



CONFINED SPACE PROGRAM

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Chapter 1: Introduction

Every year employees are killed as a result of hazardous conditions in confined spaces. Approximately 60% of these fatalities are would-be rescuers who enter these spaces in an attempt to retrieve the fallen individual(s), only to be overcome and become victims themselves.

As part of routine maintenance activities many Purdue University employees and contractors are required to enter potentially hazardous enclosed spaces. Confined spaces may have atmospheric conditions and/or physical hazards present and include: manholes, wet-wells, vaults, tanks, boilers, silos, bins, pits, sumps, and sanitary and storm sewers. Toxic and/or flammable gases and vapors may accumulate in these locations as a result of insufficient ventilation and deficient oxygen levels may be present as the result of corrosion and/or organic debris digestion. In addition, limited access to these locations complicates the retrieval of anyone incapacitated.

In accordance with the OSHA standard the regulations listed below provide minimum requirements for safe entry into these locations:

- Electrical Transmission and Distribution – 29 CFR 1910.269
- Permit-required Confined Spaces – 29 CFR 1910.146
- **Telecommunications** – 29 CFR 1910.268

This manual contains the procedures and practices for safe entry into locations, used at Purdue University, falling under the above regulations.

1.1 Scope

The provisions of this program pertain to locations required to be entered by an employee(s) that either meet the definition or the description as outlined in the following regulations:

Permit-required Confined Spaces – 29 CFR 1910.146

Non-permit required Confined Spaces

- Electrical Transmission and Distribution - 29 CFR 1910.269 e(1-14) and t(1-8)
- **Telecommunications** - 29 CFR 1910.268 o(1-5)

1.2 Applicability

This program shall apply to all personnel at Purdue University's West Lafayette Campus, Regional Campuses, University Farms and Agricultural Centers, and related facilities and operations.

1.3 Policy

It is the policy of Purdue University to take every reasonable precaution to provide a work environment free from recognized hazards for its employees in accordance with the General Duty Clause of the OSHA Act (Public Law 91-596 Section 5 (a)(1) and in accordance with any more applicable specific OSHA standards. Purdue University's policy document is entitled Environmental Health and Safety Compliance.

1.4 General Requirements

The University, in accordance with State and Federal regulations, has implemented this program to ensure safe entry into confined spaces. Before entry all potential hazards must be identified and controlled. A formalized training program has been designed to enable employees to recognize potential hazards and take the appropriate actions to control those hazards. For most work operations in electrical and telecommunication manholes safeguards and controls can be completed without entry into the location and in such cases the permit system is not required. However, if entrance into the enclosed space is required to implement hazard controls then the permit-required confined space program must be used.

1.5 Responsibilities

Each utility group is responsible for reviewing the locations within their respective areas to identify either known or suspect confined space locations. This information shall be provided to the Radiological and Environmental Management for final status determination.

- **Supervisors** must identify locations and provide a list of employees requiring training.
 - **NOTE:** Supervisors are required to attend training in accordance with the regulations pertaining to the locations their employees are required to enter.
- **Employees** must complete the training as required by their supervisors and to follow the procedures as outlined in the training when entering a confined space. A written exam will be given to provide documentation of training proficiency. They should also assist in identifying potential confined space locations and notify their supervisor if they witness an unsafe entry.
- **Radiological and Environmental Management (REM).** The Director of Radiological and Environmental Management (REM), or designees, shall be responsible for establishing

and maintaining the Confined Space Entry Program. REM is responsible for maintaining current location listings of both permit-required and non-permit required confined spaces; generating and updating the written confined space program, maintaining files on completed permits; identifying and approving equipment needed for safe entry; conducting and maintaining calibration and calibration records on air monitoring meters, (see form CS-5); and to provide training and maintain training records.

- **Fire Department** will assume the responsibility of the on-site rescue team and the on-site first-aid responder.

1.6 Contractor Requirements

Any work at the University in confined spaces must be conducted in accordance with the regulations specific to that location. Contractors must have a written confined space program that complies with the regulation pertinent to the areas to be entered. All contractors must provide copies of their written program(s) and employee training documentation to the contracting shop/department. Contractors are also responsible to supply all needed equipment to perform safe entry. For permit required confined entries the contractor shall complete form CS-4 Contractor Debriefing with a University representative and provide a copy to the University. In addition, contractors are required to coordinate emergency rescue notification with Purdue Fire Department using Form CS-2.

When a contractor is required to enter or work in proximity to a permit required confined space, the contracting department will furnish a written copy of the hazards identified in that space to the contractor.

1.7 Definitions

Acceptable Entry Conditions: Means the conditions that must exist in a space to allow entry and to ensure that the employees involved with a confined space entry can safely enter into and work within the space.

Attendant: An individual stationed outside one or more spaces who monitors the authorized entrants and who performs all attendant's duties assigned in the employer's confined space program.

Authorized Entrant: An employee who is authorized by the employer to enter a confined space.

Blanking or Blinding: The absolute closure of a pipe, line, or duct by the fastening of a solid plate (such as a spectacle blind or a skillet blind) that completely covers the bore and that is

capable of withstanding the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.

Confined Space: Is defined as a space that...

- Is large enough and so configured that an employee can bodily enter and perform assigned work; and
- Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry); and
- Is not designed for continuous employee occupancy.

Double block and Bleed: The closure of a line, duct, or pipe by closing and locking or tagging two inline valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.

Emergency: Any occurrence (including any failure of hazard control or monitoring equipment) or event(s) internal or external to the confined space, which could endanger entrants.

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

Entry: The act by which a person intentionally passes through an opening into a permit required confined space. Entry includes ensuing work activities in that 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 provided by the employer to allow and control entry into a permit space and that contains the information specified in section (f) of the Permit Required Confined Space standard. Refer to forms CS-1 and CS-2 in Appendix 1 of the written program. Form CS-2 is required at the West Lafayette campus only. This form or an equivalent form may be requested by the regional campus' Response Rescue Team (e.g. responding fire department).

- The entry permit:
 - Defines the conditions under which the permit space may be entered.
 - States the reason(s) for entering the space.

- Lists the anticipated hazards of the entry.
- For entries where the individual authorizing the entry does not assume direct charge of the entry:
 - Lists the eligible attendants, entrants, and the individuals who may be in charge of the entry; and
 - Establishes the length of time for which the permit may remain valid.
 - Establishes special procedures, hot work permits etc. that are required to ensure safe entry and work operations.

Entry Supervisor: The person (such as the employee, foreman, or crew chief) responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry.

NOTE: An entry supervisor may also serve as an attendant or as an entrant, as long as that person is trained and equipped as required by this program for each role he or she fills. Also, the duties of entry supervisor may be passed from one individual to another during the course of an entry operation.

Hazardous Atmosphere: An atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is escape unaided from a permit space); injury, or acute illness from one or more of the following causes:

- Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL);
- Airborne combustible dust at a concentration that meets or exceeds its LFL;
 - **NOTE:** This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet (1.52 m) or less.
- Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;
- Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in Subpart G, Occupational Health and Environmental Control, or in Subpart Z, Toxic and Hazardous Substances, of this part and which could result in employee exposure in excess of its dose or permissible exposure limit;
 - **NOTE:** An atmospheric concentration of any substance that is not capable of causing death, incapacitation, and impairment of ability to self-rescue, injury, or acute illness due to its health effects is not covered by this provision.
- Any other atmospheric condition that is immediately dangerous to life or health.
 - **NOTE:** For air contaminants for which OSHA has not determined a dose or permissible exposure limit, other sources of information, such as Material Safety Data Sheets, published information, and internal documents can provide guidance in establishing acceptable atmospheric conditions.

Hot Work Permit: The employer's written authorization to perform operations, which could provide a source of ignition, such as riveting, welding, cutting, burning, or heating.

Immediately Dangerous to Life or Health (IDLH): Any condition, which poses an immediate threat of loss of life, may result in irreversible or immediate severe health effects, may result in eye damage, irritation or other conditions which could impair escape from the permit space.

Immediate Severe Health Effects: Any acute clinical sign(s) of a serious, exposure-related reaction manifested within 72 hours after exposure.

Inerting: Means the displacement of the atmosphere in a permit required space by a noncombustible gas (such as nitrogen) to such an extent that the resulting atmosphere is noncombustible. It is a process of rendering the atmosphere of a permit required space non-flammable, non-explosive, or otherwise chemically non-reactive by such means as displacing or diluting the original atmosphere with steam or a gas that is non-reactive with respect to that space.

NOTE: .This procedure produces an IDLH oxygen-deficient atmosphere.

Isolation: The process by which a permit space is removed from service and completely protected against the release of energy and material into the space by such means as: blanking or blinding; misaligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tag-out of all sources of energy or mechanical linkages.

Line Breaking: The intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic material, an inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.

Non-Permitted Confined Space: A confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or egregious physical harm. A location that is governed by specific regulations may require special procedures to ensure all hazards are controlled before entry (i.e. telecommunications manholes or high voltage manholes).

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 (Permit Space): A confined space that has one or more of the following characteristics:

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

Permit Required Confined Space Program: The employer's overall program for controlling, and where appropriate, for protecting employees from, permit space hazards and for regulating employee entry into permit spaces.

Permit System: The employer's written procedures for preparing and issuing permits for entry and for returning the permit space to service following termination of entry.

Prohibited Condition: Any condition in a permit space that is not allowed by the permit during the period when entry is authorized.

Rescue Service: The personnel designated to rescue employees from confined spaces (such as Purdue Fire Department at the West Lafayette Campus).

Retrieval System: The equipment (including a retrieval line, chest or full-body harness, wrist-lets, and a lifting device or anchor) used for non-entry rescue of persons from permit spaces.

Testing: The process by which the atmospheric hazards that may confront entrants of a space are identified and evaluated. Testing includes specifying the tests that are to be performed in the space.

NOTE: Testing enables employers both to devise and implement adequate control measures for the protection of authorized entrants and to determine if acceptable entry conditions are present immediately prior to and during entry.

Chapter 2: Permit Required Confined Space Program

For confined space locations containing atmospheric or physical hazards, where neither the electrical generation and distribution nor telecommunication regulations apply, the permit – required confined space regulation (29 CFR 1910.146) must be used. The provisions of this regulation require the employer to provide the means, procedures, training, and equipment to mitigate hazards. In addition documentation is required to verify compliance through the use of a written permit. The permit required confined space program has the following components:

- **Location Listings and Hazard Identification:** A list of permit-required confined spaces locations. The listing contains the location information, including a map when possible, and identifies the hazards of each location. The master list will be maintained by Radiological and Environmental Management and updated annually.
- **Employee Training:** REM shall provide training to all employees required to enter permit-required confined spaces and electrical and telecommunications manholes. Training must be conducted before the employee can participate in entries.
- **Permit System:** A written permit (form CS-1) must be completed at the entry location and before entry occurs to identify hazards, hazard controls, verification of availability of emergency rescue team, and listing entry team members. Form CS-2 must be completed and delivered to Purdue fire department at least 24 hours before the entry is to occur. The duration of the permit is a maximum of 24 hours. Completed permits are the responsibility of the initiating department to maintain.
- **Safety Equipment:** Safety equipment for use in permit-required confined space entry or confined space entry shall be approved by REM. REM will calibrate confined space entry monitors in accordance with manufacture specifications. Purchase and repair costs for equipment shall be the responsibility of the department owning the equipment.
- **Special Hazards:** Special permits may be required (i.e. burn permit) where welding or an open flame is to be used inside a building and also involves permit-confined space entry.

2.1 Purpose, Scope, and Policy

This section outlines the practices and procedures to protect Purdue University employees and contract employees from the hazards associated with permit required confined space entry, as specified in OSHA’s Confined Space Standard 29 CFR 1910.146. This document shall serve as the written program and shall apply to all personnel at Purdue University West Lafayette campus, regional campuses, University Research Farms, Agriculture Centers, and related facilities and operations. Furthermore, this section shall apply to all permit required confined spaces, or any

non-permit-required space that becomes a permit-required space by introduction a new hazard, unless there is a more applicable standard.

The Director of Radiological and Environmental Management (REM) or designees shall be responsible for establishing and maintaining the Permit-Required Confined Space Entry Program. It is the policy of Purdue University, as required by the OSHA Permit-Required Confined Space Standard 29 CFR 1910.146, to ensure that atmospheric and physical hazards be identified associated with confined spaces and that this information and safe entry requirements be communicated to employees responsible for entry into such space.

2.2 OSHA Requirements

2.2.1 The Supervisor shall:

- Identify confined space(s) encountered by his/her employees, submit a list of the confined spaces identified to REM, and post or distribute the list to affected employees. The list shall include:
 - Location
 - Physical dimensions and construction
 - Reason for employee entry
 - Potential hazards
 - Frequency of entry
- Submit the confined space list to REM within 60 days of the effective date of this program.
- Update the confined space list annually and whenever there are changes affecting work conditions or when new confined spaces are identified.
- Ensure that all associated safety equipment is maintained and routinely inspected.
- Submit a list of affected employees to REM.
- Update the list of affected employees whenever there are additions or deletions.
- Attend training for individuals in charge of or authorizing the entry or designating such individuals.
- Assure affected employees receive training as outlined below:
 - Employees working in proximity to permit required confined spaces shall receive awareness training that shall consists of:
 - Understanding what constitutes a confined space
 - Identification of potential hazards requiring permit entry procedures
 - Employees who are required to enter any location defined as a permit entry required confined space shall receive confined space entry training:
 - Before there is a change in assigned duties;

- Whenever there is a change in permit space operations that presents a hazard about which an employee has not been previously trained and;
 - Whenever the employer has reason to believe that there are deviations from the permit space entry procedure required by this program or that there are inadequacies in the employee's knowledge or use of these procedures.
- The procedures and practices necessary for safe permit-required confined space entry, as outlined in the confined space training manual, include:
 - Specifying acceptable entry conditions;
 - Isolating the permit required space;
 - Purging, inerting, flushing, or ventilating the permit-required space to eliminate or control atmospheric hazards;
 - Providing pedestrian, vehicle or other barriers, as necessary, to protect the entrant from external hazards and;
 - Verifying that conditions in the permit-required space are acceptable for entry for the duration of an authorized entry.
- Ensure that procedures and entry permits are accurately completed and reviewed, and keep appropriate employee training and confined space entry permit records. Completed permits shall be maintained for a period of at least 1-year from the date of termination. Training records shall be maintained for at least 1 year from the date of an affected employee's termination.
- Contact REM before entry into any potential or known IDLH confined space is allowed. See the Purdue Respiratory Protection Program for requirements before entry into an IDLH condition (available from REM).
- Ensure that confined space entry equipment is properly maintained and stored.
- Ensure that all entry permits are completed and signed upon termination of entry and appropriately filed or submitted to REM.

2.2.2 The Employee shall:

- Notify the supervisor of any confined space encountered not on the confined space list.
- Notify his/her supervisor whenever work operations may require a hot work permit or work operations may result in chemical exposure or generation of hazardous atmosphere.
- Attend permit entry confined space training.
- Report to the supervisor jobs requiring entry into permit entry confined spaces.

- Comply with the requirements outlined when directly involved in entry of permit-confined spaces.
- Maintain training certificate and have available for inspection.

2.2.3 Radiological and Environmental Management shall:

- Develop the written Confined Space Program and revise the program as necessary.
- Approve all monitoring equipment, safety equipment, and materials for safe work operations.
- Conduct all employee training.
- Approve employees to serve as authorized attendants, entrants, or entry supervisor.
- Establish employee proficiency in the duties required, including new or revised procedures. Certification shall contain each employee's name, signature of trainer, and date of training.
- Inspect [potential] Permit Confined Space locations for determination of hazards.
- Provide signs for Permit Entry Confined Spaces.
- Provide periodic calibration of confined space entry monitoring equipment.
- Annually review completed permits.

2.2.4 Responding Fire Departments shall:

- Assume the role of the "In-Plant Rescue Team."
- Ensure that at least one member of each rescue team maintains current certification in basic first aid and cardiopulmonary resuscitation (CPR).
- Inspect and maintain emergency retrieval equipment.
- Conduct rescue team practice at least annually, simulating permit space rescues in which team member remove dummies, mannequins or personnel through representative openings and portals whose size, configuration and accessibility closely approximate those of the permit spaces from which rescues may be required.

2.3 General Requirements

Hazard Identification: Each permit space shall be identified and evaluated, including a determination of the severity of the hazard. The supervisory staff shall report potential permit spaces to REM. REM shall maintain a listing of all permit spaces.

Permit System: A written permit system shall be utilized for entry into permit spaces. REM shall develop the written permit system.

Employee Information: Signs shall be posted where feasible near permit spaces to notify employees what hazards may be present and that only authorized entrants may enter the permit space. Where signage is not feasible, potentially exposed employees shall be trained with regard to the danger of unauthorized entry of permit spaces. REM shall be responsible for arranging signage of permit spaces.

Prevention of Unauthorized Entry: Unauthorized entry into permit spaces shall be prevented. Prevention measures include training, signs, and security measures. All employees in or around confined spaces shall attend confined space awareness training.

Equipment: Including: testing, monitoring, communication and personal protective equipment, shall be provided, maintained, and properly used. REM will specify minimum equipment requirements for each permit space.

Rescue: Rescue procedures and equipment shall be in place prior to entry into a permit space. The use of retrieval equipment shall be required where there exists a potential for an IDLH atmosphere, engulfment, or vertical entries. There must be adequate attachment points outside the confined space for tying-off or otherwise securing retrieval lines for all authorized entrants. Where retrieval lines themselves could constitute an entanglement hazard or otherwise cannot be used, an equivalent method for rescue shall be used.

Protection from External Hazards: Barriers necessary to protect entrants from external hazards (pedestrian, vehicle, etc.) shall be in place prior to entry into a permit space.

2.4 Conditions for Permit Entry without a Permit

The alternate procedure below may be used, provided that the following conditions are met:

- All employees involved in the entry (entry supervisor, entrant, and attendant) shall have received the training required by this program.
- The only existing hazard in the permit space is an actual or potential hazardous atmosphere;
- Continuous forced air ventilation is sufficient to maintain a safe atmosphere for entry.
- Monitoring and inspection data is developed showing that the only existing hazard was atmospheric and that forced air ventilation is adequate in removing the hazard, and this information is documented and made available to each entrant; and
- Ventilation and monitoring of the space is adequately conducted without entry. If entry is necessary, all procedures of permit entry must be followed.

- For entries performed without a permit, which meet the set conditions above, the following entry procedure shall be used and documented using form CS-3:
- Any conditions making it unsafe to remove an entrance cover shall be eliminated before the cover is removed.
- When entrance covers are removed, the opening shall be promptly guarded by a railing, cover, or other temporary barrier that will prevent an accidental fall through the opening and that will protect each employee working in the space.
- Before an employee enters the space, the internal atmosphere shall be tested with a calibrated direct-reading instrument for the following conditions and in the order given:
 - Oxygen content,
 - Flammable gases and vapors, and
 - Potential toxic air contaminants.
- There may be no hazardous atmosphere within the space whenever any employee is inside.
- Continuous forced air ventilation shall be used, as follows:
 - An employee may not enter the space until the forced air ventilation has eliminated any hazardous atmosphere;
 - The forced air ventilation shall be directed as to ventilate the immediate areas where an employee is or will be present within the space and shall continue until all employees have left the space; and
 - The air supply for the forced air ventilation shall be from a clean source and may not increase the hazards in the space.
- The atmosphere within the space shall be periodically tested as necessary to ensure that the continuous forced air ventilation is preventing the accumulation of a hazardous atmosphere.
- If a hazardous atmosphere is detected during entry:
 - Each employee shall leave the space immediately;
 - The space shall be evaluated to determine how the hazardous atmosphere developed; and;
 - Measures shall be implemented to protect employees from the hazardous atmosphere before any subsequent entry takes place.
- The authorized entry supervisor shall verify that the space is safe for entry and that the measures required in Reclassification of Permit to Non-permit Space section have been taken. This is accomplished by a written certification containing the date, the location of the space, and the signature of the person providing the certification. The certification shall be made available to each employee entering the space.

Conditions for Space Reclassification - Non-Permit to Permit Space: When there are changes in the use or configuration of a non-permit confined space that might increase the hazards to entrants, REM shall re-evaluate the space and, if necessary, reclassify it as a permit required confined space.

Conditions for Space Reclassification - Permit to Non-Permit: A space classified, as a permit required confined space might be reclassified as a non-permit confined space under the following procedure:

- If the permit space possesses no actual or potential atmospheric hazards and if all hazards within the space are eliminated without entry into the space, the permit space may be reclassified as a non-permit confined space for as long as the non-atmospheric hazards remain eliminated.
- If it is necessary to enter the permit space to eliminate the hazards, such entry shall be performed under the permit entry system of this program. If testing and inspection during that entry demonstrate that the hazards within the permit space are eliminated the space may be reclassified as a non-permit confined space for as long as the hazards remain eliminated.
- The maintenance work area is responsible for documenting that all hazards in a permit space have been eliminated using through a certification that contains the date, location of the space, and the signature of the person making the determination. The certification shall be available to each employee entering the space.
- If hazards arise within a permit space that has been declassified to a non-permit space, each employee in the space shall exit the space. REM shall then reevaluate the space and determine whether it must be reclassified as a permit space, in accordance with other applicable provisions of this program.

Duty to other Employers (Contractors) - When Purdue University arranges to have employees of another employer (Contractor) perform work that involves permit space entry, the supervising department shall:

- Inform the contractor that the workplace contains permit spaces and that permit space entry is allowed only through compliance with a permit space program meeting the requirements of this program.
- Apprise the contractor of the elements, including the hazards identified and the University's experience with the space that make the space in question a permit space.
- Apprise the contractor of any precautions or procedures the University has implemented for the protection of employees in or near permit spaces where contractor personnel will be working.

- Coordinate entry operations with the contractor, when both University personnel and contractor will be working in or near permit spaces. When employees of more than one employer are working simultaneously as authorized entrants in a permit space, the entry operations of one employer shall not endanger the employees of any other employer.
- Debrief the contractor at the conclusion of the entry operations regarding the permit space program followed and regarding any hazards confronted or created in permit spaces during entry operations and complete Form CS-4 and return to REM.

Contractor Requirements In addition to complying with the permit space requirements that apply to all employers, each contractor who is retained to perform permit space entry operations shall:

- Obtain any available information regarding permit space hazards and entry operations from the supervising department.
- Coordinate entry operations with the supervising department when both University personnel and contractor personnel will be working in or near permit spaces, as required by this program.
- Inform the supervising department of the permit space program that the contractor will follow and of any hazards confronted or created in permit spaces, either through a debriefing (see Form CS-4) or during the entry.
- Coordinate emergency rescue availability using Form CS-2.

2.5 The Permit Confined Space Entry Program Shall Consists of:

Implementation of the necessary measures to prevent unauthorized entry.

Identification and Evaluation of the hazards of permit spaces before entry.

Following means, procedures, and practices necessary for safe permit space entry as outlined in the confined space training manual including any:

- Specifying acceptable entry conditions.
- Isolation of the permit space.
- Purging, inerting, flushing, or ventilating the permit space as to eliminate or control atmospheric hazards.
- Provision for pedestrian, vehicle or other barriers as necessary to protect entrant from external hazards.

- Verification that conditions in the permit space is acceptable for entry throughout the duration of an authorized entry.

The supervising department shall provide the following equipment listed below at no cost to the employee:

- Testing and monitoring equipment needed to evaluate oxygen content, explosive gases/vapor concentrations and specific toxic agents (e.g., carbon monoxide, hydrogen sulfide), that is within factory calibration.
- Ventilating equipment needed to obtain acceptable entry conditions.
- Communications equipment necessary for summoning rescue and emergency services.
- Personal protective equipment where feasible engineering and work practice controls do not adequately protect employees.
- Proper electrical and lighting equipment needed to enable employees to see well enough to work safely and exit the space.
- Barriers and shields as required protecting the entrant from external hazards.
- Equipment, such as ladders, needed for safe ingress and egress by authorized entrants.
- Rescue and emergency equipment, except equipment provided by rescue services.
- Any other equipment necessary for safe entry into and rescue from permit spaces.

Evaluate permit space conditions as follows when entry operations are conducted:

- Conditions shall be tested in the permit space to determine if acceptable entry conditions exist before entry is authorized to begin except if isolation of the space is because the space is large or is part of a continuous system (such as a sewer). Pre-entry testing shall be performed to the extent feasible before entry is authorized and, if entry is authorized, entry conditions shall be continuously monitored in the areas where authorized entrants are working.
- Test or monitor the permit space as necessary to determine if acceptable entry conditions are being maintained during the course of entry operations.
- When testing for atmospheric hazards, test first for oxygen, then for combustible gases and vapors, and then for toxic gases or vapors.
 - **NOTE:** Atmospheric testing for sewer entry: Minimum tests are oxygen deficiency, lower explosive limit and hydrogen sulfide concentration.
- At least one attendant shall be provided outside the permit space into which entry is authorized for the duration of entry operations.
- If multiple spaces are to be monitored by a single attendant, include in the permit program the means and procedures to enable the attendant to respond to an

emergency affecting one or more of the permit spaces being monitored without distraction from the attendant's responsibilities as outlined under "Duties of Attendant(s)" section of this document.

- Individuals shall be designated on the entry permit who are to have active roles (as, for example, authorized entrants, attendants, entry supervisors, or persons who test or monitor the atmosphere in a permit space) in entry operations, identify the duties of such employees, and provide each with the training specified in the "Training" section.
- Procedures for summoning rescue and emergency services, for rescuing entrants from permit spaces, and/or providing necessary emergency services to rescued employees and for preventing unauthorized personnel from attempting a rescue.
- A system for the preparation, issuance, use, and cancellation of entry permits.
- Procedures to coordinate entry operations when employees of more than one employer are working simultaneously as authorized entrants in a permit space, so that employees of one employer do not endanger the employees of any other employer.
- Procedures (such as closing off a permit space and canceling the permit) necessary for concluding the entry after entry operations have been completed.
- Review entry operations when there is reason to believe that the measures taken under the permit space program may not protect employees, and revise the program to correct deficiencies found to exist before subsequent entries are authorized.
 - **NOTE:** examples of circumstances requiring the review of the permit required confined space program are any unauthorized entry of permit space, the detection of a permit space hazards not covered by the permit, the detection of a condition prohibited by the permit, the occurrence of an injury or near-miss during entry, a change in the use or configuration of a permit space, and employee complaints about the effectiveness of the program.
- Review the permit required confined space program using the canceled permits and revise the program as necessary to ensure that employees participating in entry operations are protected from permit space hazards.

2.6 Permit System

The Entry Permit form, CS-1, shall be completed before authorizing entry into the permit-required confined space. Before the entry begins:

- Hazard determination measures shall be documented by preparing an entry permit as outlined below.
- The entry supervisor, identified on the permit, shall sign the entry permit to authorize entry.

The entry supervisor shall terminate entry and cancel the entry permit when:

- The entry operation covered by the entry permit has been completed; or
- A condition that is not allowed under the entry permit arises in or near the permit space.

The supervising department shall retain each canceled entry permit for at least 1 year to facilitate the review of the permit required confined space program. Any problems encountered during an entry operation shall be noted on the permit so that appropriate revisions to the permit space program can be made.

2.6.1 Entry Permit

The entry permit authorizing entry into a permit space shall identify:

- C.1.1** The permit space to be entered.
- C.1.2** The purpose of the entry.
- C.1.3** The date and duration of the authorized entry permit.
- C.1.4** The name of each authorized entrants within the space.
- C.1.5** The personnel, by name, currently serving as entry supervisor, with a space for the signature or initials of the entry supervisor who originally authorized entry.
- C.1.6** The hazards of the permit space to be entered.
- C.1.7** The measures used to isolate the permit space and to eliminate or control permit space hazards before entry.
- C.1.8** The acceptable entry conditions.
- C.1.9** The results of initial and periodic tests accompanied by the names or initials of the testers and by an indication of when the tests were performed.
- C.1.10** The rescue and emergency services available and the means (such as the equipment to be used and numbers to call) for summoning those services.
- C.1.11** The communication procedures used by authorized entrants and attendants to maintain contact during the entry.
- C.1.12** Equipment, such as personal protective equipment, testing equipment, communications equipment, alarm systems, and rescue equipment to be provided.
- C.1.13** Any other information whose inclusion is necessary, given the circumstances of the particular confined space, in order to ensure employee safety.
- C.1.14** Any additional permits, such as for hot work, issued to authorized work in the permit space.

The authorized entry permit shall be made available at the time of entry to all authorized entrants, by posting it at the entry portal or by any other equally effective means; so that the entrants can confirm that pre-entry preparations have been completed.

The duration of the permit may not exceed the time required to complete the assigned task or job identified on the permit in accordance with the purpose of the entry.

2.7 Training

Confined space awareness training shall be provided for University employees not required to enter permit required confined spaces as a part of their job duties, but who work in proximity to these areas. Awareness training shall consist of:

- Understanding what constitutes a confined space.
- Identifying potential hazards requiring permit entry procedures.

Confined space entry training shall be provided for employees required, in the course of completing their job duties, to enter any location defined as a permit entry required confined space. Training shall be provided to each affected employee:

- Before the employee is first assigned duties under this program.
- Before there is a change in assigned duties.
- Whenever there is a change in permit space operations that presents a hazard about which an employee has not been previously trained.
- Whenever the supervising department has reason to believe either that there are deviations from permit space entry procedures or that there are inadequacies in the employee's knowledge or use of these procedures.

The training shall establish employee proficiency in the duties required by this program and shall include new or revised procedures, as necessary, for compliance with this program.

REM shall certify that the training has been accomplished. The certification shall contain each employee's name, the signatures of the trainers, and the dates of training. The certification, refer to form CS-6, shall be available for inspection.

2.7.1 Duties of the Entry Supervisor

- Know the hazards that may be faced during entry, including the mode, signs or symptoms, and consequences of the exposure;

- Verify, by checking that the appropriate entries have been made on the permit, that all tests specified by the permit have been conducted and that all procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry to begin;
- Terminate the entry and cancel the permit as required when:
 - The entry operation covered by the entry permit has been completed; or
 - A condition that is not allowed under the entry permit arises in or near the permit space;
- Verify that rescue services are available and that the means for summoning them are operable.
- Remove unauthorized individuals who enter or who attempt to enter the permit space during entry operations.
- Determine, whenever responsibility for a permit space entry operation is transferred to a different entry supervisor and at intervals dictated by the hazards and operations performed within the space that entry operations remain consistent with terms of the entry permit and that acceptable entry conditions are maintained.

2.7.2 Duties of the Authorized Entrant(s)

- Know the hazards that may be faced during entry, including the mode, signs or symptoms, and consequences of the exposure.
- Use equipment properly in accordance with training received.
- Communicate with the attendant as necessary to enable the attendant to monitor entrant status and to alert the attendant to the need to evacuate the space as required.
- Alert the attendant whenever:
 - The entrant recognizes any warning signs or symptoms of exposure to a dangerous situation, or
 - The entrant detects a prohibited condition.
- Exit from the space as quickly as possible whenever:
 - An order to evacuate is given by the attendant or the entry supervisor,
 - The entrant recognizes any warning sign or symptom of exposure to a dangerous situation,
 - The entrant detects a prohibited condition, or
 - An evacuation alarm is activated.

2.7.3 Protective Equipment - Authorized entrant(s) shall:

- Implement non-entry rescue, retrieval systems or methods whenever an authorized entrant enters a permit space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant.
- Use a chest or full body harness, with a retrieval line attached at the center of the entrants back near shoulder level, or above the entrant's head. Wrist-lets may be used in lieu of the chest or full body harness if it can be demonstrated that the use of a chest or full body harness is infeasible or creates a greater hazard and that the use of wrist-lets is the safest and most effective alternative.
- Ensure the other end of the retrieval line is attached to a mechanical device or fixed point outside the permit space in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary. A mechanical device shall be available to retrieve personnel from vertical type permit spaces more than 5 feet deep.
- Be provided with the necessary personal protective equipment.
- Use all personal protective equipment, such as retrieval lines, respirators, or clothing needed for safe entry and exit in accordance with training received.
- Know of the external barriers needed to protect entrants from external hazards and of the proper use of those barriers (e.g., traffic barriers).
- Wear full body harness during all entries requiring portable ventilation.

2.7.4 Self-Rescue - Authorized entrant(s) shall exit the Permit Space when:

- The attendant orders evacuation;
- An automatic monitoring equipment alarm is activated; or
- The authorized entrant(s) perceive they are in danger.

2.7.5 Duties of the Attendant(s)

- Know the hazards that may be faced during entry, including the mode, signs or symptoms, and consequences of the exposure.
- Be aware of possible behavioral effects of hazardous exposure in authorized entrants.
- Maintain a continuous accurate count of authorized entrants in the permit space and ensure that the means used to identify authorized entrants accurately identifies who is in the permit space.
- Remain outside the permit space during entry operations until relieved by another authorized attendant.

- Communicate with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the space.
- Monitor activities inside and outside the space to determine if it is safe for entrants to remain in the space and orders the authorized entrants to evacuate the permit space immediately under any of the following conditions:
 - If the attendant detects a prohibited condition;
 - If the attendant detects the behavioral effects of hazards exposure in an authorized entrant;
 - If the attendant detects a situation outside the space that could endanger the authorized entrants; or
 - If the attendant cannot effectively and safely perform all the duties required under this section.
- Summon rescue and other emergency services as soon as the attendant determines that authorized entrants may need assistance to escape from permit space hazards.
- Take the following actions when unauthorized persons approach or enter a permit space while entry is underway:
 - Warn unauthorized persons that they must stay away from the permit space;
 - Advise the unauthorized persons that they must exit immediately if they have entered the permit space; and
 - Inform the authorized entrants and entry supervisor if unauthorized persons have entered the permit space.
- Perform non-entry rescue as specified by the rescue procedure.
- Perform no duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrants.

2.7.6 Rescue and Emergency Services

- Personnel assigned to a rescue team shall be provided with and trained to make proper use of the personal protective equipment, including respirators, and rescue equipment necessary for making rescues from Permit Spaces.
- The rescue team shall be trained to perform the assigned rescue functions and shall be trained as authorized entrants.
- Rescue teams shall practice making rescues at least once every twelve months by means of simulated rescue operations in which they remove dummies, mannequins, or personnel through representative openings and portals whose size, configuration and accessibility closely approximate those of the spaces from which rescues may be required.

- Each member of each rescue team shall be currently certified in basic first aid and cardiopulmonary resuscitation (CPR) skills. At least one member of the rescue service holding current certification in first aid and CPR shall be available.
- When Purdue University arranges to have persons other than University employees perform permit space rescue, the University shall.
- Inform the rescue service of the hazards they may confront when called on to perform rescue at University facilities, and
- Provide the rescue service with access to all permit spaces from which rescue may be necessary so that the rescue service can develop appropriate rescue plan and practice operations.

2.8 Additional Information

For addition information concerning this program contact REM, B173 HAMP, 494-6371.

Chapter 3: Non-permit Required Confined Spaces

3.1 Electrical Confined Space Entry Policy

The purpose of this policy is to identify and control hazards before initiating entry into a confined space as outlined in 29 CFR 1910.269 (Electrical Power Generation, Transmission and Distribution). If conditions exist and/or hazards are not controlled in the application of this policy the permit-entry confined space policy must be used to ensure that adequate controls are used.

All electrical employees required to enter below grade unventilated locations, as a portion of their work responsibilities, shall receive formal training on confined space entry before performing such work.

3.1.1 Pre-entry Procedures for Entry into Below Grade Locations

- An evaluation shall be conducted to check for the excessive heat, pressure by touching and then carefully removing the manhole lid.
- Following removal of a manhole lid, the opening shall be promptly guarded with a railing, temporary cover or other barrier intended to prevent an accidental fall through the opening and to protect entrant from falling objects.
- Before entry the internal atmosphere shall be tested for the following:
- Oxygen content (Safe Entry Range - 19.5% to 23.5%)
 - Combustible gases or vapors - (Safe Entry Range - < 10% Lower Explosive Limit [LEL])
 - If the testing identifies levels outside the safe entry ranges forced air ventilation may be used to bring the atmospheric levels back into the safe entry ranges before entry is initiated.
- Continuous atmospheric monitoring shall be conducted when conditions require forced air ventilation to be used before entry.

3.1.2 Attendants for Manholes

- While work is being performed in a manhole containing energized electrical equipment, an employee with basic first aid and CPR training shall be immediately available to render emergency assistance.
- The attendant may enter a manhole for brief periods in the process of his/her job duties.

- For the purpose of inspection, house-keeping, taking readings or other similar work, an employee working alone may enter, for brief periods of time, a manhole where energized electrical equipment is in service, if it can be demonstrated that the employee will be protected from electrical hazards.

3.2 Telecommunication Confined Space Entry Policy

The purpose of this policy is to identify and control hazards before initiating entry into a confined space as outlined in 29 CFR 1910.268(o) (Telecommunication). If conditions exist and/or hazards are not controlled in the application of this policy the permit-entry confined space policy must be used to ensure that adequate controls are used.

3.2.1 Guarding of Manholes and Street Openings

- Upon removal of a manhole lid or hatch one of the following methods will be used to prevent an accidental fall through the opening:
 - Use of a portable railing to enclose the opening or;
 - Use of cone to demarcate the opening or;
 - Any other equally effective means.
- Entry opening located where safety hazards are created by traffic patterns (i.e., vehicle or pedestrian) require:
 - Placement of flags, cones or other traffic control devices placed conspicuously to alert oncoming traffic or;
 - Placement of a vehicle as a barrier in the direction of the oncoming traffic.

3.2.2 Pre-Entry Requirements for Manholes and Un-Vented Vaults

- Testing of the internal atmosphere for oxygen content (**Safe Entry Level – 19.5-23.5%**) and the presence of combustible gases or vapors (**Safe Entry Level - < 10% Lower Explosive Limit LEL**) shall be conducted before initiating entry
- If **unsafe conditions are identified: oxygen level (< 19.5% or > 23.5%)** or a **combustible atmosphere is present (> 10% LEL)** the atmospheric level must be brought back into safe entry levels with the use of portable forced air ventilation.
- A fuel tank or cylinder (e.g., propane) may not be in a manhole unless in immediate use.

3.2.3 Locations Greater than 4 Foot in Depth

- A ladder shall be used to enter and exit all locations greater than 4 foot in depth.

3.2.4 First-Aid Availability

An employee trained in basic first-aid shall be available at the work site during entries if any of the following conditions exist:

- Entry is required into a manhole or vault where joint utilities exist and consist of energized electrical power;
- Where the opening to the underground location cannot be adequately guarded to prevent an accidental fall through the opening or from foreign objects entering the location.
- Where adequate controls (e.g., lights, barricades etc.) cannot be placed to provide employees a safe work environment from the hazards generated from traffic.

Appendix A:

Permit Confined Space Entry Forms

A-1: Confined Space Entry Permit (Form CS-1)

A-2: Confined Space Entry Data (Form CS-2)

A-3: Non-Permit Confined Space Certification (Form CS-3)

A-4: Permit Confined Space Entry Contractor Debriefing (Form CS-4)

A-5: Confined Space Meter Calibration (Form CS-5)

A-6: Attended Permit Entry Confined Space Training (Form CS-6)

Appendix A-1: Confined Space Entry Permit

Form CS-1

**PURDUE UNIVERSITY
Confined Space Program**

Confined Space Entry Permit

Department/Shop: _____ Location: _____ Permit # _____
Description of work to be done: _____

ATMOSPHERIC AND ENGULFMENT HAZARDS

Check all expected hazards:

- Oxygen deficiency (< 19.5%)
- Fire hazard (more than 23.5% oxygen or more than 10% of the LEL)
- Toxic gases, vapors, or dust (greater than PEL or TLV)
- Heat stress/Engulfment
- Other _____
- Hot Work Permit (to be attached – obtained from FES)

Entry Team Duties

Check and identify all that apply:

Entry Supervisor	Entrant	Attendant	Name
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	_____
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	_____
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____

Safety Controls and Communication Procedures

Equipment required for entry:

- Fall protection equipment
- Air mover/ventilator
- GFCI
- Hearing Protection
- Eye Protection
- Hard Hat
- Other Personal Protective Equipment: _____

Isolation:

- Electrical equipment locked out and tagged
- Mechanical equipment locked out and tagged
- Entry ways are blocked open
- Isolation valves closed and locked
- Proper ventilation or purging completed
- Operations notified and understands clearly

COMMUNICATIONS:

- Access to phone
- Radio

Atmospheric Testing Record

Continuous Periodic

Date/Time					
Oxygen (19.5%-22%)					
Flam. (< 10% LEL)					
H ₂ S (< 10 ppm)					
CO (< 200 ppm)					
Other:					

Manufacturer: _____ Model: _____ SN: _____ Last Cal. Date: _____ Initials: _____

Authorization/Termination by Entry Supervisor

I certify that all required precautions have been taken and the necessary entry equipment has been provided to safely work in this confined space.

Print Name: _____ Signature: _____
Entrant Signature: _____ Attendant Signature: _____
 Permit Initiated: _____ Duration: _____ Date: _____ Time: _____

Appendix A-2: Confined Space Entry Data

Form CS-2

**Purdue University Fire Department
Confined Space Entry Data
FAX# (765)-496-1150 TX# (765)-494-6919**

I. Site Information

Physical Facilities or Contractor's Name: _____

Dept./Shop: _____

Location(Bldg. & Room): _____

Recommended Response Point: _____

Date & Time of Entry: _____ Exit Time: _____

Maximum number of entrants at any one time: _____

Emergency Contact Person: _____

Telephone or Radio #: _____

Is this a cellular phone #? _____

Which radio frequency is being used? _____

II. Potential Site Hazards (check those that apply)

- Oxygen deficiency (less than 19.5%, *Discuss with Fire Department*)
- Flammable gases or vapors (*Discuss with Fire Department*)
- Toxic gases, vapors (***Stop & Discuss with Fire Department***)
- Heat Stress
- Engulfment
- High-pressure lines
- High voltage

III. Fire Department Standby

Personnel Standing by: _____

FD Equipment & Gear Available: _____

Duty Start Time: _____ Duty Finish Time: _____

Work Order #: _____

Appendix A-3: Non-Permit Confined Space Certification

Form CS-3

PURDUE UNIVERSITY Confined Space Program

Non-Permit Confined Space Certification

This document certifies that the _____ has been cleared for a change in status from a **Permit Confined Space** to a **Non-Permit Confined Space** provided that the below conditions are met.

- All entrants/attendants involved in any entry have completed the University's Confined Space Entry training.
- All hazards other than atmospheric (e.g., lockout/tag out) can be completed without entry.
- Any conditions making it unsafe to remove an entrance cover is eliminated before cover is removed.
- For any horizontal opening, promptly upon removal of the covering, the entrance is guarded by a railing or temporary cover/ barrier to prevent accidental fall through the opening.
- Before entry into the space, atmospheric testing is completed with the University's Confined Space Meter. Testing shall be completed for the following:
 - 1.) Oxygen Content > 19.5% and < 23.5%
 - 2.) Flammable gases or vapors < 10% LEL
 - 3.) Potential toxic air contaminants < 50 PPM CO
< 20 PPM H₂S
- If the above conditions are not met upon completion, forced air ventilation may be used provided it can be installed into the and levels within the ranges above are obtained.

Please attach at least 3 previous entry permits for the specific location.

Date: _____ Certification Completed By: _____

Appendix A-4: Permit Confined Space Entry Contractor Debriefing

Form CS-4

PURDUE UNIVERSITY Confined Space Program

Permit Confined Space Entry Contractor Debriefing

Company: _____ Entry Location: _____

Contractor: _____ Date(s) of Entry: _____

Was entry coordinated by Company employees?

Yes (If yes attach copy of entry permit)

No

Reason for entry: _____

Additional hazards identified: _____

Additional hazards generated during entry: _____

Contractor's Representative:

(Please Print) (Signature) Date: _____

Company's Representative:

(Please Print) (Signature) Date: _____

Appendix A-5: Confined Space Meter Calibration

Form CS-3

PURDUE UNIVERSITY Confined Space program

Confined Space Meter Calibration

Manufacturer: _____ Model: _____ Date: _____

Serial Number: _____ Date of Last Calibration: _____

Department/Area: _____ Location: _____

Contact Person: _____ Telephone: _____

Sensors Tested

Gas	Ambient	Calibration Span Set to Zero?		Reading
		Yes	No	
Oxygen:	O ₂ _____	<input type="checkbox"/>	<input type="checkbox"/>	O ₂ _____
Lower Explosive Limit:	LEL _____	<input type="checkbox"/>	<input type="checkbox"/>	LEL _____
Carbon Monoxide:	CO _____	<input type="checkbox"/>	<input type="checkbox"/>	CO _____
Hydrogen Sulfide:	H ₂ S _____	<input type="checkbox"/>	<input type="checkbox"/>	H ₂ S _____
Other: _____	_____	<input type="checkbox"/>	<input type="checkbox"/>	_____

Completed by: _____ Signature: _____

Appendix A-6: Attended Permit Entry Confined Space Training

Form CS-6

PURDUE UNIVERSITY

Radiological and Environmental Management

This Document Certifies

(Attendee)

Attended Permit Entry Confined Space Training

(Training Date)

**The recipient is hereby recognized as an authorized
Attendant, Entrant, and Entry Supervisor.**

Training Subjects Included:

Recognition of Entry Hazards

Recognition of Symptoms of exposure

Use of Safe Entry Equipment and Procedures

Emergency Procedures

REM IH Signature: _____ Date: _____

Appendix B: Applicable Standards

- B-1: Permit-Required Confined Space - [29 CFR 1910.146](#)**
- B-2: Electrical Power Generation, Transmission, and Distribution - [29 CFR 1910.269](#)**
- B-3: Telecommunications - [29 CFR 1910.268](#)**

B.1 Permit Required Confine Space (29 CFR 1910.146)

1910.146(a) Scope and application. This section contains requirements for practices and procedures to protect employees in general industry from the hazards of entry into permit-required confined spaces. This section does not apply to agriculture, to construction, or to shipyard employment (Parts 1928, 1926, and 1915 of this chapter, respectively).

1910.146(b) Definitions. Refer to the definitions section of this program (page 3) for the OSHA definitions.

1910.146(c) General Requirements.

1910.146(c)(1) The employer shall evaluate the workplace to determine if any spaces are permit-required confined spaces.

NOTE: Proper application of the decision flow chart in Appendix A to section 1910.146 would facilitate compliance with this requirement.

1910.146(c)(2) If the workplace contains permit spaces, the employer shall inform exposed employees, by posting danger signs or by any other equally effective means, of the existence and location of and the danger posed by the permit spaces.

NOTE: A sign reading "DANGER -- PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER" or using other similar language would satisfy the requirement for a sign.

1910.146(c)(3) If the employer decides that its employees will not enter permit spaces, the employer shall take effective measures to prevent its employees from entering the permit spaces and shall comply with paragraphs (c)(1), (c)(2), (c)(6), and (c)(8) of this section.

1910.146(c)(4) If the employer decides that its employees will enter permit spaces, the employer shall develop and implement a written permit space program that complies with this section. The written program shall be available for inspection by employees and their authorized representatives.

1910.146(c)(5) An employer may use the alternate procedures specified in paragraph (c)(5)(ii) of this section for entering a permit space under the conditions set forth in paragraph (c)(5)(i) of this section.

1910.146(c)(5)(i) An employer whose employees enter a permit space need not comply with paragraphs (d) through (f) and (h) through (k) of this section, provided that:

1910.146(c)(5)(i)(A) The employer can demonstrate that the only hazard posed by the permit space is an actual or potential hazardous atmosphere;

1910.146(c)(5)(i)(B) The employer can demonstrate that continuous forced air ventilation alone is sufficient to maintain that permit space safe for entry;

1910.146(c)(5)(i)(C) The employer develops monitoring and inspection data that supports the demonstrations required by paragraphs (c)(5)(i)(A) and (c)(5)(i)(B) of this section;

1910.146(c)(5)(i)(D) If an initial entry of the permit space is necessary to obtain the data required by paragraph (c)(5)(i)(C) of this section, the entry is performed in compliance with paragraphs (d) through (k) of this section;

1910.146(c)(5)(i)(E) The determinations and supporting data required by paragraphs (c)(5)(i)(A), (c)(5)(i)(B), and (c)(5)(i)(C) of this section are documented by the employer and are made available to each employee who enters the permit space under the terms of paragraph (c)(5) of this section or to that employee's authorized representative; and

1910.146(c)(5)(i)(F) Entry into the permit space under the terms of paragraph (c)(5)(i) of this section is performed in accordance with the requirements of paragraph (c)(5)(ii) of this section.

NOTE: See paragraph (c)(7) of this section for reclassification of a permit space after all hazards within the space have been eliminated.

1910.146(c)(5)(ii) The following requirements apply to entry into permit spaces that meet the conditions set forth in paragraph (c)(5)(i) of this section.

1910.146(c)(5)(ii)(A) Any conditions making it unsafe to remove an entrance cover shall be eliminated before the cover is removed.

1910.146(c)(5)(ii)(B) When entrance covers are removed, the opening shall be promptly guarded by a railing, temporary cover, or other temporary barrier that will prevent an accidental fall through the opening and that will protect each employee working in the space from foreign objects entering the space.

1910.146(c)(5)(ii)(C) Before an employee enters the space, the internal atmosphere shall be tested, with a calibrated direct-reading instrument, for oxygen content, for flammable gases

and vapors, and for potential toxic air contaminants, in that order. Any employee who enters the space, or that employee's authorized representative, shall be provided an opportunity to observe the pre-entry testing required by this paragraph.

1910.146(c)(5)(ii)(C)(1) Oxygen content,

1910.146(c)(5)(ii)(C)(2) Flammable gases and vapors, and

1910.146(c)(5)(ii)(C)(3) Potential toxic air contaminants.

1910.146(c)(5)(ii)(D) There may be no hazardous atmosphere within the space whenever any employee is inside the space.

1910.146(c)(5)(ii)(E) Continuous forced air ventilation shall be used, as follows:

1910.146(c)(5)(ii)(E)(1) An employee may not enter the space until the forced air ventilation has eliminated any hazardous atmosphere;

1910.146(c)(5)(ii)(E)(2) The forced air ventilation shall be so directed as to ventilate the immediate areas where an employee is or will be present within the space and shall continue until all employees have left the space;

1910.146(c)(5)(ii)(E)(3) The air supply for the forced air ventilation shall be from a clean source and may not increase the hazards in the space.

1910.146(c)(5)(ii)(F) The atmosphere within the space shall be periodically tested as necessary to ensure that the continuous forced air ventilation is preventing the accumulation of a hazardous atmosphere. Any employee who enters the space, or that employee's authorized representative, shall be provided with an opportunity to observe the periodic testing required by this paragraph.

1910.146(c)(5)(ii)(G) If a hazardous atmosphere is detected during entry:

1910.146(c)(5)(ii)(G)(1) Each employee shall leave the space immediately;

1910.146(c)(5)(ii)(G)(2) The space shall be evaluated to determine how the hazardous atmosphere developed; and

1910.146(c)(5)(ii)(G)(3) Measures shall be implemented to protect employees from the hazardous atmosphere before any subsequent entry takes place.

1910.146(c)(5)(ii)(H) The employer shall verify that the space is safe for entry and that the pre-entry measures required by paragraph (c)(5)(ii) of this section have been taken, through a written certification that contains the date, the location of the space, and the signature of the person providing the certification. The certification shall be made before entry and shall be made available to each employee entering the space or to that employee's authorized representative.

1910.146(c)(6) When there are changes in the use or configuration of a non-permit confined space that might increase the hazards to entrants, the employer shall reevaluate that space and, if necessary, reclassify it as a permit-required confined space.

1910.146(c)(7) A space classified by the employer as a permit-required confined space may be reclassified as a non-permit confined space under the following procedures:

1910.146(c)(7)(i) If the permit space poses no actual or potential atmospheric hazards and if all hazards within the space are eliminated without entry into the space, the permit space may be reclassified as a non-permit confined space for as long as the non-atmospheric hazards remain eliminated.

1910.146(c)(7)(ii) If it is necessary to enter the permit space to eliminate hazards, such entry shall be performed under paragraphs (d) through (k) of this section. If testing and inspection during that entry demonstrate that the hazards within the permit space have been eliminated, the permit space may be reclassified as a non-permit confined space for as long as the hazards remain eliminated.

NOTE: Control of atmospheric hazards through forced air ventilation does not constitute elimination of the hazards. Paragraph (c)(5) covers permit space entry where the employer can demonstrate that forced air ventilation alone will control all hazards in the space.

1910.146(c)(7)(iii) The employer shall document the basis for determining that all hazards in a permit space have been eliminated, through a certification that contains the date, the location of the space, and the signature of the person making the determination. The certification shall be made available to each employee entering the space or to that employee's authorized representative.

1910.146(c)(7)(iv) If hazards arise within a permit space that has been declassified to a non-permit space under paragraph (c)(7) of this section, each employee in the space shall exit the

space. The employer shall then reevaluate the space and determine whether it must be reclassified as a permit space, in accordance with other applicable provisions of this section.

1910.146(c)(8) When an employer (host employer) arranges to have employees of another employer (contractor) perform work that involves permit space entry, the host employer shall:

1910.146(c)(8)(i) Inform the contractor that the workplace contains permit spaces and that permit space entry is allowed only through compliance with a permit space program meeting the requirements of this section;

1910.146(c)(8)(ii) Apprise the contractor of the elements, including the hazards identified and the host employer's experience with the space, that make the space in question a permit space;

1910.146(c)(8)(iii) Apprise the contractor of any precautions or procedures that the host employer has implemented for the protection of employees in or near permit spaces where contractor personnel will be working;

1910.146(c)(8)(iv) Coordinate entry operations with the contractor, when both host employer personnel and contractor personnel will be working in or near permit spaces, as required by paragraph (d)(11) of this section; and

1910.146(c)(8)(v) Debrief the contractor at the conclusion of the entry operations regarding the permit space program followed and regarding any hazards confronted or created in permit spaces during entry operations.

1910.146(c)(9) In addition to complying with the permit space requirements that apply to all employers, each contractor who is retained to perform permit space entry operations shall:

1910.146(c)(9)(i) Obtain any available information regarding permit space hazards and entry operations from the host employer;

1910.146(c)(9)(ii) Coordinate entry operations with the host employer, when both host employer personnel and contractor personnel will be working in or near permit spaces, as required by paragraph (d)(11) of this section; and

1910.146(c)(9)(iii) Inform the host employer of the permit space program that the contractor will follow and of any hazards confronted or created in permit spaces, either through a debriefing or during the entry operation.

1910.146(d) Permit-required confined space program (permit space program). Under the permit space program required by paragraph (c)(4) of this section, the employer shall:

1910.146(d)(1) Implement the measures necessary to prevent unauthorized entry;

1910.146(d)(2) Identify and evaluate the hazards of permit spaces before employees enter them;

1910.146(d)(3) Develop and implement the means, procedures, and practices necessary for safe permit space entry operations, including, but not limited to, the following:

1910.146(d)(3)(i) Specifying acceptable entry conditions;

1910.146(d)(3)(ii) Providing each authorized entrant or that employee's authorized representative with the opportunity to observe any monitoring or testing of permit spaces;

1910.146(d)(3)(iii) Isolating the permit space;

1910.146(d)(3)(iv) Purging, inerting, flushing, or ventilating the permit space as necessary to eliminate or control atmospheric hazards;

1910.146(d)(3)(v) Providing pedestrian, vehicle, or other barriers as necessary to protect entrants from external hazards; and

1910.146(d)(3)(vi) Verifying that conditions in the permit space are acceptable for entry throughout the duration of an authorized entry.

1910.146(d)(4) Provide the following equipment (specified in paragraphs (d)(4)(i) through (d)(4)(ix) of this section) at no cost to employees, maintain that equipment properly, and ensure that employees use that equipment properly:

1910.146(d)(4)(i) Testing and monitoring equipment needed to comply with paragraph (d)(5) of this section;

1910.146(d)(4)(ii) Ventilating equipment needed to obtain acceptable entry conditions;

1910.146(d)(4)(iii) Communications equipment necessary for compliance with paragraphs (h)(3) and (i)(5) of this section;

1910.146(d)(4)(iv) Personal protective equipment insofar as feasible engineering and work practice controls do not adequately protect employees;

1910.146(d)(4)(v) Lighting equipment needed to enable employees to see well enough to work safely and to exit the space quickly in an emergency;

1910.146(d)(4)(vi) Barriers and shields as required by paragraph (d)(3)(iv) of this section;

1910.146(d)(4)(vii) Equipment, such as ladders, needed for safe ingress and egress by authorized entrants;

1910.146(d)(4)(viii) Rescue and emergency equipment needed to comply with paragraph (d)(9) of this section, except to the extent that the equipment is provided by rescue services; and

1910.146(d)(4)(ix) Any other equipment necessary for safe entry into and rescue from permit spaces.

1910.146(d)(5) Evaluate permit space conditions as follows when entry operations are conducted:

1910.146(d)(5)(i) Test conditions in the permit space to determine if acceptable entry conditions exist before entry is authorized to begin, except that, if isolation of the space is infeasible because the space is large or is part of a continuous system (such as a sewer), pre-entry testing shall be performed to the extent feasible before entry is authorized and, if entry is authorized, entry conditions shall be continuously monitored in the areas where authorized entrants are working;

1910.146(d)(5)(ii) Test or monitor the permit space as necessary to determine if acceptable entry conditions are being maintained during the course of entry operations; and

1910.146(d)(5)(iii) When testing for atmospheric hazards, test first for oxygen, then for combustible gases and vapors, and then for toxic gases and vapors.

1910.146(d)(5)(iv) Provide each authorized entrant or that employee's authorized representative an opportunity to observe the pre-entry and any subsequent testing or monitoring of permit spaces;

1910.146(d)(5)(v) Reevaluate the permit space in the presence of any authorized entrant or that employee's authorized representative who requests that the employer conduct such

reevaluation because the entrant or representative has reason to believe that the evaluation of that space may not have been adequate;

1910.146(d)(5)(vi) Immediately provide each authorized entrant or that employee's authorized representative with the results of any testing conducted in accord with paragraph (d) of this section.

NOTE: Atmospheric testing conducted in accordance with Appendix B to section 1910.146 would be considered as satisfying the requirements of this paragraph. For permit space operations in sewers, atmospheric testing conducted in accordance with Appendix B, as supplemented by Appendix E to section 1910.146, would be considered as satisfying the requirements of this paragraph.

1910.146(d)(6) Provide at least one attendant outside the permit space into which entry is authorized for the duration of entry operations;

NOTE: Attendants may be assigned to monitor more than one permit space provided the duties described in paragraph (i) of this section can be effectively performed for each permit space that is monitored. Likewise, attendants may be stationed at any location outside the permit space to be monitored as long as the duties described in paragraph (i) of this section can be effectively performed for each permit space that is monitored.

1910.146(d)(7) If multiple spaces are to be monitored by a single attendant, include in the permit program the means and procedures to enable the attendant to respond to an emergency affecting one or more of the permit spaces being monitored without distraction from the attendant's responsibilities under paragraph (i) of this section;

1910.146(d)(8) Designate the persons who are to have active roles (as, for example, authorized entrants, attendants, entry supervisors, or persons who test or monitor the atmosphere in a permit space) in entry operations, identify the duties of each such employee, and provide each such employee with the training required by paragraph (g) of this section;

1910.146(d)(9) Develop and implement procedures for summoning rescue and emergency services, for rescuing entrants from permit spaces, for providing necessary emergency services to rescued employees, and for preventing unauthorized personnel from attempting a rescue;

1910.146(d)(10) Develop and implement a system for the preparation, issuance, use, and cancellation of entry permits as required by this section;

1910.146(d)(11) Develop and implement procedures to coordinate entry operations when employees of more than one employer are working simultaneously as authorized entrants in a permit space, so that employees of one employer do not endanger the employees of any other employer;

1910.146(d)(12) Develop and implement procedures (such as closing off a permit space and canceling the permit) necessary for concluding the entry after entry operations have been completed;

1910.146(d)(13) Review entry operations when the employer has reason to believe that the measures taken under the permit space program may not protect employees and revise the program to correct deficiencies found to exist before subsequent entries are authorized; and

NOTE: Examples of circumstances requiring the review of the permit space program are: any unauthorized entry of a permit space, the detection of a permit space hazard not covered by the permit, the detection of a condition prohibited by the permit, the occurrence of an injury or near-miss during entry, a change in the use or configuration of a permit space, and employee complaints about the effectiveness of the program.

1910.146(d)(14) Review the permit space program, using the canceled permits retained under paragraph (e)(6) of this section within 1 year after each entry and revise the program as necessary, to ensure that employees participating in entry operations are protected from permit space hazards.

NOTE: employers may perform a single annual review covering all entries performed during a 12-month period. If no entry is performed during a 12-month period, no review is necessary.

Appendix C to section 1910.146 presents examples of permit space programs that are considered to comply with the requirements of paragraph (d) of this section.

1910.146(e) Permit system.

1910.146(e)(1) Before entry is authorized, the employer shall document the completion of measures required by paragraph (d)(3) of this section by preparing an entry permit.

NOTE: Appendix D to section 1910.146 presents examples of permits whose elements are considered to comply with the requirements of this section.

1910.146(e)(2) Before entry begins, the entry supervisor identified on the permit shall sign the entry permit to authorize entry.

1910.146(e)(3) The completed permit shall be made available at the time of entry to all authorized entrants or their authorized representatives, by posting it at the entry portal or by any other equally effective means, so that the entrants can confirm that pre-entry preparations have been completed.

1910.146(e)(4) The duration of the permit may not exceed the time required to complete the assigned task or job identified on the permit in accordance with paragraph (f)(2) of this section.

1910.146(e)(5) The entry supervisor shall terminate entry and cancel the entry permit when:

1910.146(e)(5)(i) The entry operations covered by the entry permit have been completed; or

1910.146(e)(5)(ii) A condition that is not allowed under the entry permit arises in or near the permit space.

1910.146(e)(6) The employer shall retain each canceled entry permit for at least 1 year to facilitate the review of the permit-required confined space program required by paragraph (d)(14) of this section. Any problems encountered during an entry operation shall be noted on the pertinent permit so that appropriate revisions to the permit space program can be made.

1910.146(f) Entry permit. The entry permit that documents compliance with this section and authorizes entry to a permit space shall identify:

1910.146(f)(1) The permit space to be entered;

1910.146(f)(2) The purpose of the entry;

1910.146(f)(3) The date and the authorized duration of the entry permit;

1910.146(f)(4) The authorized entrants within the permit space, by name or by such other means (for example, through the use of rosters or tracking systems) as will enable the attendant to determine quickly and accurately, for the duration of the permit, which authorized entrants are inside the permit space;

NOTE: This requirement may be met by inserting a reference on the entry permit as to the means used, such as a roster or tracking system, to keep track of the authorized entrants within the permit space.

1910.146(f)(5) The personnel, by name, currently serving as attendants;

1910.146(f)(6) The individual, by name, currently serving as entry supervisor, with a space for the signature or initials of the entry supervisor who originally authorized entry;

1910.146(f)(7) The hazards of the permit space to be entered;

1910.146(f)(8) The measures used to isolate the permit space and to eliminate or control permit space hazards before entry;

NOTE: Those measures can include the lockout or tagging of equipment and procedures for purging, inerting, ventilating, and flushing permit spaces.

1910.146(f)(9) The acceptable entry conditions;

1910.146(f)(10) The results of initial and periodic tests performed under paragraph (d)(5) of this section, accompanied by the names or initials of the testers and by an indication of when the tests were performed;

1910.146(f)(11) The rescue and emergency services that can be summoned and the means (such as the equipment to use and the numbers to call) for summoning those services;

1910.146(f)(12) The communication procedures used by authorized entrants and attendants to maintain contact during the entry;

1910.146(f)(13) Equipment, such as personal protective equipment, testing equipment, communications equipment, alarm systems, and rescue equipment, to be provided for compliance with this section;

1910.146(f)(14) Any other information whose inclusion is necessary, given the circumstances of the particular confined space, in order to ensure employee safety; and (15) Any additional permits, such as for hot work, that have been issued to authorize work in the permit space.

1910.146(g) Training.

1910.146(g)(1) The employer shall provide training so that all employees whose work is regulated by this section acquire the understanding, knowledge, and skills necessary for the safe performance of the duties assigned under this section.

1910.146(g)(2) Training shall be provided to each affected employee:

1910.146(g)(2)(i) Before the employee is first assigned duties under this section;

1910.146(g)(2)(ii) Before there is a change in assigned duties;

1910.146(g)(2)(iii) Whenever there is a change in permit space operations that presents a hazard about which an employee has not previously been trained;

1910.146(g)(2)(iv) Whenever the employer has reason to believe either that there are deviations from the permit space entry procedures required by paragraph (d)(3) of this section or that there are inadequacies in the employee's knowledge or use of these procedures.

1910.146(g)(3) The training shall establish employee proficiency in the duties required by this section and shall introduce new or revised procedures, as necessary, for compliance with this section.

1910.146(g)(4) The employer shall certify that the training required by paragraphs (g)(1) through (g)(3) of this section has been accomplished. The certification shall contain each employee's name, the signatures or initials of the trainers, and the dates of training. The certification shall be available for inspection by employees and their authorized representatives.

1910.146(h) Duties of authorized entrants. The employer shall ensure that all authorized entrants:

1910.146(h)(1) Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

1910.146(h)(2) Properly use equipment as required by paragraph (d)(4) of this section;

1910.146(h)(3) Communicate with the attendant as necessary to enable the attendant to monitor entrant status and to enable the attendant to alert entrants of the need to evacuate the space as required by paragraph (i)(6) of this section;

1910.146(h)(4) Alert the attendant whenever:

1910.146(h)(4)(i) The entrant recognizes any warning sign or symptom of exposure to a dangerous situation, or

1910.146(h)(4)(ii) The entrant detects a prohibited condition; and

1910.146(h)(5) Exit from the permit space as quickly as possible whenever:

1910.146(h)(5)(i) An order to evacuate is given by the attendant or the entry supervisor,

1910.146(h)(5)(ii) The entrant recognizes any warning sign or symptom of exposure to a dangerous situation,

1910.146(h)(5)(iii) The entrant detects a prohibited condition, or

1910.146(h)(5)(iv) An evacuation alarm is activated.

1910.146(i) Duties of attendants. The employer shall ensure that each attendant:

1910.146(i)(1) Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

1910.146(i)(2) Is aware of possible behavioral effects of hazard exposure in authorized entrants;

1910.146(i)(3) Continuously maintains an accurate count of authorized entrants in the permit space and ensures that the means used to identify authorized entrants under paragraph (f)(4) of this section accurately identifies who is in the permit space;

1910.146(i)(4) Remains outside the permit space during entry operations until relieved by another attendant;

NOTE: When the employer's permit entry program allows attendant entry for rescue, attendants may enter a permit space to attempt a rescue if they have been trained and equipped for rescue operations as required by paragraph (k)(1) of this section and if they have been relieved as required by paragraph (i)(4) of this section.

1910.146(i)(5) Communicates with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the space under paragraph (i)(6) of this section;

1910.146(i)(6) Monitors activities inside and outside the space to determine if it is safe for entrants to remain in the space and orders the authorized entrants to evacuate the permit space immediately under any of the following conditions;

1910.146(i)(6)(i) If the attendant detects a prohibited condition;

1910.146(i)(6)(ii) If the attendant detects the behavioral effects of hazard exposure in an authorized entrant;

1910.146(i)(6)(iii) If the attendant detects a situation outside the space that could endanger the authorized entrants; or

1910.146(i)(6)(iv) If the attendant cannot effectively and safely perform all the duties required under paragraph (i) of this section;

1910.146(i)(7) Summon rescue and other emergency services as soon as the attendant determines that authorized entrants may need assistance to escape from permit space hazards;

1910.146(i)(8) Takes the following actions when unauthorized persons approach or enter a permit space while entry is underway:

1910.146(i)(8)(i) Warn the unauthorized persons that they must stay away from the permit space;

1910.146(i)(8)(ii) Advise the unauthorized persons that they must exit immediately if they have entered the permit space; and

1910.146(i)(8)(iii) Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space;

1910.146(i)(9) Performs non-entry rescues as specified by the employer's rescue procedure; and

1910.146(i)(10) Performs no duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrants.

1910.146(j) Duties of entry supervisors. The employer shall ensure that each entry supervisor:

1910.146(j)(1) Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

1910.146(j)(2) Verifies, by checking that the appropriate entries have been made on the permit, that all tests specified by the permit have been conducted and that all procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry to begin;

1910.146(j)(3) Terminates the entry and cancels the permit as required by paragraph (e)(5) of this section;

1910.146(j)(4) Verifies that rescue services are available and that the means for summoning them are operable;

1910.146(j)(5) Removes unauthorized individuals who enter or who attempt to enter the permit space during entry operations; and

1910.146(j)(6) Determines, whenever responsibility for a permit space entry operation is transferred and at intervals dictated by the hazards and operations performed within the space, that entry operations remain consistent with terms of the entry permit and that acceptable entry conditions are maintained.

1910.146(k) Rescue and emergency services.

1910.146(k)(1) An employer who designates rescue and emergency services, pursuant to paragraph (d)(9) of this section, shall:

1910.146(k)(1)(i) Evaluate a prospective rescuer's ability to respond to a rescue summons in a timely manner, considering the hazard(s) identified;

NOTE to paragraph (k)(1)(i): What will be considered timely will vary according to the specific hazards involved in each entry. For example, §1910.134, Respiratory Protection, requires that employers provide a standby person or persons capable of immediate action to rescue employee(s) wearing respiratory protection while in work areas defined as IDLH atmospheres.

1910.146(k)(1)(ii) Evaluate a prospective rescue service's ability, in terms of proficiency with rescue-related tasks and equipment, to function appropriately while rescuing entrants from the particular permit space or types of permit spaces identified;

1910.146(k)(1)(iii) Select a rescue team or service from those evaluated that:

1910.146(k)(1)(iii)(A) Has the capability to reach the victim(s) within a time frame that is appropriate for the permit space hazard(s) identified;

1910.146(k)(1)(iii)(B) Is equipped for and proficient in performing the needed rescue services;

1910.146(k)(1)(iv) Inform each rescue team or service of the hazards they may confront when called on to perform rescue at the site; and

1910.146(k)(1)(v) Provide the rescue team or service selected with access to all permit spaces from which rescue may be necessary so that the rescue service can develop appropriate rescue plans and practice rescue operations.

NOTE to paragraph (k)(1): Non-mandatory Appendix F contains examples of criteria which employers can use in evaluating prospective rescuers as required by paragraph (k)(l) of this section.

1910.146(k)(2) An employer whose employees have been designated to provide permit space rescue and emergency services shall take the following measures:

1910.146(k)(2)(i) Provide affected employees with the personal protective equipment (PPE) needed to conduct permit space rescues safely and train affected employees so they are proficient in the use of that PPE, at no cost to those employees;

1910.146(k)(2)(ii) Train affected employees to perform assigned rescue duties. The employer must ensure that such employees successfully complete the training required to establish proficiency as an authorized entrant, as provided by paragraphs (g) and (h) of this section;

1910.146(k)(2)(iii) Train affected employees in basic first-aid and cardiopulmonary resuscitation (CPR). The employer shall ensure that at least one member of the rescue team or service holding a current certification in first aid and CPR is available; and

1910.146(k)(2)(iv) Ensure that affected employees practice making permit space rescues at least once every 12 months, by means of simulated rescue operations in which they remove dummies, manikins, or actual persons from the actual permit spaces or from representative permit spaces. Representative permit spaces shall, with respect to opening size, configuration, and accessibility, simulate the types of permit spaces from which rescue is to be performed.

1910.146(k)(3) To facilitate non-entry rescue, retrieval systems or methods shall be used whenever an authorized entrant enters a permit space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant. Retrieval systems shall meet the following requirements.

1910.146(k)(3)(i) Each authorized entrant shall use a chest or full body harness, with a retrieval line attached at the center of the entrant's back near shoulder level, above the entrant's head, or at another point which the employer can establish presents a profile small enough for the

successful removal of the entrant. Wristlets may be used in lieu of the chest or full body harness if the employer can demonstrate that the use of a chest or full body harness is infeasible or creates a greater hazard and that the use of wristlets is the safest and most effective alternative.

1910.146(k)(3)(ii) The other end of the retrieval line shall be attached to a mechanical device or fixed point outside the permit space in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary. A mechanical device shall be available to retrieve personnel from vertical type permit spaces more than 5 feet (1.52 m) deep

1910.146(k)(4) If an injured entrant is exposed to a substance for which a Material Safety Data Sheet (MSDS) or other similar written information is required to be kept at the worksite, that MSDS or written information shall be made available to the medical facility treating the exposed entrant.

1910.146(l) Employee participation.

1910.146(l)(1) Employers shall consult with affected employees and their authorized representatives on the development and implementation of all aspects of the permit space program required by paragraph (c) of this section.

1910.146(l)(2) Employers shall make available to affected employees and their authorized representatives all information required to be developed by this section.

B.2 Electrical Power Generation, Transmission and Distribution Confined Space Entry Requirements (29 CFR 1910.269 e(1) – e(14) and t(1) – t(8))

(e) "Enclosed spaces." This paragraph covers enclosed spaces that may be entered by employees. It does not apply to vented vaults if a determination is made that the ventilation system is operating to protect employees before they enter the space. This paragraph applies to routine entry into enclosed spaces in lieu of the permit-space entry requirements contained in paragraphs (d) through (k) of 1910.146 of this Part. If, after the precautions given in paragraphs (e) and (t) of this section are taken, the hazards remaining in the enclosed space endanger the life of an entrant or could interfere with escape from the space, then entry into the enclosed space shall meet the permit-space entry requirements of paragraphs (d) through (k) of 1910.146 of this Part.

(t)(1) "Access." A ladder or other climbing device shall be used to enter and exit a manhole or subsurface vault exceeding 4 feet (122 cm) in depth. No employee may climb into or out of a manhole or vault by stepping on cables or hangers.

(t)(2) "Lowering equipment into manholes." Equipment used to lower materials and tools into manholes or vaults shall be capable of supporting the weight to be lowered and shall be checked for defects before use. Before tools or material are lowered into the opening for a manhole or vault, each employee working in the manhole or vault shall be clear of the area directly under the opening.

(t)(3) "Attendants for manholes."

(t)(3)(i) While work is being performed in a manhole containing energized electric equipment, an employee with first aid and CPR training meeting paragraph (b)(1) of this section shall be available on the surface in the immediate vicinity to render emergency assistance.

(t)(3)(ii) Occasionally, the employee on the surface may briefly enter a manhole to provide assistance, other than emergency.

NOTE 1: An attendant may also be required under paragraph (e)(7) of this section. One person may serve to fulfill both requirements. However, attendants required under paragraph (e)(7) of this section are not permitted to enter the manhole.

NOTE 2: Employees entering manholes containing unguarded, un-insulated energized lines or parts of electric equipment operating at 50 volts or more are required to be qualified under paragraph (l)(1) of this section.

(t)(3)(iii) For the purpose of inspection, housekeeping, taking readings, or similar work, an employee working alone may enter, for brief periods of time, a manhole where energized cables or equipment are in service, if the employer can demonstrate that the employee will be protected from all electrical hazards.

(t)(3)(iv) Reliable communications, through two-way radios or other equivalent means, shall be maintained among all employees involved in the job.

(t)(4) "Duct rods." If duct rods are used, they shall be installed in the direction presenting the least hazard to employees. An employee shall be stationed at the far end of the duct line being rodded to ensure that the required minimum approach distances are maintained.

(t)(5) "Multiple cables." When multiple cables are present in a work area, the cable to be worked shall be identified by electrical means, unless its identity is obvious by reason of distinctive appearance or location or by other readily apparent means of identification. Cables other than the one being worked shall be protected from damage.

(t)(6) "Moving cables." Energized cables that are to be moved shall be inspected for defects.

(t)(7) "Defective cables." Where a cable in a manhole has one or more abnormalities that could lead to or be an indication of an impending fault, the defective cable shall be de-energized before any employee may work in the manhole, except when service load conditions and a lack of feasible alternatives require that the cable remain energized. In that case, employees may enter the manhole provided they are protected from the possible effects of a failure by shields or other devices that are capable of containing the adverse effects of a fault in the joint.

NOTE: Abnormalities such as oil or compound leaking from cable or joints, broken cable sheaths or joint sleeves, hot localized surface temperatures of cables or joints, or joints that are swollen beyond normal tolerance are presumed to lead to or be an indication of an impending fault

(t)(8) "Sheath continuity." When work is performed on buried cable or on cable in manholes, metallic sheath continuity shall be maintained or the cable sheath shall be treated as energized.

NOTE: Entries into enclosed spaces conducted in accordance with the permit-space entry requirements of paragraphs (d) through (k) of 1910.146 of this Part are considered as complying with paragraph (e) of this section.

(e)(1) "Safe work practices." The employer shall ensure the use of safe work practices for entry into and work in enclosed spaces and for rescue of employees from such spaces.

(e)(2) "Training." Employees who enter enclosed spaces or who serve as attendants shall be trained in the hazards of enclosed space entry, in enclosed space entry procedures, and in enclosed space rescue procedures.

(e)(3) "Rescue equipment." Employers shall provide equipment to ensure the prompt and safe rescue of employees from the enclosed space.

(e)(4) "Evaluation of potential hazards." Before any entrance cover to an enclosed space is removed, the employer shall determine whether it is safe to do so by checking for the presence of any atmospheric pressure or temperature differences and by evaluating whether there might be a hazardous atmosphere in the space. Any conditions making it unsafe to remove the cover shall be eliminated before the cover is removed.

NOTE: The evaluation called for in this paragraph may take the form of a check of the conditions expected to be in the enclosed space. For example, the cover could be checked to see if it is hot and, if it is fastened in place, could be loosened gradually to release any residual pressure. A determination must also be made of whether conditions at the site could cause a hazardous atmosphere, such as an oxygen deficient or flammable atmosphere, to develop within the space.

(e)(5) "Removal of covers." When covers are removed from enclosed spaces, the opening shall be promptly guarded by a railing, temporary cover, or other barrier intended to prevent an accidental fall through the opening and to protect employees working in the space from objects entering the space.

(e)(6) "Hazardous atmosphere." Employees may not enter any enclosed space while it contains a hazardous atmosphere, unless the entry conforms to the generic permit-required confined spaces standard in 1910.146 of this Part.

NOTE: The term "entry" is defined in 1910.146(b) of this Part.

(e)(7) "Attendants." While work is being performed in the enclosed space, a person with first aid training meeting paragraph (b) of this section shall be immediately available outside the

enclosed space to render emergency assistance if there is reason to believe that a hazard may exist in the space or if a hazard exists because of traffic patterns in the area of the opening used for entry. That person is not precluded from performing other duties outside the enclosed space if these duties do not distract the attendant from monitoring employees within the space.

NOTE: See paragraph (t)(3) of this section for additional requirements on attendants for work in manholes.

(e)(8) "Calibration of test instruments." Test instruments used to monitor atmospheres in enclosed spaces shall be kept in calibration, with a minimum accuracy of + or - 10 percent.

(e)(9) "Testing for oxygen deficiency." Before an employee enters an enclosed space, the internal atmosphere shall be tested for oxygen deficiency with a direct-reading meter or similar instrument, capable of collection and immediate analysis of data samples without the need for off-site evaluation. If continuous forced air ventilation is provided, testing is not required provided that the procedures used ensure that employees are not exposed to the hazards posed by oxygen deficiency.

(e)(10) "Testing for flammable gases and vapors." Before an employee enters an enclosed space, the internal atmosphere shall be tested for flammable gases and vapors with a direct-reading meter or similar instrument capable of collection and immediate analysis of data samples without the need for off-site evaluation. This test shall be performed after the oxygen testing and ventilation required by paragraph (e)(9) of this section demonstrate that there is sufficient oxygen to ensure the accuracy of the test for flammability.

(e)(11) "Ventilation and monitoring." If flammable gases or vapors are detected or if an oxygen deficiency is found, forced air ventilation shall be used to maintain oxygen at a safe level and to prevent a hazardous concentration of flammable gases and vapors from accumulating. A continuous monitoring program to ensure that no increase in flammable gas or vapor concentration occurs may be followed in lieu of ventilation, if flammable gases or vapors are detected at safe levels.

NOTE: See the definition of hazardous atmosphere for guidance in determining whether or not a given concentration of a substance is considered to be hazardous.

(e)(12) "Specific ventilation requirements." If continuous forced air ventilation is used, it shall begin before entry is made and shall be maintained long enough to ensure that a safe atmosphere exists before employees are allowed to enter the work area. The forced air

ventilation shall be so directed as to ventilate the immediate area where employees are present within the enclosed space and shall continue until all employees leave the enclosed space.

(e)(13) "Air supply." The air supply for the continuous forced air ventilation shall be from a clean source and may not increase the hazards in the enclosed space.

(e)(14) "Open flames." If open flames are used in enclosed spaces, a test for flammable gases and vapors shall be made immediately before the open flame device is used and at least once per hour while the device is used in the space. Testing shall be conducted more frequently if conditions present in the enclosed space indicate that once per hour is insufficient to detect hazardous accumulations of flammable gases or vapors.

NOTE: See the definition of hazardous atmosphere for guidance in determining whether or not a given concentration of a substance is considered to be hazardous.

B.3 Telecommunications Standard

(29 CFR 1910.268 o(1) - o(5))

o) Underground lines. The provisions of this paragraph apply to the guarding of manholes and street openings, and to the ventilation and testing for gas in manholes and un-vented vaults, where telecommunications field work is performed on or with underground lines.

(o)(1) Guarding manholes and street openings.

(o)(1)(i) When covers of manholes or vaults are removed, the opening shall be promptly guarded by a railing, temporary cover, or other suitable temporary barrier, which is appropriate to prevent an accidental fall through the opening and to protect employees working in the manhole from foreign objects entering the manhole.

(o)(1)(ii) While work is being performed in the manhole, a person with basic first aid training shall be immediately available to render assistance if there is cause for believing that a safety hazard exists, and if the requirements contained in paragraphs (d)(1) and (o)(1)(i) of this section do not adequately protect the employee(s). Examples of manhole worksite hazards, which shall be considered to constitute a safety hazard, include, but are not limited to:

(o)(1)(ii)(A) Manhole worksites where safety hazards are created by traffic patterns that cannot be corrected by provisions of paragraph (d)(1) of this section.

(d)(1) Before work is begun in the vicinity of vehicular or pedestrian traffic, which may endanger employees, warning signs, and/or flags or other traffic control devices shall be placed conspicuously to alert and channel approaching traffic. Where further protection is needed, barriers shall be utilized. At night, warning lights shall be prominently displayed, and excavated areas shall be enclosed with protective barricades.

(o)(1)(ii)(B) Manhole worksites that are subject to unusual water hazards that cannot be abated by conventional means.

(o)(1)(ii)(C) Manhole worksites that are occupied jointly with power utilities as described in paragraph (o)(3) of this section.

(o)(2) Requirements prior to entering manholes and un-vented vaults.

(o)(2)(i) Before an employee enters a manhole, the following steps shall be taken:

(o)(2)(i)(A) The internal atmosphere shall be tested for combustible gas and, except when continuous forced ventilation is provided, the atmosphere shall also be tested for oxygen deficiency.

(o)(2)(i)(B) When unsafe conditions are detected by testing or other means, the work area shall be ventilated and otherwise made safe before entry.

(o)(2)(ii) An adequate continuous supply of air shall be provided while work is performed in manholes under any of the following conditions:

(o)(2)(ii)(A) Where combustible or explosive gas vapors have been initially detected and subsequently reduced to a safe level by ventilation,

(o)(2)(ii)(B) Where organic solvents are used in the work procedure,

(o)(2)(ii)(C) Where open flame torches are used in the work procedure,

(o)(2)(ii)(D) Where the manhole is located in that portion of a public right of way open to vehicular traffic and/or exposed to a seepage of gas or gases, or

(o)(2)(ii)(E) Where a toxic gas or oxygen deficiency is found.

(o)(2)(iii)(A) The requirements of paragraphs (o)(2)(i) and (ii) of this section do not apply to work in central office cable vaults that are adequately ventilated.

(o)(2)(iii)(B) The requirements of paragraphs (o)(2)(i) and (ii) of this section apply to work in un-vented vaults.

(o)(3) Joint power and telecommunication manholes. While work is being performed in a manhole occupied jointly by an electric utility and a telecommunication utility, an employee with basic first aid training shall be available in the immediate vicinity to render emergency assistance as may be required. The employee whose presence is required in the immediate vicinity for the purposes of rendering emergency assistance is not to be precluded from occasionally entering a manhole to provide assistance other than in an emergency. The requirement of this paragraph (o)(3) does not preclude a qualified employee, working alone, from entering for brief periods of time, a manhole where energized cables or equipment are in service, for the purpose of inspection, housekeeping, taking readings, or similar work if such work can be performed safely.

(o)(4) Ladders. Ladders shall be used to enter and exit manholes exceeding 4 feet in depth.

(o)(5) Flames. When open flames are used in manholes, the following precautions shall be taken to protect against the accumulation of combustible gas:

(o)(5)(i) A test for combustible gas shall be made immediately before using the open flame device, and at least once per hour while using the device; and

(o)(5)(ii) A fuel tank (e.g., acetylene) may not be in the manhole unless in actual use.

Appendix C:

Purdue University Tunnel System

C.1 Introduction

The tunnel system on campus consists of approximately six miles of underground passageways. The tunnels supply, steam lines, compressed air, electrical power, and data lines to the majority of buildings on campus. The tunnel system is a controlled access work area and only authorized personnel are allowed to enter. Non Purdue employees such as contractors will be advised of the conditions of and for occupying the tunnel system by a representative of Construction Health and Safety (REM).

C.1.1 Confined Space Classification

The walkable tunnels on campus are classified as non-permit required confined spaces. Normal activities performed in the tunnel include routine inspection/walkthroughs, meter reading, and cleaning of nonhazardous debris. During normal operation conditions, the walkable tunnel system;

- is large enough to permit bodily entry;
- has limited means of entry/egress (most entry points require entrants to climb down a ladder, climb over pipes, or travel extended distances to exit);
- is not designed for continuous human occupancy;
- has mechanical ventilation system to provide fresh air to occupants and reduce the likelihood of a hazardous atmosphere to develop;
- does not contain a material with a potential to engulf and entrant;
- does not have an internal configuration in which an entrant could become trapped (there is more than one exit point in each section of walkable tunnel); and
- there are no other recognized serious safety or health hazards.

Areas of the tunnel with cross section dimensions less than 22" wide or 48" tall are classified as permit required confined spaces. Dimensions are measured from wall to wall and floor to ceiling. Even during normal operations, these non-walkable sections of the tunnel system;

- have the potential for a hazardous atmosphere (the mechanical ventilation system does not adequately ventilate these spaces);

- have a small enough cross section that entrants could become trapped by pipes in the area; and
- usually have a dead end at one end.

Entry into the walkable tunnel system will follow the practices/procedures set forth in this policy.

Entry into any non-walkable section of tunnel system shall follow permit required entry requirements.

C.1.2 Conditions/Activities that Reclassify the Tunnel as a Permit Required Confined Space

The tunnel system, like any confined space is a dynamic environment. There are certain conditions and activities that may introduce hazards to entrants. Work activities must be evaluated to determine if they would present hazards which would cause the space to be reclassified as a permit required space. The following is a list of conditions or activities that would reclassify the tunnel as a permit required confined space. If any of these conditions is met, the area may only be entered using permit entry procedures. This is not an all-encompassing list of activities which would require reclassification.

- Damaged Utility lines present
- Hot work (cutting, welding, brazing)
- Hot Tapping
- Energized electrical work
- Purging or bleeding lines
- Introduction of more than one gallon of any type of chemical at any one time

C.2 Required Training Prior to Entry in the Tunnel System

Before entering the tunnels for the first time, Purdue employees are required to complete the following training programs.

- **Asbestos Awareness** – Available through the REM department.
- **Confined Space** – Available through the REM department.
- Personal Protective Equipment
- Steam Tunnel Entry
- Heat Stress

Additional training may be needed, based on specific tasks being performed while in the steam tunnel. Additional training may include but is not limited to high voltage/electrical, lockout/tagout, and bloodborne pathogen.

C.3 Tunnel System Entry Requirements

C.3.1 Preplanning for Work in Steam Tunnels

Employees must notify their supervisor prior to entering the tunnel system. The supervisor shall verify that the employee has received the proper training to enter the tunnels. Entry into the tunnel system must be coordinated with Utilities Operations staff, Purdue Police, or Purdue Fire Department personnel. The supervisor and employee shall also discuss the scope of work to be performed while in the tunnel. Certain activities can create additional hazards within the tunnel which may reclassify the area as a permit required confined space. Entry preplanning shall include an assessment of all potential hazards, means and methods of hazards control, and emergency action plans including but not limited to:

- Identities and locations of energized steam, gas, and electrical lines
- Locations of exposed hot surfaces
- Signs of symptoms of heat exhaustion and heat stroke
- Means of communication
- Hazards created by work activity (note: certain activities will reclassify the space as a permit required space)
- External Hazards
- Means to control hazards (lockout/tagout)
- Required equipment
- Steam line de-energization and lockout procedures
- Potential emergency situations and response

C.3.2 Entry Points

Where possible, authorized individuals must enter the tunnel system through entry doors in the lower levels of campus buildings. Upon entry, doors must be closed and secured. If necessary, authorized individuals may also gain entrance to the tunnel system by properly opening an access lid. The access lid must be adequately guarded to prevent accidental or unauthorized entry. Prior to or immediately following removal of a manhole lid or opening of a hatch use one of the following methods to prevent an accidental fall through the opening:

- Use a portable railing to surround the opening; or
- Use an 8 ft. fence to completely surround the opening or work area

It is the entrant's responsibility to maintain security at access points to prevent unauthorized entry into tunnels.

C.3.3 Proper Clothing and Equipment

It is required to wear long pants to protect lower extremities from burns and cuts when crossing steam lines and walking in tight quarters. Required equipment includes a communication device (radio or cell phone) and a flashlight.

Work in the tunnel may require additional equipment and protective clothing (e.g., safety foot wear, safety glasses, hardhat, and leather gloves).

C.3.4 Electrical Safety

Plugging into light fixtures using screw in type adaptors or other means is not allowed. The lighting electrical system cannot be used to provide power to any auxiliary electrical device, which includes but is not limited to tools, radios, or auxiliary lights.

C.3.5 Security

The following departments have keys for permanent access to the tunnel system:

- Utilities Distribution
- Purdue Police Department
- Purdue Fire Department

If employees from other departments need to access the tunnel, they must coordinate entry with one of these departments and may be issued a temporary key. Non-Purdue employees (contractors) will never be issued a key to the tunnels. If a section of the tunnel is to be part of a construction site, the contractor may remove the existing lock and secure access points with their own lock. Lockable barriers must also be placed within the tunnel at all access points to the construction area. Contractors are responsible for security of sections of tunnel within the construction site.

Prior to entering the tunnels employees must notify the Purdue Police department, informing them the time and the location. All access points must be either secured or

continuously monitored during entry into the tunnels to prevent unauthorized entry. Upon leaving the tunnels, they must notify Purdue Police that they have exited the tunnels.

Any authorized personnel occupying the tunnels outside of normal university working hours (7:30 am - 4:00 pm) are required to obey the following:

- Notify Utilities Distribution (47421) preferably 24 hours prior to entry
- Notify Purdue Police before entering and after exiting the tunnels
- Work in pairs, or execute a check-in policy; Entrant contacts someone in their organization once every hour for the duration of the entry

C.3.6 Contractor Work in Tunnels

Contractors whose scope of work involves work in the tunnel system will be informed of all conditions of and for occupying the tunnel system. The contractor will assume overall responsibility for the construction site. It is the contractor's responsibility to secure the worksite by doing the following:

- Isolate portions of the tunnel within their scope of work by installing lockable barriers within the tunnel to prevent unauthorized entry into the area
- If entry doors from buildings lead into the construction site of the tunnel, post signs that alert others that the door opens into a construction site
- Post 24 hour emergency contact numbers at each entrance into the tunnel construction site
- If Purdue employees must access the tunnel construction site, the contractor must notify the employees of conditions and escort them within the area

If the contractor encounters additional hazards within the tunnel or performs work creates an additional hazard (as defined in section B.1.2), the contractor must:

- Bring additional hazards to the university's attention
- Coordinate with Purdue to reassess and reclassify the space as a permit required confined space for the duration of the project or until hazards are abated
- Perform entry into the space that complies with applicable regulations (29 CFR 1910.146 or 29 CFR 1926.800)

C.4 General Tunnel Entry Procedure

C.4.1 Non-Permit Entry

Any entry into the tunnel system that does not require a permit must comply with the following procedure

- Notify the Purdue Police department prior to entering the tunnel
- Enter the tunnel through an access door in the basement of a building, if the tunnel must be access through an outdoor floor hatch, it must be guarded appropriately
- After entering, immediately close and secure the access door
- Perform assigned duties
- Exit the tunnel through a building access door, or properly guarded floor hatch
- Immediately close and secure the door
- Notify Purdue Police that you have exited the tunnel

C.4.2 Permit Required Entry

Entry into areas of the tunnel classified as permit required confined spaces must comply with all requirements of the University's Permit Required Confined Space Program. Below is a general procedure for such entries.

- Notify the Purdue Police and Fire departments as far in advance of the entry as possible.
- Review the specific space evaluation form and work to be done in the space to determine how to control all of the hazards within the space
- Assign entry team duties and fill out the entry permit
- Perform pre entry atmospheric testing
- Notify the Purdue Police and Fire departments prior to entering the space
- Perform continuous atmospheric monitoring
- Attendant and entrant must stay in constant communication
- After work is complete and entrant has exited the space, notify the Purdue Police and Fire departments to cancel the permit

Access to areas around work that reclassifies an area non-permit space of the tunnel to a permit space must comply with the following procedure. (Dimensions of the area to be classified as permit space are dependent on hazards created and should be determined by a qualified individual prior to work being performed). If there is any doubt as to the tunnel's classification, it must be treated as a permit required confined space.

- Notify the Purdue Police and Fire departments as far in advance of the work as possible.

- Review the specific work to be done in the space to determine how to control all of the hazards within the space
- Assign entry team duties and fill out the entry permit
- Control as many hazards as possible (LO/TO, blocking and bleeding lines, etc.)
- Notify the Purdue Police and Fire departments prior beginning work
- Perform continuous atmospheric monitoring
- Attendant and entrant must stay in constant communication
- After work is complete and entrant has exited the space, notify the Purdue Police and Fire departments to cancel the permit