National Manual for Assets and Facilities Management Volume 10, Chapter 3

Utility Clearance Procedure

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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. Due to the inherent hazards associated with underground and overhead electricity and other utilities, it is necessary for Entities, and/or their contractors, to implement a procedure to provide general requirements for safe operations, and hazards identification, and controls.

2.0 SCOPE

The scope of this procedure is to provide means to the user to create a custom procedure outlining and detailing the requirements and responsibilities when working in the vicinity of underground or overhead utilities including breaking ground and working at height when Operations and Maintenance activities are being performed throughout the Kingdom of Saudi Arabia.

The procedure discusses steps necessary to obtain utility clearance before any personnel perform work around known utilities. 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.

3.0 DEFINITIONS

Definitions	Description
Conductive Testing	Geophysical method used to trace cables, water and gas distribution lines using audio frequency.
Danger Zones/Limited Approach Boundary (LAB)	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. See Table 2.
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.

4.0 REFERENCES

- OSHA – 29 CFR 1910.333 – Selection and Use of Work Practices
- OSHA – 29 CFR 1926.651 (b) (1) (2) (3) (4) - Specific Excavation Requirements
- OSHA – 29 CFR 1926 Subpart V – Electrical Power Transmission and Distribution
- EOM-KSS-PR-000032 Excavation and Trenching Procedure
- EOM-KSS-PR-000001 General Safe Working Requirements Procedure
- EOM-KSS-PR-000020 Electrical Safety Procedure

5.0 RESPONSIBILITIES

5.1 Facility or Contract Manager

Responsible for ensuring that the requirements of this procedure are properly implemented and to provide the necessary resources to implement this procedure.

5.2 HSE Representative

Responsible for the assessment of the facility/contractor compliance with HSE requirements.

5.3 Facility or Contract Engineer

Responsible for managing the overall excavation certificate process including updating of the as-built master file of the facility/contract.

5.4 Supervisor

Ensures that utility avoidance activities are completed in accordance with this procedure and ensures the location of identified and marked utilities prior to start of excavation or boring activities.

6.0 PROCESS

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

6.2 Selection of Avoidance Processes

- Personnel shall carry out a Job Hazard Analysis 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.

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, 8 kHz, 33 kHz) Conductive and Inductive Tracing	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
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

Table 1: Underground Utility Location Methods and Limitations

6.3 Method and Requirements

6.3.1 Underground Utility Locations

Personnel shall be thoroughly familiar with the requirements of the Excavation and Trenching Procedure, EOM-KSS-PR-000029 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 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 other non-mechanical means to expose the utilities prior to any equipment use.

6.3.2 Overhead Utility Locations

For work involving the use of heavy equipment (e.g., excavators/diggers, dump trucks, track-hoes) where overhead utility (e.g., power, communication) lines exist within 15 meters of the location, the Supervisor and/or the HSE Representative will provide information for the Job Hazard Analysis describing the methods to be used to help prevent contact with the overhead lines. Refer to EOM-KSS-PR-000020, Electrical Safety Procedure, for more details.

The following general requirements apply:

- A JHA must be conducted;
- Work must be planned, as far as is practical, to avoid proximity to the overhead lines and accidental contact.
- The Supervisor or electricity provider/owner will specify clearance for given voltages.
- Any work to be carried out within the Limited Approach Boundary (LAB) must be controlled by a Hazardous Work Permit. Table 2 below can be used to help ensure equipment used is kept out of the LAB.
- Equipment in transit is with equipment components (e.g., buckets, gibs, derricks, forks) in their lowest stowed position or knuckled-down as low as feasible for movement.

Activities, or activities using the following equipment should be carefully analyzed and controlled when working around overhead power lines:

- The erection of scaffold and handling scaffold tubes.
- Handling long ladders.
- Operating mobile elevated work platforms.
- Operating tipper trucks or dump trucks.
- Operating backhoes.
- Operating cranes.

As a general rule, the following situations and corresponding controls should be implemented:

- Planning work activities that have the potential to be within 15 meters of overhead utilities, the utility owner should be contacted to confirm voltage and provide for a line height measurement.
- Planning work activities that will be within 15 meters of overhead utilities, the addition of a trained equipment spotter (i.e., Safety Watch) shall be used to ensure equipment reach does not encroach the LAB. Additional flags, cones, barricade tape, etc. may be placed to indicate the LAB to aid the spotters and equipment operators.
    - For work activities being performed inside the LAB, it is highly recommended that electrical utilities, and any caustic material flows, be de-energized, isolated, and/or grounded during the performance of the work activity.

LIMITED APPROACH BOUNDARIES FOR EXPOSED OVERHEAD ELECTRICAL LINES	
Voltage	**Performing Work Activities with Equipment**
Communication Lines/Wires	3 meters
50-75 kV	4.5 meters
75.1 - 150 kV	5 meters
150.1 - 250 kV	6 meters
250.1 - 500 kV	8 meters
500.1 - 800 kV	13.5 meters

Table 2: Limited Approach Boundaries for Exposed Overhead Electrical Lines

6.3.3 Utilities Identification Scheme and Techniques

6.3.3.1 Geophysical Techniques

Ground Penetrating Radar (GPR)

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.

6.3.3.2 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 (see 6.3.4 Locating Marked Utilities)

6.3.3.3 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.

6.3.3.4 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 facility/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 Facility/Contract Manager or the Responsible Facility/Contract Engineer of the profile map is required prior to the contractor performing the bore.

6.3.4 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. Facility/Contractor shall define the pot holing plan and methods. Reconcile variances among the expected and marked utilities.

Where utility markings run parallel and within 2.5m of proposed excavation/boring, the utility shall be located and marked every 5m.

Ensure 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.

6.3.5 Selection of Contractor

IF using a subcontractor to perform the work, THEN selection of a contractor for use in excavation/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 work area or route
- Previous work history within the local municipality
- When available, Contractor "Utility Hit Report", obtained from the Utility Identification Service
- Methods they currently use 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.

6.3.6 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 (see **Attachment 1 - EOM-KSS-TP-000020 - Utility Hit Investigation Report Form Template**). This form should be used in collection and documentation of this information. The Facility/contractor shall complete the information immediately following any unplanned contact with an underground utility and forward to the Facility/Contract Engineer for further processing as per **EOM-KS0-PR-000001- Incident Notification, Investigation and Reporting Procedure.**

7.0 RECORD KEEPING

All logs, permits, and reports generated by this procedure will be maintained by the Facility/Contract Engineer until the work is complete. Documentation regarding a utility hit will be maintained by the HSE Representative 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.

8.0 MONITORING

The Facility/Contract Engineer, the Responsible Supervisor, and the HSE Representative will monitor and assess the implementation of this procedure. The HSE Representative will also audit the implementation of this procedure on a regular basis.

9.0 TRAINING

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 Facility/Contractor to verify that personnel are competent to perform utility avoidance. Supervisors and Facility/Contract 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.

10.0 ATTACHMENTS

EOM-KSS-TP-000020 - Utility Hit Investigation Report Form Template

Attachment 1 - EOM-KSS-TP-000020 - 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?**				
	☐ Water	☐ Gas	☐ Storm water/Sewage		
	☐ Telephone	☐ Other:	☐ Electric		
2.	**DEPTH OF UTILITY? (METERS)**				
	☐ 0 - 0.3	☐ 0.3 - 0 .6	☐ 0.6 - 0.9	☐ 0.9 – 1.2	
	☐ 1.2 - 1.5	☐ 1.5 - 2.1	☐ 2.1 - 2.7	☐ Other:	
3.	**SIZE OF UTILITY? (DIAMETER IN CENTIMETERS)**				
	☐ 0 - 2.5	☐ 2.5 - 5.0	☐ 5.0 - 7.6	☐ 7.6 - 10.2	
	☐ 10.2 - 12.7	☐ 12.7 - 17.8	☐ 17.8 - 22.9	☐ Other:	
4.	**WAS THE UTILITY IN SERVICE AT THE TIME OF INCIDENT?**				
	☐ Yes				
	☐ No				
5.	**UTILITY CASING MATERIAL?**				
	☐ P.V.C.	☐ Galvanized	☐ Steel	☐ Iron	
	☐ Other:		☐ Concrete		
6.	**WAS THE UTILITY MARKED/UNMARKED?**				
	☐ Marked	☐ Unmarked	☐ Unmarked, unidentified on plans		
7.	**WHAT WAS THE SOIL TYPE AROUND THE UTILITY?**				
	☐ Rock	☐ Sand	☐ Clay	☐ Other:	
8.	**UTILITY LOCATION PERFORMED BY:**				
	☐ Subcontractor		☐ Subtier		
	Name of Company:				
9.	**WHAT METHODOLOGY WAS USED TO LOCATE THE UTILITY?** (Detection Devices, Drawing Searches, City As-builts, etc.)				
10.	**TYPE OF DEVICES UTILIZED?** (Include model numbers and calibration documentation)				
11.	**ARE THERE ANY COSTS AND/OR DELAYS ASSOCIATED WITH THE HIT?**				
	☐ No	☐ Yes, explain:			