Personal Protective Equipment Selection for Oil Spill Responders

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OSHA specifically notes in their report, “Deepwater Horizon Oil Spill: OSHA’s Role in the Response, May 2011,” that personal protective equipment (PPE) was “essential for protecting workers...,” but they (OSHA) “stressed throughout the response that decisions about PPE should be based on a scientific characterization of the hazards, including air sampling…” On their PPE Matrix used during Deepwater Horizon, it is footnoted that certain PPE (e.g. full body chemical protective clothing) should only be worn when a “specific hazard associated with the given job exists and warrants wearing of this protection,” and that this is decided by the on-site safety representative conducting a field job hazard analysis. This seemingly mundane footnote is in fact at the crux of the matter, which supports the need of literature that this document is meant to alleviate. During the Deepwater Horizon Oil Spill, untrained safety personnel regularly failed to properly follow the model. Instead, the “one-size-fits-all” approach is viewed as the quickest and easiest answer to what PPE should be worn, and the PPE Matrix is implemented and codified in the Site Safety Plan.

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1 Scope

1.1 General

This recommended practice (RP) provides general information and guidance for the development of oil spill responder personal protective equipment (PPE) control measures. Although an extensive amount of information has been developed on the topic of PPE for emergency responders, this document focuses on the PPE selection process as well as its technical evaluation based on the hazards present.

This RP is intended for any company, organization, or agency that oversees or responds to oil spills. It is not a comprehensive "how-to" guide to selecting PPE for every type of situation that may be encountered; rather, it is a guidance document that discusses how proper PPE selection may be a useful control measure for responders when engineering and administrative controls may not be feasible or effective in reducing exposure to acceptable levels.

1.2 Purpose

The purpose of this RP is to assist users in developing effective PPE control measures for oil spill responses using a systematic approach.

1.3 Background

PPE is often the primary control employed during emergency response operations. PPE and administrative controls often rise to the forefront of oil spill response activities due to inherent delays involved in the implementation of effective engineering controls.

Choosing and implementing PPE as a response control measure is never a "one-size-fits-all" solution. A general PPE selection matrix such as the one shown in Annex A is a useful tool, but the proper selection of PPE requires a risk assessment (RA). Further, when working conditions change or the training provided to responders is no longer appropriate due to changing conditions, a reassessment is necessary. Response organizations, due to the failure to assess hazards appropriately, may overprescribe PPE in an attempt to ensure both compliance and protection; however, this approach has its drawbacks because the unnecessary use of PPE may actually increase the risk of injury or illness.

> "*In general, the greater the level of chemical protective clothing, the greater the associated risks. For any given situation, equipment and clothing should be selected that provide an adequate level of protection. Overprotection as well as under-protection can be hazardous and should be avoided*." (*OSHA Technical Manual*) [1]

Though practitioners may use other terminology and similar processes, this RP provides a methodology for conducting an evaluation of the conditions and choosing the appropriate PPE by assessing the hazards associated with the work environment. The process consists of:

job hazard analysis (JHA) + risk assessment (RA) = job safety analysis (JSA)

Often a JHA is done without the RA. As the work, environment, or responder conditions change, or if there is an indication that the control measures are not working as intended (e.g. several responders

[1] U.S. Department of Labor, Occupational Safety and Health Administration, 200 Constitution Avenue, NW, Washington, DC 20210, www.osha.gov.

have heat-related injuries), the JSA process shall be repeated to ensure that control measures are still current and effective.

1.4 Benefits

An effective PPE program ensures that the responders are able to perform their job functions while mitigating their exposure to the stressors created by the use of PPE. These stressors include but are not limited to heat stress created by wearing impermeable chemical protective clothing (CPC), the decreased visibility of a full-face respirator mask, and the increased strain of wearing personal flotation devices (PFDs). In general, any form of PPE can increase the workload as work on oil spill cleanup operations is normally conducted under adverse conditions. An effective PPE program:

— ensures that the selected PPE is the best suited for that particular job,

— attempts to reduce personal discomfort,

— recognizes a possible decrease in manual dexterity,

— strives for a reduction of waste and disposal,

— maximizes responder efficiency and effectiveness by avoiding unnecessary stress.

1.5 Responsibilities

1.5.1 Employer

The employer shall assess the workplace to determine if hazards are present that require the use of PPE. If such hazards are present, the employer shall:

— select protective equipment and require responders to use it;

— communicate protective equipment selection decisions to responders;

— select PPE that fits responders properly;

— train responders who are required to wear PPE on how to do the following:

  — use protective equipment properly;

  — be aware of when PPE is necessary;

  — know what kind of protective equipment is necessary;

  — understand the limitations of PPE in protecting responders from injury;

  — put on, adjust, wear, and take off PPE;

  — maintain protective equipment properly; and

  — use the appropriate disposal method.

1.5.2 Responders

Responders shall:

— properly wear PPE to provide protection;

— attend training sessions to learn how to use PPE (i.e. practice doffing and donning);

— care for, clean, and maintain PPE;

— inform a supervisor of the need to repair or replace PPE; and

— understand the limitations of PPE designed to protect from chemical hazards that can come in contact with skin and eyes.

2 Terms, Definitions, Acronyms, and Abbreviations

2.1 Terms and Definitions

For the purposes of this specification, the terms and definitions given in ISO 9000 and the following shall apply. When identical terms are defined in ISO 9000 and this specification, the following definitions shall apply.

2.1.1
absorption
Penetration of a chemical substance, a pathogen, or radiant energy through the skin or mucous membrane that occurs when the chemicals are transported from the outer surface of the skin into the systemic circulation.

NOTE Should this occur, the chemical then moves through the circulatory system, which depending on the properties of the chemical could cause organ damage or illness.

2.1.2
action level
Observed condition or measured level of exposure to a harmful substance, condition, or hazard that would identify the need for the implementation of a management action, at times determined by regulatory mandate, appropriate to address such condition.

2.1.3
assigned protection factor
APF
Workplace level of respiratory protection that a respirator or class of respirators is expected to provide to a population of properly fitted and trained users.

NOTE For example, an APF of 10 for a respirator means that a user could expect to inhale no more than one tenth of the airborne contaminant present.

2.1.4
benzene
Known carcinogen that is a natural component of coal and petroleum; a colorless liquid hydrocarbon highly flammable and toxic by inhalation, ingestion, and absorption; and an aromatic compound with a sweet smell.

2.1.5
claustrophobia
Fear of having no escape and being enclosed in small spaces or rooms.

2.1.6
confined space
A tank or space that meets all three of the following requirements:

— is large enough and so configured that a responder can bodily enter and perform assigned work;

— has limited or restricted means for entry or exit (e.g. tanks and vessels, storage bins, hoppers, vaults, and pits); and

— is not designed for or meant to be continuously occupied by personnel.

2.1.7
exclusion zone
hot zone
Zone that is usually set up in the immediate area surrounding the spilled material or incident scene.

NOTE Access to the exclusion zone should be controlled for accountability purposes as well as contamination control purposes.

2.1.8
Flame-resistant clothing
Clothing that is treated with chemicals and/or made of material that resists igniting if the responder is exposed to fire or heat.

NOTE 1 Flame-resistant clothing helps to protect responders, for instance, such as those responders in the igniter boat during ISB.

NOTE 2 The clothing should be cleaned, maintained, and regularly inspected in accordance with the manufacturer's instructions.

NOTE 3 Some flame-resistant clothing may lose its protective qualities after repeated or improper cleanings. Wearing any flammable clothing over flame-resistant clothing negates the flame-resistant protection.

NOTE 4 Flame-resistant clothing should be selected in accordance with 29 *CFR* Subpart I (*Personal Protective Equipment*), Section 1910.132 (*General Requirements*).

2.1.9
flammable gas
Substance that exists exclusively in the gaseous state at normal atmospheric pressure and temperature and is capable of igniting and burning when mixed with air (oxygen) in the proper proportion and subjected to a source of ignition.

2.1.10
hazard
Potential for adverse or harmful consequences. In practical terms, a hazard is often associated with an activity or condition that, if left uncontrolled, can result in injury, illness, death, property damage, business interruption, harm to the environment, or an impact on the reputation of an entity.

2.1.11
hazard analysis
Comprehensive analysis of the task (job) or work site to identify actual and potential hazards that a responder may encounter while performing the work and the selection of means of controlling or eliminating them.

2.1.12
hazardous atmosphere
Atmosphere that has the potential to expose entrants to the risk of death, incapacitation, impaired ability to self-rescue (e.g. escape unaided from a permit required confined space), injury, or acute illness from one or more of the following causes:

— flammable gas, vapor, or mist in excess of 10 % LEL;

— airborne combustible dust at a concentration that meets or exceeds its LEL;

— atmospheric oxygen concentrations below 19.5 % and above 23.5 %;

— atmospheric concentration of any substance for which a dose or OEL is published in applicable government regulations, safety data sheets (SDS), standards, or other published or internal documents and could result in responder exposure in excess of its dose or PEL;

— any other IDLH atmospheric condition.

2.1.13
hydrogen sulfide
H_2S
Colorless, flammable, extremely hazardous gas with a “rotten egg” smell that occurs naturally in crude petroleum, natural gas, and hot springs and is produced by bacterial breakdown of organic materials and human and animal wastes (e.g. sewage).

NOTE 1 Some common names for the gas include sewer gas, stink damp, swamp gas, and manure gas.

NOTE 2 Industrial activities that can produce the gas include petroleum/natural gas drilling and refining, wastewater treatment, coke ovens, tanneries, and paper mills. Hydrogen sulfide can also exist as a liquid compressed gas.

2.1.14
immediately dangerous to life or health
IDLH
Value defined by OSHA in their HAZWOPER regulation as an atmospheric concentration of any toxic, corrosive or asphyxiating substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere” (29 *CFR* 1910.120).

2.1.15
Incident Commander
IC
Individual responsible for the overall management of the response—responsible for all aspects of the response, including developing incident objectives and managing all incident operations, setting priorities, and defining the Incident Command System (ICS) organization for the particular response.

NOTE 1 Even if other positions are not assigned, the IC is always designated.

NOTE 2 The IC may assign deputies, who may be from the same agency or from assisting agencies; deputies may also be used at section and branch levels of the ICS organization.

NOTE 3 Deputies must have the same qualifications as the person for whom they work, as they must be ready to take over that position at any time.

2.1.16
in situ burning
ISB
Burning oil in place (Latin, “in situ”) is a response technique used to lessen the amount of the oil reaching sensitive areas, which can be employed when the thickness of the oil is sufficient to sustain combustion and can be used on both water and land.

2.1.17
job hazard analysis
JHA
Safety management technique that is used to anticipate and identify hazards in order to make decisions to appropriately control the hazards associated with a process, job, or procedure.

NOTE Any job that has actual or potential hazards is a candidate for a JHA.

2.1.18
job safety analysis
JSA
Job hazard analysis (JHA) accompanied by a risk assessment (RA), used to identify controls such as PPE requirements: JHA + RA = JSA.

2.1.19
lower explosive (flammable) limit
LEL
Minimum concentration of combustible gas or vapor in air (expressed in percent of gas or vapor in air by volume) below which propagation of flame does not occur on contact with an ignition source.

NOTE Lower flammable limit (LFL) is synonymous with lower explosive limit (LEL).

2.1.20
nonroutine responder
Individual responders who do not have experience in oil spill response, who are not affiliated with an oil spill removal organization (OSRO), and who have not received training in accordance with OSHA regulation under 29 *CFR* 1910.120 prior to introduction to response theater.

2.1.21
occupational exposure limit
OEL
Upper limit of the acceptable concentration of a hazardous substance in the environment for a particular material or substance typically established by an authority having jurisdiction (AHJ).

2.1.22
oil spill removal organization
OSRO
Any person or persons who owns or otherwise controls oil spill removal resources that are designed for, or are capable of, removing oil from the water or shoreline, providing response equipment and services, individually or in combination with subcontractors or associated contractors, under contract or other means approved by the President, directly to an owner or operator of a facility or tank vessel required to have a response plan under 33 USC 1321(j)(5).

NOTE 1 Control of such resources through means other than ownership includes leasing or subcontracting of equipment or, in the case of trained personnel, by having contracts, evidence of employment, or consulting agreements.

NOTE 2 OSROs must be able to mobilize and deploy equipment or trained personnel and remove, store, and transfer recovered oil.

NOTE 3 Persons such as sales and marketing organizations (e.g. distributorships and manufacturer's representatives) that warehouse or store equipment for sale are not OSROs.

2.1.23
particulate matter
Suspension of fine solid or liquid particles in air, such as dust, fog, fume, mist, smoke, or sprays.

NOTE Particulate matter suspended in air is commonly known as an aerosol.

2.1.24
permissible exposure limit
PEL
Exposure limit that is published and enforced by OSHA as a legal standard (see 29 *CFR* 1910.1000, Subpart Z), expressed as 8-hour TWAs, ceiling values, and STELs.

2.1.25
personal protective equipment
PPE
Clothing and equipment designed to protect responders from serious workplace injuries or illnesses resulting from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards.

NOTE Besides face shields, safety glasses, hard hats, and safety shoes, protective equipment includes a variety of devices and garments such as goggles, coveralls, gloves, vests, earplugs, and respirators.

2.1.26
responsible party
RP
Person, business, or entity that has been identified as owning the vessel or facility that caused the spill.

NOTE The term does not imply criminal negligence.

2.1.27
risk
Probability and consequences of exposure to a hazard, hazardous environment, or situation that could result in harm to personnel, the environment, or general public.

2.1.28
risk assessment
RA
Component of a JSA, where a determination of the expected level (severity) of illness, injury, and/or property damage that an identified hazard can cause is coupled with the frequency (probability) of that level of hazard occurring.

NOTE 1 This is then plotted on a matrix to determine the level of risk associated with that job.

NOTE 2 If the level of risk is not acceptable, control measures are introduced to reduce the risk to an acceptable level.

2.1.29
safety
Freedom from those conditions that can cause death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment.

2.1.30
sheen
Very thin layer of oil (less than 0.0002 in. or 0.005 mm) floating on the water surface; this is the most common form of oil seen in the later stages of a spill.

NOTE According to their thickness, sheens vary in color from rainbows (for the thicker layers) to silver/gray (for thinner layers) to almost transparent (for the thinnest layers).

2.1.31
short-term exposure limit
STEL
Fifteen-minute TWA exposure limit that shall not be exceeded at any time during a workday unless another time limit is established.

2.1.32
site safety plan
SSP
Plan that addresses the specific safety and health hazards of the site and the requirements and procedures for responder protection.

NOTE Site safety plan is also referred to as site safety and health plan and should encompass all phases of the operation and be kept on site.

2.1.33
skin contact
Touching a substance without any barrier protection leading to chemicals being absorbed through the pores or harm to the skin's surface.

2.1.34
system
Integrated composite of people, products, and processes that provide a capability to satisfy a stated need or objective.

2.1.35
tarballs
Discrete, and usually pliable, globules of weathered oil, ranging from mostly oil to highly emulsified with varying amount of debris and/or sediment.

NOTE Tarballs may vary in size from millimeters to 20–30 centimeters across, and depending on exactly how "weathered," or hardened, the outer layer of the tarball is, sheen may or may not be present.

2.1.36
time-weighted average
TWA
Average airborne exposure in any 8-hour work shift of a 40-hour workweek that shall not be exceeded (see 29 *CFR* 1910.1000, Table Z2).

2.1.37
volatile organic compound
VOC
Organic compound that participates in atmospheric photochemical reactions.

2.2 Abbreviations and Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
AHJ	authority having jurisdiction
ANSI	American National Standards Institute
APF	assigned protection factor
APR	air-purifying respirator
ASTM	American Standard for Testing and Materials
ATV	all-terrain vehicle
CFR	*Code of Federal Regulations*
CPC	chemical protective clothing
dBA	decibels (A-weighted scale)
H_2S	hydrogen sulfide
HAZWOPER	Hazardous Waste Operations and Emergency Response
HCP	hearing conservation program
HPD	hearing protective device
IC	Incident Commander
ICS	Incident Command System
IDLH	immediately dangerous to life or health
IH	Industrial Hygienist
ISB	in situ burning
JHA	job hazard analysis
JSA	job safety analysis
LEL	lower explosive (flammable) limit
MUC	maximum use concentration
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
NRR	Noise Reduction Rating
OEL	occupational exposure limit
OSHA	Occupational Safety and Health Administration
OSRO	oil spill removal organization
OVM	organic vapor monitor
PAPR	powered air-purifying respirator
PEL	permissible exposure limit
PFD	personal flotation device
PPE	personal protective equipment
PVC	polyvinyl chloride
RA	risk assessment
RP	responsible party
SCBA	self-contained breathing apparatus
SDS	safety data sheets
SSP	site safety plan
STEL	short-term exposure limit
TWA	time-weighted average

UC	Unified Command
USCG	U.S. States Coast Guard
UTV	utility-terrain vehicle
UV	ultraviolet
VOC	volatile organic compound

3 Conducting a JSA for PPE Selection

3.1 General

Oil spill response operations present a wide range of hazards from vessel operations to onshore decontamination work. A job safety analysis (JSA), defined as a job hazard analysis (JHA) accompanied by a risk assessment (RA), is used to identify controls, such as PPE requirements. Once the JSA process is completed, engineering and administrative controls are exhausted, and PPE is required to protect responders from hazards, PPE shall be appropriately evaluated for practicality. Responders can be exposed to additional risks by requiring unnecessary PPE such as wearing hard hats on a hot sunny beach with no overhead hazard when a sunhat would be much better protection.

3.2 Mandatory Requirements

The employer shall assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of PPE [29 *CFR* 1910.132*(*d)(1)]. If such hazards are present, or likely to be present, the employer shall:

1) select, and have each affected responder use, the types of PPE that protects the affected responder from the hazards identified in the hazard assessment [29 *CFR* 1910.132(d)(1)(i)];

2) communicate selection decisions to each affected responder [29 *CFR* 1910.132(d)(1)(ii)];

3) select PPE that properly fits each affected responder;

   NOTE Nonmandatory Annex B contains an example of procedures that would comply with the requirement for a hazard assessment [29 *CFR* 1910.132(d)(1)(iii)].

4) verify that the required workplace hazard assessment has been performed through a written certification that identifies the workplace evaluated; the person certifying that the evaluation has been performed; the date(s) of the hazard assessment; and the document as a certification of hazard assessment [29 *CFR* 1910.132(d)(2)];

5) avoid the use of defective or damaged PPE [29 *CFR* 1910.132(e)].

3.3 Responsibility for Conducting JSA

A JSA is a team effort requiring the participation of personnel familiar with the type of work to be performed and its hazards. The team should involve but not be limited to the following types of personnel: responders, field supervisors, safety personnel, and responders with practical knowledge of process/activity of the activity being assessed. During oil spill responses, this task is usually completed by safety personnel; however, safety personnel should work with others knowledgeable of the activities to ensure that the analysis is comprehensive and accurate. Large oil spill incidents may not have their command post close to the field operations; therefore, it becomes even more critical for field supervisors and safety personnel to work with the command staff when performing a JSA in order to make PPE decisions.

3.4 Methodology for Determining PPE Requirements

3.4.1 Introduction

The following information and Figure 1 shall be used to determine the most appropriate PPE for the job. PPE requirements are based off of the responders' work assignments and their specific tasks. Work assignments [documented on Incident Command System (ICS) Form 204] are developed during the Tactics Meeting. During this meeting, Command and General Staff members determine the best strategies and tactics to achieve the Incident Commander/Unified Command's (IC/UC's) mission goals and objectives. There should be a clear path from the mission goals to the objectives and subsequent strategies and tactics. PPE selection then becomes a natural next step in achieving the overall goals. The reasoning behind the specific PPE selected should be unambiguous and strive to ensure that the responders are not only protected but their ability to perform the work assignment is unimpeded.

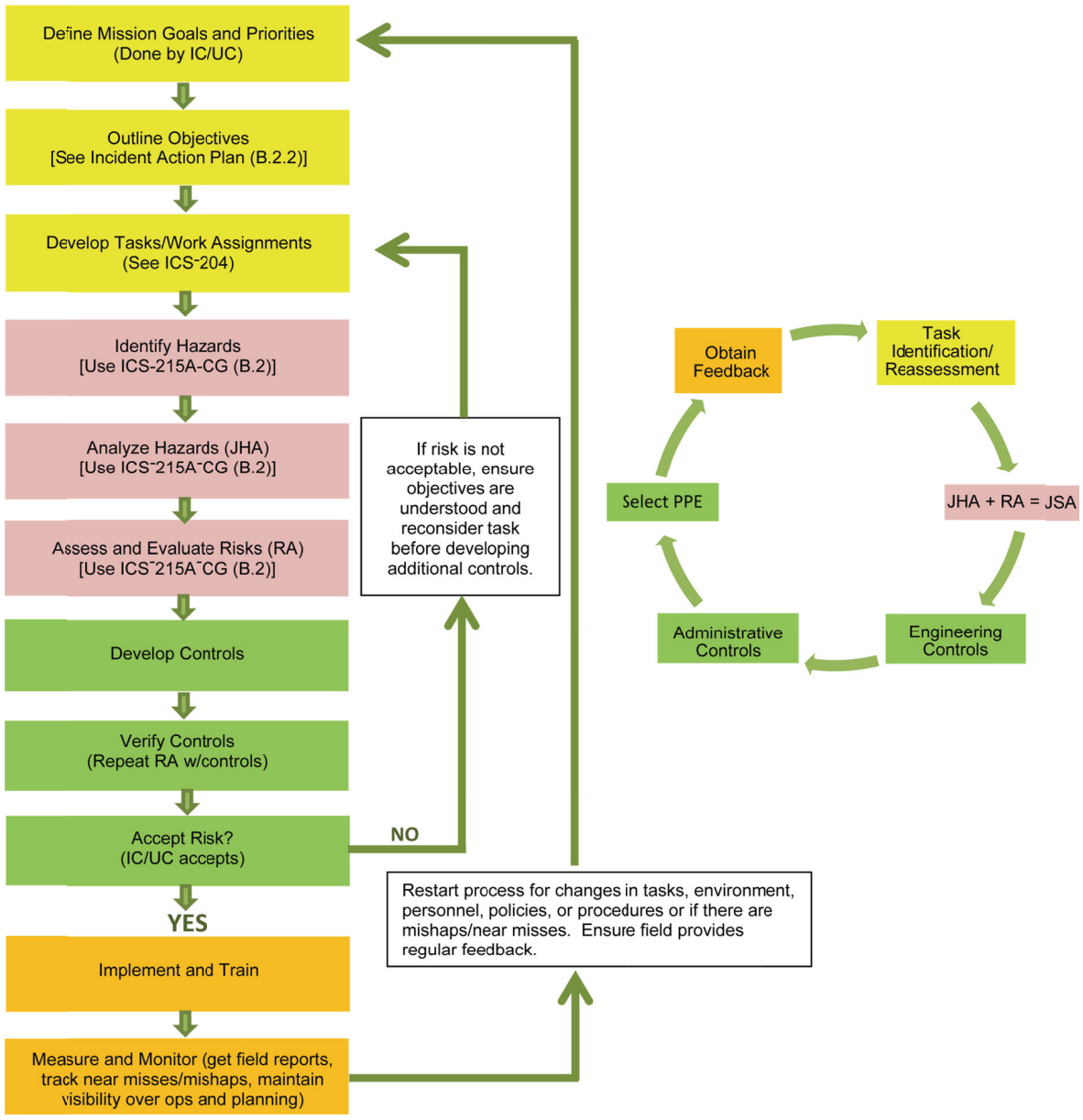


Figure 1—Job Safety Analysis Flow Chart (Forms Referenced are Used as Examples)

3.4.2 Define Mission Goals and Priorities

The first step in determining the response's PPE requirements is defining the mission goals and priorities. This happens during the Incident Command/Unified Command Objectives Meeting where the IC/UC develops overarching goals, priorities, and objectives. Goals are a statement of direction for the incident and define what desired end points need to be accomplished to consider the response a success. The primary goal is to achieve a "Best Response" where adverse impacts and consequences of the incident are minimized, and public confidence and stakeholder satisfaction are maximized. Examples of "Best Response" goals are:

a) human health and safety:

   — no public injuries, illness, or deaths;

   — no responder injuries, illness, or deaths;

   — aggressive responder stress management;

   — highly effective family outreach program;

b) environment:

   — sensitive areas protected,

   — resource damage minimized.

Priorities are areas or items of importance that need to be considered during all stages of a response (before, during, and post-operations) in order to ensure that the response has the best chance of success. Unlike mission goals that tend to remain consistent, priorities and their relative rankings can change from one operational period to another.

Examples of incident priorities are as follows:

— safety of responders and the public,

— homeland security,

— incident stabilization,

— environmental impact,

— transportation infrastructure/maritime commerce restoration,

— information management/situation awareness,

— property protection,

— investigation/apprehension of those responsible,

— crime scene preservation/evidence collection,

— threat/attack prevention.

3.4.3 Outline Objectives

During the IC/UC Objective Meeting, in addition to the goals and priorities, the objectives are also outlined. Objectives are the desired outcomes for the response and are based off of the goals. Objectives, in order to be effective, need to be specific, measurable, attainable, realistic, and time sensitive. They also need to be flexible enough to allow for strategic and tactical alternatives. The Incident Command System is built on the principle of "Management by Objectives." This is a top-down management activity that involves the following steps to achieve the mission goal: (1) establishing incident objectives, (2) selecting appropriate strategy(s) to achieve the objectives, and (3) defining the tactical direction associated with the selected strategy. Once written, objectives need to be checked against the mission goals to ensure that there is a unity of effort.

Examples of incident objectives are:

a) safety:

   — provide for the safety and welfare of citizens and response personnel,

   — provide for the safety and security of responders and maximize the protection of public health and welfare,

   — conduct operational RA and ensure controls are in place to protect responders and the public;

b) oil/hazmat spills:

   — initiate actions to control the source and minimize the volume released;

   — determine oil/hazmat fate and effect (trajectories), identify sensitive areas, develop strategies for protection, and conduct preimpact shoreline debris removal;

   — contain and recover spilled material (oil/hazmat);

   — conduct an assessment and initiate shoreline cleanup efforts;

   — remove product from impacted areas;

   — conduct efforts to effectively contain, clean up, recover, and dispose of spilled product;

c) environmental:

   — provide protection of environmentally sensitive areas, including wildlife and historic properties;

   — identify and maximize the protection of environmental sensitive areas;

   — identify threatened species and prepare to recover and rehabilitate injured wildlife;

   — investigate the potential for and, if feasible, use alternative technologies to support response efforts.

3.4.4 Develop Tasks and Work Assignments

Once developed, the IC/UC briefs the Command and General Staff on the direction of the response. The IC/UC explains the goals, priorities, and objectives and assign responsibilities. The Operations Section Chief is tasked to develop strategies and tactics to meet the objectives. The Safety Officer, in order to

assist in the operations, attends the pretactics meeting(s) and the Tactics Meeting. The role of Safety is to conduct a JSA and RA while the proposed strategies and tactics are discussed and ensure that the operations can be supported. It is noted for immediate attention if controls such as training or PPE are needed for the operations. If it becomes apparent that the tactics being discussed pose an unacceptable level of risk, even with feasible controls, Safety discusses the possibility of other options with the Operations Section.

3.4.5 JHA + RA = JSA

3.4.5.1 Where to Begin

3.4.5.1.1 General

A sample JHA form is in B.1. The terms JHA and JSA are used interchangeably in many documents. For the purpose of this document, a JSA is a JHA combined with a RA. The basic steps for conducting a JHA are as follows.

— *Basic Job Steps*—Break the job into a sequence of steps. Each of the steps should accompany some major task. That task consists of a series of movements. Look at each series of movements within that basic task.

— *Potential Hazards*—Identify all the hazards or potential hazards associated with each step. It is very important to look at the entire environment to determine every conceivable hazard that might exist.

— *Recommended Safe Job Procedures*—Using the sequence of basic job steps and potential hazards, decide what actions are necessary to eliminate, control, or minimize hazards that could lead to accidents, injuries, damage to the environment, or possible occupational illness. Each safe job procedure or action must correspond to the job steps and identified hazards.

3.4.5.1.2 Involve Responders

Involving responders in the hazard analysis process is important. They have a unique understanding of the job, and this knowledge is invaluable for defining the hazards. Moreover, involving responders reduces required oversight, ensures a quality analysis, and gains responders' "buy in" to the solutions they helped create.

3.4.5.1.3 Review Accident History

A thorough review of accidents from previous, similar oil spills is often not feasible due to the unique nature of each spill and subsequent response. Reviewing past response information, however, is sometimes possible or can be done during spill response planning and exercises. When training responders on how to handle an oil spill response, review JSAs, task or RAs, emergency response planning plans, past exercises or after-action reports of similar incidents, and the worksite's history of accidents, near misses, and occupational illnesses. Lessons learned from past events aid in planning and preparing for future responses as they indicate where existing control measures may not be adequate.

3.4.5.1.4 Conduct a Preliminary Job Review

Discuss with responders the hazards they know exist in their current work and surroundings. Brainstorm with them for ideas on how to eliminate or control the hazards.

3.4.5.1.5 List, Rank, and Set Priorities for Hazardous Jobs

List jobs with hazards that present unacceptable risks, based on those most likely to occur and with the most severe consequences. These jobs should be the first priority for analysis (Table 1).

Table 1—Risk Assessment Matrix

			Probability				
Severity			1	2	3	4	5
			Unlikely	Seldom	Occasional	Likely	Frequent
	1	Negligible	2	3	4	5	6
	2	Minor	3	4	5	6	7
	3	Moderate	4	5	6	7	8
	4	Critical	5	6	7	8	9
	5	Catastrophic	6	7	8	9	10

Red: Activities in this area are considered unacceptable levels of risk, including catastrophic and critical injuries that are highly likely to occur. Organizations should consider whether they should eliminate or modify activities that still have this rating after applying all reasonable risk management strategies.

Yellow: Activities in this area are considered critical and may cause severe injury, major property damage, significant, financial loss, and/or result in negative publicity for the organization and/or institution.

Green: Activities in this area are considered minor or negligible hazards that present a minimal threat to the safety, health, and well-being of participants. They contain minimal risk and are unlikely to occur. Organizations can proceed with these activities as planned and handle through routine procedures.

3.4.5.1.6 Outline the Steps or Tasks

Nearly every job can be broken down into job tasks or steps. When beginning a JHA, watch the responder perform the job and list each step as the responder takes it. Be sure to record enough information to describe each job action without getting overly detailed. Avoid making the breakdown of steps so detailed that it becomes unnecessarily long or so broad that it does not include basic steps. Input from other responders who have performed the same job may be valuable. Later, review the job steps with the responder to make sure nothing has been omitted. The job itself should be evaluated, not the responder's job performance. Include the responder in all phases of the analysis—from reviewing the job steps and procedures to discussing uncontrolled hazards and recommended solutions. Sometimes, in conducting a JHA, it may be helpful to photograph or videotape the responder performing the job. These visual records can be references when doing a more detailed analysis of the work.

3.4.6 Hazard Identification

3.4.6.1 General

Thorough investigations of existing or potential hazards that pose danger to a responder's life or health require immediate action. Any problems that can be corrected immediately should be done without delay. Do not wait to complete the JSA process. This is essential to demonstrate an immediate commitment to safety and health and allows the focus to be on the hazards and jobs that need more study.

3.4.6.2 Identifying Workplace Hazards

A JHA is an exercise in detective work. The goal is to discover the following.

— What can go wrong?

— What are the consequences?

— How could it arise?

— What are other contributing factors?

— How likely is it that the hazard occurs?

The answers should be documented in a consistent manner. Describing a hazard in this way helps to avoid or eliminate the hazard and implement hazard controls that target the most important contributors to the hazard.

Good hazard scenarios describe:

— where it is happening (environment),

— who or what it is happening to (exposure),

— what precipitates the hazard (trigger),

— the outcome that would occur should it happen (consequence), and

— any other contributing factors.

A sample form helps responders organize information to provide these details. Rarely is a hazard a simple case of one singular cause resulting in one singular effect. More frequently, many contributing factors tend to line up in a certain way to create the hazard (B.1).

3.4.7 Assess and Evaluate Risk

3.4.7.1 General

Use Table 1, Table 2, and Table 3 to establish a numeric value of the risk.

Table 2—Severity

Severity		
Negligible	1	First aid or minor medical treatment
Minor	2	Minor injury, lost workday
Moderate	3	Moderate injury resulting in lost workdays
Critical	4	Permanent or partial disability
Catastrophic	5	Death or permanent total disability

Table 3—Probability of Occurrence

Probability		Description
Frequent	5	Expected to occur in most circumstances
Likely	4	Will probably occur in most circumstances
Occasional	3	Occurs sporadically, not regularly
Seldom	2	Unlikely but could occur at some time
Unlikely	1	May occur only in exceptional circumstances

3.4.7.2 Combining the JHA and RA

Once a JHA and RA are completed, these are combined to create a JSA [U.S. Coast Guard (USCG) form, ICS- 215 A, is included in B.2.2]. It is possible that adding the RA portion reveals that the PPE itself may create a greater risk than the risk the PPE is being used to protect against. For example, responders working in CPC in areas with low levels of contamination may have a higher risk of a heat-related injury than a hazardous chemical exposure. Conversely, the RA may show that the job is too dangerous as is proposed even with control measures.

3.4.8 Develop and Implement Controls

3.4.8.1 Engineering Controls

The first and best strategy is to control the hazard at its source. The basic concept behind engineering controls is that, to the extent feasible, the work environment and the job itself should be designed to eliminate hazards or reduce or avoid exposure to hazards.

3.4.8.2 Administrative Controls

Administrative controls are measures aimed at reducing responder exposure to hazards. These measures may include signage, additional relief responders, exercise breaks, and rotation of responders. These types of controls are normally used in conjunction with other controls that more directly prevent or control exposure to the hazard.

3.4.8.3 PPE

When engineering and administrative controls are not sufficient to reduce the responder exposure to hazards below the applicable occupational exposure limits (OELs), then PPE required. It is important to note that PPE is last control measure in the hierarchy of controls.

3.4.9 Verify Controls/Accept Risk

Complete the RA process to verify that the controls do not increase the risk or create new hazards. Using command guidance, the risk is accepted or the decision is elevated to a higher level.

3.4.10 Implement Controls, Train, and Complete Task

After the controls are implemented, responders are trained and the task(s) is started, obtaining feedback is essential in evaluating the strengths and weaknesses of measures taken to ensure responder safety. There are many methods for obtaining feedback, for example:

— responder observation,

— responder interview,

— project planning,

— environmental sampling,

— accident history review.

3.4.11 Measure and Monitor Effectiveness of Controls

The hazard analysis process is cyclical and continuous reassessment is necessary to ensure that it remains current and continues to help reduce workplace accidents and injuries. Even if the job has not

changed, it is possible that during the review process hazards may be identified that were not identified in the initial analysis. It is particularly important to review the JSA if an illness or injury occurs on a specific job. Based on the circumstances, it may be determined that a change to the job procedure or control measure is needed to prevent similar incidents in the future. If a responder's failure to follow proper job procedures results in a "close call," the situation should be discussed with all responders who perform the job and remind them of the proper procedures. Any time a JSA is reviewed, it is important to train all responders affected by the changes in the new job methods, procedures, or adopted protective measures.

4 Hazard Control for Conducting Oil Spill Site Evaluation

4.1 General

Prior to commencing response operations, trained personnel shall conduct both a preliminary site evaluation and more detailed site characterization to determine potential hazards. A preliminary site evaluation is done prior to site entry in order to determine the condition and location of the site as well as its immediate chemical and physical hazards. A detailed survey is then conducted to evaluate the presence and concentration of specific hazardous substances, environmental and health hazards. During this preliminary site evaluation and characterization, there is the potential for responders to be exposed to chemical and physical hazards; therefore, it is vitally important to implement control measures, such as administrative, engineering, and PPE, during this phase.

Using the site characterization results, a JHA and RA are then performed for applicable operational activities. As new monitoring data become available or as conditions change, the cycle is repeated.

NOTE Although the terms "site characterization" and "site assessment" are frequently interchanged, for the purposes of this recommended practice, the term "site characterization" is used.

4.2 Mandatory Requirements

Mandatory requirements include compliance with the HAZWOPER standard (29 *CFR* 1910.120). 29 *CFR* 1910.120(q), *Emergency Response Program to Hazardous Substance Releases* covers employers whose responders are engaged in emergency response no matter where it occurs. Following are sections relevant to this document.

— The individual in charge of the ICS shall identify, to the extent possible, all hazardous substances or conditions present and shall address as appropriate site analysis, use of engineering controls, maximum exposure limits, hazardous substance handling procedures, and use of any new technologies.

— Based on the hazardous substances and/or conditions present, the individual in charge of the ICS shall implement appropriate emergency operations and assure that the PPE worn is appropriate for the hazards to be encountered.

More information can be obtained on the OSHA website at: http://www.osha.gov/.

4.3 Site Evaluation Procedure

4.3.1 Step 1—Preliminary Evaluation

A preliminary evaluation identifies and assesses hazards at the beginning of a spill response with any available information, when very little information may be known. It identifies the chemical, biological, and physical hazards, as well as any conditions that may cause death or serious harm to responders. It determines the approximate size and location of the site, including its topography. An over-flight of the

affected area, when possible, helps in identifying extent and size of contamination along with geographical conditions and other factors not easily seen from the ground.

At a minimum, the following information should be obtained by any means available at the time:

a) types and hazards of the spilled product—a responsible party's (RP's) provided SDS and/or product assay should be reviewed as a reference if available;

b) approximate quantity of product released into the environment;

c) how long the spilled product has been in the environment;

d) tide and weather conditions, including temperature, humidity, wind, rain, snow, wave conditions, and current direction;

e) the location, source, and cause of the release;

f) whether the source is secured;

g) identification of other at risk products and quantities;

h) whether the area is secure for response personnel to enter. For example, a determination should be made of whether the spilled product is only petroleum/oil or whether any other potential chemical or biological substances have contaminated it;

i) any other available critical information.

4.3.2 Step 2—Site Characterization

4.3.2.1 General

Prior to response personnel starting work, using preliminary evaluation data, the site characterization team conducts a detailed site evaluation including a comprehensive survey of the incident area. This characterization determines where the work zones are located, such as the exclusion or hot zone, identifies chemical and physical hazards, and determines the appropriate engineering, administrative, and PPE controls to mitigate observed hazards. Continuous monitoring is necessary until the site stabilizes, and reevaluations should be done as conditions change or new hazards are identified.

4.3.2.2 Potential Hazards

Potential hazards are as follows:

1) chemical hazards presented by the spilled product [note that chemicals can displace, consume, or enrich (flammable) oxygen]:

   — flammable atmosphere,

   — volatile organic compounds (VOCs),

   — benzene,

   — hydrogen sulfide (H_2S);

2) other physical hazards:

— severe weather (Section 6),

— noises (Section 10),

— terrain (Section 11),

— wildlife and vector borne diseases (Section 12),

— traffic (Section 13),

— water (Section 14).

4.3.2.3 Recommended Equipment for Conducting Site Characterization

The following air monitoring instruments should be considered if it is determined that hazardous materials present a potential workplace hazard(s):

1) a single meter or combination of meters capable of measuring oxygen (O_2), carbon monoxide (CO), H_2S, lower explosive limit (LEL), and VOCs;

2) appropriate calibration gas bottles and regulators to calibrate and bump test all air monitoring meters in accordance with the manufacturer's recommendations;

3) chemical specific sampling equipment for potential site contaminants;

4) additional sensors (if utilized) should be easily accessible.

Charge levels for battery-operated instruments should be high enough to sustain prolonged use.

See 8.4.2.4 for more details.

The following PPE should be considered for each responder conducting the site characterization:

1) appropriate respiratory protection (Section 8);

2) splash protection (Section 9);

3) eye protection (9.6);

4) gloves (inner and outer) (9.7);

5) safety shoe foot protection (9.8);

6) personal flotation device (PFD)—USCG approved for the vessel type and work environment (work vest, work suit, and/or float coat) (Section 14).

Personnel should consider the weather conditions and dress appropriately.

4.3.3 Step 3—Documentation and Communication

All findings from the previous two steps shall be documented. Afterwards, identify and establish engineering, administrative, and/or PPE controls to manage and minimize the risks to personnel presented by the identified hazards. Then, develop site safety plan(s) [SSP(s)] based on gathered information using the JSA model (Section 3). Finally, communicate findings to the IC, Command and

General Staff, and responders. At a minimum the following information should be communicated to all response personnel in a safety briefing:

— observed conditions onsite,

— identified hazards,

— air monitoring results,

— visual observations,

— weather conditions,

— SSP overview and where to locate it,

— engineering and administrative controls and PPE requirements before any response personnel begin work,

— actions to take if responders encounter an unknown hazard,

— symptoms (if any) of overexposure,

— how to communicate an emergency situation,

— authority to not proceed if something looks or feels unsafe.

5 Training for Oil Spill Responders on Use of PPE

5.1 General

Responders shall have training that includes PPE selection, limitations, use, and care.

5.2 Regulatory Requirements

5.2.1 General

Each oil spill response is unique. It is vital to the protection of responders that there be close collaboration between the RP and various government agencies early in the process during the training assessment and planning phases. The level of training, its content, and delivery locations and methods are areas that should be agreed upon.

The RP should consider following the specific standards listed below.

1) 29 *CFR* 1910.120, *Hazardous Waste Operations and Emergency Response*.

2) 29 *CFR* 1910.132, *Personal Protective Equipment*.

3) OSHA Instruction CPL 02-02-051 (CPL 2-2.51)—*Inspection Guidelines for Post-Emergency Response Operations Under 29 CFR 1910.120*.

4) OSHA 3172 (informational booklet)—*Training Marine Oil Spill Response Workers Under OSHA's Hazardous Waste Operations and Emergency Response Standard*.

5) Other federal, state, or local standards that may apply.

5.2.2 Training Requirements

The amount of PPE training may differ and, therefore, needs to be assessed in order to ensure that all responders are adequately prepared. The training requirements vary for each responder depending upon the hazards (type of oil, wildlife, location of oil, etc.) they encounter in their specific job as defined in the JSA. A responder working in the Finance Section at the command post has different PPE needs than a responder cleaning wildlife or skimming oil. Consider the following list of tasks:

1) volunteers working at a site with no contact with oil;

2) working at operational sites with potential contact with minimal, weathered oil (oiled beaches or shoreline);

3) cleaning wildlife, environmental sampling in weathered oil or government site assessments (individuals who have already met U.S. Fish and Wildlife requirements);

4) decontamination, handling oily boom, vacuum trucks, high pressure hot water, etc. at shoreline or staging areas;

5) skimming, handling absorbent booms, and controlled burning from marine vessels;

6) working on a marine vessel with the potential to come in contact with fresh oil..

5.2.3 Training Content

Training content is based on the responders' specific work duties and tasks, hazards to be encountered, and required PPE. The training content should include the following:

— what the working conditions are;

— how to conduct their tasks in a safe manner;

— which responders need what training;

— what hazards they may face;

— how to properly use and maintain (clean, inspect, store) PPE;

— signs and symptoms of overexposure;

— consequences to their health and safety if the equipment is not used or maintained properly;

— emergency procedures if controls are no longer effective or new hazards are encountered;

— work fatigue and traumatic stress;

— decontamination/personal hygiene.

The curriculum content should coincide directly with the JSA. A PPE matrix may help determine training for the proper use for the required PPE.

The oil spill training materials developed by OSHA and National Institute of Environmental Health Sciences (NIEHS) should be utilized as a starting point for any training modules. These are listed in the

Bibliography as "*Oil Spill Booklet*." PowerPoint versions in multiple languages are also available via the OSHA website. A sample training matrix for nonroutine responders is shown in Annex C.

5.2.4 PPE Training Documentation

PPE training shall be documented. Training documentation is both a best management practice and regulatory compliance issue. The purpose of documentation is to verify that responders are adequately trained and properly protected.

6 Effects of Weather on PPE Selection

6.1 General

Types of severe weather include extreme heat or cold, excessive humidity, rain, freezing rain, hail, sleet, ice, snow, wind, and lightning. Cleaning up oil spills during severe weather conditions can further complicate the hazard matrix. When a spill occurs in an area unprotected from the elements, an additional new set of hazards is created that affects all the same areas of the safety protocol. Severe weather may also affect individuals' capabilities, causing an increase in their exhaustion level, which in turn translates to an increased probability for accidents. Even during optimal weather conditions, accidents and injuries occur. The presence of severe weather can make the work environment extremely treacherous. Therefore, it is essential to make an appropriate severe weather PPE assessment during the development of an incident SSP.

6.2 Cold Weather Stress

When the body is unable to warm itself, cold related stress may result. This may include tissue damage and possibly death. Four factors contribute to cold stress: cold air temperatures, high velocity air movement, dampness of the air, and contact with cold water or surfaces. A cold environment forces the body to work harder to maintain its temperature.

6.2.1 PPE and Cold Weather

Protective clothing is an important way to avoid cold stress. The type of fabric makes a difference. Cotton loses its insulation value when it becomes wet. Wool, silk, and most synthetics, on the other hand, retain their insulation even when wet. The following are recommendations for working in cold environments. Responders should:

— wear head, face, and neck protection. The majority of body heat loss occurs through the neck and head;

— wear at least three layers of clothing:

  — an inner layer of wool, silk, or synthetic to wick moisture away from the body;

  — a middle layer of wool or synthetic to provide insulation, even when wet;

  — an outer wind and rain protection layer that allows some ventilation to prevent overheating;

— wear a hat or hood to reduce heat loss;

— wear insulated boots or other footwear;

— keep a change of dry clothing available in case work clothes become wet;

— not wear tight clothing with the exception of the wicking layer;

— not underestimate the wetting effects of perspiration. Oftentimes wicking and venting of the body's sweat and heat are more important than protecting from rain or snow.

Annex A contains descriptions and examples for cold weather PPE.

6.2.2 Cold Weather Induced PPE Problems

6.2.2.1 Hypothermia

Hypothermia, which means "low heat," is a potentially serious health condition. This occurs when body heat is lost faster than it can be replaced. When the core body temperature drops below the normal 98.6 °F to around 95 °F, the onset of symptoms typically begin. The person may begin to shiver and stomp their feet in order to generate heat. Responders may lose coordination, have slurred speech, and fumble with items in their hands. The skin is likely pale and cold. As the body temperature continues to fall, these symptoms worsen and shivering stops. Responders may be unable to walk or stand. Once the body temperature falls to around 85 °F, severe hypothermia develops and the person may become unconscious, and at 78 °F, the person could die.

Older people, however, may be at more risk than younger adults, since older people are not able to generate heat as quickly. Certain medications may also prevent the body from generating heat normally. These include antidepressants, sedatives, and tranquilizers.

6.2.2.2 Trench Foot

Trench foot or immersion foot is caused by having feet immersed in cold water at temperatures above freezing for long periods of time. It is similar to frostbite but considered less severe. Symptoms usually consist of tingling, itching, or burning sensation. Blisters may be present.

6.2.2.3 Frostbite

Frostbite occurs when the skin freezes and loses water. While frostbite usually occurs when the temperatures are 30 °F or lower, wind chill (Table 4) can allow frostbite to occur in above freezing temperatures. Frostbite typically affects the extremities, particularly the feet and hands. The affected body part is cold, tingling, stinging or aching followed by numbness. Skin color turns red, then purple, then white, and is cold to the touch. There may be blisters in severe cases.

6.2.3 How to Protect Responders

Prevention is the best way to control cold weather exposures. The following recommendations are adapted from OSHA Publication 3156.

a) Recognize the environmental and workplace conditions that may be dangerous.

b) Understand the signs and symptoms of cold-induced illnesses and injuries and what to do to help responders.

c) Train responders about cold-induced illnesses and injuries.

d) Encourage responders to wear proper clothing for cold, wet, and windy conditions, including layers that can be adjusted to changing conditions.

e) Be sure responders in extreme conditions take frequent, short breaks in warm, dry shelters to allow their bodies to warm up.

f) Try to schedule work for the warmest part of the day.

g) Avoid exhaustion or fatigue because energy is needed to keep muscles warm.

h) Use the buddy system—work in pairs so that one responder can recognize the signs of cold weather stress in the other.

i) Drink warm, sweet beverages (sugar water, sports-type drinks).

j) Avoid drinks with caffeine (coffee, tea, sodas, or hot chocolate) or alcohol.

k) Eat warm, high-calorie foods such as hot pasta dishes.

l) Remember, responders face increased risks when they take certain medications, are in poor physical condition, or suffer from illnesses such as diabetes, hypertension or cardiovascular disease.

Table 4—Wind-chill Chart

How to read the chart: Find the temperature on the left-hand side and then move to the right to find the column for the appropriate wind speed. That number is the temperature it "feels" like. For example, a temperature of 10 °F and wind speed of 20 mph feels like –9 °F.

	WIND SPEED (mph)											
TEMPERATURE (°F)	5	10	15	20	25	30	35	40	45	50	55	60
40	36	34	32	30	29	28	28	27	26	26	25	25
35	31	27	25	24	23	22	21	20	19	19	18	17
30	25	21	19	17	16	15	14	13	12	12	11	10
25	19	15	13	11	9	8	7	6	5	4	4	3
20	13	9	6	4	3	1	0	-1	-2	-3	-3	-4
15	7	3	0	-2	-4	-5	-7	-8	-9	-10	-11	-11
10	1	-4	-7	-9	-11	-12	-14	-15	-16	-17	-18	-19
5	-5	-10	-13	-15	-17	-19	-21	-22	-23	-24	-25	-26
0	-11	-16	-19	-22	-24	-26	-27	-29	-30	-31	-32	-33
-5	-16	-22	-26	-29	-31	-33	-34	-36	-37	-38	-39	-40
-10	-22	-28	-32	-35	-37	-39	-41	-43	-44	-45	-46	-48
-15	-28	-35	-39	-42	-44	-46	-48	-50	-51	-52	-54	-55
-20	-34	-41	-45	-48	-51	-53	-55	-57	-58	-60	-61	-62
-25	-40	-47	-51	-55	-58	-60	-62	-64	-65	-67	-68	-69
-30	-46	-53	-58	-61	-64	-67	-69	-71	-72	-74	-75	-76
-35	-52	-59	-64	-68	-71	-73	-76	-78	-79	-81	-82	-84
-40	-57	-66	-71	-74	-78	-80	-82	-84	-86	-88	-89	-91
-45	-63	-72	-77	-81	-84	-87	-89	-91	-93	-95	-97	-98

FROSTBITE OCCURS IN 15 MINUTES OR LESS

6.3 Hot Weather Stress

6.3.1 General

In hot weather, it is possible for the PPE itself to become the primary risk. PPE selection in hot weather conditions should protect responders from the hazard and still provide the best option for comfort and cooling, with an emphasis on hydration.

6.3.2 PPE in Hot Weather

The following PPE recommendations may improve responder comfort by reducing heat stress. However, they may not mitigate other identified hazards, which may dictate the need for additional protection.

— *Eye and Face Protection*—Polarized eye protection for responders in bright sunlight.

— *Head Protection*—If a hard hat is warranted, consider hard hats with sun shades. If no hard hat is warranted, consider a breathable sunshade hat.

— *Foot Protection*—Lightweight, breathable material for safety shoes.

— *Hand Protection*—Lightweight, breathable gloves.

— *Protective Clothing*—Long sleeve, lightweight, light colored, and breathable.

6.3.3 Heat-related Illnesses

6.3.3.1 Heat Stroke

Heat stroke occurs when the body's temperature regulating system fails and body temperature rises to critical levels (greater than 104 °F). This is a medical emergency that is the most serious heat-related health problem. The signs of heat stroke are confusion, loss of consciousness, and seizures. Responders experiencing heat stroke have a very high body temperature and may stop sweating. If a responder shows signs of possible heat stroke, immediate medical attention is required.

6.3.3.2 Heat Exhaustion

Heat exhaustion can lead to heat stroke if not properly addressed. The signs and symptoms of heat exhaustion are headache, nausea, dizziness, weakness, irritability, confusion, thirst, heavy sweating, and a body temperature greater than 100.4 °F.

6.3.3.3 Heat Cramps

Heat cramps are muscle pains usually caused by physical labor in a hot work environment. Heat cramps are caused by the loss of body salts and fluid during sweating.

6.3.3.4 Heat Rash

Heat rash is the most common heat-related illness. It can affect responders' behavior as well as their ability to work and wear PPE properly. Heat rash is caused by sweating and looks like a red cluster of pimples or small blisters. Heat rash usually appears on the neck, upper chest, in the groin, under the breasts and in elbow creases. Anything that makes the skin warm or moist may make the rash worse.

6.3.4 Measurement

Thermal environmental monitors should be available to measure heat factors such as temperature, relative humidity, and Wet Bulb Globe Temperature. With these data and information about the type of work being performed, engineering, administrative and PPE controls may be recommended.

In order to determine the heat index using Table 5, the air temperature and the relative humidity should be known. For example, if the air temperature is 100 °F and the relative humidity is 55 %, the heat index is 124 °F. When the relative humidity is low, the apparent temperature can actually be lower than the air temperature. For example, if the air temperature is 100 °F and the relative humidity is 15 %, the heat index is 96 °F. In some areas of the United States, we commonly see hot temperatures during the summer, but the low relative humidity values make it somewhat unusual to see dangerous heat index values (i.e. 105 °F or greater).

Table 5—Likelihood of Heat Disorders: NOAA's National Weather Service Heat Index

RELATIVE HUMIDITY (%) \ TEMPERATURE (°F)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	131	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	126	130					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Caution
Extreme Caution
Danger
Extreme Danger

Likelihood of Heat Disorders with Prolonged Exposure to Strenuous Activity
Temperature Groupings Based on Heat Index Values

The heat index values in the chart above are for shady locations. When a person is exposed to direct sunlight, the heat index value can be increased by up to 15 °F. As shown in Table 5, heat indices meeting or exceeding 105 °F can lead to dangerous heat disorders with prolonged exposure and/or physical activity in the heat.

6.3.5 How to Protect Responders

Prevention is the best way to control the effects of hot weather exposure. The following recommendations are adapted from OSHA Publication 3154.

a) Provide training about the hazards leading to heat stress and how to prevent them.

b) Provide a lot of cool water to responders close to the work area. At least one pint of water per hour is needed.

c) Schedule frequent rest periods with water breaks in shaded or air conditioned areas.

d) Routinely check responders who are at risk of heat stress due to protective clothing and high temperature.

e) Consider protective clothing that provides cooling.

f) Know signs/symptoms of heat illnesses; use a buddy system.

g) Block out direct sun and other heat sources.

h) Drink plenty of fluids. Drink often and BEFORE becoming thirsty. Drink water every 15 minutes.

i) Avoid beverages containing alcohol or caffeine.

j) Wear lightweight, light colored, loose-fitting clothes.

6.4 Sunlight Hazards

6.4.1 General

Sunlight contains ultraviolet (UV) radiation, which causes sunburn, premature aging of the skin, wrinkles, cataracts, and skin cancer. The amount of damage from UV exposure depends on the strength of the light, the length of exposure, and whether the skin is protected.

6.4.2 Protecting Responders

Responders should:

— cover up—wear tightly-woven clothing that blocks out light;

— use sunscreen—a sun protection factor (SPF) of at least 15 blocks 93 % of UV rays;

— wear a hat—a wide brim hat is ideal because it protects the neck, ears, eyes, forehead, nose, and scalp;

— wear UV-absorbent shades—to be effective, sunglasses should block 99 % to 100 % of UVA and UVB radiation;

— limit exposure—UV rays are most intense between 10 a.m. and 4 p.m. Considering adjusting shift start and finish times to limit exposure during the peak hours.

6.5 Lightning

There is no protective PPE for lightning. Outdoor activities should be suspended and responders should seek shelter in the event of lightning. Lightning detectors can be used to warn of approaching storms.

When lightning is possible **DO NOT:**

— be the tallest object in an area;

— stand out in the open;

— stand under a tree;

— stand in a gazebo or open shelter, like a baseball dugout or bus shelter;

— stand next to metal objects—pipes, light poles, door frames, metal fences, or communication towers—indoors or out.

— stay next to water—ponds or running water—indoors or out. (e.g. do not take a shower.)

— Use plug-in power tools or machines—indoors or out.

— Use a plug-in telephone (or a computer with a modem)—indoors or out.

7 Fatigue and Stress Effects of PPE

7.1 General

Responders may experience stress and fatigue while wearing PPE in cleanup activities due to the additional restrictions that PPE adds to responders' activities. These stresses include the following.

— *Breathing Difficulties*—Restricted breathing amplifies psychological and physical stress on responders. When air-purifying respirators (APRs) are used, breathing difficulty increases especially when filters become clogged. Frequent change of filters may be necessary. Wearing supplied air respirators or self-contained breathing apparatuses (SCBAs) intensifies the psychological stress in many responders.

— *Visibility Restrictions*—Safety glasses, goggles, or full-face respirators may restrict the area of view causing tunnel vision or blind spots. Fogging of lenses can occur where the operation involves hard physical work or temperature extremes. Ventilated goggles may reduce this problem.

— *Movement Limitations*—PPE may be heavy and cumbersome restricting mobility and frequent short rest periods may be necessary.

— *Skin Irritation*—Responders may suffer from irritation while wearing certain types of PPE particularly during temperature extremes. Responders with sensitive skin are more prone to suffer from irritation when wearing PPE.

7.2 Monitoring and Maintaining Responder Health On-Site

Wearing PPE can add additional stresses on the body, and responders may not recognize these additional stresses and the need to monitor their own emotional and physical health. This is especially true when response efforts stretch into several weeks. Responders shall be able to stay alert and focused on the job in order to preserve their own health and safety, especially given the changing work environment. Following these guidelines while at the job site and again after returning home may help responders control stress and fatigue.

— Eat and sleep regularly. Maintain as normal a schedule as possible and adhere to the team schedule and rotation.

— Maintain fluid intake by drinking plenty of water and juices.

— Eat a variety of foods and increase the intake of complex carbohydrates such as granola bars or breads and muffins made with whole grains.

— Eat and drink in the cleanest area available.

8 PPE for Respiratory Protection

8.1 General

This section provides guidance on respiratory protection during oil spill response operations. This section also provides brief guidance on air monitoring and recommended action levels for exposure control. Oil spill responders involved in oil cleanup operations may be exposed to respiratory hazards associated with oil, dispersants, degreasers and other chemicals, and fires. When engineering and administrative controls are not adequate or feasible to control exposures to acceptable levels, or until they can be implemented, respiratory protection is required. Air monitoring and sampling techniques are used to determine the nature and concentration of airborne hazards and in the selection of appropriate control measures including respiratory protection.

8.2 Mandatory Requirements

All response organizations shall follow their respiratory protection programs in compliance with applicable governing regulatory bodies and include issuance of respirators, medical evaluations, fit testing, and training.

When respiratory protection is required, a written respiratory protection program in accordance with OSHA's respiratory protection standard (29 *CFR* Section 1910.134) is required. This standard can be found on the OSHA website (http://www.osha.gov). A respiratory protection program shall include respirator selection; medical evaluations of responders required to use respirator; training responders on respiratory hazards and respirator use, limitations, and maintenance; fit testing of responders wearing tight-fitting respirators; respirator use for routine and emergency situations; respirator cartridge change schedules; respirator cleaning, maintenance, and inspection; ensuring adequate air quality, air quantity, and air flow of atmosphere-supplying respirators; and evaluation of respirator program effectiveness. Medical evaluation, fit testing, and training shall be provided before responders use respirators.

8.3 Engineering Controls

Engineering controls are the preferred method for reducing or eliminating respiratory hazards. At the Safety Officer's or Vessel Captain's discretion, the site or vessel may implement engineering controls to reduce airborne hazards. These include the use of portable industrial fans to increase air flow, repositioning vehicles or vessels, notifying standby boats with water cannons to break up sheen in the immediate area, or requesting application of dispersants or foams from standby boats, if approved. It is recommended that vessels install activated charcoal filters on the ventilation system intakes to reduce potential vapor levels.

8.4 Respiratory Hazard Identification and Site Characterization

8.4.1 Respiratory Hazards

Examples of potential respiratory hazards include: VOCs and H_2S associated with crude oil; VOCs, smoke, metals, and combustion products (e.g. carbon monoxide, carbon dioxide, sulfur dioxide, acid gases, aldehydes) associated with the burning of oil; dispersant chemicals; and oil mist from pressure washing.

Concentrations are expected to vary depending on the composition of crude oil, time in the aquatic and coastal environment, heat, wave action, treatment with dispersants and other cleanup technology. Responder exposures to the airborne contaminants are impacted by factors such as proximity to the source of exposure, task duration and frequency, and exposure control methods (e.g. engineering controls and work practices) used.

8.4.2 Site Monitoring

8.4.2.1 General

If the site characterization determined the potential presence of respiratory hazards, air monitoring is the primary method used to identify and quantify airborne hazards. This data is used to determine the appropriate level and type of respiratory protection.

8.4.2.2 Real-time Measurements

"Real-time" refers to direct reading instruments that allow nearly instantaneous determination of chemical airborne concentrations. Real-time measurements provide immediate information for targeted compound concentrations in the area and can be used to trigger actions to protect responders. Direct reading instruments perform sampling and analyses within the instrument and concentration readings can usually be obtained immediately. These instruments have fast response times and can follow rapid changes in concentration.

Real-time air monitoring shall be performed using direct reading instrumentation capable of monitoring concentrations of suspected airborne contaminants below the applicable exposure limits and action levels. Examples include:

— photo-ionization detectors capable of detecting and measuring total VOCs, and volatile components of hydrocarbons such as benzene, in the parts per million (ppm) ranges.

— electrochemical sensors that measure H_2S and carbon monoxide in the ppm range.

Additional real-time monitoring should be conducted when additional contaminants are identified. For example, particulate matter should also be monitored during in situ burning (ISB).

Instantaneous, real-time measurements do not necessarily represent conditions experienced throughout the workday and can substantially underestimate or overestimate exposures experienced by responders. Data logging monitors document the concentrations at specific time intervals. Some instruments also document the calculated 8-hour time-weighted average (TWA), short-term exposure limit (STEL), and peak measurements, based on integrated "real-time" measurements.

8.4.2.3 Site Monitoring Locations (Vessels)

Portable monitors should be used to collect real-time measurements of LEL, VOCs, H_2S, and benzene aboard vessels. Additional monitors may be placed near the edge of the vessel or in other areas of interest, such as moon pools, to gain early indications of rising LEL levels. In addition to general area monitoring aboard vessels, exhaust vents or ballast vents that discharge into the work area should be monitored. If conditions change (such as the amount of oil in the work area, an increase in a reading of VOCs, or a shift in the winds towards the responders), air monitoring should be done immediately following the change, and the need to monitor more frequently should be considered.

8.4.2.4 Air Monitoring Plan

The Safety Officer or their designee [e.g. Industrial Hygienist (IH) or Air Monitoring Specialist] shall develop an air monitoring plan that identifies the airborne contaminants to be measured, location(s), frequency, and duration of air monitoring, and detection method. Air monitoring activities shall not endanger any personnel.

After initial site characterization of the immediate work site has been completed, air monitoring results shall be reviewed and continued as determined by the Safety Officer.

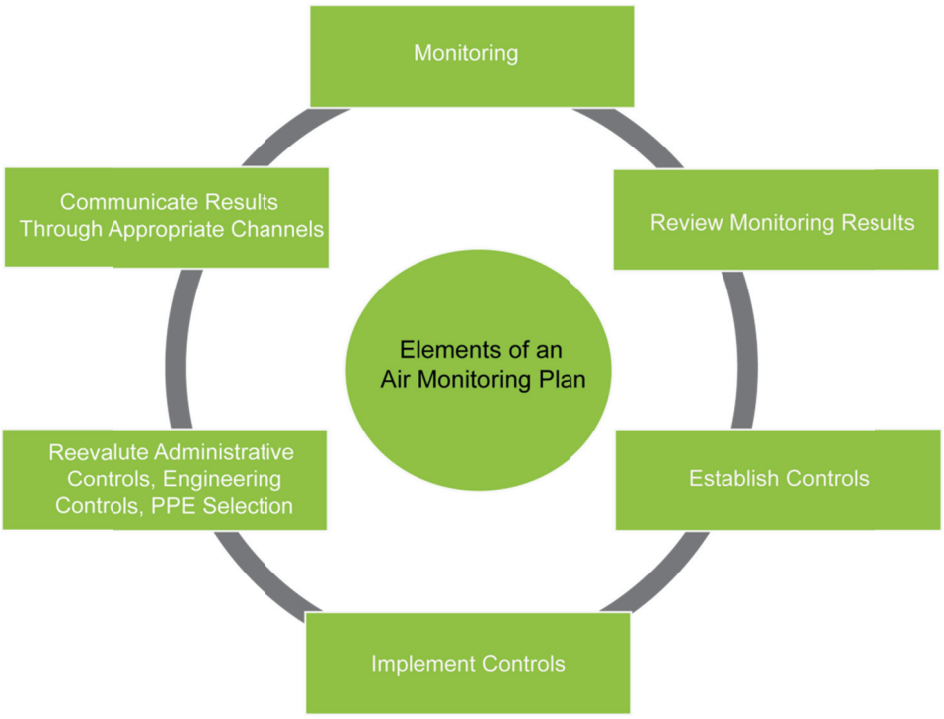


Figure 2—Air Monitoring Planning Process

Air monitoring results shall be reviewed on a regular basis or when conditions have changed. If warranted, control measures, particularly PPE, should be reevaluated. The purpose of this is to ensure the cycle in Figure 2 is continuously improving.

It is important to record and document any additional comments or observations from either the responders being monitored or the IHs performing the monitoring.

8.4.2.5 Personal Monitoring

Personal air monitoring shall be used to assess responder exposures to airborne contaminants and verify that the respirator protective equipment issued is adequate. Samples should be collected and analyzed using validated methods (e.g. OSHA or NIOSH methods). Diffusive samplers [e.g. organic vapor monitors (OVMs)], are convenient for monitoring personal exposures to hydrocarbons, such as benzene, toluene, ethyl benzene, and xylenes. Data logging, direct reading personal monitors are available for measuring TWA and peak concentrations of some gases, such as H_2S and carbon monoxide. Portable battery operated pumps and collection media (e.g. filters and sorbent tubes) may be necessary for monitoring other chemicals.

8.4.2.6 Data Quality and Documentation Management

Data shall be reported on approved field forms at prescribed intervals. This data should be made available to share with response stakeholders.

The following information applies to data quality and documentation management.

— A plan for documentation that includes a full chain of custody for every sample, between it being taken and analyzed/reported by the lab, should be developed.

— Instruments are calibrated and maintained according to the manufacturer's recommendations.

— Calibration is documented by the Safety Officer or Air Monitoring Technician daily and documented on a calibration log.

— Real-time readings are documented by handwritten notes, handheld PDA, or by the use of data logging capabilities of the instrument, if available.

— Real-time data are entered onsite and drafts made available upon request.

— All samples analyzed shall be done by an accredited laboratory for the type of analysis being conducted.

— The analytical air sample results are reviewed by the Safety Officer or other competent person, and the data undergo a data validation process.

— The analytical air samples are reviewed validated and data summaries provided to the Safety Officer.

— Personnel exposure monitoring notification letters with air sample results are provided to each company contact.

— Spill responders and supervisors should be updated regularly of the air monitoring results. Once per shift, the Safety Officer should update the supervisor of airborne concentrations detected over the preceding 12 hours or once per shift.

8.5 Respiratory Protection Program

8.5.1 Introduction

The following section describes common elements of a respiratory protection program. The Safety Officer shall communicate OELs and action levels. Example action levels are shown in Annex D.

8.5.2 Respirator Selection

8.5.2.1 General

The appropriate respirator is selected based on the type and concentration of airborne contaminant(s), its assigned protection factor (APF), work environment, and user factors. Work environment and user factors include potential adverse physical and physiological impacts such as impaired vision and communication, difficulty breathing, and the ability to regulate heat. The Safety Officer should be consulted for respirator selection.

OSHA has published APFs for the different types of respirators available. The APF shall meet or exceed the required level of protection. Respirators and their OSHA APFs [29 *CFR* 1910.134(d)(3)(i)(A)] are listed below.

NOTE Single-strap dust masks are usually not NIOSH approved. They shall not be used to protect from hazardous atmospheres. However, they may be useful in providing comfort from pollen or other allergens.

8.5.2.2 Air Purifying Respirators (APRs)

NOTE APRs shall not be used in oxygen deficient or immediately dangerous to life and health (IDLH) atmospheres.

Types of APRs include the following.

— *Approved filtering facepieces* (i.e. dust masks) can be used for mists, welding fumes, etc. They do not provide protection from gases or vapors. They have an APF of 10. Carbon-impregnated odor reduction filtering facepieces may reduce odors but do not provide health protection.

— *Half-face respirators* can be used for protection against most vapors, acid gases, dust, or welding fumes. Cartridges/filters shall match contaminant(s) and be changed periodically. They have an APF of 10.

— *Full-face respirators* are more protective than half-face respirators. They can also be used for protection against most vapors, acid gases, dust, or welding fumes. The face shield protects face and eyes from irritants and contaminants. Cartridges/filters shall match contaminant(s) and be changed periodically. They have an APF of 50.

— *Powered air-purifying respirators (PAPRs)* have a blower that pulls air through attached filters. The blower then pushes the filtered air into the facepiece/helmet/hood, which covers the user's face. Some PAPRs have loose-fitting facepieces and some have tight-fitting facepieces. The APF for various PAPRs is as follows:

  — half mask: APF 50,

  — full facepiece: APF 1000,

  — helmet/hood: APF 25 unless otherwise approved by NIOSH for APF 1000,

  — loose-fitting facepiece: APF 25.

8.5.2.3 Atmosphere-supplying Respirators

Types of atmosphere-supplying respirators include the following.

— *Supplied-air respirator (i.e. air-line respirator)* is designed to be used with a source of breathing air that is not carried by the user. When used with an auxiliary SCBA, it can be used for entry and escape from IDLH atmospheres. When worn with a full-face piece, in pressure-demand or positive pressure mode, its APF is 1000.

— *SCBA*, pressure demand or positive pressure, is equipped with a breathing air tank carried by the user. It is often used for entry and escape from atmospheres that are considered IDLH or oxygen deficient. It has an APF of 10,000.

8.5.2.4 Maximum Use Concentration (MUC)

Maximum Use Concentration (MUC) means the maximum atmospheric concentration of a hazardous substance from which a responder can be expected to be protected when wearing a respirator. This is determined by using the APF of the respirator or class of respirators and the exposure limit of the hazardous substance. The MUC can be determined mathematically by multiplying the APF specified for a respirator by the required OEL, STEL, or ceiling limit. When no OSHA exposure limit is available for a hazardous substance, an employer shall determine an MUC on the basis of relevant available information and informed professional judgment.

Example MUC Calculation				
OEL	×	APF	=	MUC
100 ppm		50		5000 ppm
Measured Concentration			=	4200 ppm

In this example, since the MUC is greater than the measured concentration, the use of respiratory protection with an APF of 50 or greater is adequate provided an oxygen deficient or IDLH atmosphere does not exist.

8.5.3 Medical Evaluation

Responders who are required to wear respirators shall be evaluated by a physician or other licensed health care provider and receive clearance before wearing a respirator on the job. Wearing respirators may place additional physiological and psychological stress on responders. The medical evaluation is designed to identify general medical conditions that place responders who use respirators at risk of serious medical consequences.

8.5.4 Fit Testing

Responders shall have a documented fit test prior to using respirators.

Fit testing shall be repeated annually or more frequently if warranted due to changes in facial characteristics of the user.

8.5.5 Training

Responders shall receive respirator training prior to using the respirator and annually thereafter. The training shall cover:

— why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;

— respirator limitations and capabilities;

— how to use the respirator in routine as well as emergency situations, including what to do when the equipment fails;

— how to inspect, put on, take off, use, and check the seals of the respirator;

— how to maintain and store the respirator;

— how to recognize medical signs and symptoms that can limit proper use of equipment.

8.5.6 Respirator Cartridge Change Schedule

Respirator cartridges shall be replaced according to manufacturer's recommendations. Consult with the Safety Officer or the respirator manufacturer to develop a change-out schedule.

When cartridges are changed, they shall be rendered unusable and disposed of according to environmental guidelines.

8.5.7 Respirator Maintenance

Respirator facepieces shall be cleaned with soap and water at the end of each work shift. At breaks when respirators are removed, appropriate cleansing/disinfecting wipes may be used for cleaning. Respirators shall be maintained in accordance with respirator manufacturer's care and maintenance instructions.

8.5.8 Voluntary Use

Responders voluntarily choosing to wear a filtering facepiece respirator to control nuisance odors shall be provided with precautions to ensure that the respirator itself does not present a hazard. OSHA's respiratory protection standard (29 *CFR* 1910.134), Appendix D provides the required information. For voluntary use of other respirator types, a respiratory protection program that includes medical evaluation, respirator use, and proper cleaning, maintenance, and storage maintenance procedures should be implemented.

9 PPE for Chemical and Physical Hazards

9.1 General

Oil spill responders involved in cleanup operations are exposed to a variety of chemicals that may enter their bodies by skin absorption or cause irritations by contact with the skin. Administrative and engineering controls should be utilized first to minimize the need for PPE when responders are exposed to hazards on the job. Should such controls not prevent skin contact or absorption, the appropriate PPE should be selected based on the particular hazards faced by the responder. This section provides guidance on selecting the proper PPE for responders subjected to possible skin contact with oil, some of its constituents, as well as dispersants and other chemicals while performing various activities during an oil spill response.

9.2 Mandatory Requirements

PPE for eyes, face, head, and extremities shall be provided, used, and maintained in a sanitary and reliable condition when the responders are at risk of injury through absorption or physical contact with chemical or physical hazards [29 *CFR* 1910.132(a)].

9.3 Hazards

Crude oil is a complex mixture of chemical constituents including various alkanes (butane, pentane, and hexane); aromatic hydrocarbons (benzene, ethyl benzene, toluene, and xylenes); cycloalkanes; other nitrogen, oxygen, and sulfur compounds (H_2S); and trace metals such as iron, nickel, copper, and vanadium. Along with oil dispersants, crude oil can cause skin irritation and inflammation. NIOSH and OSHA recommend avoiding the unprotected exposure of all skin to crude oil, dispersants, and other chemicals (benzene, H_2S) present during response activities. Skin contact can occur directly or through secondary contact with contaminated tools, work surfaces, or PPE.

Hydrocarbon exposure from crude oil constituents varies based on its exposure to the atmosphere, time in the marine aquatic and coastal environment, treatments with dispersants, and interaction of the chemicals, wave action, and heat. Generally, the more "aged" or "weathered" crude oil is (by mixing with seawater and traveling long distances from the source), the lower the VOC concentrations. Although it generates fewer VOCs, weathered crude oil still contains harmful chemicals that can cause skin irritation or other adverse reactions. Thus, use of gloves and protective clothing is recommended to minimize skin contact with weathered oil, including oil deposited on the shore ("tarballs" or "tarpatties").

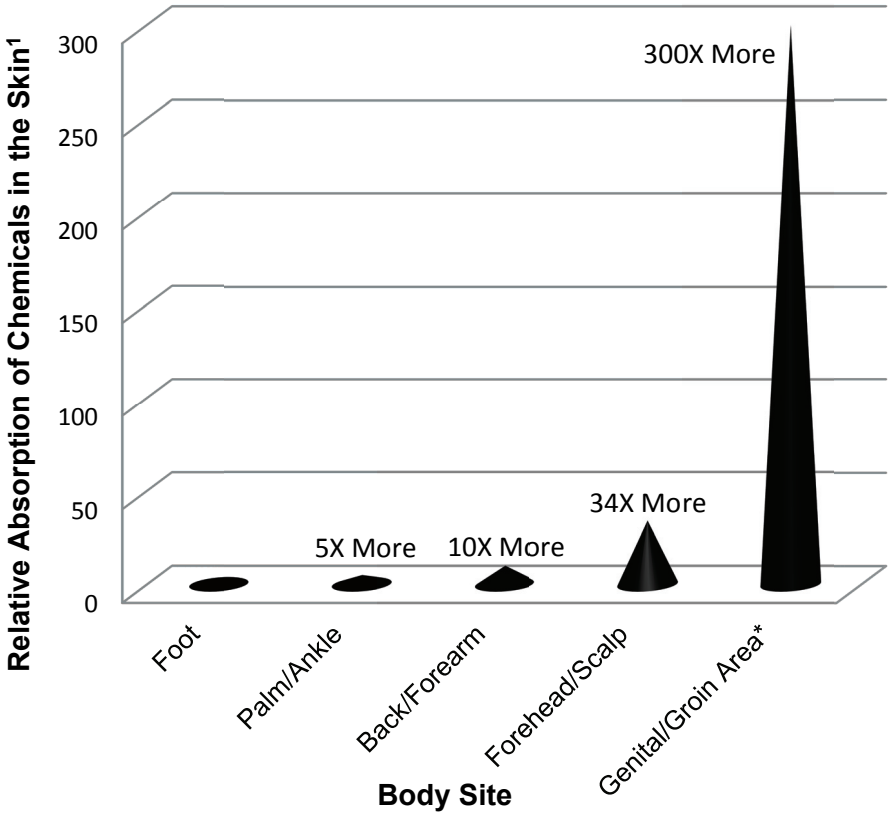
To prevent skin contact for use in a hot, wet environment, PPE shall be selected carefully. Skin damage due to chaffing from increased sweating, coupled with the mechanical stress of ill-fitting PPE, can compromise the skin's natural barrier against bacteria. In addition, the use of sunscreen, shaded safety glasses, and wide-brimmed hats are recommended.

9.4 Routes of Entry

9.4.1 General

The four ways that hazardous chemicals enter the body, commonly known as routes of entry, are by inhalation (the most common form), ingestion, injection, and absorption through skin/eye contact. This section focuses on the latter. When skin contact occurs, the chemicals can burn or irritate the skin and eyes on contact, causing damage on the surface. Dermatitis (inflammation of the skin) and conjunctivitis (inflammation of the eye membrane) are two examples. Other chemicals can be absorbed through the skin undetected and enter the bloodstream. They are carried throughout the body and may cause harm.

Skin damage due to chafing from increased sweating, coupled with the mechanical stress of ill-fitting PPE, can compromise the skin's natural barrier against chemicals and bacteria. In addition, broken skin or puncture wounds greatly increase the rate at which chemicals are absorbed, and some chemicals that only represent a skin contact hazard can be absorbed through broken skin and puncture wounds. Furthermore, certain areas of the body absorb chemicals at different rates, as shown by Figure 3.



[1] Relative to Foot Absorption
*For Men (Studies of Female Workers not yet Performed)

NOTE Appropriate hand hygiene facilities should be readily available to clean incidental skin exposures. In addition, responders should remove gloves, and any other PPE that could contaminate food or drink, and thoroughly wash their hands with soap and water before eating. Responders should also remove all PPE before leaving the contaminated areas at the end of the shift to reduce take-home exposure.

Figure 3—Skin Absorption of Chemicals

9.4.2 Methods for Evaluating Skin Exposure

Qualitative approaches for evaluating potential dermal exposure include:

— observation of work tasks/activities,

— housekeeping,

— decontamination protocols,

— understanding the chemical and physical properties and skin absorption characteristics of the compounds encountered,

— sampling inside CPC.

Quantitative approaches for evaluating dermal exposure include biological monitoring and skin exposure assessments. Biological monitoring (e.g. analysis of blood or urine samples or exhaled breadth) provides information on the total dose, including inhalation, dermal, and ingestion. Skin exposure assessments can be useful for evaluating the effectiveness of PPE, the need for additional controls, or changes in work practices. Techniques that quantify the amount of contaminant deposited on the skin include wipe sampling, absorbent pad and clothing sampling, and glove/hand wash sampling.

9.5 Selecting Protective Clothing

9.5.1 General

Selecting the proper protective garments is an exercise in the selection of fabric, seam, and design. The selection shall be based on expected exposure, verified by field audits and changed if the selected PPE does not perform adequately. The potential for contribution to physical or environmental (e.g. heat) and psychological (e.g. claustrophobia) stress should also be considered in the selection of protective clothing, in addition to the potential exposure to fire, water, oil and tar, and other chemicals.

In general, overprotection from chemical exposure generally creates a greater potential for stress. For example, partial body garments such as aprons and sleeves may be used in place of full body protection where the JSA indicates low risk of skin exposure.

9.5.2 Selecting Fabric

When exposures may require repulsion of droplets of oil, repellant-treated or coated fabrics should be used. Some treated fabrics become oil soaked when subjected to contact with higher quantities of oil. Coated fabrics generally offer a higher level of barrier to liquid oil and are divided into two categories—impermeable and selectively permeable barrier materials or fabrics. Both types provide a physical barrier to liquid and solidified oil. These fabrics come in a range of weights and durability. Full body garments made from impervious film fabrics have higher potential for heat stress.

Conversely, microporous film fabrics often use thin films to achieve high moisture transport. These products may be easily abraded and damaged, thus compromising the barrier protection of the fabric. Uncoated or permeable fabrics, spun-bonded polypropylene and polypropylene SMS (spunbond/meltblown/spunbond), in general, absorb or allow penetration of oil but typically result in lower heat stress for the wearer. Garments made with permeable fabrics should be considered in situations where minimal oil contact is expected.

Partial body garments, such as sleeves and aprons worn over these garments, can provide added barrier protection in areas of the body where greater exposure is expected or observed. These garments can be made from the same impermeable fabrics or from impervious film fabrics.

9.5.3 Selecting Seams

Taped and welded seams are appropriate when the seams come into contact with sufficient liquid to form pools, puddles, or runoff on the garment. Garments made from impervious film fabrics should have welded or taped seams to prevent liquids from entering through the seams when significant contact with liquids is expected. Sewn, serged, or bound seams without sealing tape should only be considered in situations that involve minimum liquid volumes and minimum contact pressure. Sewn, serged, or bound seams are normally found on most garments made from uncoated fabrics, microporous film fabrics, and some garments made with lightweight impervious film fabrics.

9.5.4 Selecting Design

The most common design of chemical- and flame-resistant clothing is the coverall. However, full body protection can also be obtained with a two-piece ensemble such as a combination of jacket and bib overalls. The protection provided by the garment closure and interface areas between garments should be considered when selecting PPE. Closures and interface areas (e.g. glove to jacket) provide a potential point of entry for hazards. If significant liquid contact is expected, the closure and interface areas should be minimized and provide the same level of protection as the rest of the garment.

If less than full body protection is determined to be acceptable, partial body garments present a significantly lower heat stress impact than full body coveralls. There are many job activities associated with a response where the responder has localized exposure to contaminated materials. Partial body garments, such as sleeves, aprons, pants, and shirts, can help protect those parts of the body that are potentially exposed, such as the forearms, front of the body, or legs.

9.6 Eye and Face Protection

9.6.1 General

Certain tasks may involve being exposed to dust, splashes, and impact from flying objects. Depending on the kind of exposure, at times eye protection may be required. If chemicals get into the eye, the results can be very serious. In addition to eye damage, chemicals can more easily enter the circulatory system through the eye membrane. All safety goggles, glasses, and face shields shall be used and maintained in a sanitary and reliable condition.

It is important that a JSA is done to determine the appropriate eye and face PPE.

9.6.2 Mandatory Requirements

29 CFR 1910.133(a)(1)—The employer shall ensure that each affected employee uses appropriate eye or face protection when exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation.

9.6.3 Safety Goggles

Safety goggles are used to cover the eyes and nearby skin and protect against dust, splashes, and impact from flying objects. When the risk is mostly from splashes or there is a lot of dust in the air, goggles are preferable. Should organic vapors or gases be present in the mists with a detected inhalation hazard, a full-face respirator may be required, based on the hazard assessment.

9.6.4 Safety Glasses

Safety glasses are preferable if the risk is mainly from flying objects, as they are more comfortable than goggles leading to greater use during actual exposure. They shall provide sideshield or wraparound protection. However, they do not provide protection if the hazard is in the form of liquid, vapor, or gas.

9.6.5 Face Shields

Face shields are worn over goggles to provide extra protection to the face from splashes and sprays. They may also be worn over safety glasses to protect the face from impact due to flying objects.

9.7 Hand and Arm Protection

9.7.1 General

If the JSA reveals that responders face potential injury to hands and arms that cannot be eliminated through engineering and work practice controls, responders shall wear appropriate protection. The selection of the hand and arm protection shall be based on an evaluation of the performance characteristics of the type of protection relative to the task(s) to be performed, conditions present, duration of use, and the hazards identified.

9.7.2 Mandatory Requirements

29 CFR 1910.138(a) OSHA Standards for Hand Protection—Employers shall select and require employees to use appropriate hand protection when employees' hands are exposed to hazards such as those from skin absorption of harmful substances; severe cuts or lacerations; severe abrasions; punctures; chemical burns; thermal burns; and harmful temperature extremes.

9.7.3 Chemical- (and Liquid-) Resistant Gloves

Chemical-resistant gloves are made with different kinds of rubber (natural, butyl, neoprene, nitrile, and fluorocarbon) or various kinds of plastic [polyvinyl chloride (PVC), polyvinyl alcohol, and polyethylene]. These materials can be blended or laminated for better performance. As a general rule, the thicker the glove material, the greater the chemical resistance, but thick gloves may impair grip and dexterity, having a negative impact on safety.

— *Neoprene Gloves*—Made of synthetic rubber and offer good pliability, finger dexterity, high density, and tear resistance. They protect against hydraulic fluids, gasoline, alcohols, organic acids, and alkalis. They generally have chemical and wear resistance properties superior to those made of natural rubber.

— *Nitrile Gloves*—Made of a copolymer and provide protection from chlorinated solvents such as trichloroethylene and perchloroethylene. Although intended for jobs requiring dexterity and sensitivity, nitrile gloves stand up to heavy use even after prolonged exposure to substances that cause other gloves to deteriorate. They offer protection when working with oils, greases, acids, caustics, and alcohols but are generally not recommended for use with strong oxidizing agents, aromatic solvents, ketones, and acetates.

— *Natural (Latex) Rubber Gloves*—Comfortable to wear, which makes them a popular general-purpose glove. They feature outstanding tensile strength, elasticity, and temperature resistance. In addition to resisting abrasions caused by grinding and polishing, these gloves protect responders' hands from most water solutions of acids, alkalis, salts, and ketones. Latex gloves have caused allergic reactions in some individuals and may not be appropriate for all responders. Hypoallergenic gloves, glove liners and powderless gloves are possible alternatives for responders who are allergic to latex.

— *Butyl Gloves*—Made of a synthetic rubber and protect against a wide variety of chemicals, such as peroxide, rocket fuels, highly corrosive acids (nitric acid, sulfuric acid, hydrofluoric acid, and red-fuming nitric acid), strong bases, alcohols, aldehydes, ketones, esters, and nitro compounds. Butyl gloves also resist oxidation, ozone corrosion, and abrasion and remain flexible at low temperatures.

Butyl rubber does not perform well with aliphatic and aromatic hydrocarbons and halogenated solvents.

NOTE All chemicals including crude oil can be expected to permeate through protective barriers over time. Permeation can take place without visible evidence in the protective materials. Many manufacturers of PPE, in particular manufacturers of gloves, provide information on breakthrough times from various chemicals (time it takes for the chemical to pass through the protective material). The PPE needs to be removed and discarded prior to the stated breakthrough time. Gloves should not be stored in direct sunlight or near noncompatible materials. Users should consult with the specific manufacturer to confirm the performance of their product.

9.7.4 Abrasion-resistant Gloves

Abrasion- or puncture-resistant gloves are made of leather or another material to protect against cuts and scrapes. These are recommended when handling sharp objects such as booms, skimmers, and hand tools. Should chemicals hazards be present, additional protection such as a chemical-resistant inner glove (liner) would be necessary that protect against the particular hazard.

9.8 Foot Protection

9.8.1 General

As determined by the JSA, responders who are exposed to possible foot injuries shall wear proper foot protection.

The most common type of foot protection is the steel-toed safety shoe. However, these may not provide protection from wet environments, chemicals, vermin, and/or snakes.

There are two issues regarding protective footwear to help determine which to use. They should provide protection from workplace hazards and they should be as comfortable as is reasonably practical. Typical response hazards include heavy or sharp objects that can fall on the feet or toes, penetration from sharp objects beneath the foot, slippery or wet surfaces, and splashing from chemicals or water. In order to be comfortable, they should fit well, be flexible and lightweight to reduce the tiring of feet and legs, and not accumulate sweat.

Issuing two pairs of safety boots/shoes per responder should be considered if responders are exposed to a wet environment. This allows the shoes to be worn on alternating days affording them the opportunity to dry out while not in use.

9.8.2 Mandatory Requirements

29 CFR 1910.136(a) OSHA Standard for Protective Footwear—The employer shall ensure that each affected employee uses protective footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, and where such employee's feet are exposed to electrical hazards.

9.8.3 Hazard Analysis

Footwear shall be chosen based on the hazards that are present. Assess the workplace and work activities for:

— materials handled or used by the responder,

— risk of objects falling onto or striking the feet,

— any material or equipment that might roll over the feet,

— any sharp or pointed objects that might cut the top of the feet,

— objects that may penetrate the bottom or side of the foot,

— possible exposure to corrosive or irritating substances,

— risk of contact with energized conductors.

Also, evaluate the risk:

— to ankles from uneven walking surfaces or rough terrain,

— of foot injury due to exposure to extreme hot or cold,

— of slips and falls on slippery walking surfaces,

— of exposure to water or other liquids that may penetrate the footwear causing damage to the foot and the footwear,

— of exposure to rotating or abrasive machinery (e.g. chainsaws or grinders).

9.8.4 Types of Protective Footwear

9.8.4.1 PVC Boot/Shoe Covers

PVC boot/shoe covers (“chicken boots”) provide 100 % waterproof protection. They are lightweight and worn over other shoes. They usually provide waterproof protection up to just below the knee and are best when responders need to walk in wet areas. They provide some chemical exposure protection, but this should be verified with the manufacturer as they may not be as durable as required over the long term. Slip-resistant boot/shoe covers should be worn when performing work in slippery or oily conditions.

9.8.4.2 Chemical-resistant Boots

Chemical-resistant boots are resistant to animal fats, oils, acids, and chemicals. They are available in polyurethane and PVC but can be warm when working in hot environments. They can be obtained with steel toe caps, rot-proof insoles, ankle bone padding, and cotton linings. They range from ankle boots to chest-high waders. They are ideal for chemical and hazardous material cleanup and emergency response applications.

9.8.4.3 Safety Boots or Shoes

Safety boots or shoes are the most common type of safety footwear. They have a protective toe cap and most have a protected mid-sole. Dielectric boots can be required for electric shock protection. These are electrically insulated footwear designed to give added protection to personnel where there is a risk of electric shock either due to working or contact with live power lines.

9.8.4.4 Economy-grade Boots

Economy-grade boots keep responder’s feet warm and dry in wet, muddy conditions where extreme chemical resistance is not required. These are worn without other shoes and are made of rubber.

9.8.5 Features to Look for in Safety Boots/Shoes

Features to look for in safety boots/shoes are listed below.

— *Height of the Boot/Shoe*—The use of high-cut shoes or boots is required if there is a risk of sparks, slag, or chemicals getting into the boot or shoe. Alternatively, leggings, spats, or gaiters can be used when slag from welding/cutting is possible.

— *Reinforced Toe*—Reinforced toes protect against crushing or injury from heavy weight falling on the toes and come in steel or nonsteel. Safety footwear that meets American National Standards Institute (ANSI) design and testing criteria should be selected.

— *Sole Types*—Different sole and tread designs are available and should be selected based on the conditions under which they are used. Sole types include steel shanks, which are designed to protect the sole of the foot against puncture and laceration from sharp or pointed objects that may be accidentally stepped on. Different sole compounds and tread designs create different coefficients of friction; therefore, be sure the selected sole matches the conditions.

— *Insulation*—Depending on the environment, insulation may be needed to protect the feet against the cold (outdoor cold weather conditions, freezer work, etc.).

— *Metatarsal Protection*—Provides protection for the top of the foot from the toes up to the ankle.

9.8.6 Understanding the Safety Boot/Shoes Markings

Many safety shoes have markings that denote the special safety features that are offered with the shoe. These markings and their intended use are described in Table 6.

9.8.7 Fit, Comfort, and Care of Safety Footwear

Good footwear should fit well right away; do not continue wearing them believing that they “stretch” with wear. Responders should wear new footwear when they are off work first to make sure that the footwear fits properly. There should be plenty of toe room (at least $^{1}/_{2}$ in.) while wrapping the rest of the foot comfortably. Responders should:

— pay attention to pinch spots or spots that rub too much;

— pay attention to the heel and ankle—these areas should fit snugly;

— add insoles if shoes are uncomfortable;

— make allowances for thick socks, especially in cold environments;

— make sure footwear is rated for the temperatures that are to be encountered.

Table 6—Markings Used on Safety Shoes

Marking	Criteria	Use
Blue Rectangle	Footwear has a Grade 1 protective toe only (no protective plate) Grade 1 protective toe withstands impacts up to 125 Joules. Comparable to a 22.7 kg (50lb) weight dropped from 1.3 m.	For industrial work environments not requiring puncture protection.
Green Triangle	Footwear has sole puncture protection with a Grade 1 protective toe (will withstand impact up to 125 joules). Sole puncture protection is designed to withstand a force of not less than 1,200 Newtons (270 lbs) and resist cracking after being subjected to 1.5 million flexes.	Any industrial or heavy work environment, including construction, where sharp objects are present (such as nails).
Yellow Triangle	Footwear has sole puncture protection and Grade 2 protective toe (will withstand impact up to 90 joules). Sole puncture protection is designed to withstand a force of not less than 1,200 Newtons (270 lbs) and resist cracking after being subjected to 1.5 million flexes.	Light industrial work environments that need both puncture and toe protection.
White Rectangle with Orange Ω	Footwear has soles that provide electric shock resistance. Such certified footwear contains a sole and heel design assembly that, at the point of manufacturing, has electrical insulating properties intended to withstand 18,000 Volts and a leakage current not exceeding 1 mA.	Any industrial environment where accidental contact with live electrical conductors can occur. (REMEMBER: Electric shock resistance is greatly reduced by wet conditions and with wear)
Yellow Rectangle with Green “SD” and Grounding Symbol	Footwear has soles that are static dissipative. The outer soles are made from an antistatic compound, chemically bound into the bottom components, capable of dissipating an electrostatic charge in a controlled manner.	Any industrial environment where a static discharge can be a hazard for workers or equipment.
Red Rectangle with Black “C” and Grounding Symbol	Footwear has soles that are electrically conductive.	For any industrial use where static discharge may create a hazard of explosion
White Rectangle with Green Fir Tree	Footwear provides protection when using chainsaws. Protective features are designed into the boots to prevent a running chainsaw from cutting all the way through the boot uppers so as to protect the shins, ankles, feet and toes.	For forestry workers and others who work with or around hand-held chainsaws and other cutting tools

9.9 Head Protection

9.9.1 General

Protecting responders from potential head injuries is a key element of any safety program. A head injury can impair responders for life or it can be fatal. Wearing a hard hat is one of the easiest ways to protect a responder's head from impact and penetration hazards as well as from electrical shock and burn hazards.

9.9.2 Mandatory Requirements

29 CFR 1910.135(a)(1) OSHA Standard for Head Protection—The employer shall ensure that each affected employee wears a protective helmet when working in areas where there is a potential for injury to the head from falling objects.

9.9.3 Hazard Analysis

Employers shall ensure that their responders wear head protection if any of the following apply:

— objects might fall from above and strike them on the head;

— they might bump their heads against fixed objects, such as exposed pipes or beams; or

— there is a possibility of accidental head contact with electrical hazards.

In general, protective helmets or hard hats should do the following:

— resist penetration by objects,

— absorb the shock of a blow,

— be water-resistant and slow burning.

If the JSA determines a hard hat is not necessary, alternative headgear (e.g. sunhats, beanies, liners) should be considered for other risks such as sun, heat, or cold.

9.9.4 Hard Hats

9.9.4.1 General

In addition to selecting protective headgear that meets ANSI standard requirements, responders shall wear hard hats that provide appropriate protection against potential workplace hazards.

Hard hats are divided into three industrial classes.

— Class G (General) hard hats provide impact and penetration resistance along with limited voltage protection (up to 2200 volts).

— Class E (Electrical) hard hats provide the highest level of protection against electrical hazards, with high-voltage shock and burn protection (up to 20,000 volts). They also provide protection from impact and penetration hazards by flying/falling objects.

— Class C (Conductive) hard hats provide lightweight comfort and impact protection but offer no protection from electrical hazards.

Another class of protective headgear on the market is called a “bump hat,” designed for use in areas with low head clearance. They are recommended for areas where protection is needed from head bumps and lacerations. These are not designed to protect against falling or flying objects and are not ANSI approved. It is essential to check the type of hard hat responders are using to ensure that the equipment provides appropriate protection. Each hat should bear a label inside the shell that lists the manufacturer, the ANSI designation, and the class of the hat.

9.9.4.2 Size Considerations

Hard hats come in a variety of sizes with adjustable headbands and should fit each individual appropriately. To ensure a proper fit there should be sufficient clearance between the shell and the suspension system for ventilation and distribution of an impact. The hat should not bind, slip, fall off, or irritate the skin.

9.9.4.3 Hard Hat Accessories

Some hard hats allows for the use of various accessories to help responders deal with changing environmental conditions, such as slots for earmuffs, safety glasses, face shields, and mounted lights. Optional brims may provide additional protection from the sun, and some hats have channels that guide rainwater away from the face. Protective headgear accessories shall not compromise the safety elements of the equipment.

9.9.4.4 Cleaning and Inspection

Periodic cleaning and inspection extends the useful life of hard hats. A daily inspection of the hard hat shell, suspension system, and other accessories for holes, cracks, tears, or other damage that might compromise the protective value of the hat is essential. Paints, paint thinners, and some cleaning agents can weaken the shells of hard hats and may eliminate electrical resistance. Consult the helmet manufacturer for information on the effects of paint, labels, and cleaning materials on their hard hats. Do not drill holes or store hard hats in direct sunlight, such as on the rear window shelf of a car, since sunlight and extreme heat can damage them.

Hard hats with any of the following defects should be removed from service and replaced:

— perforation, cracking, or deformity of the brim or shell;

— indication of exposure of the brim or shell to heat, chemicals, or UV light and other radiation (in addition to a loss of surface gloss, such signs include chalking or flaking).

Always replace a hard hat if it sustains an impact, even if damage is not noticeable. Suspension systems are offered as replacement parts and should be replaced when damaged or when excessive wear is noticed. It is not necessary to replace the entire hard hat when deterioration or tears of the suspension systems are noticed.

10 PPE for Hearing Protection

10.1 General

Responders are potentially exposed to a variety of noise sources during oil spill cleanup operations. Examples of such noise sources include the following:

— pumps,

— pressure washers,

— vacuum trucks,

— compressors,

— light towers,

— generators,

— engines,

— power tools.

Noise from these sources may be amplified when located in enclosed areas. Oil spill responders commonly work in these types of locations, such as near seawalls, between buildings, within vessel hulls or holds, around piers or docks, or inside confined spaces. In these areas, the noise cannot freely escape and reflects off surrounding surfaces. This results in an increase in noise exposures, as responders are exposed to a combination of direct noise emanating from the source itself, as well as the "reverberant" noise reflecting from nearby surfaces.

10.2 Mandatory Requirements

10.2.1 General

Noise exposure limits and regulatory requirements are established by OSHA in 29 *CFR* 1910.95 (general industry) and 29 *CFR* 1926.52 (construction). OSHA has established a permissible exposure limit (PEL) for noise of 90 dBA as an 8-hour TWA. The term "dBA" refers to the noise level measured in decibels (dB), utilizing the A-weighted frequency network. The A-weighted network is commonly used in the assessment of noise hazards because it provides a rating that indicates the injurious effects of noise on human hearing.

OSHA utilizes a 5 dBA exchange rate, meaning that with every increase in 5 dBA, the allowed exposure time is reduced by one half and is as follows.

As interpreted from Table 7, exposure to continuous steady-state noise is limited to a maximum of 115 dBA. In addition, the OSHA noise standard states that exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

OSHA requires that feasible engineering or administrative controls should be utilized when responders are subjected to sound exceeding the PEL. If such controls fail to reduce sound levels below the PEL, PPE shall be provided and used to reduce sound levels below the PEL.

Table 7—OSHA Permissible Noise Exposures [a]

Duration per Day hours	**Sound Level** dBA, slow response
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115

[a] Reference 29 *CFR* 1910.95, Table G-16.

In addition, the employer shall administer a hearing conservation program (HCP) whenever responder noise exposures are at or above an eight hour TWA of 85 dBA. Required elements of the HCP include, but are not limited to, the following:

— exposure monitoring,

— audiometric testing,

— hearing protection devices,

— responder training and education,

— recordkeeping.

10.2.2 Other Noise Standards

Other organizations and governmental agencies have published noise exposure limits. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends an 8-hour TWA exposure limit for noise of 85 dBA, utilizing a 3 dBA exchange rate [see Item 1) below]. The National Institute of Occupational Safety and Health (NIOSH) recommends similar limits [see Item 2)]. These limits are substantially more conservative than the regulatory limits established by OSHA but are widely considered to provide necessary protection for exposed responders. Although not legally required, many companies and organizations have adopted these limits.

1) *2012 TLVs and BEIs*, American Conference of Governmental Industrial Hygienists (2012).

2) *Criteria for a Recommended Standard: Occupational Noise Exposure*, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 98-126 (1998).

10.3 Hazard Assessment

Areas with potentially hazardous noise sources should be screened appropriately by trained safety and health personnel. If the types of equipment listed in 10.1 are present, then noise may be an issue. In addition, if responders find that they need to shout in order to be heard by others less than 3 ft away, then noise levels likely exceed 85 dBA. Sound level meters can also be used to take readings of noise levels in the area. Noise dosimetry, which consists of full-shift personal monitoring of affected responders, may be necessary to gain a better understanding of actual noise exposures.

10.4 Engineering and Administrative Controls

Engineering and/or administrative controls are considered the first priority for controlling exposures to noise. The aim of such controls is to reduce exposures as much as practical, preferably to levels below 85 dBA, thereby eliminating the need for hearing protective devices (HPDs) and implementation of a hearing conservation program.

Engineering controls involve modifying or replacing equipment or making related physical changes at the noise source or along the transmission path. Examples of effective engineering controls include some of the following.

— Select low-noise tools and machinery, also known as “Buy-Quiet.”

— Maintain and lubricate machinery and equipment.

— Place barriers between noise sources and responders.

— Enclose or isolate noise sources.

Administrative controls involve changes at the worksite that can reduce or eliminate responder exposure, such as the following.

— Relocate responders away from noisy sources or vice versa, when possible.

— Limit the amount of time a responder spends performing noisy tasks or near loud operations.

— Provide responder break areas in quiet areas, away from noise sources.

— Restrict responder presence to a suitable distance from noisy equipment.

10.5 PPE for Hearing Protection

10.5.1 General

HPDs are likely necessary during excessively loud oil spill response operations, such as when using power tools, noisy yard equipment, and heavy machinery. HPDs are typically used when engineering and administrative controls are not sufficient to reduce noise exposures to acceptable levels or as an interim basis when such controls are being implemented. Commonly used HPDs include earplugs and earmuffs. Examples of different types of HPDs include:

— formable foam ear plugs that are made from expandable slow-recovery foam;

— premolded, reusable earplugs that are made from flexible materials that are preformed to a specific shape. They can be washed and reused several times before they need to be discarded; and

— earmuffs that have rigid cups with soft plastic cushions that seal around the ears to block noises. Muffs come in one-position or multiposition bands and are also sold in styles for attachment to hard hats.

All types of HPDs possess various advantages and disadvantages and shall be worn properly in order to provide adequate noise reduction. Every commercially-available HPD in the United States. has a “Noise Reduction Rating” (NRR) expressed in decibels of reduction (other regions may use different ratings such as the Single Number Rating in the European Union). The NRR is based on data obtained under laboratory conditions. However, scientific studies have shown that real-world protection is less than the lab-based NRRs. For more information on selecting appropriate HPDs and estimating hearing protection attenuation, refer to the *OSHA Technical Manual*, Noise and Hearing Conservation chapter (http://www.osha.gov/dts/osta/otm/noise/hcp/index.html).

At extremely high noise levels (greater than 100 dBA), dual protection may be necessary. This consists of wearing earplugs in combination with earmuffs. It is important to note that using dual protection does not double the noise protection but adds only an estimated 5 to 10 dB of attenuation. The *OSHA Technical Manual* includes instructions on estimating attenuation from dual protection.

10.5.2 Selecting HPDs

When using the NRR to assess hearing protector adequacy, the following method should be used. If the HPD used has a rating other than NRR, refer to that system’s method for calculating hearing protector adequacy.

When using area monitoring procedures and a sound level meter set to the A-weighting network:

a) obtain a representative sound level for the area in question,

b) subtract 7 from the NRR and multiply the result by 0.5,

c) subtract the remainder from the A-weighted sound level for that area.

Example for selecting HPDs per OSHA guidance is as follows.

a) Obtain a representative sound level for the area in question:

   — sound level meter reading is 95 dBA.

b) Subtract 7 from the NRR and multiply the result by 0.5:

   — foam HPD inserts NRR is equal to 23 dBA;

   — (23 dBA – 7) × 0.5 = 8 dBA.

c) Subtract the remainder from the A-weighted sound level for that area:

   — 95 dBA – 8 dBA = 87 dBA.

11 PPE for Slip, Trip, and Fall Protection

11.1 General

Oil spill response work is predominately on vessels or outdoors with varied terrain such as brush, rocks, or beach. When conducting the site characterization to complete the JSA, the following points should be considered in order to prevent slips, trips, and falls.

— *Good Lighting*—While there is no specific PPE to prevent tripping, good lighting reduces the risk.

— *Maintained and Marked Pathways*—When practical, responders should be provided with well-maintained and marked pathways free of obstructions (e.g. hoses, lines/ropes, cables, duct work).

— *Proper Footwear*—To prevent slips, the right footwear for the job can significantly reduce the risk (9.8).

— *Surface Conditions*—Responders should use caution when walking across slippery or oily surfaces.

11.2 Slip and Trip Hazards

Slip resistance can vary from surface to surface, or even on the same surface, depending upon surface conditions and responder footwear. Slip-resistant flooring material such as textured, serrated, or punched surfaces and steel grating may offer additional slip resistance. These types of floor surfaces should be installed in work areas that are generally slippery because of wet, oily, or dirty operations. Slip-resistant footwear may also reduce slipping hazards.

Slips happen where there is too little friction or traction between the footwear and the walking surface. Common causes of slips are:

— wet or oil soaked decks or surfaces;

— occasional spills;

— slippery ramps, ladders, surfaces;

— shoes with worn soles.

Trips are the result of collisions (strikes, hits) with an object causing a loss of balance and an eventual stumble or fall. Common causes of tripping are:

— obstructed view;

— poor lighting;

— loose rock, debris, ground clutter;

— large rock, logs;

— underbrush;

— cables, hoses, lines/ropes;

— uneven ground, walking surfaces.

11.3 Fall Protection PPE

11.3.1 General

Fall protection is a complex subject and this PPE guideline just touches on the basics and provides PPE considerations. OSHA provides different regulations for fall protection depending upon the work environment (e.g. shipyards, general industry, construction, and longshoring). The appropriate regulation or company procedures should be referenced for fall protection requirements.

11.3.2 Mandatory Requirements Nonvessels

29 CFR 1910.23(a)—"Protection for floor openings."

29 CFR 1910.23(b)—"Protection for wall openings and holes."

29 CFR 1910.23(c)—"Protection of open-sided floors, platforms, and runways."

29 CFR 1910.23(c)(1)—Every open-sided floor or platform 4 ft or more above adjacent floor or ground level shall be guarded by a standard railing [or the equivalent as specified in Paragraph (e)(3) of this section] on all open sides except where there is entrance to a ramp, stairway, or fixed ladder. The railing shall be provided with a toe board wherever, beneath the open sides.

11.3.3 Mandatory Fall Protection for Vessels

On vessels, fall protection should be provided and required anytime that responders are exposed to a fall of 5 ft or more and are not protected by rails.

29 CFR 1915.71, *Scaffolding or Staging*—(j) "Backrails and Toeboards":

(1) Scaffolding, staging, runways, or working platforms which are supported or suspended more than 5 feet above a solid surface, or at any distance above the water, shall be provided with a railing which has a top rail whose upper surface is from 42 to 45 inches above the upper surface of the staging, platform, or runway and a midrail located halfway between the upper rail and the staging, platform, or runway.

(3) Rails may be omitted where the structure of the vessel prevents their use. When rails are omitted, employees working more than 5 feet above solid surfaces shall be protected by safety belts and life lines meeting the requirements of §§ 1915.159 and 1915.160, and responders working over water shall be protected by buoyant work vests meeting the requirements of § 1915.158(a).

29 CFR 1915.77, Working Surfaces—(c) When responders are working aloft, or elsewhere at elevations more than 5 feet above a solid surface, either scaffolds or a sloping ladder, meeting the requirements of this subpart, shall be used to afford safe footing, or the responders shall be protected by safety belts and lifelines meeting the requirements of §§ 1915.159 and 1915.160.

11.3.4 Providing Fall Protection

Fall protection should be provided and required anytime that responders are exposed to a fall of 4 ft or more (5 ft on a vessel) and are not protected by standard safety railings.

Fall protection is required in any powered aerial lift at any elevation. Responders shall tie off to the equipment. Tying off to objects outside of the equipment is dangerous and illegal. Responders using fall protection, and their supervisors, need thorough training.

Types of fall protection are as follows.

— *Positioning*—Like a pole climbing belt or window cleaner's rig. This holds a responder in a position where they cannot fall.

— *Restraint*—Responders are tied off to a fixed point, like on a flat roof or platform, so that they cannot step off or approach the edge.

— *Fall Arrest*—Responders wear a full body arrest harness, a shock absorbing lanyard, and are tied off with compatible hardware to an overhead anchorage point capable of withstanding a 5000 lb

— *Static Load*—If they fall, the lanyard stops them and absorbs some of the energy. Responders who have fallen in this manner shall be rescued quickly. Therefore, a rescue plan shall be in place prior to operations.

12 PPE for Wildlife and Vector-borne Diseases

12.1 General

Responders working in the vicinity of wildlife (both plants and animals) are at risk of injury or illness unless appropriate precautions are taken. Response personnel shall contact the Environmental Unit Section Leader or designee to report the type and location of oiled wildlife and seek guidance on specific situations. Only trained wildlife personnel should handle, touch, and/or transport oiled animals.

12.2 Types of Hazards

Responders from different geographical regions need to consult with persons that have knowledge on local wildlife and biological hazards. The seasons of the year will significantly impact hazards.

— Oiled wildlife (e.g. bites, scratches).

— Biological concerns from the oiled wildlife (e.g. rabies).

— Hazardous plants (e.g. poison ivy, cactus).

— Dangerous animals (e.g. bears, alligators, stray dogs).

— Insects bites and stings (e.g. mosquitos, bees, spiders, ticks).

12.3 Hazard Mitigation

Mitigation of hazards from wildlife and vector-borne diseases should be considered for the JSA (Section 3). Trained wildlife personnel from the Environmental Unit shall recommend appropriate PPE to be used when working near wildlife or biological hazards. One of the mitigations for these types of hazards may be an emergency rescue plan should a responder suffer a life-threatening situation or reaction as a result of an animal bite or insect sting.

12.4 Exposure Types

12.4.1 Insect Bites and Stings

Responders may be exposed to many types of venomous insects. Spiders, scorpions, and stinging insects can be found throughout various geographic regions. Stinging insects include bees, wasps, hornets, and fire ants. Venomous spiders include black widows, brown recluse spiders, and hobo spiders. They are especially dangerous to responders who have allergies to that particular venom. Anaphylactic shock is the body's severe allergic reaction to a bite or sting and requires immediate emergency care (see the CDC website for more information: http://www.cdc.gov).

12.4.2 Vector-borne Diseases

Responders may be exposed to vector-borne diseases that are spread by insects, such as mosquitoes, or ticks. When a mosquito or tick bites a responder, it may transfer a disease-causing agent, such as a parasite, bacterium, or virus. Tick-borne diseases may include Lyme disease, Babesia, Ehrlichiosis, and Rocky Mountain spotted fever. Mosquito-borne diseases may include West Nile virus, encephalitis, malaria, and yellow fever. If malaria or yellow fever is identified as a risk, consult with medical providers regarding appropriate vaccinations for yellow fever and prophylaxis for malaria.

12.4.3 Poisonous Plants

Poisonous plants found in the United States include poison ivy, poison oak, and poison sumac. These plants can cause allergic reactions if the leaves or stalks come in contact with responders' skin and can also be dangerous if they are burned and their vaporized oils come in contact with responders. Employers should train outdoor responders on how to identify and avoid poisonous plants in their work area (see the CDC website for more information: http://www.cdc.gov).

12.4.4 Dangerous Animals

12.4.4.1 General

This includes snakes, bears, alligators, crocodiles, etc., depending on the geographical area of the spill. Mitigation may include trained, armed lookouts accompanying responders while working; this is often done in Alaska with bear lookouts. The following sections are general guidelines. Wildlife experts shall be consulted during the JSA process and prior to exposure to these hazards.

12.4.4.2 Rodents and Wild or Stray Animals

Responders should:

— avoid contact with wild or stray animals;

— avoid contact with rats or rat-contaminated buildings. If responders cannot avoid contact, they should wear protective gloves and wash their hands regularly;

— contact wildlife specialist to dispose of dead animals as soon as possible. Unless trained, responders should not handle dead wildlife;

— get medical attention immediately and consider testing for rabies if bitten or scratched.

12.4.4.3 Snakes

Venomous U.S. snakes include rattlesnakes, copperheads, cottonmouths, water moccasins, and coral snakes.

— Responders should watch where hands and feet are placed when removing debris. If possible, responders should not place fingers under debris they are moving. Wear heavy cut/puncture-resistant gloves.

— If responders see a snake, step back and allow it to proceed.

— Responders should wear boots at least 10 in. high. Preferably snake boots or chaps.

— Responders should watch for snakes sunning on fallen trees, limbs, or other debris.

— If a responder is bitten, note the color and shape of the snake's head to help with treatment. Try to get a picture of the snake if possible.

— Keep bite victims still and calm to slow the spread of venom in case the snake is poisonous. Seek medical attention immediately.

12.5 Preventing Insect Stings and Tick Bites

Responders should take the following steps to prevent insect stings and tick bites.

— PPE

  — Wear a hat and light-colored clothing, including long-sleeved shirts tucked in gloves or use tape and long pants tucked into boots or socks. If possible, use elastic bottomed trousers or use tape if clothing cannot be tucked into boots.

  — Wear clothing to cover as much of the body as possible.

  — Use insect repellents that provide protection for the amount of time spent outdoors.

  — Use insecticides such as Permethrin for greater protection from ticks. Permethrin kills ticks on contact. Permethrin can be used on clothing but should not be used on skin. One application of Permethrin to pants, socks, and shoes typically stays effective through several washings.

  — Insect repellents that contain DEET or Picaridin are very effective for ticks and chiggers. Follow label's directions.

  — Wear clean clothing and bathe daily. Sweat may anger bees.

  — Avoid perfumed soaps, shampoos, and deodorants.

— General Information

  — Avoid flowering plants when possible.

  — Remain calm and still if a single stinging insect is flying around. Swatting at an insect may cause it to sting.

  — If responders are attacked by several stinging insects at once, run to get away from them.

  — If responders are able to physically move out of the area, do not to attempt to jump into water. Some insects (particularly Africanized Honey Bees) are known to hover above the water, continuing to sting when surfacing for air.

  — Responders with a history of severe allergic reactions to insect bites or stings shall inform on-site medical personnel. If employers are aware of responders that have allergic reactions to insect bites or stings, the employers should consider making an epinephrine auto injector available.

  — Avoid fire ants; their bites are painful and cause blisters. Severe reactions to fire ant bites (chest pain, nausea, sweating, loss of breath, serious swelling, or slurred speech) require immediate medical treatment.

13 PPE for Responders near Traffic, ATVs, and UTVs

13.1 General

Operating heavy equipment such as cranes, back hoes, and vacuum trucks entail varying degrees of operational hazards by virtue of their application. Section 13 is intended to provide basic PPE selection guidance for operators and general site responders. It should not be used to replace company policy or specific PPE standard operating procedures developed through proper hazard analysis methods. Listed herein are common hazards encountered in environments where traffic and ATV/UTV usage is anticipated. These recommendations are meant to aid and supplement in PPE selection decisions in conjunction with equipment manufacturers' and employers' guidelines.

13.2 Mandatory Requirements

At this time there are no mandatory OSHA requirements in the operation of ATVs and UTVs; however, the 29 *CFR* 1910.132 PPE standard does require the provision of PPE based on the risks presented by the operation. The hazards listed herein are common conditions present when considering specific variables of operation (such as traffic, heavy equipment, ATVs/UTVs).

13.3 ATVs and UTVs

13.3.1 General

All-terrain vehicles (ATVs) also known as quads, or four-wheelers, are defined as vehicles that travel on low-pressure tires, with a seat that is straddled by the operator, along with handlebars for steering control. As the name implies, they are designed to handle a wider variety of terrain than most other vehicles.

Utility-terrain vehicles (UTVs) differ from ATVs in that UTVs typically have a bench seat or side-by-side seating arrangement and are not straddled, many have seat belts and rollover protection, and most have a cargo box at the rear of the vehicle.

ATVs and UTVs should be equipped with headlights, taillights, and reflectors for increased visibility to other equipment operators. Lights should be used during daylight operations also, not just at night. Beacons or strobe lights should also be considered.

13.3.2 Types of Hazards

Some hazards to be aware of when operating ATVs and UTVs include:

— rollover,

— operating on paved roads and mixing with faster moving traffic,

— terrain,

— weight limitations.

13.3.3 PPE Selection

Some PPE is specific for particular ATVs and UTVs. Manufacturer recommendations should be considered in conjunction with the JSA when selecting the proper PPE. See Section 9 for general PPE protection including hand protection, head protection, eye and face protection, etc. See Section 10 for information concerning hearing protection.

Examples of specific PPE for ATVs and UTVs include:

— head protection, which for ATVs should include a motorcycle type helmet;

— gloves, which for heavy equipment should leave the operator with the dexterity to operate controls and still meet the cut/puncture-resistant or other requirements determined in the analysis process;

— hearing protection, which is often necessary for some heavy equipment operations;

— goggles/face shields where conditions require;

— safety shoes;

— seat belts (UTV).

13.3.4 Seat Belts

Seat belts are in nearly all vehicles and on mobile equipment that is equipped with rollover protective cabs or rollover protective structures like roll bars. One reason UTVs are usually preferred over ATVs for oil spill response is seat belts. Seatbelts are highly effective in preventing death and reducing injury in collisions and rollovers. A good PPE analysis should include a close look at all vehicles and equipment for seatbelts, the need for seatbelts, and whether or not they are being worn.

13.4 Traffic

13.4.1 Identification of Red Zones

An evaluation of the work area shall be conducted for Red Zones, which include all areas in which responders are engaged in operations where vehicular traffic exists. Examples of Red Zones include:

— locations where responders are within transportation right of way;

— work zone where travel paths or space exist where on-site equipment, such as earth moving equipment, ATVs/UTVs, and forklifts, are anticipated to occupy or move through;

— work zone where cranes or lifting operations are anticipated.

13.4.2 Hazard Red Zones

Work zone traffic control is necessary for providing a safe environment in those areas where responders and transportation modes may compete for common or adjacent space. Every effort should be made to reduce the risk of injury to both the responder and the transportation system user. Primary PPE to consider include head, foot and eye protection due to falling or flying objects. However, PPE does not protect from strikes by equipment. Instead, what protects responders most is:

— high-visibility public safety vests for all responders within Red Zones. Selection of the specific color (international orange, lime green) should be made by the safety representative onsite. The goal of color selection should be to distinguish responders independently from work zone apparatus and the environment;

— vehicle backup warning devices;

— established traffic lanes (painted lanes, cones, flags, signs, traffic control devices, etc.);

— establishing working perimeters (crane swings, forklift operations, etc.).

14 PPE for Water Safety

14.1 General

This section is meant to describe the hazards and PPE necessary to protect responders when conducting operations on or near water. When doing this type of work, responders are positioning their bodies from boats or shore over the water's surface. Work activities may include, but are not limited to the following:

— working or observing activities on any vessel that places personnel at risk of falling into the water without a barrier as a means of prevention;

— transferring to or from all watercraft, barges or platforms, etc. (except by means of a gangway);

— loading or unloading cargo or equipment from any vessel or barge, handling tag lines;

— operating or riding in any small boat, barge, vessel, skiff, etc.;

— working in isolated areas near the water;

— working on a pier or dock from which personnel may be pulled into the water (i.e. line handling off of a dock);

— where the physical limitations of the available working space creates a hazard of falling into the water;

— handling floating booms with a skirt that hangs below the water's surface to contain the oil;

— any other activity when indicated by the JHA.

It is important that a JSA is done to determine the appropriate PPE when working around water.

14.2 Mandatory Requirements

It is the responsibility of the vessel Captain/Master to ensure compliance with appropriate USCG Life Saving requirements on his/her respective vessel. The Safety Officer establishs water safety requirements for specific landside operations, including piers, docks, and applicable staging areas, etc.

29 CFR 1918.105(b)—"Personal flotation devices (PFDs)." (1) The employer shall provide and shall require the wearing of PFDs for each employee engaged in work in which the employee might fall into the water.

33 CFR 175.15(a)—"No person may use a recreational vessel unless at least one PFD of the following types is on board for each person:

(1) Type I PFD;

(2) Type II PFD; or

(3) Type III PFD."

29 CFR 1915.73(e)—"When employees are working near the unguarded edges of decks of vessels afloat, they shall be protected by personal flotation devices, meeting the requirements of §1915.158(a)."

14.3 Types of Hazards

Hazards to be aware of specific to working on or near the water's edge:

— drowning,

— water hypothermia.

Other hazards associated with working on the water may include:

— heat stroke/exhaustion (Section 6),

— exhaust from gas or diesel engines (Section 8).

— slippery surfaces and tripping (Section 11),

14.4 Drowning Prevention

14.4.1 General

Ideally, the best prevention from drowning would be engineering controls, such as protected edges in work areas preventing responders from falling in the water (e.g. railings, gunwale). In some cases, this is not possible. As appropriate, an approved USCG Type I, II, III, or V PFD shall be worn during activities that place all personnel at risk of unintentionally entering any body of water. All PFDs used on vessels and barges shall be USCG approved pursuant to 46 *CFR* Part 160, Subchapter Q.

14.4.2 Types of PFDs

— **TYPE I** (Off-Shore Life Jacket) (22 lbs. buoyancy): Best for open, rough, or remote water, where rescue may be slow in coming.

  Advantages: Provides best buoyancy. Turns most unconscious wearers face-up in water. Highly visible color.

  Disadvantages: Bulky.

— **TYPE II** (Near-Shore Buoyant Vest) (15.5 lbs. buoyancy): Good for calm, inland water, or where there is good chance of fast rescue.

Advantages: Turns some unconscious wearers face-up in water. Less bulky, more comfortable than Type I PFD. Inexpensive.

Disadvantages: Not for long hours in the water. Does not turn some unconscious wearers face-up in water.

— **TYPE III** (Flotation Aid) (15.5 lbs. buoyancy): Good for calm, inland water, or where there is a good chance of fast rescue.

Advantages: Generally the most comfortable Type for continuous wear. Freedom of movement for many active water sports. Available in many styles.

Disadvantages: Wearer may have to tilt head back to avoid going face-down. In rough water, a wearer's face may often be covered by waves. Not for extended survival in rough water.

— **TYPE V** (Hybrid Device, Work Vest): Required to be worn to be counted as a regulation PFD.

Advantages: Least bulky of all Types. High flotation when inflated. Good for continuous wear.

Disadvantages: May not adequately float some wearers unless partially inflated. Requires active use and care of inflation chamber.

14.4.3 Wearing PFDs

To work best, PFDs shall be worn with all straps, zippers, and ties fastened. Loose strap ends should be tucked in to avoid snagging.

14.4.4 Sizing PFDs

When selecting a PFD, the proper size is important. If the PFD does not fit, it shall not be altered. PFDs are sized by weight and chest size and should be tried on to assure a proper fit. Too small may not keep the responder afloat and too large may come off on impact with the water. A PFD should be snug around the torso and when lifting on the shoulder straps, they should not rise above the bottom of the wearer’s ears.

14.4.5 Inspection of PFDs

PFDs are required to be in serviceable condition. Prior to use, responders shall inspect for rips, tears, and holes. Seams, fabric straps, and hardware shall be free from defect and in proper working order. PFDs with indications of waterlogging, mildew odor, shrinkage of the buoyant materials, or any other defects shall be taken out of service.

14.4.6 Maintaining PFDs

PFDs should be thoroughly dry prior to being stored. They should always be stowed in a well-ventilated place. Heavy objects should not be place on PFDs nor should they be used as a kneeling pad or boat fender. PFDs lose buoyancy when crushed. PFDs should never be dried on a radiator, heater, or any other direct heat source.

14.4.7 Other Considerations

During any nighttime, on water operation, all personnel shall wear a USCG-approved Personal Marker Light and whistle attached to their PFD. In addition, PFDs affixed with reflective material should be available.

All personnel riding in helicopters shall wear a PFD supplied by the helicopter flight crew that shall be used in lieu of all other PFDs per the flight crew's recommendations.

14.5 Water Hypothermia Prevention

14.5.1 General

Hypothermia is a condition that exists when the body's temperature drops below 95 °F. Loss of body heat results in loss of dexterity, loss of consciousness, and eventually loss of life. Cold water robs the body's heat 32 times faster than cold air. Getting out of the water as quickly as possible is essential.

Be aware that cold water [less than 80 °F (27 °C)] can lower the body temperature. Water temperature, body size, amount of body fat, and movement in the water all play a part in cold water survival. Small people cool faster than large people. PFDs can help someone stay alive longer in cold water. They let the person float without using energy and they protect part of the body from cold water. A snug-fitting PFD is better than one that is loose fitting.

14.5.2 Cold Weather PFDs

Selection of the type of PFDs should be made considering the temperature charts provided (Table 4 and Table 8). Factors to be considered are air temperature, water temperature, and anticipated worst case scenario rescue times. When working on a boat in cold water, a flotation coat or deck-suit style PFD should be used. In cold water, they are better than vests because they cover more of the body. The design of the chosen PFD should prevent head immersion. Keeping the head out of the water lessens heat loss and increase survival time.

Table 8—Water Hypothermia Chart

If the Water Temp. (°F) is:	Exhaustion or Unconsciousness	Expected Time of Survival is:
32.5	Under 15 min.	Under 15 to 45 min.
32.5 to 40	15 to 30 min.	30 to 90 min.
40 to 50	30 to 60 min.	1 to 3 hours
50 to 60	1 to 2 hours	1 to 6 hours
60 to 70	2 to 7 hours	2 to 40 hours
70 to 80	3 to 12 hours	3 to Indefinite
Over 80	Indefinite	Indefinite
Source: USCG.		

14.5.3 Types of Cold Weather PFDs

Immersion Suits—These suits are designed to keep the wearer dry with watertight face and wrist seals. The boots are integral with the suit. Made of neoprene rubber and other impervious materials, these suits provide both flotation and insulation. Modern survival suits are rugged, easy to don, and extends survival time to an extraordinary degree if they are put on when one is dry.

Thermal Protective Coveralls (Anti-exposure Suit)—These coveralls are designed to be worn while working. They provide protection from cold air temperature and when immersed, provide insulation and flotation. However, they are not watertight and fills with water in a relatively short time. This water is

warmed by the body core and is retained within the suit, providing significant insulation value, and thus extending survival time.

Thermal System Coat—This type of coat provides insulation and flotation. Some have a "beavertail"—a neoprene rubber flap that can be pulled down from the back of the jacket, under the crotch, and secures to the front of the jacket. When immersed, one deploys the beavertail and secures it to the front of the coat. This provides a surprisingly effective barrier to the movement of water in and out of the coat, effectively trapping a layer of warm water against the body. However, the high-heat loss areas of the upper thighs are still exposed to the cooling effects of the water.

Figure 4 reflects the recommended minimum equipment. Additional protection may be worn at the responders' discretion. Use the table as follows:

— draw a horizontal line across the table that is equal to the water temperature for the mission,

— draw a vertical line up the table that is equal to the air temperature for the mission,

— don the equipment identified in the shaded area where the lines intersect.

14.6 Purposeful Water Entry

Responders are sometimes required to enter shallow water to perform work (e.g. retrieving boom, cutting vegetation, removing riprap). Besides PFDs, other PPE to consider includes waders that protect the feet, legs, and lower torso. When choosing waders, environmental conditions to consider are depth of water, temperature of air and water, types of walking surfaces, presence of oil, and the wader's resistance to oil. Wading belts should be worn with waders to prevent waders from filling with water in the event of a fall or slip into water that exceeds the height of the waders.

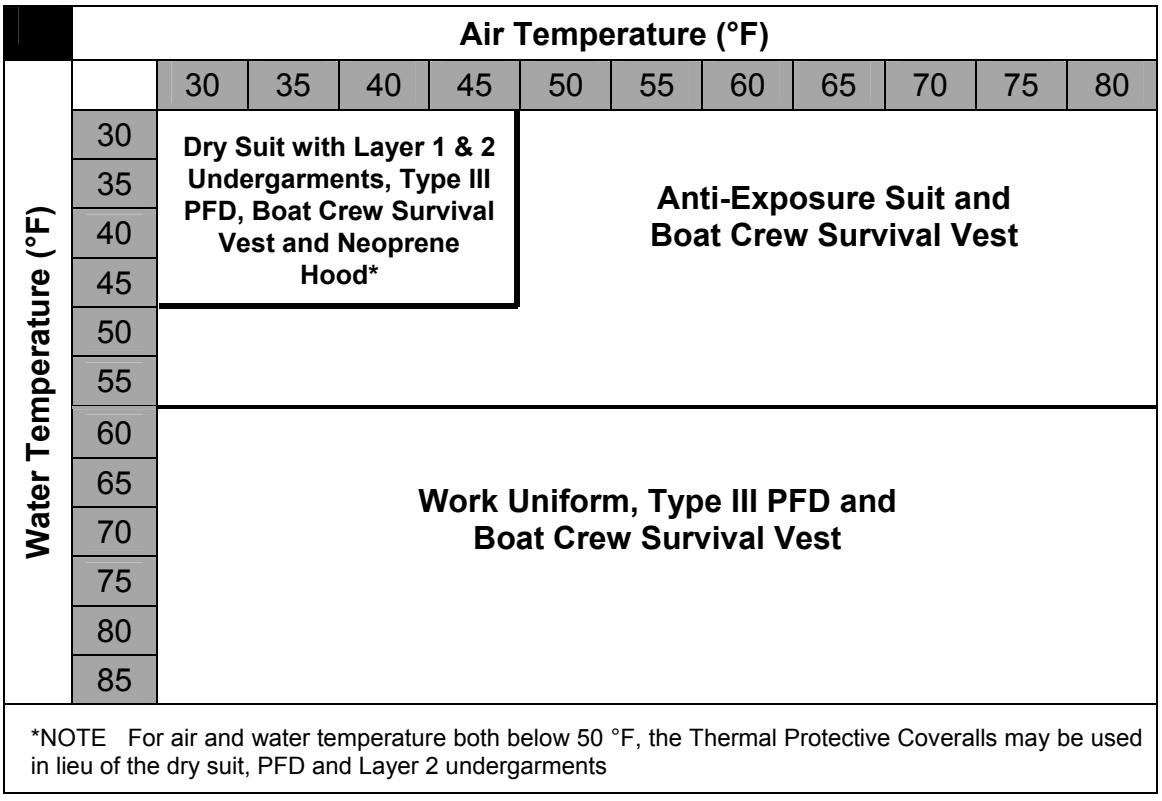


Figure 4—U.S. Coast Guard 50-50 Box

15 PPE for In Situ Burning

15.1 General

ISB can be an effective countermeasure in reducing or preventing oil from impacting the shoreline by offering the potential to convert quantities of oil into primary combustion products with a small percentage of other unburned and residual by-products.

15.2 Types of Hazards

Level of PPE should be evaluated based upon the threats identified in the JHA. According to safe ISB practices, workers should be kept out of the smoke plume and at a safe distance from the fire, thus higher level PPE requirements may be unnecessary. People with fire protective equipment may feel overconfident in their protection and move too close to the fire. If personnel are close enough to the flames to need this type of equipment, the vessel is also in danger.

General hazards include the following.

— Marine Environment

  — Responders are working on or over water. Thus, marine safety such as the use of PFDs and adherence to vessel safety need to be considered. These are discussed in previous sections.

— Heat/Cold Stress

  — Responders may be subjected to sun and heat exposure while on the other hand there is the possibility of cold extremes, depending on the spill location. How to deal with heat/cold stress is dealt with in a previous section.

— Fire/explosion caused by:

  — combustion products,

  — unignited vapors,

  — burn residue,

  — potential exposure to burn by-products.

15.3 PPE Selection

15.3.1 General

The recommended PPE ensemble is Level D for the entire burn response operation. During preignition and the burn phase, personnel should have access to respirators and goggles. As a precautionary measure, flame and fire-resistant coveralls may be necessary for personnel on the safety vessel.

15.3.2 Level D Ensemble

This list of PPE is for use by those not directly involved in igniting the oil during the ISB operation. This ensemble is usually worn by those on the support vessels that are pulling the fire boom and are at a reasonable distance from the burning oil.

— Oil-resistant coveralls.

  - OPTION: Street clothing may be worn by supervisory personnel, technicians, specialist, etc. that is not exposed to oil or the immediate flame proximity.

- Rubber steel toe/shank safety boots with textured bottoms.
  - OPTION: deck shoes with textured soles (for boat operations).
- Rubber/latex or leather work gloves.
- Rubber rain pants, jacket, and hood (as needed).
- Rubber apron (as needed).
- PFD.
- Quart bottle to carry drinking water or other fluids (during heat stress alert).
- Hearing protection (ear plugs).
- Insect repellent (if necessary).
- Hard hat (not required on vessel decks unless overhead equipment is operating).
- Safety goggles.
- Sunscreen.

Refer to Section 9 to Section 11 for more details on particular PPE mentioned above.

15.3.3 Level C Ensemble

The following list is the PPE that should be worn by the responders involved in igniting the oil on the water:

- fire-resistant coveralls;
- National Fire Protection Association (NFPA) rated fire-resistant gloves;
- half or full mask air-purifying respirator;
- fire-resistant hood;
- face shield, as required;
- dust, fume, mist respirator filter;
- organic vapor cartridge (on-hand for oil vapors prior to burn);
- goggles.

Refer to Section 8 to Section 11 for more details on particular PPE mentioned above.

Coveralls are of flame- and fire-resistant type and lightweight to prevent overheating. Coveralls are worn at all times by response personnel potentially at risk of exposure. During preburn, burn, and postburn

operations, fire-resistant coveralls should not be worn when directly handling spilled oil because any oil that gets on the suit becomes potentially flammable.

15.4 Other Issues to Keep in Mind

Vessel of opportunity systems personnel shall be properly fitted and trained prior to commencing operation. Responders handling burn residue need protective clothing.

Annex A
(informative)

PPE Selection Matrix

Type	Hazard Addressed	Secondary Considerations	Design Criteria	Possible Activities	Section Reference
Eye Protection					
Safety glasses with sideshields	Flying objects Limited splash	Fogging Lighting conditions Prescription (visibility) Size	ANSI Z87.1-2003	All site work	9.6.4
Goggles	Flying objects Moderate abundant splash Heavy dust	Glare Fogging Prescription (visibility) Size Narrowed vision	ANSI Z87.1-2003	Chemical pouring Pressure washing	9.6.3
Eye and Face Protection					
Face shield	Flying objects Splash High velocity particles	Excessive glare Fogging Prescription (visibility) Size Glare Compatibility with head protection Distorted vision	ANSI Z87.1-2003	Pressure washing	9.6.5
Foot Protection					
Steel-toed boots	Falling hazard Toe rollover/pinch/crush Rolling objects Piercing hazard	Weight Traction Foot dexterity Nonchemical resistant	ASTM F2412-2005 and ASTM F2413-2005, or ANSI Z41-1999	Boat/vessel ops Materials handling	9.8.4
Steel-toed boots with metatarsal protection	Falling hazard Foot rollover/pinch/crush	Weight Traction Foot dexterity Nonchemical resistant	ASTM F2412-2005 and ASTM F2413-2005, or ANSI Z41-1999	Materials handling Heavy lifting operations	9.8.4

Type	Hazard Addressed	Secondary Considerations	Design Criteria	Possible Activities	Section Reference
Foot Protection (continued)					
Chemical-resistant boots—steel toed	Falling hazard Foot rollover/pinch/ crush Chemical absorption	Weight Traction Foot dexterity	ASTM F2412-2005 and ASTM F2413-2005, or ANSI Z41-1999 Chemical-resistant rated	Pressure washing < 3000 psi Oily environments	9.8.4
Waders	Wet environments	Weight Limited mobility Environmental conditions (high waves)	ASTM F2412-2005 and ASTM F2413-2005, or ANSI Z41-1999	Vegetation/debris removal Boom deployment Operations in marshes/deltas	14.6
“Snake” boot—steel toed	Falling hazard Foot rollover/pinch/ crush Chemical absorption Biological hazards (snakes)	Weight Traction Foot dexterity	ASTM F-2412-2005 and ASTM F2413-2005, or ANSI Z-41-1999 Chemical-resistant rated	Materials handling Heavy lifting operations Marshy environments where wildlife is anticipated.	9.8.4
Chemical-resistant boot covers—chicken boots”	Chemical absorption	Used to cover nonchemical resistant boots Limited durability Traction Removal hazards (use safety scissors)	Chemical-resistant rated ASTM F739	Oily environments High-volume, low-pressure washing	9.8.4
Hand Protection					
Disposable nitrile gloves	Limited absorption hazard Biological hazards	Grip Circulation Sweating Fit Decon/reuse issues	Chemical-resistant rated ASTM F739	Limited chemical handling Secondary PPE method Oily environments	9.7.3
Cut/ laceration-resistant gloves	Cuts Abrasions	Grip Circulation Sweating Fit Usefulness duration Dexterity	Puncture rated Abrasion resistance/tensile strength Cut resistant	Materials handling “Clean” equipment handling	9.7.4

Type	Hazard Addressed	Secondary Considerations	Design Criteria	Possible Activities	Section Reference
Hand Protection (continued)					
Chemical-resistant gloves—cut/laceration-resistant	Chemical absorption Hazards Cuts Abrasions Punctures Biological hazards	Grip Circulation Sweating Fit Decon/reuse issues Usefulness duration Dexterity	Chemical-resistant rated ASTM F739 Puncture rated Abrasion resistance/tensile strength Cut resistant	Contaminated materials handling Vacuum truck operation Spent sorbent handling Cont. boom recovery/ maintenance Skimmer handling Decon operations Pressure washing	9.7.3
Chemical Protective Clothing					
Chemical protective garment—"stitched seam"	Limited chemical absorption hazards	Circulation User heat stress Fit Decon/reuse issues Usefulness duration Limited mobility User experience	Chemical-resistant rated ASTM F739 Elastic wrists and ankles Nonhooded (no splash potential)	Contaminated materials handling Vacuum truck operation Spent sorbent handling Cont. boom recovery/ maintenance Skimmer handling Decon operations	9.5
Chemical protective garment—sealed "taped" seam	Splash or gross chemical cont.	Circulation User heat stress Fit Decon/reuse issues Usefulness duration Limited mobility User experience	Chemical-resistant rated ASTM F739 Elastic wrists and ankles Hooded (splash potential)	Contaminated materials Handling Vacuum truck operation Spent sorbent handling Cont. boom recovery/ maintenance Skimmer handling Decon operations	9.5
Visibility					
Highly visible traffic vest	Red Zone hazards	Limited mobility Entanglement	ANSI/ISEA 107-2004 and ANSI/ISEA 207-2006	Roadside operations Railroad operations Heavy equipment operations Equipment travel paths	13.4.2

Type	Hazard Addressed	Secondary Considerations	Design Criteria	Possible Activities	Section Reference
Hearing Protection Device					
Earplugs	Noise	Fit Limited verbal communication Easily damaged	Proper Noise Reduction Rating	Vacuum truck operations Compressor operations Pressure washing operations	10.5
Earmuffs	Noise	Long hair may break seal Interfere with movement Added weight Storage and cleanliness Compatibility with head protection	Proper Noise Reduction Rating	Vacuum truck operations Compressor operations Pressure washing operations	10.5
Respiratory Protection					
Half-face APR	Contaminant < 10X OEL	Medical monitoring Fit testing Sanitation Storage	NIOSH-certified under 42 *CFR* Part 84 Proper cartridge selection	Decontamination activities Chemical handling	8.5.2
Full-face APR	Contaminant < 50X OEL	Medical monitoring Fit testing Sanitation Storage Limited visibility	NIOSH-certified under 42 *CFR* Part 84 Proper cartridge selection	Decontamination activities Chemical handling	8.5.2
Full-face SAR	Contaminant < 1000X OEL	Medical monitoring Fit Testing Sanitation Storage Limited visibility Additional weight	NIOSH Certified under 42 *CFR* Part 84 Proper cartridge selection (PAPR)	Decontamination activities Chemical handling	8.5.2
Full-face SCBA	UNKNOWN OEL Contaminant < 1000X OEL	Medical monitoring Fit testing Sanitation Storage Limited visibility Additional weight Reduced mobility	NIOSH-certified under 42 *CFR* Part 84	Decontamination activities Chemical handling Tank/vessel cleaning Confined space entry	8.5.2

Type	Hazard Addressed	Secondary Considerations	Design Criteria	Possible Activities	Section Reference
Fall Hazard					
Full body harness	Fall hazard	Storage Maintenance Inspections	ANZI 359.6	Working elevations > 5 ft (vessels) Working elevations > 4 ft (shoreside) Confined space entry operations	11.3.4
Marine Hazard					
TYPE I PFD	Water submersion	Limited mobility	USCG approved	Marine operations SCAT teams Shoreline cleanup	14.4
TYPE III PFD	Water submersion Wind chill Cold weather limited (cold water short duration)	Limited mobility	USCG approved	Marine operations SCAT teams Shoreline cleanup	14.5
Survival suits	Water submersion Wind chill Extreme cold weather Moderately cold water (limited duration)	Limited mobility	USCG approved	Marine operations SCAT teams Shoreline cleanup	14.5
Head Protection					
Hard hat	Falling objects	Additional weight Heat	ANSI Z89.1-2003, or ANSI Z89.1-1997, or ANSI Z89.1-1986	General site activities Heavy equipment operations	9.9.4

Annex B
(informative)

Example Documents for Conducting a JSA

B.1 Example JHA

JOB HAZARD ANALYSIS (JHA)		Date:	X New JHA Revised JHA
Organization/Park Unit:	Division:	Branch:	Location:
JOB TITLE:		JHA Number:	Page _____of ____
Job Performed By:	Analysis By:	Supervisor:	Concurred By:

Required Standards:	
General Notes:	
Required Personal Protective Equipment:	
Tools and Equipment:	

Activity/Sequence of Job Steps	Potential Hazards/ Injury sources	Safe Action or Procedure
Pre-work/Preseason Activities		
Refresher Training		

B.2 ICS-215A-CG

B.2.1 Incident Action Plan Safety and Risk Analysis Form, ICS 215A

INCIDENT ACTION PLAN SAFETY ANALYSIS	1. Incident Name							2. Date	3. Time
Division or Group	Potential Hazards							Mitigations (e.g., PPE, buddy system, escape routes)	
	Type of Hazard:	Type of Hazard:	Type of Hazard:	Type of Hazard:	Type of Hazard:	Type of Hazard:	Type of Hazard:	Type of Hazard:	
	Prepared by (Name and Position)								

B.2.2 JSA Incident Action Plan Safety Analysis

INCIDENT ACTION PLAN SAFETY ANALYSIS

1. Incident Name	2. Date/Time Prepared

3. DIVISION/ GROUP/ OTHER LOCATION	4. Work Assignments	5. Gain	6. HAZARDS	7. CONTROLS	8. ORM SEVERITY	PROBABILITY	EXPOSURE	GAR
		Human Health Security Environment Economy	Check	Check				
		Human Health Security Environment Economy	Check	Check				
		Human Health Security Environment Economy	Check	Check				
		Human Health Security Environment Economy	Check	Check				
		Human Health Security Environment Economy	Check	Check				
		Human Health Security Environment Economy	Check	Check				
		Human Health Security Environment Economy	Check	Check				
		Human Health Security Environment Economy	Check	Check				
		Human Health Security Environment Economy	Check	Check				
		Human Health Security Environment Economy	Check	Check				

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Operational Risk Management Key

Scale	1	2	3	4	5	Gar Scale	#	1-19	20-39	40-59	60-79	80-100
Severity	Slight	Minimal	Signif-icant	Major	Catas-trophic		Risk	Slight	Possible	Substantial	High	Very High
Probability	Remote	Un-likely	50/50	>50	Very Likely		Color	Green	Amber	Red	Red	Red
Exposure	Below Avg	Avg	Above Avg	Great	N/A		Action	Possibly Acceptabl	Attention Needed	Correction Required	Immediate Correction	Discontinue/ Stop

9. Prepared by (Name and Position)

Annex C
(informative)

Example Training Matrix [2]

[2] The following are merely examples for illustration purposes only. (Each company should develop its own approach.) They are not to be considered exclusive or exhaustive in nature. API makes no warranties, express or implied for reliance on or any omissions from the information contained in this document.

	Type Work									
Training Module	Volunteers working at a site and no contact with oil	Working at a site and no contact with oil	Working at operations sites with potential contact of minimal weathered oil (oiled beaches or shoreline)	Cleaning wildlife environmental sampling in weathered oil or government site assessments (individuals have already met U.S. Fish and Wildlife requirements)	Shoreline/ Staging Area: Decontamination, handling oily boom, vacuum trucks, high pressure hot water, etc.	Vessel of Opportunity: Marine vessel Operations for skimming, absorbent boom, and in situ burning (captains and crews)	Vessel of Opportunity: Marine vessel Operations with minimal contact of weathered oil for logistics support (captains and crews)	Working on a marine vessel and potential to come in contact with fresh oil	Supervising Mod 3/4, and HAZWOPER 40 workers in weathered oil	Supervising HAZWOPER 40 workers in fresh oil
Module 1 Basic HSE Orientation 30 Minutes	x									
Module 2 or Equivalent Site HSE Orientations 45 Minutes		x			x			x	x	x
Module 3 (Shoreline) Spilled Oil Response 4 Hours			X							
Module 3 (Shoreline) Spilled Oil Response Computer Based Training (CBT)				x						
Module 3 (Marine) Spilled Oil Response 4 Hours						x	x			
Module 4 (Marine) Spilled Oil Response 4 Hours						x				
24 Hour HAZWOPER								X (Env. Sampling only)		
40 Hour HAZWOPER					x			x	x	x
Supervisory Training 8 Hours										x

Annex D
(informative)

Example Action Levels

Chemical	Action Level	Monitoring Condition	Action
Nuisance odors, below respiratory protection requirements	Odor threshold	NA	— Voluntary use. Employees may don carbon impregnated filtering face piece respirator.
VOC, ppm	1000	Continuous levels for > 15 minutes	— Move away from location
Benzene, ppm	5 ppm	At least 3 samples over 15 minutes	— Move vessel off location
Carbon monoxide, ppm	25	Continuous levels for > 15 minutes	— Evacuate immediate work area to area of lower concentration
Sulfur dioxide (SO_2), ppm	100	Instantaneous reading on one monitor	— IDLH condition, leave the area immediately
Action Levels for Personnel Exposure Incident Management Teams should set safety action levels for airborne contaminants and these may be different for shore based operations and vessels. Action levels cited are derived from ACGIH and NIOSH exposure limits and OSHA action levels.			

Bibliography

NOTE If the section is not listed below, there are no references specific to that section.

Section 5 References

O*SHA Instruction CPL 2-2.51 November 5, 1990 Directorate of Compliance Programs Subject: Inspection Guidelines for Post-Emergency Response Operations Under 29 CFR 1910.120*

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Training Marine Oil Spill Response Workers under OSHA's Hazardous Waste Operations and Emergency Response Standard

http://www.osha.gov/oilspills/dwh_osha_response_0511a.pdf

Oil Spill Booklet, NIEHS/OSHA booklet, Deepwater Horizon Fact Sheet

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