CHAPTER 5 CONFINED SPACES

5.1 INTRODUCTION

Severe hazards to personnel may exist in **confined spaces** (see Definitions). Because these hazards may not be evident, certain fundamental precautions and procedures must be observed for positive accident prevention.

This section is intended to provide guidance for the preservation of life and health by identifying and rendering safe any confined spaces.

It is Laboratory policy that no confined space shall be entered until (1) cognizant supervisory personnel have certified that such action is necessary, (2) the Industrial Hygienist (IH) or designee has reviewed the planned entry and issued a Confined Space Entry Permit, (3) all personnel entering the confined space or acting as Safety Watch have successfully completed "Confined Space Entry Training" within the past two years, and (4) all precautions deemed necessary for personal safety, including those cited herein, have been taken.

5.2 SCOPE

This section provides procedures for personnel protection during work involving confined spaces. The requirements of this section are applicable to all personnel working at the Laboratory.

5.3 DEFINITIONS

In this section, the following definitions shall apply. Other applicable definitions may be found in ANSI Z88.2, "Practices for Respiratory Protection."

Approved - Tested and listed as satisfactory by a recognized testing agency having jurisdiction, such as the Mine Safety and Health Administration or the National Institute for Occupational Safety and Health.

Confined Space - Any partially or completely enclosed space which is large enough and so configured that an employee may bodily enter, has limited or restricted means of entry or egress, and is not designed for continuous human occupancy.

Confined Space Entry - An entry into a Confined Space is considered to occur when any part of the entrant's body breaks the plane of the opening of the Confined Space.

Confined Space Entry Permit - The written authorization issued by the Industrial Hygienist or other Permit Issuing Personnel for entry under defined conditions into a Permit-Required Confined Space for a stated purpose during a specified time period.

Entrant - Any person who will be making a Confined Space entry.

Hazardous Atmosphere - An atmosphere presenting a potential for death, disablement, injury, or acute illness from one or more of the following causes:

A. An oxygen-deficient atmosphere containing less than 19.5% oxygen by volume.

B. A flammable gas, vapor, or mist in excess of 10% of its lower explosive limit (LEL).

C. An atmosphere with a concentration of any toxic or hazardous substance above the OSHA Permissible Exposure Limit or ACGIH Threshold Limit Value (see ESHD 5008, Section 8, Chapter 1).

D. An oxygen-rich atmosphere containing greater than 23.5% oxygen by volume.

E. An airborne concentration of a combustible dust that meets or exceeds its LEL. This may be approximated as a condition in which the dust obscures vision at a distance of 5 feet or less.

F. Any other atmospheric condition that is immediately dangerous to life or health.

Immediately Dangerous to Life or Health (IDLH) - Any condition which poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a permit space.

Lower Explosive Limit (LEL) - The lower limit of flammability of a gas or vapor at ordinary ambient temperatures expressed in percent of the gas or vapor in air by volume.

Non-Permit Confined Space - Any confined space that does not contain any hazard capable of causing death or serious physical harm, and does not contain the potential for any atmospheric hazards. No special requirements above normal safe working practices are required for entry into non-permit confined spaces since they pose no special or serious hazards.

Qualified Personnel - Any personnel who have passed the Confined Space Entry Course as offered by Human Resources and Training. These personnel are qualified to act as either Safety Watch, Entrant, or Responsible Person.

Permit-Required Confined Space - A confined space that has one or more of the following characteristics:

A. Contains or has a known potential to contain a hazardous atmosphere;

B. Contains a material with the potential for engulfment of the entrant;

C. Has an internal configuration such that an entrant could be trapped or asphyxiated (due to inwardly converging walls or a floor which slopes downward and tapers to a smaller cross-section); or

D. Contains any other recognized serious safety or health hazard.

Examples of permit-required confined spaces include: vacuum enclosures, manholes, storage utility tunnels, pipelines, and rooms with openings that make access difficult, rooms with inadequate natural ventilation or with faulty or no mechanical ventilation, etc. Confined spaces which lack sufficient electrical work room must also comply with ESHD 5008, Section 2.0.

Respiratory Protective Device (Respirator) - A device designed to protect the wearer from inhalation of harmful atmospheres. Only personnel trained in the use of respiratory protection may wear these devices (see ESHD 5008, Section 8, Chapter 7).

Responsible Person - Supervisor (who is confined space qualified) or other Qualified Personnel who is responsible for the work to be carried out under the Confined Space Entry Permit.

Safety Watch - A Qualified Person knowledgeable in the hazards of the confined space who remains outside the space and safeguards the entrants.

Self-Contained Breathing Apparatus (SCBA) - Portable device which supplies breathing-air to the individual, thus protecting against inhalation of a hazardous atmosphere. Only SCBA's that operate in the pressure-demand mode shall be used in confined spaces.

Shall - A mandatory requirement.

Should - An advisory requirement.

Permit Issuing Personnel - Personnel who have been trained by the Industrial Hygienist, to issue Confined Space Entry Permits. Training on permit issuing must include instructions on this chapter, and on the Industrial Hygiene Operating Procedures IH-OP-24, "Writing a Confined Space Entry Permit" and IH-OP-25, "Evaluating Confined Spaces." Only personnel so trained may issue Confined Space Entry Permits. Note that this is not the same as a "Qualified Personnel."

5.4 POTENTIAL HAZARDS

5.4.1 Oxygen Deficiency - the normal oxygen content of air is 20.9% (by volume). Experiments show that 16% oxygen (by volume) is unsafe for human exposure because of biological effects. A requirement of 19.5% minimum oxygen (by volume) has been established as a work requirement by OSHA. Any atmosphere containing less than 19.5% oxygen is considered oxygen deficient.

A. Potential Sources of Oxygen Deficiency - Oxygen-deficient atmospheres most often occur in enclosures or confined spaces such as vacuum enclosures, tanks, process vessels, tunnels, ducts, pits, storage or holding compartments, sewers, and similar locations. Some operations create oxygen-deficient atmospheres by introducing inert gases into contained spaces. These atmospheres are sometimes maintained on a continuing basis and include:

1. Vacuum spaces let up to atmospheric pressure with a gas other than air, e.g., dry nitrogen.

2. Gases intentionally used to produce oxygen-deficient atmospheres for the control of fires or other purposes, e.g., CO_2.

3. Confined spaces where significant oxidation (rusting) has occurred. The oxidative process chemically binds the normally present atmospheric oxygen.

4. Leakage of gases into a confined space due to poor lines or cryogenic liquid boil-off.

B. Human Response - Entry into a severely oxygen-deficient atmosphere usually results in immediate collapse of the individual without warning. The individual is unaware of what is happening, and death may result in a few minutes depending upon the level of oxygen available. Serious injury or death will result if rescue is not executed promptly. The time available is generally less than five (5) minutes. The suddenness and severity of the human response to oxygen deficiency demands continuing management evaluation of jobs in potentially oxygen-deficient locations.

5.4.2 Flammable Gases and Vapors - A flammable atmosphere can be created by a flammable gas, vapor, mist, or dust. Flammable gases are also simple asphyxiants. Flammable liquids are liquids that have a flashpoint below 100 °F. Flammable vapors may also be toxic. Handling of flammable substances in a confined space requires review and approval by the IH prior to use and must be specified on the Confined Space Entry Permit. To maintain an adequate margin of safety, concentrations of flammable gases or vapors must be maintained below 10% of the lower explosive limit (LEL).

5.4.3 Toxic Gases and Vapors - An atmospheric concentration of any toxic or hazardous substance above the OSHA Permissible Exposure Limit (PEL) or ACGIH Threshold Limit Value (TLV) can create an acute hazard. Because concentrations can accumulate quickly in a confined space, the use of any volatile materials, hazardous chemicals, or processes which could release hazardous particles to the air requires review and approval by the IH prior to use and must be specified on the Confined Space Entry Permit.

5.4.4 Other hazards may exist in permit-required confined spaces, and each must be addressed to ensure the safety of the entrants. Examples of these hazards include: the presence of hazardous chemicals, radiation, heat sources, falling hazards, high noise areas, etc. Procedure IH-OP-25, "Evaluating Confined Spaces," can be used to assist in identifying all hazards, whether atmospheric or physical.

5.5 RESPONSIBILITIES

5.5.1 All Supervisors are responsible for assuring that confined space entries are carried out in accordance with this directive.

5.5.2 Responsible Persons shall:

A. Examine job requirements; plan work to avoid entry into the confined space or arrange to have as much work as possible performed outside the space. Confirm that individuals making entry have been properly trained in confined space entry and hold current certification (contact Human Resources and Training to obtain information).

B. Notify the Industrial Hygienist of the planned entry and request a Confined Space Entry Permit. Notification is recommended 24 hours before the planned entry or before any weekend during which confined space entries are planned. Brief the IH on any suspected contaminants and ask them to assess the habitability and safety of the confined space. Notify Health Physics personnel to obtain evaluations of radiological hazards, if applicable (refer to ESHD 5008, Section 10, for more information on radiological protection).

C. Sign the Confined Space Entry Permit and assure that all requirements of the permit are met. Initial on the Confined Space Entry Permit that each individual requirement listed has been completed **before** entry into the confined space.

D. Assure that the permit is posted at the entrance of the confined space while work is being conducted and that written procedures are available and understood for the task being performed. If there are multiple entrances to the confined space, each entrance must be posted with a copy of the permit.

E. Direct all persons to stay out of the space until entry by designated employee(s) is authorized.

F. Employ forced ventilation that circulates fresh air into all portions of the space sufficiently to purge toxic and/or flammable gas vapors and particulates both before and during occupancy if so specified on the Permit (see Section 8.5.6.5.A.).

G. Ascertain that all access procedures, system isolation requirements, and lock-out procedures as specified on the permit are completed in accordance with Laboratory Procedure ESH-016 (see Sections 8.5.6.5.B. and C.). In situations where all systems cannot be isolated, special precautions must be substituted.

H. Establish continuous oxygen monitoring during the time of confined space occupancy in all potentially oxygen deficient or oxygen-rich confined spaces as required on the Confined Space Entry Permit (see Section 8.5.5.5).

I. Record any monitoring results required by the permit in the appropriate location on the permit including the date and time the results were obtained. For continuous monitoring, record the initial entry results of monitoring, and the results at subsequent entry periods (i.e. the beginning of each day of entry).

J. Supervise the draining, flushing, and cleaning of the space, as needed, to remove solid or liquid residues that might further react to release dangerous contaminants or deplete oxygen.

K. Establish the means of egress from the space under normal circumstances, as well as during emergencies and accident circumstances, including the entrant(s) potentially becoming incapacitated.

L. Appoint and inform prospective entrants and their Safety Watch about specific hazards, and ensure that all persons understand and have received training in any special safety procedures for that space including the use of prescribed personal-protective equipment and the employment of any rescue devices.

M. Assure that each person entering the confined space is wearing protective equipment or emergency equipment as required by the permit.

N. Assure that only IH approved lighting is used and that all electrical equipment is properly grounded using ground fault circuit interrupters (GFCI's) for entries into metal tanks, wet enclosures, and other confined spaces where electrical shock may be a hazard.

O. Ensure that the Safety Watch is instructed and understands his or her duties (see Section 8.5.5.4) and that the Safety Watch has any required equipment, such as a portable radio, if needed.

P. Ensure that either the Safety Watch or another person on site (at the Lab) has the capability of removing the entrant(s) from a space in which entry and egress is relatively difficult due to obstructions or small opening size during non-emergency conditions (Safety Watches may perform this duty from outside the confined space). This can be done with a retrieval device or by simply assisting the entrant at the confined space entrance. This duty may not interfere with the other duties of the Safety Watch.

Q. Cancel the Confined Space Entry permit by removing it from its posting upon completion of the job specified, or upon reaching the expiration date and time, and by returning the completed permit to the Industrial Hygienist.

5.5.3 Entrants shall:

A. Adhere strictly to work procedures and precautions set forth by supervisory personnel, this Chapter, and the Confined Space Entry Permit.

B. Leave the confined space before expiration of any prescribed time limit or at the first indication that the space may be unsafe.

C. If forced ventilation is required to maintain a non-potentially oxygen deficient status for a confined space:

1. Before entry, establish a positive detection method for identifying if the forced ventilation has failed. This may be by air flow, sound of ventilator, alarm, or other means.

2. Leave the confined space immediately on failure of the forced ventilation system.

3. Do not re-enter the confined space until the forced ventilation has been restored.

D. Make every attempt to evacuate the space unassisted should an emergency situation arise.

E. Assume ultimate responsibility for personal safety.

F. Be confined space entry Qualified Personnel.

G. Be able to communicate clearly and understandably with the Safety Watch.

5.5.4 A Safety Watch shall:

A. Safeguard the confined space entrants. The Safety Watch shall not be assigned and may not perform any other duties which in any way interferes with the Safety Watch responsibilities.

B. Maintain communication with the confined space entrants.

C. Keep the tools required for accomplishing their responsibilities readily available.

D. Ensure that a watch is maintained on the respirator air supply and/or rescue lifeline when such equipment is required (other personnel may be assigned to this task).

E. Know the nearest location of communication with the Emergency Services Unit (ESU) in case of emergency, or have possession of a radio for contact.

F. Summon help in any emergency (including breakdown of equipment or procedure).

G. Remain outside the confined space at all times until relieved of Safety Watch duties. A Safety Watch is relieved of Safety Watch duties when the entrant(s) departs the confined space, when replaced by another Qualified Person, or when ESU arrives to coordinate a rescue. The Safety Watch shall not leave his/her post except to save their own life in an immediately dangerous-to- life and health (IDLH) situation or to contact ESU in case of emergency, after which they shall return to their post until relieved by ESU.

H. Be confined space entry Qualified Personnel and trained in the use of all required equipment.

I. Keep all unauthorized personnel away from the space where an entrant is located.

J. Prevent external hazards from entering the confined space including falling objects or extraneous personnel by keeping the area surrounding the entrance clear.

K. Shall not, under any circumstances, attempt a rescue that would involve entering the space.

L. Be able to communicate clearly and understandably with the entrants and with ESU.

M. Perform non-entry rescue using retrieval equipment if applicable to that entry.

5.5.5 The Industrial Hygienist or other Permit Issuing Personnel shall:

A. Evaluate potential and actual hazards in accordance with IH-OP-25 prior to issuing a Confined Space Entry Permit.

B. Issue Confined Space Entry Permits in accordance with IH-OP-24, define required precautions for entry, list the names of personnel permitted to enter, specify a valid time period for the permit, and remind responsible persons when extended permits (greater than one week in length) are about to expire.

C. Assure the availability of oxygen meters and/or toxic gas monitors where deemed necessary. (The IH maintains a limited supply of portable battery powered oxygen monitors. These are not suitable for extensive, continuous monitoring. Operations which require extensive, continuous monitoring should provide permanent AC powered monitors.)

D. Provide Confined Space Entry training to affected employees every two years.

E. Provide signs and/or placards to supervisors to identify each confined space.

F. Request Health Physics, Electrical Safety, Fire Protection, and Industrial Safety consultation on matters pertaining to those individual specialties.

G. Provide, by fax or other quick means, a copy of the Confined Space Entry Permit to ESU to ensure that ESU is aware of the work activity before the entry begins.

H. Review entry operations to find any concerns or deficiencies with the program that might fail to protect employees and take steps to correct the problems found.

I. Review the cancelled confined space permits within one year after each entry and revise the program as necessary, to ensure that employees are protected from confined space hazards.

5.6 REQUIREMENTS

5.6.1 No entry into a confined space shall be made until the IH or other Permit Issuing Personnel have evaluated the entry and have issued a Confined Space Entry Permit.

5.6.2 All Permit-Required Confined Spaces should be posted with a sign or label stating "Danger - Permit-Required Confined Space, Do Not Enter" or similar language. These postings shall be maintained so as to remain legible.

5.6.3 Monitoring Requirements - If required by the Confined Space Entry Permit, the confined space shall be monitored immediately prior to entry for any hazardous atmosphere that could potentially exist in the confined space at the time of entry.

A. Oxygen - For any potentially oxygen-deficient space, monitoring of the air quality shall be maintained while entrants are in the confined space. If personnel leave the confined space through shift or crew change or work break, the air shall be re-tested prior to re-entry. All oxygen monitors shall have audible alarms and shall be calibrated to alarm at not less than 19.5% oxygen (by volume). Monitors shall have their calibration checked immediately prior to each shift entry and shall be removed for calibration to a space of sufficient volume that the oxygen level will, without question, be 20.9%. No oxygen monitor shall be calibrated in a confined space.

B. Flammability - For any confined space potentially or actually containing flammable vapors, monitoring shall be conducted prior to the initial entry. The IH may require continuous monitoring of any process which uses flammable materials or could generate flammable vapors. Combustible gas meters with audible alarms shall be used to determine atmospheric concentration and shall be calibrated to alarm at 10% of the LEL.

C. Toxic Substances - For any confined space potentially or actually containing toxic gases, vapors, dusts, mists, or liquids, atmospheric monitoring must be conducted prior to the initial entry. The IH may require continuous or periodic monitoring of any process that uses these substances while anyone occupies the space. Direct reading instruments, such as organic vapor analyzers or chemical-specific detector tubes, shall be used.

D. Continuation of Monitoring - Lack of a hazardous atmosphere shall not be assumed, but shall be tested and evaluated periodically, as deemed appropriate by the IH. This may include testing prior to entry, periodic testing, and/or continuous monitoring.

E. Monitor Alarms/Ventilation Failure - If any meter or monitoring device should alarm, or a required ventilation system should fail while entrants are in the confined space, the confined space shall be evacuated immediately, the IH shall be notified immediately, and no further entry shall take place until the IH has been to the confined space and have re-evaluated the potential hazards. If a meter alarm was due to anything other than a faulty meter, the present permit will be voided and a new permit will be required.

5.6.4 Training Requirements

A. All qualified confined space entrants, Safety Watches and Responsible Persons shall have received training no earlier than two years prior to the expiration of the permit. The training shall cover at a minimum issues 5.6.4.B. through F. A written record of the hours and subject matter of the training shall be retained by Human Resources and Training.

B. Every employee, prior to being involved in a confined space entry containing a potential hazard, shall understand the nature of the hazard and the need to perform appropriate testing to determine if it is safe to enter.

C. Employees shall be trained to exit unaided from a confined space as rapidly as possible (self-rescue) whenever an order to evacuate is given by the Safety Watch, whenever a monitoring instrument alarm sounds, or whenever the existence of a hazardous substance or oxygen-deficient atmosphere is suspected.

D. Employees shall be made aware of the toxic effects or symptoms of exposure to anticipated hazardous substances or oxygen deficiency in the confined space. Employees shall be trained to notify their Safety Watch and to attempt self-rescue immediately on becoming aware of these effects.

E. The employee shall be trained on any modifications of normal work practices that are necessary for work in a confined space.

F. Employees performing atmospheric tests of the confined space shall be properly instructed in the use and calibration of testing equipment by the person responsible for that equipment.

G. Contractor personnel on site for specific functions which include confined space entry must provide current documented proof of training at a level equivalent to that offered at PPPL before being permitted to enter a PPPL confined space. Documentation of the training must be approved by the IH and maintained for at least one year after expiration of the Confined Space Entry Permit by Human Resources and Training.

5.6.5 Confined Space "Safing" Requirements

A. Purging and Ventilating - When air quality tests indicate a hazardous condition, the confined space shall be purged and/or ventilated prior to personnel entry. Purging and Ventilating does not preclude any requirements for air monitoring.

B. System Isolation - Confined spaces shall be isolated, whenever possible, from lines carrying materials that are capable of creating a hazardous atmosphere and toxic or flammable vapors and from any other system which poses a potential hazard to personnel inside of the confined space. Isolation shall be accomplished by using one or more of the following procedures:

1. Physically removing a section of all connecting pipes.

2. Providing blanking flanges on connecting pipes with blanks structurally strong enough to withstand incoming line pressures. Flanges shall be on the incoming side.

3. Misaligning connections of small diameter pipes and closing the open ends with threaded pipe caps or plugs.

4. Locking out pumps of any type connected to supply, exhaust, or outlet lines of a confined space.

5. Draining, flushing, and isolating pipelines containing harmful liquids (e.g., acids or bases) to prevent material from entering the confined space or dripping on entrants.

6. Any other isolation technique as approved by the IH.

C. Lockout/Tagout Procedures - The lockout/tagout system, as defined in Laboratory procedure ESH-016, shall be used to isolate and de-energize systems which could endanger the entrants of confined spaces.

5.6.6 Permit Requirements

The Confined Space Entry Permit shall:

A. Be posted at the entrance of the confined space with copies on file with the IH and ESU.

B. Authorize entry into a specific confined space and be valid for a period not to exceed 6 months, except for rescue team entry.

C. Describe the hazards known or reasonably expected to be present in the confined space.

D. Specify by name the employees assigned for entry and Safety Watch.

E. Describe the job or tasks to be performed and indicate any chemical handling, welding, etc.

F. Describe ventilation requirements.

G. Contain a completed checklist which shall:

1. Specify isolation, cleaning, purging, inerting, or ventilating to be completed prior to entry and certify that these procedures have been completed.

2. Specify any special work procedures to be followed due to additional hazards that may be generated by the activities of the entrants.

3. Specify the personal protective equipment that is necessary for entry, including respiratory protection and protective clothing.

4. Specify the atmosphere testing to be conducted immediately prior to, during, and following the entry period.

5. Be initialed by the responsible person upon completion of each individual requirement.

H. Be removed by the Responsible Person upon expiration of the permit or completion of the specified job, whichever comes first.

I. Be returned to the IH upon removal of the permit by the Responsible Person.

5.6.7 Special Conditions

Special conditions may change the normal permit issuance in the following circumstances:

A. Contractors or other outside personnel performing inspection-type entries for short durations (less than one hour) may be escorted into a confined space by confined space entry qualified personnel, if so specified on the Confined Space Entry Permit. The unqualified entrants must be instructed on the hazards of the specific confined space to be entered.

B. Contractors performing work involving Permit-Required Confined Spaces must be informed that such spaces exist and may be entered only through compliance with the OSHA standard. Contractors may either inform the IH of their own training and permit program to be used by submitting a copy of their written program for approval, or comply with PPPL's program including full training as supplied by Human Resources and Training. Operations involving both PPPL personnel and outside contractors shall be coordinated through the IH to ensure that no conflicts of programs exist. Prior to entry outside contractor personnel will be thoroughly briefed on the known or expected hazards of the confined space(s) which might be entered.

C. Procedures for safe entry may be used in place of all other requirements of this Chapter except for all training requirements (5.5.2.A., 5.5.3.F., 5.5.4.H., and 5.6.3) if the following conditions are met:

1. The only hazard posed by the permit space is an actual or potential hazardous atmosphere;

2. Continuous forced air ventilation is present and is sufficient to maintain safe entry conditions;

3. Monitoring and inspection data have been generated demonstrating both 5.6.7.C.1 and 5.6.7.C.2, using full entry permit procedures when appropriate;

4. The determinations and data are made available to all entrants and the procedure for entry meets the following requirements:

a. Any conditions making it unsafe to remove an entrance cover shall be eliminated before the cover is removed;

b. The opening must be guarded by a barrier that will prevent an accidental fall through the opening and will protect entrants from foreign objects entering the space;

c. The atmosphere must be tested prior to entry for oxygen content, flammable gases and vapors, and potential toxic air contaminants;

d. There shall be no hazardous atmosphere present when an entrant is in the space.

e. Continuous forced air ventilation shall be used such that any hazardous atmosphere is eliminated, the air flow shall be directed to ventilate the areas where an entrant will be present, and the air supply shall be from a clean source and may not increase the hazards in the space;

f. The atmosphere shall be periodically tested as necessary to ensure that the ventilation is adequate to prevent hazardous atmospheres from accumulating;

g. If a hazardous atmosphere is detected during entry, the space must be evacuated immediately and may not be re-entered until the IH has thoroughly inspected the space and the problem has been corrected.

h. The IH must approve the procedure and issue a confined space entry permit citing the procedure for safe entry which includes the date, the location of the space, and the signatures of both the person issuing the permit and the responsible person. The permit and accompanying procedure must be posted at the entrance to the confined space and be made available to each employee entering the space.

5.6.8 A space classified as a permit-required confined space may be reclassified as non-permit confined space if:

A. The permit space poses no actual or potential atmospheric hazards and if all hazards within the space are eliminated prior to entry.

B. The basis for declassification is certified including the date, the location of the space, and the signature of the person making the determination. The certification must be posted at the entrance to the confined space.

C. When hazards arise within the declassified space, the space shall be immediately evacuated and the IH must reevaluate the space and re-determine the appropriate classification.

5.7 EMERGENCY OPERATIONS

Under emergency conditions when immediate danger to the life and health of a person is evident, detailed procedures cannot be followed, although pre-planning for emergency action shall be performed. Many people are lost under these conditions because of improper response to the conditions of toxicity or oxygen deficiency. Therefore, it is vital to train personnel in proper emergency plans and responses, including the following:

A. Under no conditions shall anyone except those under the direction of Emergency Services personnel enter a confined space under emergency conditions. Call extension 3333 for help and wait for it to arrive.

B. Do not enter any confined space that may have a hazardous atmosphere without self-contained breathing apparatus. (A person cannot hold their breath long enough to effect a rescue.) Only Emergency Services personnel are authorized to don self-contained breathing apparatus and perform rescue.

C. In confined space entries where there is the potential of an oxygen deficient and/or otherwise hazardous atmosphere, emergency ventilation of the space shall be planned. Two ports shall be provided where possible. These ports shall facilitate emergency ventilation of the space. The Safety Watch shall be trained in the operation of the emergency ventilating equipment when supplied.

D. Each member of the rescue team (all ESU personnel involved) must be trained in emergency confined space rescue. They must be trained in, and supplied with the appropriate personal protective equipment necessary for making rescues from confined spaces. They must also be trained as "Qualified Personnel" and maintain current certification in basic first-aid and cardiopulmonary resuscitation (CPR).

E. Each member of the rescue team shall practice making permit space rescues at least once every 12 months, by means of simulated rescue operations in which they remove mannequins or actual persons from the actual permit spaces or representative spaces simulating real conditions.

F. To facilitate non-entry rescue, retrieval systems or methods shall be used whenever an 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. Responsible persons must obtain and maintain this equipment. Such equipment must include:

1. A chest or full body harness, with a retrieval line attached at the center of the entrant's back near shoulder level, or above the entrant's head. Wristlets may be used if the full body harness is infeasible or creates a greater hazard and the wristlets are the safest and most effective alternative.

2. A retrieval line 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 for vertical spaces greater than 5 feet deep.

5.8 REFERENCES

Farrison, Richard, Ravi Nabar, and Muzaffer Erig, "Ventilation to Eliminate Oxygen Deficiency in a Confined Space," Applied Industrial Hygiene, Vol. 4, No.1, January 1989, pp.1-10.

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U.S. Department of Energy, Division of Operational and Environmental Safety, "Recommended Practices for Protection of Personnel from Oxygen-Deficient Atmospheres," Operational and Environment Safety Standards, Draft 4, July 1978.