

SECTION I. RECOGNITION

1.0 INTRODUCTION

The ability to recognize hazards (i.e., chemical, biological or physical) is the most important step in handling them safely. A hazard has the ability to cause harm due to the unpredictable actions or inherent properties of the material(s). Hazardous waste sites may be controlled or uncontrolled conditions that contain multiple hazards that threaten worker safety. Determining the chemicals of concern and the concentrations of these materials at a site is often a difficult task and workers may potentially contact these other hazards due to changing site conditions, the use of personal protective equipment and task performance. One of the major functions of this course is to point out site conditions and work tasks that may affect worker safety.

The types of hazards that are frequently found at hazardous waste sites include:

- Physical hazards
- Electrical hazards
- Mechanical hazards
- Structural hazards
- Noise
- Confined space hazards
- Biological hazards
- Chemical hazards

We will discuss each of these hazard types later in this chapter.

2.0 Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120)

2.1 Training Requirements under 29 CFR 1910.120 include the following:

- Information on chemical and physical hazards potentially present on site.
- Use of personal protective equipment and limitations of PPE.
- Work practices to minimize risks from hazards.
- Safe use of engineering controls and equipment on the site.
- Medical surveillance requirements
- Health and safety plans
- Confined space entry
- Spill containment practices

2.3.1 First Responder Awareness Level

These individuals are employees who are likely to witness or discover a hazardous substance release and trained to initiate an emergency response by notifying the proper authorities of the release.

First responders should not take any actions beyond notification.

First responders at the awareness should demonstrate the ability to:

- Understand what hazardous substances are and the risks associated with them.
- Understand the potential outcomes associated with an emergency situation.
- Recognize the presence of hazardous substances in an emergency situation.
- Identify the hazardous material, if possible.
- Understand their role in the employer's emergency response plan.
- The ability to realize the need for additional resources and notify appropriate persons.

2.3.2 First Responder Operations Level

These individuals respond to releases or potential releases of hazardous substances as part of an initial response for the protection of nearby persons, property, or the environment. These persons take defensive actions without trying to stop the release.

Their function is to contain the release from a safe distance, keep it from spreading, and prevent exposures. They must receive at least eight hours of training or have sufficient experience to demonstrate competency in the following areas:

- Items identified in 2.3.1
- Knowledge of basic hazard and risk assessment techniques.
- Understanding of basic hazardous materials terms
- Knowledge of how to perform basic control, containment and confinement operations.
- Know how to perform basic decontamination procedures.
- Understanding of relevant standard operating procedures and termination procedures.

2.3.3 Hazardous Materials Technician Level

These individuals respond to releases or potential releases to stop them. They are aggressive responders that plug, patch, or otherwise stop the release.

Employees involved in hazardous waste site characterization are required to have 40 hours of training plus 3 days of supervised field experience.

2.5 Incident Response Activities

Hazardous materials incidents vary because of the chemicals and amounts involved, types of potential or present hazards, level of response required, and resulting effects. Incident response activities may require emergency measures or long-term cleanup activities to reach "acceptable" conditions.

All activities that are performed at incident responses fall into five interactive categories:

1. Recognition: identification of materials involved and the degree of hazard present
2. Evaluation: risk or impacts to public health and the environment.
3. Information: acquiring specific data and knowledge about the conditions of the incident.
4. Control: methods to eliminate or reduce the impacts and hazards of the incident.
5. Safety: protection of incident responders from risk.

Each of these categories interact with each other during an incident response to prevent or reduce impacts to public health, property and the environment and return site conditions to "acceptable" levels.

2.5.1 Recognition

Recognition of the types and degrees of hazard present should be the first action you take at a site. The materials involved in the incident should be identified and their inherent properties that may cause harm should be used to predict and anticipate potential problems.

Recognition of hazards may be readily found on placards, bills of lading, or hazardous waste manifests. Hazard recognition at hazardous waste sites is more difficult since there may be a large variety of chemicals or other hazards at the sites. Recognition tools may include sampling results, historical data, visual observation, direct reading instrumentation, interview data, shipping papers, and labels.

Hazardous substances exhibit one or more characteristics of flammability, corrosivity, toxicity, ignitability or radioactivity. The degree of hazard associated with the material itself. The physical and chemical properties and the levels of materials present all affect the degree of hazard at a given time and place.

Identification of the hazardous materials is the first step in hazard recognition. Additional data from monitoring devices is needed to determine the concentration levels present and the locations of the materials at an incident site.

INTRODUCTION TO TOXICOLOGY

1.0 INTRODUCTION

Toxicology is the study of the adverse effects of materials on biological systems. The effects of toxic materials on the body are determined by the chemical or chemicals involved, the route(s) of exposure, the concentration of the dose, the duration of the exposure, the frequency of the exposure, and the susceptibility of the exposed individual.

2.0 Routes of Entry

Chemical substances may enter the body through inhalation, ingestion, dermal absorption or injection. The primary route of entry at hazardous waste sites or incident response sites is inhalation. Chemicals that reach the enormous surface area of the lungs can be absorbed into the bloodstream and transported to various organ systems throughout the body. Water soluble chemicals enter the lungs where they cause damage. Chemicals that enter the lung do not necessarily cause harm to the lungs. They are transported to other organs (e.g., liver, kidney, brain) where they show their toxic effects.

Dermal absorption requires direct contact with the hazardous material. The material may be a solid, gas, liquid, aerosol, mist or fume. The skin is an excellent barrier against particulates, but lipid soluble materials are readily absorbed through the skin and into the bloodstream. Damaged skin is susceptible to chemical entry.

Ingestion of hazardous chemicals should be the least effective method of exposure at a hazardous waste site or incident response site. The normal activities that generally lead to ingestion (e.g., gum chewing, tobacco use, eating/drinking, using cosmetics) are not permitted at a hazardous waste site or incident response. Personal protective equipment should eliminate the potential for accidental ingestion, however, improper usage or removed of PPE may lead to ingestion.

Injection may occur if a worker is punctured or lacerated by contaminated materials. This is usually the least effective pathway for exposure. Proper site surveillance and safety training should greatly reduce this exposure route.

3.0 Dose-Response

There is a direct relationship between dose and response. For most chemicals, a low dose does not show an appreciable hazard for exposed individuals. These threshold levels are called No Observable Adverse Effect Levels (NOAELs). If multiple chemical exposure is possible, the threshold levels can not be accurately determined.

The toxicity ratings for animal data are rough estimates and great care should be used when attempting to equate the LC₅₀ or LD₅₀ values to humans.

6.0 Carcinogen Categories

Carcinogenic compounds are those capable of producing cancer in exposed individuals. When determining the carcinogenic potential of chemicals that are present at the site, your research will tell you if a chemical is in one of five categories of carcinogenicity. The categories are:

- A1: Confirmed Human Carcinogen
- A2: Suspected Human Carcinogen
- A3: Animal Carcinogen
- A4: Not classifiable as a Human Carcinogen
- A5: Not suspected as a Human Carcinogen

7.0 Exposure Limit Guidance

The Occupational Safety and Health Administration (OSHA), National Institute for Occupational Safety and Health (NIOSH), American Conference of Governmental Industrial Hygienists (ACGIH) and American Industrial Hygiene Association have developed guidelines and standards to protect the health of workers. Exposure limits have been developed from historical data, animal studies, epidemiological studies, human experimental studies or combinations of each.

7.1 OSHA Permissible Exposure Limits (PELs)

OSHA PELs have regulatory authority, therefore, these levels must be followed by industry. PELs are values based on the maximum average concentrations to which workers may be exposed. The values are for 8-hour/day, 40-hours/week exposures.

OSHA has also established standards for short-term exposures to hazardous materials. A short-term exposure limit (STEL) is a regulatory level for peak exposure concentration during the workday. STEL values cover a 15-minute exposure time that must be followed by a 60-minute interval with no exposure.

An OSHA Ceiling Limit (C) is a chemical concentration in air that can never be exceeded during a workday.

7.2 ACGIH Threshold Limit Values (TLVs)

TLVs are recommended exposure levels for air contaminants in the workplace. These values have no regulatory authority but most industries follow the recommendations made by ACGIH. These values are derived for 8-hours/day, 40-hours/week exposures

HAZARD CATEGORIES

1.0 INTRODUCTION

Hazardous waste site workers and incident response personnel are potentially exposed to hazardous materials that exhibit biological, radiological or chemical characteristics. It is possible that more than one hazard will be present at one incident site. It is imperative that site workers or responders understand each hazard category to effectively plan safety practices that eliminates or reduces the risks to the public and the on-site personnel.

2.0 Biological Hazards

Individuals may be exposed to biological hazards that are capable of causing infection, disease and death in exposed persons. Biological agents may be viral, rickettsial/chlamydial, bacterial, fungal, or parasitic forms. Also, biological agents include allergic reactions such as from poison ivy or the stings from organisms (bees, scorpions). Finally, wild animals (e.g., snakes, dogs, etc.) may be located at incident sites.

Personal protective equipment requirements for biological agents are equivalent to those for chemical agents. Protective clothing and appropriate respiratory protective equipment should be worn when responding to an incident where biological agents are present. Decontamination procedures should be followed. Showering after removing protective clothing and thoroughly washing all exposed areas should be done.

3.0 Radiation Hazards

Radiation hazards do not provide any warning signs that alert personnel of exposure. Radiation is classified into two main categories, ionizing and nonionizing radiation. Ionizing radiation hazards include alpha and beta particles and gamma rays and x-rays.

Alpha particles are positively charged, high-energy radiation. Their energy is quickly released as the particles pass through air. These particles travel very short distances, up to 10 cm, and can be stopped by a piece of paper or a layer of dead skin cells. Alpha particles are not generally hazardous unless they enter the body through inhalation or ingestion. The materials can cause localized cellular damage and can be stored in bone, kidney or liver tissues.

Beta particles are small, negatively charged particles that can travel up to 18m (usually 1-9m) in air and penetrate clothing or skin tissue. Tissue damage can occur from beta particle exposure. Beta particles are hazardous by ingestion, inhalation and dermal

concentration less than the LFL does not promote flammability. The highest ratio that is flammable is the Upper Flammable Limit (UFL). A concentration greater than the UFL is not flammable because there is too much fuel displacing the oxygen (ex. benzene: LFL= 1.3% and UFL is 7.1%)

The National Fire Protection Association (NFPA) has divided flammable liquids into three classes for definition purposes. These liquid classes are for liquids with flashpoints equal to or less than 200°F. A flashpoint is defined as the temperature to which a liquid or solid must be raised to emit sufficient vapors to form an ignitable mixture with air.

- A. Class 1A: $F_p < 73$ and $bp < 100$ (n-pentane)
- B. Class 1B: $F_p \geq 73$ and $bp \geq 100$ (gasoline)
- C. Class 1C: $F_p \geq 73$ and $bp < 100$ (turpentine)
- D. Class II: $F_p \geq 100 < 140$ (kerosene)
- E. Class III: $F_p \geq 140 < 200$ (creosote)

The Department of Transportation (DOT) defines a material as being flammable if it has a $F_p < 100^\circ\text{F}$. The DOT defines a material as being combustible if it has a $F_p > 100^\circ\text{F} < 200^\circ\text{F}$.

The Environmental Protection Agency defines a liquid as ignitable if it has a $F_p < 140^\circ\text{F}$.

4.2 Explosive Hazards

A gas or vapor explosion is a rapid and violent release of energy, which releases large amounts of kinetic energy, heat, gases and debris. All of these materials can adversely affect health and property. Confinement increases the energy, thereby increasing the hazard.

A High or Low explosive description does not indicate the hazard associate with the material but the rate of reaction.

4.3 Reactivity Hazards

A reactive hazard describes a substance that undergoes an abnormal, usually violent reaction with water or ambient air. The reaction may produce an increase in pressure, heat or chemical vapors. Some reactive materials produce hydrogen gas during a reaction. This gas can be ignited by the heat of the reaction. For this reason, many reactive substances are also flammable substances.

A chemical reaction occurs during the interaction of two or more substances in which chemical change occurs. Exothermic reactions give off heat and can present the most hazards to workers.

Toxic hazards can be grouped by the physiological effects that are shown by the exposed individual; however, one substance may have more than one effect.

4.6.1 Asphyxiants

This hazard group is comprised of substances that deprive tissues of oxygen (anoxia). The group can be divided into two subgroups, simple and chemical. Simple asphyxiants dilute or displace ambient oxygen. The resulting air has a lower concentration of oxygen present, which, in turn, reduces sufficient oxygen delivery to blood and tissues. Resulting effects include headache, unconsciousness and finally death.

Chemical asphyxiants either by preventing the uptake of oxygen in the blood (e.g., CO binding to hemoglobin), or by not allowing normal oxygen transfer from the blood to tissues or within the cell itself (e.g., HCN).

4.6.2 Systemic Poison Hazard

A chemical substance that acts as specific target organs or organ systems is termed a systemic poison. Systemic poison may be solids, liquids, or gases.

4.6.3 Irritant Hazards

Irritant substances cause inflammation of membranes by corrosive or drying actions. Mucous membranes and skin tissues are common targets or irritants. The irritant must come into direct contact with the membranes to cause the adverse effect.

Irritant substances may be liquids, solids or gases.

4.6.4 Sensitizer Hazards

Sensitization to a chemical material involves changes in immune system mechanisms. The first exposure to a sensitizing agent creates the opportunity for antibody formation. Subsequent exposures cause an increased production of antibodies until a threshold is reached. After this level of antibody production is reached, an allergic reaction occurs.

Sensitizing agents exhibit the same symptomology as irritants; however, the reactions can be more life threatening than irritants.

4.6.5 Mutagenic, Teratogenic and Carcinogenic Hazards

Mutagenic substances cause genetic alterations by damaging genes or chromosomes. These substances do not affect exposed individuals, but offspring will exhibit the effects of the mutagenic substances.

PROPERTIES OF HAZARDOUS MATERIALS

1.0 Introduction

The evaluation of risks at a hazardous waste site or an incident response site depends on understanding the inherent properties of the hazardous materials facing responders. The physical form and the physiochemical properties of the material determine environmental movement, behavior characteristics and hazards at the site.

2.0 Physical State

A chemical may exist as a solid, liquid, gas, vapor, or aerosol phase. Most hazardous materials can exist in more than one form. Temperature, pressure, and concentration all affect the physical form of the material.

2.1 The ability of a solid, liquid, gas, or vapor to dissolve in a solvent is solubility. The solubility of a substance is independent of its density or specific gravity. Solubility is important in determining dispersion, reactivity, and treatment.

2.2 The density of a material is its mass per unit volume (g/cc). The density of water is 1 g/cc. Specific gravity is the ratio of the density or weight of a substance to a reference material (usually water) at a given temperature. Specific gravity is equivalent to density in g/cc, but is usually expressed as a value without units. A substance with a specific gravity greater than 1 will sink in water. If the specific gravity is less than 1, it will float on water.

2.3 Vapor density is the weight of a vapor or gas relative to an equal volume of air at an equivalent temperature and pressure. The vapor density of air is 1, therefore, a gas or vapor with a vapor density greater than air will settle in low points. A material with a vapor density less than or equal to 1 will disperse.

If a material settles in low points, it may cause additional hazards to workers or responders. Settling will increase the potential for oxygen displacement, increased inhalation exposure, or explosive hazards at ground level.

2.4 Evaporation Rate

The evaporation rate is the rate at which a solid or liquid evaporates into the air compared to a reference compounds. Butyl acetate is the reference material used because it has been assigned an evaporation rate of 1.0.

2.5 Boiling Point

A boiling point (Bp) is the temperature at which a liquid changes to vapor at a given

PHYSICAL HAZARDS

1.0 Introduction

Physical hazards are of great concern to hazardous waste site workers and incident responders because they encounter conditions that are beyond their control. Site conditions and terrain and the wearing of PPE increase the potential for accidents to site personnel. PPE increases accident potential by: reducing movement, visibility, and communication abilities; increasing heat stress, and; reducing reaction times from physical/mental stress.

2.0 Accident Hazards

An accident is an unplanned event that results in injury or damage to property. An accident occurs as a result of an unsafe act or unsafe conditions. All site workers or incident responders should examine the site conditions to recognize and eliminate, if possible, unsafe conditions. It is the responsibility of each person to work safely. Safety awareness training must be a significant part of task performance information.

3.0 Mechanical Hazard

Mechanical hazards are present when machinery is in operation at a site. Machines are made of moving parts that can cut, catch, or crush humans. Workers can be struck by moving vehicles (truck, tractor, bulldozer, backhoe) during response activities. In addition, mechanical hazards also include "slip-trip-fall" type injuries.

4.0 Structural Hazards

Structural hazards exist at sites where there are unstable buildings, equipment, and smoke stacks. Open man-ways or man-ways with corroded or missing covers present hazards to workers.

The walls and faces of trenching and excavation operations over five feet deep must be shored or sloped to prevent injury due to collapse. Those areas less than five feet deep also require protection, particularly if the soil has been disturbed. All tools, equipment, and excavated soil must be kept two feet or more away from the trench edge to prevent injury.

5.0 Materials Handling

The manual handling of materials provides an opportunity for potential injury to workers. In general, injuries occur due to improper lifting techniques, incorrect gripping, carrying too heavy a load, and failure to wear or improper use of personal protective equipment.

7.0 Electrical Hazards

Electrical hazards are usually present at hazardous waste sites and incident sites. Hazards from overhead and buried power lines and electrical equipment are possible during site responses. Injuries from shock or electrocution are potential hazards facing workers. Lightning is also a potential hazard to site workers that should be considered.

Protection of workers can be provided to workers by using grounded equipment, insulated tools, and circuit breakers.

8.0 Noise Hazards

Noise is defined as unwanted sound. Workplace noise interferes with communication and may cause an injury to occur. Noise can cause damage to the ear resulting in long-term or permanent hearing loss.

There are three types of noise exposure that can be found at hazardous waste sites or incident responses: 1) continuous; 2) intermittent, and; 3) impact.

Excessive noise can lead to an increased heart rate and blood pressure and stress to body organs and muscles.

OSHA and ACGIH have established Threshold Limit Values and Permissible Exposure Levels for occupational noise exposure. A continuous or intermittent noise exposure limit of 85 decibels (dBA) on the A weighted scale for an 8-hour workday has been established. If this dBA level is met or exceeded, employers must establish a hearing conservation program (29 CFR 1910.95). Impact noise measurements should also be included in all noise measurements.

No individual should be exposed to a sound level above 140 dBA without ear protection.

Since individuals are generally exposed to various sound levels during the workday, the combined exposure level can be calculated using the following:

$$\text{Total Exposure} = \frac{C_1}{T_1} + \frac{C_2}{T_2} \dots + \frac{C_x}{T_x}$$

If the Total Exposure equals or is greater than 1.0, the allowable daily noise level has been exceeded.

HAZARD CLASSIFICATION SYSTEM

1.0 Introduction

Hazardous materials are often stored, transported, and used in large quantities. Any release of these materials poses a hazard to public health and the environment. The immediate need for information about the materials is imperative for rapid and safe response actions. The U.S. Department of Transportation (49 CFR) outlines a placard and labeling system that is to be used on containers and vehicles during transport of hazardous materials.

2.0 Identification

Placard size, markings and placement areas are provided in 49 CFR. Placards are 10 3/4 inch square diamonds that are placed on each side and end of vehicles (e.g., railcar, motor vehicle, freight container or portable tank) used for the transport of hazardous materials. Most placards are not needed for the highway transportation of less than 1000 pounds of a material.

Labels are 4-inch square diamonds that are placed on shipping containers (e.g., drums). All DOT hazardous materials must carry the appropriate label or labels.

Identification numbers used on the placards are listed in the North American Emergency Response Guidebook. The guidebook provides identification information, initial response data, and evacuation criteria. The US DOT gives 9 classes of hazards that can be used on individual placards. These nine classes include:

Class 1: Explosives (orange background, bursting ball symbol)

- 1.1 Mass detonating
- 1.2 Mass detonating with fragments
- 1.3 Fire hazard, minor blast
- 1.4 No significant blast hazard
- 1.5 Very insensitive explosives
- 1.6 Extremely insensitive explosive

Class 2: Compressed Gases (green or red background, cylinder symbol)

- 2.1 Flammable gases
- 2.2 Nonflammable gases
- 2.3 Poisonous gases (white background, skull and crossbones symbol)

The NFPA 704 system does not identify the substances being stored or used at the facility.

4.0 Product Labels

The labels found on containers and packaging should provide product name, active ingredients, physical and chemical hazards, degree of hazard, and exposure/treatment information.

5.0 MSDS

MSDS are provided by product manufacturers to alert workers about the use, storage, transportation, health effects after exposure, treatment alternatives, hazards and product information.

6.0 Chemical Transportation Emergency Center (CHEMTREC)

CHEMTREC was established by the Chemical Manufacturer's Association to assist in providing information and assistance during transportation release incidents. CHEMTREC is available 24 hours a day for assistance (800-424-9300).

SECTION II. EVALUATION

1.0 Introduction

Site or incident characterization is key in protecting worker health, public health and the environment. Evaluating a hazardous site requires an initial characterization and a comprehensive, long-term characterization. Initial characterization uses information that is readily available to determine the hazardous substances involved and potential effects on health and the environment. Comprehensive characterization requires the use of direct-read instrumentation and laboratory sampling results.

2.0 Preliminary Assessment

Data collection is important in establishing a baseline to work from. Information that is needed includes: pathways of dispersion, location, description of materials, populations at risk, type of zoning, sensitive areas, waterways, topographic information and aerial photographs.

This information can be obtained from state, local and federal environmental agencies, company records, bills of lading, hazardous waste manifests, placards, labels and interviews.

Off-site investigations are important information sources if hazards are unknown or if immediate response is not needed. Off-site sampling of air, soil, and water provides information on migration pathways and populations at risk.

On-site preliminary inspection activities will provide information on site hazards and safety risks. However, prior to site entry, a plan should be formed that describes the work to be performed and appropriate worker safety and health precautions to be taken. Initial on-site activities may include air monitoring, soil and water sampling, storage area identification, physical condition of the hazardous substances, leaking containers, dead vegetation or other migration areas, and any identifying labels, placards or markings.

3.0 Comprehensive Characterization

A comprehensive investigation provides an opportunity to refine the data gathered in the initial investigation. A better characterization of the hazards and environmental changes can be accomplished during a comprehensive study.

AIR MONITORING

1.0 Introduction

Monitoring for air contaminants at hazardous waste sites or incident response sites is an essential element of protecting the health of site workers, the public and the environment. Hazardous atmospheres can be explosive, toxic, oxygen-deficient, or radioactive. Primary monitoring results will determine the level of PPE that will be worn at the site. A long-term air monitoring program must be used to ensure proper PPE selection, to evaluate the effectiveness of site controls and work practices, to eliminate worker questions about overexposure and to document adherence to occupational and environmental regulations.

HAZWOPER requires air monitoring when there is a possibility of employee exposure to hazardous materials. Initial monitoring should identify any Immediately Dangerous to Life and Health (IDLH) values, Permissible Exposure Level (PEL) overexposure, exposure to radioactive materials or flammable or oxygen-deficient atmosphere.

2.0 Instrument Response

Instruments are designed to respond to a particular type of hazard at specific concentrations (i.e., detection range). A lower detection limit is the lowest concentration that an instrument will respond to accurately. The upper detection limit is the concentration that saturates an instrument's sensor and receives the highest reading the instrument can give.

An instrument's response time is the interval between sample acquisition and a 90% final reading. For direct reading instruments, this time period can range from seconds to minutes. Lag time is the interval between sample introduction and the first instrument response. Recovery time is the interval an instrument requires to return to zero after removing it from the test area.

An instrument should provide precise and accurate readings. Precision is a measure of the reproducibility and reliability of an instrument's response to a known concentration. Accuracy is a measure of how close the instrument reads to the actual concentration present. Accuracy is usually given as a predetermined range by the instrument's manufacturer (e.g., colorimetric tubes are $\pm 25-35\%$ accurate).

Instruments used at hazardous waste sites should be intrinsically safe. This means that the instrument has been tested and given an NFPA rating using the National Electric Code and certified as safe by Underwriters Laboratory, Inc. (UL) or the Factory Mutual Research Corporation (FM). The instrument will be permanently marked with the testing

Wheatstone Bridge and the charge is noted as a meter reading. All CGI readings are relative to the calibration gas (methane, pentane or hexane). Manufacturers provide response curves that indicate meter response to individual gases or vapors throughout the LEL range. The curves can be used to determine actual % LEL concentrations from measured % LEL values.

4.2 Electrochemical Sensors

Sensor equipment use electrolytic solutions to detect a specific gas. An electric current moves from one electrode, through the solution, and into a second electrode. The charge measured across the solution is the observed meter reading.

4.3 Colorimetric Detector Tubes

Detector tubes are sealed glass tubes that contain a treated inert material that changes color when it contacts specific air contaminants. The length of color change in the tube or the intensity of the color is related to the air contaminant concentration.

Sample air is drawn through the tube using a bellows, bulb or piston pump. Each pump stroke pulls 100 cc of air through the tube and a specific number of strokes is needed for specific contaminants. Most detector tubes contain a filter layer in the front of the tube to remove water vapor or other gases, which might interfere with obtaining an accurate reading. The color change should be compared to the standards provided by the manufacturer. Do not use a different manufacturer's standard for a tube made by a second manufacturer. The accuracy of detector tubes may be $\pm 25-35\%$.

4.4 Dosimeter Badges

Dosimeters are used to detect and measure specific chemical contaminants over a specific period of time, usually an 8-hour workday. Passive dosimeters do not use pumps to collect a sample; they rely on diffusion to collect the sample. Badges do not give real-time readings, they must be sent to a laboratory for analysis.

4.5 Photoionization Detectors (PID)

PIDs are used to measure the presence of organic vapors and gases. Air samples are drawn into the PID using a small internal pump and the samples are bombarded with high-energy ultraviolet light. The ions released during the bombardment result in an instrument response.

The ionization potential (IP) of chemicals varies; the lower the IP, the lower the amount of energy required for ionization.

SECTION III. CONTROL

SITE SAFETY PLANNING

1.0 Introduction

The purpose of a site safety plan is to establish the requirements for protecting the health and safety of site workers. The site safety plan should be reviewed by qualified personnel and then posted and reviewed by all response personnel. The plan must contain guidance for routine activities and for unexpected site emergencies (Contingency Plan).

2.0 General Requirements

A site specific Health and Safety Plan (HASP) must be developed for each individual site where workers are potentially exposed to hazardous materials. Any subcontractors will prepare a HASP for his planned activities and provide it to the site manager, who will then incorporate it into the general site HASP. There can only be one HASP for each site and all workers must be trained in the plan's content. The development of the HASP should be a continuous process as site data is gathered.

The key components of a HASP are:

- 1) Key personnel responsible for site safety;
- 2) Health and Safety Risk Analysis for each task;
- 3) Site control measures, including work zones;
- 4) Training requirements for each work task;
- 5) Medical surveillance program description;
- 6) Personal protective equipment available for use;
- 7) Environmental monitoring program;
- 8) Spill containment program;
- 9) Confined space program;
- 10) Decontamination procedures;
- 11) Emergency Response/Contingency Plan
- 12) Emergency Medical Assistance

3.0 General Safety Practices

There are a number of general safety practices that should always be part of a HASP. These include:

- 1) No eating, drinking, chewing gum or tobacco, smoking or any practice that increases hand-to-mouth transfer and ingestion of hazardous materials in designated work areas.

SITE CONTROL PROGRAM

1.0 Introduction

Site control and the establishment of control zones is important in HASPs because it controls worker activities and equipment movement on-site. Control zones assist in reducing worker exposure potential and minimizing the spread of contaminants.

A site control program should be developed during the initial planning of site response. It is a dynamic program that should be modified as new information becomes available.

A site map that includes the geographic layout and site hazards should be developed. The map should include site drainage, topographic features, man-made structures, underground utilities, fences and overhead hazards.

2.0 Work Zones

Work zone establishment is used to describe the types of activities that can be performed in each zone, the degree of hazard present, and specific areas that should be avoided by unauthorized or unprotected site workers.

The three most widely used work zones are:

- 1) Zone 1: Exclusion zone
- 2) Zone 2: Contamination Reduction Zone
- 3) Zone 3: Support Zone

The size and shape of each zone is based on the hazards and conditions specific to each site. Each zone should be large enough to allow adequate space for work operations, to prevent the spread of contamination and to eliminate the possibility of injury due to fire or explosion.

2.1 Exclusion Zone

The Exclusion Zone is the innermost area and is where the contamination is or is suspected to be located. All persons entering this zone must wear all appropriate personal protective equipment for the types and degrees of hazard present. There may be varying levels of PPE being used in this zone if the area is subdivided or if workers are performing different activities. Entry and exit check points should be established to control personnel and equipment flow into and out of the area.

During non-working hours, private security guards should be used to keep the site secure. In addition, public agencies (e.g., police and fire) should be made aware of the potential hazards associated with the site. If possible, periodic surveillance by police should be requested.

All visitors should sign in and out and state their purpose for wanting site entry. All visitors should be approved by a site authority before entry is granted. The daily log kept by the project/site manager should record the entry and exit of workers and visitors. Visitors should receive training on where they can and cannot go, the hazards that are present, and be provided personal safety equipment (hard hats, safety glasses) before entry.

4.0 Site Communications

A system of communication should be established on-site before site entry. Internal communication describes a system used between on-site workers. External communication refers to a system used between site workers and off-site personnel.

Internal systems should be used to alert site workers to emergencies, advise workers about site changes or work reassignments, provide new safety information and maintaining site control. Commonly used devices include two-way radios, air horns, megaphones, sirens, bells, and visual signals (hand signals, flags).

Any electronic equipment that is used inside the Exclusion Zone or Contamination Reduction Zone should be certified as intrinsically safe.

It is important that all site personnel know and understand the communication system being used at the site.

External communication systems are used to make routine reports to management and clients or to call for emergency medical assistance. Telephones or radios are most often used in this system. All site workers and security guards should know where the nearest telephone or radio is located.

5.0 The Buddy System

The buddy system is used to organize workers so that one worker is under observation of at least one other worker at all times during the performance of daily work tasks. A safety backup is a team of at least two individuals who stand by to assist another team in an emergency situation.

The buddy system provides an opportunity for partners to observe each other for signs of exposure, fatigue or heat stress. In addition, partners should check on PPE integrity during the performance of work activities.

PERSONAL PROTECTIVE EQUIPMENT

1.0 Introduction

Hazardous site workers or incident responders must be protected from injury as they perform activities at a site. Personal protective equipment (PPE) should be selected to protect individuals from exposure to biological, chemical and physical hazards.

PPE includes respiratory protection, protective clothing and hearing protection. Selection criteria should consider hazard types and concentrations, site conditions, activities to be performed, routes of potential exposure and the limitations of each type of equipment.

A comprehensive PPE Plan should be included in the Health and Safety Plan that was designed for each specific site. The OSHA regulations describe the components of a PPE Program in 29 CFR 1910.120 (g)(5). The basic components include:

- 1) Selection criteria due to site hazards;
- 2) Description of PPE use and associated limitations;
- 3) Duration of work allowed for specific PPE combinations;
- 4) Procedures for regular inspection, cleaning, maintenance and storage of PPE;
- 5) Decontamination procedures and disposal methods for contaminated PPE;
- 6) Training on proper fitting, use and limitations of PPE;
- 7) Guidance on wearing and removing PPE;
- 8) Evaluation of program effectiveness, and;
- 9) Limitations of PPE due to external or medical conditions.

2.0 Chemical Protective Clothing

The selection process for choosing protective clothing consists of the following:

- 1) Type of environment the workers will be in;
- 2) The physical, chemical and toxicological properties of the chemicals of concern;
- 3) The dermal hazards associated with the chemicals;
- 4) The clothing with the least permeation and degradation for the longest period of time, and;
- 5) Encapsulating suit or non-encapsulating suit.

Fully encapsulating suits are one-piece suits that completely cover the worker. This type of suit, if made from appropriate materials, totally encloses the user and offers the highest form of protection.

- 4) Physical state: Gases, vapors and low-viscosity liquids have a potential of higher permeation rates than does high-viscosity liquids or solids.

The major function of chemical protective clothing is the protection of site workers or incident responders. There are three major points that a protective clothing wearer must remember:

- 1) There is no protective material that is impermeable;
- 2) There is no material that affords protection against all chemicals, and;
- 3) For certain hazardous substances or mixtures, there is no material that provides more than one hour protection.

3.0 Personal Protective Equipment Inspection Plan

The development of a checklist for chemical protective clothing can assist workers in determining the readiness of the equipment (See page 57 of OERR publication).

4.0 Other PPE for Site Workers

Head protection should always be worn during site activities to prevent injury from falling debris or operational equipment. Headgear must meet OSHA requirements (29 CFR 1910.135).

Face shields should be long enough to cover the entire face. Face shields provide protection against flying debris, dusts, splashes and light, however, shielding in a secondary protection barrier. Safety glasses should be worn as primary protection. Face shielding does not provide protection from gases or vapors.

Hand protection is important in minimizing potential absorption of chemicals during work activities. Glove materials are made from the same materials as chemical protective clothing. Chemical protective gloves are often worn over latex or vinyl gloves and covered by a leather, cotton, or wool glove. The outer glove offers protection from heat, cold or sharp objects. The outer gloves offer no chemical protection. If there is a high probability that chemical contamination will contact outer gloves, a second chemical resistant glove can be worn.

Workers should use safety footwear that has a steel toe, steel shank and slip-resistant sole. Leather work boots offer no chemical resistance and cannot be decontaminated. An over boot made with chemical resistant material should be worn if leather safety shoes are worn.

Hearing protection should be worn to protect site workers from noise. There are two basic types of hearing protection; those that are inserted into the ear and those worn over the ear.

RESPIRATORY PROTECTION

1.0 Introduction

Respirator usage for hazardous waste site workers or incident responders is defined and regulated by OSHA (29 CFR 1910.134). A written respirator program must be developed to satisfy the requirements. The program should describe the use, selection, cleaning, inspection, and fit testing of respirators. In addition, the medical surveillance program that is to be used should be explained.

Respirators that filter gases, vapors, and particulates from normal breathing air are called air-purifying respirators. Respirators that provide clean breathing air to the user are called air-supplying respirators.

2.0 Respiratory Protection

Inhalation is the major route of exposure to toxic chemicals faced by site workers. As we have learned, there are some chemicals that displace oxygen, particularly in confined spaces. Humans require oxygen to live. Normal ambient air contains 20.9% oxygen. OSHA has stipulated that any atmosphere with an oxygen concentration less than 19.5% is unacceptable.

Air purifying respirators cannot be used in oxygen deficient atmospheres.

Prior to using a respirator, the following must be done:

- 1) Employer must have a written respiratory program;
- 2) Employee must have medical approval to wear a negative-pressure air-purifying respirator;
- 3) Employee must have a current fit-test to wear a negative-pressure air-purifying respirator;
- 4) Employer must provide NIOSH/MSHA approved equipment.

2.1 Air-Purifying Respirators (APRs)

Air purifying respirators remove contaminants by passing breathing air through a filter or purifying agent. Particulates are filtered out using a high efficiency particulate air (HEPA) filter. Gases and vapors are collected using chemical sorbent treated filters.

APRs can operate using positive pressure or negative pressure. Powered air-purifying respirators (PAPRs) are positive pressure respirators because they maintain a continuous flow of air into the facepiece. Negative pressure APRs are commonly found at work sites. When the wearer breathes in, a negative pressure seal is formed between the face and the facepiece of the respirator.

The components of an open-circuit pressure-demand system are compressed air cylinders, high pressure hose, alarm, regulator assembly, breathing hose and facepiece, and a backpack with a harness.

3.0 Limitations of Respirators

The protection provided by respirators to users is a function of how well the facepiece fits. Not all respirators fit everyone; therefore a series of respirators should be made available for testing. There are three basic configurations for facepieces: (1) quarter mask, which fits over the bridge of the nose, along the cheek and across the top of the chin; (2) half mask which fits over the bridge of the nose, along the cheek and under the chin, and; (3) full-face which fits across the forehead, down over the temples and cheeks and under the chin.

Fit tests are used to determine if a facepiece provides a proper seal to the wearer's face. Use of an APR is prohibited if a good seal is not attained. Beards, sideburns, mustaches, long hair, skullcaps, and eyeglass earpieces all prevent a good seal. In addition, contact lenses cannot be worn with respirators.

There are two types of respirator fit tests: qualitative and quantitative. Quantitative fit tests are complex, time-consuming, and expensive tests. It is an analytical measurement of the concentration of a contaminant outside the mask and inside the mask. The ratio of the two values is called a protection Factor (PF). For example, if the outside concentration of a contaminant is 1000 ppm and the inside concentration is 10 ppm, a PF value of 100 is given to the respirator.

$$PF = \frac{1000 \text{ ppm}}{10 \text{ ppm}} = 100$$

Qualitative fit testing is a subjective, non-analytical method of determining the fit of a facepiece to a user. These tests are performed using banana oil, saccharin or irritant smoke to test the face to facepiece seal. The user must inform the person giving the test if he/she tastes or smells the test substance. If the user does not report any affects, the respirator passes the test and a standardized PF is given. NIOSH PF values do not supercede substance-specific OSHA PF-values.

The PF value is used to determine Maximum Use Concentrations (MUC) of a successfully fit-tested respirator. The MUC is the highest concentration, not exceeding the IDLH concentration, in which the respirator can be worn without exceeding the protection-factor.

$$MUC = PF \times TWA \text{ (PEL)}$$

PF for full face APR = 50 and TWA = 10 ppm then MUC = 50 x 10 ppm = 500 ppm.

LEVELS OF PROTECTION

1.0 Introduction

Personnel must don PPE when work activities involve known or suspected atmospheric contamination, when gases, vapors or particulates will be generated during site work, or when direct contact with contaminants may occur. The US EPA has defined four levels of protection for PPE ensembles.

The selected level of protection should be based on the type and measured concentration(s) of the chemical substance(s) in the air and their associated toxicity and the potential for inhalation or direct contact with the materials.

2.0 Level A Protection

Level A protection should be used when the highest level of protection is needed for the eyes, skin, and respiratory tract. Level A consists of a one piece, gas-tight, vapor-tight, fully encapsulating chemical protective suit and a full facepiece, positive pressure supplied air respirator (SCBA or airline). If the site worker will handle contaminated materials, inner chemical resistant gloves are recommended. Other recommended equipment includes chemical resistant shoes, two-way communication, cooling unit, hardhat and long cotton underwear.

3.0 Level B Protection

Level B responses require the same respiratory protection as Level A, but not the same skin protection. Level B equipment includes full facepiece, positive pressure supplied air respirator, chemical resistant clothing (one piece or two piece), inner and outer chemical resistant gloves, hardhat, protective footwear (chemical resistant), two-way communications.

4.0 Level C Protection

Level C is differentiated from Level B in the protection provided for respirator exposure. Level C allows for the use of air purifying respirators using appropriate cartridges or canisters. The EPA does not accept cartridge use or half face respirator for its own personnel, but other agencies or companies may use these types of respirators or absorbent elements. Level C equipment includes chemical protective clothing, inner and outer protective gloves, hardhat, escape mask, and chemical safety footwear.

Periodic air surveillance should be performed to determine any changes in atmospheric conditions are occurring due to work activities. If substantial increases or unknown concentrations of airborne contamination occur, the level of protection should be upgraded to Level B at a minimum.

MEDICAL SURVEILLANCE

I. Introduction

1.0 Medical Surveillance

Medical surveillance is required for HAZWOPER employees: (1) who are exposed or may be exposed to chemical, biological, or radiological hazards above the PEL or other published exposure levels for 30 days or more per year, (2) who wear a respirator for 30 days or more per year; (3) who are injured, ill, or develop symptoms due to possible over exposure, and; (4) who are members of a HAZMAT team.

2.0 Program Requirements

The goal of a medical surveillance program is to detect pre-existing disease or medical conditions that could worsen if exposure occurred during site activities, to minimize worker exposure and to assign work tasks. Site workers must have an exam prior to beginning work (baseline health assessment) and annually thereafter unless the physician believes it should be done at another interval. The baseline exam should establish a medical history, include a full physical examination, and define the ability of the individual to wear protective equipment while performing work tasks.

If an employee is reassigned, terminated, or resigns, a final comprehensive physical exam should be given. Medical records for site workers should be maintained for 30 years after their employment ends.

The records to be kept include name, social security number, examination and test results, physicians written opinions for fitness for duty, recommended occupational limitations, employee complaints related to exposure and illness or injury records. The records are confidential.

3.0 Information to be Provided by Physicians

Since the information required from physicians is specific, in terms of occupational activities, examinations are usually performed by occupational physicians who are aware of the regulatory requirements. However, it is the responsibility of employers to provide the following information to physicians:

- 1) Copy of 29 CFR 1910.120;
- 2) Description of employee's duties;
- 3) Employee's measured or expected exposure levels;
- 4) Description of PPE to be used by employee, and;
- 5) Any information from previous exams.

DECONTAMINATION

1.0 INTRODUCTION

During normal hazardous waste site work, personal protective clothing and equipment will likely contact contaminated soil, water, mud, and air. In addition, large equipment and vehicles may become contaminated when driven on site. All contaminated materials must be properly decontaminated or containerized before the next use or disposal.

Decontamination consists of physically removing contaminants or chemically changing them to harmless forms. The most important factor affecting decontamination is the type of contaminants at the site.

Combining decontamination procedures and the use of work zones minimizes the possibility of cross-contamination from PPE to the wearer, from equipment to the user, and from one area to another.

2.0 DECONTAMINATION PLAN

A decontamination plan should be developed as part of the HASP. The plan should apply to any worker or equipment that may be exposed to hazardous materials. The plan should be concise, specific and address the following points:

- (1) The location of the decontamination area(s) (CRZ);
- (2) The number of decontamination areas needed;
- (3) The design of each area;
- (4) The equipment needed for each area;
- (5) The procedures to be used at each area;
- (6) Procedures to prevent contamination of clean areas and monitoring procedures to ensure effectiveness of procedures;
- (7) Procedures for the disposal of contaminated clothing, equipment and liquids;
- (8) Procedures for returning decontaminated equipment back into use;
- (9) On-site training program and practice sessions for site personnel;
- (10) Procedures for amending the plan as site conditions change;
- (11) Procedures for ensuring worker compliance with the plan.

The materials used in decontamination procedures must be compatible with the contaminants and the clothing or equipment being decontaminated. A check with protective clothing manufacturers should be made to determine the best types of cleaning agents to be used.

4.0 PROTECTION OF DECONTAMINATION PERSONNEL

Workers performing decontamination procedures must wear a level of protection that protects them from exposure. Past procedures have shown that decon workers should wear the same level of protection as those workers being decontaminated. This may not be required at all times. Lower levels of protection can be used by persons if the contamination on workers leaving the exclusion zone are lower than expected or if the decon person is far down in the decon sequence.

5.0 DECONTAMINATION STATIONS

Decontamination procedures should be performed within the Contamination Reduction Zone in an area called the "Contamination Reduction Corridor". The size of the corridor is based on the number of decon stations needed to complete the process.

Each station represents one step in the decon process. At small work sites, several steps may be combined into one station. There should be three to six feet between stations to prevent cross-contamination. Decon procedures should follow a logical sequence and least contaminated workers (less visual material) should go through the decon line first. Workers should approach from the downwind side. When temperature extremes are present, a cooling or warming station may be necessary.

There is no one design that fits all conditions. Decon planning should be site-specific so the site contaminants and conditions are considered in design development. All workers should practice decon procedures to understand the time requirements for each stage.

CONFINED SPACE ENTRY

1.0 INTRODUCTION

OSHA published its "Permit-Required Confined Space Rule" (29CFR 1910.146) in 1993. OSHA has made a distinction between a confined space and a permit-required confined space. A confined space meets the following criteria: (1) large enough to enter and work but not designed for continuous occupancy and; (2) limited entry or exit ports.

A permit-required confined space is defined as containing both points (1) and (2) above and any of the following:

- (1) Contains or potentially contains a hazardous atmosphere;
- (2) Contains materials with a potential for engulfment (water, dust, soil or sludge);
- (3) Contains a configuration that would allow a worker to become entrapped or asphyxiated, or;
- (4) Contains any other recognized serious safety or health hazards.

A confined space must be evaluated before it can be designated as a "confined space" or a "permit-required" confined space.

2.0 CONFINED SPACE HAZARDS

2.0.1 Hazardous Atmospheres

The most frequently encountered but ignored hazard in a confined space is atmospheric hazards. Oxygen deficient atmospheres (<19.5% oxygen or >23.5%), flammable gas concentrations at or above IDLH or PEL values and combustible dust concentrations above safe levels are frequently encountered by site workers. Typical gases found in confined spaces are H₂S, CO and NO₂.

2.0.2 Physical Hazards

Unstable slopes, slippery surfaces and sharp debris are often found in confined spaces. In addition moving parts, such as gears or augers, should be identified and disabled to avoid crushing, tearing, or cutting injuries.

2.0.3 Engulfment Hazards

Engulfment of workers may occur if there are solid or liquid materials present in the confined

5.0 ENTRY PERMITS

A permit that has been signed by the entry supervisor, who has insured that pre-entry preparations have been completed, must be posted at entrances or made available to entrants before they go into the permit space.

The duration of the permit must be for the time allotted for the work tasks to be completed. The entry permit should be terminated when the work is completed or canceled if new conditions arise. New conditions must be noted on all canceled permits. The employer must keep canceled permits for at least one year.

Entry permits must contain the following information:

- 1 Test results;
- 2 Test person's initials or signature;
- 3 Name and signature of supervisor who authorized entry;
- 4 Name of permit space to be entered, authorized entrant(s), attendants, and individual(s) authorized to be entry supervisor(s);
- 5 Purpose of entry and known space hazards;
- 6 Measures to be taken to isolate entry-space (lock-out/tag-out) and control space hazards (ventilation);
- 7 Name and telephone numbers of rescue and emergency services;
- 8 Date and duration of entry;
- 9 Acceptable entry conditions;
- 10 Communication procedures and equipment to maintain contact during entry;
- 11 Additional permits that have been issued for work in the space;
- 12 Special equipment and procedures (PPE, alarms) and;
- 13 Any other information needed to ensure employee safety.

6.0 TRAINING REQUIREMENTS

Employers must provide training for all workers required to perform activities in permit spaces. The training must ensure that workers have acquired the understanding, knowledge and skill necessary for the safe performance of their duties. Additional training is required when: (1) job duties change, (2) permit space program changes or new hazards are identified, and (3) an employee's job performance shows deficiencies. In addition, rescue team members must receive CPR and first aid training.

After completing training requirements, employees must receive a training certificate that includes the employee's name, signature or initials of the trainer(s), and dates of the training. The certification must be made available for inspection by employees and their authorized representatives.

- (4) Take appropriate measures to remove unauthorized entrants, and;
- (5) Ensure that entry operations remain consistent with the entry permit and that acceptable entry conditions are maintained.

6.4 SYSTEM SAFETY ANALYSIS

System safety analysis techniques can be used to examine systems and subsystems to determine appropriate operational methods, rescue methods, training points and maintenance procedures. System safety analysis provides a method to:

- 1 Identify hazards and recommend abatement measures;
- 2 Evaluate safety aspects of a given system, and;
- 3 Document the hazard identification and evaluation process.

DRUM HANDLING

1.0 INTRODUCTION

Accidents may occur during the handling of hazardous materials containers, particularly drums. Drums or barrels come in a variety of sizes: 10-, 30- and 55-gallon being the common sizes. Closed head (nonremovable top) drums have a closed, sealed top with a bung hole for emptying and filling. Drum bungs are usually made of the same material as the drum. The gaskets were made of polyethylene or Teflon. Closed head drum are designed to hold liquids.

Open head (removable tops) drums are closed using a retaining seal that is fastened with a nut and bolt or lever-locking device. Open head drums are designed to hold solids.

The composition of the drums may be indicators of the material they are holding. Polyethylene drums are generally used to transport corrosive materials. Drums constructed of metal or aluminum often contains highly hazardous wastes. Other drums may be made of 16-gauge stainless steel, which are durable and corrosion-resistant, and used to transport heavier-than-water corrosives.

2.0 REGULATIONS

New standards for barrel specifications are provided in 49CFR Transport of Hazardous Materials Regulations or HM-181 (1990); DOT 49CFR 171-178, OSHA 29CFR 1910.120 (j) and 29CFR 1926, and EPA 40CFR 264-265.

HM-181 revised packaging requirements to the UN performance oriented packaging (POP) standard. This POP standard applied to drums manufactured after 1990, however many hazardous waste sites contain drums manufactured before 1990. Drums manufactured before HM-181 had specification numbers stamped on the bottom to describe material composition and function (STC – single trip container). Drums manufactured after HM-181 have a number-letter-number specification code stamped on it (1A2: Drum-steel-open head).

3.0 DRUM INSPECTION

Any drums that are found at hazardous waste sites or incident release sites should be inspected for labels, symbols, signs of deterioration, signs of pressure, type of drum (open head or closed head), and construction material.

4.0 DRUM EXCAVATION AND REMOVAL

Drums should be moved only when circumstances dictate that they must be. In many cases, drums are stacked, buried or crowded together. This makes inspection difficult, if not impossible.

- (6) Open exotic metal drums through the bung or by drilling;
- (7) Reseal open bungs or drill holes as soon as possible, and;
- ~~---~~ (8) ~~Decon-~~all equipment after each use to avoid mixing incompatible waste materials.

7.0 DRUM SAMPLING

Drum sampling activities can be hazardous to site workers because they have direct contact with unidentified materials. Prior to sampling, a plan should be developed to insure the safety of site workers. Information in the plan should include research of the type of waste materials to be sampled, identification of drums to be sampled, selection of appropriate sampling devices and sampling containers, and a drum opening plan.

CONTROL OF PHYSICAL, ELECTRICAL AND MECHANICAL HAZARDS

1.0 INTRODUCTION

Personnel responding to hazardous materials sites may encounter conditions that are unsafe or potentially unsafe due to a multitude of safety hazards. The information contained in this final section addresses many of the conditions that a responder may encounter during site work activities.

2.0 BOTTLED GASES

General safety requirements for bottled gases should include the following:

- (1) Visually inspect each tank for integrity;
- (2) Bottled gases should never be moved without capping them first;
- (3) When bottled gases are standing, they should be secured to a wall or other permanent structures, and;
- (4) Oxygen bottles must be stored a minimum of 20 feet away from fuel gases or other combustible materials. However, bottles may be stored closer if a 5-foot barrier with a fire resistance rating of 30 is placed around the oxygen bottles.

3.0 COMPRESSED AIR

Compressed air systems may be used during site activities, therefore, the following safety issues must be addressed prior to use: The use of compressed air lines requires that a pressure gauge be installed and that the system be approved for the amount of pressure supplied by the system. Also, the supply lines must be equipped with a spring-loaded safety valve.

4.0 FIRE PROTECTION

Fire is a very real possibility at sites where combustible and flammable chemicals are stored. Fire protection is an important aspect of site safety. Employers must provide portable fire extinguishers for site personnel protection. The extinguishers should be conspicuously located and employees provided with training on use, placement, maintenance and inspection. Local fire departments have inspection jurisdiction as well as OSHA inspectors.

Employers must also provide a written emergency action plan that provides for the following:


- (1) Emergency escape procedures and routes;
- (2) Critical operations procedures;
- (3) Personnel accounting procedures after evacuation;

Lock out/Tag out requirements include the following:

- 1 Energy Control Plan;
- 2 Use locks if equipment can be locked;
- 3 Ensure new equipment can accommodate locks;
- 4 Identify program needs and implement procedures to be followed in a written plan;
- 5 Obtain standardized equipment for marking areas of work;
- 6 Locking devices must be removed by the employee who applied the device;
- 7 Training of workers and annual inspections of the program, and;
- 8 Devise and adopt procedures for non-customary activities.


The Energy Control Plan requires six steps that must be followed to insure worker safety. These steps are:

- (1) Prepare the area for the shutdown;
- (2) Equipment shutdown;
- (3) Equipment isolation;
- (4) Application of lock out/tag out devices;
- (5) Control of stored energy, and;
- (6) Equipment isolation verification.



**North American
Emergency
Response Guide
(ERG)**

*"The Hazmat
responders bible"*



Analyze The Incident


» Determine the hazardous materials present and basic response information by completing the following tasks:

- Detect the presence of Hazmat's Survey from a safe distance
- Collect information from the North American Emergency Response Guidebook (NAERG)

Responder Definition

Person who respond as part of a public or public emergency response organization to releases or potential releases of hazardous materials as part of an initial response for the purpose of protecting:

- » Nearby persons from exposure
- » Environment
- » Property



Responsibilities of the HAZMAT First Responder include:

- 1. Never assume the scene is safe.
- 2. Assess the situation before taking any action.
- 3. Utilize proper PPE.
- 4. Utilize resource manuals for product identification.

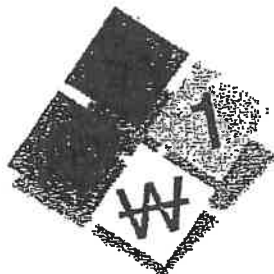
Analyze the Incident

- 1. Determine if the hazardous materials involved and the amount present are reportable.
- 2. Determine whether a spill exists.
- 3. Obtain a hazardous materials report from a safe location. Products are named. United Nations identification number is required. Appropriate hazard class, physical state, and type.
- 4. Obtain an identification from the incident logs of the North American Emergency Response System (NAERD).

Placards, Signs, and Classifications Review

NFPA 704
Numbers 0-4

- 0- Indicates a slight hazard
- 4- Indicates a severe hazard



Class 2: Compressed Gas

Placards:

- Flammable - Red background, White Flame
- Non-Flammable - Green background, White Cylinder
- Oxidizer - Yellow background, Flaming "O"
- Poison Gas - White background, Skull & Crossbones



Class 3: Flammable & Combustible Liquids



Placards:

- Flammable - Red background, White Flame with the word Flammable
- Combustible - Red background, White Flame with the word Combustible

Examples - No. 6 Fuel oil, Mineral Spirits, Pine Oil, Peanut oil, Plastic Solvents

Class 4: Flammable Solids



Placards

- Division 4.1 - Red and White Vertical Stripes. Black Flame and the words Flammable Solid
- Division 4.2 - White Top, Red Bottom Black Flame with words Spontaneously

Division 4.3 Blue background, White Flame, words Dangerous when Wet

Examples - Dry Lime, Matches, Magnesium Powder, Potass. Metal Alloys

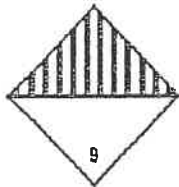
Class 8: Corrosives



Placard - White Top, Black bottom, two test tubes, hand and steel bar

Examples - Nitric Acid, Sulfuric Acid, Phosphorus Trichloride

Class 9: Miscellaneous Hazmat



Placard - Black and white vertical stripes on top, white bottom

Examples - Adipic acid, PCBs, molten sulfur, hazardous waste).

Mixed Loads

The "Dangerous" placard is used with mixed loads of 2,200 pounds or less which contain hazardous materials that do not meet quantity requirements for their hazard class or division.



Principles of Hazardous Materials Behavior

Release Event:

- Can be explosive (from pressure)
- The product could drip
- Leak
- Pour
- Release as a gaseous cloud

Principles of Hazardous Materials Behavior

Engulfment:

- Product might spread and disperse
- Reproly's only
- Spread based on it's state - solid, liquid, gas
- Weather conditions - Wet? Dry? Hot? Cold?
- High energy, explosive release - slow low energy release

Principles of Hazardous Materials Behavior

Impingement:

- Can cause when release product makes actual contact with people or objects
- Can be as small as a drop, vapor
- From fire
- Release of product or pressure or water supply
- Chemical incident

While help is on the way:

- 1 Assume and announce Command
- 2 Establish a Command Post
- 3 Establish a HOT ZONE (the area of contamination or danger)
- 4 Establish a WARM ZONE (the area where patients will be decontaminated)
- 5 Establish a COLD ZONE (the area where equipment and responding agencies will initially report to. This is where you will be)

Reporting the Incident

- 1. Location (street name, address)
- 2. Location (street name, address) (if not on street)
- 3. Direction of flow (river, stream, etc.)
- 4. Direction of flow (river, stream, etc.)
- 5. Direction of flow (river, stream, etc.)
- 6. Direction of flow (river, stream, etc.)
- 7. Direction of flow (river, stream, etc.)
- 8. Direction of flow (river, stream, etc.)
- 9. Direction of flow (river, stream, etc.)
- 10. Direction of flow (river, stream, etc.)

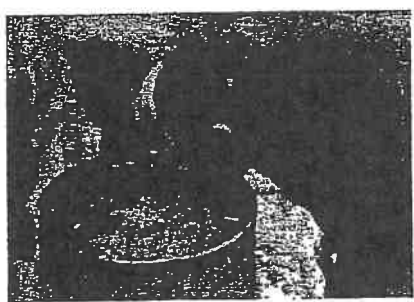
Analyzing The Incident

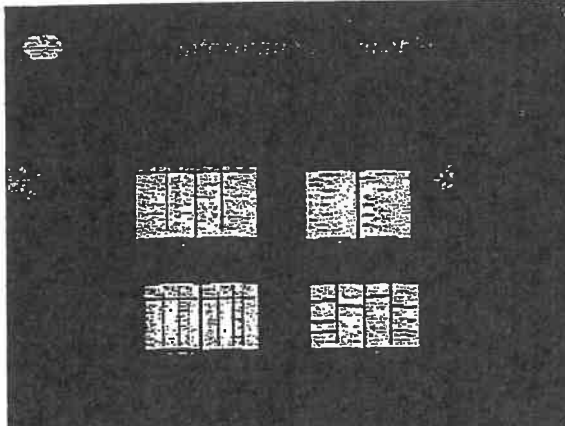
- Incident Command and Response
- Situation
- Equipment
- Boat Loading?

Surrounding Conditions

1. To do report	7. Public Exposure Potential
2. Location	8. Land Use
3. Area of Interest	9. Spill or Release Data
4. Weather	10. Possible Unknown Sources
5. Distance of Origin	

Identifying the Agent/Product





NAERG Orange Pages

- All orange pages are Guide Pages and are in numerical order.
- These pages provide information pertaining to:
 - Potential hazards;
 - Public safety;
 - Emergency response.

NAERG Orange Pages

- Potential hazards:
 - Fire or explosion;
 - Health.
- Public safety:
 - General info;
 - Protective clothing;
 - Evacuation.

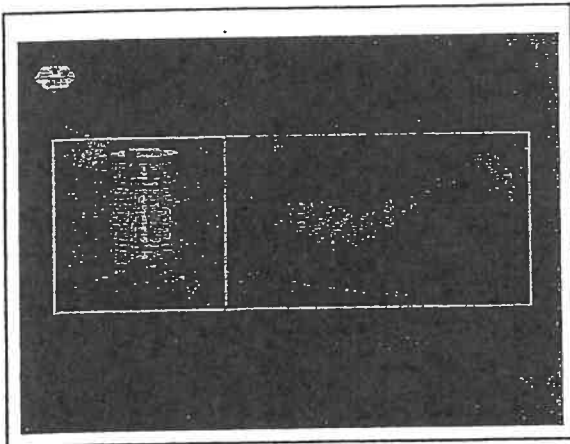
NAERG Orange Pages

- Emergency response:
 - Fire;
 - Spill or leak;
 - First Aid.



NAERG Green Pages

- Specific guidance for distances is dependent on the size of the release and the time of day that the release occurs.
- So FIRST, define the type of release or spill!

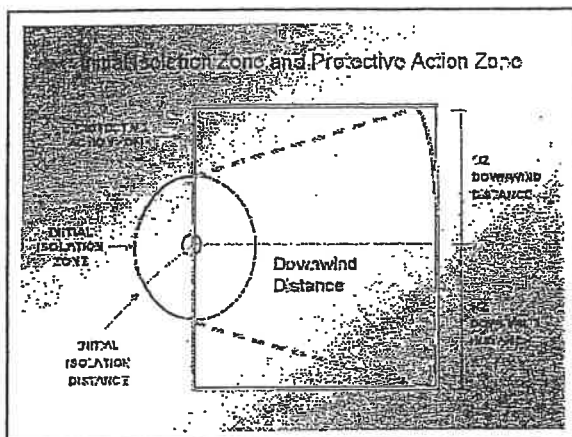


NAERG Green Pages

- Factors that may change the Protective Action Distances:
 - Explosion hazard;
 - If more than one tanker is involved. LARGE spill distances may need to be increased;
 - Atmospheric conditions or time of day;
 - Water reactive materials may produce toxic gases.

NAERG Green Pages

- Initial Isolation and Protective Action Distances have been determined for small and large spills during day and night.
- Modeling programs were conducted for each chemical in the NAERG and the given distance are a result of:
 - Release amounts and emission rates;
 - Downwind dispersion;
 - Toxicological short-term exposure guidelines.



NAERG Green Pages

- Remember:
 - ADJUSTING THESE DISTANCES FOR A SPECIFIC INCIDENT INVOLVES MANY INTERDEPENDENT VARIABLES AND SHOULD BE MADE ONLY BY PERSONNEL TECHNICALLY QUALIFIED TO MAKE SUCH ADJUSTMENTS.

EQUIPMENT NEEDED TO PERFORM MINIMUM DECONTAMINATION MEASURES FOR LEVELS A, B, AND C

Station 1:

- a. Various Size Containers
- b. Plastic Liners
- c. Plastic Drop Cloths

Station 2:

- a. Containers (20-30 Gallons)
- b. Decon Solution
- c. Rinse Water
- d. 2-3 Long-Handled, Soft-Bristled Scrub Brushes

Station 3:

- a. Containers (20-30 Gallons)
- b. Plastic Liners
- c. Bench or Stools

Station 4:

- a. Air Tanks or Masks and Cartridges Depending Upon Level
- b. Tape
- c. Boot Covers
- d. Gloves

Station 5:

- a. Containers (20-30 Gallons)
- b. Plastic Liners
- c. Bench or Stools

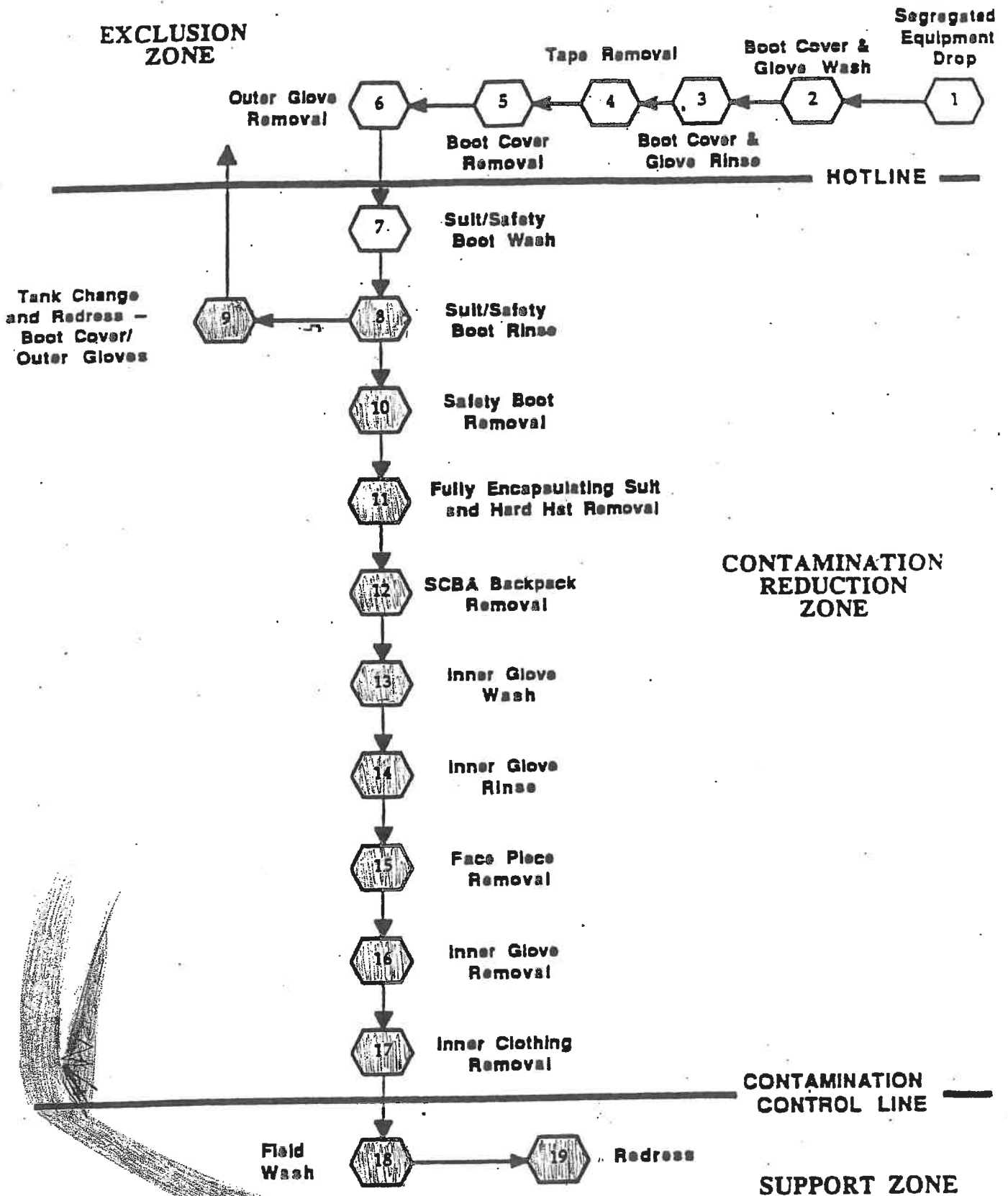
Station 6:

- a. Plastic Sheets
- b. Basin or Bucket
- c. Soap and Towels
- d. Bench or Stools

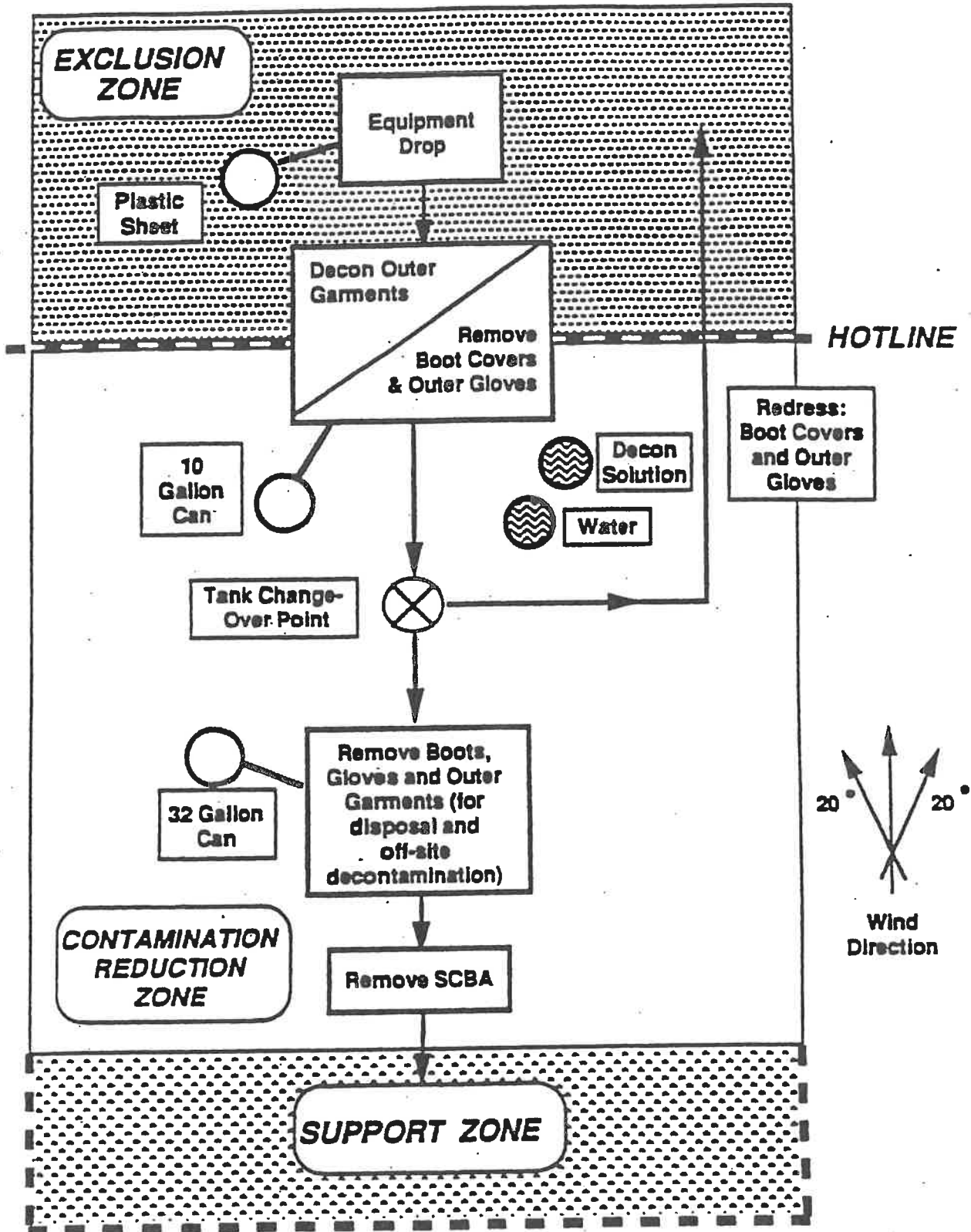
Station 7:

- a. Water
- b. Soap
- c. Towels
- d. Wash Basin or Bucket

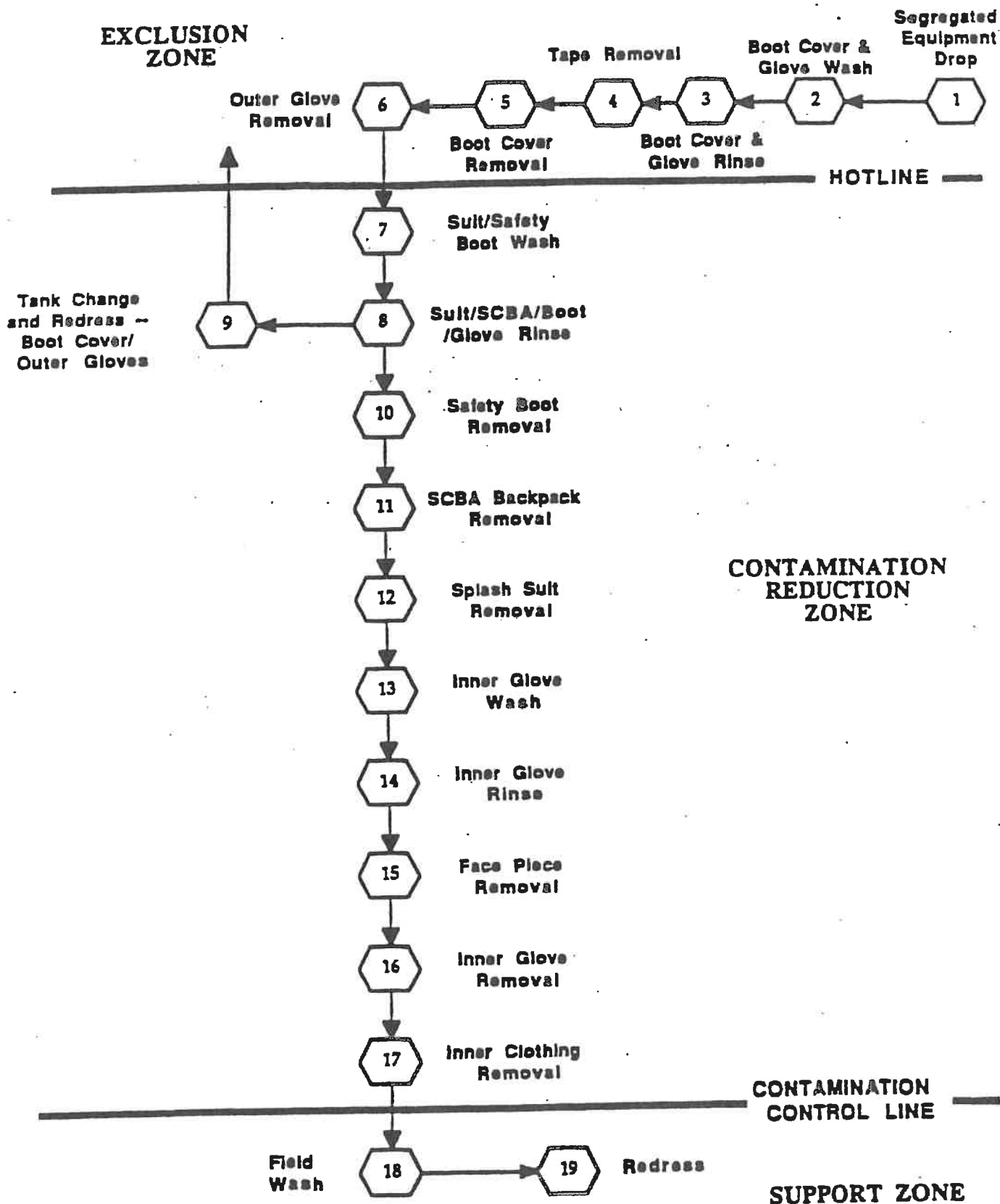
MAXIMUM DECONTAMINATION LAYOUT FOR LEVEL A PROTECTION



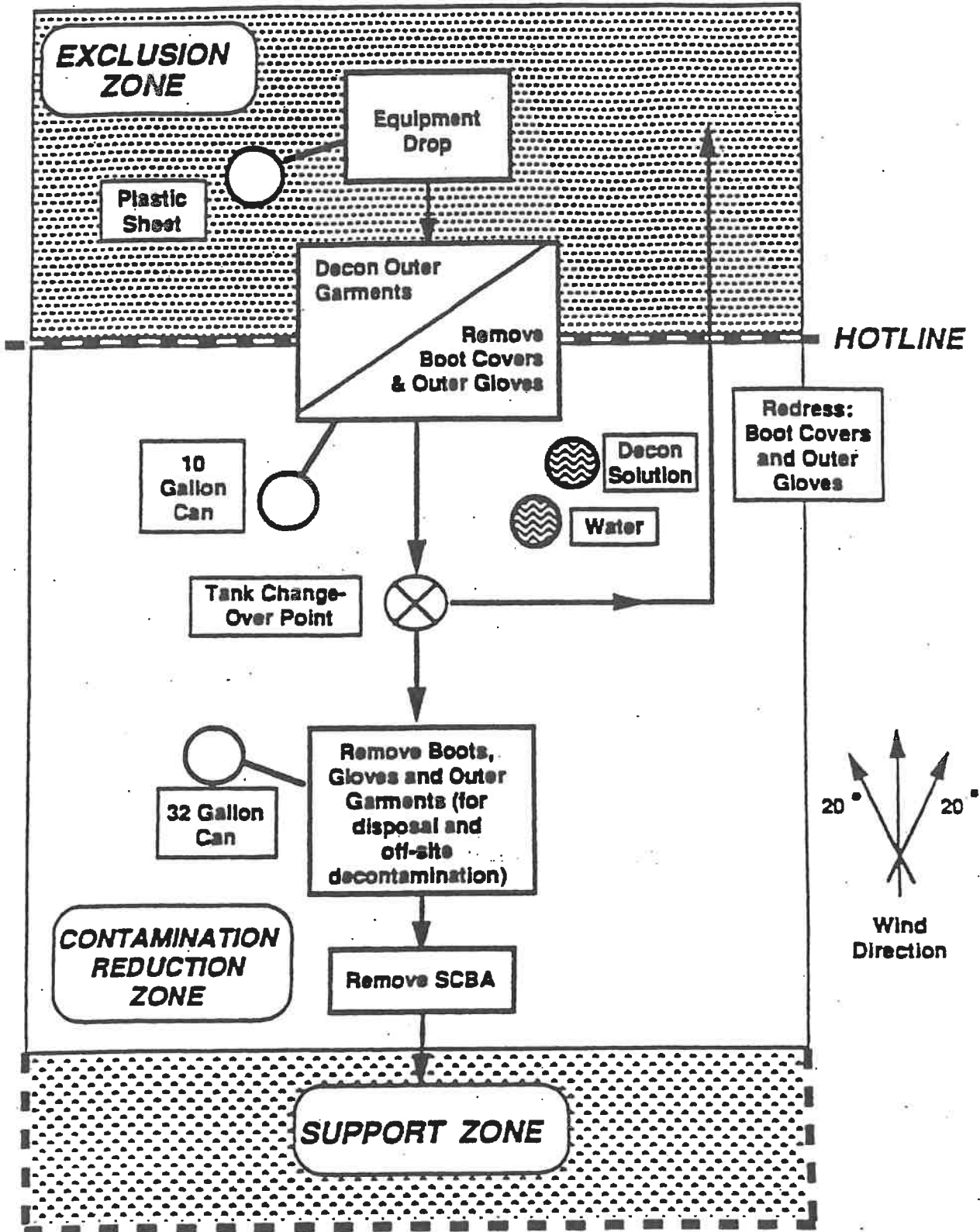
MINIMUM DECONTAMINATION LAYOUT FOR LEVELS A & B PROTECTION



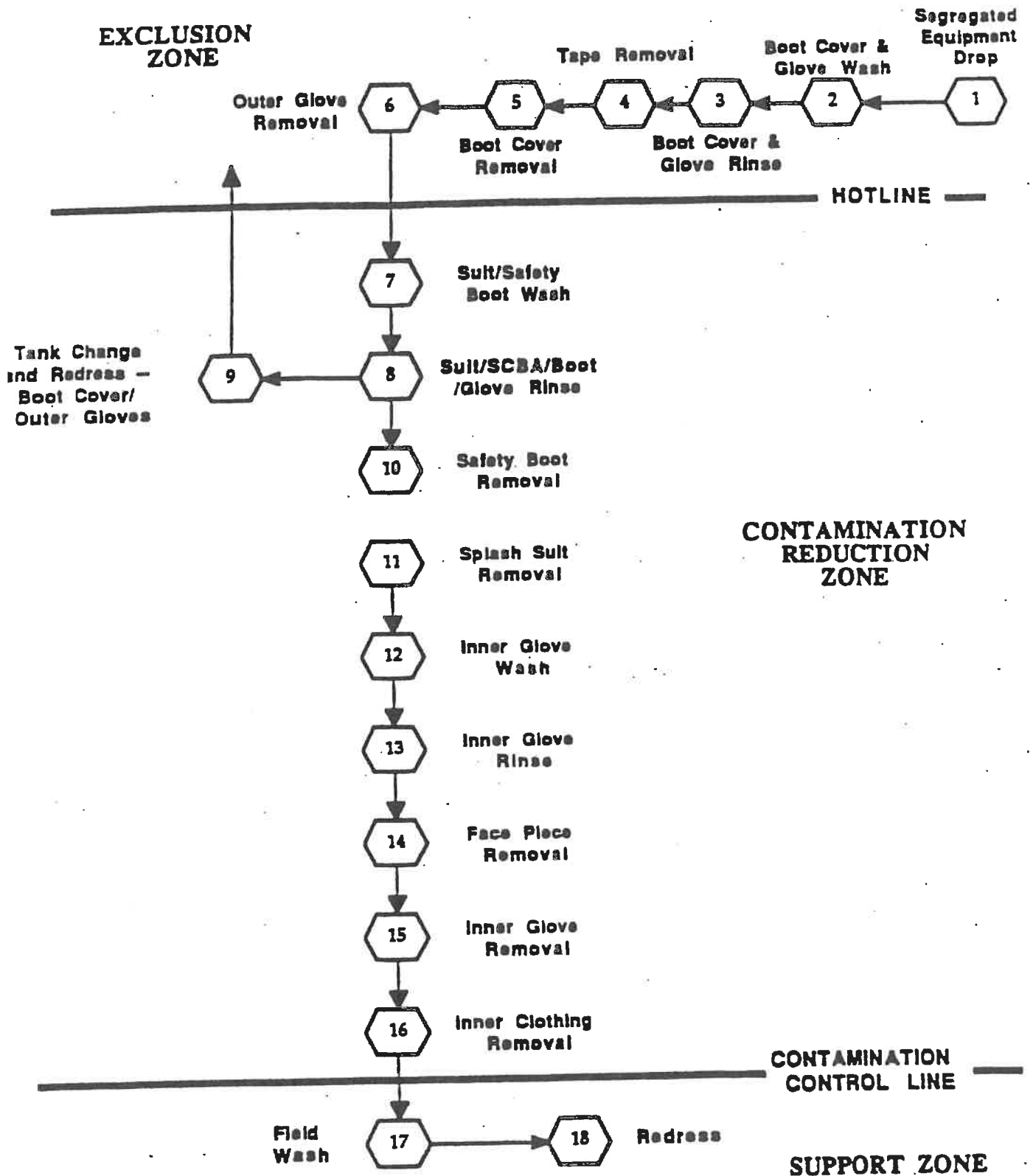
MAXIMUM DECONTAMINATION LAYOUT FOR LEVEL B PROTECTION



MINIMUM DECONTAMINATION LAYOUT FOR LEVELS A & B PROTECTION



MAXIMUM DECONTAMINATION LAYOUT FOR LEVEL C PROTECTION



MINIMUM DECONTAMINATION LAYOUT FOR LEVEL C PROTECTION

