

Confined Space Entry Program

University of California, Berkeley

APPLICATION:

Apply this program whenever the space is:

1. Large enough and configured so that an employee can bodily enter and perform assigned work, and is
2. Limited or has restricted access for entry or exit, and is
3. Not designed for continuous occupancy, and

The space has one or more of the following qualities:

1. Contains or has a potential to contain a hazardous atmosphere, or
2. Contains a material that has the potential for engulfing an entrant, or
3. Has an internal configuration such that an entrant could be trapped or asphyxiated by an inwardly converging wall or by a floor which slopes downward and tapers to a smaller cross-section, or
4. Contains any other known serious safety or health hazard.

DO NOT apply this program whenever:

1. Employment or work takes place 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.

Instead, apply UC Berkeley's Confined Space Entry Program for Construction, Telecommunications Operations and Electrical work.

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UC Berkeley Confined Space Entry Program

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* manual outlines the procedures, practices, and requirements necessary to ensure the safety of personnel working inside confined spaces. 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,

§5156–5157, Confined-Space Entry Procedures

DEFINITION OF A CONFINED SPACE

A confined space as it applies to all operations including research related operations that are NOT classified as construction and maintenance¹, must have all three of the following conditions:

- It is large enough to permit an individual to enter and perform assigned work.
- It has limited or restricted means of entry or exit.
- It is not designed for continuous human occupancy.

In addition, the confined spaces are further classified into one of two categories: “Permit-Required” and “Non-permit Required.” These are defined as follows:

PERMIT-REQUIRED CONFINED SPACE (Part II of this Program): A confined space that has one or more of the following characteristics in addition to the three conditions listed above:

¹ §Cal/OSHA 8 CCR 1502. Application. [Defines ‘construction and maintenance’] whenever employment exists in connection with the construction, alteration, painting, repairing, construction maintenance, renovation, removal, or wrecking of any fixed structure or its parts. [And also applies to] all excavations not covered by other safety orders for a specific industry or operation. [For spaces that fall under the Construction and Maintenance definition, apply UC Berkeley’s Confined Space Entry Program for Construction, Telecommunications Operations and Electrical Work.]

- It contains an uncontrollable hazardous atmosphere, or
- It contains material that has the potential to engulf an entrant, or
- It has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls, or a floor that slopes downward and tapers to a smaller cross section, or
- It contains any other recognized serious safety or health hazard.

Examples of potential “Permit-required” confined spaces include fuel tanks, waste-retention tanks, boiler vessels, storage silos with sloping bottoms, and some types of transformer vaults.

NON-PERMIT CONFINED SPACE (Part III of this Program): A confined space that contains no hazard capable of causing death or serious physical harm.

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 PROGRAM 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 (Program Parts II or III).
4. Based upon the type of confined space, 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.
8. Staging of emergency response equipment to be immediately available for use should a rescue be needed.

The evaluation and plan is documented on the appropriate log, form, or permit, and is considered part of a training record. Apply the procedural flow chart (Appendix B) to evaluate and determine if a 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 in the Confined Space Entry Procedures for Entrant Supervisors found in Program Parts II and III.

UC Berkeley Confined Space Entry Program

Part II

Permit-Required Confined Space

Space Classification:

A permit-required confined space is a space that has all of the following characteristics:

1. Is large enough and configured so that an employee can bodily enter and perform assigned work; and
2. Has limited or restricted means for entry or exit; and
3. Is not designed for continuous occupancy.

A permit-required confined space also must have one or more of the following characteristics:

1. Contains or has a potential to contain a hazardous atmosphere; or
2. Contains a material that has the potential for engulfing an entrant; or
3. Has an internal configuration such that an entrant could be trapped or asphyxiated by an inwardly converging wall or by a floor which slopes downward and tapers to a smaller cross-section; or
4. Contains any other recognized serious safety or health hazard.

If the space being evaluated does not meet the above criteria, it is not a “Permit-Required Confined Space” and likely may be classified and entered under the less stringent “Non-permit Required Confined Space” procedure as outlined in Part III of this program.

Who may enter a permit-required confined space?

It is recommended that UC Berkeley employees avoid entering permit-required confined spaces. If such entry is unavoidable, extensive training (including rescue training) is required beforehand (see Part IV, “Personnel Responsibilities”, and Part V, “Training”). Contractors may be hired to perform work in permit-required confined spaces if they comply with all applicable Cal/OSHA permit-required confined-space regulations. Requirements for contractors are shown in the Coordinating Operations with Other Employers section of this part of the program.

Permit-required Confined Space Procedures for Entrant Supervisors

Permit-Required Confined-Space Entry Procedure <i>When trenching or excavating, apply the procedural flow chart (Appendix B) to determine if a confined space exists, and how this program is to be applied to it.</i>
Secure the space from unauthorized entry by untrained and unequipped personnel.
Ensure, by inspecting their training certificates, that personnel (entrants and attendants) have received appropriate training.
Permit only authorized personnel to enter these spaces. Supervisors may only authorize employees to enter confined spaces who have been trained in the permit-required or non-permit confined-space entry procedures.
Complete a written Confined-Space Entry Permit (Appendix D) including defining the scope of work requiring entry and post it near the entry point. (It is not necessary to complete a Confined-Space Evaluation/Entry Form (Appendix C) in addition to the permit.)
Ensure that at least one employee (attendant) will remain outside the space to assist the entrant(s) and initiate non-entry rescue if necessary. The attendant must be capable of and equipped for contacting emergency response services. The attendant must be capable of conducting a non-entry rescue if necessary and be trained in non-entry rescue techniques and qualified in standard first aid and CPR, and trained on respiratory hazards and protection.
Prior to entry, evaluate the space for hazards by following the Confined-Space Evaluation/Entry Form. This includes monitoring the air for potential hazardous atmospheres, identifying sources of stored energy, and noting any other hazard that may cause serious injury or death.
Control identified hazards prior to entry. Provide adequate ventilation to remove or prevent the generation of a hazardous atmosphere. Lock out and tag out sources of stored energy. Remove standing water and other liquids or hazardous materials.
Install barricades or otherwise isolate the workspace to prevent unauthorized entry.
Continually monitor the space for potential atmospheric and other hazards, including those identified during the course of work.
Provide non-entry rescue equipment as appropriate, and use as necessary.
Purge and ventilate the space for actual or potential atmospheric hazards.
Test the atmosphere before and during entry into, and occupancy of, the confined space.
Ensure two-way communication between the attendant and entrants inside the confined space.
Provide all appropriate personal protective equipment (PPE), and use as necessary.
Provide non-entry rescue equipment, unless it increases the risk of injury.
Designate properly trained and equipped standby entry rescue personnel.
Allow work to commence in the space until the scope of the work is completed.
Once work is completed, debrief with entrants and discuss any hazards confronted or created during the operation.
Re-secure the space from unauthorized entry by untrained and unequipped personnel.

If unexpected hazards arise, all employees within a confined space must immediately exit the space. If the Entry Supervisor cannot control the hazard(s), the Office of Environment, Health & Safety (EH&S) must be notified to understand the problems and re-evaluate the space before re-entry.

No entry into a permit-required confined space is allowed until all permit-noted precautions have been taken, requirements met, and personal protective equipment (PPE) employed. The entry supervisor must brief entrants, attendants, and atmospheric monitors (if other than the entry supervisor) on their responsibilities, and on the hazards and controls for safe entry. In addition, proper use of emergency equipment must have been demonstrated to and by all personnel.

Training Requirements

Before anyone is allowed to enter or have any other role associated with a confined space, they must be trained on this Confined Space Program and acquire the understanding, knowledge, and skills for the safe performance of their duties. The training must be updated in the event any changes of procedures or unforeseen hazards have been recognized. That training must be documented as a certificate and include the employee's name, the trainer's signature, and the date of the training. (See Training Requirements in "Training", Part V.)

Coordinating Operations with other Employers

When UC Berkeley contracts work that involves this definition of confined space or a permit-required or non-permit confined space, the "Entry Supervisor" or "Host Department" 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 the confined space.
5. At the conclusion of the confined space operation, debrief with the contractor and discuss any hazards confronted or created during the operation.
6. Contractors who perform confined space entry operations are responsible for obtaining all the information mentioned in items 1 through 4 above.

UC Berkeley Confined Space Entry

Program Part III

Non-Permit-Required Confined Space

Space Classification:

A Non-Permit-Required Confined Space is a space that has all of the following characteristics:

1. Is large enough and configured so that an employee can bodily enter and perform assigned work; and
2. Has limited or restricted means for entry or exit; and
3. Is not designed for continuous occupancy; and

Also has the following characteristic:

Does not contain (or have the potential to contain) any hazard capable of causing death or serious physical harm.

Non-Permit Required Confined Space Procedures for Entrant Supervisors

Non-Permit Confined Space Entry Procedures:
Secure the space from unauthorized entry by untrained and unequipped personnel.
Ensure, by inspecting their training certificate, that personnel (entrants and attendants) have received appropriate training.
Permit only authorized personnel to enter these spaces. Entrant Supervisors may only authorize employees trained in non-permit required confined-space entry procedures to enter the space.
On the Confined Space Evaluation/Entry Form (Appendix C), define the scope of work requiring entry.
Ensure that at least one employee (attendant) will remain outside the space to assist the entrant(s) and initiate non-entry rescue if necessary. The attendant must be capable of and equipped for contacting emergency response services. The attendant must be capable of conducting a non-entry rescue if necessary.
Prior to entry, evaluate the space for hazards by following the Confined-Space Evaluation/Entry Form. This includes monitoring the air for potential hazardous atmospheres, identifying sources of stored energy, and noting any other hazard that may cause serious injury or death.
Control identified hazards prior to entry. Provide adequate ventilation to remove or prevent the generation of a hazardous atmosphere. Lock out and tag out sources of stored energy. Remove standing water and other liquids or hazardous materials.
Install barricades or otherwise isolate the workspace to prevent unauthorized entry.
Continually monitor the space for potential atmospheric and other hazards, including those identified during the course of work.

Provide non-entry rescue equipment as appropriate, and use as necessary unless it increases the risk of injury.
Ensure two-way communication between the attendant and entrants inside the confined space.
Provide all appropriate personal protective equipment (PPE), and use as necessary.
Designate properly trained and equipped standby entry rescue personnel.
Allow work to commence in the space until the scope of the work is completed.
Once work is completed, debrief with entrants and discuss any hazards confronted or created during the operation.
Re-secure the space from unauthorized entry by untrained and unequipped personnel.

Training Requirements

Before anyone is allowed to enter or have any other role associated with a confined space they must have been provided training on this Confined Space Program and acquire the understanding, knowledge, and skills for the safe performance of their duties. The training must be updated in the event any changes of procedures or unforeseen hazards have been recognized. That training must be documented as a certificate, and include the employee's name, the trainer's signature, and the date of the training. See Training Requirements in "Training", Part V.

Coordinating Operations with other Employers

When UC Berkeley contracts work that involves entry into a permit required or non-permit confined space, the "Entry Supervisor" or "Host Department" 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 spaces 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 the confined space.
5. At the conclusion of the confined space operation, debrief with the contractor and discuss any hazards confronted or created during the operation.
6. Contractors who perform confined space entry operations are responsible for obtaining all the information mentioned in items 1 through 4 above.

UC Berkeley Confined Space Entry Program

Part IV

Personnel Responsibilities

These roles apply to both Permit Required and Non-Permit Required Confined Space Entry procedures used in this Program.

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 V, Training.
- Ensure that equipment is 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 (Appendix C) or Permit (Appendix D) and agree to abide by its conditions, including the use of personal protective equipment (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 V, Training.
- Read the Confined Space Evaluation/Entry Form (Appendix C) or Permit (Appendix D) 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 a permit-required confined 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 and/or attendant 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 V, 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 or Permit, 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 permit.
- 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 Permit-required and Non-permit Required confined spaces. (The entry supervisor is usually a line supervisor, Lead, or Manager, but may delegate authority to another competent person to serve as lead). An entry supervisor may oversee more than one permit-required 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 confined spaces; 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 V, 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 permit and allowing entry, verify that the appropriate notations have been made on the permit, that all tests specified on the permit have been conducted, and that all procedures and equipment specified on the permit are in place.
 - Cancel the permit authorization when unacceptable conditions exist or upon completion of the permitted 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 permit space entry changes at the end of a shift, transfer responsibility to another authorized entry supervisor. Ensure that the terms and conditions of the permit 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, or the Permit, for future reference. Maintain CSE documentation files for at least 30 years. Provide copies of the completed Confined Space Entry / Evaluation Form, or the Permit, 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 permit.

Standby entry rescue personnel. Individuals authorized to enter permit-required 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 V, Training.

- Read the Confined Space Evaluation/Entry Form (Appendix C) or Permit (Appendix D) 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 or Permits 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 V, ‘Recommended’ Training.

- Understand all hazards associated with spaces under their administrative control.
- Post all permit-required confined spaces with warning signs that read

DANGER
PERMIT-REQUIRED CONFINED SPACE
DO NOT ENTER

- Prior to the operation, inform the entry supervisor of the hazards and operations associated with the confined space.
- Notify EH&S when you 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 permit-required and non-permit required 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 V, Training (recommended).
- Read the Confined Space Entry Permit and be knowledgeable about the identified hazards of the space.
- Apprise the contractor of all hazards associated with the confined space.
- Inform the contractor that the workplace contains permit-required spaces and that entry is allowed only through 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 follows these procedures when working in or around the permit-required confined 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.
- Periodically audit the contractor's compliance with procedures for confined space entry.

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 entry permits. Contractors must provide documentation that their employees/subcontractors are trained and qualified to perform all required roles to enter a permit-required confined space.

In addition, contractors must comply with the following requirements:

- Obtain all available information regarding permit-required confined space hazards and entry procedures from the host department.
- When working jointly with host-department personnel in confined spaces, coordinate entry operations 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 permit-required confined spaces.

UC Berkeley Confined Space Entry Program

Part V

Training

All personnel involved in any of the roles mentioned in Part IV associated with confined space entries must complete required training (see 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.

- Permit-required 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 both permit and non-permit 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 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.

UC Berkeley Confined Space Entry Program

Part VI

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, and potentially permits, for entry due to the 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 1,000 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

Appendix A: Glossary of Terms

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

Attendant. An individual stationed outside of a permit-required 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 permit-required 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, Non-Permit and Permit Required (general-industry definition, §5157):

An enclosed area that;

- (1) is large enough and configured such that an employee can bodily enter and perform assigned work, but that
- (2) has limited or restricted means for entry or exit; and that
- (3) is not designed for continuous human occupancy. *See also "permit-required confined space" and "non-permit confined space." See Appendix B for determination of classification.*

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.

Contractor. A person not directly employed by the University who is contracted to perform work on campus, 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 permit-required 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 permit-required confined space.

Entry. The action by which a person passes through an opening into a permit-required 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 permit. The written or printed document that allows and controls entry into a permit-required confined space and documents termination of the operation.

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 permit.

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 is required on all permit-required confined spaces, 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 permit-required 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 permit-required 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.

Non-permit confined space. A confined space, according to the definitions in Part IV, and does not contain (or, with respect to atmospheric hazards, have the potential to contain) any hazard capable of causing death or serious physical harm.

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.

Permit-required confined space. A confined space, according to the definitions in Part III, and containing one or more of the following:

- A hazardous atmosphere.
- A material with the potential to engulf an entrant.
- An internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section.
- Any other serious safety or health hazards (exposed electrical equipment, mechanical machinery, extreme heat or cold, chemical and/or biological hazards, etc.).

Examples of potential permit-required confined spaces include sanitary sewer maintenance holes, waste-retention tanks, boiler vessels, and transformer tanks. (*See appendix B for determination of classification.*)

Prohibited condition. Any condition not allowed in a permit-required 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 permit-required confined spaces.

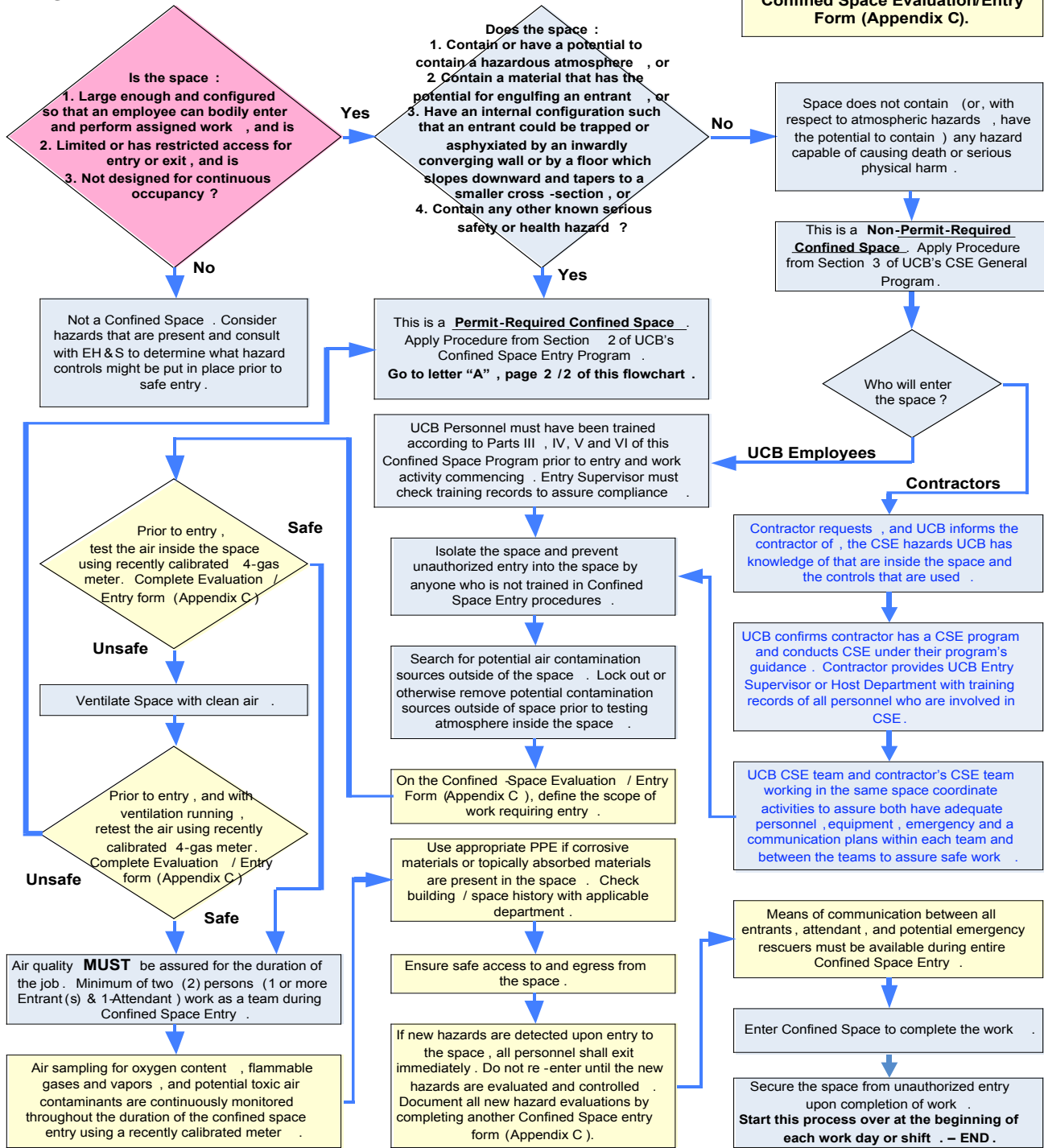
Standby rescue service or team. Personnel trained and designated to enter confined spaces for the purpose of rescuing ill or injured entrants.

Appendix B: Confined Space Entry Program Flow Chart

Confined Space Entry (CSE) Program and Program Flow Chart for Non-Permit CSE.

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A yellow box indicates a process documentation point completed by the Entry Supervisor on the Confined Space Evaluation/Entry Form (Appendix C).



APPENDIX D
UC Berkeley
PERMIT- REQUIRED CONFINED SPACE ENTRY PERMIT

DATE ISSUED:	START TIME:	END TIME:										
1. THIS PERMIT MUST BE COMPLETED BY ENTRY PERSONNEL AND RECEIVE ENTRY SUPERVISOR AUTHORIZATION PRIOR TO ENTRY. 2. KEEP THIS PERMIT AT THE WORK SITE DURING ENTRY OPERATION. RETURN COMPLETED PERMIT TO THE ENTRY SUPERVISOR WHEN FINISHED. 3. PERMIT IS VALID FOR EIGHT (8) HOURS ONLY. A SEPARATE PERMIT IS REQUIRED FOR EACH 8-HOUR ENTRY PERIOD.												
LOCATION/BUILDING:	ROOM/AREA:											
TYPE OF CONFINED SPACE (I.E. MANHOLE, WETWELL, VAULT, ETC.):												
PURPOSE OF ENTRY:												
ENTRY SUPERVISOR: (print names)		ATTENDANT:										
AUTHORIZED ENTRANT(S) <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;"><u>NAME</u></th> <th><u>TRAINING DATE</u></th> </tr> </thead> <tbody> <tr><td>1.</td><td></td></tr> <tr><td>2.</td><td></td></tr> <tr><td>3.</td><td></td></tr> <tr><td>4.</td><td></td></tr> </tbody> </table>		<u>NAME</u>	<u>TRAINING DATE</u>	1.		2.		3.		4.		COMMUNICATION PLAN/EQUIPMENT: (Describe)
<u>NAME</u>	<u>TRAINING DATE</u>											
1.												
2.												
3.												
4.												

	<u>POTENTIAL HAZARDS</u>				<u>PRECAUTIONS TAKEN BEFORE ENTRY</u>						
	<u>Yes</u>	<u>No</u>	<u>Yes</u>	<u>No</u>	<u>Yes</u>	<u>No</u>	<u>Yes</u>	<u>No</u>			
Moving Equipment	—	—	Oxygen Deficiency	—	—	Lockout Equipment	—	—	First Aid Kit Onsite	—	—
Toxic Vapor	—	—	Oxygen Enrichment	—	—	Lockout Input Lines	—	—	Protective Clothing	—	—
Unknown Chemicals	—	—	Heat	—	—	Lockout Valves	—	—	Eye Protection	—	—
Flammables / Combustibles	—	—	Chemical Input Lines	—	—	Pipes Blanked	—	—	Fire Extinguisher	—	—
Poor Ventilation	—	—	Steam Input Lines	—	—	Test Oxygen	—	—	Hearing Protection	—	—
Corrosive Materials	—	—	Water Input Lines	—	—	Test for Toxic Vapor	—	—	Complete Hot Work Permit	—	—
Inadequate Light	—	—	Sludge	—	—	Provide Ventilation	—	—	Secure Area-barricades/signs	—	—
Dust	—	—	Falling Objects	—	—	Purge Space with Air	—	—	Lighting (explosion proof)	—	—
Electrical Shock	—	—	Entrant Visibility	—	—	Read MSDS(s)	—	—	Use Non-sparkling Tools	—	—
Difficult Entry/Exit	—	—	Poor Communication	—	—	Tripod and Harness	—	—	Ground Fault	—	—
Venomous Insects	—	—	Other:	—	—	Respirator Onsite	—	—	Rescue Team Ready**	—	—

RESCUE TEAM: BERKELEY FIRE DEPT. (CONTACT PRIOR TO ENTRY)	BERKELEY FIRE CONTACT: (print name)	PHONE:	DATE/TIME CONTACTED:				
ATMOSPHERIC MONITORING RESULTS							
INSTRUMENT NO.:		BATTERY CHARGED: YES ___ NO ___		DATE CHARGED:		DATE CALIBRATED:	
GAS	LIMIT	INITIAL RESULT	2ND HOUR RESULT	4TH HOUR RESULT	6TH HOUR RESULT	8TH HOUR RESULT	
OXYGEN	19.5% - 23.5%						
CARBON DIOXIDE	<5000 PPM						
CARBON MONOXIDE	<25 PPM						
FLAMMABLES 1. 2. 3.	<10% LEL						
OTHER 1. 2. 3.							
Initials and Note TIME TESTED:							
PERSON PERFORMING TESTING: (print name)							
MONITOR CONTINUOUSLY, RECORDING RESULTS EVERY TWO HOURS. RETEST AFTER BREAKS AND LUNCH.							

SUPERVISOR AUTHORIZING ENTRY

Emergency Phone Numbers:

PRINTED NAME: PHONE:	Fire Dept.:	Land Line : 911 Using Cell Phone :
	Ambulance: Police:	
SIGNATURE:	DATE:	

Debriefing: Note any hazards confronted / created during Permit work and suggestions for safe future entry.

Appendix E: Confined Space Entry Procedures for Specific Campus Locations

[EH&S WILL ADD IN LOCATION-SPECIFIC PROCEDURES IN THIS SECTION AS THEY ARE DEVELOPED BY HOST DEPARTMENTS AND SENT TO EH&S.]