Welcome to the OSFM Hazardous Materials Division

Due to circumstances beyond our control this is the first time this page has been updated since its inception. These problems have been corrected and we hope to update this page monthly.

Mt. Vernon plastics warehouse fire. Photo: Courtesy of Enrico Garcia

The purpose of this page is to provide an open forum for the free exchange of information and to inform you of the latest hazmat incidents as they happen around the State of Indiana. However, **these goals can only be achieved if you participate.** You MUST provide us with this information, so that we can post it on this web page. Lets all work together to make this happen!

OSFM MISSION STATEMENT

We commit ourselves to ensuring the safety of the public. To that end, we will provide service and conduct business efficiently, honestly, cordially, ethically, and in an atmosphere of mutual cooperation and trust.

We will be leaders in providing a safe and productive work environment for each other, in which we all will experience a balance of autonomy and teamwork, while promoting mutual respect, open communications, accountability and personal growth.

HAZMAT DIVISION UPDATES

UNDER CONSTRUCTION

TRAINING

The OSFM HazMat Division has been hard at work developing a "Counter Terrorism Training Course for Hazardous Materials Technicians". This is an advanced course covering threat updates, federal and state directives, B-NICE agent updates, PPE, detection equipment, decontamination protocols for B-NICE agents, scene management, crime scene management, lessons learned, explosive devices, practical skills development, and final written and practical skills examinations. Larry Hamby of the OSFM Division primarily developed this course.

The pilot presentation of this course is tentatively set for sometime in June of this year. This presentation will be held at Grissom AFB.

STANDARD OPERATING GUIDELINES (SOG's)

Listed below are ***examples*** of SOG's that may be adapted for use by hazardous materials teams. The OSFM does not necessarily endorse any/all SOG(s) - these are examples only. Feel free to copy/use any of these SOG's that may be of use to you. The OSFM has developed and/or "borrowed" these SOG's from other hazmat teams. It is our hope that by seeing examples of other SOG's we might save you some time and trouble.

Subject: CHEMICAL PERSONAL PROTECTIVE EQUIPMENT

1. Purpose: The State Fire Marshals Office is committed to maintaining a safe work environment for its employees. This guideline has been developed to provide you with guidance for safely working in a hazardous materials environment and the proper use of chemical protective clothing.

2. Scope: This guideline covers all personnel who could be "reasonably anticipated" as the result of performing their assigned duties to come in contact with hazardous materials, both confined and unconfined.

3. When using encapsulating or non-encapsulating chemicals suits, the following guidelines should be followed:

   A. All jewelry (watches, rings, necklaces, earrings, etc.) and leather items should be removed prior to donning chemical suits.

   B. Work uniform should be removed, and a pair or nomex, cotton, or disposable coveralls should be worn under the chemical resistant suits. Using a coverall undergarment will provide additional protection for the wearer, will act as an absorbent for perspiration, and will prevent the uncomfortable feeling when the skin of the legs and arms directly contacts the interior of the suit. With incidents involving flammables, the nomex coverall should be used.

   C. Before donning a chemical resistant suit, two inspections should be made. If an inspection record for the suit is available, check the record to insure the suit is suitable to use. Then conduct a physical inspection of the suit. Check for holes or tears in the suit and look for any wear or abrasions that may damage the suit's ability to keep chemicals out. Check the attachments (gloves, boots, facepiece, etc.) are properly attached and in good condition.

   D. When the chemical resistant suits have booties attached, a pair of heavy socks should be worn. After donning the suit, a pair of turnout or other boots MUST be worn over the booties to protect the booties. The splash-guards attached to the legs of the chemical suit should be pulled over the boots to prevent any chemicals from entering the boots. DO NOT ATTEMPT TO WEAR YOUR REGULAR SHOES OVER THE BOOTIES OF CHEMICAL SUITS, as they do not offer any protection from the chemicals, they will be too tight, and they may become contaminated which will require their disposal.

E. If the chemical resistant suits do not have booties attached, a chemical resistant boot MUST be worn with the suit. Regular firefighters turnout boots are made of neoprene rubber and offer some chemical resistant qualities. However, turnout boots that are used for regular fire suppression service are not recommended for chemical protection as their integrity may have been damaged during fire service (cuts and holes) thus allowing contamination of the interior of the boot. When these boots are subsequently worn without the chemical resistant suit, the wearer can become contaminated.

F. For encapsulating suits with the gloves permanently attached, a second pair of gloves shall always be worn over the permanently attached gloves. This procedure will protect the permanently attached gloves from mechanical damage and also from excessive chemical exposure. Double gloving is always recommended when working with compressed gases, as the product being released is cold.

G. The use of surgical gloves under the other gloves is sometimes appropriate, as this will prevent any contact with contamination during the doffing of the chemical resistant clothing. Double or "triple" gloving is occasionally eliminated as it reduces some of the manual dexterity required for certain operations. Before making decisions on protection for the hands, the hazards of the product. compatibility of the gloves with the chemical, and job functions should be considered.

H. Standard issue firefighter gloves should never be worn for protection from chemicals at chemical incidents. These gloves have seams that will allow the entry of chemicals, and they are made of materials that will absorb chemicals. Standard issue firefighter gloves may be worn over chemical resistant gloves to protect the chemical resistant gloves from mechanical damage. If the firefighter gloves have been exposed to chemicals, it is recommended that they be disposed of properly. (If the exposed firefighter gloves are worn at a later time without the chemical resistant gloves underneath them, the wearer would be exposed to the chemical.)

I. Positive-Pressure Self-Contained Breathing Apparatus (PP-SCBA) shall always be utilized at chemical related incidents.

J. Prior to any personnel entering the Hot Zone (an area where the potential for exposure with the chemical exists), back-up personnel shall be standing by with appropriate chemical protective clothing ready to provide any necessary assistance or rescue to those personnel operating in the Hot Zone, and a decontamination procedure shall be developed and ready for use.

K. The number of emergency response personnel at the emergency site shall be limited to only those who are actively engaged in performing emergency operations or essential support. All other personnel shall be removed to a remote area. All operations in the Hot Zone shall be performed using the buddy system in groups or two or more.

L. During operations in the Hot Zone, personnel qualified and equipped to provide basic life support procedures shall be standing by with the ability to transport injured personnel to a medical facility.

M. All personnel, clothing (suits, boots, gloves), and equipment leaving a contaminated area shall be properly decontaminated. In some instances, it may be appropriate to properly dispose of the clothing and/or equipment. Usually, due to safe operating practices, the level of contamination on clothing should be low. Remember, prevention is the key.

N. Decontamination shall be performed in an area that will minimize the exposure of

uncontaminated personnel or equipment. Personnel performing decontamination shall wear protective clothing and respiratory protection appropriate for the contaminants expected. At the least, coated disposable coveralls, chemical resistant gloves, and chemical resistant boots shall be worn by personnel performing decontamination. The need for respiratory protection should be evaluated after considering the hazards of the materials involved and the likelihood of exposure of personnel requiring decontamination.

0. At a minimum, personnel exiting the Hot Zone should be washed-off with a hose line or safety shower. When deemed appropriate, personnel should be gently scrubbed with a warm water/detergent solution and rinsed prior to doffing the chemical resistant clothing. When chemical resistant clothing has been severely exposed, at least three washings and rinses with a warm water/detergent solution shall be performed prior to doffing the clothing.

P. There are some chemical exposures that may require the use of a special decontamination solution for clothing and equipment. When working around chemicals requiring special decontamination procedures, the Hazardous Materials Team leader will advise personnel of any special solutions or procedures necessary. All equipment and solvents used during decontamination shall be contained, evaluated, and properly disposed of.

Q. After use, the suits shall be treated as hazardous waste and properly disposed of per established protocols.

Subject: CHEMICAL/BIOLOGICAL TERRORISM INCIDENT RESPONSE

1. Purpose: Emergency response to incidents which may involve chemical or biological warfare agents present several unique hazards to emergency responders-In order for Hazardous Materials response personnel to provide adequate protection for the citizens of the State of Indiana and still maintain a sufficient level of self protection, it is essential that all personnel have some base knowledge of these agents and guidelines to provide a foundation for the response effort.

2. Scope: Civilian Emergency Response Personnel are trained to respond to natural disasters or traditional chemical accidents. They are seldom trained to deal with chemical attacks intended to kill or maim people. Protecting people against toxic chemical warfare agents used to be a military problem. However, chemical warfare and the potential for biological warfare have become real concerns for **all** emergency response teams, especially Hazardous Materials Response units. All emergency response personnel need to be prepared to safely and effectively respond to these types of emergencies.

3. Definitions:

Note: **Chemical warfare agents** are classified into five (5) groups based on their physiological effects: nerve agents, blister agents, blood agents, choking agents and irritants.

a) **Blister agents** (vesicants), such as mustard (HD) and Lewisite (L), cause severe burns to the skin, eyes, and respiratory tissues. Exposure occurs when the liquid form of the agent comes in contact with skin or eyes or the vapor is inhaled. Symptoms may be delayed (2-24 hours), making detection and response more difficult. Although much less lethal than nerve agents, blister agents easily penetrate clothing and are readily absorbed through the skin. These agents are also systemic poisons and potent carcinogens.

b) **Blood agents,** including the cyanide group, interfere with the blood's ability to transfer oxygen to the cells. High concentrations can cause rapid death by asphyxiation. Lower concentrations cause breathing problems, gastrointestinal distress, dizziness, and headaches. The lack of oxygen rapidly affects all body tissues, especially the central nervous system. Examples are hydrogen cyanide (AC), cyanogen chloride (CK).

c) **Choking agents,** injure the respiratory system, causing the lungs to fill with fluid, pulmonary edema ("dryland drowning") High concentrations result in death by asphyxiation. Lower concentrations of these agents cause severe coughing. Examples of choking agents include chlorine and phosgene, which are common industrial chemicals. These agents are liquids under pressure, but injury occurs when the vapor is inhaled.

d) **Irritants,** fall into two (2) categories; vomiting agents and riot gases.

1) **Vomiting agents** can cause nausea$_1$ vomiting, coughing, sneezing, nose/throat pain, nasal discharge, and tears. They have been used in tandem with other chemical warfare agents (i.e. soldiers would be overcome by the vomiting agent, remove their masks, and be exposed to the second (and more lethal) agent.

2) **Riot gases/tear agents** (lacrimators), such as tear gas (CS), cause copious tearing and coughing. They are non-lethal chemicals that cause short-term incapacitation. High doses can be lethal, however.

e) **Nerve agents,** are the **most lethal.** They are comparable to pesticides (organophosphates), but are much more toxic than pesticides and other standard industrial chemicals. These agents interfere with the central nervous system by disrupting nerve impulse transmissions. Nerve agents can be fatal in very small quantities. The most well-known nerve agents are tabun (GA), sarin (GB), soman (GD), and VX. Although they are liquids at room temperature, they evaporate quickly enough to create toxic vapor. Sarin is the most volatile, evaporating at about the same rate as water. Exposure occurs when the liquid form of the agent comes In contact with skin or eyes or the vapor is inhaled. Symptoms include pinpoint pupils, severe headache, and extreme tightness in the chest.

Note: Biological warfare agents are living organisms (or their derivatives) that cause disease in humans. Examples include anthrax, tularemia, cholera, and excephalitis. These agents can cause more damage than chemical agents because they are contagious diseases that can spread far past the incident site, infecting unlimited numbers of people.

The presence of a biological warfare agent can be difficult to recognize, identify, and treat. Many of the initial symptoms of these diseases are common to other diseases. There may be a delay between the time of exposure and the appearance of symptoms. The symptoms may also be mistaken for a naturally occurring outbreak of a disease.

Responding to a biological warfare incident includes identifying the event as a biological warfare incident, controlling access to and from the site, and imposing quarantines.

4. Initial Response - First Responder Operational:

A. Successful initial response to these types of incidents requires that First Responders perform the following tasks **safely**:

1) Detect the presence of hazardous materials which in this case of chemical ***I*** biological weapons where they need to realize that the signs and symptoms of these weapons are present (i.e. multiple victims would be an obvious sign). See attached **appendix A** for symptoms.

2) Ensure your personal safety.

3) Initiate Command and Control Activities.

    a) Report on conditions.
    b) Assume initial command and establish a command post in a safe location.
    c) Isolate the area and deny entry.
    d) Initiate the notification process.

4) Analyze (size up) the incident to determine the magnitude of the problem in terms of potential outcomes.

    a) Materials
    b) Container

5) Plan an initial response.

    a) **The response must be within the capabilities and competencies of available personnel, personal protective equipment, and control equipment...**

6) Implement planned response to favorably change the outcome.

    a) The response **must be** consistent with the local emergency response plan and organization's SOP's.

    b) Establish and enforce scene control procedures:

        - Control zones
        - Emergency decontamination
        - Communications

    c) Initiate the incident command system for hazardous materials incidents.

    d) Use personal protective equipment which is appropriate for the hazards/unknowns and your level of training. **Fire PPE and SCBA <u>do not</u> generally provide the required protection from chemical/biological agents... EPA Level "A" or "B" w/SCBA is required.**

7) Evaluate the progress of actions taken to ensure response objectives are being met **safely, effectively and efficiently.**

8) Document all your activities.

5. GENERAL GUIDELINES FOR HAZ-MAT TECHNICIANS/SPECIALISTS:

A. Military-issued equipment to protect against these agents varies widely based on the level of anticipated exposure. Civilian activities in the presence of these materials are regulated by Title 29 CFR 1910.120 HAZWOPER which is more stringent than military standards. As in any chemical emergency***, use the highest level of protection available until the chemical is identified.*** Modify that level of protection as appropriate after determining what chemicals are present. For example, nerve and blister agents require SCBA with Level A protection. Other toxic chemicals may require a lower level of protection.

B. Chemical agents are largely colorless and odorless. Those that do have color and odor (such as chlorine) are not likely to be used by terrorists, because their presence would only be too readily discovered, possibly aborting an attempt at surprise. The terrorist 5 will want the situation to go undiscovered as long as possible, so they will choose substances that will be very difficult to detect.

C. Blood agents such as cyanide disperse quickly, and death can occur within minutes. Nerve agents such as VX, VXY and GB (sarin) and vesicants such as mustard gas can't be detected by common detection devices operated by most fire departments ***I*** hazardous materials response teams. Specialized detection equipment is necessary.

D. Ordinary combustible gas indicators (CGI) and photo-ionization detection devices are not designed for war agents, nor would they be especially reliable if they were used in such a role.

E. Biological agents are;

- **1000 times more lethal than chemical agents**
- **Cause immune system response**
- **Solids, nonvolatile**
- **Are obtained from nature**
- **Invisible to the senses**
- **Have delayed effects from incapacitating to lethal**
- **Easy to produce**
- **Primarily an inhalation threat**
- **29 CFR 1910.1030 Bloodborne Pathogens standard requirements apply**

F. Chemical agents

- **Are generally liquids, but some am gases or solids at room temperature**
- **Are usually disseminated as aerosols**
- **Generally evaporate over a period of minutes to weeks**
- **Can have a range of effects on the body including death**
- **Are effective in a few seconds to several hours**
- **Would best be used by terrorists in enclosed spaces Can be detected, protected from, and decontaminated**

G. Reassessment of PRE Levels

The level of PPE should be upgraded or downgraded based upon changes in site conditions or levels of contamination.

Some indicators for the need to reassess PPE levels are:

- **Commencement of a new work phase**
- **Change in job tasks or scope of work which affects the degree of contact with contaminants**
- **Change in weather conditions**
- **Contaminants which were not previously identified are encountered**
- **Changes in ambient levels of contaminants occur during the work phase**
- **Temperature extremes affect the effectiveness of PPE**

6. Emergency Medical Guidelines:

A. Choking Agent Action:

1) Disrupts ability of the body to deliver oxygen to body tissues

2) Hydrolized in the lungs into HCI (and C02)

3) HCI destroys tissue at the alveolar - capillary membrane

4) C02 interrupts 02 supply

B. Medical action for Choking Agents:

1) Terminate exposure:

a) Remove casualty from the area

b) Mark the casualty

2) Resuscitate:

a) Ensure air passages open; check for hoarse or high pitched noise during inhalation.

b) Evaluate for low blood pressure

c) Enforce rest; litter evacuation required

d) Manage airway secretions

e) Provide continued support, if possible

3) Triage:

a) Low blood pressure, pulmonary edema & cyanosis reflect poor outlook.

C. Nerve Agent Action:

1) Nerve action:

a) Releases ACh to stimulate tissue

b) AChE from blood and at receptor sites hydrolizes ACh to allow the tissue to relax

2) Agent action:

a) Agent attaches to AChE, preventing hydrolysis of ACh

b) ACh builds up at receptor sites

c) Tissue remains stimulated

D. Medical action for Nerve Agents**:**

1) Decontaminate

2) Administer antidote

a)	Mild symptoms	2 mg atropine 600 mg pralidoxine chloride
b)	Severe symptoms	6 mg atropine 1800 mg pralidoxine chloride diazepam
c)	Ventilate:	Up to three hours

3) Triage:

a) Low blood pressure plus symptoms reflect poor outlook

E. Blood Agent Action:

1) CN - combines with Fe3+ in cytochrome oxidase enzyme complex in mitochondria

2) Prevents mitochondria from using oxygen during metabolism

3) Cell metabolizes without oxygen

4) Lactic acid buildup → metabolic acidosis

F. Medical Care for Blood Agents:

1) Terminate exposure

a) Allows body to detoxify

2) Administer antidote, amy nitrate, to attract and bind the CN-

3) Provide oxygen

4) Triage:

a) Circulatory failure and lack of breathing presents a poor outlook.

G. Blister Agent Action:

1) Mustard (H, HD)

a) Unknown mechanism

b) No agent present in blisters

c) Mustard reacts rapidly upon skin penetration

2) Lewisite (L)

a) Causes increased capillary permeability

b) Low blood volume, shock

c) Organ damage

d) Blisters

3) Phosgene oxime (CX) - unknown

H. Medical Care for Blister Agents:

1) Decontaminate

2) Intubate respiratory casualties

3) Use atropine for nausea and vomiting

4) Triage:

a) 50% burns or severe pulmonary distress reflect a poor outlook**.**

I. Biological Agents:

1) Pathogens;

a) Bacteria **Treat the symptoms**
b) Viruses **Isolate**
c) Rickettsiae **Evacuate**

2) Toxins

J. Medical Care for Biological Agents:

1) Treat the symptoms

2) Antibiotics I antitoxins

3) Vaccine therapy if indicated.

CARBON MONOXIDE DETECTOR ACTIVATION

NOTICE OF FINDINGS

Carbon Monoxide is an odorless, tasteless, colorless gas that is DEADLY. It is a by-product of a fuel burning process. It can cause symptoms that can mimic flu, unconsciousness and even death. Many appliances around the home are capable of producing Carbon Monoxide when a faulty or unusual condition exists. **Since the source may be transient in nature, the source may not always be detectable.**

The _____ Fire Protection District responded to investigate a possible

Carbon Monoxide problem at: Time: _____.

_____, on _____.
Location Date

CARBON MONOXIDE ( ) was ( ) was not found by our instruments. This does not mean that this was a false alarm. Our instruments found the highest interior level of CO to be _____ p.p.m. (parts per million)

WHAT DOES THIS READING MEAN?	
9 P.P.M. or less:	**Our instruments did not detect elevated levels <u>at this time</u>. However, this does not mean that higher levels did not exist prior to our arrival nor that higher levels will not accumulate after our departure.** Check your carbon monoxide detector per the manufacturer's recommendations. Call the manufacturer for additional information (number may be on back of unit). Replace or reset detector as directed by the manufacturer's specifications.
More than 9 P.P.M.:	**Our instruments have detected potentially dangerous levels of carbon monoxide.** We recommend that you leave this building immediately. We feel that it is unsafe to re-occupy this building until repairs are made and your detector is replaced or reset according to manufacturer's specifications.
35 P.P.M.:	Maximum allowable concentration for continuous exposure in any 8 hour period according to OSHA Law.
100 P.P. M.	**We have detected a potentially lethal level of carbon or monoxide in your home.** Leave your building greater immediately! It is not safe until repairs are made or the source is found and corrected. Have your sources of carbon monoxide examined and if necessary repaired by a qualified repair technician. Replace or reset your detector according to manufacturer's specifications.

Carbon Monoxide affects individuals differently depending on the size, age, and medical history of the occupant(s). Therefore, families with young children or members with medical conditions, or aged individuals, should take extra precautions in the event that Carbon Monoxide is detected.

Issued by: _____ of the _____Fire Protection District.

Received by: _____ Date: _____

White copy: Fire Department Copy: Owner/Occupant

CHECKLIST FOR CARBON MONOXIDE

LOCATION OF INCIDENT: _____ DATE:_____

QUICK CHECKLIST

Headache	Yes___	No___
Fatigue	Yes____	No____
Nausea	Yes____	No____
Dizziness	Yes____	No____
Confusion	Yes____	No____

Are any members of the household feeling ill? Yes____ No____
Do YOU feel better when away from the house? Yes____ No____

Since the detectors alarm went off, what have you done?

_____ Shut-off carbon monoxide sources? If yes. which ones? _____

_____ Let in fresh air? If yes, how and for how long? _____

PPM ACCEPTABLE **Yes____** **No____** **PPM Reading_____**

	SOURCE CHECKLIST	LOCATION	PPM READING
Chimney:	Clogged flue, blocked opening	_____	_____
Fireplace:	Gas or Wood	_____	_____
Portable Heater:	Emissions	_____	_____
Gas Refrigerator:		_____	_____
Kitchen Stove:		_____	_____
Cook Top Vent:		_____	_____
Gas Dryer:		_____	_____
Water Heater:	Chimney pipe	_____	_____
Furnace:	Gas/Oil; leaking flue/chimney pipe	_____	_____
Barbecue Grill:	In enclosed area	_____	_____
Car – Garage	Car started or running recently	_____	_____
Operating Fireplace:	With HVAC on, possible back-flow	_____	_____
Carbon Monoxide Detector:		_____	_____

Make: **Model:** **Serial #**

Name of Individual Handling CO Monitor: _____

Officer Completing Checklist:_____

THE COMPLETED CHECKLIST MUST BE RETURNED TO THE FIRE PREVENTION BUREAU TO THE ATTENTION OF THE FIRE MARSHAL.
05/25/94

(NOTE: This is a sample received from a fire department that based it on the knowledge of CO and CO detectors at that time. It may not reflect the current status of knowledge, and is not necessarily completely accurate).

Subject: CARBON MONOXIDE RESPONSE AND MEDICAL

1. Purpose: To enhance the safety and protection of assigned personnel and to provide guidance in the proper response to carbon monoxide incidents and potential emergencies. These guidelines will identify the factors and conditions involved in such a response, if no established SOP or emergency response plan is currently in effect by the Authority Having Jurisdiction.

2. Scope: These guidelines covers all personnel who could be "reasonably anticipated" as the result of performing their job duties to come in contact with carbon monoxide.

3. Definitions:

a) **Acute Health Effect::** Results from a single dose or exposure to a material, such as a single exposure to a highly toxic material or a large dose of a less toxic material.. Signs and symptoms may be immediate or may not be evident for 24 to 72 hours after the exposure.

b) **Asphyxiation**: Those events related to oxygen deprivation within the body. Asphyxiants can be categorized as simple or chemical.

Simple asphyxiants act on the body by displacing or reducing the oxygen in the air for normal breathing. Examples include carbon dioxide, nitrogen$_1$ and natural gas.

Chemical asphyxiants disturb the normal body chemistry processes which control respiration. They can range from chemicals which inhibit oxygen transfer from the lungs to the cells (carbon monoxide) or prevent respiration at the cellular level (hydrogen cyanide) to those which totally paralyze the respiratory system (hydrogen sulfide in large concentrations).

c) **Carboxyhemoglobin (COHg):** Hemoglobin bound with carbon monoxide. Causes symptoms similar to the flu, such as headaches, fatigue, nausea, dizzy spells, confusion and irritability. As levels of COHg increase, vomiting, loss of consciousness and eventually brain damage or death can result.

d) **Chronic Health Effect:** Results from a single exposure or from repeated doses or exposures over a relatively long period of time.

e) **Immediately Dangerous to Life and Health (IDLH):** An atmosphere concentration of any toxic, corrosive or asphyxiate substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere.

f) **Inhalation:** A means of gaining access into the body via the respiratory system. The most common exposure route and often the most damaging.

g) **IOSHA:** Indiana Occupational Safety and Health Administration, a component of the Indiana Department of Labor; an agency with safety and health regulatory and enforcement authorities in the State of Indiana.

h) **Safe Atmosphere:** Means no harmful hazmat effects exist, which allows personnel to handle routine emergencies without specialized personal protective equipment (PPE).

i) **Unsafe Atmosphere:** Means once a hazmat is released from its container, an unsafe condition or atmosphere exists. if one is exposed to the material long enough, some form of either acute or chronic injury will often occur.

j) **Dangerous Atmosphere:** Means those environments where serious irreversible injury or death may occur.

4. General Information:

Carbon monoxide (CO) is an odorless, colorless, and nonirritating gas. It is produced as a by-product in incomplete combustion and is used in manufacturing and laboratories. Common exposures to this chemical involve smoking, combustion engine exhausts, faulty gas and kerosene stoves, space heaters, charcoal and sterno fires, and industrial facilities. The gas can only enter the body via the respiratory system where it crosses the alveolocapillary membrane and enters the bloodstream. Once in the bloodstream its effects are systemic.

Although CO is odorless and colorless, some victims of an acute exposure report an acidic taste in the mouth. It is important for all personnel to have a high suspicion of the presence of the gas because of how it is generated or used and the signs and symptoms displayed by the victim(s). Smoke from structure fires generates an enormous amount of CO especially in the smoldering phase.

The symptoms of acute exposure may appear suddenly and without warning. The concentration of this gas within the body and the effects experienced are directly related to the physical activity and susceptibility of the victim and the percentage of the gas in the environment. There is presently no field testing devices capable of diagnosing carbon monoxide within the blood.

Once CO is inhaled, it crosses the alveolocapillary membrane and enters the bloodstream. In the bloodstream it rapidly combines with hemoglobin, forming a strongly bonded compound called carboxyhemoglobin (COHg). Hemoglobin's affinity to CO is between 200 to 250 times as great as it is for oxygen. Therefore the bond formed with CO is also a much stronger bond than that formed with oxygen, making the problem for patient care even more difficult to treat.

Because of the distinctive manner in which carbon monoxide affects the body, it is classified as a chemical asphyxiant. *See Appendix A for signs and symptoms of concentrations of carboxyhemoglobin.*

CO detectors and their activation level depends on the concentration level measured in parts per million (ppm) and time exposure based on a healthy adult performing heavy exercise. The levels set by Underwriter Laboratory correspond to a CO concentration level that will equal an accumulation of 10% CO in the blood. This level was selected to give adequate time to warn people of a potentially dangerous condition within their homes, before the average adult shows any signs or symptoms. CO has a cumulative effect on the body, detectors will also sound an alarm for levels as low as 15 ppm over an eight-hour (8) period. Detectors will also sound an alarm for extremely high concentrations in just a few minutes to give early warning to the occupants.

5. Response Objectives:

a) Investigate a reported carbon monoxide problem$_1$ to include a CO detector sounding. Not to repair the problem.

b) Render emergency medical care, if applicable.

c) Advise the occupant(s) of findings.

d) Issue a “Notice of Findings” form. (See Appendix C)

e) Assist them in exiting the structure, if necessary.

6. Potential Action Options:

a) Ensure the safety of response personnel by securing the immediate area and establishing control zones.

b) Immediately establish a site specific Incident Command System (ICS).

c) Ensure that proper Emergency Medical Service is provided to occupants that require it.
(CO will often activate a detector prior to the occupants presenting any symptoms).

d) Establish accountability and assign a entry & backup team. If it is determined that a "**Life Threatening Condition"** exists, a immediate primary rescue search will be undertaken by personnel who have the necessary "full protective clothing", as defined by these guidelines.

e) Incident Commander (IC) shall conduct a interview with facility occupants:

- observe occupants to confirm CO signs & symptoms. If occupants are displaying signs of exposure, a Level 1 HazMat will be declared and communications notified at this point. No signs evident then continue with the investigation.

- observe the behavior of any pets in the area.

- check for presence of people in "at-risk" groups (e.g. very young, elderly, pregnant females, anyone already sick.)

- ask about activities of the occupants over the past several hours, since lower concentrations can take several hours to activate the detector.

- determine location of CO detector(s), by area and level in a residence/occupancy.

- determine if occupants opened any windows or doors.

- determine if occupants shut-off any appliances.

f. The Incident Commander shall request that the gas company respond to the scene through the local communications center if:

- a CO level of over 9 ppm is indicated through on-scene monitoring.

- responding fire company/hazmat team shuts off a gas appliance.

- someone is showing signs of being ill due to CO.

- Incident Commander feels a response by the gas company is needed.

g. The Entry Team shall:

- **donn required personal protective equipment as established by the IC/Safety Officer and this SOG.**

- prepare air monitoring instrumentation for use and comply with recommendations by the manufacturer of the equipment.

- verify back-up team in place and ready to assist, as needed.

- prior to interior testing, observe the exterior of the structure for possible causes.

- upon entering the structure for sampling purposes, sample the air at ground, mid and ceiling levels (diamond pattern) in all areas and all building levels.

- SCBA will initially be utilized during interior operations. If air sampling determines that the parts per million (ppm) is less than 35, SCBA use may be discontinued after notification of findings to the IC. However, the SCBA should still be donned in the event that conditions change.

- if CO readings over **10 ppm** are detected in any area, ventilation of that area should begin.

- continue ventilation of affected areas until CO is dissipated.

- resample air five (5) minutes after ventilation is stopped to insure CO level remains absent.

- **if CO source is located:**

  -- attempt to correct if within scope of duties

  -- shut-off fuel supply (if applicable)

  -- advise command if it involved a fuel burning appliance to advise fuel supplier and/or service personnel.

  -- record the reading indicated at each location and level.

  -- begin baseline exposure levels.

- if CO source is not found and CO continues to be detected:

  -- continue scene control; no reentry by occupant

  -- advise command to contact either gas utility or other potential resource to assist in CO source determination.

- if no CO is detected and no source of the CO detector activation is located:

  -- exit the structure, clear the instrument in fresh air, then reenter and recheck the structure.

  -- if an additional sensing device is available, utilize it to verify the findings of the first unit.

  -- if possible, check the CO detector for evidence of activation by looking at the sensor element for discoloration.

  -- advise command of your findings

7. Personal Protective Requirements:

a) Carbon monoxide is classified as a compressed flammable gas. For this reason, a complete structural fire fighting ensemble, will be worn by each member of the entry team/back-up team.

b) The minimum requirement for respiratory protection at a CO incident (**emergency operations until concentrations have been determined)** is positive pressure self-contained breathing apparatus (SCBA).

Note: IOSHA 191O.12O, Subpart L, 4 iiiD requires that "employees engaged in emergency response and exposed to hazardous substances shall wear positive pressure SCBA while engaged in emergency response until such time that the individual in charge of the ICS determines through the use of air monitoring that a decreased level of respiratory protection will not result in hazardous exposure to employees".

8. Decontamination:

a) Decontaminating a victim of carbon monoxide poisoning is usually not necessary.

b) The gas can only be inhaled, not absorbed through the skin.

c) Usually the clothing of a victim will not hold enough of the gas to injure a medical provider, but it is always good practice to roughly decontaminate (remove the clothing) the victim involved in any type of exposure.

d) Fire victims who have been removed from burning structures have many chemicals, including cyanide, formaldehyde, and hydrogen chloride, within their clothing.

e) Therefore, it is very important to, at the minimum, remove the clothing of these victims.

9. Field Treatment

a) Remove the patient from the toxic atmosphere and administer 100% oxygen. if intubation or a bag valve device is used, attach a PEEP valve and use a setting of 4cm/H20 with 100% oxygen supplemented. Breathing room air COHg is halved in six hours (also referred to as half-life). Breathing 100% oxygen reduces COHg half-life to 1.5 hours. Providing hyperbolic oxygen inside a chamber reduces the COHg half-life to less than 1 hour.

b) Provide continuous cardiac monitoring and treatment of arrhythmia's with the consideration of the possibility that an acute myocardial infarction may have resulted from the poisoning.

10. Definitive Treatment and Follow-Up Care:

a) If a medical hyperbolic chamber is located within the area, all attempts should be made to transport the patient to that facility. Hyperbarics have been proven to provide the best reduction of carboxyhemoglobin.

b) At a pressure of 2.5 atmospheres and 100% oxygen of COHgT1/2 is less than one hour. Furthermore, the oxygen carrying capacity of the blood is significantly increased not only because of the reduction of carboxyhemoglobin but also because of the increased oxygen carried in solution.

11. Termination Procedures:

a) Command is to advise occupants of the situation and complete the "Notice of Findings" form, located in Appendix D of this guideline.

b) Entry team is to complete debriefing and secure instrument equipment as outlined by the manufacturer.

APPENDIX A: Signs and Symptoms resulting for inhalation of various concentrations of Carboxyhemoglobin (COHg):

Percent Carboxyhemoglobin	Signs and Symptoms
0 - 10	No signs or symptoms
10 - 20	Tightness across forehead, possible slight headache, dilation of the cutaneous blood vessels.
20 - 30	Headache & throbbing in the temples.
30 - 40	Severe headache, weakness, dizziness dimness of vision, nausea, vomiting and collapse.
40 - 50	Same as above, greater possibility of collapse; cerebral anemia, and increased pulse and respiratory rates.
50 - 60	Cerebral anemia, increased respiratory and pulse rates, coma, and intermittent convulsions.
60 - 70	Coma, intermittent convulsions, depressed heart action and respiratory rate, and possible death.
70 - 80	Weak pulse and slow respiration, leading to death within hours.
80 - 90	Death in less than 1 hour.
90 - 100	Death within a few minutes.

Note: The average concentration of carboxyhemoglobin in the blood of heavy smokers is 6.2% by volume.

AFPENDIX B: Parts per million (ppm) values for Carbon Monoxide exposure.

35 ppm	The maximum allowable concentration for continuous exposure in any 8 hour period according to IOSHA.
100 ppm	In an average healthy person the blood level will not reach a level higher than 10% carboxyhemoglobin within 90 minutes, which means it will have little or no affect on the average healthy person.
200 ppm	Slight headache, tiredness, dizziness, nausea after 2 to 3 hours exposure. **Maximum** CO concentration for exposure at any time as prescribed by IOSHA.
400 ppm	Frontal headaches within 1 to 2 hours of exposure. **Life threatening** after 3 hours.
800 ppm	Dizziness, nausea and convulsions within 45 minutes. Unconsciousness within 2 hours. Death within 3 hours.
1600 ppm	Headache, nausea, dizziness within 20 minutes. Death within 1 hour.
3200 ppm	Headache, nausea, dizziness within 5 to 10 minutes. Death within 30 minutes.
6400 ppm	Headache, nausea, dizziness within 1 to 2 minutes. Death in 10-15 minutes.
12, 800 ppm	**Death** within 1 to 3 minutes.

Subject: CLANDESTINE DRUG LABORITORIES INCIDENT RESPONSE

1. Purpose: In the course of law enforcement activities, local officials with increasing frequency are confronted with the necessity at handling, transporting, and storing substances used in the manufacture of illegal products, especially illicit drugs. This guideline is not a comprehensive treatment of the subject, but to provide the Hazardous Materials Specialist with information about the chemicals most often encountered in these operations and the procedures to ensure the safety at all emergency responders.

2. Scope: All emergency response personnel need to be prepared to safely and effectively respond to this type of emergency. It is important to keep in mind that a clandestine drug lab is three things;

a. A law enforcement action.
b. A hazardous materials emergency.
c. A crime scene.

It is pure survival that the utmost care b~ exercised by ALL emergency responders when working the scene.

3. Definition:

a. Absorption: Absorption by the body refers to the intake of chemical's or other agents through the skin, mucous membranes, lungs, or intestines. Generally, the longer the contact, the greater the amount of chemical absorbed. Usually, the more chemical absorbed, the more severe the health effects.

b. Asphyxiants: Gases that deprive the body of oxygen. there are two types of asphyxiants: simple asphyxiants and chemical asphyxiants. Simple asphyxiants displace oxygen in the atmosphere, making less oxygen available to inhale. Chemical asphyxiants interfere with the body's ability to use oxygen, even though normal amounts or oxygen are inhaled.

c. Essential Chemical: Chemical that reacts with one or more precursors, but does not become part of the finished product. For example, in method of making methamphetamine$_1$ hydriodic acid is an essential chemical. All of the salts, solvents, and acids used in the process of making illegal drugs are known as essential chemicals

d. Exposure Records: Documentation of an individual's exposure to chemicals, blood, body fluids, or other biologic agents. Such records help health and safety representatives keep track of potentially exposed responders who may require medical follow-up. Reports of exposures should be completed after each applicable response.

e. Extremely Hazardous Substance: A substance determined by the Environmental Protection Agency to be so potentially hazardous to life and health that if released accidentally, it requires special notification to planning committees.

f. Ingestion: Occurs when hazardous substances are swallowed. This may occur by direct contact with the mouth or when contaminated hands or clothing come into contact with the mouth. in addition, it is possible to consume toxic materials by eating or smoking in contaminated areas.

g. Inhalation: Intake of vapors, gases, mists, or small particles through the upper respiratory system. Many chemicals are absorbed through the lungs after they have been inhaled. The lungs may serve only as a route of entry and may not be affected by the inhaled hazardous material.

h. Irritant: Irritants cause temporary, but sometimes severe, inflammation of the eyes, skin, or respiratory tract. Irritation may result in permanent damage if it is repeated over time. The symptoms of irritation depend on the tissue affected. Many solvents cause skin irritation.

i. Material Safety Data Sheet (MSDS) : Form containing standard information about hazardous chemicals at fixed locations, as required by the Hazard Communications Standard 1910.1200.

j. Phenyl-2-Propanone (P-2-F) : A precursor used in the production of methamphetamine; some clandestine drug labs only manufacture this precursor and sell it to other drug lab operators.

k. Precursor: Raw material or controlled substance that becomes part of the finished drug when it is used in a chemical reaction. For example$_1$ pseudoephedrine (a common cold remedy) is used in one method to make methamphetamlne.

l. Reagent: Substance that reacts chemically with one or more precursors but does not become part of the finished product.

m. Reflux: A method of heating liquid so that the vapors condense and return to be heated again.

4. INTRODUCTION:

Hazardous materials are a pervasive part of the world in which we live, and incidents involving such materials are inevitable. Those persons involved in manufacturing, using, and transporting hazardous materials are trained to safely undertake initial protective actions when an unplanned release occurs and to assist emergency responders who may be called upon to minimize and control the potential hazard. However, when the situation is determined the illegal use of hazardous materials the game plan changes.

A clandestine drug laboratory (CDL), in law enforcement parlance, is an illegal and covert operation that produces a controlled substance by chemical reactions. Hazardous materials responders must be able to recognize a drug laboratory when they respond to an incident at one, for their own safety. Numerous regulated hazardous chemicals are traditionally used in these laboratories under very unsafe conditions by people who may have no forna^7 training and little understanding of chemistry or of the potential hazards of their endeavors. In fact, “cookers" as these people are known, are often employed for the very specific reason that they do not understand the dangers of their ventures and are thus willing to perform them.

CDL presents the same fire and chemical hazards found in legal drug manufacturing facilities. But what makes CDL operations more dangerous is the lack of fire and chemical release safeguards, untrained operators, unknown chemicals compounds, booby traps, firearms and ammunition, improper storage containers, improper methods of chemical storage and use, and the total disregard for human safety by the operators.

5. Types of clandestine Drug Operations:

A. Synthesis Laboratories:

1. Most frequently encountered type of CDL.

2. Use common chemicals to make products resembling controlled substances.

3. Manufactures a controlled substance from two or more precursor chemicals, the controlled substance is listed as the end product.

B. Extraction Laboratories:

1. Remove or extract the drug from raw plant materials, e.g., morphine from opium poppies or hashish from the marijuana plant.

2. Raw plant material is changed into a finished drug by the use of chemical solvents and/or acids.

3. Chemical structure of the drug is not altered.

4. Also includes indoor or underground confined space marijuana grow farms.

C. Conversion Laboratories:

1. Alters the extracted drug into a refined product by changing the chemical structure.

2. EX: Process cocaine base to cocaine hydrochloride (the white powder sold in the streets as cocaine), cocaine hydrochloride to cocaine sulfate (commonly known street drug rock or crack cocaine)

D. Tableting Laboratories:

1. Operated solely to divide the refined product into individual doses.

NOTE: These four types of laboratories do not necessarily exist independently of each other. It is quite probable, for instance, that an extraction laboratory will also function as a conversion laboratory to transform the product into a refined form.

Hazardous materials responders would have little reason to know these different types of laboratories if it were not for the tact that this knowledge imparts information about the types of chemicals likely to be stored and used at various facilities. The recurring presence of Class 3 flammable/combustible liquids, Division 2.1 flammable gases, Class S corrosives, and Division 6.1 poisons among the precursors. (Appendix A)

6. Methamphetarnine Synthesis:

Methamphetamine, or "crank", as it is known on the street, is a powerful stimulant drug, now with limited legitimate use, has effects of intoxication similar to cocaine. These shared effects have resulted in the drug being so1d as a cocaine substitute. Methamphetamine is often injected intravenously, but may also be ingested orally or snorted.

An assessment of the chemical processes in the manufacture of methamphetamine provides information regarding the types of chemicals likely to be present at the lab site. If it is known that labs are producing methamphetamaine utilizing a particular method, It may be expected that specific reagents, solvents and precursors will likely be present.

^ Awareness of the types of chemicals used in these processes allow a more accurate appraisal of possible health, fire or explosion risks to emergency responders, building occupants and others.

^ A better assessment of necessary decontamination procedures can be made from this information.

Illicit manufacture of methamphetamine is a simple process that does not require any special knowledge or expertise in chemistry. Most methamphetamine is produced by relatively uneducated persons who synthesize the drug from published or handwritten recipes. Due to multi-step processes and dissimilar methods of methamphetamine production, a wide variety of chemicals may be encountered at a clandestine laboratory, many of which have common industrial or household uses. (See Appendix A) However, relatively few chemicals may actually be required[1] depending on the type of process employed. Most manufacturing processes allow some chemical reagents or solvents to be substituted for others, depending upon the specific process.

The **"amalgam process"** is the method of choice for most methamphetamine synthesis operations. This process utilizes phenyl-2-propanone (P-2-P) and methylamine as principle precursors. Reagents and solvents containing mercury, aluminum, hydrochloric acid and alcohol are also used in the reaction process. Several other recipes utilizing F-2-E and methylamine are available to the clandestine chemist which make use of alternate techniques and reagent chemicals. Some laboratories have used a process involving ephedrine as the major precursor. Although there are several versions of the ephedrine process, the red phosphorous method is the most wide spread.

Any methamphetamine production process will result in the presence of by-products and contaminants in the final drug product and within the reaction vessel. These substances are primarily unintended combinations of precursors, reagents and solvents (Appendix B).

7. Precursor Synthesis:

Efforts to control precursors and reagents have resulted in the clandestine chemist seeking alternate methods to produce methamphetamine. Since 1979, P-2-P has been a controlled substance and is only occasionally smuggled into this country. Most clandestine chemists now prefer to manufacture methamphetamine from legal and easily obtained chemicals. In the absence of a legitimate source of P-2-P most chemists will produce methamphetamine by first synthesizing their own P-2-P from phenylacetic acid, or purchase P-2-P from other clandestine chemists. In the absence of phenylacetic acid there are several alternative reactions the clandestine chemist may choose to produce methamphetamine, utilizing easily available chemicals but requiring more complex, and, often, more dangerous reactions.

There are laboratories that have been seized which contain benzyl chloride or benzyl cyanide, indicating that these substances have been utilized as precursors.

8. Phencyclidine Process:

The most popular way to produce phencyclidine (PCP) is by the "bucket" method. The first stage (bucket) contains piperidine mixed with cyanide (either sodium or potassium). The cyanide is first dissolved into water then the piperidine is added to the mixture. If the step is done backward, there will be a release of cyanide gas because of the strong basic characteristic of the piperidine. The

second stage (bucket) contains cyclohexanone mixed with sodium bisulfate. The two buckets are then mixed together.

Once thismixture stands, piperidinocyclohexanecarbonitrile (PCC) is formed as a solid at the top. It is removed and washed in water. Then the powder is dissolved into Coleman fuel or petroleum ether (solvent) . To this solution phenyl magnesium bromide (PMB or grignard reagent) is added. This reaction yields PCP base, which is sold on the streets as a solid or a liquid in small single-dose bottles. If a pill from is desired, hydrogen chloride gas or hydrochloric acid is added to form PC? hydrochloride. (Base + HCL = PCP hydrochloride.)

The passing of the piperidine reporting act has reduced the availability of piperidine to illegal buyers. Piperidine is commonly used in industry as a curing agent for rubber, in epoxy resins, and as an ingredient in oils and fuels.

By reviewing this one process demonstrates the need to effectively conduct a in-depth **SITE CHARACTERIZATION PLAN** before taking any further action that could jeopardize

9. Chemical and Physical Properties:

Physical and chemical properties of the chemicals are the most important consideration for evaluation of potential exposure risk for emergency response personnel. Most of the chemicals associated with the illicit production of methamphetamine may be grouped into distinct categories of similar general toxic and physical properties. There is some overlap between some chemicals and some have unique or special properties. Regardless of the production method, chemicals in each of these groups are utilized in the process. Chemicals involved in methamphetamine production may be considered within the following groups:

a. Solvents
b. Metals and salts
c. Corrosives
d. Precursors
e. By-products and contaminants

10. Site Operations:

The process of site characterization must begin as soon as possible to determine the products on-site. The Site Safety Plan development will require this information. As in any hazardous materials incident, the unknown must be treated as a worst case situation.

Personal protective clothing and self-contained breathing apparatus are essential for entry into any laboratory, clandestine or otherwise. Use EPA Level B protective clothing at least, but a responder is better protected and thus more comfortable with Level A clothing. Firefighter structural turnout gear **will not** provide adequate protection.

Specific examples of some chemicals requiring this level of protection: Mercuric chloride and mercuric bromide are each highly poisonous by ingestion, inhalation and absorption through the skin. Sodium cyanide and potassium cyanide, both salts, release deadly hydrogen cyanide gas when mixed with an inorganic acid such as hydrochloric acid or sulfuric acid, and sometimes even with water. Hydriodic acid is a severe corrosive that causes rapid tissue damage and respiratory failure it is inhaled.

Other chemicals used in clandestine drug laboratories are extremely serious fire and explosion risks. Ethers, of course, are well known for their flammability and for the potential of some of them to oxidize to shock-sensitive organic peroxides. Raney nickel is a dark gray, pyrophoric powder that must be handled with the greatest care.

Lithium aluminum hydride is a white powder used in the production of methamphetamine. This, too, is a dangerous fire risk because it can be ignited spontaneously by the heat of friction if it is rubbed or ground. It reacts fiercely with air and water, and with many organic chemicals as well. Once ignited, lithium aluminum hydride can be extinguished only with a dry chemical extinguishing agent or with powered limestone.

If the laboratory is operating when emergency response personnel arrive, **DO NOT** do anything that will disrupt the chemical reactionary sequence. Do not shut off any heating appliances or interrupt the flow of any cooling water, because sudden and violent consequences can result. Consult a chemist who is knowledgeable in the manufacture of controlled substances for technical advice about shutting the operation down. Complex operations must usually be shut down in a specific sequence to avoid initiating an uncontrolled and ultimately violent reaction. Shut off both gas and electrical services at the respective meters **only "if"** the occupants are not "cooking" their chemicals at the time.

Although it is not recommended to turn off the chemical process involved in making drugs, hazardous materials personnel may be met with having to make that decision based on a **risk versus benefit analysis.** It would be very easy to state that the process should never be turned off by qualified personnel, but realistically the term "never" often does not hold true. Most resources recommend waiting for a chemist from the Federal Department of Drug Enforcement (DEA) to arrive and decide how to turn off the laboratory. Other options include calling chemists from the Indiana State Police (IS?) or from local colleges or universities to determine the best option for stopping the process. All of these alternatives should be exercised before making the decision to intervene on the process.

If the determination to stop a process has been made by the **On-Scene Incident Commander** after evaluating all other options, several safety steps should be taken to deactivate the chemical process in progress. The DEA suggests a method that should safely accomplish the shut down.

- Examine and determine if heating or cooling is taking place.
- Some reactions involve the heating of a chemical and then condensing utilizing tap water. In these cases remove the heat and allow the glassware to cool before turning off the water.
- If vacuum or gravity filtration is occurring allow this process to finish.
- If compressed gas is being used in a reaction, it should be first shut off at the cylinder top_1 then the regulator should be shut down.
- If vacuum is used within the system, the system should be slowly brought back to atmospheric pressure then the vacuum pump turned off.
- If there is an exothermic reaction (producing heat) taking placer it should be left until the process is completed then the reaction cooled to room temperature.

The laboratory apparatus used in these operations can be a simple container and stirring mechanism such as that used in producing methamphetamine and phencyclidine. More sophisticated reactions require heating and cooling devices, and even pressure and vacuum lines. Pressure- and vacuum-controlled reactions can be shut down by closing the valve at the regulator on the compressed gas cylinder and by shutting the vacuum pump off, respectively if the scene safety officer approves of

this. Most laboratory heaters are electrically operated, so these can best be halted by interrupting the electrical supply at the meter.

Those exothermic chemical reactions that must be cooled, usually with running tap water, are the most difficult to interrupt. It is usually advisable to allow the reaction to proceed to completion before interrupting the flow of the cooling water. Once the reaction vessel has cooled to ambient temperature, it should then be packed in ice to stabilize the chemical product further.

11. SUMMARY:

It is simple to imagine how emergency providers could end up on the site of a clan lab and virtually walk into disaster. It is estimated that 30% of the drug labs are discovered as a result of explosion or fire.

The chemicals and equipment can usually be bought or acquired easily. One book currently available called "The Construction and operation of Clandestine Drug Laboratories" (Nimble, l986) identifies alternative ways to construct the apparatus necessary to set up an illegal laboratory. It also points out other means of obtaining chemicals used in the process of manufacturing the drugs. Another legal book that assists the would-be drug manufacturer is the "The Anarchist Cookbook" (Powell, 1971).

APPENDIX A:

Chemicals Frequently Used in Clandestine Drug Laboratories:

End Product	Chemicals Used in the Process	Hazard class	Other Known Hazards
Cocaine			
	Acetone	3	Moderately toxic
	Ammonium hydroxide	8	-
	Calcium carbonate	-	-
	Calcium hydroxide	-	Toxic (inhalation)
	Ethers (various)	3	Toxic (inhalation)
	Hydrochloric acid	8	Toxic
	Kerosene	3	Toxic (inhalation)
	Potassium permanganate	5.1	-
	Raney Nickel	-	Ignites in air
	Sulfuric acid	8	Toxic (inhalation)
Fentanyl		-	-
	Aniline	6.1	Alergen
	Methyl acrylate	3	Moderately toxic
	2-Phenyl-l- bromoethane	-	-
	N-4-Piperidinyl-aniline	-	-
Herion		-	-
	Acetic anhydride	8	Strong irritant
	Acetone	3	Moderately toxic
	Alcohol's (various)	3	Toxic
	Ammonium chloride	-	Toxic (inhalation)
	Calcium carbonate	-	-
	Hydrochloric acid	-	Toxic
d-Lysergic acid diethylamide (LSD)		-	Mutagenic
	d-Lysergic acid	-	-
	Ergotamine tartrate	-	-
Methamphetamine (ephedrine method)		-	Moderate fire risk
	Ephedrine	-	-
	Freons (various)	-	-
	Hydriodic acid	8	-
	Lithium aluminum hydride	4.3	Violently H^20 reactive
	Phosphorus, red	-	-
	Sodium hydroxide	8	-
	Sodium sulfate	-	-
	Sodium thiosulfate	-	-
	Sulfuric acid	8	Toxic (inhalation)
Methamphetamine (hydrogen method)		-	-
	Acetic acid	8	Moderate fire risk
	Chloroform	6.1	Carcinogenic
	Ephedrine	-	-
	Hydrogen	2.1	-
	Lithium aluminum hydride	4.3	Violently H^20 reactive
	Palladium on carbon	-	-
	Perchloric acid	5.1	Toxic
	Thionyl chloride	8	-

Methamphetamine (P-2-P Method)			
	Aluminum metal	4.3	-
	Ethers (various)	3	Toxic (inhalation)
	Lithium aluminum hydride	4.3	Violently H^2O reactive
	Mercuric bromide	-	Highly toxic
	Mercuric chloride	6.1	-
	Methyl alcohol	3	Toxic (ingestion)
	Methyl amine	2.3	-
	Phenyl-2-propanone	-	-
	Sodium-hydroxide	8	-
Methaqualone		-	-
	N-Acetylanthranilic acid	-	-
Phencyclidine pyrrolidine analogues (PCPy)			
	Cyclohexanone	3	Toxic
	Morpholine	-	Toxic, flammable
Phencyclidine (PCP)			
	Phenyl-2 -propanone	-	-
	Benzene	3	Carcinogenic
	Bromobenzene	3	-
	Cyclohexanone	3	Toxic
	Ethers (various)	3	Toxic (inhalation)
	Hydrochloric acid	8	Toxic
	Iodine	-	Toxic
	Magnesium metal	4.1	-
	1-Octane	3	-
	Petroleum ether	-	Flammable liquid
	Piperidine	-	Toxic (ingestion)
	Potassium cyanide	6.1	-
	Sodium bisulfite	8	-
	Sodium cyanide	6.1	-
	Sodium hydroxide	8	-
	Sodium metabisulfite	-	-
	Toluene	3	Toxic
Phenyl-2-propanone			
	Acetic anhydride	8	Strong irritant
	Phenylacetic acid	-	-
	Sodium acetate	-	-
	Sodium hydroxide	8	-

APPENDIX B:

Chemicals Associated with Illicit Methamphetarnine Manufacture

Metal/Salt Reagents

Aluminum foil
Iodine
Lead Acetate
Lithium Aluminum Hydride
Magnesium
Mercuric Chloride
Palladium
Red Phosphorus
Sodium
Sodium Cyanide
Thionyl Chloride

Solvents

Acetone
Benzene
Chloroform
Ethyl Ether
Freon
Hexane
Isopropanol
Methanol
Pyridine

Precursors

Acetaldehyde
Benzyl Chloride
Ephedrine
Methylamine
Phenylacetic Acid
Phenyl-2-Propanone

Acid-Base Reagents

Acetic Acid
Acetic Anydride
Ammonia
Hydrochloric Acid
Hydrogen Peroxide
Hydroiodic Acid
Sodium Hydroxide
Sulfuric Acid

CLANDESTINE DRUG LABORATORY RESPONSE WORKSHEET

SITE OPERATIONS:

BEGIN SITE CHARACTERIZATION AND ANALYSIS (Prelim - Survey)

DEVELOP SITE SAFETY PLAN (191O.12O)

ESTABLISH SITE CONTROL:

- Suspects
- Weapons
- Booby traps
- Control Zones (Hot, $Warm_1$ Cold)

ATTEMPT TO IDENTIFY TYPE OF LABORATORY OPERATION:

- Synthesis
- Extraction
- Conversion Tableting

ANALYSIS PROCESS FOR IDENTIFYING UNKNOWN PRODUCTS:

- Radioactivity
- Combustibility
- Oxygen availability (deficiency)
- pH (if liquid)
  - Carbon monoxide
  - Organic vapor

ON-SITE CHEMICAL CLASSIFICATIONS:

- Flammable/Combustible liquids (3)
- Corrosives (8)
- Oxidizers/Organic Peroxide (5)
- Radioactive (7)
- Explosives (1)
- Poisonous/Toxic (6)
- Compressed gases (2)
- Flammable solid (4)
- Infectious substance (6 1)

GENERAL PHYSICAL HAZARD CLASSIFICATIONS:

Electrical
Slip trip, fall
Access/egress
If it's on/leave it on
If it's off I leave it off
Fire I explosion
Intrinsically safe equipment
Use of portable I mobile radio
IDLH Atmosphere
Broken glassware

ESTABLISH EVIDENCE CONTROL PROCEDURES:

CONFINED SPACE OPERATIONS (1910.146)

EXPOSURE CONTROL RECORDS ESTABLISHED (1910.20)

ESTABLISH CLEAN-UP OPERATIONS

INITIATE TERMINATION PROCEDURES

INCIDENT COMMAND ORGANIZATION:

Incident Commander: _____
Incident Safety Officer: _____
Operations Officer: _____
Fire/Rescue: _____
EMS/Medical: _____
Hazardous Materials Group Supervisor: _____
Entry Officer: _____
Haz-Mat Safety Officer: _____
Research Officer: _____
Decontamination Officer: _____
Site Control Officer: _____
Site Clean-up Contractor: _____

Subject: HAZARDOUS MATERIALS RESPONSE

1. Purpose: To enhance the safety and protection of emergency response personnel who are involved in a hazardous materials incident.

2. Scope: This plan covers personnel who could be "reasonably anticipated" as the result of performing their job duties to come in contact with hazardous materials.

3. Definitions:

a. First Responder Awareness Level: are individuals who are likely to witness or discover a hazardous substance release and who have been trained to initiate an emergency sequence by notifying the authorities of the release. First responders at the awareness level shall have sufficient training or have had sufficient experience to objectively demonstrate competency in the required areas, as outlined in IOSHA 1910.120.

b. First Responder Operations Level. are individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release. They are trained to respond in a defensive fashion without actually trying to stop the release. Their function is to contain the release from a safe distance, keep it from spreading, and protect exposures. First responders at the operational level shall have received at least eight hours of training or have had sufficient experience to objectively demonstrate competency in the areas, as outlined in IOSHA 1910.120 and the employers shall so certify.

c. Hazardous Materials Technician: are individuals who respond to releases or potential releases for the purpose of stopping the release. They assume a more aggressive role than a first responder at the operations level in that they will approach the point of release in order to plug, patch or otherwise stop the release of a hazardous substance. Hazardous materials technicians shall have received at least 24 hours of training equal to the first responder operations level and in addition have competency in the areas, as outlined in OSHA 1910.120 and the employer shall so certify.

d. Hazardous Materials Specialist: are individuals who respond with and provide support to hazardous materials technician. Their duties parallel those of the hazardous materials technician, however, those duties require a more directed or specific knowledge of the various substances they may be called upon to contain. The hazardous materials specialists would also act as the site liaison with federal, state, local and other government agencies in regards to site activities. Hazardous materials specialists shall have competency in the areas, as outlined in IOSHA 1910.120 and the employer shall so certify.

e. On-Scene Incident Commander: Incident commanders who will assume control of the incident scene beyond the first responder awareness level, shall receive at least 24 hours of training equal to the first responder operations level and in addition have competency in the areas outlined in IOSHA 1910.120 and the employer shall so certify.

f. Hazardous Materials Response (HAZMAT) Team: means an organized group of employees, designated by the employer, who are expected to perform work to handle and control actual or potential leaks or spills of hazardous substances requiring possible close approach to the substance. The team members perform responses to releases or potential releases of hazardous substances for the purpose of control or stabilization of the incident.

4. First Responders:

a. The following are **recommended** standard operating procedures for first responders to incidents involving hazardous materials. When hazardous materials are known to be involved, the first responder should immediately take the steps outlined in their county emergency response plan and make the proper notifications for assistance.

b. The State Fire Marshals Office - Hazardous Materials Division is available for immediate dispatch to assist you with the incident. Personnel assigned are Hazardous Material Specialists and will provide technical, communication and coordination assistance.

c. If the situation is threatening life and property, it is also recommended that a qualified Hazardous Materials Response Team be notified to assist in scene stabilization.

d. At fixed facilities, the first responder should request a copy of the facility emergency response plan and material safety data sheets (MSDS) for the materials involved or stored in the incident area.

e. When the generator of the spilled materials is known, that generator is responsible for all costs incurred for the proper clean-up and disposal. The recovered material, including any contaminated absorbents, diking material, and contaminated clothing or equipment should be left with the generator for proper disposal.

f. When the generator is known, but the generator is unavailable or when the generator of the spilled materials is not known and clean-up and disposal action must be initiated and the Hazardous Materials Team or other qualified person(s) has responded and determines the need for clean-up and disposal, the representative from city/county health, county emergency management office, LEPC representative, or who ever is directed by the county response plan should notify the Indiana Department of Environmental Management (IDEM) and make arrangements to secure the clean-up and disposal through a qualified contractor.

5. DOT Hazard Classes:

a. The United Nations has divided hazardous materials into ten major hazard classes. The United Nations (U. N.) hazard class number is the small number on the bottom corner of placards and labels. Those classes are:

Class 1 - EXPLOSIVES
Class 2 - COMPRESSED GASES
Class 3 - FLAMMABLE LIQUIDS
Class 4 - FLAMMABLE SOLIDS
Class 5 - OXIDIZERS
Class 6 - POISONS
Class 7 - RADIOACTIVE
Class 8 - CORROSIVES
Class 9 - MISCELLANEOUS HAZARDOUS MATERIALS
ORM-D - OTHER REGULATED MATERIAL D

b. The following procedures use the United Nations classifications for determining the appropriate procedures. The hazard class is listed at the top of the page, and the United Nations class number is listed at the bottom of the page ahead of the page number.

OSFM - HAZARDOUS MATERIALS DIVISION

STANDARD OPERATING PROCEDURE: EXPLOSIVES

U. N. Hazard Class 1

DEFINITION:

An explosive is any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion, which will occur with an instantaneous release of gas and heat. (Rockets, grenades, bombs, flashpowders, propellant explosives, small arms ammunition, and common fireworks).

A blasting agent is any material designed for blasting that has been tested and has been found to be so insensitive that there is little probability of accidental initiation to explosion (Mixture of ammonium nitrate and fuel oil).

GENERAL INFORMATION:

1. Identify the material(s) involved, if safe to do so**.**
2. Keep non-essential people away. (This includes non-essential emergency service personnel).
3. Establish control zones. (Isolate area and deny entry). Strict hazard control zones and personnel accountability must be maintained.
4. Extinguish all sources of ignition in the vicinity. Do not allow vehicles or other sources of ignition in the area.
5. Wear positive-pressure SCBA and full protective clothing.
6, Avoid exposure to smoke, fumes, vapors, dust, or direct contact. The products of combustion of some propellant explosives are poisonous.
7. Do not allow personnel to touch or move explosives. Explosives should be moved only under the advice and supervision of trained explosive personnel.
8. Contact local police bomb units or nearest military explosives team for assistance.
9. Contact State Fire Marshals Office @ 1-800-669-7362 for assistance.
10. If a Hazardous Materials Team (HMT) is requested to respond to a bomb threat involving hazardous materials, it is recommended the under no circumstances will the HMT conduct building or area searches even when hazardous materials are involved. The HMT should stage in a safe area, but in no case less than 800 feet from the incident scene. The HMT should act as a technical resource for the bomb squad. This may involve the loaning of chemical protective clothing to bomb squad personnel, assistance in dressing, researching chemical data, etc.

11. The OSFM will follow the same procedures as above.

FIRE CONDITIONS:

1. DO NOT FIGHT FIRES IN CARGO OR STORAGE AREAS CONTANING EXPLOSIVES. Withdraw from the area and let the fire burn.

2. If a fire is near explosives, efforts should be made to prevent the fire from reaching the explosives. For fires involving the motor, cab, or tires of vehicles transporting explosives, flood the involved area with water.

3. The application of water to burning Division 1.1 or 1.2 explosives may cause an explosion.

4. EVACUATE AREA:

Division 1.1 (Explosives A) =	1/2 mile in all directions
Division 1.2 (Explosives A & B) =	1/2 mile in all directions
Division 1.3 (Explosives B) =	1/2 mile in all directions
Division 1.4 (Explosives C) =	1500 Feet in all directions
Division 1.5 (Blasting Agents) =	1/2 mile in all directions
Division 1.6 =	1/2 mile in all directions

5. Do not overhaul areas where explosives have burned or exploded.

6. Explosives that have been exposed to heat may be very shock sensitive. Keep all personnel away and do not move these containers.

7. When explosives are involved in fire or serious accidents on the railroad, the Bureau of Explosives (202) 835-9500 should be notified.

OSFM - HAZARDOUS MATERIALS DIVISION

STANDARD OPERATING PROCEDURE: FLAMMABLE GASES

U. N. Hazard Class 2

DEFINITION:

A material or mixture having a vapor pressure exceeding 40 psi absolute at 100ºF, and either a mixture of l3% or less by volume) with air forms a flammable mixture or the flammable range with air is wider than 12% regardless of the lower limit. (Hydrogen, propane).

GENERAL INFORMATION:

1. Identify the material(s) involved.

2. Keep nonessential people away. (This includes nonessential emergency service personnel).

3. Establish control zones. (Isolate area and deny entry).

4. Stay upwind and keep out of low areas.

5. Do not enter confined spaces.

6. Wear positive pressure SCBA and full protective clothing. This is a minimum level of protective clothing and will not provide adequate protection for all incidents. In some cases chemical protective clothing carried by a hazardous material team will be required for the safe handling of the incident.

7. Avoid exposure to gas.

8. Since the application of water to pools of liquefied gas will increase the vaporization rate, this is not usually a recommended practice.

9. If a tank truck or tank car is involved in fire, isolate 1/2 mile in all directions.

10. Determine and implement appropriate decontamination procedures for personnel and equipment.

11. Consult CHEMTREC (1-800-424-9300) for product information & assistance.

12. Contact State Fire Marshals Office @ 1-800-669-7362 for assistance.

FIRE CONDITIONS:

1. Do not extinguish the fire unless the flow of gas can be stopped. The recommended means of extinguishing is to stop the flow.

2. If leaking tank is involved in a fire, the internal pressure and the rate of leakage may be reduced by cooling the tank with water. If sufficient water is available, use water spray to cool tanks and adjacent combustibles affected by the heat of the fire. For massive fires, use unmanned monitors. If this is not possible, withdraw from the area and let the fire burn.

    a. Pressure vessels should have a minimum of 500 GPM applied at the point of fire impingement.

    b. Atmospheric storage tanks up to 100' diameter require 500 GPM minimum.

    c. Atmospheric storage tanks from 100' to 150' diameter require 1,000 GPM minimum.

    d. Atmospheric storage tanks exceeding 150' require 2,000 GPM minimum.

3. Non-insulated pressure tanks may rupture violently if there is flame impingement on the vapor space at the top of the tank.

4. If it can be done safely, remove any vehicles or containers not already burning.

5. Let tank car, tank truck, or storage tank burn unless leak can be stopped.

6. Stay away from the ends of tanks exposed to heat or flame impingement.

7. Observe tanks for evidence of bulging or red hot spots in the metal, and listen for a rising sound from venting safety devices. These indicate that the tank may flail.

SPILL OR LEAK:

1. Extinguish all sources of ignition in the vicinity (traffic light control boxes, machinery, tar pots, etc.).

2. Flammable gases may be heavier or lighter than air. Determine the vapor density of the material from reference sources and use combustible gas detectors to determine the boundary of the gases. Survey the areas where gases are likely to accumulate. (Hydrogen, acetylene, hydrogen cyanide, ammonia, methane, and ethylene (ethene) are lighter than air flammable gases.)

3. Flammable gases may ignite and flash back to the opening from which the gas originated.

4. Do not allow vehicles or other sources of ignition in the area as long as the combustible gas detector indicates the presence of flammable gases.

5. Do not enter the gas cloud. Be aware that the flammable gases extend beyond any visible clouds.

6. Water spray can be used to absorb water miscible gases, and water spray or explosion-proof fans can be used to disperse gas clouds. Do not get water inside containers. Run-off must be contained for later analysis and possible disposal. Do not permit the run-off to enter storm, sewer, or water systems.

7. If it can be done safely, move undamaged containers to a safe area, being careful to avoid sparks or friction.

8. Post guards and keep spectators at least 2500 feet away from leaks from tank cars, tank trucks, or large storage tanks containing compressed gas, liquefied gas, and cryogenics.

9. Wrecking operations or transfer of product should not begin until all the gas is dispersed Confirmation of gas dispersal should be done with a combustible gas detector

10. To prevent the build-up of static electricity, bond and ground containers and equipment before any product transfer.

11. Empty tanks or tanks containing residue should be regarded as containing an ignitable gas-air mixture.

OSFM - HAZARDOUS MATERIALS DIVISION

STANDARD OPERATING PROCEDURES - <u>FLAMMABLE LIQUIDS</u>

U. N. Hazard Class 3

DEFINITION:

1. Identify the material(s) involved.

2. Keep nonessential people away. (This includes nonessential emergency service personnel.)

3. Establish control zones. (Isolate area and deny entry.)

4. Stay upwind and keep out of low areas.

5. Eliminate ignition sources.

6. DO NOT ENTER CONFINED SPACES.

7. Wear positive pressure SCBA and full protective clothing. This is a minimum level of protective clothing and will not provide adequate protection for all flammable liquid incidents. In some cases chemical protective clothing carried by the hazardous material team will be required for the safe handling of the incident.

8. Avoid exposure to smoke, fires, vapors, or direct contact.

9. If spilled material has entered storm, sewer, or water systems, notify the proper authority. Maps should be used to determine the direction of flow and destination (outflow) of the system. Consideration should be given to diking the storm, sewer, or water system ahead of the flow. It may be appropriate to apply foam not only at the spill site, but also into storm, sewer, or water system to lessen the chances of ignition. It may be advisable to apply foam ahead of the flowing spill, either into storm drains or manholes down-flow from the spill, or down-flow on the surface of open storm, sewer, or water systems.

10. If a tank truck or tank car is involved in fire, isolate 1/2 mile in all directions.

11. Most flammable liquids float on water. Therefore, the application of water to a spill area may enable the flammable liquid to spread beyond the boundaries of the original incident.

12. The vapors of all flammable liquids are heavier than air. Therefore, in addition to eliminating ignition sources in the immediate spill area, the downwind area and adjacent low areas should be checked for sources of ignition and accumulations of flammable vapors.

13. Consider the need for additional resources and equipment. Diking material, absorbents, foam, overpack containers, transfer equipment, private clean-up contractors, etc).

14. Secure sufficient foam supplies.

15. Determine and implement appropriate decontamination procedures for personnel and equipment.

16. Consult CHEMTREC (1-800-424-9300) for product information and assistance.

17. Notify the State Fire Marshals Office @ 1-800-669-7362 for assistance.

FIRE CONDITIONS:

1. For small fires, use dry chemical, $C0^2$, the appropriate foam or water spray.

2. For large fires use the appropriate foam or water spray. Water may be ineffective on low flash-point flammable liquids.

3. If sufficient water is available, use water spray to cool tanks and adjacent combustible's affected by the heat of the fire. For massive fires, use unmanned monitors. If this is not possible, withdraw from the area and let the fire burn.

4. If it can be done safely, remove any vehicles or containers not already burning.

5. Dig trenches or build dikes in the path of the burning liquid to confine the fire and protect exposures.

6. If vapors are burning at the valves, do not extinguish the fire unless re-ignition can be prevented.

7. Observe tanks for evidence of bulging or red hot spots in the metal. Listen for pinging sounds or loud noises from the tank that increase in intensity. Withdraw immediately in case of rising sound form venting safety device or discoloration of tank. These indicate that the tank may fail.

8. Do not puncture or rupture the shell of a transport vehicle involved in a fire as this may liberate more flammable liquid and extend the fire.

9. If safety relief valves are obstructed, try to reposition the tank to allow the valves to function properly.

LEAK:

1. Extinguish or eliminate all sources of ignition in the vicinity (traffic light control boxes, machinery, tar pots, etc.). Use combustible gas detectors to determine the boundary of the vapors.

2. Do not allow vehicles or other sources of ignition in the area as long as the combustible gas detector indicates the presence of flammable vapors.

3. Keep oxidizing materials away from spilled flammable liquids.

4. Post guards and keep spectators at least 2500 feet away for leaks from tank cars, tank trucks or large storage containers.

5. Dig trenches or build dikes ahead of the flow to confine the spill for later disposal or recovery,

6. Do not permit flammable liquids to enter storm, sewer, or water systems.

7. Cover flammable liquids with appropriate foam to blanket the suffocate and reduce the rate of evaporation. When ambient temperatures are less than 100 degrees F., combustible liquids will usually not require blanketing to reduce vapors. Do not permit the run-off to enter storm, sewer, or waters systems.

8. Water spray can be used to absorb water miscible vapors, and water spray or explosion-proof fans can be used to disperse vapors. Do not get water inside containers. Run-off must be contained for later analysis and possible disposal. Do not permit the run-off to enter storm, sewer, or water systems.

9. If it can be done safely, attempt to dose valves or otherwise reduce the amount of leakage.

10. Since most flammable liquids float, for leaks near the bottom of the tank, water may be added to the tank to float the flammable liquid if the leak cannot be controlled or stopped. The water flow can be adjusted so only water leaks out and the flammable liquid does not overflow the tank. This will provide time to off-load the remaining flammable liquid.

11. Wrecking operations or transfer of product should not begin until the area is determined safe. A combustible gas detector should be used to check the area continually during the entire operation.

12. To prevent the build-up of static electricity, bond and ground containers and equipment before product transfer.

13. Empty tanks or tanks containing residue should be regarded as containing an ignitable vapor air mixture.

14. Cutting torches or spark generating saws must not be used on the shell of empty or loaded cars or containers.

15. If it can be done safely, move undamaged containers to a safe area, being careful to avoid sparks or friction.

16. Do not separate tractor units from their trailer, as the support gear on the trailer may fail.

OSFM HAZARDOUS MAIXRIALS DIVISION

STANDARD OPERATING PROCEDURES: FLAMMABLE SOLID

U. N. Hazard Class 4

DEFINITON:

Any solid material, other than an explosive, which under conditions normally related to transportation is likely to cause fires through friction or retained heat from manufacturing or proceeding, or which can be ignited readily and when ignited burns vigorously and persistently it creates a serious transportation hazard. Included in this class are spontaneously combustible and water-reactive materials. Two materials shipped in bulk that can cause major problems for responders are phosphorus and sodium.

GENERAL INFORMATION:

1. Identify the material(s) involved.

2. Keep nonessential people away. (This includes nonessential emergency service personnel).

3. Establish control zones. (Isolate area and deny entry).

4. Wear positive pressure SCBA and full protective clothing. This is a minimum level of protective clothing and will not provide adequate protection for all incidents. In some cases chemical protective clothing carried by a hazardous materials team will be required for the safe handling of the incident.

5. Stay upwind and keep out of low areas.

6. Avoid exposure to smoke, fumes, vapors, dust, or direct contact. Toxic products may be produced from contact with water, heat, and other substances.

7. Consider the need for additional resources and equipment. (Diking material, absorbents, overpack containers, transfer equipment, private clean-up contractors, etc.).

8. If spilled material has entered storm or sewer systems, notify the proper authority.

9. Determine and implement appropriate decontamination procedures for personnel and equipment.

10. Contact the State Fire Marshals Office @ 1-800-669-7362 for assistance.

11. Consult CHEMTREC (1-800-424-9300) for product information and assistance.

FIRE CONDITIONS:

1. DO NOT USE WATER OR FOAM ON WATER REACTIVE MATERIALS.

2. If it can be done safely, move containers from the fire area

3. Chemical reference sources will indicate appropriate extinguishing agents. Agents such as dry chemical, soda ash, lime, or sand may be appropriate for use on water reactive materials, but they must be moisture free.

4. Water may be used to cool containers exposed to fire, but if the water contacts water-reactive materials, the incident could escalate rapidly.

SPILL OR LEAK:

1. Keep ignition sources away.

2. Extinguish all sources of ignition in the vicinity. Do not allow vehicles or other sources of ignition in the area.

3. If it can be done safely, attempt to close valves, plug, reposition containers, or otherwise reduce the amount of leakage.

4. Keep water-reactive materials dry, and DO NOT get water inside containers containing water-reactive materials.

5. Keep material out storm, sewer, and water systems.

6. Dig trenches or build dikes around spills of water reactive or environmentally damaging materials to prevent water from reaching them.

7. Powder spills can be covered with a plastic sheet or tarp to minimize spreading and prevent water/moisture contact. WARNING: If the sun is shining directly on the plastic sheeting, moisture may collect on the under-side of the sheeting, producing a reaction with water-reactive materials.

OSFM - HAZARDOUS MATERIALS DIVISION

STANDARD OPERATING PROCEDURES - <u>OXIDIZER & ORGANIC PEROXIDE</u>

U. N. Hazard Class 5

DEFINITION:

An oxidizer is a substance that yields oxygen readily to stimulate the combustion of organic matter. (Chlorate, permanganate, inorganic peroxide, or nitrate.)

An organic peroxide is a derivatives of hydrogen peroxide in which part of the hydrogen has been replaced by an organic material. (Benzoyl peroxide.)

GENERAL INFORMATION:

1. Identify the material(s) involved. The percent of concentration of the material should be determined, as many materials in this category have been specially formulated to reduce the threat of reaction.

2. Keep nonessential people away. (This includes nonessential emergency service personnel.)

3. Establish control zones. (Isolate area and deny entry.)

4. Stay upwind and keep out of low areas.

5. Do Not enter confined spaces.

6. Wear positive pressure SCBA and full protective clothing. This is a minimum level of protective clothing and will not provide adequate protection for all incidents. In some cases chemical protective clothing carried by a hazardous materials team will be required for the safe handling of the incident.

7. Avoid exposure to smoke, fumes, vapors, dust, or direct contact. Toxic products are frequently produced by burning oxidizers.

8. Caution should be exercised when water is used on oxidizers, as most oxidizers are water soluble and will produce solutions which can impregnate wood and other organic combustibles. Upon drying, these materials can spontaneously ignite and burn vigorously.

9. In accidents involving chlorates and other oxidizing materials, care is necessary to prevent ignition by friction or contact with acids.

10. When chlorates are mixed with organic matter, or even dust, a very flammable mixture is formed.

11. Chlorates mixed with finely divided combustible material may burn with explosive violence.

12. Fire may be caused by leaking of nitric acid, perchloric acid, or hydrogen peroxide. These materials are also corrosive.

13. Organic Peroxides generally have the special property that if they are heated beyond their transportation temperatures, they are likely to detonate.

14. Consider the need for additional resources and equipment. (Diking material, absorbents, overpack containers, transfer equipment, private clean-up contractors, etc.).

15. If spilled material has entered storm or sewer systems, notify the proper authority.

16. Determine and implement appropriate decontamination procedures for personnel and equipment.

17. Contact the State Fire Marshals Office ® 1-800-669-7362 for assistance.

18. Consult CHEMTREC (1-800-424-9300) for product information and assistance.

FIRE CONDITIONS:

1. If it can be done safely, remove any containers not already burning.

2. Cool affected containers with flooding quantities of water. For massive fires, use unmanned monitors. If this is not possible, withdraw and let the fire burn. Run-off water must be contained for later analysis and possible disposal.

SPILL OR LEAK:

1. Keep flammables, combustibles and organic materials away from spilled material.

2. Avoid contact with the spilled material.

3. Extinguish all sources of ignition in the vicinity. Do not allow vehicles or other sources of ignition in the area.

4. Water spray can be used to absorb water miscible vapors, and water spray or explosion-proof fans can be used to disperse vapors. Do not get water inside containers. Run-off must be contained for later analysis and possible disposal. Do not permit the run-off to enter storm, sewer, or water systems.

5. Keep material out of storm, sewer, and water systems.

6. Dig trenches or build dikes ahead of the flow to contain the spill for later disposal.

7. Powder spills can be covered with a plastic sheet or tarp to minimize spreading.

OSFM HAZARDOUS MATERIALS DIVISION

STANDARD OPERATING PROCEDURES - <u>POISONS & PESTICIDES</u>

U. N. Hazard Class 6

DEFINTION:

Class A poisons are poisonous gases or liquids which are extremely dangerous, and a very small amount of the gas or vapor of the liquid mixed with air is dangerous to life. (Hydrogen cyanide and phosgene).

Class B poisons are liquids or solids (including pastes and semi-solids) which are known to be so toxic to man as to create a health hazard during transportation, or which are presumed toxic to man based on laboratory tests with animals. (Parathion and toluene diisocyanate).

A pesticide is any substance, organic or inorganic, used to destroy or inhibit the action of plant or animals pests; the term includes insecticides, herbicides, rodenticides, mitidices, etc. Virtually all pesticides are toxic to humans to some degree.

GENERAL INFORMATION:

1. Identify the material(s) involved.

2. Keep nonessential people away. (This includes nonessential emergency service personnel).

3. Establish control zones. (Isolate area and deny entry).

4. Wear positive pressure SCBA and full protective clothing. This is a minimum level of protective clothing and will not provide adequate protection for all incidents. Due to the construction and materials used for firefighter turnout clothing, the clothing may actually absorb and hold the pesticide or poison if contact with the smoke, fires, vapors, dust, or material occur. The firefighter would be re-exposed each time the clothing was worn if proper decontamination operations were not performed. In most incidents involving pesticides and poisons, the chemical protective clothing carried by a hazardous material team will be required for the safe handling of the incident.

5. Stay upwind and keep out of low areas. If you can smell the pesticide, you are too close and not sufficiently protected.

6. Avoid exposure to smoke, fumes, vapors, dust, or direct contact.

7. Determine signs and symptoms of exposure and advise all personnel operating at the site. Some symptoms may not become present for up to 48 hours following exposure.

8. Ventilate confined areas before entering. It is not advisable for fire department personnel to enter tanks or other confined spaces that contain or have contained pesticides and/or poisons. Specific procedures are needed to be in place prior to entering any type of confined space. Make necessary notification prior to taking any action.

9. If spilled material has entered storm, sewer, or water systems, notify the proper authority. Maps should be used to determine the direction of flow and destination (outflow) of the system. Consideration should be given to diking ahead of the flow.

10. Determine and implement appropriate decontamination procedures for personnel and equipment.

11. Flush any contacted material from skin immediately.

12. Remove and isolate any contaminated clothing at the site and avoid spreading contamination to non-contaminated areas.

13. Contact the State Fire Marshals Office @ 1-800-669-7362 for assistance.

14. Consult CHEMTREC (1-800-424-9300) for product information and assistance.

15. Have EMS personnel contact local Poison Control Center.

FIRE CONDITIONS:

1. Consider protecting exposures and allowing the fire to burn. This may create less of a hazard to people and the environment, especially if run-off cannot be confined.

2. For small fires, use dry chemical, $C0^2$, water spray or the appropriate foam.

3. For large fires use the appropriate foam or water spay.

4. Do not extinguish fire unless the flow can be stopped.

5. If sufficient water is available, use water spray to cool containers exposed to fire.

6. Dike fire control water for later analysis and/or disposal.

SPILL OR LEAK:

1. For liquid pesticides spills, extinguish or eliminate all sources of ignition in the vicinity as many pesticides have flammable liquids as the carrier for the poison. Use combustible gas detectors to determine the boundary of the flammable vapors if the pesticide is a flammable. The absence of a reading on a CGI does NOT indicate the absence of a toxic atmosphere.

2. Do not allow vehicles or other sources of ignition in the area as long as the combustible gas detector indicates the presence of flammable vapors.

3. Water spray can be used to absorb water miscible vapors, and water spray or explosion-proof fans can be used to disperse vapors. Do not get water inside containers. Run-off must be contained for later analysis and possible disposal. Do not permit the run-off to enter storm, sewer, or water systems.

4. Keep material out of storm, sewer, and water systems.

5. Dig trenches or build dikes ahead of the flow to confine the spill for later disposal or recovery.

6. Powder spills can be covered with a plastic sheet or tarp to minimize spreading.

OSFM - HAZARDOUS MATESIALS DIVISION

STANDARD OPERAIING PROCEDURES: <u>INFECTIOUS SUBSTANCE</u>

U. N. Hazard Class 6

DEFINITION:

An etiologic agent is a micro-organism or its toxin which causes or may cause human disease.

GENERAL INFORMATION:

1. Identify the material(s) involved. Infectious substances include the red "Infectious Waste" bags and "Sharps" containers from hospitals. Sharps containers are used for the disposal of needles and other sharp instruments. Caution should be used if these containers are encountered.

2. Keep nonessential people away. (This includes nonessential emergency service personnel).

3. Establish control zones. (Isolate area and deny entry).

4. Wear positive pressure SCBA and chemical protective clothing. Firefighter protective clothing will not provide adequate protection for all incidents involving infectious substances. The chemical protective clothing carried by a hazardous materials team will be required for the safe handling of the incident.

5. Stay upwind and keep out of low areas.

6. Avoid exposure to smoke, fumes, vapors, or dust. Do not contact damaged containers or spilled material. Virus and disease bearing substances are often present.

7. If leakage is discovered in transit, the vehicle must not be moved and the area must be isolated.

8. If spilled material has entered storm or sewer systems, notify the proper authority.

9. Implement appropriate decontamination procedures. A freshly mixed 10% or stronger bleach water solution is an effective decontamination solution for most infectious substances exposures.

10. Contact State Fire Marshals Office @ 1-800-669-7362 for assistance.

11. Made necessary notifications to local Health Department officials.

FIRE CONDITIONS:

1. If it can be done safely, move containers from fire area. Do not touch or move damaged containers.

2. Use dry chemical, soda ash, or lime for small fires.

SPILL OR LEAK.

1. Cover damaged containers or spill area with dampened towel or rag, and keep wet with liquid bleach. To decontaminate the area and equipment, a garden sprayer with a 10% bleach/water solution can be used to spray exposed surfaces. Recently mixed bleach/water solutions should be used, as premixed solutions will lose their strength after a few days.

2. Dike spills for later disposal.

3. Keep material out of the storm, sewer, and water systems.

OSFM - HAZARDOUS MATERIALS DIVISION

STANDARD OPERATING PROCEDURES: <u>RADIOACTIVE MATERIAL</u>

U. N. Hazard Class 7

DEFINITION:

A radioactive material is a substance having a specific activity greater than 0.002 microcuries per gram.

GENERAL INFORMATION:

1. Identify the material involved. Radioactive materials are often shipped in lead containers.

2. Keep all persons as far away as is practical, at least 150 feet upwind.

3. Establish control zones. (Isolate area and deny entry). Use radiation monitoring devices to determine control zones and assess areas of contamination.

4. Wear positive pressure SCBA and full protective clothing. This is a minimum level of protective clothing and will not provide adequate protection for radioactive incidents.

5. Avoid exposure to smoke, fumes, vapors, dust, or direct contact.

6. All personnel should utilize dosimeters. Zero dosimeters prior to use.

7. Entry should not be made until appropriate radiological personnel are on scene and the degree of radiation is known.

8. Enter Hot Zone only to save life, and limit entry into the Hot Zone to shortest possible time.

9. If spilled material has entered storm or sewer systems, notify the proper authority.

10. Implement appropriate decontamination procedures for personnel & equipment.

11. Delay clean-up until arrival or instructions of qualified radiation personnel.

12. Equipment used in the Hot Zone shall not be removed until appropriate decontamination procedures have been performed and the equipment has been monitored and declared clean.
13. Contact the State Fire Marshals Office @ 1-800-669-7362 for assistance

14. Contact local radiological team for assistance and equipment

15. Consult CHEMTREC (1-800-424-9300) for product information and assistance.

FIRE CONDITIONS:

1. Do not move damaged containers, but undamaged containers should be moved to a safe area if it can be done safely.

2. Assume the fire involves the radioactive materials.

3. Avoid exposure to smoke, fumes, or dust. Airborne contamination is a great cause of concern for emergency responders. Stay upwind of fire area.

4. Evacuate downwind area.

5. The fire should be extinguished as quickly as possible, with a minimum amount of water. Try not to disturb the radioactive containers.

6. Fight fire from maximum distance. Do not allow personnel into the area after fire knockdown.

7. For massive fires, use unmanned monitors.

8. Dig trenches or build dikes ahead of the flow to contain the spill for later disposal.

9. The fire area should not be overhauled.

SPILL OR LEAK:

1. Do not touch damaged containers or contact the spilled material.

2. Prevent spread of spilled material and keep it out of water systems and sewers. Dike far ahead of large spills to confine for later disposal.

OSFM - HAZARDOUS MATERIALS DIVISION

STANDARD OPERATING PROCEDURES: <u>CORROSIVES</u>

U. N. Hazard Class 8

DEFINITION:

A corrosive material is a liquid or solid that causes visible destruction or irreversible alterations in human skin tissue at the site of contact, or, in the case of leakage from its packaging, a liquid that causes a severe corrosion rate to steel. (Acids [sulfuric, hydrochloric, nitric] and bases [sodium hydroxide, ammonia, amines]).

GENERAL INFORMATION:

1. Identify the material(s) involved.

2. Keep nonessential people away. (This includes nonessential emergency service personnel).

3. Establish control zones. (Isolate area and deny entry).

4. Wear positive pressure SCBA and chemical protective clothing. This is a minimum level of protective clothing and will not provide adequate protection for corrosive incidents. The chemical protective clothing carried by a hazardous materials team will be required for the safe handling of most incidents involving corrosives.

5. Stay upwind and keep out of low areas.

6. Avoid exposure to smoke, fumes, vapors, dusts, or direct contact. Highly toxic fumes are often present.

7. Do not enter confined spaces.

8. Consider the need for additional resources and equipment. (Diking material, absorbents, overpack containers, transfer equipment, private clean-up contractors, etc. will be needed).

9. If spilled material has entered storm or sewer systems, notify the proper authority.

10. Determine and implement appropriate decontamination procedures for personnel and equipment.

11. Contact the State Fire Marshals Office @ 1-800-669-7362 for assistance.

12. Consult CHEMTREC (1-800-424-9300) for product information and assistance.

FIRE CONDITIONS:

1. Many corrosive chemicals react violently with water, liberating heat and toxic gases.

2. If it can be done safely, move undamaged containers from the fire area.

3. Do not get water inside container.

4. Use water to cool containers that are exposed to flames until well after the fire is out. Do not allow water to get inside containers.

SPILL OR LEAK:

1. Avoid contact with the spilled material.

2. Extinguish all sources of ignition in the vicinity. Do not allow vehicles or other sources of ignition in the area.

3. Do not apply water unless directed to do so. Contact with water may cause the generation of large quantities of vapors and heat.

4. Do not get water inside container

5. Water spray can be used to absorb water miscible vapors, and water spray or explosion-proof fans can be used to disperse vapors. Do not get water inside containers and do not put water on leak or spill area. Run-off must be contained for later analysis and possible disposal. Do not permit the run-off to enter storm, sewer, or water systems.

6. Keep combustibles (wood, paper, oil, etc.) away from spilled material.

7. Dig trenches or build dikes ahead of the flow to contain the spill for later disposal or recovery.

8. Powder spills can be covered with a plastic sheet or tarp to minimize spreading.

9. Keep material out of storm sewer, and water systems.

10. Do not attempt neutralization!

OSFM - HAZARDOUS MATERIALS DIVISION

STANDARD OPERATING PROCEDURES - MISCELLANEOUS

U. N. Hazard Class 9

DEFINITION:

Simply a material that presents a hazard during transport, but does not meet the criteria for any other hazard class. Carbon dioxide, solid (dry ice). This class **does** indeed embody a miscellany of potential hazards. Ex: (molten products, fused salts and salt baths, and hazardous wastes).

GENERAL INFORMATION:

1. Identify the material(s) involved, if safe to do so.

2. Keep nonessential people away. (This includes nonessential emergency service personnel).

3. Establish control zones. (Isolate area and deny entry).

4. Stay upwind and keep out of low areas.

5. Wear positive pressure SCBA and full protective clothing. This is a **minimum** level of protective clothing and will not provide adequate protection for all incidents. In some cases chemical protective clothing carried by a hazardous materials team will be required for the safe handling of the incident.

6. Eliminate ignition sources.

7 Avoid exposure to smoke, fumes, vapors, dust or direct contact. Toxic products may be produced from contact with water, heat, and other substances.

8. Consider the need for additional resources and equipment

9. If spilled material has entered storm or sewer systems, notify the proper authority.

10. Determine and implement appropriate decontamination procedures for personnel and equipment.

11. Contact State Fire Marshal Office @ 1-800-669-7362 for assistance.

12.. Consult CHEMIREC (1-800-424-9300) for product information and assistance. Seek information and assistance from product specialists. Hazards in this classification should not be underestimated.

OSFM - HAZARDOUS MATERIALS DIVISION

STANDARD OPERATING PROCEDURES - <u>ORM D</u>

U. N. Hazard Class 10

DEFINITION:

Those materials such as consumer commodities that, though otherwise subject to regulation, present a limited hazard during transportation due to their form, quantity, or packaging.

GENERAL INFORMATION:

1. Identify the material(s) involved, if safe to do so.

2. Keep nonessential people away. (This includes nonessential emergency service personnel).

3. Establish control zones. (Isolate area and deny entry).

4. Stay upwind and keep out of low areas.

5. Wear positive pressure SCBA and full protective clothing. This is a minimum level of protective clothing and will not provide adequate protection for all incidents. In some cases chemical protective clothing carried by a hazardous materials team will be required for the safe handling of the incident.

6. Eliminate ignition sources.

7 Avoid exposure to smoke, fumes, vapors, dust or direct contact. Toxic products may be produced from contact with water, heat, and other substances.

8. Consider the need for additional resources and equipment.

9. If spilled material has entered storm or sewer systems, notify the proper authority.

10. Determine and implement appropriate decontamination procedures for personnel and equipment.

11. Contact State Fire Marshal Office @ 1-800-669-7362 for assistance.

12. Consult CHEMTREC (1-800-424-9300) for product information and assistance.

13. Don't wait to ask for help. Seek out information and assistance from shipper and product specialists. Hazards in this classification should not be underestimated.

14. Never underestimate the potential risk from a product simply, because only a little bit has been spilled or just because it is categorized as an ORM.

15. The danger of chemicals mixing within the same load is very high with ORM-D loads. An assessment of the risk potential is necessary in this case.

Subject : CONFINED SPACE RESCUE RESPONSE

1. Purpose: The State Fire Marshals Office is committed to maintaining a safe work environment for its employees. This guideline has been developed to provide you with guidance for safely working in confined spaces. Many times hazardous materials response involves the evaluation of a confine space.

2. Scope: This guideline covers all personnel who could be "reasonably anticipated" as the result of performing their assigned duties to come in contact with hazardous materials, as ft relates to confined spaces.

3. Introduction:

There are 2.1 million Americans who work in confined spaces each year who know and understand that their job is dangerous. Serious injury and death in a confined space can be result of asphyxiation, engulfment, electric shock, falls and heat stress. The Indiana Occupational Safety and Health Administration (TOSHA) believes that 80 to 90 percent of these accidents can be prevented if you learn about the hazards you face on the job. The National Institute for Occupational Safety and Health (NIOSH) has recently completed a study in the areas of lack of proper equipment, little, or no training, and failure to follow common sense rules of safety, and concluded with the results that, an average of 300 deaths occur every year from lack of proper safety procedures. Another interesting fad involves emergency responders and how they share in the increased number of deaths as related to confined space entries. First responders responding to an incident involving confined spaces account for 60% of the fatalities in the last 10 years. This is why it is terribly important that we as hazardous

materials specialists understand the potential for unseen hazards associated with confined space entries and rescue.

4. Definitions:

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

1) Is large enough and so configured that an employee can bodily enter and perform assigned work; and

2) Is limited to 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

3) Is not designed for continuous employee occupancy

4) Some of the more typical confined spaces may be: cable vaults, sewer manholes, sewer lines, junction structures, valve vaults, meter vaults, pumping station wells, storage tanks, pits, filter beds, wires, flusher truck tanks, traveling screens, railroad cars/tankers, and equipment, caves, wells, manholes, storm drains, etc.

Confined space; Non-permit: means 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 serious physical harm

Confined Space; Permit-Required: means a confined space that:

1) Contains or has a potential to contain a hazardous atmosphere;

2) Contains a material that has the potential for engulfing an entrant;

3) 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

4) Contains any other recognized serious safety or health hazard.

Engulfment: means the surrounding and effective capture of a person by a liquid or finely divided (flowable) solid 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 Supervisor: means the person (such as the employer, 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 as required by this 1910.146. Note: An entry supervisor also may serve as an attendant or as an authorized entrant as long as that person is trained and equipped as required by 1910.146 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 operations.

Hazardous atmosphere: means 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:

1) Flammable gas, vapor, or mist in excess of 10% of its lower flammable limit.

2) 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 (1.52rn) or less.

3) Atmospheric oxygen concentration below 19.5% or above 23.5%;

4) Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in Subpart C, 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, impairment of ability to self-rescue, injury, or acute illness due to its health effects is not covered by this provision.

5) Any other atmospheric condition that is immediately dangerous to life or health (IDLH). **Note**: For air contaminants for which IOSHA has not determined a dose or permissible exposure limit, other sources of information, such as MSDS that comply with the Hazard Communication Standard, 1910:1200 of this part, published information, and internal documents can provide guidance in establishing acceptable atmospheric conditions.

Immediately dangerous to life or health (ILH): means any condition that 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. Note: Some materials - hydrogen fluoride gas and cadmium vapor, for example - may produce immediate transient effects that, even if severe, may pass without medical attention, but are followed by sudden, possibly fatal collapse 12-72 hours after exposure. The victim "feels normal" from recovery from transit effects until collapse. Such materials in hazardous quantities are considered to be "immediately" dangerous to life or health.

Rescue service: means the personnel designated to rescue employees from permit spaces. Normally this service is provided by the employer on-site. However, a agreement may be in place that assigns this duty to the fire department having jurisdiction. The rescue service should meet the following, as a minimum:

1) The employer shall ensure that each member of the rescue service is provided with, and is trained to use properly, the personal protective equipment and rescue equipment necessary for making rescues from permit spaces.

2) Each member of the rescue service shall be trained to perform the assigned rescue duties. each member of the rescue service shall also receive the training required of authorized entrants.

3) Each member of the rescue service shall practice making permit space rescues at least once every 12 months, by means of simulated rescue operations in which they remove dummies, mannequins, 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.

4) Each member of the rescue service shall be trained in basic first aid and in cardiopulmonary resuscitation (CPR). At least one member of the rescue service is required to have a current certification in first aid and CPR.

5) When a employer (host employer) arranges to have persons other than the host employer's employees per permit space rescue, the host employer shall:

   a) Inform the rescue service of the hazards they may confront with when called to perform rescue at the host employer's facility, and

   b) 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 plans and practice rescue operations.

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

   a) Each authorized entrant shall use a full body harness, with a working entrant retrieval line attached at the center of the entrant's back near shoulder level, or above the entrant's head. Wristlets may be used in lieu of the 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,

   b) The other end of the working entrant retrieval line shall be attached to a mechanical device or fixed point outside of 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 than 5 feet deep.

7) If the injured entrant is exposed to a substance from which a Material Safety Data Sheet (MSDS) or other similar written information is required to be kept at the work site, that MSDS or written information shall be made available to the medical facility treating the exposed entrant.

5.0 GENERAL PRECAUTIONS:

If at any time there is a situation that requires your entry and you are not sure if it is a confined space, "ALWAYS CONSULT WITH FACILITY/EMERGENCY PERSONNEL BEFORE ENTERING, AND PROPERLY COMPLETE A CONFINED SPACE PERMIT."

When entering a confined space, observe all previously mentioned precautions to avoid accidents and injuries and follow the precautions and procedures in this section:

5.01 Keep work area clean and orderly at all times.
5.02 No horseplay.
5.03 NO SMOKING in or around a confined space.
5.04 Use **only explosion-proof lights and support equipment** in a confined space.
5.05 Any worker feeling nauseous, weak, or lightheaded should leave the confined space immediately and make proper notifications.
5.06 Rescue - rescue attempts by attendant should only be made by mechanical means from outside the confined space.
5.07 Do not enter a confined space to extract an unconscious person.

6.0 ISOLATION OF THE AREA:

Isolation of a confined space is a process where the space is removed from service by:

6.01 Referring to the lockout/tagout program (IOSHA 1910).
6.02 Remove all equipment and tools from the vicinity of the opening of the confined space to prevent an object from falling into the opening and to ensure sound footing.
6.03 Ventilate the confined space with an air supply blower when testing indicates that the manhole atmosphere is hazardous. Sufficient ventilation must be provided before entry and must be continued for the duration of work in the area. Do not allow internal combustion engine exhaust near or upwind of the blower.
6.04 Complete the confined space entry permit before anyone enters the space. Only authorized persons whose names appear on the permit may enter. Only persons authorized on the permit to be an attendant can function as so. It is possible to have persons authorized to perform both functions, but not at the same time The person authorizing entry should not sign the permit until all information is completed and the atmosphere has been tested and determined safe for entry.

There shall be a permit completed on every permitted Confine Space Entry. These permits must be posted on the job site until the job has been completed.

While the worker is in the permit space:

6.05 Continue to test the atmosphere of the permit space with the proper gas detector. If at anytime the alarm sounds on the atmospheric monitor, the confined space must be cleared by the attendant and the assigned safety officer immediately notified.
6.06 Continue to ventilate the permit space with the selected engineering device, as necessary.
6.07 Keep all tools and equipment away from the access opening.

A permit becomes void when any condition of the permit is violated. The maximum length of time for a permit is 8 hours unless designated otherwise by the on-scene safety officer or Incident Commander.

7.0 SPACE VENTILATION:

Mechanical ventilation systems, where applicable, shall be set at 100% outside air- where possible, open additional manholes/vents to increase air circulation. Use portable blowers to augment natural circulation if needed. After a suitable ventilating period, repeat the testing. Entry may not begin until testing has demonstrated that the hazardous atmosphere has been eliminated or proper procedures are followed under the direction of the team leader/safety officer.

Continuous forced air ventilation shall be used as follows:

7.01 An employee may not enter the space until the forced air ventilation has eliminated any hazardous atmosphere or proper procedures are followed under the direction of the team leader/safety officer.
7.02 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 employed have left the space or proper procedures have been completed.
7.03 The air supply for the forced air ventilation shall be from a clean source and may not increase the hazards in the space.

8.0 PERSONNEL DUTIES AND RESPONSIBILITIES:

Personnel involved in confined space entry:

8.01 Individual authorizing or in charge of entry
8.02 Authorized entrants
8.03 Authorized attendants
8.04 Rescue attempts by attendants should only be made by mechanical means from outside the confined space.
8.05 Rescue Team

Personnel involved in confined space entry have specific duties and responsibilities. The following details the duties of each of these individuals.

Individual Authorizing or in Charge of Entry:

Determine that the entry permit contains the proper information before entry.
The permit must be filled out in full by the Entry/Safety Officer. This person can also act as entrant or an attendant during the confined space duration.

Procedures for checking for hazardous atmosphere should be as follows:

1) Oxygen content

2) Flammable gases and vapors

3) Potential toxic air contaminants

9.0 HAZARDOUS CONDITION:

If and when **any type of hazardous conditions exist,** the entry supervisor must notify the on-scene Incident Commander immediately so that steps can be taken to ventilate or close the confined space.

9.01 Determine that the necessary procedures, practices and equipment for safe entry are in effect before allowing entry.
9.02 Cancel the entry authorization and terminate entry whenever acceptable entry conditions are not present.
9.03 Take the necessary measures for concluding an entry operation, such as dosing off a permit space and canceling the permit, once the work authorized by the permit has been completed this done by marking the permit CLOSED and signing and dating the permit.
9.04 Take appropriate measures to remove unauthorized personnel who are in or nearby permitted spaces.

Individuals authorizing or in charge of entry may also serve as authorized entrants.

10.0 AUTHORIZED ENTRANTS:

10.01 Hazard Recognition:

a) Understand the hazards which may be faced during entry

b) Recognize the signs and symptoms of exposure to a hazard

c) Understand the consequences of exposure to a hazard

11.0 AUTHORIZED ATTENDANT:

11.01 Remain stationed outside the permit space at all times during entry operations.
11.02 Maintain an accurate count of all persons in the space.
11.03 Monitor activities inside and outside the permit space to determine if it is safe for entrants to remain in the space.
11.04 Recognize potential hazards.
11.05 Order entrants to evacuate permit space immediately when one of the followingoccurs:

a) The attendant observes a condition which is not part of the entry permit.

b) The attendant detects behavioral effects of hazard exposure.

c) The attendant detects a situation outside the space which could endanger the entrants.

d) The attendant is monitoring entry in more than one permit space and must focus attention on the rescue of entrants from another space.

e) The attendant must leave the work station.

11.06 Summon emergency medical services as soon as it is determined that authorized entrants need to escape and may have injuries from permit space hazards.
11.07 Take the following actions, as necessary, when unauthorized persons approach or enter a permit space while entry is underway:

a) Warn the unauthorized persons to remain away from the space.

b) Request the unauthorized persons to exit immediately if they have entered the permit space.

c) Inform the person authorizing or in charge of entry.

11.08 Detects behavioral effects of hazard exposure in entrant(s)

12.0 COMMUNICATIONS:

12.01 Maintain contact with the attendant.
12.02 Notify the attendant when the entrants self-initiate evacuation of a permit space.If at any time communications between the entrant and attendant becomes a factor and prohibits a safe operation in a confined space, the entrant shall be removed from the space and the Incident Commander/Safety Officer notified immediately so that proper communication can be restored.

12.03 Alert the Attendant:

a) The entrant recognizes any warning signs or symptoms of exposure to a dangerous situation.

b) The entrant detects a prohibited condition.

The entrant must exit from the permit space as soon as possible whenever:
c) An order to evacuate is given by the attendant or the entry officer/safety officer.

d) An evacuation alarm is activated.

12.04 Protective Equipment:

a) Maintain all personal protective equipment such as retrieval lines, and clothing necessary for safe entry and exit.

b) Provide all entrants with the necessary personal protective equipment.

c) Ensure proper use of the personal protective equipment.

d) Ensure proper use of the external barriers necessary to protect entrants from external hazards.

12.05 Authorized entrants must exit the permit space, unless it is impossible to do so, when:

a) The attendant orders evacuation.

b) An automatic alarm is activated.

c) The authorized entrants perceive that they are in danger.
Attendants shall not enter the permit space to attempt the rescue of entrants.

13.0 RESCUE BRANCH/SECTOR RESPONSIBILITIES:

13.01 Executing monitoring of site
13.02 Setting up ventilation system
13.03 Establishing rigging for:

a) Access to space (i.e., tripod hauling system)

b) Extrication from space

c) Safety of rescuers and victim(s) (i.e., safety lines)

13.04 Entering space
13.05 Extricating victim(s) from space.
Overview of basic duties of entry branch/sector rescue personnel (ref: 1910.146(h)(k-i):
13.06 Apply measures necessary to prevent unauthorized entry
13.07 Identify/evaluate hazards before entry into confined spaces
13.08 Implement means, procedures, and practices necessary for safe confined space entry operations including:

a) Specifying acceptable entry conditions

b) Isolating the space

c) Establishing processes for purging/inerting/flushing/ventilation of spaces in order to eliminate/control atmospheric hazards

d) Providing pedestrian, vehicle, or other barriers to protect entrants from external hazards.

e) Verifying that conditions in a space are acceptable for entry both pre-entry and throughout the duration of entry by using testing and monitoring equipment.

f) Using communication equipment

g) Donning and wearing during operations personal protective equipment that is within the capacity and trainang of the entrant.

h) Providing lighting equipment to enhance space visibility.

i) Establishing barriers and/or shields for isolating spaces when indicated.

j) Providing means for safe ingress and egress.

k) Applying rescue equipment.

l) Continually evaluating space conditions both initially and throughout the operation.

14.0 SAFETY OFFICER RESPONSIBILITIES:

14.01 Assessing actual and potential hazardous conditions/situations during incident
14.02 Correcting, preventing, stopping safety violations/dangerous actions
14.03 Developing measures or procedures to protect rescuers and victim(s)
14.04 Monitoring physical and mental stresses on rescuers during extended operations including recommendations for crew rotations
14.05 Keeping personnel accountability status board to track the status of all members who enter a space.
14.06 Ensuring the following actions are undertaken:

a) Air monitoring is completed

b) Appropriate lockout and tagout procedures are used if indicated

c) All rope and rigging is checked before entering a space

d) Realistic work limits are set and followed by the entry team

14.07 Advising Command
14.08 Stopping any operation that is deemed as hazardous
14.09 Recommendation for medium to large operations:

a) At least one person should be directly responsible to the safety officer.

14.10 Assigned person should report any changes reflected in the levels of monitored hazards.
14.11 Complete a Site Safety Plan and ensure that brief(s) are conducted prior to rescues executing operations
14.12 Make sure that entrant SCHA use is monitored and documented including a 5-minute warning for limited air supply type units.

15.0 INCIDENT MANAGEMENT SYSTEM (IMS) FOR CONFINED SPACE RESCUES:

15.01 Two (2) basic types of command operations will be used:

1) **Single:**
   - involves only one agency
   - only one jurisdiction is impacted by the incident
   - ex: department handles an alarm for confined space rescue within their own community and does not need additional outside resources to execute the operations indicated.
2) **Unified:**
   - involves multiple agencies/multiple jurisdictions
   - additional input at the command-decision-making level
   - ex: confined space rescue incident involving hazardous materials

15.02 Levels of IMS:

Level I: Rescue incident that can be controlled (mitigated) utilizing equipment, supplies, and resources immediately available to the responding agency having jurisdiction (i.e. first alarm).

- does not require specialized operations other than those for which the jurisdictional responders have been trained to execute.
- involves small jurisdictional operations
- essentially is a jurisdictional contained emergency operation
- may require limited assistance from cooperating agencies (i.e. law enforcement-traffic control; dept. of environmental management-reporting of hazardous materials release, etc.)

Level II: More complex rescue and/or rescue that is larger in size, complexity, and magnitude. Requires more time and/or involves a bigger geographical area than a Level I incident.

- Control/mitigation of a rescue incident utilizing specially trained resources of the agency having jurisdiction.
- May require local physical/human resources beyond the capabilities of the jurisdiction

Level III-IV: Rescue situation involving a severe hazard and/or large sized, complex situation which will require a large-scale operations which may last a long time. Situation that is/has become a large-proportion, multi-agency/multi-jurisdictional operation.

Level III: Rescue operation that requires **highly specialized equipment supplies, and resources** *beyond those available to the jurisdictional agency's community* (i.e. regional/state rescue task force/teams)

Level-IV: Rescue operation that requires **highly specialized equipment supplies, and resources** *beyond those available to the jurisdictional agency's community and state* (i.e. national US&R task force team, FEMA).

15.03 Command Responsibilities:

1) Develop strategies and tactics

2) Communicate strategies and tactics

3) Establish strong central command that is focused on incident stabilization:
   - Control
   - Direct
   - Plan
   - Organize
   - Evaluate

4) Assess priorities

5) Allocate, obtain, coordinate, and direct resources

6) Develop and support action plan

7) Sign off Site Safety Plan

8) Evaluate outcomes with written action plan adjustments, as needed

9) Sign-off Confine Space Permit, as required.

16.0 ATMOSPHERIC TESTING PROCEDURES:

Before testing the atmosphere in a confined space, ensure that the audio and visual alarms of the approved detector unit is operating properly. A self-test in a non-contaminated area must be performed before the equipment is used. Testing of the confined space must include tests for oxygen deficiency and the presence of hydrogen sulfide, combustible/explosive gases, carbon monoxide and other toxic fumes.

To obtain the most accurate measurement of atmospheric conditions inside the confined spaces, minimize the mixing of outside air with the air in the confined space by opening the access only enough to get the gas detector into the area. use the gas detector to perform this function safely. Do enter the confined space to test the atmosphere. Conduct testing by lowering the device on a line to all levels.

Overview of atmospheric hazards: IOSHA's analysis of **hazardous atmospheres** related to confined space death and injuries:

1) Oxygen deficiency

2) Toxic gases/vapors

3) Flammable gases/vapors

Some chemical substances presented multiple atmospheric hazards - example: Methane. Product is odorless, non-toxic, lighter than air when both are at the same temperature (normally the case). Configuration in some confined spaces variable, can trap accumulating methane at ceiling level and if liquid methane released into atmosphere, would be heavier than air and would displace air from the ground up. Harmless at some concentrations. Can displace all or part of the atmosphere in a confined space. 10% displacement of air with methane can produce atmosphere adequate for respiration and can explode violently (within flammable range). 90% displacement of air with methane produces asphyxiating atmosphere, but will not burn or explode (too rich).

16.01 Oxygen-deficiency atmospheres. IOSHA term: “asphyxiating atmosphere” contains less than 19.5% oxygen which is inadequate for entrant’s respiratory needs when performing physical work even if the space contains no toxic materials.

a) Example: absorption of oxygen by materials by activated charcoal. Dereased oxygen due to operations; welding, cutting, brazing

16.02 Victims of asphyxiation often are unaware of their predicament until they are incapable of saving themselves or even calling for help.

16.03 Toxicity criteria:

a) **Irritant criterion:** chemical that is not corrosive but causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.

b) **Sensitizer criterion:** chemical that causes a substantial proportion of exposed people or animals to develop a an allergic reaction in normal tissue after repeated exposure.

c) **Toxic substance criteria:**
- a chemical that has a median lethal doses (LD_{5O}) or more than 50 mg per kg, but not more than 500 mg per kg of body weight when administered orally to test animals weighing between 200 & 300 g each.
- a chemical that has a median lethal dose (LD_{5O}) of more than 200 mg per kg but not more than 1,000 mg per kg of body weight when administered by continuous contact for 24 hours (or less if death occurs with 24 hours) with the bare skin of test animals weighing 2 - 3 kg each
- a chemical that has a median lethal concentration (LC_{5O}) in air or more than 200 parts per million but not more than 3,000 ppm by volume of gas or vapor, or more than 2 mg per liter but not more than 200 mg per liter of mist, fume, or dust when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to test animals weighing between 200 - 300 g each.

d) **Highly toxic substance criteria:**
- chemical that has a median lethal dose (LD_{5O}) of 50 mg or less per kg of body weight when administered orally too test animals weighing between 200 and 300 g each.
- chemical that has a median lethal dose (LD_{5O}) of 200 mg or less per kg of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of test animals weighing between 2 and 3 kg each.
- chemical that has a median lethal concentration of (LD_{5O}) in air of 200 ppm by volume or less of gas or vapor, 2 mg per liter or less of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to test animals weighting 200 - 300 grams each.

The term **TOXIC ATMOSPHERE** refers to atmospheres containing gases, vapors, fumes, dusts, or mists known to have poisonous physiological effects. The toxic effects is independent of the oxygen concentration which may, in fad, be greater than 20%. Examples would be carbon monoxide and hydrogen sulfide.

Remember, some toxic atmospheres may have several harmful effects which may not show up until years after the exposure. Others may kill quickly, the difference in these exposures are known as *ACUTE* and *CHRONIC.*

Acute Exposure: refers to a large dose of a toxic material over a short period of time. This usually results in an immediate reaction. However, the reaction from some materials can be delayed as much as 72 hours.

Chronic Exposure: refers to the adverse effects on the body when a toxic material over a prolonged period of time. Chronic exposures results in delayed health effects.

Toxicity: refers to the adverse effects on the body when a toxic substance has entered into the blood stream. There are four (4) primary routes by which toxic materials can enter the blood stream. 1. Inhalation, 2. Absorption, 3. Ingestion, 4. Injection

PHYSICAL HAZARDS:

Engulfment Hazards: Engulfment is the capture of a person by a liquid or finely divided solid substance. EX: loose granular material stored in bins and hoppers, such as grain, sand, coat or similar material, can engulf and suffocate a worker. The loose material can crust and bridge over a bin and break loose under the weight of a worker. IOSHA explains as "situations where a confined space entrant is trapped or enveloped, usually by dry bulk materials. The engulfed entrant is in danger of asphyxiation, either by the filling of the respiratory systems the engulfing materials is inhaled, or through compression of the torso by the engulfing material. In some cases the engulfing materials may be so hot or corrosive that the victim sustains *fatal* chemical or thermal burns, but are never buried below a point at which they can breath."

Noise Hazards: Noise within a confined space can be amplified because of the design and acoustic properties of the space. Excessive noise can not only damage hearing, but can also effect communication, such as causing a shouted warning to go unheard. Areas containing steam lines or motors could also be considered high level noise areas. Although noise may not be the problem at the start of the job, because of the nature of the work, noise levels may become hazardous to the entrants. If verbal communications is inadequate, use alternate kinds of communication.

Temperature Extremes: Extreme COLD temperatures can cause people to become clumsy, tire easily, make more mistakes, and be at greater risk of injury. Extremely hot temperatures can present problems to workers.

Insecure footing/slick/wet surfaces: Slips and falls can occur on a wet surface causing injury or death to workers. Also, a wet surface will increase the likelihood for the effect of electrical shock in areas where electrical circuits, equipment and tools are used. Many confined spaces have oily, slippery floors which cause insecure footing. This could also be a manhole with pipes running through it, making it difficult to have a *flat* secure surface to stand on. Use footwear with non-slip soles for better footing.

Falling Objects: Workers working in confined spaces should be mindful of the possibility of falling objects, particularly in spaces which have topside openings for entry, and where work is being done above the worker. Personnel working within confined spaces should have good work habits and see to it that all tools and equipment that are used at the confined space entry site are placed a good distance away from the opening to help prevent accidental injury to confined space entrants.

Critters: Some confined spaces may contain potentially dangerous animals such as snakes and rats. Spiders although are not extremely dangerous physically, may mentally confuse personnel who may have a great fear of these types of insects. Don't rule out even the smallest critter when making a confined space entry. Be sure that while the pre-entry briefing is being performed that this fact be brought up to the entrant just in case the entrant may have a great fear for any type of critter.

Structural Collapse: Anytime rescuers enter collapsed structures to do search and rescue operations, they must be suspect of all the physical and atmospheric hazards that could be present. Secondary collapse of the structure is the most obvious hazard potential. But, if you consider all the ways that confined spaces can become contaminated, you'll see that collapsed structures have potential for contaminated atmospheres. Approach to these rescue operations should be similar to the approach used in confined space rescue.

FLAMMABLE ATMOSPHERES:

16.04 Flammable atmospheres:

a) Causes of flammable atmospheres:
   - oxygen in air

- flammable gases, vapors, or dusts in proper mixtures

b) If source of ignition introduced into flammable atmosphere = explosion

c) Oxygen-enriched atmosphere:
- above 21% 0^2
- can cause flammable materials (clothing, hair) to burn
- **Safety Note: Never use pure oxygen to ventilate a confined space, ventilate with normal air.**

d) Flammable concentrations in confined spaces:
- flammability of gases/vapors: related to the concentration of gas/vapors
- lower explosive (flammable) limit (LEL or LFL):
  --least concentration of a gas and oxygen mixture that will support a fire/explosion
  -- if lower than the explosive (flammable) limit, atmosphere is considered too lean = cannot support burning/explosion
- upper explosive (flammable) limit (UEL or UFL):
  -- point at which a gas is too concentrated in an air mixture to support a fire/explosion
  -- concentration is considered too rich.
- flammable range:
  -- specific mixture of gas and air (oxygen) needed to support burning and/or explosion
  -- concentration of a product between its LEL and UEL
  -- values usually expressed as percent by volume m air.

PSYCHOLOGICAL FIAZARDS:

Psychological hazards also account for hidden dangers. The stress to the rescuers involved in an extended confined space rescue operation can have an adverse effect on other rescue personnel and the rescue operation itself.

Claustrophobia is an abnormal fear of small places. However, like any phobia, it can be controlled. If entrants into a confined space know they are claustrophobic, they can better understand how to deal with it. Remember that while the mind may be trying to convince you that the walls are dosing in, the rational part of your mind knows better.

Critical Incident Stress is another potential hazard that could compound the problems already encountered on the scene. Team members, company officers and command officers must be vigilant of the signs and symptoms of critical incident stress, including anxiety, increased respiratory effort or hyperventilation, fear, fatigue, diaphoresis, emotionally inappropriate behavior, and agitation with anger that is atypical of the individual's normal behavior. Unusual incidents that involve a lot of emotion have a propensity for causing stress in rescuers. Extended operations have the effect of physical and mental fatigue, as well as emotional stress. Although most rescuers have the coping skills necessary for proceeding this stress, we are all human and therefore have a stress threshold. Signs and symptoms of critical incident stress need to be dealt with. To ignore them is like ignoring any other hazard; it can get you.

17.0 CONFINE SPACE ISOLATION:

Space isolation prevents hazards from entering the space while people are inside. These hazards can take many forms and are introduced in a number of ways. There are a number of hazards that can present a problem in a confined space situation. These include liquids, gases, solids, mechanical and electrical. Therefore, there needs to be different methods available to prevent these hazards from entering the space.

In most cases, the space should be isolated before your arrival. These techniques are common practice in situations where permits are in effect. In any case, the space must be isolated. Be sure of this before committing personnel into the space.

In the extremely rare situations whether it is not possible to isolate the space (such as sewer systems), take every precaution to monitor for the unexpected release of a hazard into the space. An example would be to station personnel at various points of the sewer system to monitor for a rise in liquid level or introduction of a hazardous material (such as an industrial discharge).

"Six Step" Procedure for ensuring a space is properly isolated for sale entry:

17.01 Prepare for shutdown. Determine energy type and control methods.
17.02 Shut down the equipment. Use the normal stopping procedure if possible.
17.03 Isolate the equipment. This includes ALL sources - both primary and secondary energy sources.
17.04 Apply lockout tagout and/or bleed/block devices.
17.05 Control stored energy. This includes bleeding off pressure in lines$_1$ etc.
17.06 Verify equipment isolation.

Lockout/tagout is used for all types of hazards. It prevents valves or switches from being opened; utilizes locks, chains, lockout hasps, circuit breaker lockouts, ball valve lockouts, valve covers, plug locks, and warning tags.

Bleed/block or blank/blind is used on piping that carries liquids, flowable solids and gases. It uses blind flanges, removal of sections of pipe and bleeding materials from the piping and is sometimes used in combination with lockout/tagout.

If it is not possible to lockout or bleed/block a line or device, a person should be stationed at the switches and/or valves to ensure they are not turned on. The best policy in this situation is to use fire department personnel with a dear policy/order/statement on who can order that a line or device be opened or turned on.

18.0 FALL PROTECTION:

IOSHA Standard 1910.146 for fall protection took effect February 6, 1995. Conditions under which fall protection is necessary, training, equipment and fall protection plans are all addressed by requirements found in the new standard. IOSHA now requires employers of any employee who works at a height of 6 feet or above to provide fall protection.

Statistics provided by IOSHA indicates that falls account for 21 percent of all construction fatalities. With full compliance with the new standard, IOSHA hopes to save 70 lives per year and prevent over 15,000 injuries. As of 1 January 1998 the use of the body belts for fall protection and non-locking snap-hooks will be prohibited under the new standard. Many experts are applauding the new standard, because it spells out exactly what is necessary for full compliance.

Example: The minimum static tensile strength for "D"- rings and snap hooks is set at 5,000 pounds with out cracking, breaking or taking permanent deformation. The maximum static tensile load for sell retracting life-lines and lanyards that automatically limit free fall distance to two feet or less is set at 3,000 pounds. Self retracting life-lines and lanyards which do not automatically limit free fall distance to two feet or less, ripstitch lanyards must be capable of sustaining a minimum tensile load of 5,000 pounds.

Under the new standard, the maximum arresting force on employees wearing body belts is limited to 900 pounds, and the limit for employees wearing body harnesses is 1,800 pounds. The maximum deceleration distance is limited to 3.5 feet.

The new standard requires employers to provide training for each employee who might be exposed to a fall hazard. The program should instruct employees on how to recognize the hazards of falling and train them in the procedures designed to minimize the hazard.

Every employee must be trained in the following:

18.01 Fall hazards in the work area.
18.02 The correct procedures for erecting, maintaining, disassembling and inspecting the fall protection system to be used.
18.03 The use and operation of guardrail systems, personnel fall arrest systems, safety net system, warning line systems, controlled access zones and other protection to used.
18.04 The role of each employee in the safety monitoring system.
18.05 The limitations on the use of mechanical equipment during the performance of roofing work.
18.06 The correct procedure for the handling and storage of equipment and materials and the erection of overhead protection.

Subject: HANDLING DRUMS AND OTHER CONTAINERS

1. Purpose: Accidents may occur during handling of drums and other hazardous waste containers. Hazards include detonations, fires, explosions, vapor generation, and physical injury resulting from moving heavy containers by hand and working around stacked drums, and deteriorated drums. While these hazards are always present, proper work practices such as minimizing handling and using equipment and procedures that isolate workers from hazardous substances can minimize the risks to site personnel.

2. Scope: These guidelines are designed to increase the safety of personnel who may through the course of their duties become involved in working with hazardous materials shipping and storage drums and other containers.

3. Applications: The following guidelines defines practices and procedures for safe handling of drums and other hazardous waste containers. It is intended to aid the Hazardous Materials Specialists in setting up a safe environment for all personnel concerned with the operation. Also, it is designed to address pertinent regulations regarding drums and other containers. OSHA regulations (29 CFR parts 1910 and 1926) include general requirements and standards for storing, containing, and handling chemical's, containers, and for maintaining equipment used for handling materials. EPA regulation (40 CFR Part 265) stipulates requirements for the types of containers, maintenance of containers and containment structures, and design and maintenance of storage areas. DOT regulations (49 CFR Parts 171 through 178) also stipulate requirements for containers and procedures for shipment of hazardous wastes.

I. INSPECTION

A. The appropriate procedures for handling drums depend on the drums contents.

B. Thus, prior to any handling, drums should be visually inspected to gain as much information as possible about their contents.

C. The Hazardous Materials Specialist should look for:

1) Symbols, words, or other marks on the drum indicating that its contents are hazardous, (e.g., radioactive, explosive, corrosive, toxic, flammable).

2) Symbols, words, or other marks on a drum indicating that it contains discarded laboratory chemicals, reagents, or other potentially dangerous materials in small-volume individual containers.

3) Signs of deterioration such as corrosion, rust, and leaks.

4) Signs that the drum is under pressure such as swelling and bulging.

5) Drum type (see checklist).

6) Configuration of the drumhead (see checklist).

D. Conditions in the immediate vicinity of the drums may provide information about drum contents and their associated hazards.

E. Monitoring should be conducted around the drums using instruments such as a radiation survey instrument, organic vapor monitors and a combustible gas meter.

F. The results of this survey can be used to classify the drums into preliminary hazard categories, for example:

1) Radioactive

2) Leaking/deteriorated

3) Bulging

4) Explosive/shock-sensitive

5) Contain small-volume individual containers of laboratory wastes or other dangerous materials.

G. As a precautionary measure, personnel should assume that unlabeled drums contain hazardous materials until their contents are characterized.

H. Drums are frequently mislabeled - particularly drums that are reused. Thus, a drum's label may not accurately describe its contents.

I. If buried drums are suspected, contact IDEM personnel immediately so further, more intense tests can be performed.

Il. PLANNING:

A. Since drum handling is fraught with danger, every step of the operation should be carefully planned, based on all the information available at the time.

B. The results of the preliminary inspection can be used to determine:

1) If any hazards are present and the appropriate response.

2) Which drums need to be moved in order to be opened & sampled.

C. A preliminary plan should be developed which specifies:

1) Extent of handling necessary.

2) Personnel selected for the job.

3) Most appropriate procedures based on the hazards associated with the probable drum contents as determined by visual inspection.

D. This plan should be revised as new information is obtained during drum handling.

E. It is **NOT** the responsibility of OSFM personnel to handle, move or transport any container that is suspect of containing hazardous materials. Our purpose is to assist in the evaluation and hazards that these containers can pose on-scene personnel, exposures and the environment. It is important to note that this type of situation does pose a fire/explosion hazard and this must be placed into the Site Safety Plan.

F. During the Planning Phase, caution needs to be addressed when consulting with local jurisdiction personnel in that, only an "Approved Contractor" be consulted regarding any movement of the drums or other containers. IDEM personnel should be contacted for their input and recommendations regarding regulatory matters.

G. The following section regarding "Handling" is for information only and to provide some guidance in what should be taking place when handling drums.

III. HANDLING:

A. The purpose of handling is to:

1) Respond to any obvious problems that might impair worker safety.

2) Unstack and orient drums for sampling.

3) If necessary, to organize drums into different areas on-site to facilitate characterization and remedial action.

B. Handling may or may not be necessary, depending on how the drums are positioned at a site.

C. Since accidents occur frequently during handling, particularly initial handling, drums should be only be handled if necessary.

D. Prior to handling, all personnel should be warned about the hazards of handling, and instructed to minimize handling as much as possible and to avoid unnecessary handling.

E. In all phases of handling, personnel should be alert for new information about potential hazards.

F. These hazards should be addressed/responded to before continuing with more routine handling operations.

G. Overpacked drums are placed for storage or shipment, and an adequate volume of absorbent should be kept near areas where minor spills may occur.

H. Where major spills may occur, a containment berm adequate to contain the entire volume of liquid in the drums should be constructed before any handling takes place. If the drum contents spill, personnel trained in spill response should be used to isolate and contain the spill.

I. Several types of equipment can be used to move drums:

1) A drum grappler attached to a hydraulic excavator.

2) A small front-end loader, which can be either loaded manually or equipped with a bucket sling.

3) A rough terrain forklift.

4) A roller conveyor equipped with solid rollers

5) Drum carts designed specifically for drum handling.

J. Drums are also sometimes moved manually.

K. The drum grappler is the preferred piece of equipment for drum handling.

1) It keeps the operator removed from the drum.

2) If a drum is leaking, the operator can stop the leak by rotating the drum and immediately placing it into an overpack drum.

3) In case of an explosion, grappler claws help protect the operator by partially deflecting the force of the explosion.

L. The following recommended guidelines can be used to maximize worker safety during handling and movement:

1) Train personnel in proper lifting and moving techniques to prevent back injuries.

2) Make sure the selected vehicle has a sufficiently rated load capacity to handle the anticipated loads, and make sure the vehicle can operate smoothly on the available road surface.

3) Air condition the cabs of vehicles to increase operator efficiency; protect the operator with heavy splash shields.

4) Operators should have all appropriate respiratory protection equipment when needed.

5) Have overpack drums ready before any attempt is made to move drums.

6) Before moving anything, determine the most appropriate sequence in which the various drums and other containers should be moved. Ex: small containers may have to be removed first to permit heavy equipment to enter and move the drums.

7) Exercise extreme caution in handling drums that are not intact and tightly sealed.

8) Ensure that operators have a clear view of the roadway when carrying drums. Where necessary, have ground workers available to guide the operator's motion.

IV. DRUMS CONTAINING RADIOACTIVE WASTE:

A. If the drum exhibits radiation levels above background, immediately contact a health physicist. Do not handle any drums that are determined to be radioactive.

V. DRUMS THAT MAY CONTAIN EXPLOSIVE OR SHOCK-SENSITIVE WASTE:

A. If a drum is suspected to contain explosive or shock-sensitive waste as determined by visual inspection, seek specialized assistance before any handling

B. If handling is necessary, handle these drums with extreme caution.

C. Prior to handling these drums, make sure all non-essential personnel have moved a safe distance away.

D. Use a grappler unit constructed for explosive containment for initial handling of such drums.

E. Palletize the drums prior to transport. Secure drums to pallets.

F. Use an audible siren signal system, similar to that employed in conventional blasting operations, to signal the commencement and completion of explosive waste handling activities.

G. Maintain continuous communication with the Site Safety Officer and/or the command post until drum handling operations are complete.

VI. BULGING DRUMS:

A. Pressurized drums are extremely hazardous. Wherever possible, do not move drums that may be under internal pressure, as evidenced by bulging or swelling.

B. If a pressurized drum has to be moved, whenever possible, handle the drum with a grappler unit constructed for explosive containment. Either move the bulged drum only as far as necessary to allow seating on firm ground, or carefully overpack the drum. Exercise extreme caution when working with or adjacent to potentially pressurized drums.

VII. DRUMS CONTAINING PACKAGED LABORATORY WASTES:

A. Laboratory packs (i.e. drums containing individual containers of laboratory materials normally

surrounded by cushioning absorbent material) can be an ignition source for fires at hazardous waste sites. They sometimes contain shock-sensitive materials. Such containers should be considered to hold explosive or shock-sensitive wastes until otherwise characterized. If handling is required, the following precautions are among those that should be taken.

B. Prior to handling or transported lab packs, make sure all non-essential personnel have moved a safe distance.

C. Whenever possible, use a grappler unit constructed for explosive containment for initial handling of such drums.

D. Maintain continuous communication with the Site Safety Officer and/or the command post until handling operations are complete.

E. Once a lab pack has been opened, have a chemist inspect, classify, and segregate the bottles within it, without opening them, according to the hazards of the wastes. An example of a system for classifying lab-pack wastes can be found in the attached checklist. The objective of a classification system is to ensure safe segregation of the lab packs' contents. Pack these bottles with sufficient cushioning and absorption materials to prevent excessive movement of the bottles and to absorb all free liquids, and ship them to an approved disposal facility.

F. If crystalline material is noted at the neck of any bottle, handle it as a shocksensitive waste, due to the potential presence of picric acid or other similar material, and get expert advice before attempting to handle it.

G. Palletize the repacked drums prior to transport. Secure the drums to pallets.

VIII. LEAKING, OPEN, AND DETERIORATED DRUMS:

A. If a drum containing a liquid cannot be moved without rupture, immediately transfer its contents to a sound drum using a pump designed for transferring that liquid.

B. Using a drum grappler, place immediately in overpack containers:

1) Leaking drums that contain sludge's or semi-solids.

2) Open drums that contain liquid or solid waste.

3) Deteriorated drums that can be moved without rupture.

IX. BURIED DRUMS:

A. Prior to initiating sub-surface excavation, use ground-penetrating systems to estimate the location and depth of the drums.

B. Remove soil with great caution to minimize the potential for drum rupture.

C. Have a dry chemical fire extinguisher on hand to control small fires.

X. OPENING DRUMS:

A. Drums are usually opened and sampled in-place during site investigations.

B. To enhance the efficiency and safety of drum-opening personnel, the following procedures should be instituted and overseen by the Site Safety Officer.

1) Insure that an adequate and proper air-respiratory protection system is in-place.

2) Protect personnel by keeping them at a safe distance from the drums being opened. If personnel must be located near the drums, place explosion-resistant plastic shields between them and the drums to protect them in case of detonation. Locate controls for drum-opening equipment, monitoring equipment, and fire suppression equipment behind the explosion-resistant plastic shield.

3) If possible, monitor continuously during opening. Place sensors of monitoring equipment, such as colorimetric tubes, dosimeters, radiation survey instruments, explosion meters, organic vapor analyzers, and oxygen meters, as close as possible to the source of contaminants, (i.e. at the drum opening).

4) Use the following remote-controlled devices for opening drums:

a) Pneumatically operated impact wrench to remove drum bungs.

b) Hydraulically or pneumatically operated drum piercers.

c) Backhoes equipped with bronze spikes for penetrating drum tops in large-scale operations.

5) Do **Not** use picks, chisels and firearms to open drums.

6) Hang or balance the drum-opening equipment to minimize worker exertion.

7) If the drum shows signs of swelling or bulging, perform all steps slowly.

8) Relieve excess pressure prior to opening and, if possible, from a remote location using such devices as a pneumatic impact wrench or hydraulic penetration device.

9) If pressure must be relieved manually, place a barrier such as explosion-resistant plastic sheeting between the worker and bung to deflect any gas, liquid, or solids which may be expelled as the bung is loosened.

10) Open exotic metal drums and polyethylene or polyvinyl chloride lined (PVC-lined) drums through the bung by removal or drilling. Exercise extreme caution when manipulating these containers.

11) Do **Not** open or sample individual containers within laboratory packs.

12) Reseal open bungs and drill openings as soon as possible with new bungs or plugs to avoid explosions and/or vapor generation. If an open drum cannot be resealed, place the drum in an overpack drum.

13) Plug any openings in pressurized drums with pressure-venting caps set to a 5-psi (pounds per square inch) release to allow venting of vapor pressure.

14) Decontaminate equipment after each use to avoid mixing incompatible wastes.

XI. SAMPLING:

A. Drum sampling can be one of the most hazardous activities to worker safety and health because it often involves direct contact with unidentified wastes. Prior to collecting any sample, develop a sampling plan:

1) Research background information about the waste.

2) Determine which drums should be sampled.

3) Select the appropriate sampling device(s) and container(s).

4) Develop a sampling plan which includes the number, volume, and locations of samples to be taken.

5) Develop Standard Operating Guidelines (SOG's) for opening drums, sampling, and sample packaging and transportation. Some guidance in designing proper sampling procedures can be found in the "Site Characterization SOG".

6) Have a trained health and safety professional determine, based on available information about the wastes and site conditions, the appropriate personal protection to be used during sampling, decontamination, and packaging of the sample.

B. When manually sampling from a drum, use the following techniques:

1) Keep sampling personnel at a safe distance while drums are being opened. Sample only after opening operations are complete.

2) Do not lean over other drums to reach the drum being sampled, unless absolutely necessary.

3) Cover drum tops with plastic sheeting or other suitable non-contaminated materials to avoid excessive contact with the drum tops.

4) Never stand on drums. This extremely dangerous. Use mobile steps or another platform to achieve the height necessary to safely sample from the drums.

5) Obtain samples with either glass rods, plastic pipette, or vacuum pumps. Do not use contaminated items such as discarded rags to sample. The contaminants may contaminate the sample and may not be compatible with the waste in the drum. Glass rods should be removed prior to pumping to minimize damage to pumps.

XII. CHARACTERIZATION:

A. The goal of characterization is to obtain the data necessary to determine how to safely and efficiently package and transport the wastes for treatment and/or disposal.

B. If wastes are bulked, they must be sufficiently characterized to determine which of them can be safely combined.

C. As a first step in obtaining this data, standard tests should be used to classify the wastes into general categories, including;

1. Auto-reactives
3. Pesticides
3. Water reactives
4. Cyanides
5. Inorganic acids
6. Inorganic oxidizers
7. Organic acids
8. Organic oxidizers
9. Heavy metals

D. In some cases, further analysis should be conducted to more precisely identify the waste materials.

E. When possible, materials should be characterized using an on-site laboratory. This provides data as rapidly as possible, and minimizes the time lag before appropriate action can be taken to handle any hazardous materials. It also precludes any potential problems associated with transporting samples to an offsite laboratory (e.g. sample packaging, waste incompatibility, fume generation).

F. If samples must be analyzed off site, samples should be packaged on-site in accordance with DOT regulations (49 CFR) and shipped to the laboratory for analysis.

CHECKLIST 1 - SPECIAL DRUM TYPES AND THEIR HAZARDS

DRUM TYPES	THEIR HAZARDS
Polyethylene or PVC-Lined Drums	Often contains strong acids or bases. If the lining is punctured, the substance usually quickly corrodes the steel, resulting in a significant leak or spill.
Exotic Metal Drums (e.g. aluminum, nickel stainless steel, or other unusual metal)	Very expensive drums that usually contain an extremely dangerous material.
Single-Walled Drums Used as a Pressure Vessel	These drums have fittings for both product filling and placement of an inert gas, such as nitrogen. May contain reactive, flammable, or explosive substances.
Laboratory Packs	Used for the disposal of expired chemicals and process samples from university laboratories, hospitals, and similar institutions. Individual containers within the lab pack are often not packed in absorbent material. They may contain incompatible materials, radioisotopes, shock-sensitive, highly volatile, highly corrosive, or very toxic exotic chemicals Laboratory packs can be an ignition source for fires at hazardous waste sites.

CHECKLIST 2 - INFORMATION PROVIDED BY DRUMHEAD CONFIGURATION...

CONFIGURATION	INFORMATION
Whole lid removable.	Designed to contain solid material.
Has a BUNG.	Designed to contain a liquid.
Contains a liner	May contain a highly corrosive or otherwise hazardous material.

CHECKLIST 3 - EXAMPLE OF LAB PACK CONTENT CLASSIFICATION SYSTEM FOR DISPOSAL..

CLASSIFICATION	EXAMPLES
Inorganic acids	Hydrochloric Sulfuric
Inorganic bases	Sodium hydroxide Potassium hydroxide
Strong oxidizing agents	Ammonium nitrate Barium nitrate Sodium chlorate Sodium peroxide
Strong reducing agents	Sodium thiosulfate Oxalic acid Sodium sulphite
Anhydrous organics & organometallics	Tetraethyl lead Phenylmercuric chloride
Anhydrous inorganics & metal hydrides	Potassium hydride Sodium hydride Sodium metal Potassium
Toxic organics	PCB's Insecticides
Flammable organics	Hexane Toluene Acetone
Inorganics	Sodium carbonate Potassium chloride
Inorganic cyanides	Potassium cyanide Sodium cyanide Copper cyanide
Organic cyanides	Cyanoacetamide
Toxic metals	Arsenic, cadium, lead, mercury

Subject: GENERAL SAFE WORK PRACTICES

* Walk cautiously to avoid tripping
* Never walk on drums
* Take special care when working near stacked drums
* Always test an object before attempting to lift or carry it
* If practical, drums and containers should be inspected to ensure their integrity prior to being moved
* Un-labeled containers will be assumed to contain hazardous substances until proven otherwise
* portable dock boards must be secured in position with devices which will prevent their slipping during loading and unloading
* Any attempt to open a vehicle involved in a response operation should be carried out in such a way that the person(s) making the attempt are not in the path of materials or containers which might spill out of the part of the vehicle being opened
* Any driver-operated equipment used on a site with uneven terrain must have some form of roll-over protection
* Use equipment to detect explosive or flammable atmosphere
* Use explosion-proof instruments and non-sparking tools
* In areas where flammable liquids are present, smoking and carrying lighters, matches, and other spark producing devices (including warning flares) is prohibited
* All containers involved in flammable liquids transfer shall be bonded and grounded
* If a fire starts, workers should leave the area unless they have been assigned fire-fighting responsibilities
* Allow only medically and physically fit responders to be exposed to heat or other stress
* Drink liquids to replace body water and electrolytes lost during sweating
* Rest frequently
* Allow a 10-foot clearance area between raised equipment and electric power lines
* Before entering a confined space, test atmosphere of oxygen and toxic and combustible levels of gases or vapors
* A second worker (buddy) shall be on hand at the entrance to the confined space throughout the entry time
* The buddy shall wear all PPE required for the worker inside the confined space
* The buddy shall be equipped with some means of communication to be used in summoning help if needed
* Under no condition should the buddy enter the confined space unless other back-up personnel are standing by
* Before response operations begin, dedicated ALS shall be provided for responders
* Medical supplies shall be readily available
* Proper equipment shall be available for prompt transportation of injured person(s) to medical facilities