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Emergency Responder Health and Safety Manual

Chapter 9

Chemical and Biological Agents

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LIST OF ACRONYMS

APR	Air-purifying respirator
CBRN	Chemical, biological, radiological, and nuclear (agents)
CDC	Centers for Disease Control and Prevention
CFR	Code of Federal Regulations
DHS	Department of Homeland Security
EMT	Emergency medical technician
EPA	U.S. Environmental Protection Agency
FRM	Field Readiness Module
HASP	Health and safety plan
HAZCOM	Hazard communication
HAZMAT	Hazardous material
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	High-efficiency particulate air (filter)
HSPC	Health and Safety Program Contact
HQ	Headquarters
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
NRF	National Response Framework
NRT	U.S. National Response Team
OLEM	Office of Land and Emergency Management (formerly called Office of Solid Waste and Emergency Response (OSWER))
OSC	On-Scene Coordinator
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor)
PAPR	Powered air-purifying respirator
PPE	Personal protective equipment
SCBA	Self-contained breathing apparatus
SHEMP	Safety, Health, and Environmental Management Program
USAMRIID	U.S. Army Medical Research Institute of Infectious Diseases
USFA	U.S. Fire Administration

1.0 INTRODUCTION

1.1 Background Information and Regulatory Basis

The purpose of this chapter is to help emergency responders respond safely and effectively to incidents involving chemical or biological agents, as defined in Text Box 1. **As always, saving lives and preserving public health take precedence over all other considerations.** This chapter provides an overview of chemical and biological agents, as well as procedures unique to the release of these agents. It focuses on biological agents because they are not addressed elsewhere in the manual.

This chapter does not discuss individual agents in detail; providing comprehensive information on the many potential agents is beyond its scope. However, emergency responders should maintain a working knowledge of the agent categories and their general properties. Chemical and biological agents are discussed together in this chapter because many response procedures are the same for both types of releases. Moreover, this chapter does not address any classified substances or agents. For additional information on specific chemical and biological agents see the U.S. National Response Team's (NRT's) Quick Reference Guides.

Text Box 1
What Are Chemical and Biological Agents?

Chemical and biological agents are substances that can be used to inflict lethal or incapacitating casualties. Incidents involving such agents can occur from deliberate, accidental, or natural releases.

Chemical agents discussed in this chapter include a wide range of toxic substances, such as nerve agents, blister agents, choking agents, incapacitating agents (e.g., tear gas), and toxic chemicals and metals. Some agents were first developed for military operations (such as sarin and VX nerve agents) and some are common toxic industrial chemicals (such as chlorine and ammonia).

Biological agents include naturally occurring microorganisms and novel microorganisms created in the laboratory. Some agents can be weaponized and disseminated through the air (such as aerosolized anthrax), and some agents are intentionally modified to be resistant to multiple antibiotics.

An emergency response to the release of a chemical or biological agent is similar to a conventional hazardous material (HAZMAT) incident response. However, there are some important differences that may have profound implications for the responders. Chemical and biological agents may be designed to be extremely difficult to identify in real time. They can be lethal in very small amounts that are hard to detect. Even after a substance is identified, experiential knowledge on which to base an effective response plan is limited. Further complicating the response, emergency responders may need to follow special procedures to treat the incident site as a crime scene. A biological agent release and its magnitude may be detected through the BioWatch program. The release of biological agents or chemical agents may also be recognized through epidemiological information as victims develop symptoms. These factors pose unique challenges to those charged with responding to an incident.

EPA is responsible for supporting state and local responders addressing the environmental consequences of a chemical or biological incident to minimize or mitigate human health threats. In this capacity, EPA serves as a safety net to state and local first responders by providing a range of capabilities (e.g., characterization, decontamination, clearance sampling, and waste disposal). During such an incident, EPA emergency responders will likely integrate into or establish an Incident Command System/Unified Command. As in the case of a conventional HAZMAT response, each incident is unique and response procedures as well as site-specific health and safety plans (HASPs) must be developed based on the site-specific hazards.

Besides chemical or biological agents, emergency responders may be exposed to other health and safety hazards during response activities. The hazards listed below are covered elsewhere in this manual:

- Inhalation hazards (see the Respiratory Protection Program chapter)
- Skin and ingestion hazards (see the Personal Protective Equipment [PPE] Program chapter)
- Heat stress, cold stress, fatigue, and noise exposure (see the Physical Stress Management Program chapter)
- Confined space entry (see the Confined Space Safety Program chapter)
- Ionizing radiation (see the Radiation Safety Program chapter)
- Bloodborne pathogens (see the Bloodborne Pathogen Exposure Control Plan chapter)

In addition to the regulations and standards listed below, other chapters in this manual also present regulatory authorities that address the health and safety of emergency responders. See, for example, the regulatory basis outlined in the Medical Surveillance Program chapter, the Respiratory Protection Program chapter, and the PPE Program chapter.

- Public Health Security and Bioterrorism Preparedness and Response Act of 2002, PL 107-188.
- 40 CFR 300—National Oil and Hazardous Substances Pollution Contingency Plan.
- 29 CFR 1960—Basic Program Elements for Federal Employee Occupational Safety and Health Program and Related Matters.
- 29 CFR 1910.1200/1926.59—Hazard Communication (HAZCOM).
- 29 CFR 1910.120—Hazardous Waste Operations and Emergency Response (HAZWOPER).
- HAZWOPER Standard Interpretation, "Application of HAZWOPER (1910.120) to Terrorist and Weapons of Mass Destruction Incident Responses," November 24, 2003.

This chapter is intended for use by emergency responders who have received, at a minimum, the 40-hour Occupational Safety and Health Administration (OSHA) HAZWOPER training and annual refresher training, prescribed in 29 CFR 1910.120. This chapter supplements, but does not replace, this comprehensive training, and is based on the premise that the user has a thorough working knowledge of HAZMAT incident response. By itself, this chapter is not intended to prepare responders to work in areas contaminated with chemical or biological agents. This information must be integrated into existing emergency responder training and HASPs. This chapter also refers the user to the procedures described in other chapters of the manual.

1.2 Instructions for Users

This chapter must be implemented across all EPA regions, OLEM special teams, and Headquarters (HQ). This means that each EPA organization must adopt the minimum Agency requirements and management practices listed in this chapter and produce a customized version of the chapter that is reviewed/updated on an annual basis. Other organizations within EPA are also encouraged to implement this chapter.

To customize the chapter, users must (1) complete Appendix A and (2) insert organization-specific information into the blank spaces (highlighted in yellow) that appear throughout the chapter. If organizations advocate additional policies and procedures, they must document them in Appendix B. Tools have been developed to support this chapter, including a glossary (Appendix C). An

implementation checklist is included in the "Forms" section of the manual's website as a tool to assist each organization in ensuring that they have met the requirements of this chapter.

See the Introduction to this manual for details on customizing and posting an organization's chemical and biological agent program to the manual's website. The website also includes tools and resources that will be helpful to users, including downloadable forms, reference documents, and training materials.

2.0 ROLES AND RESPONSIBILITIES

Health and Safety Program Contacts (HSPCs); Removal Managers; Safety, Health, and Environmental Management Program (SHEMP) Managers; On-Scene Coordinators (OSCs); OLEM special teams and directors; and individual emergency responders have roles and responsibilities in implementing the Agency's emergency response program. Appendix A details the tasks that these key personnel must perform. If an organization wishes to delegate a task to someone other than the default assignment presented in the appendix, users can do so when they customize Appendix A and when they fill in the yellow-highlighted areas that appear throughout the chapter's text. During an emergency response, an OSC often serves as the Onsite Safety Officer.

3.0 AWARENESS TRAINING

Emergency responders who have the potential to be exposed to chemical or biological agents on the job must receive Chemical and Biological Agent Awareness training. The awareness training may be provided as a standalone course or as part of initial 40-hour HAZWOPER training or annual 8-hour refresher training. The training should address the safety and health elements covered in this chapter and the primary references provided within the chapter. Completed training requirements will be tracked in the agency's Field Readiness Module (FRM).

4.0 OVERVIEW OF CHEMICAL AND BIOLOGICAL AGENTS

Chemical or biological agents can be released accidentally or deliberately. Releases may be in combination (for instance, an explosion that releases biological agents) or in sequence. Threats from chemical and biological agents may also arise from natural or unintentional events, such as the spread of influenza viruses; naturally occurring anthrax; the release of carbon monoxide in interior spaces; or accidental releases of toxic industrial chemicals that result from hurricanes, floods, or other natural disasters. As noted in the introduction to this chapter, emergency response to an incident involving a chemical or biological agent is similar in many ways to a conventional HAZMAT incident response.

During a significant incident, federal agencies, including EPA, have designated response roles, as defined in the National Response Framework (NRF) (see Text Box 2). The NRF presents the guiding principles that enable all response partners to prepare for and provide a unified national response to disasters. For more detailed information, please visit the NRF's website.

Numerous agencies and organizations have developed lists of potential chemical and biological agents, and there is a growing body of research on the subject. Discussing each agent in detail is beyond the scope of this chapter. However, emergency responders should familiarize themselves with the sources referenced in this chapter and elsewhere in this manual, in order to develop a basic understanding of the major classes and types of chemical and biological agents and their properties. The following sections address chemical and biological agents that are widely recognized as potential threat agents.

Text Box 2
The National Response Framework

The **National Response Framework** (NRF) is a guide that details how the nation conducts all-hazards response—from the smallest incident to the largest catastrophe. The NRF establishes a comprehensive, national, all-hazards approach to domestic incident response. The NRF identifies the key response principles, as well as the roles and structures that organize national response. It describes how communities, states, the federal government, and private-sector and nongovernmental partners apply these principles for a coordinated, effective national response. It also describes special circumstances where the federal government exercises a larger role, including incidents where federal interests are involved and catastrophic incidents where a state would require significant support. It lays the groundwork for first responders, decision-makers, and supporting entities to provide a unified national response.

Under the NRF, EPA is responsible for coordinating federal interagency support under Emergency Support Function (ESF) #10, Oil and Hazardous Materials Response. In addition to ESF #10, the NRF Biological Incident Annex outlines the actions, roles, and responsibilities associated with response to a human disease outbreak of known or unknown origin requiring federal assistance.

4.1 Chemical Agents

The National Fire Protection Association (NFPA) 1994 Standard on Protective Ensembles for First Responders to Chemical, Biological, Radiological, and Nuclear (CBRN) Terrorism Incidents defines "chemical terrorism agents" as: "Liquid, solid, gaseous, and vapor chemical warfare agents and toxic industrial chemicals used to inflict lethal or incapacitating casualties, generally on a civilian population as a result of a terrorist attack." The Centers for Disease Control and Prevention (CDC) has defined 13 categories of chemical agents, as shown in Table 1.

Chemical agents come in many forms and may pose a hazard through multiple exposure routes such as dermal (skin), ocular (eye), inhalation, and ingestion. Within each class of compounds, such as nerve agents, the individual substances have distinct physical properties. They may be dispersed as a liquid, gas, aerosol, or even contaminated dust. The agents also vary in volatility and persistence and can pose different degrees of hazard by inhalation. Therefore, the response effort must be tailored to the unique hazards posed by the agent. A detailed discussion of all potential chemical agents is beyond the scope of this chapter; nerve agents are presented in Text Box 3 as just one example of a chemical agent.

CDC's Emergency Preparedness and Response website contains detailed information on chemicals recognized as potential threats. Also, the NRT has developed Quick Reference Guides for a range of chemicals, including many on CDC's list of chemical agents. The Quick Reference Guides are available for downloading at the NRT's website.

Table 1
CDC's 13 Categories of Chemical Agents

Agent	Properties	Examples
Biotoxins[a]	Poisons from plants or animals	Digitalis, ricin, tetrodotoxin
Blister agents/vesicants	Chemicals that severely blister eyes, skin, and the respiratory tract on contact	Mustards, phosgene oxime, lewisite
Blood agents	Poisons that affect the body through blood absorption	Arsine, carbon monoxide, hydrogen cyanide, cyanogen chloride
Caustics (acids)	Chemicals that burn or corrode skin, eyes, and mucus membranes on contact	Hydrofluoric acid, phosphoric acid, sulfuric acid
Choking/lung/pulmonary agents	Chemicals that cause severe irritation or swelling of the respiratory tract	Ammonia, methyl bromide, phosgene, diphosgene, phosphine, phosphorus (elemental, white, or yellow)
Incapacitating agents	Drugs that make people unable to think clearly or that cause an altered state of consciousness (possibly unconsciousness)	BZ (3-quinuclidinyl benzilate), etorphine, fentanyl
Long-acting anticoagulants (e.g., hemorrhagic agents)	Poisons that prevent blood from clotting properly, resulting in uncontrolled bleeding	Brodifacoum, bromadiolone, super warfarin
Metals	Agents that contain metallic poisons	Arsenic, barium, mercury, thallium
Nerve agents	Highly poisonous chemicals that work by preventing the nervous system from working properly	Sarin (GB), soman (GD), tabun (GA), VX
Organic solvents	Agents that damage living tissues by dissolving fats and oils	Benzene, carbon tetrachloride, toluene, tetrachloroethylene, trichloroethylene
Riot control agents/tear gas	Highly irritating agents normally used by law enforcement for crowd control or by individuals for protection (for example, mace)	Bromobenzylcyanide (CA), chloroacetophenone (CN), chloropicrin (PS), dibenzoxazepine (CR)
Toxic alcohols	Poisonous alcohols that can damage the heart, kidneys, and nervous system	Ethylene glycol, diethylene glycol, methanol
Vomiting agents	Chemicals that cause nausea or vomiting	Adamsite (DM), diphenylchloroarsine (DA), diphenylcyanoarsine (DC)

[a] Biotoxins are identified as chemical agents within CDC's classification system and are therefore listed in Table 1. *(Note: CDC lists ricin as both a chemical and biological agent, so ricin is listed in Tables 1 and 2.)* Consensus has not been achieved regarding how to classify biotoxins. This chapter follows CDC's classification system.

Text Box 3
Nerve Agents

Nerve agents are so named because they affect the transmission of nervous system impulses. They are organophosphorus compounds, a group that also includes many pesticides, but they are more potent than pesticides. Considered potential threats because they are stable, easily dispersed, and highly toxic, they can be produced with relatively simple laboratory equipment and techniques. The raw materials are inexpensive, but some are subject to the controls of the Chemical Weapons Convention and the Australia Group Agreement. Commonly known nerve agents include:

- GA (tabun): A low-volatility,[a] persistent chemical absorbed by skin contact or inhaled as a gas or aerosol.
- GB (sarin): A volatile, non-persistent chemical mainly taken up through inhalation.
- GD (soman): A moderately volatile chemical absorbed by skin contact or inhaled.
- GF (cyclosarin): A low-volatility persistent chemical absorbed by skin contact or inhaled.
- VX: A low-volatility persistent chemical, with a consistency similar to that of motor oil, which can remain on material, equipment, and terrain for long periods. Uptake is mainly through the skin but also through inhalation of the substance as a gas, aerosol, or contaminated dust.

[a] "Volatility" refers to a substance's ability to become airborne as a vapor at relatively low temperatures. A highly volatile (non-persistent) substance poses a greater respiratory hazard than a less volatile (persistent) substance.

Source: National Institute of Justice. 2001. *Guide for the Selection of Chemical and Biological Decontamination Equipment for Emergency First Responders.* NIJ Guide 103–00. Washington, D.C.: National Institute of Justice, Office of Science and Technology.

4.2 Biological Agents

The NFPA 1994 Standard on Protective Ensembles for First Responders to CBRN Terrorism Incidents defines "biological terrorism agents" as: "Liquid or particulate agents that can consist of a biologically derived toxin or pathogen used to inflict lethal or incapacitating casualties, generally on a civilian population as a result of a terrorist attack."

The time lapse between release of an agent and its discovery is frequently longer for biological agents than chemical agents. Chemical agents typically (although there are exceptions) have an immediate impact, with symptoms manifesting upon exposure. By contrast, the release of a biological agent may not be detected for days, weeks, or months given the latency between exposure and onset of symptoms in the host/victim unless the release is detected through an early warning system such as the BioWatch System that the Department of Homeland Security (DHS) manages and EPA supports.

Homeland Security Presidential Directive 18: Medical Countermeasures against Weapons of Mass Destruction identifies four categories of potential biological agents. They are:

- **Traditional agents** are naturally occurring microorganisms or toxin products that can be weaponized and disseminated to cause mass casualties. Aerosolized agents (such as aerosolized anthrax) pose particularly challenging hazards. Such materials are easily spread by air currents and can be re-aerosolized by slight movements or disturbances in air currents.[1]
- **Enhanced agents** are organisms that are modified to circumvent current countermeasures (e.g., microorganisms that are intentionally manipulated to be resistant to multiple antibiotics).

[1] Research is being conducted on the re-aerosolization of anthrax.

- **Emerging agents** are naturally occurring agents but are newly recognized or anticipated to pose a public health threat (e.g., a highly lethal and readily transmissible influenza strain that may cause a pandemic).
- **Advanced agents** are novel microorganisms created in the laboratory.

CDC classifies biological agents into three priority categories: A, B, and C. These categories are described in Table 2 below. CDC's Bioterrorism Agents/Diseases website provides more information on these categories as well as many of the specific agents. *(Note: Table 2 lists bioagents as examples only and does not present a definitive list. Also, these items reflect CDC classifications only and do not necessarily represent which agents pose the greatest toxicity or risk.)*

Table 2
CDC's Agent Classifications and Example Biological Agents

CDC Agent Classifications	Example Agents[a,b]
Category A agents: High-priority agents that are rarely seen in the United States and pose a risk to national security because they: • Can be easily disseminated **or** transmitted from person to person • Result in high mortality rates and have the potential for a major public health impact • Might cause public panic and social disruption • Require special action for public health preparedness	Anthrax (*Bacillus anthracis*) Botulism (*Clostridium botulinum* toxin) Plague (*Yersinia pestis*) Smallpox (*Variola major*) Tularemia (*Francisella tularensis*) Viral hemorrhagic fevers (filoviruses [e.g., Ebola, Marburg] and arenaviruses [e.g., Lassa, Machupo])
Category B agents: Second-highest-priority agents, which: • Are moderately easy to disseminate • Result in moderate morbidity (illness) rates and low mortality rates • Require specific enhancements of CDC's diagnostic capacity and enhanced disease surveillance	Brucellosis (*Brucella* species) Glanders (*Burkholderia mallei*) Psittacosis (*Chlamydia psittaci*) Q fever (*Coxiella burnetti*) Ricin toxin from castor beans Staphylococcal enterotoxin B Typhus (*Rickettsia prowazekii*)
Category C agents: Third-highest-priority agents—emerging pathogens that could be engineered for mass dissemination in the future because of: • Availability • Ease of production and dissemination • Potential for high morbidity and mortality rates and major health impact	Nipah virus Hantavirus

[a] Biotoxins are identified as chemical agents within CDC's classification system and are therefore listed in Table 1. (*Note: CDC lists ricin as both a chemical and biological agent, so ricin is listed in Tables 1 and 2.*) Consensus has not been achieved regarding how to classify biotoxins. This chapter follows CDC's classification system.

[b] Links have been provided for agents if they are available.

Given the wide spectrum of biological agents and possible symptoms and health effects, a comprehensive discussion of all biological agents is beyond the scope of this chapter. The following resources provide detailed information on specific biological agents:

- CDC's "Emergency Preparedness and Response" website.
- NRT's Quick Reference Guides for biological agents, many of which are cross-listed with the CDC agents. The Quick Reference Guides are available for downloading at NRT's website.
- U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID)'s *Defense Against Toxin Weapons*.
- *USAMRIID's Medical Management of Biological Casualties Handbook*.
- "Bioterrorism," Infectious Diseases Society of America.

4.2.1 BioWatch

BioWatch is a nationwide bio-surveillance system, designed to detect the individual release of select aerosolized biological agents. EPA may be responsible for leading operational planning with state and local first responders and health departments, and may execute environmental sampling necessary to verify a biological release. EPA also serves as the primary contact for state and local environmental monitoring agencies during a biological agent incident (see Text Box 4). Each EPA region has at least one BioWatch Coordinator.

4.3 Secondary Attacks

Emergency responders must be alert to the threat posed by secondary attacks. Secondary attacks are designed to cause casualties and inflict injury and panic on those responding to the initial incident. For example, they may involve explosive devices placed at the scene of an ongoing emergency response and detonated after response personnel arrive. OSHA's Safety and Health Guide provides guidance on the nature of secondary explosive devices and their potential health and safety effects.

Text Box 4
BioWatch: Early Warning System for Biological Agents

BioWatch is designed to detect the intentional release of select aerosolized biological agents. Operating nationwide, BioWatch uses a coordinated team of field, laboratory, and response personnel from city, state, and federal organizations. The team is responsible for installing the BioWatch sampling units (air samplers equipped with special filters), collecting and analyzing samples, reporting results, and responding to alerts. The BioWatch sampling units are positioned around the country using special site selection modeling programs.

BioWatch is one of many systems used to make public health decisions. In combination with corroborative information, BioWatch results could trigger emergency response activities. DHS provides funding and oversight. The key partners and their roles are as follows:

- City, county, and state stakeholders operate the BioWatch system.
- CDC oversees the Laboratory Response Network and acts as the liaison with state and local health departments.
- In some regions, EPA leads field operations and serves as the primary contact for state and local environmental monitoring agencies.
- The Department of Energy's national laboratories, Los Alamos and Lawrence Livermore, provide technical oversight for field and laboratory operations, including development of new technologies.
- The Federal Bureau of Investigation leads criminal investigations.

In the event of confirmed biological agent detection, DHS is poised to dispatch federal response assets to support the public health infrastructure of an impacted area, including:

- The Strategic National Stockpile, a reserve of large quantities of medicine and medical supplies.
- The National Disaster Medical System, composed of teams of health professionals to be deployed to support local health care delivery systems, including public health officials.

5.0 SAFETY AND HEALTH PROGRAM ELEMENTS

This section covers program elements that specifically address the safety and health of emergency responders who will participate in chemical and biological incident response. It supplements the safety and health program elements described elsewhere in this manual.

5.1 Medical Surveillance

EPA OSCs will have ready access to a medical professional in the event of a suspected chemical or biological release. During onsite emergency response activities, a Medical Monitor[2] must closely observe and monitor emergency responders for signs of acute exposures as well as other safety or health problems (such as heat stress). Nerve agent antidote kits (e.g., Mark I) may be administered immediately upon exposure of a nerve agent. Medical Monitors can use the sample *Onsite Medical Monitoring Tracking Form* provided in the "Forms" section of the manual's website to document vital signs and potential exposures. In the event that a worker is potentially exposed to a chemical or biological agent (e.g., PPE is breached or the worker develops symptoms), appropriate medical attention must be sought and the SHEMP Manager and Removal Manager must be notified. Also, the Medical Monitor, working with the Onsite Safety Officer (or another designated person), must contact and share potential exposure information with the health care provider (i.e., either a physician at a health care facility where an employee is being transported or an employee's personal physician) so that the health care provider can

[2] Refer to the Glossary, Appendix C, for the definition of a Medical Monitor.

determine whether special tests (e.g., acetylcholinesterase) are required and develop and implement agent- and site-specific protective measures, such as the administration of vaccines and prophylactic antibiotics. Follow up medical treatment and monitoring will be performed as determined by the SHEMP manager and the health care provider to address any possible chronic or latent health effects.

Depending on the individual responder's activities and potential exposure to a chemical or biological agent, the following medical considerations may apply:

- Immunizations—Section 4.1 and Table 4, Vaccination Recommendations for EPA's Emergency Responders, in the manual's Medical Surveillance Program chapter provide general guidance on recommended immunizations. For general guidance on immunizations for selected CDC Category A agents, see Table 3 in Section 5.3.2 below. For example, as stated in that table, all EPA emergency responders involved in a smallpox cleanup effort must be immunized before deploying to the field.
- Chemoprophylaxis (antibiotics)—Section 4.2 and Text Box 4 of the manual's Medical Surveillance Program chapter provide general recommendations on antibiotics. Also, general information on recommended chemoprophylaxis measures for selected CDC Category A biological agents is presented in Table 3 in Section 5.3.2 below.[3]
- Procedures for administering nerve agent antidotes—Section 4.3 of the manual's Medical Surveillance Program chapter provides general guidance on access to and use of nerve agent antidote kits. (Also see OSWER Directive 9200.51 on the storage, training, use, and disposal of Mark 1 Kits.)

5.2 Hazard Evaluation

EPA's emergency responders must perform a hazard evaluation before entering an incident site. Level B is the minimum level of protection to be used for initial site entry or during the early phases of a response where site conditions have not been fully characterized (Chapter 6.9.3 of the Standard Operating Safety Guides). Where site conditions have been fully characterized following the early phases of a response, sampling must be conducted to determine the necessary exposure controls and type of PPE to be used. Sampling is also conducted during field operations to reassess site hazards as additional information on site hazards becomes available and job tasks become better defined. The manual's Respiratory Protection Program chapter and PPE Program chapter provide detailed guidance on conducting hazard evaluations at response sites. For example, Appendix E of the Respiratory Protection Program chapter presents a *Site/Task Specific Hazard Evaluation Form* and a list of items to consider when performing an evaluation for respiratory protection. Additionally, Appendix E of the PPE Program chapter presents a sample *Site Hazard Assessment and Certification Form* that lists items to consider when selecting PPE. The information provided in this appendix is designed to assist emergency responders in obtaining and organizing information during the hazard evaluation process.

The Onsite Safety Officer (or another designated person) should work with experts from EPA and other agencies to determine the appropriate sampling or monitoring method(s) for the site-specific chemical or biological hazards. In cooperation with other onsite and/or knowledgeable personnel, EPA emergency responders are responsible for obtaining details regarding hazardous contaminants, work areas, work activities, and other related information that is needed to assess site-specific hazards.

The following guide contains information for selecting biological agent detection equipment: National Institute of Justice. 2001. *An Introduction to Biological Agent Detection Equipment for Emergency First*

[3] EPA has formed a Medical Countermeasures Workgroup to ensure that antibiotics are available to EPA's emergency responders.

Responders. NIJ Guide 101–00. Washington D.C.: National Institute of Justice, Office of Science and Technology.

5.3 PPE—General Information

PPE provides essential protection to emergency responders if it is properly used. **PPE must be used only after other control methods, including engineering controls, work practices, and administrative controls, have been exhausted.** For guidance on PPE for CBRN incidents, see Guidance on Emergency Responder Personal Protective Equipment (PPE) for Response to CBRN Terrorism Incidents.

Selection of PPE must be based on the nature of the hazard and conditions known to be present at the response site. As in any HAZMAT response, selected PPE must meet the requirements of OSHA's PPE standards and HAZWOPER standard. The manual's Respiratory Protection Program chapter and PPE Program chapter provide detailed information on PPE program requirements that apply to emergency responders, but the information provided below supplements the PPE program information contained in those two chapters.

PPE use in itself poses health and safety hazards, including heat stress, fatigue, and psychological stress, as well as impaired vision, mobility, and communication. PPE that provides a high level of protection is more physically restrictive than less protective ensembles. The selected PPE must match the magnitude of the hazard. **Both over-protection and under-protection can be hazardous and must be avoided.**

NIOSH Respirator Certification

NIOSH has an ongoing program to test and certify self-contained breathing apparatus (SCBA) and air-purifying respirators (APRs) for use in CBRN environments. Only a limited number of models have been certified to date. To determine if a given SCBA or APR has been NIOSH-certified for use in CBRN environments:

- Check the NIOSH website for a list of CBRN-certified respirators.
- Look for the label shown below, which will either be attached to the respirator or included in the respirator's packaging materials.

If this CBRN Agent Approved label is **not** on the SCBA or APR, the device is **not** approved by NIOSH for use in CBRN environments. **Check the label!** (Note that about 5 percent of the population will not achieve a good fit with a given respirator brand. This necessitates obtaining a second brand that is certified by NIOSH for use in CBRN environments.)

Additional information is provided in respirators' instruction manuals. For more information, visit the NIOSH website.

5.3.1 PPE for Chemical Agents

The selection of PPE for use during a response to a chemical agent follows the same principles as PPE selection and use in conventional toxic industrial chemical incidents. Detailed guidance on PPE selection is provided in the manual's PPE Program chapter, and information on ensembles for selected chemical agents is presented in the Guidelines for PPE Ensemble Selection.

5.3.2 PPE for Biological Agents

During a response to an incident involving a biological agent release, the main function of PPE is to prevent exposures. Exposure to biological agents may occur through any of the following pathways: inhalation, ingestion, ocular, or dermal.

Recommendations for PPE selection are based on the assumption that biological agents occur mainly as fine airborne particles and have the same physical properties in air or on surfaces as inorganic dust particles. This similarity in behavior between organic (biological) particles and inorganic dust has been demonstrated in military research on bioweapons and in civilian research on infection control in hospitals. (See CDC/NIOSH's "Recommendations for the Selection and Use of Respirators and Protective Clothing for Protection Against Biological Agents.")

NIOSH recommendations for PPE during a response to a biological agent incident are based on site conditions and, in particular, the dissemination method and nature of the release:

- Where the agent is unknown, dissemination with an aerosol-generating device is still occurring, or the event is otherwise uncontrolled, NIOSH recommends that each emergency responder use a Level A protective suit with a NIOSH-approved, CBRN pressure-demand SCBA.
- Where the suspected biological aerosol is no longer being generated, but other conditions may present a splash hazard, NIOSH recommends that each emergency responder use a Level B protective suit with a NIOSH-approved, CBRN pressure-demand SCBA.
- Where the agent has been identified, and it can be determined that an aerosol-generating device was not used to create high airborne concentrations or dissemination was by a letter or package that can be easily bagged, NIOSH recommends that each responder use a full-facepiece respirator with a P100 filter or powered air-purifying respirator (PAPR) with high-efficiency particulate air (HEPA) filters.

In the event of an incident involving a biological agent, the Onsite Safety Officer (or another designated person) must work closely with public health officials and disease experts to select the PPE that best protects emergency responders from the risk of infection. Also, the use of vaccines and antibiotics may play an integral role in risk management during the incident. Table 3 summarizes the recommended PPE and available types of prophylaxis measures for selected CDC Category A biological agents. The manual's Medical Surveillance Program chapter provides EPA's recommendations on vaccinations and antibiotics.

Table 3
CDC's Category A Biological Agents—Recommended PPE and Prophylaxis for Emergency Responders

Disease (Agent)	Person-to-Person Transmission?	Persistence/Stability	Recommended PPE[a]	Available Types of Prophylaxis for Potentially Exposed
Anthrax *(Bacillus anthracis)*	No	Spores highly persistent/stable; risk of secondary aerosolization	Level B or Level C (PAPR)	Vaccine; antibiotics
Botulism (*Clostridium botulinum* toxin)	No	Readily inactivated by sunlight and air	Level C (PAPR)	Vaccine; anti-toxin if exposed
Plague *(Yersinia pestis)*	Yes; pneumonic, possible bubonic	Readily inactivated by sunlight	Level C	Antibiotics; also treat contacts
Smallpox virus *(Variola major)*	Yes; up to two months after rash appears	Inactive in about two days outdoors, active for up to two weeks indoors; heat and humidity make less stable	Level B	Vaccine required, no exceptions; treat contacts
Tularemia *(Francisella tularensis)*	No	Minimally stable; slight risk of secondary aerosolization	Level C	Vaccine; antibiotics

[a] The recommended PPE levels are based on the following site conditions: the agent has been identified and controlled; an aerosol-generating device was not used to create high airborne concentrations; dissemination was by a letter or package that can be easily bagged; and the agent is in the form of airborne particles, which will not penetrate the materials of properly assembled and fitted respirators or protective clothing.

Sources: (1) Rupert, R. 2008. *Biological Threat Assessment & Awareness.* Presented at the 11th Annual OSC Readiness Training Program, San Diego. (2) U.S. National Response Team. 2008. NRT Quick Reference Guides for Biological Warfare Agents. (3) U.S. Army Medical Research Institute of Infectious Diseases. 2005. *U.S. AMRIID's Medical Management of Biological Casualties Handbook.* 6th edition. Fort Detrick, MD.

5.4 Decontamination—General Information

All personnel, clothing, equipment, and samples leaving a contaminated area must be decontaminated to remove any harmful chemicals or biological agents that may have adhered to them. Decontamination procedures must be tailored to site-specific hazards and will vary in complexity, depending on the agent(s), the extent of contamination, the items being decontaminated, and prevailing environmental conditions (e.g., wind). The chemical and physical compatibility of the decontamination solutions or other decontamination materials must be evaluated before they are used. Any decontamination method that permeates, degrades, damages, or otherwise impairs the safe functioning of the PPE must not be used. Some chemical decontamination agents may be hazardous if they are inhaled or are in prolonged contact with skin, eyes, and/or mucous membranes. **Care must be taken to protect personnel from such materials.**

In the case of a life-threatening event, decontamination may be delayed until the victim is stabilized. But decontamination must always be performed first, when practical, if it can be done without interfering with essential life-saving techniques or first aid, or if a worker has been contaminated with an extremely toxic

or corrosive substance that could cause severe injury or loss of life. During an emergency, provisions must be made for protecting responding medical personnel. **In all cases, fluids used for decontamination must be captured for appropriate treatment and disposal.**

The *Guide for the Selection of Chemical and Biological Decontamination Equipment for Emergency First Responders* (NIJ Guide 103–00, published by the National Institute of Justice) provides information about the selection and use of chemical and/or biological decontamination equipment for various applications. Emergency responders should contact EPA's Consequence Management Advisory Team if they require additional assistance in determining the appropriate decontamination procedures for agents (e.g., anthrax).

5.4.1 Decontamination of Chemical Agents

Decontamination procedures for chemical agents depend on the nature of the agent. Decontamination procedures must be tailored to the specific site hazards and will vary in complexity, depending on the agent(s), the extent of contamination, the items being decontaminated, and prevailing environmental conditions (e.g., wind). Section 5.0 of the manual's PPE Program chapter provides procedures for decontamination of PPE.

The NRT Quick Reference Guides for chemical warfare agents contain recommendations for decontaminating equipment and personnel. In general, the NRT recommends decontaminating outer PPE with a dilute hypochlorite solution (0.5 percent) or one part household bleach to 10 parts water. For decontaminating bare skin, soap and clean or potable water must be used instead of dilute bleach. Other information about decontamination can be found on EPA's Homeland Security Research website.

5.4.2 Decontamination of Biological Agents

Decontamination of protective clothing and equipment used during a biological incident response must begin before gear is removed, to ensure the removal or neutralization of particles that have settled on the outside of protective equipment. Decontamination sequences used for hazardous material incidents must be followed for biological agent incidents as well.

Equipment can be decontaminated using soap and clean or potable water. A 0.5 percent hypochlorite solution can be used if gear has any visible contamination or if otherwise necessary. However, bleach damages some types of PPE. After taking off gear, emergency responders must shower using copious quantities of soap and water. Care must be taken to protect personnel from bleach or other hazardous agents used to decontaminate equipment. Text Box 5 presents various methods used to decontaminate items used in a biological incident response.

The NRT Quick Reference Guides for biological warfare agents contain recommendations for decontamination of equipment and personnel. Also, Appendix D contains a list of references on emergency response and remediation techniques related to aerosolized anthrax.

Text Box 5
Decontamination of Emergency Responders and Equipment

Decontamination removes and/or neutralizes (inactivates) biological agents on contaminated surfaces and plays an important role in controlling the spread of the agent. Decontamination includes the disinfection or sterilization of infected articles (e.g., clothing and equipment) to make them suitable for reuse. Items can be decontaminated by mechanical, chemical, and physical methods depending on the agent and site-specific conditions:

- **Mechanical** decontamination involves measures that remove (but not necessarily neutralize) agents, such as, rinsing or washing with soap and water or using a brush to remove agents. Physical removal by HEPA vacuuming or brushing inside a negative pressure enclosure is a sound practice for initial decontamination.

- **Chemical** decontamination inactivates a biological agent by the use of disinfectants. Washing with a bleach solution is one example. **Careful washing with soap and water removes most biological contamination from a surface, including skin and hair, and is often sufficient to avert contact infection.** Rooms should be decontaminated with disinfectant gases or liquids in aerosol form (e.g., chlorine dioxide) to ensure complete decontamination. These methods are not appropriate for decontaminating people.

- **Physical** decontamination renders most biological agents harmless through physical means, such as heat (autoclave), sunlight, or ionizing radiation. These methods are only suitable for decontaminating durable items. However, sunlight cannot destroy *Bacillus anthracis* spores.

6.0 RECORDKEEPING

EPA's recordkeeping goal is to ensure that nationally consistent, readily accessible records are maintained at each EPA organization. Table 4 and the rest of this section provide details about the specific recordkeeping procedures that must be followed, who is expected to complete specific forms, and who must retain copies of the records.

Table 4
Recordkeeping Requirements Associated With the Chemical and Biological Agents Program

Required Record	Details/Specified Forms	Completed/Compiled By[a]	Retained By[a]
Awareness training records	Training certificates (or other forms of documentation)	Course instructor or SHEMP Manager	Individual employee[b]
Documentation of onsite medical monitoring	*Onsite Medical Monitoring Tracking Form* (see the "Forms" section of the manual's website)	Medical Monitor (see glossary for a definition)	SHEMP Manager

[a] The delegation of recordkeeping responsibilities presented in this table reflects the chapter authors' opinions. The assignments have been made with regional audiences in mind; the positions listed might not be applicable for OLEM special teams and HQ. Users can adjust the assignments when they go through the process of customizing this chapter.

[b] Employees must provide documentation certifying the completion of their training requirements to the SHEMP Manager or HSPC (or another designated person), who in turn will document it in the FRM.

6.1 Training Records

Employees must obtain a training certificate (or an equivalent form of documentation) that certifies that they have completed Chemical and Biological Awareness training. They must present this documentation to the SHEMP Manager or HSPC (or another designated person), who in turn will ensure that the training is documented in the FRM. Upon completing that task, the SHEMP Manager or HSPC (or another designated person) is not required to retain a hardcopy of the training documentation. Emergency responders should, however, retain proof that they have completed the training.

6.2 Documentation of Onsite Medical Monitoring

The Medical Monitor (e.g., an emergency medical technician [EMT] or health professional who has been hired to perform onsite monitoring) must use a form (see the sample posted in the "Forms" section of the manual's website) to track employee vital signs in the field. These forms must be given to the Onsite Safety Officer, who will submit them to the SHEMP Manager (or another designated person).

APPENDIX A

Chemical and Biological Agents: Designation of Roles and Responsibilities

Instructions for Users

Appendix A provides a place for users to insert organization-specific information into the Chemical and Biological Agents chapter. The appendix presents a list of tasks that must be performed to ensure chemical and biological agents are addressed properly during a response. The tasks are listed in rows. EPA position titles (e.g., the Removal Manager or the Health and Safety Program Contact) are listed in columns. Each task has been assigned to a default position. For some of the tasks, check marks have been placed in two or more columns to indicate that more than one person is responsible for that task. **Please note that users can re-delegate tasks.**

Users must take the following steps to customize Appendix A:

- Fill in the background information requested at the top of page A-3. For example, indicate when the table is being updated and who is doing the updating.
- Fill in actual names under the position titles.
- Add additional key players to the table (if necessary). *Note: The chapter authors have already provided a placeholder to add a new position, as the last column is labeled "Other." Users should customize this column to identify the position title (and name) of any additional key player assigned responsibility to implement this chapter. Users can insert more columns to include additional key players (if necessary).*
- Add rows to the table (if necessary) to provide information about activities that exceed the minimum requirements already included in Appendix A. (See Appendix B for a list of your organization's additional policies and procedures related to this chapter.)
- Determine whether any of the recommended task assignments must be delegated to another person. (If so, move the check marks to re-assign the task.)
- Ensure that each task has been assigned.

ATTENTION OLEM Special Teams and HQ Users: The tasks and position titles that appear in Appendix A have been written with regional audiences in mind. OLEM special teams and HQ users should modify the language that appears in the rows and column headers to reflect the needs of their organization.

APPENDIX A
Task Table for Implementing the Chemical and Biological Agents Chapter

This table has been customized for: Region 4.
Last Updated on: March 3, 2017.
Updated by: Kevin Eichinger.

TASKS ▼ / ROLES ►	Who Is Responsible for Each Task or Action?							
	Removal Manager	SHEMP Manager	Health and Safety Program Contact	Immediate Supervisors	Onsite Safety Officers	Emergency Responders*	Medical Monitors (defined in glossary)	Other
Name of person in role ►	See Appendix A-2 in the Introduction chapter for the names of personnel that fill these roles.							
General Tasks								
1. Ensure that procedures outlined in the Chemical and Biological Agents chapter are followed by all responsible parties.	✓							
2. Serve as the organization's health and safety expert (or establish a link to a technical expert) for responses to chemical and biological agents.		✓	✓					✓
3. Facilitate and coordinate chemical/biological emergency response health and safety issues for EPA's emergency responders.			✓					
4. Implement the Chemical and Biological Agents chapter by: (1) customizing the chapter with organization-specific information, (2) reviewing/updating the customized version annually, and (3) adopting the requirements and practices in the chapter. Post the customized chapter to the manual's website and inform stakeholders of its availability.	✓	✓	✓	✓	✓	✓		
Tasks Associated With Chemical and Biological Agents Awareness Training (Section 3.0)								
5. Attend and complete Chemical and Biological Agent Awareness training. *(Note: The awareness training may be provided as a standalone course or as part of initial 40-hour HAZWOPER training or annual 8-hour refresher training.)*	✓		✓	✓	✓	✓		
6. Develop (and/or arrange for) emergency responders to receive Chemical and Biological Agent Awareness training.		✓	✓					
Tasks Associated With Medical Surveillance (Section 5.1)								
7. Ensure that emergency responders receive appropriate immunizations or prophylactic treatment, such as antibiotics, before going on site (see the manual's Medical Surveillance Program chapter). Once in the field, continuously reassess the situation to determine whether chemical or biological hazards are present. Ensure that emergency responders receive appropriate antibiotics or other prophylaxis if the onsite Medical Monitor (see glossary for a definition) deems it necessary.	✓	✓	✓	✓	✓		✓	
8. Determine whether onsite medical monitoring is necessary. If monitoring is necessary, make arrangements for a trained Medical Monitor (see glossary for a definition) to observe responders on site.		✓	✓		✓			

TASKS ▼ / ROLES ►	Who Is Responsible for Each Task or Action?							
	Removal Manager	**SHEMP Manager**	**Health and Safety Program Contact**	**Immediate Supervisors**	**Onsite Safety Officers**	**Emergency Responders***	**Medical Monitors** (defined in glossary)	**Other**
Name of person in role ►	See Appendix A-2 in the Introduction chapter for the names of personnel that fill these roles.							
9. If onsite medical monitoring is necessary, establish a checkpoint for employees to go through when entering/exiting the work zone. Take vital signs as employees pass through the checkpoint. Alert employees, their immediate supervisors, and the Onsite Safety Officer if monitoring results suggest that an employee may have been exposed to a chemical or biological agent, or other site hazard.							✓	
Tasks Associated With Onsite Health and Safety Controls (Section 5.2 and (Section 5.3)								
10. Determine whether a biological agent poses a risk of infection or a chemical agent poses acute and/or chronic health hazards. Perform environmental monitoring and determine the level of PPE that is to be worn (see the manual's Respiratory Protection Program chapter and PPE Program chapter for guidance on respirator and PPE selection), incorporate information about these controls into the site-specific HASP, and ensure that the controls are implemented in the field.					✓			
11. Upon request, assist the Onsite Safety Officer in determining/implementing work practice, engineering, or administrative controls.		✓	✓					
12. Upon request, perform task-specific evaluations to assess the hazards posed by chemical or biological agents.		✓	✓		✓			
13. Provide emergency responders with the Quick Reference Guide in the Chemical and Biological Agents chapter.		✓	✓	✓	✓			
14. Ensure that employees have access to emergency medical services in a reasonable time frame.				✓	✓			
15. Provide technical support to emergency responders to ensure that the HASP addresses management of exposure to chemical or biological agents.		✓	✓					
16. Ensure that all chemical/biological agent components of the HASP are implemented in the field.	✓	✓	✓		✓			
Tasks Associated With Recordkeeping Activities (Section 6.0)								
17. Retain a certificate (or an equivalent form of documentation) certifying that you have completed Chemical and Biological Awareness training.						✓		
18. Ensure that training requirements are tracked in the FRM and that the Removal Manager or supervisor is aware of which employees have/have not completed their training requirements.	✓	✓	✓	✓				
19. Retain copies of onsite medical monitoring records.		✓						
Additional Tasks That Reflect Organization-Specific Procedures (Appendix B)								
Attention users: Add rows if necessary.								

*Note: A list of the organization's emergency responders is provided in Appendix A-2 of the Introduction chapter.

APPENDIX B

Chemical and Biological Agents: Documentation of Additional Policies and Procedures

The procedures and tasks outlined in the Chemical and Biological Agents chapter represent the **minimum requirements** that each EPA organization must meet. If organizations advocate the use of additional policies and procedures, they must document them in the table below. After doing so, they must also:

- Ensure that any of the additional policies and procedures that are added to the table below are also addressed in the main text of the Chemical and Biological Agents chapter. This can be accomplished by either (1) inserting the additional policies and procedures directly into the relevant portions of the main body of the chapter or (2) adding a sentence within the main text that directs readers to Appendix B for more information.
- Update Appendix A to capture any additional tasks that are listed in the table below and ensure that each task is assigned to a specific individual.

Topic	**Please document the additional elected policies and procedures required for Region 4 here.**
Section 3.0 Awareness Training	See R4 ERRB Standard Operating Guidelines at https://response.epa.gov/hsmanualregion4 1. SOG A101: Medical Countermeasures Program, Biological Agent Prescription 2. SOG T100: Chemical, Biological, Radioactive, Nuclear and Explosive (CBRNE) Response Plan 3. SOG T102: Nerve Agent Antidote Kit Procedures
Section 5.1 Medical Surveillance	
Section 5.2 Hazard Evaluation	
Section 5.3 PPE	
Section 5.4 Decontamination	
Section 6.0 Recordkeeping	
Other topics _____ _____	

APPENDIX C

Glossary

GLOSSARY

Acetylcholinesterase
An enzyme that degrades the neurotransmitter acetylcholine in the brain and other tissues of the body. Acetylcholine is a chemical substance that sends signals between nerve cells (called neurotransmission). Neurotransmitters are secreted by neurons (nerve cells) into the space between neurons called the synapse. Acetylcholine is a primary neurotransmitter in the brain, and is associated with memory and cognition. When acetylcholinesterase breaks down the neurotransmitter acetylcholine, the signal between the nerve cells is effectively terminated. Nerve agents are organophosphate-based chemical agents that inhibit the action of the acetylcholinesterase. The result is a buildup of acetylcholine in the neural synapse causing a massive, uncontrolled neurotransmission of nerve signals leading to uncontrolled muscle movements, convulsions, and eventual death. An acetylcholinesterase test may be used to measure potential nerve agent exposures in workers.

Aerosol
A collection of fine liquid or solid particles suspended in air. An aerosolized substance is easily dispersed through the air and can be spread over a wide area.

Antibiotic
A substance that inhibits the growth of or kills microorganisms.

Anthrax
A non-contagious, infectious, often fatal, naturally occurring disease caused by the bacterium *Bacillus anthracis* that may be contracted by humans or animals via exposure through inhalation, the skin, or the gastrointestinal tract.

Bacillus anthracis
A spore-forming bacterium that causes anthrax. The spore form is about 1 by 2 microns in size and can easily be inhaled. In a warm, moist environment (such as the lungs), spores grow into vegetative, rod-shaped cells that multiply and cause hemorrhage, edema, and necrosis in humans and animals.

Biotoxin
A toxic substance that is either produced by, or extracted from, living or dead bacteria, fungi, plants, or animals.

Biological Incident
A natural or human-caused incident involving microbiological organisms (bacteria, fungi, and viruses) or biologically-derived toxins that pose a hazard to humans, animals, or plants.

BioWatch
A nationwide bio-surveillance system that is designed to detect the individual release of select aerosolized bioagents using a coordinated team of field, laboratory, and response personnel from city, state, and federal organizations.

Chemoprophylaxis
A method of preventing disease by the use of chemicals or drugs.

Contagious
Capable of being transmitted from one person to another. A contagious disease is easily spread from one person to another by contact with the infectious agent that causes the disease. The agent may be in droplets of liquid particles made by coughing or sneezing, contaminated food utensils, water, or food.

Decontamination
The process of inactivating or reducing a contaminant in or on buildings, humans, animals, plants, food, water, soil, air, areas, or other items through physical, chemical, or other methods to meet a cleanup goal (EPA, DHS, November 2008).

Disinfection
A chemical or physical agent that destroys pathogenic or other harmful microorganisms, but not bacterial spores on inanimate surfaces (EPA, DHS, November 2008).

Immunization
A technique used to cause an immune response that results in resistance to a specific disease, especially an infectious disease. Immunization (through vaccinations) works by stimulating the immune system, the natural disease-fighting system of the body. The healthy immune system is able to recognize invading bacteria and viruses and produce substances (antibodies) to destroy or disable them. Immunizations prepare the immune system to ward off a disease. In addition to the initial immunization process, it has been found that the effectiveness of immunizations can be improved by periodic repeat injections of vaccines or "boosters."

Infection
The invasion and multiplication of disease-causing microorganisms in the body. Infections can occur in any part of the body, and can be localized or systemic.

Infectious
Capable of being transmitted by infection, with or without direct contact.

Laboratory Response Network (LRN)
An organization of public health laboratories established by the Department of Health and Human Services' Centers for Disease Control and Prevention (CDC) in accordance with Presidential Decision Directive 39, which outlines national anti-terrorism policies and assigns specific missions to federal departments and agencies. The LRN and its partners maintain an integrated national and international network of laboratories that are fully equipped to respond quickly to acts of chemical or biological terrorism, emerging infectious diseases, and other public health threats and emergencies. (CDC, 2005)

Latency
The time between exposure and the first appearance of an effect. In the case of exposure to a pathogenic microorganism, latency is the state in which the organism is present in the body but not actively replicating or causing illness.

Medical Monitor
A Medical Monitor must be a competent health and safety professional (e.g., a local emergency medical technician [EMT], a nurse, or a nurse assistant) who knows how to measure and interpret vital signs, recognize the symptoms of physical stress-related disorders, and monitor work/rest cycles.

Medical monitoring
The early detection and treatment of injury or illness in individual workers.

Morbidity
Morbidity is the state of being ill or diseased. The term also refers to the extent of illness, injury, or disability in a defined population.

Mortality
Mortality is synonymous with death. Mortality is also a measure of the rate of death from a disease within a given population.

Secondary explosive device
A bomb placed at the scene of an ongoing emergency response intended to cause casualties among responders. Secondary explosive devices are designed to explode after a primary explosion or other major emergency response incident has attracted large numbers of responders to the scene to inflict additional injury, damage, and fear.

Sterilization
A process intended to remove or destroy all viable forms of microbial life, including bacterial spores, to achieve an acceptable sterility assurance level. (AAMI, 1995)

Vaccine
A suspension of attenuated live or killed microorganisms, administered to induce immunity and thereby prevent infectious disease.

Volatility
A measure of how readily a substance will vaporize. Substances that are highly volatile easily become airborne.

APPENDIX D

Aerosolized Anthrax:
Emergency Response Resources

Aerosolized Anthrax: Emergency Response Resources

The NRT's Quick Reference Guide: Anthrax.

NIOSH's Emergency Response Resources: Anthrax.

The National Research Council's *Reopening Public Facilities After a Biological Attack: A Decision-Making Framework. Committee on Standards and Policies for Decontaminating Public Facilities Affected by Exposure to Harmful Biological Agents: How Clean Is Safe?,* available in PDF format from the National Academies Press.

Anthrax-Contaminated Facilities: Preparations and a Standard for Remediation, December 16, 2005, Michael M. Simpson, Resources, Science, and Industry Division, Congressional Research Service, Library of Congress, available in PDF format at http://www.wbdg.org/pdfs/crsreport_anthrax_lessons.pdf.

Interagency Biological Restoration Demonstration's Capstone Exhibition, available in PDF format at http://www.itsallon.tv/media/slides/10.09.21.ibrd.s.1015progman.pdf.

OSHA's Model Health & Safety Plan (HASP) for Clean-up of Facilities Contaminated with Anthrax Spores.

DHS and EPA's Draft, Planning Guidance for Recovery Following Biological Incidents, May 2009.

Interagency Report (published jointly by EPA and DHS). Remediation Guidance for Major Airports After a Bioterrorist Attack, November 2008.

CDC and EPA, Interim Clearance Strategy for Environments Contaminated with *Bacillus anthracis*, July 2012

EPA's Bioresponse Operational Testing and Evaluation (BOTE)-related materials, including:

- Technical Brief (January 2012) and video