Chapter 13
Personnel Protection

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13.1 Introduction

For adequate protection and prevention of contaminant exposure to workers at hazardous waste sites in all phases of investigation, personal protective equipment (PPE) should be utilized as required by a site-specific health and safety plan (HASP), and personnel contamination reduction practices must be implemented. The procedures must be appropriate to protect against potential or known hazards at a site. All personal protective clothing and equipment utilized at hazardous waste sites must comply with 29 Code of Federal Register (CFR) 1910.120 of the Occupational Safety and Health Agency (OSHA) Standard for Hazardous Waste Operations and Emergency Response with 29 CFR 1910.132, 133 and 134 which are the OSHA requirements for PPE, Eye and Face protection and the use of Respiratory Protection, respectively.

The information in this chapter on PPE is adapted from the *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, developed by The National Institute for Occupational Safety and Health (NIOSH), OSHA, United State Coast Guard, and United States Environmental Protection Agency (USEPA) in October 1985. Included here are key factors in the selection and use of PPE, discussion of heat stress, and other physiological factors for consideration when planning site activities. Chapter 4 of this manual, *Site Entry Activities*, addresses other factors for consideration prior to site entry.

In addition to general guidance provided here on levels of protection, a more subjective determination should be made of the PPE required for initial safety should situations exist where the type of materials/contaminants have not been identified, the potential for contact with contamination is unknown and/or the hazards are not clearly identifiable. Level B protection is the *minimum* level recommended for initial entries until the hazards have been further identified and defined through monitoring, sampling and other reliable methods of analysis, and PPE corresponding with these findings can be utilized. The appropriate level of protection shall be determined prior to the initial entry into an area suspected of containing hazardous materials, or contamination, based on the best available information. Subsequent information obtained through exposure monitoring or other site assessment and evaluation procedures may suggest changes in the original level selected. Personnel should only don PPE that they have been adequately trained and deemed medically fit to wear.

The New Jersey Department of Environmental Protection (NJDEP) maintains a library of guidance manuals on its website at https://www.nj.gov/dep/srp/guidance/. It is recommended the reader access the website and review the guidance manuals pertinent to the respective task. Additional guidance may also be found at websites of the USEPA and the American Society for Testing and Materials (ASTM). Examples of some of the relevant guidance manuals pertaining to this chapter are:

Quality Assurance Project Plan Technical Guidance:
https://www.nj.gov/dep/srp/guidance/#analytic_methods

OSHA: https://www.osha.gov

OSHA PPE Manual: https://www.osha.gov/sites/default/files/publications/osha3151.pdf

13.2 Project Planning

Project planning should take place before field work and be based on 29 CFR 1910.120(b) – Safety and Health Program and Section 6.1.6 *Assuring Health and Safety* of this guidance document. In general, a project plan involves establishing a health and safety program before an environmental investigation commences. An environmental investigation can span from due diligence with unknown hazards to a remedial action with known contaminants of concern. Project planning should incorporate the organizational

structure of the investigating entity, workplan or Quality Assurance Project Plan (QAPP), and site-specific HASP or similar document. The organizational structure should give details such as the chain of command, supervisor(s), health and safety supervisor(s), and any personnel needed to enforce health and safety requirements. Workplan and QAPP requirements are listed in Chapter 2 and Chapter 6 of the FSPM as well as the QAPP Technical Guidance Document. A site-specific HASP or similar document should contain information on the health and safety training and medical surveillance requirements needed to complete the investigation.

The HASP or similar document should also contain the hazard analysis or standard operating procedures for the site-specific activities, as well as the applicable levels of PPE required based on known or anticipated conditions and hazards. Depending on the hazard(s) identified, elimination, substitution, engineering, work practices/administrative controls should be implemented first or in conjunction with PPE based on the hazard analysis of the site. Project planning can also incorporate research about the potential site hazards and portable monitoring devices needed to record monitoring parameters such as volatile organic contaminant concentrations, Lower Explosive Level, etc. Although a HASP can incorporate most of the things mentioned in this section, additional information from other sources may be needed for health and safety project planning.

13.3 Personal Protective Clothing and Equipment Use

PPE can offer a high degree of protection only if it is used properly depending on the hazards and complexity of hazardous site work encountered. PPE and a Respiratory Protection Program should be implemented as part of a HASP plan per OSHA requirements. The following aspects of PPE use should be considered:

- Selection
- Fit testing
- Training
- Medical Surveillance
- Personal use factors
- Storage
- Inspection
- In-use monitoring
- Work mission duration
- Donning
- Doffing
- Decontamination
- Maintenance

For specific information on OSHA Hazardous Site Requirements please see OSHA: https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.120.

13.4 Selection of Protective Clothing and Accessories

In this manual, personal protective clothing is considered to be any article offering skin and/or body protection. Each type of protective clothing has a specific purpose; many, but not all, are designed to protect against chemical exposure. Accessories that might be used for personal protection in conjunction with a PPE ensemble include:

Chemical protective clothing (CPC) is available in a variety of materials that offer a range of protection against different chemicals. The most appropriate clothing material will depend on the chemicals present and the task to be accomplished. Ideally, the chosen material resists permeation, degradation, and penetration. Permeation is the process by which a chemical dissolves in and/or moves through a protective clothing material on a molecular level. Degradation is the loss of or change in the fabric's chemical resistance or physical properties due to exposure to chemicals, use, or ambient conditions (e.g., sunlight). Penetration is the movement of chemicals through zippers, stitched seams, or imperfections (e.g., pinholes) in a protective clothing material.

Selection of chemical-protective clothing is a complex task and should be performed by personnel with training and experience. Under all conditions, clothing is selected by evaluating the performance characteristics of the clothing against the requirements and limitations of the site- and task- specific conditions. Manufacturers' information should be carefully reviewed to determine compatibility, breakthrough times, and other limitations. For known or potential chemicals of concern, safety data sheets should also be reviewed. In all cases, the employer is responsible for the entire health and safety program including personal protective equipment (see OSHA standard 29 CFR Part 1910.132-1910.138). Additional information about selecting the appropriate PPE is available in the OSHA publication *Personal Protective Equipment* available at: https://www.osha.gov/sites/default/files/publications/osha3151.pdf.

13.4.1 Other Considerations

In addition to permeation, degradation and penetration, several other factors should be considered during clothing selection. These affect not only chemical resistance, but also the worker's ability to perform the required task. The following checklist summarizes these considerations.

- Durability: strength for task at hand
- Dexterity: for the task at hand
- Temperature effects: maintain protective integrity under hot and cold extremes
- Ease of decontamination: can it be decontaminated, or will it need to be discarded
- Compatibility with site conditions, sampling/contaminant considerations, and other equipment: should not preclude the use of another article of protective equipment
- Duration: the material will not degrade during its use
- Proper fit (oversized PPE or PPE too small can cause additional hazards)

13.4.2 Special Conditions

Fire, explosion, heat, and radioactive materials are considered special conditions that require special protective equipment. Unique problems are associated with radioactive material, and it is beyond the scope of this manual to discuss them properly. A qualified health physicist should be consulted if radioactive materials are present. See Chapter 12 *Radiological Assessment* for additional information. When using special-protective equipment for fire, explosion, heat, or radiation, it is important to also provide protection against chemicals, since the specialized equipment may provide little or no protection against chemicals that may also be present.

13.4.3 Ensembles/Level of Protection

Table 13.1 lists ensemble components based on OSHA's Levels of Protection: Levels A, B, C, and D. These lists should be considered a starting point for ensemble selection however, each ensemble should be tailored to the specific situation, such as, but not limited to, specific chemical hazards, physical hazards, or biological hazards, in order to provide the most appropriate level of protection.

The type of equipment used, and the overall level of protection should be reevaluated periodically as additional site information is gained and if site conditions change, and as workers are required to perform different tasks. Personnel should be able to upgrade or downgrade their level of protection based on

specific action levels which are delineated in the HASP or concurrence of the Safety Officer.

Table 13.1 Protective Ensembles

Level D Protection (lowest level of protection)			
Equipment	**Protection Provided**	**Should be Used When:**	**Limiting Criteria**
RECOMMENDED: • Coveralls • Safety boots/shoes • Safety glasses or chemical splash goggles • Traffic safety vest • Hard Hat	No respiratory protection	• The atmosphere contains no known hazard • Work functions preclude splashes, immersion, or the potential for unexpected inhalation or contact with hazardous levels of any chemicals	• The atmosphere must contain at least 19.5% oxygen
OPTIONAL: • Gloves • Escape mask • Face shield • Hearing protection • Chemical resistant outer covering for boots/shoes		• When splash hazards are present, this level of protection can be modified to mitigate the hazard.	

Level C Protection			
Equipment	**Protection Provided**	**Should be Used When:**	**Limiting Criteria**
RECOMMENDED: • Full face, air purifying cartridge respirator • Chemical-resistant coverall • Inner and outer chemical-resistant gloves • Chemical-resistant safety boots/shoes • Hard hat • Two-way radio *Powered Air Purifying Respirator (PAPR) can be used in place of APR.	The same level of skin protection as Level B, but a lower level of respiratory protection	• The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any exposed skin • The types of air contaminants have been identified, concentrations measured, and a canister is available that can remove the contaminant • All criteria for the use of air purifying respirators are met	• Atmospheric concentration of chemicals must not exceed Immediately Dangerous to Life & Health (IDLH) levels • The atmosphere must contain at least 19.5% Oxygen • Contaminant exhibit adequate breakthrough warning properties
OPTIONAL: • Coveralls • Disposable boot covers • Face shield • Escape mask • Moisture wicking base layer			

Level B Protection			
Equipment	**Protection Provided**	**Should be Used When:**	**Limiting Criteria**
RECOMMENDED: • Pressure-demand, full face-piece SCBA or pressure-demand supplied air respirator with escape bottle • Chemical-resistant coverall • Inner and outer chemical-resistant gloves • Chemical-resistant safety boots/shoes • Hard hat • Two-way radio	Highest Level of Respiratory Protection Minimum level recommended for initial site entry	• The type and atmospheric concentration of substances have been identified and require a higher level of respiratory protection, but less skin protection. This involves atmospheres: – Where IDHL concentrations of specific substances that do not represent a severe skin hazard; or – that do not meet the criteria for the use of air purifying respirators. • Oxygen deficient atmospheres • Presence of incompletely identified vapors or gases is indicated by direct-reading organic vapor detection instrument, but vapors and gases are not expected of containing high levels of chemicals harmful to skin or capable of being absorbed through the intact skin.	• Use only when the vapor or gases present are not suspected of containing high concentrations of chemical that are harmful to skin or capable of being absorbed through the intact skin. • Use only when it is highly unlikely that the work being done will generate either concentrations of vapors, gas or particulates or splashes of material that will affect exposed skin.
OPTIONAL: • Coveralls • Disposable boot covers • Face shield • Moisture wicking base layer			

Level A Protection (highest level of protection)			
Equipment	**Protection Provided**	**Should be Used When:**	**Limiting Criteria**
RECOMMENDED: • Pressure demand, full face-piece SCBA or pressure demand supplied-air respirator with escape-bottle • Fully-encapsulating chemical- resistant suit • Inner chemical resistant gloves • Chemical-resistant safety boots • Outer chemical resistant gloves • Chemical-resistant shoes • Hard Hat • Two-way radio	The highest available level of skin, eye, and respiratory protection	• The chemical substance is identified and requires highest level of protection for skin, eyes and the respiratory system based on either: – measured (or potential for) IDLH concentration of atmospheric vapors gases, or particulates or – site operations and work functions involving a high potential for splash immersion, or exposure to unexpected vapors, gases or particles of materials that are harmful to skin or can be absorbed through the intact skin • Substances with a high degree of hazard to the skin are known or suspected and contact with the skin is possible • Operations must be conducted in confined, poorly ventilated areas until the absence of conditions requiring Level A protection are determined	• Fully encapsulating suit material must be compatible with the substances involved

OPTIONAL: • Cooling unit • Coveralls • Moisture wicking base layer • Disposable gloves and boot covers			

13.5 Selection of Respiratory Equipment

The following section assumes that all other engineering and protective measures have been implemented to mitigate the need for respiratory requirements as such the following includes respiratory equipment when those measures have not been sufficiently protective. A comprehensive written respiratory protection plan is required before any respiratory protection equipment can be considered for employee protection (29 CFR 1910.134). The plan requires a program administrator and should include documentation and written work specific procedures.

This includes:

- Medical evaluation and surveillance
- Inspection of Respirator equipment
- Fit testing
- Cleaning and storage procedures
- Limitations of equipment
- Proper use
- Workplace surveillance
- Training
- Annual review of written plan

13.5.1 Self-Contained Breathing Apparatus

A self-contained breathing apparatus (SCBA) consists of a face-piece connected by a hose and a regulator to an air source (compressed air, compressed oxygen, or an oxygen generating chemical) carried by the wearer. Only positive-pressure SCBAs are recommended for entry into atmospheres that are IDLH. SCBAs offer protection against most types and levels of airborne contaminants. However, the duration of the air supply is an important planning factor in SCBA use. This is limited by the amount of air carried and the rate of consumption by the user, which can be highly variable. SCBAs are worn and may be bulky, they may increase the likelihood of heat stress and impair movement in confined spaces. SCBAs are used in permit required confined spaces where there is an oxygen deficient atmosphere, asphyxiation hazards, or when making an initial entry and the type and concentration of a hazardous atmosphere is unknown or when the limitations of an Air Purifying Respirators (APR) exceeded.

13.5.2 Supplied-Air Respirators

Supplied-air respirators (SARS) supply Grade D breathing air, to a face- piece via a supply line from a stationary source. Pressure-demand SARs with escape provisions provide the highest level of protection (among SARs) and are the only SARs recommended for use at hazardous waste sites.

SARs are not recommended for entry into Immediately Dangerous to life and Health (IDLH) atmospheres (Mine Safety and Health Administration (MSHA)/NIOSH 30 CFR Part II) unless the apparatus is equipped with an escape bottle. SARs are used in confined spaces where there is an oxygen deficient or

asphyxiation hazard, or when concentrations of the contaminant are too high, or the toxicity of a material is too hazardous for an air purifying respirator.

The air source for supplied-air respirators may be compressed air cylinders, or a compressor that purifies and delivers Grade D breathing air to the face-piece.

13.5.3 Combination SCBA/SAR

Respiratory protection is available that combines the features of an SCBA with a SAR. The user can operate the respirator in the SCBA or SAR mode. This type of respirator allows entry into and exit from an area using the self-contained air supply, as well as extended work periods within a contaminated area while connected to the airline. It is particularly appropriate for sites where workers must travel an extended distance to a work area within an exclusion zone and remain within that area for relatively long work periods (e.g., drum sampling). Workers would enter the site using the SCBA mode, connect to the airline during the work period, and shift back to the SCBA mode to leave the site.

13.5.4 Air-Purifying Respirators

Air-Purifying Respirators (APR) consist of a face-piece and an air-purifying device, which is either a removable cartridge on the face-piece or an air-purifying apparatus worn (canister) on a body harness attached to the face-piece by a corrugated breathing hose. Air-purifying respirators selectively remove specific airborne contaminants (particulates, gases, vapors, and fumes) from ambient air by filtration, absorption adsorption, or chemical reactions. They are approved for use in atmospheres containing specific chemicals up to designated concentrations, and not for IDLH atmospheres. Air-purifying respirators have limited use at hazardous waste sites and can be used only when the ambient atmosphere contains sufficient oxygen (19.5 %) (30 CFR Part 11.90(a)). Conditions that may exclude or limit the use of air-purifying respirators include:

- Oxygen deficiency
- IDLH concentrations of specific substances
- Entry into an unventilated or confined area where exposure conditions have not been characterized
- Presence or potential presence of unidentified contaminants
- Contaminant concentrations are unknown or exceed designated maximum use concentration(s)
- Identified gases or vapors have inadequate warning properties and the sorbent service life is not known, and the unit has no end-of-service-life (ESLI) indicator
- High relative humidity (may reduce the protection offered by the sorbent)
- Temperature that falls outside the manufacturer's use recommendations

There are three types of air-purifying devices: 1) particulate filters; 2) cartridges and canisters which contain sorbents for specific gases and vapors; and 3) combination devices.

MSHA and NIOSH have granted approvals for manufacturers' specific assemblies of air-purifying respirators for a limited number of specific chemicals. Respirators should be used only for those substances for which they have been approved. Most chemical sorbent canisters are imprinted with an expiration date. They may be used up to that date if they were not opened previously. Once opened, they begin to adsorb humidity and air contaminants whether they are in use or not in use and their efficiency and service life decreases. Therefore, cartridges and canister should not be opened until they will be used.

The Health & Safety Plan should include information about the cartridge's: service life estimate with a safety factor (math model calculation); Warning Properties, End of Service Life Indicators, and manufacture's recommendations. Cartridges should be discarded after use.

Where a canister or cartridge is being used to protect against gases or vapors, the appropriate device shall

be used only if the chemical(s) has "adequate warning properties" (30 CFR Part 11.150). NIOSH considers a substance to have adequate warning properties when its odor, taste, or irritant effects are detectable and persistent at concentrations below the recommended exposure limit (REL). A substance is considered to have poor warning properties when its odor, or irritation threshold, is above the applicable exposure limit. Warning properties are essential to safe use of air-purifying respirators since they allow detection of contaminant breakthrough, should it occur. While warning properties are not foolproof, because they rely on human senses which vary widely among individuals and in the same individual under varying conditions (e.g., olfactory fatigue), they do provide some indication of possible sorbent exhaustion, poor face-piece fit, or other malfunctions. OSHA permits the use of air-purifying respirators for protection against specific chemicals with poor warning properties provided that: 1) the service life of the sorbent is known, and a safety factor has been applied or 2) the respirator has an approved end-of-service-life indicator.

13.6 Heat Stress and Other Physiological Factors

Wearing PPE puts a hazardous waste worker at considerable risk of developing heat stress. This can result in health effects ranging from transient heat fatigue to serious illness or death. Several interacting factors, including environmental conditions, clothing, workload, and the individual tolerance of the worker may lead to heat stress. Because heat stress is probably one of the most common (and potentially serious) illnesses at hazardous waste sites, regular monitoring and other preventative precautions are vital.

Individuals vary in their susceptibility to heat stress. Factors that may predispose someone to heat stress include lack of physical fitness, lack of acclimatization, age, dehydration, obesity, alcohol/ drug use, infection, sunburn, diarrhea, and chronic disease.

The amount and type of PPE worn directly influence reduced work tolerance and the increased risk of excessive heat stress. PPE adds weight and bulk, severely reduces the body's access to normal heat exchange mechanisms (evaporation, convection, and radiation), and increases energy expenditure.

Therefore, when selecting PPE, each item's benefit should be carefully evaluated in relation to its potential for increasing the risk of heat stress. Once PPE is selected, the safe duration of work/rest periods should be determined based on the anticipated work rate, ambient temperatures and other environmental factors, protective ensembles used, and individual worker characteristics and fitness. To ensure workplace safety, sufficient field staff should be present in relation to the level of PPE, ambient temperatures, etc. during site work.

13.6.1 Monitoring

Because the incidence of heat stress depends on a variety of factors, all workers, even those not wearing protective equipment, should be monitored.

Worker monitoring can include:

- Heart rate. Count the radial pulse during a 30-second period as early as possible in the rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same. If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third.
- Oral temperature. Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking). If oral temperature exceeds 99.6°F (37.6C), shorten the next work cycle by one-third without changing the rest period. If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third. Do not permit a worker to wear a semi-permeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C).

- Body water loss, if possible. Measure weight on a scale accurate to 0.25 lb. at the beginning and end of each workday to see if enough fluids are being taken to prevent dehydration. The body water loss should not exceed 1.5 % total body weight loss in a workday. Urine color charts can be posted in restrooms/porta potties to monitor body water loss. Additional information for the OSHA Heat Stress Page please see https://www.osha.gov/heat.
- Cognitive Response. Frequent checks should be given to the individual to ensure proper cognitive response. For example, asking questions and receiving appropriate responses, no slurred speech, and good response time.

13.6.2 Prevention

Proper OSHA training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important because once someone suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat injuries. To avoid heat stress, take the following steps:

- Adjust work schedules to include acclimatization period, working in cooler parts of the day, and implementation of a work/rest schedule
- Provide shelter or shade during rest periods
- Maintain worker's body fluids and nourishment at normal levels
- Provide cooling devices
- Train workers to recognize heat stress (see Table 13.2)
- Implement monitoring as described in section 13.7.1
- If possible, increase fluid intake several days prior to event.
- Have on hand adequate fluids for individuals during event
- Limit caffeine intake

Table 13.2 Signs and Symptoms of Heat Stress[1]

- Heat rash may result from continuous exposure to heat or humid air.
- Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:
  - muscle spasms
  - pain in the hands, feet, and abdomen
- Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:
  - pale, cool, moist skin
  - heavy sweating
  - dizziness
  - nausea
  - fainting
- Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action should be taken to cool the body before serious injury and death occur. Competent medical help should be obtained. Signs and symptoms are:
  - red, hot, usually dry skin
  - lack of or reduced perspiration
  - nausea
  - altered mental status
  - strong, rapid pulse
  - loss of consciousness (coma)

13.6.3 Other Factors

PPE decreases worker performance as compared to an unequipped individual. The magnitude of this effect varies considerably, depending on both the individual and the PPE ensemble used. The physiological factors, which may affect worker ability to function using PPE, include physical characteristics and health, level of acclimatization, age, and body mass. See NIOSH or OSHA for additional information https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf?id=10.26616/NIOSHPUB2016106

Heat - Personal Risk Factors | Occupational Safety and Health Administration (osha.gov)

13.7 Personal Contamination Reduction Considerations

Before a worker may enter any area of a site where potential exposure to hazardous substances exists, a site-specific decontamination procedure needs to be developed and outlined in the HASP, communicated to employees, and implemented. This section will outline measures for workers to take when leaving

[1] National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG), and Environmental Protection Agency (EPA), Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, DHHS (NIOSH) Publication No. 85-115, October, 1985.

contaminated areas at hazardous waste sites. For additional information on decontamination of sampling equipment and other instruments/equipment used on site please see Decontamination in Chapter 5. The intent of this section is to reduce the chance of spreading contamination from personal protective equipment (PPE) utilized into clean areas, to avoid contaminant exposure to workers when doffing PPE, and to address the proper handling of PPE after use and removal (disposal or decontamination and re-use). All decontamination procedures utilized at hazardous waste sites must comply with 29 CFR 1910.120 of the OSHA Standard for Hazardous Waste Operations and Emergency Response.

Contamination reduction procedures may vary among hazardous waste sites, depending upon the associated hazards. For example, after sampling a well contaminated with volatile organics, avoiding hand and skin contact is the primary control measure while doffing the PPE. Or if heavy metal contamination of soil is the hazard, then the careful removal of PPE without exposing personnel to particles and avoiding a respiratory hazard from airborne release are the main control measures.

Prior to entry, the site history should be reviewed in order to anticipate the main contaminants of concern. These contaminants, plus the potential for unanticipated contaminants, will form the basis of the site Health and Safety Plan. This information should be considered when planning decontamination procedures for workers that will exit contaminated areas at the site.

The planning for, and the setting up of the decontamination area should occur prior to any entry into any exclusion zone or contaminated areas of a hazardous waste site.

13.7.1 Steps in Doffing Disposable PPE

The procedures/methods depicted in the figures 13.1 through 13.4 below show the order recommended for contaminant reduction of personnel and for doffing PPE. These figures are adapted from the *NIOSH/OSHA/USCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*. Since the contamination hazards at hazardous waste sites vary greatly, the methods of decontamination may be adjusted by omitting, adding, or changing the stations identified to reflect the contamination hazards at a site. Once the order and method of decontamination and doffing equipment is established, is important that the method be followed by workers and monitored for its effectiveness to prevent contaminant spread and exposure to personnel.

As outlined in Chapter 4, *Site Entry Activities*, the hazardous waste site should have a designated contamination reduction zone. Decontamination/backup personnel should be wearing the appropriate PPE, based on the chemical characteristics of the contaminants at the site. In general, the level of protection worn by decontamination personnel will be one level lower than that worn by exclusion zone entry personnel. For example, if entry personnel are wearing Level B PPE, then the decontamination personnel should employ level C as a minimum for their PPE.

Additional information about donning, doffing, and decontamination procedures are available in the OSHA Technical Manual (OTM) – Section VIII: Chapter 1: https://www.osha.gov/otm/section-8-ppe/chapter-1.

13.7.2 Doffing Reusable PPE

When reusable personal protective equipment (i.e., fully encapsulated suit for work in Level A, steel toe boots and hard hats in Level B-C) is worn, it should either be decontaminated on site or carefully packed and transported for later decontamination and inspection.

13.7.3 Low Level Contamination

In many, if not most cases, site work may be conducted at sites where the contamination hazards have been determined not to warrant the use of respiratory protection. However, just because work at these sites is carried out in Level D PPE, it does not necessarily mean there is no contamination threat. Decontamination of personnel at sites with low levels of contamination, or having no exclusion zone

activities, is often overlooked.

13.7.4 Investigation Derived Waste

Investigation Derived Waste (IDW) is any waste material generated during investigation or remediation activities. These items could include (list not exhaustive):

- Purged Groundwater
- Drill Cuttings
- Decontamination Water and Rinse Water
- PPE (disposable glove, Tyvek suits, booties, etc.)
- Disposable Bailers, Soil Scoops, Mixing Spoons
- Acetate Sleeve from Soil Core
- Absorbent Pads/Booms

It is recommended that an IDW plan be included with the workplan. The materials need to be handled according to local, state and/or federal waste handling rules. IDW should also be stored in inspected containers/drums with no visible leaks, holes or deformities and should also be made of compatible materials. If purge water or drilling soils are to be drummed for offsite disposal, check with the disposal company for their specific waste classification sampling requirements. All drums need to be labeled prior to placement of waste into the drums. Disposal of PPE and sampling equipment is specific to the level of contamination at the site. Check with the local solid waste facility if this type of material is accepted or if needs to be disposed of at a specialized facility.

All haulers and disposal facilities should be licensed and approved to accept the waste being sent to them and the hauler should provide documentation for collection and disposal unless incidental supplies, i.e., gloves, are disposed of within municipal waste stream.

It is also important to take into consideration the storage of the materials, especially for offsite activities. All precautions should be made to secure the material from access by the public to protect from exposure, theft, vandalism etc. Be sure that an offsite property owner has provided authorization for waste storage.

For consideration in the IDW Plan it is recommended that the person conducting the investigation determine:

- what waste will be generated and if it will be hazardous or non-hazardous;
- how it will be managed, i.e., drummed, bagged, stockpiled, etc.
- what sampling is required
- what labeling is required;
- where will it be stored;
- is waste disposal included in the project budget;
- is the person completing the work trained in Resource Conservation and Recovery Act (RCRA) or other waste transportation rules;
- is the stored waste accessible for pick up by the waste hauler; and
- how long can the waste be stored.

For more detailed guidance check https://www.epa.gov/sites/default/files/2015-06/documents/Management-of-IDW.pdf.

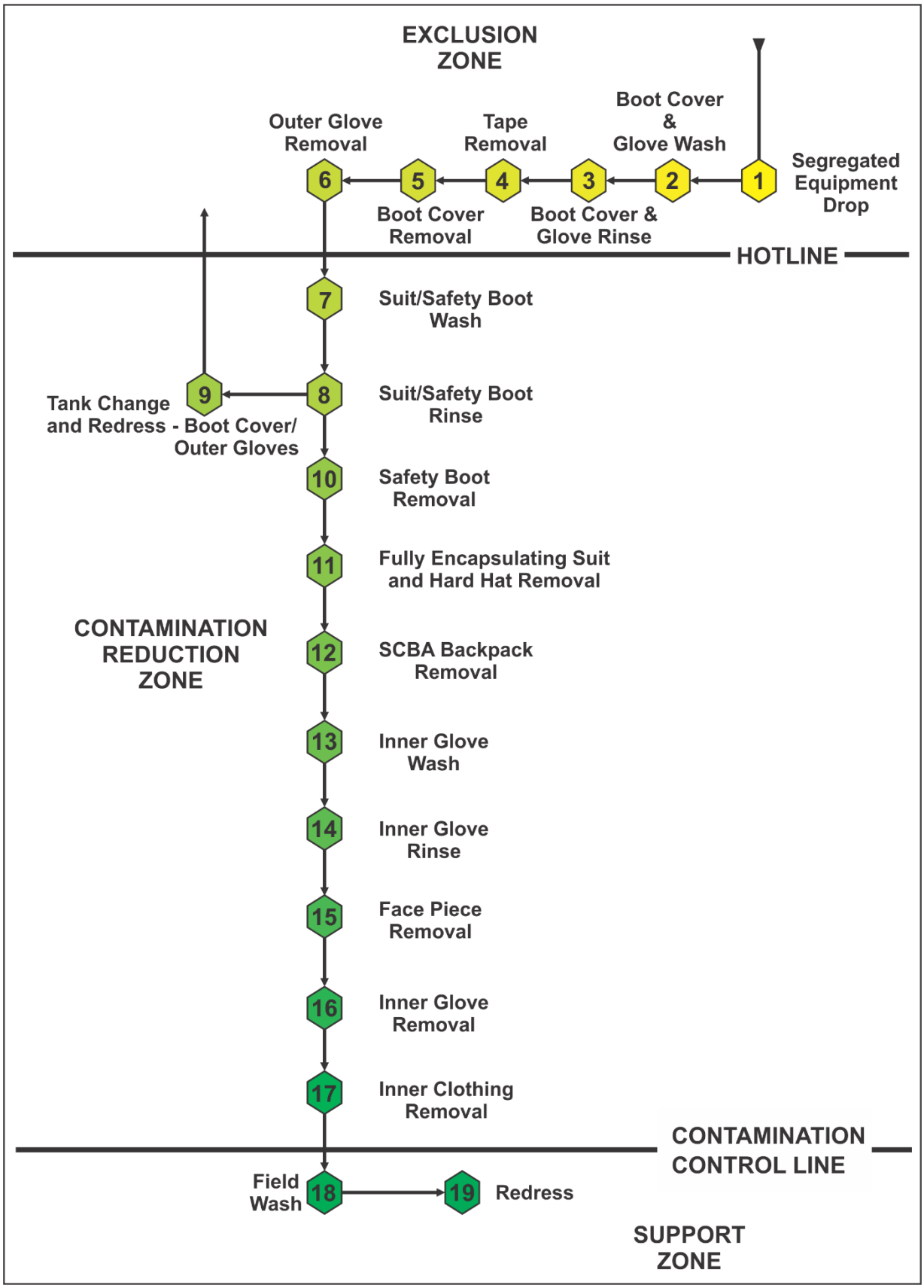

Figure 13.1 Maximum Decontamination Area Layout for Level A Protection

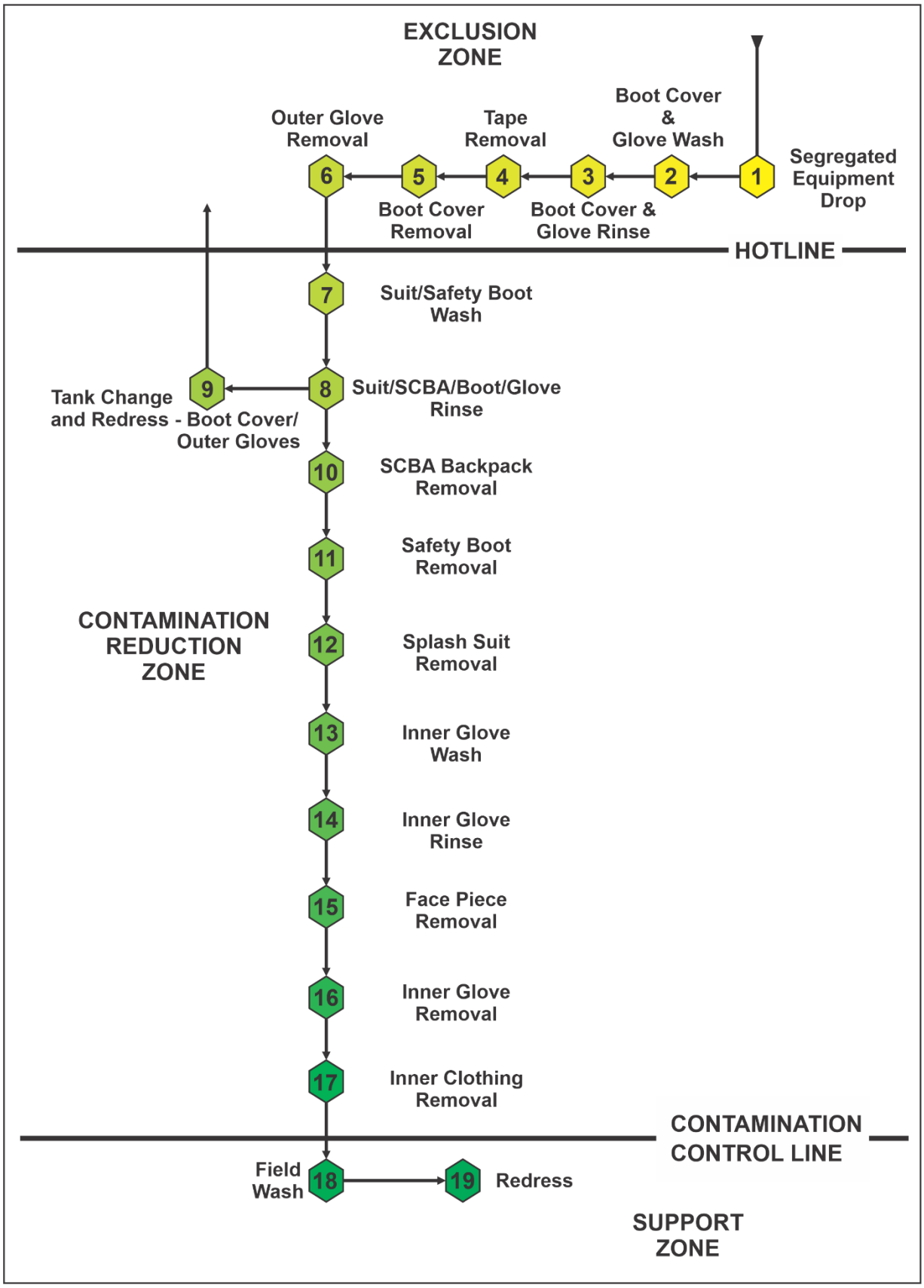

Figure 13.2 Maximum Decontamination Area Layout for Level B Protection

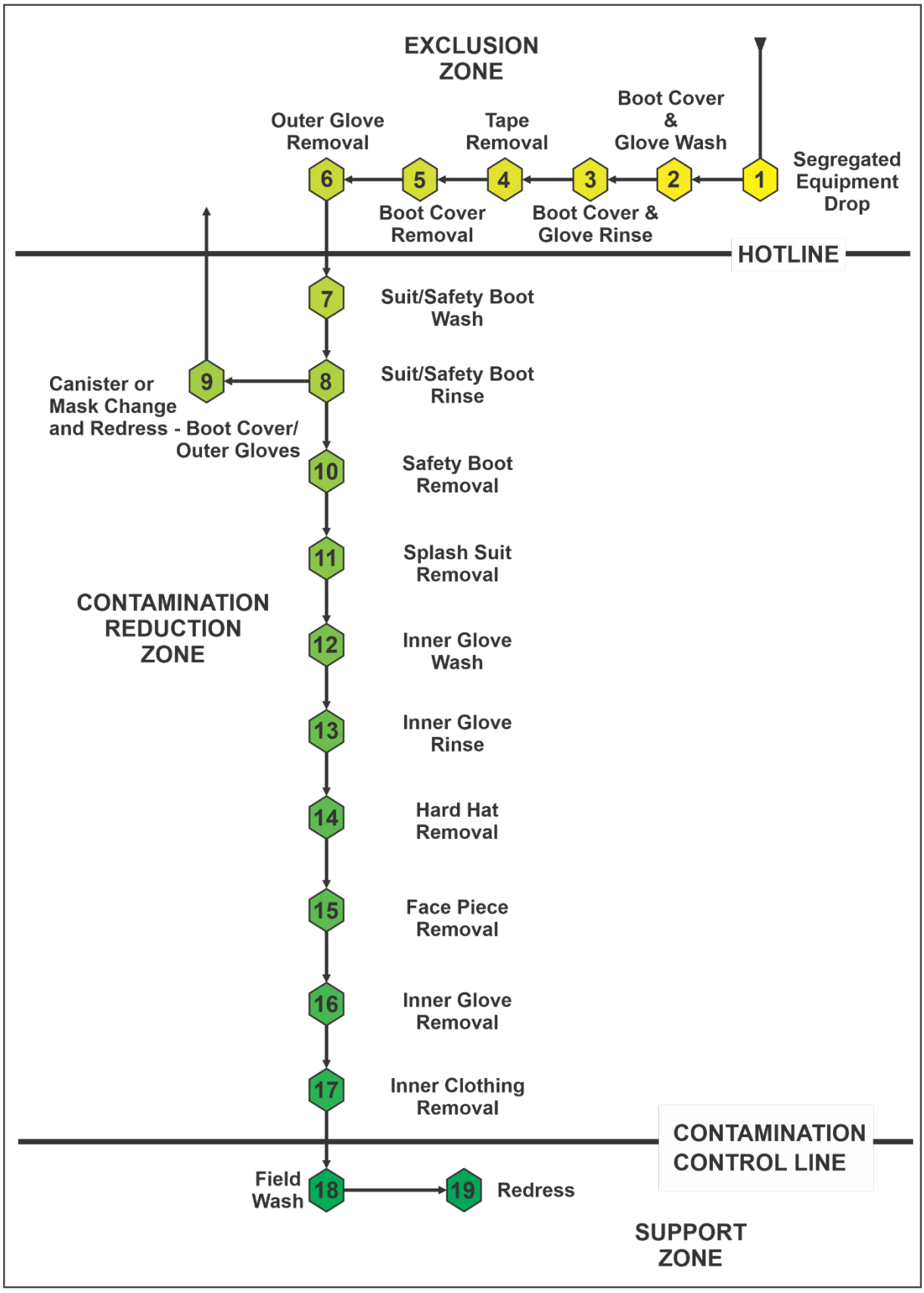

Figure 13.3 Maximum Decontamination Area Layout for Level C Protection

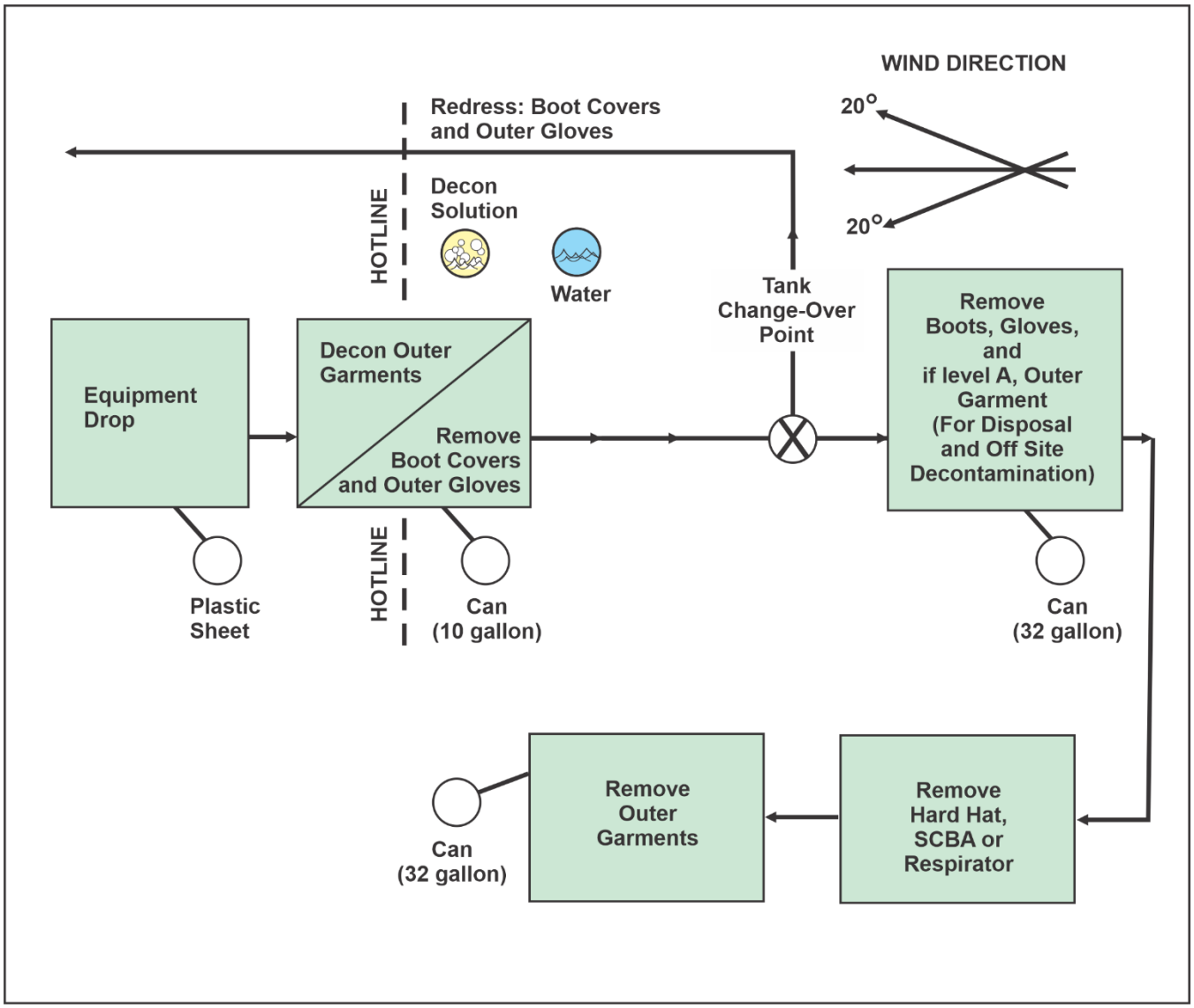

Figure 13.4 Minimum Decontamination Area Layout for Levels A through C Protection

References

National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG), and Environmental Protection Agency (EPA), Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, DHHS (NIOSH) Publication No. 85-115, October, 1985.

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eCFR :: 29 CFR 1910.120 -- Hazardous waste operations and emergency response. (appendix B to 29 CFR 1910.120- General Description and Discussion of the Levels of Protection and Protective Gear)