

Confined Space Entry Program

for

Construction, Telecommunications Operations and Electrical Work

University of California, Berkeley

Apply this program whenever:

- 1. Employment exists in connection with the construction, alteration, painting, repairing, construction maintenance, renovation, removal, or wrecking of any fixed structure or its parts, or when**
- 2. Accessing telecommunications or electrical manholes or vaults made of fire-resistant construction that is primarily used to house electrical equipment.**

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UC Berkeley Confined Space Entry Program for Construction, Telecommunications Operations and Electrical Work

Part I Introduction

PURPOSE and SCOPE

It is the policy of the University of California, Berkeley (UC Berkeley), to maintain a safe and healthy work environment for all employees, including student and contract employees, and to comply with all applicable occupational health and safety regulations.

This “Confined-Space Entry Program for Construction, Telecommunications Operations and Electrical Work” outlines the procedures, practices, and requirements necessary to ensure the safety of personnel conducting work in the following areas:

1. Whenever employment exists in connection with the construction, alteration, painting, repairing, construction maintenance, renovation, removal, or wrecking of any fixed structure or its parts, or when
2. Accessing telecommunications or electrical manholes or vaults made of fire-resistant construction that is primarily used to house electrical equipment.

This program meets applicable legal requirements and applies to all UC Berkeley faculty, staff, students, and contractors performing confined-space entries on the UC Berkeley campus or at associated field stations and offices.

CALIFORNIA REGULATORY REQUIREMENTS

This program complies with the California Code of Regulations Title 8,
General Industry Safety Orders,

§5156 subsection (b)(2), and §5158 “Other Confined Space Operations”

§8616 (b) Telecommunications, Underground Lines

Construction Safety Orders, Subchapter 4, §1502 (a) Applications

§1541(g), General Requirements for Excavations, Hazardous Atmospheres

Electrical Safety Orders, Subchapter 5, §2700 Definitions

DEFINITIONS OF A CONFINED SPACE

A confined space, as it applies to electrical, telecommunications, construction and maintenance¹ operations, and in some cases, excavation is defined as having both of the following conditions:

- Its existing ventilation is [or may be] insufficient to remove dangerous air contamination, oxygen enrichment, and/or oxygen deficiency that may exist or develop.
- Ready access to or egress from the space for retrieval of a suddenly disabled employee is difficult due to the location and/or size of the opening(s).

Note on Trenches / Excavations: An area such as a trench or excavation may be designated as a confined space depending upon local environmental hazards.

OVERVIEW OF REQUIREMENTS

Confined Space Plan

Campus and field-station workspaces require confined-space evaluations prior to entry. While it may ultimately be determined that a space is not defined as a confined space, special care may still be necessary while preparing, entering, and conducting work in the space.

Procedures for evaluating, entering, and working in confined spaces vary depending on space configuration and the type of work performed. With the goals of avoiding injuries and fatalities, and assuring Cal/OSHA compliance, each department or research group intending to enter such a space must establish a Confined Space Plan that includes:

- Evaluation of potential physical and atmospheric hazards to determine the type of confined space,
- Safe means of entry into and performing activities in the confined space, and
- Safe emergency evacuation in the event of injuries or unforeseen atmospheric hazards.

In general, the evaluation and planning consists of the following:

1. A scope of work defined by the supervisor.
2. A thorough analysis of the hazards associated with the space.
3. A decision on the type of confined space (Construction versus Non-construction Space).
4. Establishment and implementation of appropriate controls for recognized or potential hazards.
5. Continuous monitoring of potential, existing, and newly identified hazards and modification of controls accordingly.
6. Planning for immediate evacuation should new or previously unidentified hazards be found.
7. Methods for communication between those within the confined space and to those outside.

¹Cal/OSHA 8 CCR 1502. Application. (a) These Orders establish minimum safety standards whenever employment exists in connection with the construction, alteration, painting, repairing, construction maintenance, renovation, removal, or wrecking of any fixed structure or its parts. These Orders also apply to all excavations not covered by other safety orders for a specific industry or operation.

8. Staging of emergency response equipment to be immediately available for use should a rescue be needed.

The evaluation and plan is documented on a location-specific entry log (if applicable) and Evaluation / Entry form (Appendix C), and is considered part of a training record. Apply the procedural flow chart (Appendix B) to evaluate and determine if a “Construction Confined Space” exists, and how this program is to be applied to it.

A Confined Space Entry Plan can be documented in the Confined Space Evaluation/Entry Form found in Appendix C and is part of the requirements for the “*Entry Supervisor*” as defined in Program Parts III.

UC Berkeley Confined Space Entry Program

Part II

for

Construction, Electrical, and Telecommunications Operations

This is Part II of a five-part Confined Space Program. The definition of a confined space for this program applies ONLY to Construction, Electrical and Telecommunications Operations.

This “Confined-Space Entry Program for Construction, Telecommunications Operations and Electrical Work” outlines the procedures, practices, and requirements necessary to ensure the safety of personnel conducting work in the following areas:

1. Whenever employment exists in connection with the construction, alteration, painting, repairing, construction maintenance, renovation, removal, or wrecking of any fixed structure or its parts, or when
2. Accessing telecommunications or electrical manholes or vaults made of fire-resistant construction that is primarily used to house electrical equipment.

A confined space as it applies to electrical, telecommunications, maintenance, and construction² operations is defined as having both of the following conditions:

- Its existing ventilation is insufficient to remove dangerous air contamination, oxygen enrichment, and/or oxygen deficiency that may exist or develop.
- Ready access to or egress from the space for retrieval of a suddenly disabled employee is difficult due to the location and/or size of the opening(s).

If one of the conditions does not exist during operations in the space, then it is not a confined space and work can continue without the measures stated below. However, the air testing procedures stated below should still be utilized.

If both of the conditions do exist during operations, the procedures and controls in this Confined Space Program must be used and documented (e.g., entry form, training sign-in sheets, etc.), before and during the work inside of the space.

There may be other requirements influencing work in the confined space such as access control, guarding, platforms in a confined space, Lockout/Tagout, and fixed or portable ladders that are not covered in this Confined Space Program but are addressed in other sections of Cal/OSHA not directly associated with confined space issues. Please contact your supervisor, department safety coordinator, or EH&S for assistance with these issues.

²Cal/OSHA 8 CCR 1502. Application. (a) These Orders establish minimum safety standards whenever employment exists in connection with the construction, alteration, painting, repairing, construction maintenance, renovation, removal, or wrecking of any fixed structure or its parts. These Orders also apply to all excavations not covered by other safety orders for a specific industry or operation.

Equipment Preparations

Prior to testing the atmosphere in the space, or entering the space, search for potential air contamination sources and other hazards outside of the space. Prepare the space for entry by controlling hazards as follows:

- Pipe lines or ducts that convey incapacitating substances into the space must be closed, blocked off, blinded, or restrained by any other means to prevent flow of a substance into the confined space.
- The space must be emptied, flushed or purged by any practical means, of any flammable, injurious or incapacitating substances.
- If the space is connected to other spaces, or blinded off from other spaces, it will be treated as though they are the same space and the requirements of this Confined Space Program apply to all the connected spaces.
- If access or ventilation openings are required on a horizontal surface - such as a roadway or walkway - the opening must be guarded by a railing or similar barrier to prevent personnel or objects from falling into the opening.
- Rescue equipment, Self Contained Breathing Apparatus, Radios or other communication devices, and other Personal Protective Equipment may be needed based upon the hazards present. Assure that all equipment is functioning properly prior to entering the space.

Air Quality and Ventilation Controls Before Entry

1. Survey surrounding areas for potential atmospheric hazards that could contaminate the space.
2. Test the air using a four-gas meter or a similar direct reading device to test for combustible gas, and for oxygen deficiency. The results must be documented in the Confined Space Evaluation/Entry Form in Appendix C.
3. If unsafe conditions are found by testing the air, some means of forced air ventilation must be added to adequately ventilate the space, indicated by continuous air testing.
4. Forced air ventilation must be provided to a confined space under this definition at all times during an operation where any of the following conditions apply:
 - a. Combustible or explosive gas vapors have been detected at any time, including the initial air test.
 - b. Organic solvents are used in any part of the operations.
 - c. Open flame torches are used in any part of the operation.
 - d. The space is located in a public right-of-way open to vehicular traffic and could be exposed to drifting gases.
 - e. Toxic gas or oxygen deficiency is found. (The only exception to this procedure is if the space is in a central location, such as a server room inside a building that is adequately ventilated.)

(The direction of airflow and type of forced air ventilation used is to be determined based upon an analysis of environmental conditions of each specific confined space and the specific hazards to be controlled within the space by the ventilation.)

5. No sources of ignition should be used within the space until ventilation controls and air testing has shown there are no ignitable gases or flammable substances in the space.
6. If oxygen consuming heating devices are used within the space, adequate combustion air and exhaust gas venting must be provided.
7. Entry and exit must be readily available, to the extent feasible.

If the presence of dangerous air contamination, oxygen enrichment, or oxygen deficiency cannot be ensured by the air quality and ventilation control actions, the following steps must be taken:

1. Confined spaces with side and top openings must be entered from side openings when practicable.
2. Appropriate respiratory protection must be used in accordance with UC Berkeley Respiratory Protection Program.
3. If respiratory protection is used, at least one person trained in first aid and CPR must be immediately available outside the space.
4. An approved safety harness with an attached line of at least 1/2" diameter, 2,000 lb test, and attached outside the entry opening must be worn and used.
5. At least one person (standby), with rescue training, first aid training, and appropriate respiratory protection must be immediately available and must remain outside the confined space to give assistance in case of emergency.
6. At least one other person who may have other duties must be within sight or call of the standby person.
7. The standby can enter the confined space only in case of emergency and only after alerting at least one other person outside of the confined space of intent to enter, and the existence of an emergency.
8. An effective means of communication between the entrant(s) and the standby must be provided and tested prior to entry if respiratory protection equipment is used or if the entrant is out of sight of the standby. Each person who uses the means of communication must be trained in its use and that training must be documented.
9. If entry must be through a top opening, the following must be used:
 - a. A construction fall protection harness, so the person can be suspended in an upright position.
 - b. A hoisting device or means of lifting the person out of the space.
10. If oxygen enrichment or air contamination due to flammable and/or explosive substances could develop in the space, the use of any ignition source is prohibited, and lighting and electrical equipment that complies with the Cal/OSHA Low-Voltage Electrical Safety Orders must be used.
11. If inert gas atmospheres are used to prevent ignition or fire in a space, no source of ignition is permitted to be used unless the oxygen concentration is less than 20% of the concentration that would support combustion. In this condition, air testing must be continuous, the results must be documented, and the results must be available to employees.
12. If the space has contained materials corrosive to the skin, or that could be absorbed through the skin, personnel are required to use the appropriate personal protective equipment (PPE) to prevent contact with the corrosive materials that may remain.

Training Requirements

Before anyone is allowed to enter a confined space they must have been provided training on this Confined Space Program and that training must be documented, (e.g., training sign-in sheet), and stored in the *Shop Safety Manual* or other appropriate location.

All employees involved in the operation must be trained as shown in Part IV, “Training”, in operation and rescue procedures, and be made aware of the hazards they may encounter.

Coordinating Operations with other Employers

When UC Berkeley contracts work that involves this definition of confined space, the “Entry Supervisor” for UC Berkeley must:

1. Verify that the contractor has a Confined Space Program and enters confined spaces based upon their program.
2. Inform the contractor of the hazards associated with the confined space that have been identified by UC Berkeley.
3. Inform the contractor of any precaution or procedures UC Berkeley has used for the protection of UC Berkeley employees working near the confined space.
4. Coordinate entry operation and operations procedures with the contractor when UC Berkeley personnel will be working near or within the confined space.
5. Coordinate communications between the Contractor personnel and UC Berkeley personnel.
6. At the conclusion of the confined space operation, debrief with the contractor and discuss any hazards confronted or created during the operation.
7. Contractors who perform confined space entry operations are responsible for obtaining all the information mentioned in items 1 through 4 above.

Summary

What Must Be Done Prior To Entry?

1. Employees must be trained, and the training documented, on the use of this Confined Space Entry Program. This may include the use of the Confined Space Evaluation Form/Entry Form in Appendix C, and the use of the air monitoring equipment necessary to use that form.
2. Lines containing hazardous substances must be disconnected, blinded, or blocked.
3. The space must be emptied, flushed, or purged.
4. The air must be tested for dangerous contamination or oxygen deficiency and the results entered on the Confined Space Evaluation/Entry Form.
5. Ventilation must be provided if testing reveals any atmospheric hazard.
6. Communications methods and equipment must be determined and equipment proved functional.
7. Known hazards within the Confined Space must be analyzed and hazard controls planned / implemented. *For example, in the case of high-heat hazards, such as in the steam tunnels, hazard control means two entrants may need to be working as a team to help each other*

maintain safety and health, and personnel may need to be rotated in / out on a 15-minute frequency.

8. Personal Protective Equipment must be obtained and available for exposure controls to known hazards at the site.

What Must Be Done While Working in a Confined Space Containing Dangerous Air Contamination.

1. Appropriate respiratory protection must be provided and UC Berkeley's Respiratory Protection Program must be followed.
2. Provisions must be in place for ready entry and exit where feasible.
3. The entrant must wear a safety harness attached to a retrieval line and retrieval equipment (tripod and winch or similar).
4. One standby person must remain close to the entry point. That person must be equipped with entry gear and trained in first aid and cardiopulmonary resuscitation. Also, an additional employee must remain within sight or call distance.
5. Effective communication between the entrant and the standby person and the standby person and emergency rescuers must be operational.
6. Ongoing atmospheric testing for dangerous air contamination and oxygen deficiency must be in use whenever someone is in the confined space.
7. The standby person must continually survey the surrounding area to avoid hazards, such as vapors drifting from nearby tanks, piping, sewers, exhaust gases, or any other operations producing atmospheric hazards.

Confined Space Entry Program
for
Construction, Electrical, and Telecommunications Operations
Part III

Personnel Responsibilities

Entrant. Before entering the space, individuals authorized to work in confined spaces must comply with the following requirements:

- Complete the required training, as outlined in Table 1 of Part IV, Training.
- Ensure that all hazards are properly isolated in accordance with lockout and tagout procedures.
- Understand the hazards associated with confined spaces. Recognize the signs and symptoms of exposure, including behavioral effects, and understand the consequences of exposure to the hazards in these spaces.
- Read the Confined Space Evaluation/Entry Form and agree to abide by its conditions, including the use of PPE.
- Maintain communication with the attendant.
- Stop work and exit a confined space whenever:
 - instructed by an attendant
 - any sign/symptom of hazardous exposure is detected
 - an alarm is activated
 - danger is perceived
 - an unusual or unexplained potentially hazardous event takes place.

Attendant. Attendants must comply with the following requirements for confined-space entry:

- Complete the required training, as outlined in Table 1 of Part IV, Training.
- Read the Confined Space Evaluation/Entry Form and agree to abide by its conditions.
- Perform no other tasks (other than atmospheric monitoring, if also assigned) that might interfere with the primary duty of monitoring and protecting entrants at all times during the confined-space work.
- Provide standby assistance to entrants, and remain immediately outside the space unless relieved by another.
- Understand the hazards associated with confined spaces. Recognize the signs and symptoms of exposure, including behavioral effects, and understand the consequences of exposure to the hazards of these spaces.
- Monitor activities inside and outside the confined space for any change or condition that could adversely affect the entrants. Order the entrants to evacuate the confined space if **any** of the following is detected:
 1. A prohibited condition.
 2. Any behavioral effects caused by exposure to a hazard.
 3. A situation inside or outside the confined space that could endanger the entrants.

- Perform non-entry rescues and summon rescue or other emergency services when entrants are unable to rescue themselves. Inform rescue and/or medical personnel of the hazards in the confined space.
- Maintain continuous and effective communication with entrants.
- Take necessary measures to remove unauthorized persons who have entered or are about to enter confined spaces.

Note: Attendants, serving as atmospheric monitors must also adhere to the requirements for atmospheric monitoring personnel, below.

Atmospheric monitor. The entry supervisor, the attendant (prior to entry) and/or the entrant (during entry) may concurrently assume the role of atmospheric monitor. Atmospheric monitoring personnel must comply with the following requirements for confined-space entry:

- Complete all required training, as outlined in Table 1 of Part IV, Training.
- Determine and monitor hazards associated with the confined space by examining
 - a) the past and current uses of the area;
 - b) the physical characteristics and configurations of the space;
 - c) the potential hazards in the area, including oxygen deficiency or enrichment, flammable materials, or toxic substances (pay particular attention to contaminants that may be absorbed through the skin); and
 - d) the actual and potential biological and mechanical hazards in the area.
- Test atmospheric monitoring equipment in accordance with the manufacturer's recommendations before each use. This includes a **field test** to verify instrument performance immediately before use. Also, check that the instrument's calibration sticker is up to date.
- Perform the tests indicated on the Confined Space Evaluation/Entry Form, as well as any additional tests necessary to ensure safety. Repeat testing as needed throughout the shift to ensure safe conditions. Record all results on the confined space log or Evaluation / Entry Form.
- Ensure that atmospheric monitoring data represent all occupied areas of the confined space.
- Report any concerns regarding atmospheric test results to the entry supervisor, and work with EH&S, the confined-space owner, and entrants to resolve the problem(s).

Entry supervisor. The entry supervisor is responsible for ensuring the safety of all personnel who enter or work in the confined space(s). (The entry supervisor is usually Lead, Supervisor or Manager, but may delegate authority to another competent person to serve as lead). An entry supervisor may oversee more than one confined-space entry at a time, and is not required to remain at the entry location unless fulfilling the role of attendant.

Entry supervisors must comply with the following requirements:

- Identify the hazards associated with a confined space by examining
 - a) The past and current uses of the area;
 - b) The physical characteristics and configurations of the space;
 - c) The potential hazards in the area, including oxygen deficiency or enrichment, flammable materials, or toxic substances;
 - d) The actual and potential biological and mechanical hazards in the area; and

- e) The physical hazards, including electrical hazards and excessive temperatures, noise, or vibration.
- Understand the hazards associated with the confined space(s); recognize the signs and symptoms of exposure, including behavioral effects; and understand the consequences of exposure to the hazards of these spaces.
- Complete the required training as outlined in Table 1, of Part IV, Training, and ensure that supervised individuals have received the proper training for confined-space entry, including medical examinations and respiratory fitness testing when applicable.
- Confer with owners of confined spaces to identify hazards associated with the space; perform pre-operational review of activities; and discuss with entrants the potential hazards, appropriate safeguards, and personal protective equipment (PPE) required for the operation. Contact EH&S for assistance, if needed.
- Before completing, signing and posting the Confined Space Entry / Evaluation Form, and allowing entry, verify that the appropriate notations have been made on the form, that all tests specified on the form have been conducted, and that all procedures and equipment required for safe entry are in place.
- Cancel the Confined Space Entry / Evaluation Form authorization when unacceptable conditions exist or upon completion of the planned activities.
- Have all employees leave the area immediately if unexpected hazards arise, and re-evaluate the space before re-entry.
- Verify that a means for summoning rescue services is readily available and operable.
- Take appropriate measures to remove unauthorized entrants or would-be entrants.
- When the responsibility for a CSE Construction space entry changes at the end of a shift, transfer responsibility to another authorized entry supervisor. Ensure that the terms and conditions of the Confined Space Entry / Evaluation Form are transferred as well.
- Once work is completed, debrief with entrants and discuss and document any hazards confronted or created during the operation.
- Re-secure the space from unauthorized entry by untrained and unequipped personnel.
- File / archive the completed original Confined Space Entry / Evaluation Form for future reference. Maintain CSE documentation files for at least 30 years. Provide copies of the completed Confined Space Entry / Evaluation Form to the Department Safety Coordinator (DSC), and to the Assistant Manager – Safety at EH&S, within 10 working days.

Note: An entry supervisor may also serve as an atmospheric monitor, attendant, or entrant if trained and equipped for each role as required by this program. The duties of the entry supervisor may be passed from one individual to another during an entry operation, as long as it is noted on the Confined Space Evaluation Form/Entry Form (Appendix C) and all Entrants, Attendants and Atmospheric Monitors are immediately notified.

Entry rescue personnel. Individuals authorized to enter confined spaces for the purpose of performing rescue services must comply with the following requirements:

- Complete the required training, as outlined in Table 1 of Part IV, Training.

- Read the Confined Space Entry Evaluation / Entry Form and be knowledgeable about the identified hazards of the space.
- Ensure that all rescue equipment and PPE, including respiratory protection, is in good condition. The rescuer must be knowledgeable in the operation and use of such equipment.
- Understand the hazards associated with confined spaces. Recognize the signs and symptoms of exposure, including behavioral effects, and understand the consequences of exposure to the hazards in these spaces.
- As needed, and if it is safe to do so, initiate rescue before emergency medical services arrive. This may include safely removing incapacitated entrants from the confined space and beginning appropriate CPR and/or first-aid techniques.
- Maintain communication with the attendant during rescue entry.

The Office of Environment, Health & Safety (EH&S). EH&S provides the following services:

- Maintain this written program manual and provide associated employee training.
- When requested, help identify confined-space hazards, including providing assistance in interpreting air monitoring data.
- Provide guidance and expertise as needed on the potential hazards, appropriate safeguards, and proper PPE.
- Provide regulatory guidance regarding confined space entry.
- Provide technical guidance on the procurement and use of confined space equipment.
- As needed, develop special procedures to protect against hazards created by unique operational activities. Examples might include procedures for:
 - cleaning and decontaminating work areas and equipment,
 - performing hot-work operations in double-walled vessels, and
 - rendering an atmosphere inert.
- Provide confined space owners with specifications for posting entrances to the space.
- Collects copies of completed CSE Evaluation Forms as evidence of CSE Program activities.
- Periodically audit compliance with confined space entry and testing procedures.

Confined space owners. The confined space owner is the person (building coordinator, department safety coordinator [DSC], principal investigator [PI], and/or experimenter) who has administrative control over the confined space and understands the chemical and physical hazards associated with it. With the assistance of EH&S and the department conducting the work, confined space owners must comply with the following requirements:

- Attend the training for confined space owners as listed in Table 1 of Part IV, Training (recommended).
- Understand all hazards associated with spaces under their administrative control.
- Prior to the operation, inform the entry supervisor of the hazards and operations associated with the confined space.
- Notify EH&S when they are no longer a confined-space owner, so that any replacement can be given applicable regulatory updates and/or training on confined-space entry.

- Take appropriate measures to remove unauthorized personnel who have entered or are about to enter confined spaces under your administrative control.

Host department. Departments hiring contractors or contract labor to perform work in confined spaces must comply with the following requirements:

- Contact EH&S for a pre-operational review of contractor activities and documentation before initiating confined-space operations, if needed.
- Attend the training for host departments, as listed in Table 1 of Part IV, Training (recommended).
- Read previously completed Confined Space Evaluation Form/Entry Form (Appendix C) and be knowledgeable about the identified hazards of the space.
- Apprise the contractor of all known hazards associated with the confined space.
- Inform the contractor that the workplace contains confined spaces and that entry is allowed through their compliance with the contractor's Confined Space Entry Program.
- Apprise the contractor of any procedures or precautions that have been implemented in the past for protection of personnel entering the space.
- Ensure that the contractor and subcontractors who may enter the confined space(s) are trained by obtaining documentation substantiating training of contractor employees prior to entry.
- When UC Berkeley personnel and the contractor are working together within a confined space, assure both teams are in communication and plan safe entry and work together. (This includes procedures for Energy Isolation, atmospheric monitoring, communication, work completion, exiting strategies and emergencies).
- If unexpected hazards arise, notify the entry supervisor or attendant to have all workers leave the area immediately. Contact EH&S if conditions cannot be made safe.

Contractors. Contractors are responsible for following all requirements of applicable Cal/OSHA standards, or an equivalent program. They must provide their own entry supervisor, atmospheric monitor(s), attendants, rescue personnel, confined space testing, safety equipment, and Confined Space Evaluation Form/Entry Form (Appendix C) or similar. Contractors must provide documentation that their employees/subcontractors are trained and qualified to perform all required roles to enter a confined space under the Construction Telecommunications and Electrical Work standard.

In addition, contractors must comply with the following requirements:

- Obtain all available information regarding confined space hazards and entry procedures from the host department.
- When working jointly with host-department personnel in confined spaces, coordinate entry operations, planned work, communication and exit strategies with the host department.
- Either during the entry or through an end-of-job debriefing, inform the host department of any hazards or problems encountered in the confined space(s).

**Confined Space Entry Program
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Part IV
Training**

All personnel involved in any of the roles mentioned in Part III associated with confined space entries must complete required training (see Part IV Table 1) before proceeding with evaluation of the space, monitoring, or entry. Specifically:

- Entry supervisors, atmospheric monitors, rescue personnel, attendants, and entrants must complete “Confined Space Entry / Energy Isolation” training. Contractors must have their own CSE / Energy Isolation program that they determine meets all California CSE program requirements. This training is also recommended for confined space owners and department safety coordinators (DSCs).
- All persons serving as atmospheric monitors must also complete the “Confined Space Atmospheric Testing Course.”

Note: These courses are offered by EH&S, and must be re-taken every two years. Equivalent coursework from outside training firms is acceptable only if pre-approved by EH&S.

- For confined spaces with unknown or unsure air quality, confined space entrants, attendants, and standby rescue personnel must be currently qualified in standard first aid and CPR, and trained on respiratory hazards and protection.
- In addition to the generic confined space training listed in Table 1, all participants must receive site-specific training on all anticipated hazards and applicable safe work practices before entering confined spaces. Any employee serving in more than one role must complete training for all additional roles.
- For Construction Telecommunications and Electrical Work confined spaces, a training certification document must be produced for each participant in confined space projects. The certificate must include the employee’s name, the trainer’s signature, and the training date. The certificate must be available for inspection at each confined space entry project.

Table 1. Training Requirements for Confined-Space Entry

Program Roles	Confined-Space Entry/Energy Isolation*	Atmospheric Testing	Respiratory Protection	First Aid/ CPR	Entry Rescue
Manager/supervisor	O	O			
Confined-space owner	O	O			
Entry supervisor	X	O	O	O	
Atmospheric monitor	X	X	O	O	
Entrant	X	X	X	X	
Attendant	X	X	X	X	
Standby entry rescue personnel	X	X	X	X	X
Host department & / or Contractor	O	O			

X = Required
O = Recommended

COMPLIANCE WITH THESE PROCEDURES

All faculty, staff, students, contractors, and confined space owners are required to comply with the procedures established in this manual and its appendices. Failure to comply will result in standard progressive disciplinary measures in accordance with the applicable personnel policy, labor contract, or code of conduct. Employees who fail to follow confined space entry procedures will have their confined space entry authorization revoked, and must attend re-training before being allowed any future entry into a confined space. Such training may be performed by the entry supervisor or by EH&S.

Contractors who fail to comply may have their contract terminated or have imposed other measures afforded by the contract terms.

Confined Space Entry Program for Construction, Electrical, and Telecommunications Operations Part V

Hazards of a Confined Space

Entering a confined space is done usually to perform a necessary function, such as inspection, repair, maintenance (cleaning or painting), telecommunications and electrical utility work performed in manholes and unvented vaults, cutting or welding in confined spaces, Work in excavations or trenches that could develop hazardous atmospheres, work in sewers, manholes, pits, traps or similar operations which would be an infrequent or irregular function of the total Maintenance activities.

Entry may also be made during new construction. Potential hazards should be easier to recognize during construction since the confined space has not been used. One of the most difficult entries to control is that of unauthorized entry, especially when there are large numbers of workers and trades involved, such as welders, painters, and electricians.

Confined spaces include tanks, silos, ducts, pipelines, sumps, boilers, casings, sewers, pits, trenches, utility vaults, and similar locations. All need detailed evaluation for entry due to the potential presence of chemical, physical, mechanical, and/or other hazards.

Chemical Hazards:

Some of the chemical hazards of entering confined spaces include the presence of;

- Flammable/explosive atmospheres,
- Toxic/hazardous atmospheres,
- Corrosive exposures, and
- Asphyxiating atmospheres.

Flammability/Explosive:

A flammable atmosphere generally arises from enriched oxygen atmospheres, vaporization of flammable liquids, byproducts of work, chemical reactions, concentrations of combustible dusts, and desorption/off gassing of chemical from inner surfaces of the confined space.

An atmosphere becomes flammable when the ratio of oxygen to combustible material in the air is neither too rich nor too lean for combustion to occur. Combustible gases or vapors will accumulate when there is inadequate ventilation in areas such as a confined space. Flammable gases such as acetylene, butane, propane, hydrogen, methane, natural or manufactured gases or vapors from liquid hydrocarbons can be trapped in confined spaces, and since many gases are heavier than air, they will seek lower levels as in pits, sewers, and various types of storage tanks and vessels. The byproducts of work procedures can generate flammable or explosive conditions within a confined space. Specific kinds of work such as spray painting can result in the release of explosive gases or vapors. Welding in a confined space is a major cause of explosions in areas that contain combustible gas.

Asphyxiation:

Our normal atmosphere is composed approximately of **20.9% oxygen and 78.1% nitrogen, and 1% argon**. The consumption of oxygen takes place during combustion of flammable substances, as in **welding, heating, cutting, and brazing**. A more subtle consumption of oxygen occurs during **bacterial action**, as in the fermentation process. Oxygen may also be consumed during **chemical reactions** as in the formation of rust on the exposed surface of the confined space (iron oxide). The ventilation air should not create an additional hazard due to recirculation of contaminants, location of the air inlet duct where airborne contaminants may be introduced, or by the substitution of anything other than fresh air.

The **number of people** working in a confined space and the amount of their physical activity will also influence the oxygen consumption rate.

Oxygen deficiency can also be caused by **displacement by another gas**. Examples of gases that are used to displace air, and therefore reduce the oxygen level are helium, argon, and nitrogen. Carbon dioxide may also be used to displace air and can occur naturally in sewers, storage bins, wells, and tunnels.

Gases such as nitrogen, argon, helium, and carbon dioxide, are frequently referred to as **non-toxic inert gases** but have claimed many lives. The use of nitrogen to inert a confined space has claimed more lives than carbon dioxide. Carbon dioxide and argon, with specific gravities greater than air, may lie in a tank or manhole for hours or days after opening. Since these gases are **colorless and odorless**, they pose an immediate hazard to health unless appropriate oxygen measurements and ventilation are adequately carried out.

Corrosive:

Common corrosive irritants which can be present in confined spaces include chlorine, ozone, hydrochloric acid, hydrofluoric acid, sulfuric acid, nitrogen dioxide, ammonia, and sulfur dioxide. The past use (history) of the space may require the need for surface/atmospheric testing.

Toxicity:

Carbon monoxide (CO) is a hazardous gas that may build up in a confined space. This odorless, colorless gas that has approximately the same density as air is formed from incomplete combustion of organic materials such as wood, coal, gas, oil, and gasoline; it can be formed from microbial decomposition of organic matter in sewers, silos, and fermentation tanks. Carbon monoxide is an insidious toxic gas because of its poor warning properties. Early stages of CO intoxication are nausea and headache. Carbon monoxide may be fatal at 1000 ppm in air, and is considered dangerous at 200 ppm, because it forms carboxyhemoglobin in the blood which prevents the distribution of oxygen in the body.

Mechanical Hazards:

Lockout/Tagout/Static Charges

The most hazardous kind of confined space is the type that combines limited access and mechanical devices. If activation of electrical or mechanical equipment would cause injury, each piece of equipment should be **manually isolated** (lockout/tagout) to prevent inadvertent activation before workers enter or while they work in a confined space. The **interplay of hazards** associated with a confined space, such as the potential of flammable vapors or gases being present, and the build-up of static charge due to mechanical cleaning, such as abrasive blasting, all influence the precautions which must be taken.

Vapor Leaks

To prevent **vapor leaks, flashbacks, and other hazards**, workers should completely isolate the space. To completely isolate a confined space, the closing of valves is not sufficient. All pipes must be physically disconnected or isolation blanks bolted in place. Other special precautions must be taken in cases where flammable liquids or vapors may re-contaminate the confined space. The pipes blanked or disconnected should be inspected and tested for leakage to check the effectiveness of the procedure. Other areas of concern are steam valves, pressure lines, and chemical transfer pipes.

Noise

Noise problems are usually intensified in confined spaces because the interior tends to cause sound to reverberate and thus expose the worker to higher sound levels than those found in an open environment. This intensified noise increases the **risk of hearing damage** to workers which in a confined space may not be intense enough to cause hearing damage may still **disrupt verbal communication** with the emergency standby person on the exterior of the confined space. If the workers inside are not able to hear commands or danger signals due to excessive noise, the probability of severe accidents can increase.

Vibration

Whole body vibration may affect multiple body parts and organs depending upon the vibration characteristics. Segmental vibration, unlike whole body vibration, appears to be more localized in creating injury to the fingers and hands of workers using tools, such as pneumatic hammers, rotary grinders or other hand tools which cause vibration.

Cutting & Welding in Confined Spaces:

Hazards result from the fumes, gases, sparks, hot metal and radiant energy produced during hot work and should not be conducted in the presence of explosive mixtures of flammable gases, vapors, liquids, or dusts or where explosive mixtures could develop inside improperly prepared tanks or equipment. Atmospheric testing and monitoring for combustible gases and vapors should be done before work begins and at regular, predetermined intervals thereafter. Ventilation of the work site, either through local or general exhaust ventilation, should be adequate for the work performed.

Scaffolding:

Some physical hazards cannot be eliminated because of the nature of the confined space or the work to be performed. The use of scaffolding in confined spaces has contributed to many accidents caused by workers or materials falling, improper use of guard rails, and lack of maintenance to insure worker safety. The choice of scaffolding depends upon the type of work, the calculated weight to be supported, the surface on which the scaffolding is placed, and the substance previously stored in the confined space.

Surface Residues

Surface residues in confined spaces can increase the already hazardous conditions of electrical shock, reaction of incompatible materials, liberation of toxic substances, and bodily injury due to slips and falls. Without protective clothing, additional hazards to health may arise due to surface residues.

Structural Hazards:

Typical internal structure hazards within a confined space include baffles in horizontal tanks, trays in vertical towers, bends in tunnels, overhead structural members, or scaffolding (above) installed for maintenance. Workers must review these hazards plus implement and enforce safety precautions to manage these hazards.

Communication Hazards:

Communication between the worker inside and the standby person outside is of utmost importance. If the worker should **suddenly feel distressed** and not be able to summon help, an injury could become a fatality. Frequently, the body positions that are assumed in a confined space make it difficult for the standby person to detect an unconscious worker. When visual monitoring of the worker is not possible because of the design of the confined space or location of the entry hatch, a **voice or alarm-activated explosion proof type of communication** system will be necessary. Suitable illumination of an approved type is also required.

Physical Hazards:

Entry & Exit

Entry and exit time is of major significance as a physical limitation and is directly related to the potential hazard of the confined space. The extent of precautions taken and the standby equipment needed to maintain a safe work area will be determined by the means of access and rescue. The following should be considered: type of confined space to be entered, access to the entrance, number and size of openings, barriers within the space, the occupancy load, and the time requirement for exiting in event of fire or vapor incursion, and the time required to rescue injured workers.

Thermal Effects:

Heat

Four factors influence the heat exchange in confined spaces: (1) air temperature, (2) air velocity, (3) moisture contained in the air, and (4) radiant heat. Ventilation of the confined space is critical since moisture content and radiant heat are difficult to control. Workers will continue to function until the

body temperature reaches approximately 102°F. Above this level, workers are less efficient, and are prone to heat exhaustion, heat cramps, or heat stroke.

Cold

In a cold environment, physiologic mechanisms tend to limit heat loss and increase heat production. The most severe strain in cold conditions is chilling of the extremities so that activity is restricted. Special precautions must be taken in cold environments. Using **protective insulated clothing** for both hot and cold environments will add additional bulk to the worker and must be considered in allowing for movement in the confined space and exit time. Therefore, air temperature of the environment becomes an important consideration when evaluating working conditions in confined spaces.

Rescue:

Rescue procedures may require withdrawal of an injured or unconscious person. Rescue from confined spaces must be carefully planned with attention given to the relationship between the internal structure, the exit opening, and the worker. If the worker is above the opening, the system must include a rescue arrangement operated from outside the confined space, if possible, by which the employee can be lowered and removed without injury.

Personal Protective Equipment (PPE) and Entry Equipment:

Personal protective equipment (gloves, boots, safety glasses, coats, etc.) may be necessary and is usually required for safe entry into confined spaces. Entry Equipment may include equipment for atmospheric testing, ventilation, communication, lighting, and rescue. Personal protective equipment appropriate for the hazards of the space must also be provided to workers.

Contractors:

Departments must inform outside contractors of the potential hazards that may be encountered during their work at the University. This includes giving the contractor access to any information available on the confined spaces involved in their project.

Similarly, the contractor must inform the Department of any changes made to a confined space in the course of their work. Any change, no matter how minor, would require a re-evaluation of the space before entry would again be allowed.

UC Berkeley Confined Space Entry Program for Construction, Electrical, and Telecommunications Operations

Appendix A: Glossary of Terms

Acceptable entry conditions. Prerequisite conditions for safe entry into and work in a confined space.

Attendant. An individual stationed outside of a Construction-Telecommunications confined space to monitor authorized entrants and summon help as needed.

Atmospheric monitor. A trained individual qualified in the use of atmospheric testing equipment, who determines if atmospheric hazards are present within a confined space.

Atmospheric testing. The process of identifying and evaluating atmospheric hazards in a Construction-Telecommunication confined space using real-time monitoring instrumentation. Atmospheric monitoring must include tests for combustibility, toxicity, and proper oxygen levels. Atmospheric testing enables entry supervisors to devise and implement adequate control measures for the protection of entrants, and to determine if acceptable entry conditions are present immediately before and during entry.

Blanking or blinding. The absolute closure of a pipe, line, or duct by application of a solid plate (e.g., a spectacle blind or skillet blind) that completely covers the bore and can withstand the maximum pressure of the pipe, line, or duct without leaking.

Confined space (construction, electrical, and telecommunications industry definition, §5158):

Concurrent existence of the following conditions:

- (1) insufficient existing ventilation to remove dangerous air contamination and actual or potential oxygen enrichment and/or deficiency, and
- (2) insufficient ready access or egress for the removal of a suddenly disabled employee, due to the location and/or size of the opening(s).

Confined space owner. The person (building coordinator, department safety coordinator [DSC], principal investigator [PI], and/or experimenter) who has administrative control over the confined space, and who has knowledge of the chemical and/or physical hazards associated with it.

Construction, Electrical and Telecommunications related to confined space operations in Part II. According to Cal/OSHA 8 CCR §1502. Application. (a) These Orders establish minimum safety standards whenever employment exists in connection with the construction, alteration, painting, repairing, construction maintenance, renovation, removal, or wrecking of any fixed structure or its parts. These Orders also apply to all excavations not covered by other safety orders for a specific industry or operation.

Contractor. A person not directly employed by the University who is contracted to perform work on University property, which may include confined space entry.

Double-block-and-bleed. The closure of a pipe, line, or duct by first closing, locking, and tagging two in-line valves, and then opening and locking or tagging a drain or vent valve in the line between the two closed valves.

Emergency. Any event or occurrence internal or external to a confined space (including failure of hazard controls or monitoring equipment) that could endanger entrants.

Engulfment. The surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can (1) be aspirated and cause death by filling or plugging the respiratory system, or (2) exert enough force on the body to cause death by strangulation, constriction, or crushing.

Entrant. An individual authorized to enter a Construction, Electrical or Telecommunications confined space.

Entry. The action by which a person passes through an opening into a Construction, Electrical or Telecommunications confined space. "Entry" includes work activities within the space, and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.

Entry supervisor. The individual (supervisor, foreman, lead, or other designated person) responsible for (1) overseeing operations at the confined space, (2) ensuring that all entry conditions are met, (3) authorizing entry, and (4) transferring and/or terminating the entry.

Exhaust ventilation. The method of removing contaminants from a confined space by using localized suction at the source of the contaminant.

Forced-air ventilation. The method of diluting or dissipating actual or potentially hazardous atmospheres to safe levels in a confined space by using mechanical blowers to push air into the space. Forced-air ventilation may be required on confined spaces with hazardous atmospheres, and may be used in combination with exhaust ventilation.

Hazardous atmosphere. An atmosphere that exposes employees to risk of death, incapacitation, acute illness, or impairment of the ability to rescue themselves. A hazardous atmosphere can occur from one or more of the following causes:

- Flammable gas, vapor, or mist greater than 10 percent of the lower flammable limit (LFL);
- Airborne combustible dust at a concentration that meets or exceeds its LFL;
- Oxygen concentration of less than 19.5 percent or greater than 23.5 percent;
- Carbon monoxide greater than 35 ppm;
- Hydrogen sulfide greater than 10 ppm; and/or
- Any airborne contaminant that may expose a worker above the contaminant's permissible exposure limit (PEL) or be "immediately dangerous to life or health" (see below).

Hot-work. Operations employing potential source(s) of ignition (e.g., welding, cutting, burning, soldering, and heating).

Immediately dangerous to life or health. Any condition that poses an immediate or delayed threat to life, would cause irreversible adverse health effects, or would interfere with an individual's ability to escape unaided from a Construction, Electrical or Telecommunications confined space.

Inerting (rendering inert). The displacement of flammable gases from a system (piping, pressure, etc.) by injecting a non-combustible inert gas such as nitrogen.

Isolation. The process by which a Construction, Electrical or Telecommunications confined space is removed from service and completely protected from release of energy and material into the space by any of the following means:

- Blanking, blinding, misaligning, or removing sections of lines, pipes, or duct;
- Using a double-block-and-bleed system;
- Locking or tagging out all sources of energy; and/or
- Blocking or disconnecting all mechanical linkages.

Lockout and tagout (LOTO). The process by which hazards are locked out or tagged out, providing personnel with complete protection against chemical, electrical, and mechanical energies. For more information, obtain a copy of *Lockout and Tagout: Procedures to Control Hazardous Energies* from EH&S.

Non-entry rescue. Use of a retrieval system to remove ill or injured entrants from a confined space without entering the space.

Oxygen-deficient atmosphere. An atmosphere containing less than 19.5 percent oxygen by volume.

Oxygen-enriched atmosphere. An atmosphere containing more than 23.5 percent oxygen by volume.

Prohibited condition. Any condition not allowed in a Construction, Electrical or Telecommunications confined space during the period when entry is authorized.

Retrieval system. The equipment (including a retrieval line; chest or full-body harness; wristlets, if appropriate; and a lifting device and anchor) used for non-entry rescue of persons from a Construction, Electrical or Telecommunications confined space.

Standby rescue service or team. Personnel trained and designated to enter confined spaces for the purpose of rescuing ill or injured entrants.

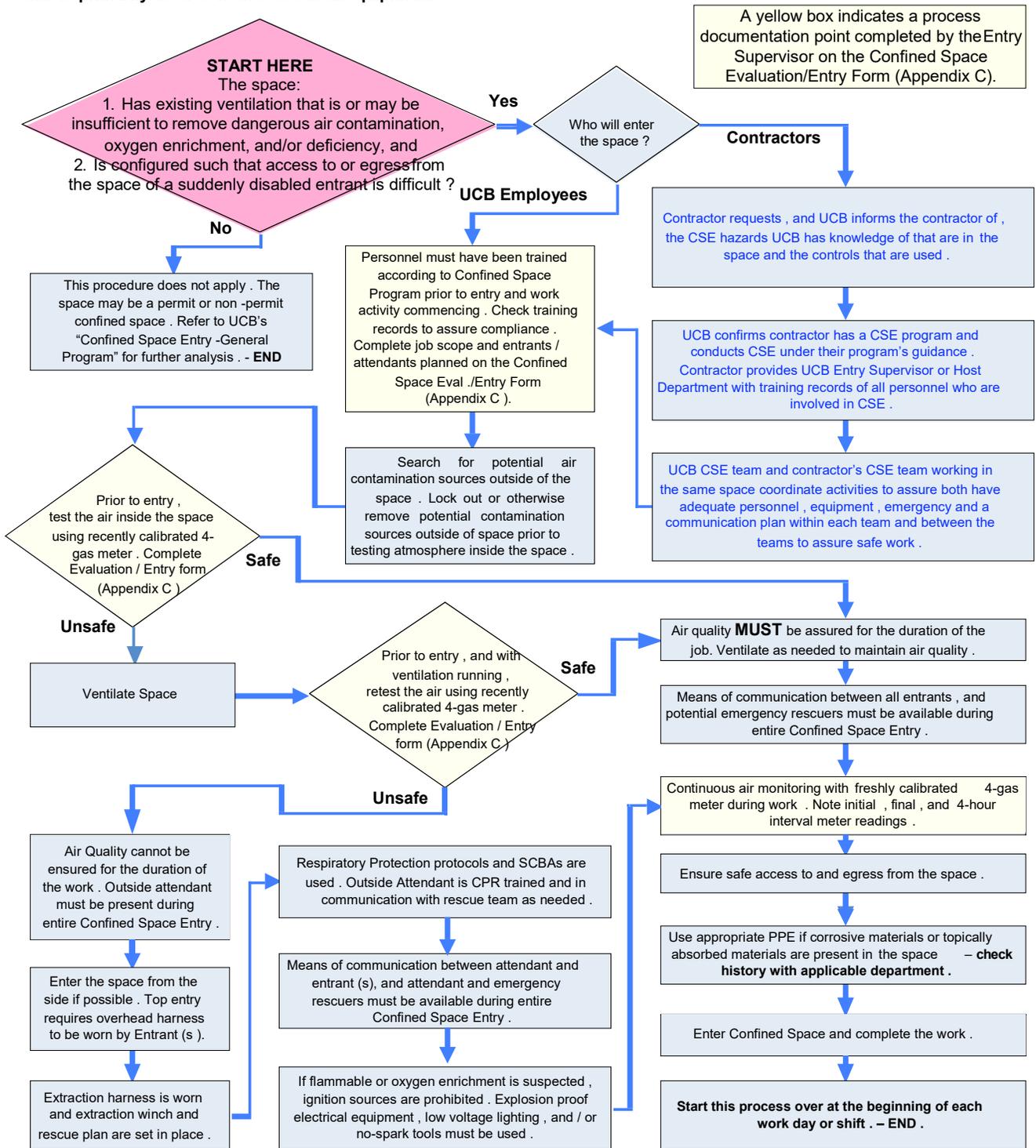
Appendix B: Confined Space Entry Program Flow Chart

CONSTRUCTION CONFINED SPACE ENTRY (CSE) - EVALUATION FLOW CHART

Confined Space Entry Program for Construction, Electrical, Telecommunications or an Excavation.

Apply this program whenever:

1. Employment exists in connection with the construction, alteration, painting, repairing, construction maintenance, renovation, removal, or wrecking of any fixed structure or its parts, or when
2. Accessing telecommunications or electrical manholes or vaults made of fire-resistant construction, that is primarily used to house electrical equipment.



Appendix C: Confined Space Evaluation/Entry Form

Location/description: _____ Date/Time: _____

Scope of work: _____

Type of Confined Space work (Check one): Construction/Maintenance ___ Non-Permit Required ___

Verification of Atmosphere Analysis: Instrument No.: _____ Battery Charged? YES _ NO _
 Date Calibrated: _____ Date Charged: _____

Initial monitoring:

Instrument Reading

Test	Acceptable Levels	Initial Result	4 th Hour Result	8 th Hour Result	Other Result
Oxygen	19.5% – 23.5%				
Carbon-dioxide CO ₂	5000 ppm PEL TWA				
Carbon-monoxide CO	25 ppm PEL TWA				
Flammable* -	≤10% LEL =				
Toxic: _____					
Toxic: _____					

Ventilation (if necessary):

Air Movement (CFM)	Size of Space (Cubic feet)	Ventilation Time

Concurrent / Post-ventilation monitoring:

Instrument Reading

Test	Acceptable Levels	Initial Result	4 th Hour Result	8 th Hour Result	Other Result
Oxygen	19.5% – 23.5%				
Carbon-dioxide CO ₂	5000 ppm PEL TWA				
Carbon-monoxide CO	25 ppm PEL TWA				
Flammable* -	≤10% LEL =				
Toxic: _____					
Toxic: _____					

*Enter flammable(s) present and 10% of LEL. Use the back of this form to log additional flammables or toxics monitored, or additional instrument readings as necessary.

Other hazards controlled*

Potential Hazard	Control
1. _____	1. _____
2. _____	2. _____

*Use the back of this form to log additional potential hazards and controls as necessary.

Entrant 1 (printed name(s)) _____ Attendant (printed name) _____

Entrant 2 _____ Entrant 3 _____ Entrant 4 _____

Rescue Personnel (printed names) 1. _____ 2. _____

Space evaluation conducted by: _____

 Signature Date

Debriefing: Please note any hazards confronted or created during CSE work and suggestions for safe future entry on the back of this form.

Appendix D: Confined Space Entry Procedures for Specific Campus Locations

UCB STEAM TUNNEL - CONFINED SPACE ENTRY (CSE) PROCEDURE - FLOW CHART

Maintenance and Repair work in the UCB Steam Tunnel falls under the compliance codes for Construction, Electrical, or Telecommunications (Title 8 Section 5158). If you need to enter the steam tunnel, follow this procedure to assure your safety within the tunnel.

