Chapter 11: Excavation Safety

Quick Start Summary

1 Who needs to know about these requirements

The requirements of Excavation Safety apply to all personnel engaged in excavation operations at SLAC that meet any of the following conditions, at any time: 1) depth is one foot or more; 2) power tools will be used; 3) utilities are identified; and 4) any hazardous condition is likely to be encountered. The requirements do not apply to 1) sampling soil, concrete, and asphalt from bins, hoppers, or stockpiles using hand tools; 2) replacing existing sign posts in and around SLAC roads, parking areas, and pathways, provided sleeves are used.

2 Why

Among the hazards that may be encountered are unidentified utilities, structural instability, and contact with materials affected by chemicals or radiation.

3 What do I need to know

- A permit must be obtained for excavations covered by this program.
- All utilities in the area must be located and marked before digging (and de-energized/de-pressurized and locked and tagged unless an exception is approved by the Infrastructure and Safety Directorate associate laboratory director or designee). Use of heavy machinery is not allowed within an exclusion zone (comprised of the width of the utility plus 18 inches in all directions) around a known utility. Mark-ups of plans and drawings documenting as-built conditions must be submitted.
- Physical requirements for excavations (such as shoring, traffic control, oxygen deficiency, and access/egress) must be met.
- An excavation competent person must be present during active operations and inspect the excavation daily.

4 When

These requirements take effect 23 April 2014.

5 Where do I find more information

SLAC Environment, Safety, and Health Manual (SLAC-I-720-0A29Z-001)
- Chapter 11, “Excavation Safety”

Or contact the program manager
1 Purpose

The purpose of this program is to ensure that excavations are conducted in a safe manner and in compliance with applicable regulations. This program applies if an excavation meets any of the following conditions, at any time:
1. Depth is one foot or more
2. Power tools will be used
3. Utilities are identified
4. Any hazardous condition is likely to be encountered

The following excavation types are exempt from the requirements of this program:
- Replacing existing sign posts in and around SLAC roads, parking areas, and pathways, provided sleeves are used
- Sampling soil, concrete, and asphalt from bins, hoppers, or stockpiles using hand tools

The program covers planning and performing excavations, including approving and closing out excavation permits, locating utilities, updating as-built drawings, and ensuring that all physical and recordkeeping requirements are met. It applies to workers, supervisors, competent persons, utility locators, subcontractors, project and field construction managers (PMs and FCMs), the facilities engineer, the Infrastructure and Safety Directorate associate laboratory director, and the program manager; and the Field Services (FS), Radiation Protection (RP), and Environmental Protection (EP) departments.

2 Roles and Responsibilities

Functional roles and general responsibilities for each are listed below. More detailed responsibilities and when they apply are provided in the procedures and requirements.

The roles may be performed by one or more individuals and one individual may play more than one role, depending on the structure of the organizations involved. Responsibilities may be delegated.

2.1 Worker

- Conducts work according to permit conditions and excavation requirements
- In the event of an emergency, exits immediately, providing assistance to others only when not endangering his or her own safety
2.2 Competent Person

- Is designated by subcontractor, or if a SLAC worker, by the excavation safety program manager in consultation with line management.
- Must be present during:
  - Active operations in which employees workers are expected to descend.
  - Placement of support systems and/or access/egress components such as ramps, ladders, or stairs.
  - Activities where powered or heavy machinery is to be used.
  - Activities that present a significant hazard to personnel or equipment.

Note: If work is being conducted in a trench by more than one subcontractor, each subcontractor must have its own competent person present when worker exposure can reasonably be anticipated.

- Identifies and ensures the use of adequate protective systems, work methods, and personal protective equipment (PPE).
- Performs and documents daily excavation inspections and maintains the documentation for review.
- Stops work and removes exposed personnel from the hazardous area until necessary precautions have been taken to ensure their safety whenever finding evidence of a potentially hazardous situation that could result in a possible cave-in, failure of protective systems, hazardous atmospheres, or other hazardous conditions (see Work Planning and Control: Stop Work Procedure).

2.3 Utility Line Locator

- Uses SLAC as-builts as reference.
- Surveys area at least three feet beyond the limit of the proposed excavation.
- Uses techniques as necessary to locate all utilities and add any located utilities that are not already on the drawing(s).
- Marks utilities following Excavation Safety: Utility Marking Requirements.
- Documents survey results on the Excavation Safety: Utility Location Results Form.
- Updates as-builts following Excavation Safety: Drawing Requirements.

2.4 Supervisor / Line Management

- Ensures work is conducted according to permit conditions and excavation requirements.
- Approves designation by the excavation safety program manager of SLAC excavation competent persons.

2.5 Project Manager / Field Construction Manager

- For projects carried out by SLAC personnel (no subcontractor involvement) requests program manager assign a SLAC excavation competent person.
- Requests excavation permit (and completes Section A).
Chapter 11: Excavation Safety

- Utility survey
  - For projects carried out by SLAC personnel, submits request to the facilities engineer for utility location
  - In all cases, notifies Safety Services of the utility survey date (so that Safety Services representative can attend as needed)
  - Attends the required in-field utility survey and ensures that underground installations and utilities are located and marked before the excavation begins
- Ensures all work planning and control (WPC) documentation is at the job site before work begins (work package must include approved excavation permit, work authorization, and any additional required permits or documents; see Work Planning and Control: Procedure)
- Meets at least daily with workers and supervisors to discuss the job safety analysis (JSA) and ensures JSA and pre-work/tailgate briefings cover hazards and controls for that day
- Verifies that the excavation competent person is at the excavation site when required
- Verifies that the excavation competent person conducts and documents daily inspections
- Is present at the excavation site as necessary to ensure work is being performed safely
- Documents activities at the job site in daily log
- Ensures work practices are (and remain) in place to meet permit conditions and excavation requirements, including those in Excavation Safety: Physical Requirements, such as
  - De-energizing/de-pressurizing and locking and tagging all utilities in the area before digging begins unless an exception is approved by the Infrastructure and Safety Directorate associate laboratory director or designee
  - Only hand digging within an exclusion zone (comprised of the width of the utility plus 18 inches in all directions) around a known utility. Use of heavy machinery is not allowed.
  - Ensuring adequate shoring, access/egress, and fall protection are in place
  - Ensuring sediment/erosion control
- Notifies the excavation safety program manager if the project scope changes
- Ensures that associated drawings are updated, including verifying drawings in the field
- Ensures completion of the excavation then meets with the excavation safety program manager, delivering as-builts (and completes Section G of the permit)

2.6 Subcontractor

- Designates an excavation competent person and ensures that person carries out all required duties
- Conducts operations following the conditions of the excavation permit and all other requirements
- Arranges for utility survey and ensures the excavator attends
2.7 Infrastructure and Safety Directorate Associate Laboratory Director (or Designee)

- Approves exceptions to requiring utilities within the excavation area to be de-energized/de-pressurized and locked and tagged before digging

2.8 Infrastructure Engineering Division, Facilities Engineer

- Maintains as-builts and other construction drawings
- Initiates the permit process (numbering the permit)
- Makes as-builts available to PM/FCM
- Arranges for utility surveys if requested by PM/FCM
- Confirms results of utility survey by being present during the survey and completing Section D of the permit

2.9 Field Services Department

- Safety Services Group
  - Attends utility survey as needed
  - Provides construction safety oversight to ensure general construction requirements are met
- Waste Management Group
  - Provides proper containers for waste based on waste classification, type, and volume as indicated on the permit
  - Ensures proper disposal

2.10 Environmental Protection Department

- Completes Section C of the excavation permit
  - Reviews all excavation permits for environmental concerns such as impact on stormwater
  - Notifies Waste Management with waste disposal recommendations
- Classifies waste and collects samples as needed for waste disposition

2.11 Radiation Protection Department

- Completes Section B of the excavation permit
- The Field Operations Group reviews all excavation permits for
  - Access requirements (including specialized training)
  - Potential for generating radioactive materials (such as soil)
  - Need for material sampling and analysis prior to waste declaration
Need for a radiological work permit if excavating through radioactive material

Radioactive sources such as those found in a soil density gauge with a radioactive source (may require a radiation generating device authorization sheet)

The Radiation Physics Group reviews the excavation permit if the excavation is within 25 lateral feet of an underground beam line housing and as needed for

Potential to uncover previously shielded beam areas

Necessity for a radiation survey during excavation

2.12 Excavation Safety Program Manager

Maintains SLAC excavation competent person status

Designates SLAC excavation competent persons in consultation with line management

Maintains excavation designations in the Competent and Qualified Persons and Engineers list

Administers excavation permit (or designates permit administrator):

Completes approval (Section E)

Notifies others of status (Radiation Protection, Environmental Protection, and facilities engineer)

Determines if permit needs to be revised and resubmitted if the scope of work changes (Section F)

Ensures the PM/FCM submits documentation of as-found and as-built conditions during project to the facilities engineer

Ensures updated as-builts are delivered to the facilities engineer upon project completion

Closes out permit (Section G)

Inspects excavation job sites for safety as part of construction safety oversight

Develops program and requirements and guidance as appropriate

3 Procedures, Processes, and Requirements

These documents list the core requirements for this program and describe how to implement them:

Excavation Safety: Excavation Procedures (SLAC-I-730-0A23C-001). Describes process for planning, performing, and closing out excavations

Excavation Safety: Utility Marking Requirements (SLAC-I-730-0A23S-009). Describes requirements for marking utilities

Excavation Safety: Drawing Requirements (SLAC-I-730-0A23S-005). Describes requirements for plans and drawings to be submitted to the facilities engineer

Excavation Safety: Physical Requirements (SLAC-I-730-0A23S-007). Describes requirements for establishing protections for utilities and encumbrances, workers, and the environment
4 Training

4.1 SLAC Excavation Competent Person

Workers may only act in the capacity of a SLAC excavation competent person once they have completed the following or equivalent training:

- ESH Course 312, Excavation Safety Training (ESH Course 312)

4.2 Subcontractor Excavation Competent Person

A subcontractor excavation competent person must have completed training equivalent to ESH Course 312 before performing work at SLAC.

5 Definitions

Atmosphere, hazardous. An atmosphere that by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, may cause death, illness or injury.

Benching. A method of protecting workers from a cave-in by excavating so that the side walls are shaped as one or a series of horizontal levels or steps.

Cave-in. The separation of a mass of soil or rock material from the side of an excavation, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.

Classification, waste. Determination made for appropriate waste disposition (handling and disposal):

- Class I. Hazardous waste as defined by state and federal regulations and laws; involves strict handling requirements
- Class II. Non-hazardous waste that does not meet standards and criteria for disposal at municipal solid waste landfills
- Class III. Non-Hazardous waste that meets standards and criteria for disposal at municipal solid waste landfills
- Re-use. Non-hazardous excavated material that may be reused as specified on the excavation permit (generally backfill in the excavation from which it originated only)

Data, tabulated. Tables and charts approved by a registered professional engineer and used to design and construct a protective system.

Egress. Means of exiting an excavation, usually a stairway, ladder, or ramp.

Excavation. Any man-made cut, cavity, trench, or depression in an earth surface formed by earth removal. This definition includes but is not limited to the following: grading, trenching, backfilling, stockpiling.
and/or surcharging, core drilling, boring, jack hammering, and asphalt- or concrete-cutting placement, demolition or removal, and indoor drilling/digging operations that may contact soil. In general, excavations are operations where contact with soil is expected, such as trenching and removing soil to install foundation footings or exposing underground pipes for repair or replacement.

Failure. The breakage, displacement, or permanent deformation of a structural member, trench, grade, embankment, or connection so as to reduce its structural integrity and its supportive capabilities or ability to resist any imposed loads

Person, competent. As defined by federal Occupational Safety and Health Administration: “one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.”

Potholing. A utility location method, usually utilizing water and suction or hand digging, to locate underground utilities physically

Shoring, aluminum hydraulic. A pre-engineered shoring system comprised of aluminum hydraulic cylinders (cross-braces) used in conjunction with vertical rails (uprights) or horizontal rails (whales). This system is designed specifically to support the sidewalls of an excavation to prevent cave-ins.

System, protective. A method of protecting workers from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include but are not limited to shoring systems, sloping and benching systems, and shield systems

Trench. A narrow excavation made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet. If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet or less (measured at the bottom of the trench), the excavation is considered to be a trench.

Zone, exclusion. Zone around a known utility, comprised of the width of the utility plus 18 inches in all directions, in which the use of heavy machinery is not allowed. Only hand digging is permitted.

6 References

6.1 External Requirements

The following are the external requirements that apply to this program:


- Title 8, California Code of Regulations, “Industrial Relations”, Division 1, “Department of Industrial Relations”, Chapter 4, “Division of Industrial Safety”, Subchapter 4, “Construction Safety Orders”, Article 6, “Excavations” (8 CCR 1539–1947) with the following exception: SLAC uses an internal permitting and notification system to control excavations in lieu of 8 CCR 1541, paragraph (2).
11. Related Documents


**San Mateo County Code**, Title 4, “Sanitation and Health”, Chapter 4.68, “Wells” *(SMCC 4.68.010–4.68.420)*

  - Chapter 32, “Encroachments into the Public Right-of-Way” *(24 CCR Part 2, Chapter 32)*
  - Chapter 33, “Safeguards during Construction” *(24 CCR Part 2, Chapter 33)*

### 6.2 Related Documents

**SLAC Environment, Safety, and Health Manual** *(SLAC-I-720-0A29Z-001)*

- **Chapter 2**, “Work Planning and Control”
  - Work Planning and Control: Procedure *(SLAC-I-720-0A21C-002)*
  - Work Planning and Control: Stop Work Procedure *(SLAC-I-720-0A21C-003)*

- **Chapter 9**, “Radiological Safety”

- **Chapter 17**, “Hazardous Waste”

- **Chapter 26**, “Stormwater”

- **Chapter 51**, “Control of Hazardous Energy”

Other SLAC Documents

- Competent and Qualified Persons and Engineers

Other Documents

- None
Chapter 11: Excavation Safety

Excavation Procedures

1 Purpose

The purpose of these procedures is to ensure that excavations are conducted in a safe manner and in compliance with applicable regulations. They cover planning, performing, and closing out excavations in which contact with soil is expected – such as trenching, drilling, and removing soil – that meet any of these conditions at any time:

1. Depth is one foot or more
2. Power tools will be used
3. Utilities are identified
4. Any hazardous condition is likely to be encountered

The following operations are exempt:

- Sampling soil, concrete, and asphalt from bins, hoppers, or stockpiles using hand tools
- Replacing existing sign posts in and around SLAC roads, parking areas, and pathways, provided sleeves are used

These procedures apply to workers, supervisors, competent persons, utility locators, subcontractors, project and field construction managers (PMs and FCMs), the facilities engineer, the Infrastructure and Safety Directorate associate laboratory director (ALD), and the program manager; and the Field Services (FS), Radiation Protection (RP), and Environmental Protection (EP) departments.

2 Procedures

Procedures for planning an excavation, conducting excavation operations, and closing the project out follow.

2.1 External Permits

Specific requirements apply for certain types of excavations:

- A San Mateo County Environmental Health Services Division subsurface drilling permit is required under any of these conditions:
  - Soil borings are anticipated to encounter groundwater
  - Soil borings extend deeper than 10 feet
Groundwater monitoring wells, including geotechnical wells, will be installed or destroyed (installation or destruction must be in accordance with California Well Standards as established by the California Department of Water Resources)

### 2.2 Planning

The planning phase of the permit process includes defining the project scope, a review by multiple departments of the Environment, Safety, Health, and Quality Division, documenting utility location results, and obtaining approval for the excavation to proceed.

**Note**  Allow 10 working days for required reviews to be completed. If soil testing is required, allow up to two weeks of additional time from the sampling date.

<table>
<thead>
<tr>
<th>Step</th>
<th>Person</th>
<th>Action</th>
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<tbody>
<tr>
<td>Define excavation</td>
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<td>1.</td>
<td>PM/FCM</td>
<td>Submits service request to the facilities engineer</td>
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<td>2.</td>
<td>Facilities engineer</td>
<td>Initiates permit process</td>
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<td>• Assigns a unique number to each permit request (if a permit is cancelled, the cancelled permit number cannot be reused)</td>
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<td>• Pulls all as-builts pertaining to the proposed excavation area</td>
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<td>• Completes top part of Section D, “Utility Drawing Review”, of Excavation Safety: Excavation Permit Form and sends permit and as-builts to the PM or FCM</td>
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<td>3.</td>
<td>PM/FCM</td>
<td>Completes Section A, “Description”, of the permit and marks specific location, width, length, and depth of the proposed excavation on the as-builts and forwards permit to RP</td>
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<td>4.</td>
<td>RP</td>
<td>Reviews the permit for potential radiological concerns such as</td>
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<td>• Location: any excavation located within an area posted as any type of controlled area, radiologically controlled area, contamination area, radiation, high radiation or radioactive material area or if within 25 lateral feet of beam housing (see Beam Line Map) to determine if a radiological work permit is required</td>
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<td>• New wells or soil borings near accelerator housing: investigate to ensure that no radiological conditions will be encountered (such as tritium in groundwater)</td>
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<td>• Radioactive sources that are to be brought on-site (such as soil density gauge, x-ray generator, thoriated weld rods, radiographic devices) to determine if a radiological device authorization is required</td>
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<td>• Potential for generating radioactive waste</td>
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<td>Completes Section B, “Radiological Review”, of permit and submits to EP</td>
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<td>5.</td>
<td>EP</td>
<td>Completes Section C, “Environmental Review”, of the permit to note</td>
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<td>• Special requirements</td>
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<td>• Recommendations for excavated material handling and disposition</td>
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<td>6.</td>
<td>EP</td>
<td>Notifies Waste Management with waste disposal recommendations</td>
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</tbody>
</table>
### Step 7
**Person:** EP  
**Action:** Forwards permit to PM/FCM

### Step 8
**Person:** PM/FCM or subcontractor  
**Action:** For excavations performed by SLAC personnel, the PM/FCM submits a request for utility location to the facilities engineer. For excavations performed by a subcontractor, the subcontractor arranges for a utility survey (and ensures that the excavator will be present during the survey).

### Step 9
**Person:** PM/FCM  
**Action:**
- Notifies building or area manager of work plans
- Notifies Field Services Department, Safety Services Group of the utility survey date so that a representative can be present as needed

### Survey Work Site

#### Step 10
**Person:** PM/FCM, facility engineer, excavator  
**Action:** Must be present during utility location (PM/FCM should be familiar with the limitations of survey techniques)  
**Recommended:** Safety Services representative presence during survey

#### Step 11
**Person:** Utility locator  
**Action:** Surveys excavation area and three feet beyond and marks utilities following Excavation Safety: Utility Marking Requirements. Every utility shown on the as-built drawings must be located, using all applicable methods.

- If an electrical line is difficult to locate, such as direct-bury Romex, methods and/or equipment that improve the chances of locating that line must be used, such as inducing a signal with the locator's equipment or causing current flow by energizing the circuit.
- If a known utility is not found using these methods, potholing (hand digging or vacuum excavation) of the entire excavation area is required to locate it.

If a utility is found that is not marked on the drawing, it must be drawn in. If the excavation will be within three feet of a utility, the exact location (horizontal and vertical position and depth below surface) of the utility must be determined by potholing and recorded on the as-builts. As-builts must comply with Excavation Safety: Drawing Requirements.

### Step 12
**Person:** Utility locator  
**Action:** Completes an Excavation Safety: Utility Location Results Form

### Step 13
**Person:** PM/CM, facilities engineer, and Safety Services rep (if present)  
**Action:** Sign completed utility location results form if results are complete and accurate

### Step 14
**Person:** PM/FCM  
**Action:** Submits permit to facility engineer

### Step 15
**Person:** Facilities engineer  
**Action:** Completes Section D of permit and forwards to excavation safety program manager (or designee) for approval

### Plan Work

#### Step 16
**Person:** PM/FCM  
**Action:** If indicated, coordinates with RP to obtain radiological work permit(s) and/or radiological device authorization(s)

#### Step 17
**Person:** PM/FCM  
**Action:** Ensures hazard analysis and work planning and control (WPC) documents are complete as required per Chapter 2, "Work Planning and Control", and Chapter 42, "Subcontractor Safety"
Step | Person | Action
--- | --- | ---
18. | PM/FCM | Plans excavation to meet permit conditions and excavation requirements, including those in *Excavation Safety: Physical Requirements*, such as:
- De-energizing/de-pressurizing and locking and tagging all utilities in the area before digging begins unless an exception is approved by the Infrastructure and Safety Directorate associate laboratory director or designee.
- Only hand digging within an *exclusion zone* (comprised of the width of the utility plus 18 inches in all directions) around a known utility. Use of heavy machinery is not allowed.
- Ensuring adequate shoring, access/egress, and fall protection are in place.
- Ensuring sediment/erosion control.

19. | PM/FCM | Contacts Waste Management to arrange for disposal coordination or waste containers.

**Approve Permit**

20. | Excavation safety program manager or designee | Reviews permit and approves as applicable (Section E) or ensures that missing sections are completed and any missing documentation is attached.

21. | Safety Services staff | If the excavation involves a drilling rig:
- Completes the *Excavation Safety: Mobile / Portable Drilling Rig Initial Inspection Form* (or equivalent).
- Ensures the completed form is in the WPC package.

22. | Excavation safety program manager or designee | Delivers approved permit (original or copy) to PM/FCM and notifies RP, EP, and facilities engineer that the permit is approved.

### 2.3 Excavation

#### 2.3.1 Emergency Protocol

The following procedure applies to normal working conditions. In the event of an emergency, anyone in the excavation who is physically able to must exit immediately, providing assistance to others only when not endangering his or her own safety.

If the emergency is life-threatening, call 911 and provide accurate detail (see permit if needed). Any rescue action that can be performed safely from outside the excavation, such as hoisting a harnessed victim, may be undertaken while waiting for rescue personnel. Also call SLAC Site Security (ext. 5555) to report the incident.

**Warning** Do not attempt to enter an unprotected or failed trench to perform a rescue – call professional responders.

If the emergency is non-life-threatening, contact the supervisor and PM and SLAC Site Security (ext. 5555) to report the incident. (See *Emergency Management: Emergency Notification, Response, and Reporting Procedures*.)
### 2.3.2 Excavation Procedure

<table>
<thead>
<tr>
<th>Step</th>
<th>Person</th>
<th>Action</th>
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<tbody>
<tr>
<td>1.</td>
<td>PM/FCM</td>
<td>Ensures permit is current</td>
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<td>If permitted work is not initiated within three months of original submission, the permit must be resubmitted to confirm the in-field survey is still accurate.</td>
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<td>2.</td>
<td>PM/FCM</td>
<td>Ensures the WPC work folder contains all required documents (excavation permit with hazard analysis, work planning documents, and any additional required permits) before work begins (see Chapter 2, &quot;Work Planning and Control&quot;)</td>
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<tr>
<td>3.</td>
<td>PM/FCM</td>
<td>Ensures work practices are (and remain) in place to meet permit conditions and excavation requirements, including those in Excavation Safety: Physical Requirements, such as:</td>
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<td>- De-energizing/de-pressurizing and locking and tagging all utilities in the area before digging begins unless an exception is approved by the Infrastructure and Safety Directorate associate laboratory director or designee</td>
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<td>- Ensuring adequate shoring, access/egress, and fall protection are in place</td>
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<td>- Ensuring sediment/erosion control</td>
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<td>4.</td>
<td>PM/FCM</td>
<td>Meets at least daily with workers and supervisors to discuss the job safety analysis (JSA) for that day and is present at the excavation site as necessary to ensure the work is being performed safely</td>
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<td>Ensures JSA and pre-work/tailgate briefings cover hazards and controls</td>
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<td>Verifies that competent person is present when required (see Step 6)</td>
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<td>5.</td>
<td>Supervisor and worker</td>
<td>Conducts work according to permit conditions and excavation requirements (including Excavation Safety: Physical Requirements)</td>
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<td>6.</td>
<td>Competent person</td>
<td>Must be present during:</td>
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<td>- Active operations in which employees workers are expected to descend</td>
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<td>- Placement of support systems and/or access/egress components such as ramps, ladders, or stairs</td>
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<td>- Activities where powered or heavy machinery is to be used</td>
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<td>- Activities that present a significant hazard to personnel or equipment</td>
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<td>At least one person meeting the requirements for an excavation competent person must be present during active operations. If work is being conducted in the trench by more than one subcontractor, each must have its own competent person when worker exposure can reasonably be anticipated.</td>
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<td>7.</td>
<td>Competent person</td>
<td>Conducts inspections, takes steps to mitigate identified problems (such as removing workers until the excavation area is stabilized), and maintains record of inspections using the Excavation Safety: Daily Inspection Checklist or equivalent that demonstrates the adequacy of the inspection.</td>
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<td>Inspections are required:</td>
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<td>- Daily</td>
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|      |                 | - Before start of work and as needed throughout the shift (as determined by the
### Step 8
**PM/FCM**
Documents activities at the job site in daily log.

### Step 9
**PM/FCM and/or competent person**
Invokes stop work requirements for such conditions as:
- Encountering an unknown/unidentified subsurface utility: the exact nature and condition of the utility must be determined before work can commence.
- Observation of discolored soil, an odor, or oily sheen: contacts excavation safety program manager before work commences to ensure that the permit can be updated for proper waste disposition.

### Step 10
**PM/FCM**
Notifies excavation safety program manager of any scope changes (for example if any unexpected conditions are encountered or excavation size or extent increases).

### Step 11
**Excavation safety program manager or designee**
If scope changes, determines, in consultation with all permit reviewers as needed, if the permit should be revised and re-approved (Section F of permit).

### Step 12
**Excavation safety program manager / Safety Services staff**
Visits excavation site as part of routine construction safety oversight; checks for presence of a competent person and compliance with requirements. If problems are noted, meets with PM/FCM and/or competent person to resolve.

### Step 13
**Waste Management**
Coordinates disposition of excavated material with PM/FCM according to recommendations from EP and RP.

---

### 2.4 Excavation Close Out

<table>
<thead>
<tr>
<th>Step</th>
<th>Person</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PM/FCM</td>
<td>Ensures drawings are marked up with as-built information, if required, and verifies in the field.</td>
</tr>
<tr>
<td>2.</td>
<td>PM/FCM</td>
<td>Ensures completion of excavation.</td>
</tr>
<tr>
<td>3.</td>
<td>PM/FCM</td>
<td>Meets with the excavation safety program manager, delivers marked-up drawings, if required, and signs Section G of permit.</td>
</tr>
<tr>
<td>4.</td>
<td>Excavation safety program manager or designee</td>
<td>Closes permit record by signing Section G of permit and notifies RP, EP, and facilities engineer that the permit has been closed.</td>
</tr>
<tr>
<td>5.</td>
<td>Excavation safety program manager or designee</td>
<td>Ensures that marked-up drawings, if required, are delivered to the facilities engineer.</td>
</tr>
</tbody>
</table>
### Step 6
<table>
<thead>
<tr>
<th>Person</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavation safety program manager</td>
<td>Maintains the record copies of all closed permits</td>
</tr>
</tbody>
</table>

### Step 7
<table>
<thead>
<tr>
<th>Person</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facilities engineer</td>
<td>Updates as-builts</td>
</tr>
</tbody>
</table>

## 3 Forms

The following forms are required:

- **Excavation Safety: Excavation Permit Form** (SLAC-I-730-0A23J-006). Form for documenting safety review and closing-out of an excavation
- **Excavation Safety: Utility Location Results Form** (SLAC-I-730-0A23J-004). Form for documenting results of required in-field utility survey
- **Excavation Safety: Daily Inspection Checklist** (SLAC-I-730-0A23J-003) (or equivalent). Form for documenting required daily inspection of excavations by a competent person
- **Excavation Safety: Mobile / Portable Drilling Rig Initial Inspection Form** (SLAC-I-730-0A23J-005) (or equivalent). Form for documenting required initial inspection of any drill rigs brought on-site

## 4 Recordkeeping

The following recordkeeping requirements apply:

- The excavation permit (with attached survey results form), daily inspection checklist, and mobile / portable drilling rig initial inspection (if applicable) must be kept at the work site during excavation operations with the WPC work package.
- The PM/FCM must maintain a daily log of operations.
- The excavation safety program manager maintains the record copies of all closed permits.
- The facilities engineer updates and maintains as-builts.

## 5 References

**SLAC Environment, Safety, and Health Manual** (SLAC-I-720-0A29Z-001)

- **Chapter 11, “Excavation Safety”**
  - **Excavation Safety: Physical Requirements** (SLAC-I-730-0A23S-007)
  - **Excavation Safety: Utility Marking Requirements** (SLAC-I-730-0A23S-009)
  - **Excavation Safety: Drawing Requirements** (SLAC-I-730-0A23S-005)
- **Chapter 2, “Work Planning and Control”**
- **Chapter 37, “Emergency Management”**
SLAC National Accelerator Laboratory
Environment, Safety, Health, and Quality Division
Chapter 11 | Excavation Procedures

  ▪ Chapter 42, “Subcontractor Safety”

Other SLAC Documents
  ▪ Beam Line Map (8628A1)
  ▪ Radiological Work Permit
  ▪ Radiation Generating Devices Program Manual (SLAC-I-760-2A30C-015, FO 035)

Other Documents
  ▪ San Mateo County Environmental Health Services Division Subsurface Drilling Permit
Chapter 11: Excavation Safety

Excavation Permit Form

Instructions This form must be completed, approved, and kept with work planning and control (WPC) documentation at the work site for the duration of the described excavation operations. (See Excavation Safety: Excavation Procedures.)

Important The conditions and hazard mitigations listed below must be included in the appropriate job safety analysis (JSA) and pre-work/ Tailgate briefing.

Scheduling
1) Allow 10 working days for required reviews.
2) If soil testing is required, allow an extra 2 weeks after the sampling date.
3) Permitted work must be initiated within 3 months of original submission. If it is not initiated the permit must be resubmitted to confirm in-field survey accuracy.
# A Description

*Completed by the project manager (PM) or field construction manager (FCM)*

<table>
<thead>
<tr>
<th>Initiated by:</th>
<th>Phone:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM or FCM:</td>
<td>Phone:</td>
<td>Service request #:</td>
</tr>
<tr>
<td>PM or FCM:</td>
<td>Phone:</td>
<td>PO #:</td>
</tr>
<tr>
<td>Competent person:</td>
<td>Phone:</td>
<td>Estimated start date:</td>
</tr>
<tr>
<td>Subcontractor:</td>
<td>Phone:</td>
<td>Estimated end date:</td>
</tr>
<tr>
<td>Project location (include grid coordinates):</td>
<td>Nearest building:</td>
<td></td>
</tr>
</tbody>
</table>

**Describe excavation purpose:**

**Attach a detailed sketch or drawing (include location, dimensions of work to be completed, and grading plans for cut-and-fill work)**

<table>
<thead>
<tr>
<th>Maximum dimensions (feet)</th>
<th>Estimated volume of excavated material, cubic yards (yd³)</th>
<th>As-builts, if needed, will be completed by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length:</td>
<td></td>
<td>Subcontractor</td>
</tr>
<tr>
<td>Width:</td>
<td>Request soil reuse as backfill?</td>
<td>Facilities engineer (see service request # above)</td>
</tr>
<tr>
<td>Depth:</td>
<td>Yes ☐ No ☐</td>
<td>Requester</td>
</tr>
</tbody>
</table>

Will the excavation be five or more feet deep and will personnel be entering? If yes

What protective system (sloping, benching, shoring) is planned? ____________________

Will the excavation be 20 or more feet deep? If yes

1. The protective system must be designed by a registered professional engineer. Yes ☐ No ☐
2. A description of the system must be submitted prior to excavation. Yes ☐ No ☐

Will soil compaction testing be needed? Yes ☐ No ☐
If yes, specify testing method: ☐ nuclear gauge (prior authorization required) ☐ sand cone test

Is the excavation within any area that is posted as any type of controlled area, radiologically controlled area, contamination area, radiation, high radiation, or radioactive material area? Yes / not sure ☐ No ☐

Is the excavation within 25 lateral feet of an underground beam line housing? (indicated by yellow on the Beam Line Map)

[Diagram of beam line and ground level]

<table>
<thead>
<tr>
<th>Within 25 lateral feet of beam housing</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 feet</td>
</tr>
<tr>
<td>Ground level</td>
</tr>
<tr>
<td>Beam housing</td>
</tr>
<tr>
<td>Beam pipe</td>
</tr>
</tbody>
</table>

Does the excavation involve a well or soil boring? If yes

1. Will the bore be near accelerator housing or is there any reason to suspect that radiological conditions may be encountered (such as tritium in groundwater)? Yes / not sure ☐ No ☐
2. Will a drill rig be brought on-site? Yes ☐ No ☐

Are there utilities within the excavation area (confirm after utility survey, Section D)? If yes

1. All known utilities must be located before digging. Yes ☐ No ☐
2. Use of heavy machinery is not allowed within an exclusion zone (the width of the utility plus 18 inches in all directions) around the utility. Yes ☐ No ☐
3. All utilities in the area must be de-energized/de-pressurized and locked and tagged before digging unless an exception is approved by the Infrastructure and Safety Directorate associate laboratory director. Yes ☐ No ☐

**Important:** these hazard mitigations must be included in the JSA and pre-work/tailgate briefing for the days digging will occur.
B  Radiological Review

Completed by the Radiation Protection Field Operations (RPFO) Group

☐ No additional RPFO requirements

☐ Additional requirements apply as follows:

☐ A radiation generating device authorization is required prior to bringing the device onto SLAC property.

☐ A radiological work permit is required and must be attached to this form during excavation operations.

☐ Radioactive waste management is required. Contact Radioactive Waste Management. Allow 3-5 days for container delivery.

☐ Other:

☐ Call ext. ____________ for further instructions

Reviewed by (print name)  
Date: __________________________

Signature

Completed by the Radiation Physics Group if excavation is or may be within 25 lateral feet of any underground beam housing.

☐ No special requirements apply.

☐ Additional requirements apply as follows:

Reviewed by (print name)  
Date: __________________________

Signature
C Environmental Review

completed by the environmental protection (EP) department

Waste classification of excavated material:

Contact the waste management group for any disposal coordination and containers by means of the hazardous waste pick up and disposal form. Allow 3-5 days for container delivery.

Other requirements:

__________________________
Reviewed by (print name)

__________________________
Date:

Signature
## D Utility Drawing Review

**Completed by the facilities engineer**

The following utilities are present in the excavation area *(check all that apply)*:

<table>
<thead>
<tr>
<th>Utility</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>Storm drain</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>Sanitary sewer</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>Natural gas</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>Compressed air</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>Water</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>Process piping</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>Telephone</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>Control cables</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>Groundwater monitoring wells</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>Other</td>
<td>☐</td>
<td>☑</td>
</tr>
</tbody>
</table>

Refer to drawing number(s):

**Important:**

An in-field utility line location is required for all excavations that require a permit; a completed [Excavation Safety: Utility Line Location Results Form](#) must be attached to this form.

Updated as-builts required upon completion? Yes ☐  No ☑

---

Reviewed by *(print name)*

Date: ______________________

Signature
### ESHQ Approval
Drilling rig initial inspection required?  Yes ☐ No ☐  
If yes, attach completed [Excavation Safety: Mobile / Portable Drilling Rig Initial Inspection Form](#).  
I have reviewed this permit and work may proceed.  

Excavation safety program manager (or designee) *(print name)*  
Date:  
Signature

### Scope Change
If the scope of work changes the PM or FCM must notify the excavation safety program manager (ESPM) or designee to determine if the permit must be revised and reapproved. (Examples of a scope change include encountering unexpected conditions or an increase in the size of the excavation.)

<table>
<thead>
<tr>
<th>Change</th>
<th>Revise and Reapprove?</th>
<th>Date</th>
<th>ESPM (initial)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes ☐ No ☐</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes ☐ No ☐</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes ☐ No ☐</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Close Out
**Completion:** As-built drawings and utility line location results were verified in the field, the drawings were delivered to the excavation safety program manager, and the excavation has been completed according to the permit conditions.

PM or FCM *(print name)*  
Date:  
Signature  
**Close out:** As-built drawings and utility line location results have been transmitted to the facilities engineer, as required.  

Excavation safety program manager *(print name)*  
Date:  
Signature
Chapter 11: **Excavation Safety**

**Daily Inspection Checklist**

Product ID: **120**  |  Revision ID: **1612**  |  Date Published: **23 April 2014**  |  Date Effective: **23 April 2014**


---

**Instructions**

The excavation competent person must complete this or a comparable inspection form at least once per day while the excavation is open. This checklist may also be used to record conditions and observations at other times. A record of the daily inspection must be maintained for the duration of the excavation. (See *Excavation Safety: Excavation Procedures*.)

Project location *(include grid coordinates)*: ________________________________  Nearest building: ________________________________

**Inspection Certification**

I am an excavation competent person and I completed the following inspection

Date: ________________________________  Time: ________________________________  Inspection purpose:

- [ ] Daily required inspection prior to beginning
- [ ] Routine inspection during work
- [ ] After rainstorm
- [ ] After a hazardous condition *(describe)*
- [ ] Other *(describe)*

Name *(print)*: ________________________________  Phone: ________________________________

Signature: ________________________________

**Current Conditions**

<table>
<thead>
<tr>
<th>Current Conditions</th>
<th>N/A</th>
<th>Description or Measure</th>
<th>Comments / Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terrain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weather</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water accumulation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic conditions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy equipment location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy materials location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spoils location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building proximity to spoils</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Possible vibration sources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previously disturbed soil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trench width</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trench depth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other trench characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access / egress conditions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atmospheric test results</td>
<td></td>
<td>%O₂  % LEL</td>
<td></td>
</tr>
<tr>
<td>Toxic or hazardous atmosphere source</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Changing conditions / change of plan**

23 April 2014  SLAC-I-730-0A23J-003-R003  1 of 2
Site Survey

<table>
<thead>
<tr>
<th>The excavation is within the original scope of the excavation permit</th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavation permit conditions for disposal, shielding, and training are being adhered to</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Utility survey markings are complete, accurate, and legible</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Utilities within the excavation area have been de-energized/de-pressurized and locked and tagged</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Storm drains are adequately protected from sediment</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Stockpiles/excavated materials are at least two feet from excavation edge</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Shoring equipment is damaged (if yes, describe)</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Protective Systems

Options (check one)
- Option (1) slope is 1.5:1 (34°) (Type C)
- Option (2) slope is _____ based on soil type
- Trench shield manufacturer:
- Aluminum hydraulic shoring system manufacturer:

Supporting information:
Tabulated data on site:

Soils Analysis / Classification

Note: soil does not need to be reclassified every inspection but should be reviewed and updated if conditions change.

Soil Analysis Method(s) Used
- Visual
- Manual

Soil Characteristics (check all that apply)
- Cemented
- Cohesive
- Dry
- Fissured
- Granular
- Layered
- Moist
- Plastic
- Saturated
- Submerged

Soil Classification (check all that apply)
- Type A
- Type B
- Type C
- Stable rock

Avg. compressive strength: ____________ tsf
Compressed strength data: ____________

Manual Test Used (check all that apply)
- Plasticity
- Dry strength
- Thumb penetration
- Drying Test
- Pocket penetrometer
- Other (list)
Instructions
Safety Services Group staff must complete an initial inspection of any mobile or portable drilling rig brought on-site.

1. The inspection must cover the items listed below and must be documented on this or a similar form.
2. Items that fail inspection: subcontractor must bring the equipment into passing condition before use at SLAC.
3. The completed form must remain with the work planning and control (WPC) documents.

Contact Information
Subcontractor: 
Phone: 
Drill rig type:  
Inspector's name: 
Phone:  
Inspection date:  
Work location:  

<table>
<thead>
<tr>
<th>Equipment</th>
<th>N/A</th>
<th>Fail</th>
<th>Pass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tracks / outriggers (no damage)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moving parts guarded / no guards removed (includes drill shaft or head)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drill rig (No physical damage on crawler tracks, bits, etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No fluid leaks (pneumatic/ hydraulic)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel, hydraulic, and lubricating oil reservoirs properly filled</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire extinguisher on rig (10 BC or larger; fully charged and inspected)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating mechanisms functional (such as controls)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All brakes and clutches functional (inspected and tested)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency stop functional</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operator panel and gauges functional</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warning lights functional</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Records</th>
<th>N/A</th>
<th>Missing</th>
<th>Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator training (Cal / OSHA, Title 8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment inspection and maintenance records available</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes
**Chapter 11: Excavation Safety**

**Utility Location Results Form**

Product ID: 138 | Revision ID: 1617 | Date Published: 23 April 2014 | Date Effective: 23 April 2014

URL: [http://www-group.slac.stanford.edu/esh/eshmanual/references/excavationsFormUtilityLocation.pdf](http://www-group.slac.stanford.edu/esh/eshmanual/references/excavationsFormUtilityLocation.pdf)

---

**Instructions** (see *Excavation Safety: Excavation Procedures*)

1. Ensure required parties are present during the survey:
   a) Required: facilities engineer
   b) Required: the project manager (PM) or field construction manager (FCM)
   c) As needed: a Safety Services Group representative
      (PM/FCM provides survey date to Safety Services)
   d) Note: if a subcontractor arranged the survey the subcontractor is responsible for ensuring the excavator attends.

2. Attach completed, signed form to excavation permit (PM/FCM)

---

**Utility Location Results** *(completed by utility location service provider)*

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Were all the utilities shown on the drawings located and are the drawings accurate as shown? <em>(If no, complete 1b and 1c)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Were any utilities located that were not shown on the drawings? <em>(If yes, sketch the location on drawings.)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) Were any utilities shown on the drawings that were not located? <em>(If yes, list each utility indicated but not found.)</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. **Does the in-field survey area extend 3 feet beyond the border of the intended excavation area? (required)**
   - Yes
   - No

2. **Utility location method(s) used:**

3. **Comments:**

---

**Certification**

I used the most appropriate equipment and technology to identify all underground utilities – both those indicated on the provided drawings and any unknown utilities.

**A** Utility locator:

<table>
<thead>
<tr>
<th>Name (print)</th>
<th>Start time:</th>
<th>End time:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signature</td>
<td></td>
<td>Date:</td>
</tr>
</tbody>
</table>

**Company:**

**B** Facilities engineer:

<table>
<thead>
<tr>
<th>Name (print)</th>
<th>Signature</th>
<th>Date:</th>
</tr>
</thead>
</table>

**C** PM/FCM:

<table>
<thead>
<tr>
<th>Name (print)</th>
<th>Signature</th>
<th>Date:</th>
</tr>
</thead>
</table>

**D** Safety Services rep *(if present)*

<table>
<thead>
<tr>
<th>Name (print)</th>
<th>Signature</th>
<th>Date:</th>
</tr>
</thead>
</table>

---

23 April 2014 SLAC-I-730-0A23J-004-R003 1 of 1
Chapter 11: Excavation Safety

Utility Marking Requirements

1 Purpose

The purpose of these requirements is to ensure that markings meet standards and are uniform. They cover the marking of utilities in the area to be excavated for all excavations that require a permit. They apply to the project manager (PM) and the utility location service provider.

2 Requirements

2.1 Utility Locating Service

The utility locating service must use the most appropriate equipment and technology to identify all underground utilities, both known and unknown, and active and abandoned. The surveyed area must extend three feet beyond the border of the intended (or active) excavation area.

2.2 Markings

2.2.1 Marking in Paved Areas

Avoid excessive or oversized marking, especially if marking outside the excavation area. Conditions permitting, use spray chalk paints, water-based paints, or equivalent, less permanent, type marking. Limit length, height, and interval of marks to those recommended. Letters and numbers must not exceed three to six inches in height.

2.2.2 Marking in Non-paved Areas

When paint is not used, use appropriately colored stakes, lath, pennants, or chalk lines. Select marker types that are most compatible to the purpose and marking surface. Adhere to paved area marking suggestions to the extent practical.

If any marking information is omitted due to site conditions, communicate omitted data by direct contact, signs, phone, fax, etc. Mark the as-built drawings attached to the excavation permit.

Offset markings must clearly indicate the direction, distance, and path of facility or excavation.
2.2.3 Requirements for Excavation Delineation

Delineate the area to be excavated. Delineated areas must be identified in white markings.

2.2.3.1 Single-point Excavations

Dots may have less than 4’ spacing

<table>
<thead>
<tr>
<th>Full Line</th>
<th>Radius or Arc</th>
<th>Four Corner</th>
<th>Dash Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>1” Wide</td>
<td>Co. Name or Logo 1” Wide</td>
<td>6” Approx. Length</td>
</tr>
<tr>
<td>• • • 1” Dia. Dots</td>
<td>• • • 6” Approx. Length</td>
<td>• • • 4” Intervals</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1** Single-point Excavation Markings

Delineate the exact area of excavation through the use of dots or dashes, or a continuous solid line. Limit the size of each dash to approximately six inches in length and one inch in width, with interval spacing not less than approximately four feet. Dots of approximately one inch diameter are typically used to define arcs or radii and may be placed at closer intervals in lieu of dashes. Limit width of lines to one inch.

2.2.3.2 Trenching, Boring, or Other Continuous Type Excavations

**Figure 2** Continuous-type Excavation Markings

Mark centerline of planned excavation with six inch by one inch arrows (approximately four feet apart) to show direction of excavation. For boring or continuous operations where marked paving is not to be removed, mark at critical points with maximum mark separation of approximately 50 feet. Mark lateral excavations with arrows showing excavation direction from centerline with marks at curb or property line if crossed. Intermittently indicate excavation width on either side of centerline in three-inch to six-inch high figures. Dots may be used for curves and closer interval marking.
1. Marks must be placed on either side of the facility to define the hand dig area, defined as the width of the facility itself plus the tolerance zone of 36 inches on all sides of the facility.

2. Changes in direction and lateral connections must be clearly indicated at the point where the change in direction or connection occurs, with an arrow indicating the path of the facility. A radius must be indicated with marks describing the arc.

3. Structures, such as vaults, that are physically larger than obvious surface indications, must be marked so as to generally define the parameters of the structure.

4. Termination points or dead ends must be indicated as such.
2.2.4 Color Codes and Abbreviations

Table 1 Color Codes and Identifiers

<table>
<thead>
<tr>
<th>Color</th>
<th>Color Name</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Red</td>
<td>Electric</td>
</tr>
<tr>
<td>Yellow</td>
<td>Yellow</td>
<td>Gas/oil/steam/chemical</td>
</tr>
<tr>
<td>Orange</td>
<td>Orange</td>
<td>Communications/CATV</td>
</tr>
<tr>
<td>Blue</td>
<td>Blue</td>
<td>Water</td>
</tr>
<tr>
<td>Green</td>
<td>Green</td>
<td>Sewer/storm drain</td>
</tr>
<tr>
<td>Purple</td>
<td>Purple</td>
<td>Reclaimed water</td>
</tr>
<tr>
<td>Pink</td>
<td>Pink</td>
<td>Temporary survey</td>
</tr>
<tr>
<td>White</td>
<td>White</td>
<td>Proposed excavation</td>
</tr>
</tbody>
</table>

Table 2 Common Marking Identifiers

<table>
<thead>
<tr>
<th>Abbreviation / Acronym</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>Compressed air</td>
</tr>
<tr>
<td>CTWR</td>
<td>Cooling tower water return</td>
</tr>
<tr>
<td>CTWS</td>
<td>Cooling tower water supply</td>
</tr>
<tr>
<td>DW</td>
<td>Domestic water</td>
</tr>
<tr>
<td>E</td>
<td>Electric</td>
</tr>
<tr>
<td>FO</td>
<td>Fiber optic</td>
</tr>
<tr>
<td>G</td>
<td>Gas</td>
</tr>
<tr>
<td>HWR</td>
<td>Hot water return</td>
</tr>
<tr>
<td>HWS</td>
<td>Hot water supply</td>
</tr>
<tr>
<td>S</td>
<td>Sewer</td>
</tr>
<tr>
<td>SD</td>
<td>Storm drain</td>
</tr>
</tbody>
</table>
### Abbreviation / Acronym Item

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>SL</td>
<td>Street lighting</td>
</tr>
<tr>
<td>TEL</td>
<td>Telephone</td>
</tr>
<tr>
<td>TS</td>
<td>Traffic signal</td>
</tr>
<tr>
<td>TV</td>
<td>Television</td>
</tr>
<tr>
<td>W</td>
<td>Water / reclaimed water</td>
</tr>
</tbody>
</table>

### Table 3  Common Abbreviations and Descriptions as Used in Underground Construction

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Item</th>
<th>Abbreviation</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS</td>
<td>Acrylonitrile - butadiene - styrene</td>
<td>P</td>
<td>Plastic (conduit or pipe)</td>
</tr>
<tr>
<td>ACP</td>
<td>Asbestos cement pipe</td>
<td>PB</td>
<td>Pull box</td>
</tr>
<tr>
<td>CAP</td>
<td>Corrugated aluminum pipe</td>
<td>PC</td>
<td>Plastic conduit</td>
</tr>
<tr>
<td>CIP</td>
<td>Cast iron pipe</td>
<td>PE</td>
<td>Polyethylene</td>
</tr>
<tr>
<td>CMC</td>
<td>Cement mortar coated</td>
<td>PL</td>
<td>Property line</td>
</tr>
<tr>
<td>CML</td>
<td>Cement mortar lined</td>
<td>PVC</td>
<td>Polyvinyl chloride</td>
</tr>
<tr>
<td>CSP</td>
<td>Corrugated steel pipe</td>
<td>R</td>
<td>Radius</td>
</tr>
<tr>
<td>CU</td>
<td>Copper</td>
<td>RCB</td>
<td>Reinforced concrete box</td>
</tr>
<tr>
<td>DIP</td>
<td>Ductal iron pipe</td>
<td>RCP</td>
<td>Reinforced concrete pipe</td>
</tr>
<tr>
<td>DU</td>
<td>Duct</td>
<td>SCCP</td>
<td>Steel cylinder concrete pipe</td>
</tr>
<tr>
<td>ELC</td>
<td>Electrolier lighting conduit</td>
<td>STL</td>
<td>Steel</td>
</tr>
<tr>
<td>FC</td>
<td>Fiber conduit</td>
<td>STRUC</td>
<td>Structure</td>
</tr>
<tr>
<td>GIP</td>
<td>Galvanized iron pipe</td>
<td>T</td>
<td>Transmission facility</td>
</tr>
<tr>
<td>GSP</td>
<td>Galvanized steel pipe</td>
<td>TR</td>
<td>Transite (asbestos cement pipe)</td>
</tr>
<tr>
<td>IP</td>
<td>Iron pipe</td>
<td>TRANS</td>
<td>Transition</td>
</tr>
<tr>
<td>MCD</td>
<td>Multiple concrete duct</td>
<td>TSC</td>
<td>Traffic signal conduit</td>
</tr>
<tr>
<td>MH</td>
<td>Manhole</td>
<td>VCP</td>
<td>Vertrified clay pipe</td>
</tr>
<tr>
<td>MTD</td>
<td>Multiple tile duct</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 3  Forms

The following forms are required:

- [Excavation Safety: Utility Location Results Form](SLAC-I-730-0A23J-004)
4 Recordkeeping

The following recordkeeping requirements apply:

- The utility location form must be completed and attached to the excavation permit upon completion of the survey.

5 References

**SLAC Environment, Safety, and Health Manual** (SLAC-I-720-0A29Z-001)
- Chapter 11, “Excavation Safety”
  - Excavation Safety: Excavation Procedures (SLAC-I-730-0A23C-001)
  - Excavation Safety: Drawing Requirements (SLAC-I-730-0A23S-005)
  - Excavation Safety: Potholing Requirements (SLAC-I-730-0A23S-004)

Other Documents

Chapter 11: Excavation Safety

Drawing Requirements

1 Purpose

The purpose of these requirements is to ensure that plans and drawings submitted to the facilities engineer are complete and contain the required level of detail.

These requirements cover preparing plans and drawings associated with excavation operations and related permits and utility location requirements. They apply to persons responsible for those preparing those plans and drawings: the project manager (PM) and field construction manager (FCM) and the utility location service provider.

2 Requirements

An in-field survey is required to locate all utilities during the planning phase of an excavation (see Excavation Safety: Excavation Procedures). All utilities must be marked at the work location (see Excavation Safety: Utility Marking Requirements) and all utilities must be verified and/or indicated on the drawings (see Excavation Safety: Utility Location Results Form). Specific requirements for each type of plan or drawing follow. Include all applicable details as described.

2.1 As-built Underground Utilities (Mechanical)

Do all of the following on the drawing:

- Identify utility
- Identify size and type
- Provide spot elevations (top/bottom of pipe)
- Show location of installation (dimension from closest landmark, for example, building, curb, manhole, catch basin)
- Show complete routing of pipes, including turn points and elbows
- Show tap-ins from mains, or tie-ins from existing pipes (if applicable)
- Show all shut-offs
- Identify conduit size/duct bank (top of duct) size and width
2.2 Electrical Drawing Plans

For electrical drawing plans, show all of the following:

- Spot elevations (depth) throughout equipment installation
- Installation location (dimension from closest landmark, for example, building, curb, manhole, catch basin)
- Complete conduit or duct routing, including turn points and elbows
- Pull-boxes, hand holes, shut-offs, and panel boxes associated with project

2.3 Piping Plan Drawings

For piping plan drawings, show all of the following:

- Identify pipe size/duct bank (top of duct) size and width for all site and building schematic drawings such as sanitary sewer, storm drain, hot water, chilled water, and domestic water
- Spot elevations (depth) throughout equipment installation
- Location of installation (dimension from closest landmark, for example, building, curb, manhole, catch basin)
- Complete pipe or duct routing, including turn points and elbows
- Catch basins, sanitary sewer manholes, and storm drains associated with project

2.4 Above Ground Utility and Installation Drawings

For above ground utility and installation plan drawings, show all of the following:

- Identify pipe size/duct bank (top of duct) size and width for all site utility drawings such as sanitary sewer, storm drain, hot water, chilled water, and domestic water
- Spot elevations (depth) throughout equipment installation
- Installation location (dimension from closest landmark, for example, building, curb, manhole, catch basin)
- Complete pipe or duct routing, including turn points and elbows
- Catch basins, sanitary sewer manholes, and storm drains associated with project
- Any new installations of guardrails, bollards, speed bumps, concrete pads, foundations
- In addition to any new, relocated or abandoned underground utilities, the following must be marked on the drawings before submitting: new sidewalks, ramps, decks, pathways, pads, structures, stairways, berms, trailers, and new roads

3 Forms

The following forms are required:
4 Recordkeeping

The following recordkeeping requirements apply:

- None

5 References

**SLAC Environment, Safety, and Health Manual** (SLAC-I-720-0A29Z-001)

- Chapter 11, “Excavation Safety”
  - *Excavation Safety: Excavation Procedures* (SLAC-I-730-0A23C-001)
  - *Excavation Safety: Excavation Permit Form* (SLAC-I-730-0A23J-006)
  - *Excavation Safety: Utility Location Results Form* (SLAC-I-730-0A23J-004)
Chapter 11: Excavation Safety

Physical Requirements

1 Purpose

The purpose of these requirements is to protect workers, SLAC property, and the environment from common hazards associated with excavations, such as structural instability, cave-in, lack of egress, falls, hazardous atmosphere(s), water accumulation, and hazards associated with heavy equipment. These requirements cover establishing protections for utilities and encumbrances, workers, and the environment. They apply to workers, supervisors, competent persons, and project managers (PMs)/field construction managers (FCMs).

2 Requirements

2.1 Protecting Utilities / Encumbrances

2.1.1 Surface Encumbrances

All surface encumbrances that could cause a hazard (such as equipment, pipe, spoil, sources of vibration) must be evaluated and removed or supported, as necessary, to safeguard workers.

2.1.2 Underground Installations

All exposed utilities must be protected, supported, or removed to prevent damage to the utility and to prevent injury to workers.

2.1.3 Heavy Equipment

Use of heavy machinery is not allowed within an exclusion zone (comprised of the width of the utility plus 18 inches in all directions) around a known utility. Only hand digging is allowed.

2.1.4 De-energization / De-pressurization

All utilities in the area must be de-energized/de-pressurized and locked and tagged before digging begins unless an exception is approved by the Infrastructure and Safety Directorate associate laboratory director or designee. (See Chapter 51, “Control of Hazardous Energy”.)
2.2 Protecting Workers

2.2.1 Access and Egress

All excavations four feet or more in depth must have a stairway, ladder, ramp, or other safe means of egress so as to require no more than 25 feet of lateral travel for workers. Requirements include the following:

- Structural ramps used solely by personnel as a means of access or egress from an excavation must be designed by a competent person.
- Structural ramps used for access or egress of equipment must be designed by a competent person qualified in structural design and constructed in accordance with the design.
- If a ramp or runway is constructed of two or more structural members, the members must be connected together to prevent their displacement.
- Structural members must be of uniform thickness.
- Cleats or other appropriate means used to connect structural members must be attached either to the bottom of the runway or in a manner so as to prevent tripping.
- Structural ramps used in lieu of steps must be provided with cleats or other surface treatments on the top surface to prevent slipping.

2.2.2 Shoring

All excavations five feet or more in depth must be shored, benched, or sloped according to Occupational Safety and Health Administration (OSHA) standards. Excavations less than five feet in depth that are not shored must be examined by a competent person and found to have no potential for edge or wall collapse, cave-in, or other hazardous conditions before entry.

Where the stability of adjoining buildings, walls or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning must be provided to ensure the stability of such structures for the protection of workers. A qualified engineer must make this determination.

All excavations 20 feet or more in depth must have a protective system designed by a registered professional engineer and a description of the system must be submitted prior to excavation.

All materials and equipment used for protective systems must be free from damage and defects that might impair their proper function.

Support systems must be installed and removed in a manner that protects workers from edge or wall collapse, cave-in, structural collapse, or from being struck by members of the support system. Removal must begin at, and progress from, the bottom of the excavation. Members must be released slowly to so as to note any indication of possible failure of the remaining members of the structure or possible cave-in of the sides of the excavation. During the removal of support systems, a competent person must be present, and, only persons involved in the removal must be in the excavation.

2.2.3 Protection of Workers from Loose Rock or Soil

Workers must be protected from excavated or other material or equipment that could pose a hazard by falling or rolling into excavations. Protection must be provided by placing and keeping such materials or
equipment at least two feet from the edge of excavations, or by the use of retaining devices that are sufficient to prevent materials or equipment from falling or rolling into excavation, or by a combination of both if necessary. If a retaining device is to be used, it must be placed at least two feet from the edge of the excavation.

2.2.4 Fall Protection

The following requirements apply

- Where workers or equipment are required or permitted to cross over excavations over six feet in depth and wider than 30 inches, walkways or bridges with standard guardrails that comply with 29 CFR 1926.502(b) must be provided.
- Adequate barrier physical protection must be provided at all remotely located excavations. All openings such as wells, pits, and shafts must be barricaded or covered and when the work is complete any such temporary opening must be backfilled.
- Each worker within six feet of the edge of an excavation that is six feet or more in depth must be protected from falling by guardrail systems, fences, personal fall arrest systems, or barricades.

For more information on fall protection, see Chapter 45, “Fall Protection”.

2.2.5 Oxygen Deficiency

The excavation atmospheres must be tested before personnel enter any excavation that is five feet or more deep and where oxygen deficiency (atmospheres containing less than 19.5 percent oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist. Examples of such areas are excavations in a landfill area or in an area where hazardous substances are stored nearby.

For more information, see Chapter 36, “Cryogenic and Oxygen Deficiency Hazard Safety”.

2.2.6 Water Accumulation

Personnel must not work in an excavation in which water has accumulated or in which water is accumulating unless adequate precautions have been taken to protect against this hazard.

2.2.7 Traffic

Barricades, trench plates, or other measures must be placed over an open excavation to prevent workers from falling in and to prevent damage to any exposed utilities. Use of trench plates must be approved by a California-licensed civil engineer and in accordance with approved building and construction plans. Trench plates used to bridge excavations over which vehicles will travel must be secured against displacement.

Personnel exposed to public vehicular traffic must be provided with and wear warning vests or other suitable garments marked with or made of reflectorized or high-visibility material.

2.2.8 Warning System for Mobile Equipment

When mobile equipment is operated adjacent to an excavation, or when such equipment is required to approach the edge of an excavation and the operator does not have a clear and direct view of the
excavation’s edge, a warning sign must be used such as barricades, hand or mechanical signals, or stop logs. If possible, the grade should be away from the excavation.

2.2.9 Exposure to Falling Loads

No personnel will be permitted underneath loads handled by lifting or digging equipment. Personnel must be required to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials.

2.3 Environmental Protection

2.3.1 Erosion Control

Appropriate sediment controls must be used during all excavation operations to prevent stormwater pollution. Examples of sediment controls that may be used include covering stockpiles, use of drain inserts or covers and/or wattles (see Stormwater: BMP Category 13 – Building Repair, Remodeling, and Construction and Stormwater: Construction Site Requirements).

2.3.2 Disposal of Excavated Material

Excavated material such as soil, asphalt, concrete, base rock, and slurry, must be disposed of as specified in the excavation permit.

*Important:* Construction debris must remain segregated from excavated material.

2.3.3 Backfill and Restoration

Backfilling and pavement or surfacing restoration must be in accordance with the excavation permit and project specifications. If excavated material is listed as re-use, the permit will specify if it is to be used as backfill or if it can be relocated on-site. In all instances, guidance and oversight by EP and the Building Inspection Office (BIO) is required.

3 Forms

The following form (or equivalent) is required:

- None (See Excavation Safety: Excavation Procedures for required inspections and forms.)

4 Recordkeeping

The following recordkeeping requirements apply:

- None
5 References

SLAC Environment, Safety, and Health Manual (SLAC-I-720-0A29Z-001)
- Chapter 11, “Excavation Safety”
  - Excavation Safety: Excavation Procedures (SLAC-I-730-0A23C-001)
- Chapter 2, “Work Planning and Control”
- Chapter 6, “Confined Space”
- Chapter 17, “Hazardous Waste”
- Chapter 26, “Stormwater”
  - Stormwater: BMP Category 13 – Building Repair, Remodeling, and Construction (SLAC-I-750-0A16E-013)
  - Stormwater: Construction Site Requirements (SLAC-I-750-0A16S-009)
- Chapter 36, “Cryogenic and Oxygen Deficiency Hazard Safety”
- Chapter 45, “Fall Protection”
- Chapter 51, “Control of Hazardous Energy”

Other Documents