past and present). These randomly selected documents were reviewed with the following objectives:

Document Number: 3

Document Year: Dec 2007

Project Manager #: 1

Document Type: SSHP

1. Did the document make any reference to the performance of underground utility clearance activities?

Yes or No (circle one)

2. If the performance of underground utility clearance activities were referenced, did the document outline specific activities and procedures to be executed?

Yes or No (circle one)

References EM385-1-1

3. If specific underground utility clearance activities and procedures were outlined in the document, would the activities and procedures be effective in minimizing the risk of inadvertently striking an underground utility line?

Yes or No (circle one)

4. If the answer was "yes" question number three, Should these activities and procedures be retained for inclusion in the development of a company-wide UUDPP?

Yes or No (circle one)

5. If the answer was "yes" to question numbers three and four, Specify those recommended activities and procedures for retention in Company XYZ's UUDPP.

① Contact utility companies ② Check blue prints / as built Drawings ③ Use detection equipment (e.g. magnetometer survey).
④ Excavate by hand. ⑤ Utility clearance documented.

The results are summarized in Table 2 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Review: 03-17-08

Document Review: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ

Document Review Conducted by Researcher: Lance J. Dockter of Company XYZ

Method: Existing in-house underground utility damage prevention practices were ascertained through the collection and review of company-wide and project-specific documents (both past and present). These randomly selected documents were reviewed with the following objectives:

Document Number: 4

Document Year: March 2007

Project Manager #: 2

Document Type: SSHP

1. Did the document make any reference to the performance of underground utility clearance activities?

Yes or No (circle one)

2. If the performance of underground utility clearance activities were referenced, did the document outline specific activities and procedures to be executed?

Yes or No (circle one)

3. If specific underground utility clearance activities and procedures were outlined in the document, would the activities and procedures be effective in minimizing the risk of inadvertently striking an underground utility line?

Yes or No (circle one) NA

4. If the answer was "yes" question number three, Should these activities and procedures be retained for inclusion in the development of a company-wide UUDPP?

Yes or No (circle one) NA

5. If the answer was "yes" to question numbers three and four, Specify those recommended activities and procedures for retention in Company XYZ's UUDPP.

NA

The results are summarized in Table 2 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Review: 03-17-08

Document Review: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ

Document Review Conducted by Researcher: Lance J. Dockter of Company XYZ

Method: Existing in-house underground utility damage prevention practices were ascertained through the collection and review of company-wide and project-specific documents (both past and present). These randomly selected documents were reviewed with the following objectives:

Document Number: 5

Document Year: Aug 2004

Project Manager #: 2

Document Type: Work Plan

1. Did the document make any reference to the performance of underground utility clearance activities?

Yes or No (circle one)

2. If the performance of underground utility clearance activities were referenced, did the document outline specific activities and procedures to be executed?

Yes or No (circle one)

3. If specific underground utility clearance activities and procedures were outlined in the document, would the activities and procedures be effective in minimizing the risk of inadvertently striking an underground utility line?

Yes or No (circle one) NA

4. If the answer was "yes" question number three, Should these activities and procedures be retained for inclusion in the development of a company-wide UUDPP?

Yes or No (circle one) NA

5. If the answer was "yes" to question numbers three and four, Specify those recommended activities and procedures for retention in Company XYZ's UUDPP.

NA

The results are summarized in Table 2 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Review: 03-17-08

Document Review: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ

Document Review Conducted by Researcher: Lance J. Dockter of Company XYZ

Method: Existing in-house underground utility damage prevention practices were ascertained through the collection and review of company-wide and project-specific documents (both past and present). These randomly selected documents were reviewed with the following objectives:

Document Number: 6

Document Year: July 2001

Project Manager #: CS 23

Document Type: FSP

1. Did the document make any reference to the performance of underground utility clearance activities?

☒ Yes or ☐ No (circle one)

2. If the performance of underground utility clearance activities were referenced, did the document outline specific activities and procedures to be executed?

☒ Yes or ☐ No (circle one)

3. If specific underground utility clearance activities and procedures were outlined in the document, would the activities and procedures be effective in minimizing the risk of inadvertently striking an underground utility line?

Yes or ☒ No (circle one)

4. If the answer was "yes" question number three. Should these activities and procedures be retained for inclusion in the development of a company-wide UUDPP?

Yes or ☒ No (circle one) NA

5. If the answer was "yes" to question numbers three and four. Specify those recommended activities and procedures for retention in Company XYZ's UUDPP.

① call local utility companies - Ohio Utilities Prot.
800-362-2764

② Note: Not all utilities are covered

The results are summarized in Table 2 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Review: 03-17-08

Document Review: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ

Document Review Conducted by Researcher: Lance J. Dockter of Company XYZ

Method: Existing in house underground utility damage prevention practices were ascertained through the collection and review of company-wide and project-specific documents (both past and present). These randomly selected documents were reviewed with the following objectives:

Document Number: 7

Document Year: July 2001

Project Manager #: 3

Document Type: SSHP

1. Did the document make any reference to the performance of underground utility clearance activities?

☒ Yes or ☐ No (circle one)

2. If the performance of underground utility clearance activities were referenced, did the document outline specific activities and procedures to be executed?

Yes or ☒ No (circle one)

3. If specific underground utility clearance activities and procedures were outlined in the document, would the activities and procedures be effective in minimizing the risk of inadvertently striking an underground utility line?

Yes or No (circle one)

NA

4. If the answer was "yes" question number three. Should these activities and procedures be retained for inclusion in the development of a company-wide UUDPP?

Yes or No (circle one)

NA

5. If the answer was "yes" to question numbers three and four. Specify those recommended activities and procedures for retention in Company XYZ's UUDPP.

NA

The results are summarized in Table 2 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Review: 03-17-08

Document Review: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ

Document Review Conducted by Researcher: Lance J. Dockter of Company XYZ

Method: Existing in-house underground utility damage prevention practices were ascertained through the collection and review of company-wide and project-specific documents (both past and present). These randomly selected documents were reviewed with the following objectives:

Document Number: 8

Document Year: Oct 2004

Project Manager #: 4

Document Type: W.P.

1. Did the document make any reference to the performance of underground utility clearance activities?

Yes or No (circle one)

2. If the performance of underground utility clearance activities were referenced, did the document outline specific activities and procedures to be executed?

Yes or No (circle one)

3. If specific underground utility clearance activities and procedures were outlined in the document, would the activities and procedures be effective in minimizing the risk of inadvertently striking an underground utility line?

Yes or No (circle one)

4. If the answer was "yes" question number three. Should these activities and procedures be retained for inclusion in the development of a company-wide UUDPP?

Yes or No (circle one)

5. If the answer was "yes" to question numbers three and four. Specify those recommended activities and procedures for retention in Company XYZ's UUDPP.

① Miss Utility ② Property Owner

The results are summarized in Table 2 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Review: 03-17-08

Document Review: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ

Document Review Conducted by Researcher: Lance J. Dockter of Company XYZ

Method: Existing in-house underground utility damage prevention practices were ascertained through the collection and review of company-wide and project-specific documents (both past and present). These randomly selected documents were reviewed with the following objectives:

Document Number: 9

Document Year: Oct. 2004

Project Manager #: 4

Document Type: FSP

1. Did the document make any reference to the performance of underground utility clearance activities?

Yes or No (circle one)

2. If the performance of underground utility clearance activities were referenced, did the document outline specific activities and procedures to be executed?

Yes or No (circle one)

NA

3. If specific underground utility clearance activities and procedures were outlined in the document, would the activities and procedures be effective in minimizing the risk of inadvertently striking an underground utility line?

Yes or No (circle one)

NA

4. If the answer was "yes" question number three, Should these activities and procedures be retained for inclusion in the development of a company-wide UUDPP?

Yes or No (circle one)

NA

5. If the answer was "yes" to question numbers three and four, Specify those recommended activities and procedures for retention in Company XYZ's UUDPP.

The results are summarized in Table 2 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Review: 03-17-08

Document Review: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ

Document Review Conducted by Researcher: Lance J. Dockter of Company XYZ

Method: Existing in-house underground utility damage prevention practices were ascertained through the collection and review of company-wide and project-specific documents (both past and present). These randomly selected documents were reviewed with the following objectives:

Document Number: 10

Document Year: July 2005

Project Manager #: 5

Document Type: W.P.

1. Did the document make any reference to the performance of underground utility clearance activities?

Yes or No (circle one)

2. If the performance of underground utility clearance activities were referenced, did the document outline specific activities and procedures to be executed?

Yes or No (circle one)

3. If specific underground utility clearance activities and procedures were outlined in the document, would the activities and procedures be effective in minimizing the risk of inadvertently striking an underground utility line?

Yes or No (circle one) NA

4. If the answer was "yes" question number three, Should these activities and procedures be retained for inclusion in the development of a company-wide UUDPP?

Yes or No (circle one) NA

5. If the answer was "yes" to question numbers three and four, Specify those recommended activities and procedures for retention in Company XYZ's UUDPP.

NA

The results are summarized in Table 2 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Review: 03-17-08

Document Review: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ

Document Review Conducted by Researcher: Lance J. Dockter of Company XYZ

Method: Existing in-house underground utility damage prevention practices were ascertained through the collection and review of company-wide and project-specific documents (both past and present). These randomly selected documents were reviewed with the following objectives:

Document Number: 11

Document Year: July 2005

Project Manager #: 5

Document Type: SSHP

1. Did the document make any reference to the performance of underground utility clearance activities?

☒ Yes or ☐ No (circle one)

2. If the performance of underground utility clearance activities were referenced, did the document outline specific activities and procedures to be executed?

Yes or ☒ No (circle one)

3. If specific underground utility clearance activities and procedures were outlined in the document, would the activities and procedures be effective in minimizing the risk of inadvertently striking an underground utility line?

Yes or ☒ No (circle one) NA

4. If the answer was "yes" question number three, Should these activities and procedures be retained for inclusion in the development of a company-wide UUDPP?

Yes or ☒ No (circle one) NA

5. If the answer was "yes" to question numbers three and four, Specify those recommended activities and procedures for retention in Company XYZ's UUDPP.

NA

The results are summarized in Table 2 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Review: 3-17-08

Document Review: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ.

Document Review Conducted by Researcher: Lance J. Dockter of Company XYZ

Method: Existing in-house underground utility damage prevention practices were ascertained through the collection and review of company-wide and project-specific documents (both past and present). These randomly selected documents were reviewed with the following objectives:

Document Number: 412

Document Year: Nov. 2003

Project Manager #: 6

Document Type: FSP

1. Did the document make any reference to the performance of underground utility clearance activities?

☒ Yes or ☐ No (circle one)

2. If the performance of underground utility clearance activities were referenced, did the document outline specific activities and procedures to be executed?

Yes or ☒ No (circle one)

3. If specific underground utility clearance activities and procedures were outlined in the document, would the activities and procedures be effective in minimizing the risk of inadvertently striking an underground utility line?

Yes or ☐ No (circle one) NA

4. If the answer was "yes" question number three, Should these activities and procedures be retained for inclusion in the development of a company-wide UUDPP?

Yes or ☐ No (circle one) NA

5. If the answer was "yes" to question numbers three and four, Specify those recommended activities and procedures for retention in Company XYZ's UUDPP.

NA

The results are summarized in Table 2 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Review: 3/7-08

Document Review: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ

Document Review Conducted by Researcher: Lance J. Dockter of Company XYZ

Method: Existing in-house underground utility damage prevention practices were ascertained through the collection and review of company-wide and project-specific documents (both past and present). These randomly selected documents were reviewed with the following objectives:

Document Number: 13

Document Year: Jan 2003

Project Manager #: 3

Document Type: FSP

1. Did the document make any reference to the performance of underground utility clearance activities?

☒ Yes or ☐ No (circle one)

2. If the performance of underground utility clearance activities were referenced, did the document outline specific activities and procedures to be executed?

Yes or ☒ No (circle one)

3. If specific underground utility clearance activities and procedures were outlined in the document, would the activities and procedures be effective in minimizing the risk of inadvertently striking an underground utility line?

Yes or ☒ No (circle one) NA

4. If the answer was "yes" question number three, Should these activities and procedures be retained for inclusion in the development of a company-wide UUDPP?

Yes or ☒ No (circle one) NA

5. If the answer was "yes" to question numbers three and four, Specify those recommended activities and procedures for retention in Company XYZ's UUDPP.

NA

The results are summarized in Table 2 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Review: 3-17-08

Document Review: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ

Document Review Conducted by Researcher: Lance J. Dockter of Company XYZ

Method: Existing in-house underground utility damage prevention practices were ascertained through the collection and review of company-wide and project-specific documents (both past and present). These randomly selected documents were reviewed with the following objectives:

Document Number: 14

Document Year: Sept. 2003

Project Manager #: 3

Document Type: FSP

1. Did the document make any reference to the performance of underground utility clearance activities?

☒ Yes or ☐ No (circle one)

2. If the performance of underground utility clearance activities were referenced, did the document outline specific activities and procedures to be executed?

Yes or ☒ No (circle one)

3. If specific underground utility clearance activities and procedures were outlined in the document, would the activities and procedures be effective in minimizing the risk of inadvertently striking an underground utility line?

Yes or ☐ No (circle one) NA

4. If the answer was "yes" question number three, Should these activities and procedures be retained for inclusion in the development of a company-wide UUDPP?

Yes or ☐ No (circle one) NA

5. If the answer was "yes" to question numbers three and four, Specify those recommended activities and procedures for retention in Company XYZ's UUDPP.

NA

The results are summarized in Table 2 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Review: 3-17-08

Document Review: Development of an Underground Utility Damage Prevention Plan (UDDPP) for Company XYZ

Document Review Conducted by Researcher: Lance J. Dockter of Company XYZ

Method: Existing in-house underground utility damage prevention practices were ascertained through the collection and review of company-wide and project-specific documents (both past and present). These randomly selected documents were reviewed with the following objectives:

Document Number: 15

Document Year: May 2004

Project Manager #: 2

Document Type: W.P.

1. Did the document make any reference to the performance of underground utility clearance activities?

Yes or No (circle one)

2. If the performance of underground utility clearance activities were referenced, did the document outline specific activities and procedures to be executed?

Yes or No (circle one)

3. If specific underground utility clearance activities and procedures were outlined in the document, would the activities and procedures be effective in minimizing the risk of inadvertently striking an underground utility line?

Yes or No (circle one) NA

4. If the answer was "yes" question number three, Should these activities and procedures be retained for inclusion in the development of a company-wide UDDPP?

Yes or No (circle one) NA

5. If the answer was "yes" to question numbers three and four, Specify those recommended activities and procedures for retention in Company XYZ's UDDPP.

NA

The results are summarized in Table 2 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Review: 3-17-08

Document Review: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ

Document Review Conducted by Researcher: Lance J. Dockter of Company XYZ

Method: Existing in-house underground utility damage prevention practices were ascertained through the collection and review of company-wide and project-specific documents (both past and present). These randomly selected documents were reviewed with the following objectives:

Document Number: 16

Document Year: Feb 2007

Project Manager #: --

Document Type: Corp. Health + Safety Manual

1. Did the document make any reference to the performance of underground utility clearance activities?

Yes or No (circle one)

2. If the performance of underground utility clearance activities were referenced, did the document outline specific activities and procedures to be executed?

Yes or No (circle one)

NA

3. If specific underground utility clearance activities and procedures were outlined in the document, would the activities and procedures be effective in minimizing the risk of inadvertently striking an underground utility line?

Yes or No (circle one)

NA

4. If the answer was "yes" question number three, Should these activities and procedures be retained for inclusion in the development of a company-wide UUDPP?

Yes or No (circle one)

NA

5. If the answer was "yes" to question numbers three and four, Specify those recommended activities and procedures for retention in Company XYZ's UUDPP.

NA

The results are summarized in Table 2 of Chapter 4.

Appendix D: Employee Surveys

Date of Survey: _____

Subject Number: _____

Survey: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ

Survey Administered by Researcher: Lance J. Dockter of Company XYZ

Method: One-on-one telephone interview with subject employee. The survey questions consisted of a combination of closed and open ended questions. Closed ended questions received "yes" or "no" responses, while open ended questions provided free-form verbal responses. A total of eight questions (some in multiple parts) were developed for the survey:

1. When managing projects that require intrusive activities (e.g. excavating, drilling, etc.) or performing field tasks involving intrusive activities, are underground utility clearance activities always conducted prior to initiation of intrusive activities (yes/no)?

2. If the answer was "yes" to question number one. Do the project-specific documents (including Work Plans, Field Sampling Plans, or Site Safety and Health Plans) require that underground utility clearance activities be performed prior to initiation of intrusive activities (yes/no)?

3. If the answer was "no" to question number one.
 - a. In those instances where underground utility clearance activities were not performed prior to conducting intrusive activities, why were underground utility clearance activities not performed?
 - b. In your opinion, was the decision or reason for not to perform the underground utility clearance activities justified (yes/no)?
 - c. Did the decision not to perform the underground utility clearance activities place Company XYZ at an increased risk of striking an underground utility line (yes/no)?
 - d. Where intrusive activities were performed, what is the frequency in which underground utility clearance activities not performed on Company XYZ projects?

4. If the answer was "yes" to question number one and "no" to question number two. What specific utility clearance activities are typically performed on projects requiring intrusive activities?

Date of Survey: _____

Subject Number: _____

5. If the answer was "yes" to question number one and "yes" to question number two.
 - a. What specific utility clearance activities are required when performing intrusive activities for each project?
 - b. Are these activities and procedures *clearly* outlined in the project-specific documents (yes/no)?
 - c. Is there a checklist or form that documents that the utility clearance activities were performed for a project (yes/no)?
 - d. If the answer was "no" to question number 5c. Might a checklist or form that documents that the utility clearance activities were completed for a project be useful (yes/no)?

6. In your opinion, are underground utility clearance activities that are being performed at Company XYZ adequate in minimizing the risk of striking an underground utility line (yes/no)?

7. If the answer was "no" to question number six. What additional utility clearance activities would you recommend adding to a U-UDPP?

8. Have you ever managed or worked on a project at Company XYZ where:
 - a. Underground utility lines were unintentionally damaged (yes/no)?
 - i. Were underground utility clearance activities performed prior to the incident (yes/no)?
 - ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?
 - b. Had a near miss (yes/no)?
 - i. Were underground utility clearance activities performed prior to the incident (yes/no)?
 - ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?

A copy of the completed survey is included in Appendix C, and the results are summarized in Table 3 of Chapter 4.

Table D.1: Summary of Company XYZ Employee Survey

| Employee | | Survey Questions ⁽¹⁾ | | | | | | | | |
|----------|---|--|--|---|--|---|--|---|--|--|
| # | Type: Project Manager, Field Operations Leader (Engineer, Geologist, Scientist) | #1
Utility Clearance Activities Always Conducted? | #2
If "Yes" to #1, Required in Project Documents? | #3
If "No" to #1,
a) Why not performed?
b) Decision Justified?
c) Increased Risk?
d) Freq. Not Performed | | #4
If "Yes" to #1 and "No" to #2, what activities are typically performed? | #5
If "Yes" to #1 and "Yes" to #2,
a) Required Activities.
b) Activities Clearly Defined?
c) Check-List?
d) If "No" to 5c, would a checklist be useful? | #6
Are Clearance Activities at Company XYZ Adequate? | #7
If "No" to #6, Recommended Activities. | #8
Have you ever worked on a project where:
a) Utilities Damaged?
i) Clearance Performed?
ii) Inadequate Procedures?
b) Near Miss?
i) Clearance Performed?
ii) Inadequate Procedures? |
| 1 | Project Manager | Yes | Yes | NA ⁽²⁾ | | NA | a) Contact property owner, walk site, State One Call
b) Yes
c) Yes
d) NA | Yes | NA | a) No
b) No |
| 2 | Project Manager | Yes | No | NA | | State One Call | NA | Yes | NA | a) No
b) No |
| 3 | Project Manager | Yes | Yes | NA | | NA | a) Dig Permit, State One Call, Site Utilities
b) Yes
c) No
d) No | No | Soft Dig | a) No
b) No |
| 4 | Engineer | Yes | Yes | NA | | NA | a) State One Call
b) No
c) No
d) Yes | No | Separate utility check of area. | a) No
b) No |
| 5 | Engineer | Yes | Yes | NA | | NA | a) State One Call, Private locating service
b) Yes
c) Yes
d) NA | Yes | NA | a) No
b) No |
| 6 | Scientist | Yes | Yes | NA | | NA | a) Sign off by federal facility public works department
b) No
c) Yes – Excavation Permit required by Federal Facility
d) NA | Yes | NA | a) No
b) No |

| Employee | | Survey Questions (1) | | | | | | | | | |
|----------|---|--|--|---|---|--|---|--|--|--|--|
| # | Type: Project Manager, Field Operations Leader (Engineer, Geologist, Scientist) | #1
Utility Clearance Activities Always Conducted? | #2
If "Yes" to #1, Required in Project Documents? | #3
If "No" to #1,
a) Why not performed?
b) Decision Justified?
c) Increased Risk?
d) Freq. Not Performed | #4
If "Yes" to #1 and "No" to #2, what activities are typically performed? | #5
If "Yes" to #1 and "Yes" to #2,
a) Required Activities.
b) Activities Clearly Defined?
c) Check-List?
d) If "No" to 5c, would a checklist be useful? | #6
Are Clearance Activities at Company XYZ Adequate? | #7
If "No" to #6, Recommended Activities. | #8
Have you ever worked on a project where:
a) Utilities Damaged?
i) Clearance Performed?
ii) Inadequate Procedures?
b) Near Miss?
i) Clearance Performed?
ii) Inadequate Procedures? | | |
| 7 | Field Operations Leader | Yes | Yes | NA | NA | a) State One Call
b) Yes
c) No
d) Yes | Yes | NA | a) No
b) No | | |
| 8 | Field Operations Leader | Yes | Yes | NA | NA | a) State One Call, Private Utility Locate
b) Yes
c) Yes
d) NA | Yes | NA | a) No
b) No | | |
| 9 | Health and Safety Coordinator | Yes | Yes | NA | NA | a) Contact utility companies, review drawings, use of detection equipment
b) Yes
c) Yes
d) NA | Yes | NA | a) No
b) No | | |
| Totals | | Yes (9) / No (0) | Yes (8) / No (1) | NA (9) | NA (8) | Results Summarized in Text | Yes (7) / No (2) | NA (7) / Activities Summarized in Text | No to both a) and b) (9) | | |

(1) Survey Questions:

- When managing projects that require intrusive activities (e.g. excavating, drilling, etc.) or performing field tasks involving intrusive activities, are underground utility clearance activities always conducted prior to initiation of intrusive activities?
- If the answer was "yes" to question number one. Do the project-specific documents (including Work Plans, Field Sampling Plans, or Site Safety and Health Plans) require that underground utility clearance activities be performed prior to initiation of intrusive activities?
- If the answer was "no" to question number one.
 - In those instances where underground utility clearance activities were not performed prior to conducting intrusive activities, why were underground utility clearance activities not performed?

- b. In your opinion, was the decision or reason for not to perform the underground utility clearance activities justified?
 - c. Did the decision not to perform the underground utility clearance activities place Company XYZ at an increased risk of striking an underground utility line?
 - d. Where intrusive activities were performed, what is the frequency in which underground utility clearance activities not performed on Company XYZ projects?
4. If the answer was "yes" to question number one and "no" to question number two. What specific utility clearance activities are typically performed on projects requiring intrusive activities?
 5. If the answer was "yes" to question number one and "yes" to question number two.
 - a. What specific utility clearance activities are required when performing intrusive activities for each project?
 - b. Are these activities and procedures *clearly* outlined in the project-specific documents?
 - c. Is there a checklist or form that documents that the utility clearance activities were performed for a project?
 - d. If the answer was "no" to question number 5c. Might a checklist or form that documents that the utility clearance activities were completed for a project be useful?
 6. In your opinion, are underground utility clearance activities that are being performed at Company XYZ adequate in minimizing the risk of striking an underground utility line?
 7. If the answer was "no" to question number six. What additional utility clearance activities would you recommend adding to a UUDPPP?
 8. Have you ever managed or worked on a project at Company XYZ where:
 - a. Underground utility lines were unintentionally damaged?
 - i. Were underground utility clearance activities performed prior to the incident?
 - ii. If so, was the incident a result of inadequate underground utility clearance procedures?
 - b. Had a near miss?
 - i. Were underground utility clearance activities performed prior to the incident?
 - ii. If so, was the incident a result of inadequate underground utility clearance procedures?

(2) NA = Not Applicable

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Survey: March 30, 2008

Subject Number: 1

Survey: Development of an Underground Utility Damage Prevention Plan (UDDPP) for Company XYZ

Survey Administered by Researcher: Lance J. Dockter of Company XYZ

Method: One-on-one telephone interview with subject employee. The survey questions consisted of a combination of closed and open ended questions. Closed ended questions received "yes" or "no" responses, while open ended questions provided free-form verbal responses. A total of eight questions (some in multiple parts) were developed for the survey:

1. When managing projects that require intrusive activities (e.g. excavating, drilling, etc.) or performing field tasks involving intrusive activities, are underground utility clearance activities always conducted prior to initiation of intrusive activities (yes/no)?
Yes
2. If the answer was "yes" to question number one. Do the project-specific documents (including Work Plans, Field Sampling Plans, or Site Safety and Health Plans) require that underground utility clearance activities be performed prior to initiation of intrusive activities (yes/no)?
Yes
3. If the answer was "no" to question number one. **NA**
 - a. In those instances where underground utility clearance activities were not performed prior to conducting intrusive activities, why were underground utility clearance activities not performed?
 - b. In your opinion, was the decision or reason for not to perform the underground utility clearance activities justified (yes/no)?
 - c. Did the decision not to perform the underground utility clearance activities place Company XYZ at an increased risk of striking an underground utility line (yes/no)?
 - d. Where intrusive activities were performed, what is the frequency in which underground utility clearance activities not performed on Company XYZ projects?
4. If the answer was "yes" to question number one and "no" to question number two. What specific utility clearance activities are typically performed on projects requiring intrusive activities? **NA**
5. If the answer was "yes" to question number one and "yes" to question number two.
 - a. What specific utility clearance activities are required when performing intrusive activities for each project?

Normally we contact the property owner for a review of utility lines that are on the property, walk the site to look for evidence of underground utilities, and

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

contact a local underground utility alert service to notify them of the up coming work. We mark the site for the underground utility alert people so they know where the work is to take place.

- b. Are these activities and procedures *clearly* outlined in the project-specific documents (yes/no)?

Yes

- c. Is there a checklist or form that documents that the utility clearance activities were performed for a project (yes/no)?

Yes

- d. If the answer was "no" to question number 5c. Might a checklist or form that documents that the utility clearance activities were completed for a project be useful (yes/no)? **NA**

6. In your opinion, are underground utility clearance activities that are being performed at Company XYZ adequate in minimizing the risk of striking an underground utility line (yes/no)?

Yes

7. If the answer was "no" to question number six. What additional utility clearance activities would you recommend adding to a UUDPP? **NA**

8. Have you ever managed or worked on a project at Company XYZ where:

- a. Underground utility lines were unintentionally damaged (yes/no)?

No

- i. Were underground utility clearance activities performed prior to the incident (yes/no)?
- ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?

- b. Had a near miss (yes/no)?

No

- i. Were underground utility clearance activities performed prior to the incident (yes/no)?
- ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?

A copy of the completed survey is included in Appendix C, and the results are summarized in Table 3 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Survey: March 27, 2007

Subject Number: 2

Survey: Development of an Underground Utility Damage Prevention Plan (UDPP) for Company XYZ

Survey Administered by Researcher: Lance J. Dockter of Company XYZ

Method: One-on-one telephone interview with subject employee. The survey questions consisted of a combination of closed and open ended questions. Closed ended questions received "yes" or "no" responses, while open ended questions provided free-form verbal responses. A total of eight questions (some in multiple parts) were developed for the survey:

1. When managing projects that require intrusive activities (e.g. excavating, drilling, etc.) or performing field tasks involving intrusive activities, are underground utility clearance activities always conducted prior to initiation of intrusive activities (yes/no)?

Yes

2. If the answer was "yes" to question number one. Do the project-specific documents (including Work Plans, Field Sampling Plans, or Site Safety and Health Plans) require that underground utility clearance activities be performed prior to initiation of intrusive activities (yes/no)?

No

3. If the answer was "no" to question number one. NA
 - a. In those instances where underground utility clearance activities were not performed prior to conducting intrusive activities, why were underground utility clearance activities not performed?
 - b. In your opinion, was the decision or reason for not to perform the underground utility clearance activities justified (yes/no)?
 - c. Did the decision not to perform the underground utility clearance activities place Company XYZ at an increased risk of striking an underground utility line (yes/no)?
 - d. Where intrusive activities were performed, what is the frequency in which underground utility clearance activities not performed on Company XYZ projects?
4. If the answer was "yes" to question number one and "no" to question number two. What specific utility clearance activities are typically performed on projects requiring intrusive activities?

Does not believe it is uniformly true that work plans specifically call for utility clearances. Generally we rely on the good judgment of the field team leader to institute this "industry standard" practice. This will generally entail a phone call to "Miss Utility" or similar organization for mark-out of utilities.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Survey: March 27, 2007

Subject Number: 2

5. If the answer was "yes" to question number one and "yes" to question number two. **NA**
 - a. What specific utility clearance activities are required when performing intrusive activities for each project?
 - b. Are these activities and procedures *clearly* outlined in the project-specific documents (yes/no)?
 - c. Is there a checklist or form that documents that the utility clearance activities were performed for a project (yes/no)?
 - d. If the answer was "no" to question number 5c. Might a checklist or form that documents that the utility clearance activities were completed for a project be useful (yes/no)?
6. In your opinion, are underground utility clearance activities that are being performed at Company XYZ adequate in minimizing the risk of striking an underground utility line (yes/no)?
Yes
7. If the answer was "no" to question number six. What additional utility clearance activities would you recommend adding to a UUDPP?
NA
8. Have you ever managed or worked on a project at Company XYZ where:
 - a. Underground utility lines were unintentionally damaged (yes/no)?
No
 - i. Were underground utility clearance activities performed prior to the incident (yes/no)?
 - ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?
 - b. Had a near miss (yes/no)?
No
 - i. Were underground utility clearance activities performed prior to the incident (yes/no)?
 - ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?

A copy of the completed survey is included in Appendix C, and the results are summarized in Table 3 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Survey: April 4, 2008

Subject Number: 3

Survey: Development of an Underground Utility Damage Prevention Plan (UDPP) for Company XYZ

Survey Administered by Researcher: Lance J. Dockter of Company XYZ

Method: One-on-one telephone interview with subject employee. The survey questions consisted of a combination of closed and open ended questions. Closed ended questions received "yes" or "no" responses, while open ended questions provided free-form verbal responses. A total of eight questions (some in multiple parts) were developed for the survey:

1. When managing projects that require intrusive activities (e.g. excavating, drilling, etc.) or performing field tasks involving intrusive activities, are underground utility clearance activities always conducted prior to initiation of intrusive activities (yes/no)?
Yes
2. If the answer was "yes" to question number one. Do the project-specific documents (including Work Plans, Field Sampling Plans, or Site Safety and Health Plans) require that underground utility clearance activities be performed prior to initiation of intrusive activities (yes/no)?
Yes
3. If the answer was "no" to question number one. **NA**
 - a. In those instances where underground utility clearance activities were not performed prior to conducting intrusive activities, why were underground utility clearance activities not performed?
 - b. In your opinion, was the decision or reason for not to perform the underground utility clearance activities justified (yes/no)?
 - c. Did the decision not to perform the underground utility clearance activities place Company XYZ at an increased risk of striking an underground utility line (yes/no)?
 - d. Where intrusive activities were performed, what is the frequency in which underground utility clearance activities not performed on Company XYZ projects?
4. If the answer was "yes" to question number one and "no" to question number two. What specific utility clearance activities are typically performed on projects requiring intrusive activities? **NA**
5. If the answer was "yes" to question number one and "yes" to question number two.
 - a. What specific utility clearance activities are required when performing intrusive activities for each project?

Contacting the local Miss Utility is required by Federal law. If working on a military installation there is typically an intrusive action permit process in place

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(Dig Permit). This typically includes contacting Miss Utility as well as each "shop" on the installation (electrical, plumbing, etc.)

- b. Are these activities and procedures *clearly* outlined in the project-specific documents (yes/no)?

Yes

- c. Is there a checklist or form that documents that the utility clearance activities were performed for a project (yes/no)?

No (Unless the installation has a permitting process)

- d. If the answer was "no" to question number 5c. Might a checklist or form that documents that the utility clearance activities were completed for a project be useful (yes/no)?

No. When contacting Miss Utility there are forms that must be completed (over the phone or on line). Once Miss Utility has the information the various utility companies are contacted. Responses from the various utilities are consolidated and are faxed or emailed to the requestor (Company XYZ) for their records. Because checking with Miss Utility is a Federal law, the use of a form in a work plan document would be redundant.

6. In your opinion, are underground utility clearance activities that are being performed at Company XYZ adequate in minimizing the risk of striking an underground utility line (yes/no)?

No

7. If the answer was "no" to question number six. What additional utility clearance activities would you recommend adding to a UUDPP?

Doesn't believe that the required contacting of Miss Utility is occurring on all intrusive utilities undertaken by Company XYZ. Even on projects where Miss Utility has been contacted and the site has been marked or cleared, personnel may mistakenly believe that the markings are accurate and proceed with intrusive activities by mechanical means. Additional requirements such as a requirement to use a soft dig process should be employed.

8. Have you ever managed or worked on a project at Company XYZ where:

- a. Underground utility lines were unintentionally damaged (yes/no)?

No

- i. Were underground utility clearance activities performed prior to the incident (yes/no)?
- ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?

- b. Had a near miss (yes/no)?

No

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

- i. Were underground utility clearance activities performed prior to the incident (yes/no)?
- ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?

A copy of the completed survey is included in Appendix C, and the results are summarized in Table 3 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Survey: March 27, 2007

Subject Number: 4

Survey: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ

Survey Administered by Researcher: Lance J. Dockter of Company XYZ

Method: One-on-one telephone interview with subject employee. The survey questions consisted of a combination of closed and open ended questions. Closed ended questions received "yes" or "no" responses, while open ended questions provided free-form verbal responses. A total of eight questions (some in multiple parts) were developed for the survey:

1. When managing projects that require intrusive activities (e.g. excavating, drilling, etc.) or performing field tasks involving intrusive activities, are underground utility clearance activities always conducted prior to initiation of intrusive activities (yes/no)?
Yes
2. If the answer was "yes" to question number one, Do the project-specific documents (including Work Plans, Field Sampling Plans, or Site Safety and Health Plans) require that underground utility clearance activities be performed prior to initiation of intrusive activities (yes/no)?
Yes
3. If the answer was "no" to question number one. **NA**
 - a. In those instances where underground utility clearance activities were not performed prior to conducting intrusive activities, why were underground utility clearance activities not performed?
 - b. In your opinion, was the decision or reason for not to perform the underground utility clearance activities justified (yes/no)?
 - c. Did the decision not to perform the underground utility clearance activities place Company XYZ at an increased risk of striking an underground utility line (yes/no)?
 - d. Where intrusive activities were performed, what is the frequency in which underground utility clearance activities not performed on Company XYZ projects?
4. If the answer was "yes" to question number one and "no" to question number two, What specific utility clearance activities are typically performed on projects requiring intrusive activities? **NA**
5. If the answer was "yes" to question number one and "yes" to question number two,
 - a. What specific utility clearance activities are required when performing intrusive activities for each project?

Most States have a one-call system which is notified of the pending work and its location. The call and response are documented.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Survey: March 27, 2007

Subject Number: 4

- b. Are these activities and procedures *clearly* outlined in the project-specific documents (yes/no)?
No
- c. Is there a checklist or form that documents that the utility clearance activities were performed for a project (yes/no)?
No
- d. If the answer was "no" to question number 5c. Might a checklist or form that documents that the utility clearance activities were completed for a project be useful (yes/no)?
Yes
- 6. In your opinion, are underground utility clearance activities that are being performed at Company XYZ adequate in minimizing the risk of striking an underground utility line (yes/no)?
No
- 7. If the answer was "no" to question number six. What additional utility clearance activities would you recommend adding to a UUDPP?
Besides relying on utility company markings a separate check of the area should be performed. To determine if there might be forgotten or undocumented lines present.
- 8. Have you ever managed or worked on a project at Company XYZ where:
 - a. Underground utility lines were unintentionally damaged (yes/no)?
No
 - i. Were underground utility clearance activities performed prior to the incident (yes/no)?
 - ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?
 - b. Had a near miss (yes/no)?
No
 - i. Were underground utility clearance activities performed prior to the incident (yes/no)?
 - ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?

A copy of the completed survey is included in Appendix C, and the results are summarized in Table 3 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Survey: April 6, 2008

Subject Number: 5

Survey: Development of an Underground Utility Damage Prevention Plan (UDDPP) for Company XYZ

Survey Administered by Researcher: Lance J. Dockter of Company XYZ

Method: One-on-one telephone interview with subject employee. The survey questions consisted of a combination of closed and open ended questions. Closed ended questions received "yes" or "no" responses, while open ended questions provided free-form verbal responses. A total of eight questions (some in multiple parts) were developed for the survey:

1. When managing projects that require intrusive activities (e.g. excavating, drilling, etc.) or performing field tasks involving intrusive activities, are underground utility clearance activities always conducted prior to initiation of intrusive activities (yes/no)?
Yes
2. If the answer was "yes" to question number one. Do the project-specific documents (including Work Plans, Field Sampling Plans, or Site Safety and Health Plans) require that underground utility clearance activities be performed prior to initiation of intrusive activities (yes/no)?
Yes
3. If the answer was "no" to question number one. **NA**
 - a. In those instances where underground utility clearance activities were not performed prior to conducting intrusive activities, why were underground utility clearance activities not performed?
 - b. In your opinion, was the decision or reason for not to perform the underground utility clearance activities justified (yes/no)?
 - c. Did the decision not to perform the underground utility clearance activities place Company XYZ at an increased risk of striking an underground utility line (yes/no)?
 - d. Where intrusive activities were performed, what is the frequency in which underground utility clearance activities not performed on Company XYZ projects?
4. If the answer was "yes" to question number one and "no" to question number two. What specific utility clearance activities are typically performed on projects requiring intrusive activities? **NA**
5. If the answer was "yes" to question number one and "yes" to question number two.
 - a. What specific utility clearance activities are required when performing intrusive activities for each project?

Required to utilize the "Call Before You Dig" system. Private utility locating service may also be required.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

- b. Are these activities and procedures *clearly* outlined in the project-specific documents (yes/no)?

Yes

- c. Is there a checklist or form that documents that the utility clearance activities were performed for a project (yes/no)?

Yes

- d. If the answer was "no" to question number 5c. Might a checklist or form that documents that the utility clearance activities were completed for a project be useful (yes/no)? **NA**

6. In your opinion, are underground utility clearance activities that are being performed at Company XYZ adequate in minimizing the risk of striking an underground utility line (yes/no)?

Yes

7. If the answer was "no" to question number six. What additional utility clearance activities would you recommend adding to a UUDPP? **NA**

8. Have you ever managed or worked on a project at Company XYZ where:

- a. Underground utility lines were unintentionally damaged (yes/no)?

No

- i. Were underground utility clearance activities performed prior to the incident (yes/no)?
- ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?

- b. Had a near miss (yes/no)?

No

- i. Were underground utility clearance activities performed prior to the incident (yes/no)?
- ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?

A copy of the completed survey is included in Appendix C, and the results are summarized in Table 3 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Survey: March 26, 2007

Subject Number: 6

Survey: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ

Survey Administered by Researcher: Lance J. Dockter of Company XYZ

Method: One-on-one telephone interview with subject employee. The survey questions consisted of a combination of closed and open ended questions. Closed ended questions received "yes" or "no" responses, while open ended questions provided free-form verbal responses. A total of eight questions (some in multiple parts) were developed for the survey:

1. When managing projects that require intrusive activities (e.g. excavating, drilling, etc.) or performing field tasks involving intrusive activities, are underground utility clearance activities always conducted prior to initiation of intrusive activities (yes/no)?

Yes

2. If the answer was "yes" to question number one, Do the project-specific documents (including Work Plans, Field Sampling Plans, or Site Safety and Health Plans) require that underground utility clearance activities be performed prior to initiation of intrusive activities (yes/no)?

Yes. In general.

3. If the answer was "no" to question number one. **NA**
 - a. In those instances where underground utility clearance activities were not performed prior to conducting intrusive activities, why were underground utility clearance activities not performed?
 - b. In your opinion, was the decision or reason for not to perform the underground utility clearance activities justified (yes/no)?
 - c. Did the decision not to perform the underground utility clearance activities place Company XYZ at an increased risk of striking an underground utility line (yes/no)?
 - d. Where intrusive activities were performed, what is the frequency in which underground utility clearance activities not performed on Company XYZ projects?
4. If the answer was "yes" to question number one and "no" to question number two, What specific utility clearance activities are typically performed on projects requiring intrusive activities?

NA

5. If the answer was "yes" to question number one and "yes" to question number two.
 - a. What specific utility clearance activities are required when performing intrusive activities for each project?

Everything – electrical, cable, gas, phone, etc. When working on a federal facility, it needs to be signed off by public works.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Survey: March 26, 2007

Subject Number: 6

- b. Are these activities and procedures *clearly* outlined in the project-specific documents (yes/no)?

Not necessarily. Usually it states utility clearance will be had and then it is the responsibility of whomever to take the necessary steps.

- c. Is there a checklist or form that documents that the utility clearance activities were performed for a project (yes/no)?

Believes so – it's usually required for a federal facility to sign off on digging (Excavation Permit) and kept at the site in case anybody asks

- d. If the answer was "no" to question number 5c. Might a checklist or form that documents that the utility clearance activities were completed for a project be useful (yes/no)? **NA**

6. In your opinion, are underground utility clearance activities that are being performed at Company XYZ adequate in minimizing the risk of striking an underground utility line (yes/no)?

Yes

7. If the answer was "no" to question number six. What additional utility clearance activities would you recommend adding to a UUDPP?

NA

8. Have you ever managed or worked on a project at Company XYZ where:

- a. Underground utility lines were unintentionally damaged (yes/no)?

No

- i. Were underground utility clearance activities performed prior to the incident (yes/no)?
- ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?

- b. Had a near miss (yes/no)?

No

- i. Were underground utility clearance activities performed prior to the incident (yes/no)?
- ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?

A copy of the completed survey is included in Appendix C, and the results are summarized in Table 3 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Survey: April 2, 2008

Subject Number: 7

Survey: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ

Survey Administered by Researcher: Lance J. Dockter of Company XYZ

Method: One-on-one telephone interview with subject employee. The survey questions consisted of a combination of closed and open ended questions. Closed ended questions received "yes" or "no" responses, while open ended questions provided free-form verbal responses. A total of eight questions (some in multiple parts) were developed for the survey:

1. When managing projects that require intrusive activities (e.g. excavating, drilling, etc.) or performing field tasks involving intrusive activities, are underground utility clearance activities always conducted prior to initiation of intrusive activities (yes/no)?

Yes

2. If the answer was "yes" to question number one. Do the project-specific documents (including Work Plans, Field Sampling Plans, or Site Safety and Health Plans) require that underground utility clearance activities be performed prior to initiation of intrusive activities (yes/no)?

Yes

3. If the answer was "no" to question number one. **NA**

- a. In those instances where underground utility clearance activities were not performed prior to conducting intrusive activities, why were underground utility clearance activities not performed?
- b. In your opinion, was the decision or reason for not to perform the underground utility clearance activities justified (yes/no)?
- c. Did the decision not to perform the underground utility clearance activities place Company XYZ at an increased risk of striking an underground utility line (yes/no)?
- d. Where intrusive activities were performed, what is the frequency in which underground utility clearance activities not performed on Company XYZ projects?

4. If the answer was "yes" to question number one and "no" to question number two. What specific utility clearance activities are typically performed on projects requiring intrusive activities? **NA**

5. If the answer was "yes" to question number one and "yes" to question number two.

- a. What specific utility clearance activities are required when performing intrusive activities for each project?

Must notify local utilities companies and have them come out and mark the utilities before any intrusive activities.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

- b. Are these activities and procedures *clearly* outlined in the project-specific documents (yes/no)?

Yes

- c. Is there a checklist or form that documents that the utility clearance activities were performed for a project (yes/no)?

No

- d. If the answer was "no" to question number 5c. Might a checklist or form that documents that the utility clearance activities were completed for a project be useful (yes/no)?

Yes

6. In your opinion, are underground utility clearance activities that are being performed at Company XYZ adequate in minimizing the risk of striking an underground utility line (yes/no)?

Yes

7. If the answer was "no" to question number six. What additional utility clearance activities would you recommend adding to a UUDPP? **NA**

8. Have you ever managed or worked on a project at Company XYZ where:

- a. Underground utility lines were unintentionally damaged (yes/no)?

No

- i. Were underground utility clearance activities performed prior to the incident (yes/no)?
- ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?

- b. Had a near miss (yes/no)?

No

- i. Were underground utility clearance activities performed prior to the incident (yes/no)?
- ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?

A copy of the completed survey is included in Appendix C, and the results are summarized in Table 3 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Survey: April 7, 2008

Subject Number: 8

Survey: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ

Survey Administered by Researcher: Lance J. Dockter of Company XYZ

Method: One-on-one telephone interview with subject employee. The survey questions consisted of a combination of closed and open ended questions. Closed ended questions received "yes" or "no" responses, while open ended questions provided free-form verbal responses. A total of eight questions (some in multiple parts) were developed for the survey:

1. When managing projects that require intrusive activities (e.g. excavating, drilling, etc.) or performing field tasks involving intrusive activities, are underground utility clearance activities always conducted prior to initiation of intrusive activities (yes/no)?
Yes
2. If the answer was "yes" to question number one. Do the project-specific documents (including Work Plans, Field Sampling Plans, or Site Safety and Health Plans) require that underground utility clearance activities be performed prior to initiation of intrusive activities (yes/no)?
Yes
3. If the answer was "no" to question number one. **NA**
 - a. In those instances where underground utility clearance activities were not performed prior to conducting intrusive activities, why were underground utility clearance activities not performed?
 - b. In your opinion, was the decision or reason for not to perform the underground utility clearance activities justified (yes/no)?
 - c. Did the decision not to perform the underground utility clearance activities place Company XYZ at an increased risk of striking an underground utility line (yes/no)?
 - d. Where intrusive activities were performed, what is the frequency in which underground utility clearance activities not performed on Company XYZ projects?
4. If the answer was "yes" to question number one and "no" to question number two. What specific utility clearance activities are typically performed on projects requiring intrusive activities? **NA**
5. If the answer was "yes" to question number one and "yes" to question number two.
 - a. What specific utility clearance activities are required when performing intrusive activities for each project?

Contact Miss Utility (State One Call) and sometimes hire a private utility locator.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

- b. Are these activities and procedures *clearly* outlined in the project-specific documents (yes/no)?

Yes

- c. Is there a checklist or form that documents that the utility clearance activities were performed for a project (yes/no)?

Yes

- d. If the answer was "no" to question number 5c. Might a checklist or form that documents that the utility clearance activities were completed for a project be useful (yes/no)? **NA**

6. In your opinion, are underground utility clearance activities that are being performed at Company XYZ adequate in minimizing the risk of striking an underground utility line (yes/no)?

Yes

7. If the answer was "no" to question number six. What additional utility clearance activities would you recommend adding to a UUDPP? **NA**

8. Have you ever managed or worked on a project at Company XYZ where:

- a. Underground utility lines were unintentionally damaged (yes/no)?

No

- i. Were underground utility clearance activities performed prior to the incident (yes/no)?
- ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?

- b. Had a near miss (yes/no)?

No

- i. Were underground utility clearance activities performed prior to the incident (yes/no)?
- ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?

A copy of the completed survey is included in Appendix C, and the results are summarized in Table 3 of Chapter 4.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Survey: March 27, 2007

Subject Number: 9

Survey: Development of an Underground Utility Damage Prevention Plan (UUDPP) for Company XYZ

Survey Administered by Researcher: Lance J. Dockter of Company XYZ

Method: One-on-one telephone interview with subject employee. The survey questions consisted of a combination of closed and open ended questions. Closed ended questions received "yes" or "no" responses, while open ended questions provided free-form verbal responses. A total of eight questions (some in multiple parts) were developed for the survey:

1. When managing projects that require intrusive activities (e.g. excavating, drilling, etc.) or performing field tasks involving intrusive activities, are underground utility clearance activities always conducted prior to initiation of intrusive activities (yes/no)?

Yes

2. If the answer was "yes" to question number one. Do the project-specific documents (including Work Plans, Field Sampling Plans, or Site Safety and Health Plans) require that underground utility clearance activities be performed prior to initiation of intrusive activities (yes/no)?

Yes.

3. If the answer was "no" to question number one. **NA**

- a. In those instances where underground utility clearance activities were not performed prior to conducting intrusive activities, why were underground utility clearance activities not performed?
- b. In your opinion, was the decision or reason for not to perform the underground utility clearance activities justified (yes/no)?
- c. Did the decision not to perform the underground utility clearance activities place Company XYZ at an increased risk of striking an underground utility line (yes/no)?
- d. Where intrusive activities were performed, what is the frequency in which underground utility clearance activities not performed on Company XYZ projects?

4. If the answer was "yes" to question number one and "no" to question number two. What specific utility clearance activities are typically performed on projects requiring intrusive activities?

NA

5. If the answer was "yes" to question number one and "yes" to question number two.

- a. What specific utility clearance activities are required when performing intrusive activities for each project?

Contact utility companies, review drawings, use of detection equipment.

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Date of Survey: March 27, 2007

Subject Number: 9

- b. Are these activities and procedures *clearly* outlined in the project-specific documents (yes/no)?

Yes

- c. Is there a checklist or form that documents that the utility clearance activities were performed for a project (yes/no)?

Yes – client location has a checklist or form (Excavation permit).

- d. If the answer was “no” to question number 5c. Might a checklist or form that documents that the utility clearance activities were completed for a project be useful (yes/no)? **NA**

6. In your opinion, are underground utility clearance activities that are being performed at Company XYZ adequate in minimizing the risk of striking an underground utility line (yes/no)?

Yes

7. If the answer was “no” to question number six. What additional utility clearance activities would you recommend adding to a UUDPP?

NA

8. Have you ever managed or worked on a project at Company XYZ where:

- a. Underground utility lines were unintentionally damaged (yes/no)?

No

- i. Were underground utility clearance activities performed prior to the incident (yes/no)?
- ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?

- b. Had a near miss (yes/no)?

No

- i. Were underground utility clearance activities performed prior to the incident (yes/no)?
- ii. If so, was the incident a result of inadequate underground utility clearance procedures (yes/no)?

A copy of the completed survey is included in Appendix C, and the results are summarized in Table 3 of Chapter 4.

Appendix E: Intrusive Activities Commonly Performed by Company XYZ

Table E.1: Summary of Intrusive Activities Commonly Performed by Company XYZ

| Activity | Potential Hazards | Recommended Controls |
|--|--|--|
| Stage of Cleanup: Assessment/Investigative Activities Commonly Performed by Company XYZ | | |
| Clearing and Grubbing of Work Site | Contact underground utilities with mechanical clearing equipment. | Utility clearance must be performed before clearing or grubbing begins. |
| Soil Sampling (using either Direct Push Rig or Standard Penetration Test (SPT) Method) | Contact underground utilities with downhole equipment associated with drilling or direct push rig. | Utility clearance must be performed before drilling or direct push activities begins. |
| Monitoring Well Installation (using either Direct Push Rig or Standard Penetration Test (SPT) Method) | Contact underground utilities with downhole equipment associated with drilling or direct push rig. | Utility clearance must be performed before drilling or direct push activities begins. |
| Test Pits | Contact underground utilities with mechanical earth moving equipment. | Utility clearance must be performed before excavation of test pits begins. |
| Exploratory Trenching | Contact underground utilities with mechanical earth moving equipment. | Utility clearance must be performed before excavation of trench begins. |
| Collection of Concrete Core Samples | Contact underground utilities located below (or within) concrete with concrete core machine. | Utility clearance must be performed before concrete coring begins. |
| Stage of Cleanup: Common Remediation Activities Commonly Performed by Company XYZ | | |
| Excavation of Contaminated Soil | Contact underground utilities with mechanical earth moving equipment. | Utility clearance must be performed before excavation of soils begins. |
| Install Remediation System Unit | Contact underground utilities with mechanical earth moving equipment. | Utility clearance must be performed before excavation of soils begins. |
| Remediation Well Installation (using either Direct Push Rig or Standard Penetration Test (SPT) Method) | Contact underground utilities with downhole equipment associated with drilling or direct push rig. | Utility clearance must be performed before drilling or direct push activities begins. |
| Installation of Well Vaults | Contact underground utilities with mechanical earth moving equipment. | Utility clearance must be performed before excavation begins. |
| Installation of Remediation Pipeline Trench | Contact underground utilities with mechanical earth moving equipment. | Utility clearance must be performed before excavation begins. |
| Landfill Gas Migration Control System Trench | Contact underground utilities with mechanical earth moving equipment. | Utility clearance must be performed before excavation begins. |
| Saw Cut Concrete | Contact underground utilities located below (or within) concrete with concrete saw. | Utility clearance must be performed before saw cutting begins. |
| Demo-Hammer and Load-Out of Concrete | Contact underground utilities with mechanical hammer and earth moving equipment. | Utility clearance must be performed before concrete breaking and removal of concrete begins. |
| Excavation and Removal of Sewer Lines | Contact underground utilities with mechanical earth moving equipment. | Utility clearance must be performed before excavation of soils begins. |

Appendix F: Best Practices for Inclusion in company XYZ's UUDPP

Table F.1: Best Practices for Inclusion in Company XYZ's UUDPP

| Best Practice | Practice Description |
|---|---|
| Pre-Planning and Site Investigative Activities | |
| Preparation of Project Plans | <p>Project plan documents should include safety provisions for the prevention of damage to underground utilities.</p> <ul style="list-style-type: none"> Planning documents and drawings should include the actual locations of all existing, abandoned, and out-of-service utilities. |
| Drawings and Records Review | <p>Review all reasonably attainable drawings and records pertaining to the project area. Drawings, plans, and records may include, but not limited to:</p> <ul style="list-style-type: none"> Civil/utility drawings Historic site information (maps, photos, files) Site as-built drawings Plats, which include utility easements Historic plot plans Previous site investigations Fire insurance plans Proposed utility plans Elevations and coordinates maps |
| One Call Notification | <p>One Call Notification in the Planning Phase (see below, "Effective Use of One Call System" for practice description)</p> |
| Site Investigative Activities | <p>Walk around of the site to:</p> <ul style="list-style-type: none"> Identify area(s) proposed for intrusive activities Identify aboveground indicators of underground utilities. Identify potential critical areas for the project. |
| Effective Use of One Call System | |
| Locate Request | <ul style="list-style-type: none"> Contractor requests the location of underground utilities at the site by notifying the utility owner/operator through the One Call Center (available 24 hours per day, 7 days per week). As of May 1, 2007, by dialing "811", the caller is automatically connected to the nearest local One Call Center. Required to notify the One Call Center at least two to 10 working days (depending on the state) prior to intrusive activities. Prior to working in a particular state, the state's One Call Statutes should be reviewed. |
| Process of Notification | <p>At a minimum, the caller provides the following information to the State One Call Center operator:</p> <ul style="list-style-type: none"> Caller's name and phone number; Company's name, address and phone numbers; Where is the work being conducted; Start date and time of the excavation; and |

| | |
|--|--|
| | <ul style="list-style-type: none"> • Description of the activity. <p>More detailed information (e.g. Latitude/Longitude, highway mile markers, subdivision and lot number, etc.) may be required. Prior to working in a particular state, the state's One Call Statutes should be reviewed to identify necessary required information.</p> |
| Reference Ticket Number | Caller is issued a reference ticket number from the One Call Center which verifies that the contractor has notified the underground facility operators. |
| Reference Ticket Number Update | In most states, the locate ticket number is only active in the range of 10 to 30 calendar days. If the project extends beyond the active period for that particular state, must contact the One Call Center to extend the active period <u>before</u> it expires. |
| Log Utility Owner/Operators | When the contractor makes the request to the One Call Center, log which utility owners/operators are to be notified so you can identify which utility owners/operators have responded by marking and which ones have cleared the area. |
| Accurately Locating and Marking Utilities | |
| Private Utility Locator | Privately-owned utilities (and some public utilities) are not typically located under the National One Call notification. These private utilities are underground lines or pipes that were not installed by the utility company and are those that were installed beyond the utility meter (e.g. electric lines for parking lot lights, lawn sprinkler piping, communication lines for satellite dishes, and in service lines from propane tank). For this reason, when working on private property it is often necessary to hire a private utility locator. |
| Properly Trained Locators | It is recommended that persons locating utilities at the worksite belong to companies that are National Utility Locator Contractor Association (NULCA) members. The NULCA developed the locating industry's first locating and training standards and procedures. |
| Markings | Markings typically consist of spray paint, flags, chalk, or stakes. Once a marking system is in place, it needs to be maintained through the life of the project. The preservation of the utility marks is the responsibility of the contractor. When the marks are faded or destroyed, the contractor must re-notify the One Call Center. |
| White Lining | When the proposed locations/areas for borings, excavations, or other intrusive activities cannot be clearly and adequately identified on the locate ticket, these locations/areas should be marked in white by the contractor prior to notifying the One Call and the arrival of the locator. |
| Safety/Tolerance Zones | A safety/tolerance zone indicates the distance (usually in inches) on either side of the marking in which the contractor must assume the presence of a utility line. These safety zones typically range from 18 to 30 inches. |
| Determining Exact Location of Utility Line | <p>Some states require that the contractor must determine the exact location of a utility line (both horizontally and vertically), prior to using mechanical equipment. In-field clearance methodologies are used to physically uncover an underground utility location and are the surest method of determining the exact location of utilities. In field clearance methodologies can be broken down into two categories:</p> <ol style="list-style-type: none"> 1. Direct Contact: Typically involves proper hand-digging tools (e.g. hand augers, post-hole diggers, steel rods) and digging techniques as to not damage the utility line. 2. Avoid Direct Contact: Includes vacuum excavating (a.k.a. potholing or "soft" excavating), air knifing, and water jetting. |

| | |
|---|---|
| Mismarked Utility Lines | In the event that a mismarked utility line is discovered, many states require that the One Call Center be re-notified. |
| Proper Excavation Practices | |
| Pre-Excavation Meeting | An on-site pre-excavation meeting between the contractor, the utility owners/operators, and locators (where applicable) is recommended on large projects or that are located near critical or high priority facilities (e.g. high-pressure gas, high voltage electric, fiber optic communication, and major pipe or water lines). |
| Utility Owner/Operator Failure to Respond | A contractor may not proceed with intrusive activities until every utility owner/operator has marked their utility lines, regardless of how many notifications have been given. However, at the end of two working days, unless otherwise specified in state/provincial law, the contractor may proceed if due care is exercised. |
| Documentation of Marks | Use of dated pictures, videos, or sketches with distance from markings to fixed objects should be used to document the actual placement of markings. |
| Work site Review | Prior to starting work, the contractor should review the location of underground utilities with personnel. |
| Reference Ticket Number at Site | Personnel at the job site should have the reference ticket number. |
| Contact Names and Numbers | Names and phone numbers of all utility owner/operators contacts should be maintained on-site. |
| Facility Avoidance | Use reasonable care to avoid damaging underground utility lines. |
| Excavation Observer | A excavation observer should be used to assist the equipment operator when operating mechanical equipment around known underground utilities. |
| Exposed Facility Protection | Support and protect exposed underground utilities from damage. |
| Backfilling | Protect all utilities from damage when backfilling an excavation. |

Appendix G: Underground Utility Clearance Form/Checklist

**Underground Utility Clearance Form/Checklist**

PROJECT NAME: _____

PROJECT #: _____

PROJECT LOCATION: _____

DESCRIPTION OF PLANNED ACTIVITY: _____

PROPOSED START DATE: _____

ESTIMATED COMPLETION DATE: _____

- 1.
- ☐
- REVIEWED PLANNING DOCUMENTS (e.g. excavation and/or boring details, locations, etc.)

Did the planning documents and drawings should include the actual locations of all existing, abandoned, and out-of-service utilities? ☐ Yes ☐ No (Check One)

DESCRIPTION OF PLANNED ACTIVITY: _____

PROPOSED START DATE: _____

ESTIMATED COMPLETION DATE: _____

- 2.
- ☐
- REVIEWED ALL AVAILABLE DRAWINGS AND RECORDS FOR LOCATIONS OF ALL EXISTING, ABANDONED, AND OUT-OF-SERVICE UTILITIES

Name, Type, and Date of Documents and Drawings Obtained/Reviewed (retain copies for the project file):

- _____
- _____
- _____
- _____

- 3.
- ☐
- PROPOSED EXCAVATION AREA OR BORING LOCATIONS MARKED ("white lining") (should be performed when the proposed locations/areas for borings, excavations, or other intrusive activities cannot be clearly and adequately identified during the One Call Notification).

- 4.
- ☐
- ONE-CALL NOTIFICATION (dial "811" - the caller is connected to the nearest local One Call Center, a list of State One Call Centers is also attached)

DATE AND TIME OF CALL: _____

REFERENCE TICKET NUMBER: _____

DATE REFERENCE TICKET NUMBER EXPIRES: _____

Update of Reference Ticket Number Anticipated? ☐ Yes ☐ No (Check One)

LIST OF UTILITY OWNER/OPERATORS TO BE NOTIFIED:

| <u>Name of Owner/Operator</u> | <u>Date/Time of Response</u> | <u>Utilities Clear</u> | <u>Utilities Marked</u> |
|-------------------------------|------------------------------|--------------------------|--------------------------|
| • _____ | _____ | ☐ | ☐ |
| • _____ | _____ | ☐ | ☐ |
| • _____ | _____ | ☐ | ☐ |
| • _____ | _____ | ☐ | ☐ |
| • _____ | _____ | ☐ | ☐ |

Note: Required to notify the One Call Center at least two to 10 working days (depending on the state) prior to beginning intrusive activities.

DATE(S) UTILITIES MARKED: _____

5. ☐ LIST OF NON-MEMBER UTILITIES:

| <u>Name of Owner/Operator</u> | <u>Date/Time Contacted</u> | <u>Utilities Clear</u> | <u>Utilities Marked</u> |
|-------------------------------|----------------------------|--------------------------|--------------------------|
| • _____ | _____ | ☐ | ☐ |
| • _____ | _____ | ☐ | ☐ |
| • _____ | _____ | ☐ | ☐ |
| • _____ | _____ | ☐ | ☐ |
| • _____ | _____ | ☐ | ☐ |

Note: Privately-owned utilities (and some public utilities) are not typically located under the One Call Notification. The contractor needs to contact these Non-Member Utilities.

DATE(S) UTILITIES MARKED: _____

6. ☐ PRIVATE UTILITY LOCATOR

Contact Information for Private Utility Locator: _____

DATE(S) UTILITIES MARKED: _____

Note: Private utilities located beyond the utility meter (e.g. electric lines for parking lot lights, lawn sprinkler piping, communication lines for satellite dishes, and in service lines from propane tank) are not marked under the One Call Notification. For this reason, when working on private property it is often necessary to hire a private utility locator.

7. ☐ PRE-EXCAVATION MEETING (an on-site pre-excitation meeting between the contractor, the utility owners/operators, and locators (where applicable) is recommended on large projects or that are located near critical or high priority facilities).

8. ☐ SITE INVESTIGATION ACTIVITIES

A walk around of the site to identify aboveground indicators of underground utilities (e.g. permanent signs or markers, manhole covers, valve boxes, vent pipes, pad mounted devices, riser poles, power and communication pedestals, valve covers) should be performed.

Date/Time of Walk Around: _____

Were there any indicators of underground utilities that were not marked? ☐ Yes ☐ No (Check One)

If yes, specify: _____

Follow-Up Action (e.g. contacted Utility Owner/Operator, re-notified One Call Center): _____

9. ☐ UTILITIES IDENTIFIED ON-SITE:

☐ NONE ☐ ELECTRIC ☐ GAS ☐ WATER ☐ TELEPHONE ☐ CATV ☐ SEWER

☐ OTHER _____

10. ☐ DOCUMENTATION OF MARKINGS (use of pictures, videos, or sketches)

11. ☐ LEVEL OF RISK: (Based upon incurring substantial loss of, or causing damage to, life, health, property, the environment, or essential public services.)

Specify Safety/Tolerance Zone for Project: _____ Inches

☐ SEVERE: Intrusive Activity required within the Safety/Tolerance Zone of a MARKED utility.

☐ MODERATE: Intrusive Activity required outside the Safety/Tolerance Zone of a MARKED utility.

☐ MINIMAL: Intrusive Activity required in an area with NO utilities.

Note: A safety/tolerance zone indicates the distance (usually 18 to 30 inches) on either side of the marking in which the contractor must assume the presence of a utility line (refer to the State One Call Center Statutes for the specified distance).

12. ☐ EXISTING FACILITIES IN VICINITY:

13.

☐ NON-CRITICAL

☐ CRITICAL

☐ HIGH-PRIORITY

☐ OTHER _____

Note: High Priority or Critical Facilities may include: high-pressure gas, high voltage electric, fiber optic communication, and major pipe or water lines.

14. ☐ ENGINEERING CONTROLS REQUIRED:

☐ NONE

☐ HAND EXCAVATE OR "SOFT DIG" TO LOCATE UTILITY

☐ EXCAVATE WITH DUE CARE

☐ EXPOSED UTILITY PROTECTION

☐ OTHER _____

Specify/Document Action(s): _____

15. ☐ ADMINISTRATIVE CONTROLS REQUIRED:

☐ NONE

☐ Notification of Utility Owner/Operator Representative REQUIRED

☐ Utility Owner/Operator Representative REQUIRED on site during excavation.

16. ☐ EMERGENCY CONTACT INFORMATION

- _____
- _____
- _____
- _____

National One Call Directory

Directory by State

• ALABAMA

Alabama One Call (800) 292-8525

• ALASKA

Locate Call Center of Alaska, Inc. (800) 478-3121

• ARIZONA

Arizona Blue Stake, Inc. (800) 782-5348

• ARKANSAS

Arkansas One Call System, Inc. (800) 482-8998

• CALIFORNIA

Underground Service Alert North (800) 227-2600

Underground Service Alert South (800) 227-2600 or (800) 422-4133

• COLORADO

Utility Notification Center of Colorado (800) 922-1987 or (800) 833-9417

• CONNECTICUT

Call Before You Dig (800) 922-4455

• DELAWARE

Miss Utility of Delmarva (800) 282-8555

• FLORIDA

Sunshine State One Call of Florida, Inc. (800) 432-4770

• GEORGIA

Utilities Protection Center, Inc. (800) 282-7411

• HAWAII

Underground Service Alert North (800) 227-2600

• IDAHO

Dig Line (800) 342-1585 or (208) 342-1585

Palouse Empire Underground Coordinating Council (800) 822-1974

Pass Word (800) 428-4950

Utilities Underground Location Center (800) 424-5555

One Call Concepts - Idaho (800) 626-4950 or (800) 822-1974

Shoshone County One Call (800) 398-3285

• ILLINOIS

Julie, Inc. (800) 892-0123

Chicago: Digger (312) 744-7000

• INDIANA

Indiana Underground Plant Protection Service, Inc. (800) 382-5544

• IOWA

Iowa Underground Plant Location Service, Inc. (800) 292-8989

• KANSAS

Kansas One Call Center (800) DIG-SAFE

• KENTUCKY

Kentucky Underground Protection, Inc. (800) 752-6007

• LOUISIANA

Louisiana One Call System, Inc. (800) 272-3020

• MAINE

Dig Safe System, Inc. (888) 344-7233

• MARYLAND

Miss Utility of Delmarva (800) 282-8555

Miss Utility (800) 257-7777

MASSACHUSETTS

Dig Safe System, Inc. (888) 344-7233

• MICHIGAN

Miss Dig System, Inc. (800) 482-7171

• MINNESOTA

Gopher State One Call (800) 252-1166

• MISSISSIPPI

Mississippi One Call System, Inc. (800) 227-6477

• MISSOURI

Missouri One Call System, Inc. (800) 344-7483

• MONTANA

Utilities Underground Location Center (800) 424-5555 or (800) 551-8344

Montana One Call (800) 551-8344

• NEBRASKA

Diggers Hotline of Nebraska (800) 331-5666

• NEVADA

Underground Service Alert North (800) 227-2600

• NEW HAMPSHIRE

Dig Safe System, Inc. (888) 344-7233

• NEW JERSEY

New Jersey One Call (800) 272-1000

• NEW MEXICO

New Mexico One Call System, Inc. (800) 321-ALERT
Las Cruces-Dona Ana Utility Council (888) 526-0400

• NEW YORK

Underground Facility Protection Organization (800) 962-7962
New York City - Long Island One Call Center (800) 272-4480

• NORTH CAROLINA

North Carolina One-Call Center (800) 632-4949

• NORTH DAKOTA

North Dakota One Call (800) 795-0555

• OHIO

Ohio Utilities Protection Service (800) 362-2764
Oil and Gas Producers Underground Protection Service (800) 925-0988

• OKLAHOMA

Call Okie (800) 522-6543 or (800) 654-8249

• OREGON

Oregon Utility Notification Center (800) 332-2344

• PENNSYLVANIA

Pennsylvania One Call System, Inc. (800) 242-1776

• PUERTO RICO

Puerto Rico Excavation & Demolition Coordination Center
Public Service Commission (GOVERNMENT AGENCY) 787-764-4900
Puerto Rico Telephone Excavation Center 787-792-7478

• RHODE ISLAND

Dig Safe System, Inc. (888) 344-7233

SOUTH CAROLINA

Palmetto Utility Protection Service (800) 922-0983

• SOUTH DAKOTA

South Dakota One Call (800) 781-7474

• TENNESSEE

Tennessee One Call System (800) 351-1111

• TEXAS

Lone Star Notification Center (800) 669-8344
Texas Excavation Safety System (800) 344-8377
Texas One Call System (800) 245-4545 00

• UTAH

Blue Stakes Location Center (800) 662-4111 00

• VERMONT

Dig Safe System, Inc (888) 344-7233

• VIRGINIA

Miss Utility of Virginia (800) 552-7001

• WASHINGTON

Washington Call Before You Dig (800) 424-5555

• WASHINGTON, DISTRICT OF COLUMBIA

Miss Utility (800) 257-7777

• WEST VIRGINIA

Miss Utility of West Virginia (800) 245-4848

• WISCONSIN

Diggers Hotline (800) 242-8511

• WYOMING

Wyoming One-Call (800) 348-1030

Call Before You Dig of Wyoming (800) 849-2476

Utilities Underground Location Center (800) 454-5555

• CANADA

Alberta: Alberta One-Call Location Corporation (800) 242-3447

British Columbia: BC One Call (800) 474-6886

Ontario: Ontario One Call Ltd. (800) 400-2255

Quebec: Info-Excavation (800) 663-9228