

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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Personal Protective Equipment Selection for Oil Spill Responders

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

H₂S

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	<i>Code of Federal Regulations</i>
CPC	chemical protective clothing
dBA	decibels (A-weighted scale)
H ₂ S	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.

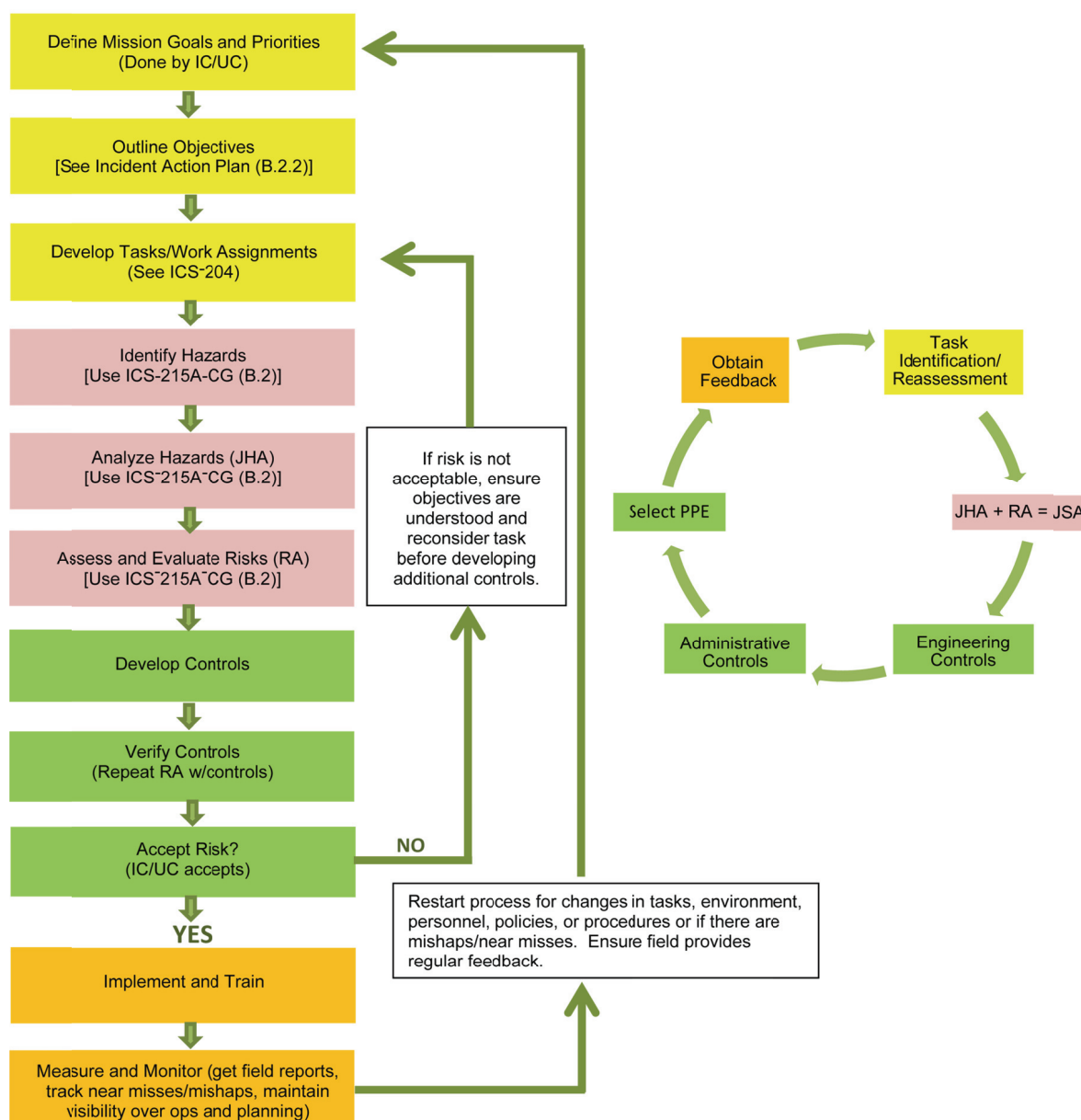


Figure 1—Job Safety Analysis Flow Chart (Forms Referenced are Used as Examples)

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 (H₂S);
- 2) other physical hazards: