هيئة كفاءة الإنفاق والمشروعات الحكومية
Expenditure Efficiency & Projects Authority

# EXPRO National Manual for Projects Management

## Volume 11 ,Chapter 2

# Project Utility Clearance Procedure

Document No. EPM-KSS-PR-000026 Rev 003

## Document Submittal History:

| Revision: | Date: | Reason For Issue |
|---|---|---|
| 000 | 21/09/2017 | For Use |
| 001 | 03/12/2017 | For Use |
| 002 | 02/12/2018 | For Use |
| 003 | 09/08/2021 | For Use |

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## 1.0 PURPOSE

Underground and overhead utilities can contain hazardous energy that could pose a vital threat to workers, public, and the environment if an unintentional contact occurs. What one cannot see beneath the soil surface can cause significant damage to human health or loss of life, equipment, and the environment if an uncontrolled release takes place due to striking an underground utility.

The purpose of this specific procedure is to provide guidance that shall be implemented to eliminate the potential and mitigate hazards of unintentional contact with overhead and underground utilities within the site and public location. The procedure also provides steps necessary to obtain utility clearance before any personnel perform subsurface work. This procedure is not intended to take the place of or override the requirements that maybe applicable to any governing jurisdiction, municipality or other controlling authority.

## 2.0 SCOPE

The scope of this procedure applies to all works to be undertaken in the vicinity of underground or overhead utilities including breaking ground and working at height when work is performed under all Construction Contracts executed throughout the Kingdom of Saudi Arabia.

## 3.0 DEFINITIONS

| Definitions | Description |
|---|---|
| Conductive Testing | Geophysical method used to trace cables, water and gas distribution lines using audio frequency. |
| Danger Zones | Minimum Safe Approach Distances that must be maintained from overhead power lines and underground utility. No work should be undertaken without written permission or permit to work from utility provider. |
| Ground Penetrating Radar (GPR) | This is a tool for determining locations of buried underground utilities or embedded items inside concrete walls, such as rebar by non-invasive reflected energy means. Radar used to measure changes in the dielectric properties of subsurface materials. |
| Inductive Testing | Geophysical method used to trace cables, water and gas lines using radio frequency. |
| Locating | The exposure of a utility, so that measurements regarding its position and data regarding its character can be obtained. |
| Non-destructive Vacuum Extraction | The process of exposing underground utilities using high-pressure air or water to penetrate, expand, and break up the soil (also known as potholing). As the ground is loosened, it is removed by a high volume vacuum machine usually truck or trailer mounted. The removed soil is stored in a holding tank and can be used as backfill or hauled away for disposal. |
| OSHA | Occupational Safety and Health Administration |
| HSSE | Health Safety Security and Environment |
| JHA | Job Hazard Analysis |
| WMS | Work Method Statement |
| PPE | Personal Protective Equipment |
| RF | Radio Frequency |
| AF | Audio Frequency |

## 4.0 REFERENCES

- OSHA - 1926.651 (b) (1) (2) (3) (4) - Specific Excavation Requirements
- OSHA - 1926 Subpart V – Electrical Power Transmission and Distribution
- EPM-KSS-PR-000032 Project Excavation and Trenching Procedure
- EPM-KSS-PR-000001 Project General Safe Working Requirements Procedure

# 5.0 RESPONSIBILITIES

## 5.1 Site Manager

The Site Manager is responsible for ensuring that the requirements of this Procedure are properly implemented and to provide all necessary resources to implement this procedure.

## 5.2 HSSE Manager

The Project HSSE (Health Safety Security and Environment) Manager is responsible for the assessment of the Project's compliance with HSSE requirements.

## 5.3 Field Engineer

The Field Engineer is responsible for assignment of field engineering personnel required to provide technical support consistent with the requirements of this procedure. Field Engineering discipline is responsible for managing the overall excavation certificate process including updating of the as-built master file of the project.

## 5.4 Responsible Superintendent

The Responsible Superintendent has primary responsibility for verifying the technical compliance, approving methods and controls as well as coordinating and monitoring work. He ensures that utility avoidance activities are completed in accordance with project procedures and verifies the location of identified and marked utilities prior to start of excavation or boring activities.

# 6.0 RISK ASSESSMENTS

Before any Project/Work Activity/ commences it is important that Risk Assessments are completed prior to beginning any work.

Risk assessments must be conducted at the Planning Stage:

- Project Risk Assessment.
- Work Method Statements (WMS)
- Job Hazard Analysis (JHA).

It is imperative that prior to beginning of any work activity, a pre-start briefing occurs to discuss the contents of the WMS/JHA which includes mitigations of for other hazards noted by the crew at the jobsite. The discussion shall also include job steps, expected hazards associated with the activity, and the mitigation and protection methods that shall be implemented to prevent incidents.

The Hierarchy of hazards control shall be used to reduce the likelihood of an incident occurring.

- ***Elimination*** (Remove the Hazard)
- ***Substitution/Isolation*** (Replacing material, process or hazard with a lower risk one/ separate people from the hazard (such as through guarding, distance, etc.)
- ***Engineering Controls*** (Redesign or replacement of plant and equipment, Isolate People from the hazards)
- ***Administration Controls*** (Procedures, training, signage, change the way people work)
- ***PPE -*** Protect the Worker with PERSONAL PROTECTIVE EQUIPMENT

No work is to commence until the above has been implemented and signed by the relevant Supervisor in charge.

# 7.0 PROCESS

## 7.1 General Requirements

Underground and overhead utility strikes pose a serious threat to the safety of the workers and the public, and damage equipment. Utilization of all or some combination of the utility avoidance measures identified in this procedure is required to eliminate unintentional utility contacts.

The following are general requirements:

- Advance planning for work will include review of site locations to identify any overhead utility lines, pipe racks, or other potential hazards in the vicinity of the site or transport routes.
- Planning will also include review of site locations with the site/installation public works point of contact to identify areas potentially traversed by utilities (sewer, telephone, electrical, water, etc.) or other underground locations.
- The executing contractor representative should contact the project management, the client entity and/or outside utility agencies (where applicable) by obtaining and/or reviewing digging permits, walking down known areas of excavation, and assessing with ongoing inspections of the site excavation.
- The HSSE representative will assist in training excavation operators and other site personnel regarding underground utility safe digging work practices and working at height.

## 7.2 Selection of Avoidance Processes

- Personnel shall carry out a risk assessment of scope of work to determine whether workers may be exposed to above ground and underground utility hazards during excavation or any work to be performed near underground and/or electrical overhead network. Using this procedure, personnel shall identify the methods and requirements to be implemented and shall be documented on their work execution plan. The intent is to use a combination of cost-effective methods that will provide the highest level of assurance that all underground utilities have been identified.

Table 1 below, is an example that provides the limitations of certain detection methods, and to help personnel to select a method of detection that best suits the application.

### Table 1: Underground Utility Location Methods and Limitations

| Method | Type of material Locatable | Type of material Not Locatable | Effective Locating Depth | Depth Estimation | Soil or Backfill Effects | Discrimination Multiple material in Same Trench |
|---|---|---|---|---|---|---|
| Ground Penetrating Radar | Metallic, plastic, concrete | Effectiveness depends on size versus depth | Metal: 25 cm diameter for each foot depth; 15.cm Diameter for each foot over 3.6 m | Yes. Variable: depends on soil homogeneity | Yes. Wet sandy soils best; saturated clay soils limit depth penetration | Very good discrimination of multiple targets unless stacked |
| EM-61 Metal Detector | Metallic or pipes with metallic reinforcement | Nonmetallic | 76.2 cm diameter pipe at 1.9 m depth; up to 3.6 m for larger diameter pipes | Yes. Accuracy +15% under ideal conditions | None unless backfill contains metallic debris | Poor discrimination of multiple targets |
| Metrotech 810 Radio Frequency (83 kHz) Conductive and Inductive Tracing Radio Detection DL-400-2 (Audio Frequency 0.5 kHz, | Copper: excellent Aluminum: very good Steel: good Cast Iron: poor Conductive better than inductive | Nonconductive * | Inductive: 3.0 m under ideal conditions Conductive: 3.0m under ideal conditions Location depth affected by conductor and soil type | Yes. Accuracy + 10% under ideal conditions to depths of 90 cm | Yes. Moist compact soils best; poor tracing in dry sandy soils or alkaline high iron content soils | Good discrimination of multiple targets in conductive mode |

| Method | Type of material Locatable | Type of material Not Locatable | Effective Locating Depth | Depth Estimation | Soil or Backfill Effects | Discrimination Multiple material in Same Trench |
|---|---|---|---|---|---|---|
| 8 kHz, 33 kHz) Conductive and Inductive Tracing | | | | | | |
| Metrotech 50/60 Hz Locator | Underground power lines / E&I cables | Pipes without flowing electric current | 10mA current at 90 cm depth for 50%-meter deflection; 1.8 m maximum effective locating depth | None | Yes. Same as Metrotech 810 | Poor discrimination; affected by nearby conductors and most nearby metal structures |

## 7.3 Method and Requirements

### 7.3.1 On-Site Underground Utility Locations

Personnel shall be thoroughly familiar with the requirements of the Project Excavation and Trenching Procedure, EPM-KSS-PR-000032 in order to perform excavation work. A “Permit to Dig” process shall be used by personnel before commencing excavation activities. Mapping of encountered utilities shall be undertaken and to produce an as-built survey report of all underground utilities. The underground utility as-built master file will be kept and updated on a regular basis. All existing private, government and on-site buried power lines, pipes, telecommunications and other utilities shall be marked clearly and located by hand digging, pot-holing or any other non-mechanical means to expose the utilities prior to any equipment use.

### 7.3.2 Off-Site Utility Locations

All works where there is a potential for encountering any utility should be planned using a formal hazardous work permit system and risk assessment.

### 7.3.3 Utilities Identification Scheme and Techniques

#### 7.3.3.1 Geophysical Techniques

***Ground Penetrating Radar (GPR) with Valid Calibration Certificate***

GPR has been successful in locating underground metallic, plastic, and concrete pipes. This method works well for depths less than 2 m. The smaller the object the more difficult it is to identify. On average, 2.5cm diameter for each 30cm of depth is needed for effective locating. Best results are obtained in wet sandy soils, whereas saturated clay limits the penetration.

***Subsurface Utility Tracing***

Inducing a signal onto a subsurface utility and tracing the signal as it moves along or within the utility can map underground piping and utilities. This method works well for copper, aluminum, and steel pipes. The effective locating depth is 3.0 m with ideal (compact soil) soil conditions and is somewhat less deep for soils of dry sand, alkaline, or high iron content. Using this method to identify cast iron usually has poor results, and nonconductive pipes cannot be traced unless a steel tape can be fished through the pipe.

#### 7.3.3.2 Non-destructive Vacuum Extraction

Non-destructive Vacuum Extraction, otherwise known as Potholing, is used to physically expose a marked utility to verify existence and determine its exact location. This method helps insure that the existing utility will not be damaged by adjacent construction activities. Locating marked utilities shall be completed as required by Section 7.3.4. A typical pothole measuring 30 cm and 1.2 –1.5 m deep can be dug in 15 minutes or less with an average time of 7 to 8 minutes in all soil conditions.

#### 7.3.3.3 Lateral Identification

Because some utilities do not identify the customer's service line, additional investigation will be required. Gas companies may identify main lines only and will not mark laterals to the resident or business. Additional investigation is required to check for visual indications of existing utilities. A method of investigation that has been successfully used on a major underground construction project is to enter the basements of all buildings along the proposed excavation route to identify exiting utility lines that may exist as laterals to a main service. Where a lateral has been identified that is potentially within the excavation limits, further investigation is completed to expose or locate the line. Conductive and inductive testing using Radio Frequency (RF) and Audio Frequency (AF) can easily be used to trace the route where an exposed portion of the line is available.

#### 7.3.3.4 Directional Boring Profile Mapping

To ensure the contractor has completed a thorough investigation of underground utilities and has a routing plan that imposes minimum risk, a boring profile map should be developed by the contractor that clearly depicts all utilities and their proximity to the bore route. Where the proximity to utility lines could cause damage from boring and/or fluid migration, justification should be documented particularly in poor soil conditions. Approval by the Supervisor and the Responsible Superintendent/Responsible Field Engineer of the profile map is required prior to the contractor performing the bore.

### 7.3.4 Locating Marked Utilities

All utility crossings shall be located. Potholing is the preferred method of locating to avoid contact resulting in potential damage or injury. Contractor shall define the pot holing plan and methods. Reconcile variances among the expected and marked utilities.
Where utility markings run parallel and within 2.5 m of proposed excavation/boring, the utility shall be located. For proposed excavations/borings that run a continuous parallel route, the utility shall be located every 5 m.

Ensure the personnel understand the requirements of potholing, the frequency and the various mechanical methods and means available within the area and the process of positively locating utilities as pre-scribed in this procedure.

### 7.3.5 Selection of Contractor

The selection of a contractor for use in installation of an underground system is critical. When reviewing contractors in preparation for award, the following should be considered beyond the normal cost comparison:

- Experience in working around existing underground utilities
- Knowledge of the proposed site or route
- Previous work history within the local municipality
- When available, Contractor "Utility Hit Report", obtained from the Utility Identification Service
- Methods currently used to locate underground utilities.

The contractor's work process plan/procedure shall be reviewed to see what controls, if any, exist to ensure utility avoidance.

### 7.3.6 Identification/Trending of Utility Hits

To identify a potential trend associated with a specific utility or method of locating, all unplanned contact with underground utilities must be documented using a standard format. This information is also valuable in communicating lessons learned information to prevent reoccurrence. An example "Utility Hit Investigation Report Form," is provided as Attachment 1. This form should be used in collection and documentation of this information. The contractor shall complete the information immediately following any unplanned contact with an underground utility and forward to the Project Field Engineer for further processing.

## 8.0 RECORD KEEPING

All logs, permits, and reports generated by this procedure will be maintained by the Responsible Field Engineer until the work is complete. Documentation regarding a utility hit will be maintained by the HSSE Manager in the investigation file. Other documentation generated by this procedure shall be submitted to the Document Management Department and be retained in accordance with the requirements.

## 9.0 MONITORING

The Responsible Field Engineer, the Responsible Superintendent, and the HSSE Manager will monitor and assess the implementation of this procedure. The HSSE Manager will also audit the implementation of this procedure on a regular basis.

## 10.0 TRAINING

All personnel will receive awareness level information regarding this procedure. Contractors will be required to provide training prior to performing the any activities that require utility avoidance. It shall be the responsibility of the Contractor to verify that personnel are competent to perform utility avoidance. Superintendents and Field Engineers will be required to read and understand this procedure. This required reading shall be documented and the documentation shall be made available for audit. All training documents shall be maintained and kept up to date.

## 11.0 ATTACHMENTS

1. EPM-KSS-TP-000006 - Utility Hit Investigation Report Form Template

## Attachment 1 - EPM-KSS-TP-000006 - Utility Hit Investigation Report Form Template

**UTILITY HIT INVESTIGATION REPORT FORM** (Page 1)

| | |
|---|---|
| **NAME:** | **COMPANY/AFFILIATION:** |
| **PHONE NUMBER:** | |
| **DATE OF INCIDENT:** | **TIME OF INCIDENT:** |

| | |
|---|---|
| 1. | **WHAT UTILITIES ARE IMPACTED?**<br>☐ Water ☐ Gas ☐ Storm water/Sewage<br>☐ Telephone ☐ Other: ☐ Electric |
| 2. | **DEPTH OF UTILITY? (METERS)**<br>☐ 0 - 0.3 ☐ 0.3 - 0.6 ☐ 0.6 - 0.9 ☐ 0.9 – 1.2<br>☐ 1.2 - 1.5 ☐ 1.5 - 2.1 ☐ 2.1 - 2.7 ☐ Other: |
| 3. | **SIZE OF UTILITY? (DIAMETER IN CENTIMETERS)**<br>☐ 0 - 2.5 ☐ 2.5 - 5.0 ☐ 5.0 - 7.6 ☐ 7.6 - 10.2<br>☐ 10.2 - 12.7 ☐ 12.7 - 17.8 ☐ 17.8 - 22.9 ☐ Other: |
| 4. | **WAS THE UTILITY IN SERVICE AT THE TIME OF INCIDENT?**<br>☐ Yes<br>☐ No |
| 5. | **UTILITY CASING MATERIAL?**<br>☐ P.V.C. ☐ Galvanized ☐ Steel ☐ Iron<br>☐ Other: ☐ Concrete |
| 6. | **WAS THE UTILITY MARKED/UNMARKED?**<br>☐ Marked ☐ Unmarked ☐ Unmarked, unidentified on plans |
| 7. | **WHAT WAS THE SOIL TYPE AROUND THE UTILITY?**<br>☐ Rock ☐ Sand ☐ Clay ☐ Other: |
| 8. | **UTILITY LOCATION PERFORMED BY:**<br>☐ Subcontractor ☐ Subtier<br>Name of Company: |
| 9. | **WHAT METHODOLOGY WAS USED TO LOCATE THE UTILITY?** (Detection Devices, Drawing Searches, City Asbuilts, etc.) |
| 10. | **TYPE OF DEVICES UTILIZED?** (Include model numbers and calibration documentation) |
| 11. | **ARE THERE ANY COSTS AND/OR DELAYS ASSOCIATED WITH THE HIT?**<br>☐ No ☐ Yes, explain: |